The Time of Music

Jonathan D. Kramer

This innovative, provocative book offers a new, comprehensive theory of musical time. Exploring the qualitative, philosophical aspects of this elusive yet fundamental basis of music, Jonathan D. Kramer unlocks the dimensions of musical time not considered by theories that limit study to the concrete elements of rhythm and meter. By taking a larger view, Kramer grapples with the evasive, subjective elements of time—and supports his aesthetic speculation with hard evidence from musical structure.

It is this engaging mix of abstract theory and practical application that securely ranks THE TIME OF MUSIC among the best contemporary music scholarship. Kramer draws on the diverse studies of philosophy, psychology, cultural history, and music theory to examine the qualitative elements of musical time: direction, tension, resolution, cumulation, proportion, pacing, and duration. Close musical analysis brings theoretical speculation back to real music and real perception.

Focusing on the here and now, THE TIME OF MUSIC considers how contemporary Western listeners hear and understand the music of all eras and places. Through vivid examples of musical analysis, Kramer engages the reader with innovative answers to questions that reveal the depth of musical time: how this century's music differs from music of the past, how compositions are organized in time, how durations are perceived and remembered, how pieces begin and end, and the importance of technology to how music is heard, used, and created.

(Continued on back flap)

The Time of Music

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Dedicated to:

Martin Bresnick
Bruce MacCombie
Robert Moore
Robert Morris
David Mott

We six were the junior composition faculty at Yale University in the 1970s. Many of the ideas in this book were born, or nurtured, or challenged in our weekly Thursday evening seminars and in our frequent social evenings together. We created an atmosphere of intellectual stimulation, musical commitment, open-mindedness, mutual respect, camaraderie, and lasting friendship. We have since all gone our separate ways—musically, intellectually, and geographically. But what we created together a decade ago in New Haven remains in each of us and is, in some small way, reflected in this book.

Contents

Preface

The Time of Music has but one main thesis: that time in music can be many different things. Such a nebulous hypothesis is not well served by a step-by-step exposition. Thus this book is as nonlinear as much of the music it describes. The reader will find frequent references to upcoming discussions and to ideas presented far earlier. Sometimes terms are used before it is appropriate to define them rigorously. Several topics interweave again and again, appearing in new contexts with different emphases.

Music's temporalities are too varied to be explicated solely by a linear argument. Rather than a chain of causally related ideas, therefore, I try to present a field of information, opinion, speculation, and strategies for listening. My thoughts about music and time are as interrelated as they are diverse. I hope that a broad picture of what I am trying to say will emerge gradually, on the basis of ideas that accumulate throughout the book.

My aims are not mainly to prove hypotheses, nor to develop scientific theories. Rather, I want to challenge readers with suggestions about new ways to listen to many kinds of music, new and old. I am more interested in asking the right questions than in finding the right answers. Questions can open up discussions, avenues of thought, and modes of perception; answers tend to close off such things.

I am a composer, and this book is as much composed as it is written. There are main themes and contrasting themes, sometimes starkly juxtaposed and other times linked by transitions. They undergo variation, development, transformation, and recapitulation. I am concerned with pacing. I enjoy sudden shifts of tone or subject matter. I like to contrast a leisurely pace with a rapid scanning of far-ranging materials. I enjoy finding less than obvious relationships between apparently contradictory thoughts.

Furthermore, I believe in the power of analogy and metaphor to communicate what can be conveyed by no other means.

This book is alternately speculative, theoretical, informal, analytic, scientific, personal. Who will read such a melange of approaches to an enormous subject? The main audience will probably consist of serious students of music: theorists, plus composers, musicologists, and performers with a strongly theoretical orientation. Those with interests in aesthetics, psychology, and/or cultural history should find much of interest here, provided they have music backgrounds. Anyone who is not intrigued by detailed analysis may wish to skip the "analytic interludes" and the theoretical discussions (Chapters 4, 5, 7, and 9 and Sections 6.4, 10.2, 10.3, 10.4, and 12.7).

It is possible to browse through this book. The lack of an overall linear argument may well encourage a casual reading. But there are reasons why things are presented as they are, and only by reading the entire book in order can anyone come fully to grips with the interrelatedness of its many subjects.

A lot of music is referred to, some in considerable detail and much more in passing. Anyone who really wishes to understand what is being said needs to hear this music, and hear it deeply. The ultimate purpose of the book is to encourage readers to be listeners: creative, involved, vital listeners.

Montgomery, Ohio
23 March 1987

Acknowledgements

Throughout the twenty years during which I thought about the ideas in this book, I often had the opportunity to bounce my thoughts off other people. Rather fanatic about time and its importance to music, I readily talked. And I readily listened. As a result, I have a large number of people to thank. Some were teachers, some colleagues, some students, some friends, some acquaintances. Some critically read portions of the book or of the articles that preceded it. Some made a casual remark or two that struck a deep resonance in me, or that suggested a solution to a difficult problem. Some told me of a book or article that subsequently proved helpful. Some people in the latter two categories may be surprised to find their names listed here, so brief was our exchange about musical time. Others may be surprised to be omitted. No omission is intentional. I have tried to remember everyone who has helped, whether in a large or a small way. I did, however, speak about time to many people during the last twenty years, and if I have neglected anyone I can only hope that he or she will accept my apology as a form of flattery: such a person provided ideas that became so integrated with my own thinking that I no longer remember their source.

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Special thanks must go as well to the International Society for the Study of Time, which, through its triennial conferences, its publications, and its membership has put me in touch with many fine scholars of time and useful ideas about time from fields outside music.

Also, I must thank Edwin Dugger, whose casual remark on time and music in 1968 aimed my thinking in the direction of exploring problems that are addressed in this book. When he said that in his compositions the beginnings are not at the beginning, the middles not in the middle, and the endings not at the end, he could not have known that he was planting a seed in fertile ground. This book is the result of a lot of thinking about what he might have meant.

If Ed Dugger planted the seed, another of my teachers from my graduate years at the University of California in Berkeley provided the nourishment as the plant began to grow. In one ten-week seminar, Joseph Kerman managed to seal my destiny as a thinker about and writer on music. I do not think of myself as a disciple of his (nor of any of my teachers), but he taught me more in those ten weeks than any of the others. He showed me the importance of criticism, as distinct from yet embracing analysis and theory. He taught me to welcome and even seek out, not to shun, the most difficult questions. He made me understand the importance of aesthetics to music theory and analysis. It is my hope that this book lives up to his ideals of what responsible criticism of music should be.

The others I wish to thank I will not separate into categories. As the book itself amply demonstrates, I distrust categorization. I simply list the following as persons to whom I am indebted, whether in large or small ways:

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"Discontinuity and Proportion in the Music of Stravinsky," in *Confronting Stravinsky: Man, Musician, Modernist,* ed. Jann Pasler (Berkeley: University of California Press, 1986), pp. 174-94. This essay, which forms a portion of Chapter 10 of the current book, is copyright © 1986 The Regents of the University of California and is reprinted here by permission of the University of California Press.

"The Fibonacci Series in Twentieth-Century Music," *Journal of Music Theory,* vol. 17 no. 1 (1973), pp. 110-48.

"Music Theory Today: An Opinion," *Perspectives of New Music,* vol. 20 (1983-1984), pp. 588-93.

"The Impact of Technology on Musical Time," *Percussive Notes,* vol. 22 no. 3 (1984), pp. 16-25.

"New Temporalities in Music," *Critical Inquiry* vol. 7 no. 3 (1981), pp. 539-56, © 1981 The University of Chicago.

"Moment Form in Twentieth-Century Music," *Musical Quarterly,* vol. 64 no. 2 (1978), pp. 177-94. Reprinted in Gregory Battcock (ed.), *Breaking the Sound Barrier* (New York: E.P. Dutton, 1981), pp. 53-70.

"Multiple and Nonlinear Time in Beethoven's Opus 135," *Perspectives of New Music,* vol. 11 no. 2 (1973), pp. 122-45.

"The Row as Structural Background and Audible Foreground: The First Movement of Webern's First Cantata," *Journal of Music Theory,* vol. 15 (1971), pp. 158-81.

"Studies of Time and Music: A Bibliography," *Music Theory Spectrum*, vol. 7 (1985), pp. 72–106.

"Temporal Linearity and Nonlinearity in Music," in J. T. Fraser, Nathaniel Lawrence, and Francis C. Haber, eds., *The Study of Time*, vol. 5 (Amherst: University of Massachusetts Press, 1986), pp. 126–37.

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Chapter 1

Music and Time

1.1 INTRODUCTION

Music unfolds in time. Time unfolds in music. Music, as Susanne Langer wrote, "makes time audible."[1] And, I might add, music becomes meaningful in and through time. That is a central theme of this book.

While few would deny that music has meaning, there has been vigorous debate for centuries about the nature of musical significance and how (and whether) it is transmitted from composer through performer to listener. This book is founded on my belief that the meanings of music reside not mainly in the emotions a listener experiences, nor in direct expressions by a composer, nor in stories or images associated with program music, nor in the inherent beauty of musical sounds, nor even in syntactical relationships between pitches. Rather, music is meaningful, as I have said, primarily through time.

I thoroughly agree with Marvin Minsky's whimsical characterization of the way time makes music meaningful:

> Of what use is music-knowledge? Here is one idea. Each child spends endless days in curious ways; we call it "play." He plays with blocks and boxes, stacking them and packing them; he lines them up and knocks them down. What is that all about? Clearly, he is learning Space! But how, on earth, does one learn Time? Can one Time fit inside another, can two of Them go side by side? In Music we find out!
>
> Many adults retain that play-like fascination with making large structures out of smaller things—and one way to understand music involves building large mind-structures out of smaller music-things. So that drive to build music-structure might be the same one that makes us try to understand the world.[2]

Despite the fundamental link between music and time, musical time has not been widely recognized as an independent field of study. The *New Grove* has no article on time; *RILM* has no separate category for time; *The Music Index* has only recently begun to list articles under the heading "Time." One might conclude that the field is small and/or new. But the study of musical time ought reasonably to consider every musical process that takes (place in) time—everything, in fact, inherent in a piece of music.

Despite the existence of some 850 books and articles on the topic, listed in my bibliography "Studies of Time and Music,"[3] musical time is not usually considered a subject of music theory at all. The work that has been done is fragmented, isolated, and inconclusive. "Hopes have been high, but results have been disappointing," as Lewis Rowell states.[4] The neglect of time by the theoretical mainstream and the uneven and tentative (with a few notable exceptions) nature of the existing work are understandable, considering the preoccupation of music theory with the quantifiable and verifiable. But the way time has been ignored is nonetheless ironic, since music *is* temporal: abstract sonorous shapes moving through yet simultaneously creating time. Time is both the essential component of musical meanings and the vehicle by which music makes its deepest contact with the human spirit.

Most theories of music have been concerned not with time but with pitch, in part because pitch is discretely defined, precisely notated, and hence quantifiable. The musical score, which provides data for pitch studies, does not unfold in time, whereas heard music exists only in experienced duration. The majority of works on musical time have dealt with rhythm and meter—once again, notated parameters, although their appearance on the page is less precise and less complete than is pitch notation. Less obvious than rhythm and meter and more difficult to discuss are motion, continuity, progression, pacing, proportion, duration, and tempo. Yet it is these values that must be studied if the full force of musical time is to be understood.

What one thinks time in music is depends on what one thinks time is. While there is comparatively little difficulty with the question "What is pitch?" the question "What is time?" (discussed briefly in Section 1.6) has never been answered to general satisfaction, nor is it likely to be. There has been little agreement among philosophers, scientists, or even cultures about the nature of time. A study of musical time must therefore address its subject from a number of viewpoints, must be willing to adopt a variety of different assumptions, and must utilize many methodologies: scientific vs. humanistic, objective vs. subjective, value-free vs. evaluative, relativist vs. universalist, speculative vs. verifiable. And such a study must ask difficult, possibly unanswerable, questions (such as those listed in Section 1.5).

Furthermore, such a study must on occasion be willing to forego traditional logic, even while highly valuing rigor. As J. T. Fraser has argued, time is not bound by the "law of contradiction," which holds that a proposition and its negation cannot be simultaneously true.[5] For example, if we decide that time is continuous, it is erroneous to conclude that time cannot be discontinuous.[6] One of the central theses of this book is that musical time is both linear *and* nonlinear (these terms are defined in Section 2.1). Opposing characterizations are not mutually exclusive when we are studying time. Music can be, for example, linear on a deep structural level yet nonlinear on the surface.

According to Fraser, "If the idea of time refuses to conform to the law of contradiction, then we must conclude that time is not independent of experience."[7]

Just as time does not exist apart from experience, so musical time does not exist apart from music. As we listen to music, the time we experience is a special kind. We *simultaneously* experience musical time and ordinary, or "absolute," time. Because musical time differs pointedly from the time of daily existence, experiencing them both at once violates logic's law of contradiction. But time can be many things, and it can be them at once.

Philosopher Susanne Langer (deriving her ideas from those of Basil de Selincourt)[8] argues for the difference between time in music (which she calls an instance of "virtual time")[9] and absolute time, which she identifies as "the sequence of actual happenings."[10] Langer calls the antithesis of virtual time "clock time," but I prefer "absolute time" because there are more types of temporality that can be characterized as a "one-dimensional, infinite succession of moments"[11] than just what is ruled by the clock. Langer quotes de Selincourt on the fundamental difference between virtual and absolute time:

> Music . . . suspends ordinary time and offers itself as an ideal substitute and equivalent. Nothing is more metaphorical or more forced in music than a suggestion that time is passing while we listen to it.[12]

De Selincourt and Langer make strong cases for a musical time that is not one-dimensional and not concerned with pure duration. Their idea that ordinary time is suspended is an exaggeration, but deep listening does give primacy to musical time. Langer is less than specific about the actual mechanisms by which music creates virtual time and about the real nature of a musical continuity fundamentally different from that of absolute time.

In Section 5.5 I describe one way in which musical time differs quite drastically from ordinary time. I am interested in the *interaction* between musical and absolute time, not in the replacement of one by the other. Both species of time coexist in our consciousness—a further indication of time's refusal to follow the law of contradiction.

Few theories of music admit the suspension of traditional logic, just as they do not accept divergent methods or assumptions. At the one extreme we find formalist concerns with the internal syntax of music, as exemplified in hierarchic theories of tonal music, set-theoretic approaches to atonal music, some applications of linguistics and semiotics to music analysis, and studies of rhythmic and metric patterning. At the other extreme there are humanist concerns with personal, social, or aesthetic meanings of music. While formalist theorists have explained much about music, their common failure to step back from the notated score and ask questions about the individual or cultural significance of their findings *is* a limitation. Humanist theory is hardly more complete. Seemingly perceptive aesthetic ideas can fail to hold up under the scrutiny of careful musical analysis. Criticism that is not based on thorough analysis can be elegant prose about nothing. Formalist theorists seldom consider the cultural contexts of their studies; humanist theorists frequently fail to test their perceptions against the hard evidence of musical structure. Theoretical writing that avoids both the formalist and the humanist limitations is rare.

I am not alone in seeking a musical scholarship that avoids the dangers of both excessive formalism and excessive humanism. In his much-discussed book *Contemplating Music,* Joseph Kerman calls for a pluralistic music theory. Although respecting their craft, he criticizes analysts for their myopia:

> Their dogged concentration on internal relationships within the single work of art is ultimately subversive as far as any reasonably complete view of music is concerned. Music's autonomous structure is only one of many elements that contribute to its import. Along with preoccupation with structure goes the neglect of other vital matters—not only the whole historical complex . . ., but also everything else that makes music affective, moving, emotional, expressive. By removing the bare score from its *context* in order to examine it as an autonomous organism, the analyst removes that organism from the *ecology* that sustains it.[13] [Emphasis added.]

By "context" and "ecology" I trust (and hope) Kerman refers not only to history but also to the cultural setting in which all music, old and new, is heard today. Because of my concern with contemporary understanding of music, the focus of this book is on the present, despite the difficulty of achieving an objective perspective on today's art. But I am less interested in objectivity than in the contemporary listener. My focus is more on the ways we understand Beethoven's music now than what it meant in 1800.

Building meaningful bridges across the enormous gap between formalism and humanism in music theory is a formidable challenge. Yet this challenge must be faced if the elusive nature of musical time is to be understood. It has been in the spirit of uncovering significant connections between musical structure and human values that this book has been conceived. I have tried to address Lewis Rowell's plea that theorists "be willing to consider the nonquantifiable and the nondiagrammable in their quest for the ideas, principles, and methods which will eventually inform their understanding of the subtle impulses, feelings, and intuitions by which the temporal structure of music is created and perceived."[14] I have been heartened by Rowell's belief that theorists are "beginning to concentrate on the *qualities* (as opposed to the *quantities*) of time—those vital dynamic and kinetic properties which we praise so extravagantly and understand so superficially."[15] Nonetheless, I am unwilling to forego totally the quantitative or to *oppose* it to the qualitative. The two must coexist. Several charts, diagrams, and calculations do appear in the following pages. It is as problematic to err on the side of excessive humanism as it is limiting to use exclusively (pseudo-)scientific methods.

The underlying argument between formalists and humanists is the eternal question of whether music's meanings are primarily internal (to music in general if not to particular compositions) and hence syntactic, or external and hence representational or at least symbolic of extramusical values. Since time in music not only communicates syntactic meanings but also presents symbolic meanings, it must be studied both theoretically and aesthetically. Therefore this book takes both approaches. It analyzes temporal spans in particular compositions, considers theories of rhythm and meter, and concerns itself with the perception of duration. But it also studies the progressions and continuities of music as metaphors for the temporality of life. Thus it should not be surprising that the book occasionally turns to fields as diverse as psychology, sociology, philosophy, criticism of other temporal arts, and anthropology, in addition to the wide range of scholarship on music.

1.2 TIME IN MUSIC, MUSIC IN TIME

Does music exist in time or does time exist in music? This question is not simply a semantic game. If we believe primarily that music exists in time, then we take time as an absolute, as an external reality, as somehow apart from the experiences it contains. I do not wish to deny absolute time totally but rather to posit a substantially different musical time. If we believe in the time that exists uniquely in music, then we begin to glimpse *the power of music to create, alter, distort, or even destroy time itself, not simply our experience of it.*

As Thomas Clifton explains, the age-old idea that time is out there, flowing by us, is questionable. Events, not time, are in flux. And music is a series of events, events that not only contain time but also shape it.

> We are not spectators of time: we do not stand on time's "banks" and observe it flowing by. The words "past," "present," and "future" express relationships between objects or events, and people. These words exist and have meaning because people are in the world. It is the experience of objects, events, and other people which is in constant flux: certain events were experienced *then,* others *are* being experienced, still others *will be* experienced. These are all distinct but related experiences of time. Time has no grip on events. It is events, as lived through by people, which define time.[16]

Similar ideas are expressed by philosopher of science Errol Harris:

> Time does not move or pass, for all movement and passage is in space and takes time, but time itself is not in space and does not *take* time to elapse. Time, therefore, cannot be a moving image nor a process of actualization, for the movement and the process are in time and cannot be of it. Yet even this manner of speaking is metaphorical for time is not a container of events. It would be more plausible, but no less false, to think of space as the receptacle in which events took place.[17]

I take Clifton's statement as an essential characterization of time, as the term is used in this book. Time is a *relationship* between people and the events they perceive.[18] It is an ordering principle of experience. Thus I am focusing on the time that exists primarily *within us.* Yet even what I call "absolute" time (a term Clifton rejects) is little more than a social convention agreed to for practical reasons. Clifton states:

> Objective time (or real, or absolute time) is a contradiction in terms. It presupposes the existence of a time which exists independently of us, and of a "time sense" whereby a person perceives this time. . . . It is useless to measure the sense of time against a clock which is alleged to keep real time. A clock may be very useful in arranging appointments, but it can tell us nothing about time itself. A recording studio may wish to know the time a

> certain composition takes, but its timing, in terms of minutes and seconds, will tell us nothing about time as *meant* by the composition.[19]

Viewing time as a relationship is not really defining the term. As Justin London has pointed out,[20] "time" is not really a proper predicate of the verb "to define," just as, for example, "pencil" is not a reasonable predicate of "to ride." "Time" must ultimately be taken as undefinable. We have intuitive knowledge of what time is, but it is impossible to draw up a list of attributes that belong exclusively to time. As psychologist Masanao Toda has written,

> It is a fool's errand to try to "define" time. Defining a notion is to find for it an equivalent ideational construct made of some other, usually more primitive, notions. The prerequisite for a successful definition, however, is that *every* aspect of the target notion is represented by some of the component notions used for the definition. Any attempt at defining time, therefore, is bound to be ridiculous, as there is nothing in this world that even remotely resembles time.[21]

In the following chapters I postulate many types of musical time. To do so becomes possible once I accept the notion that *music creates time.* For example, I discuss "multiply-directed time" in Sections 2.9, 6.4, and 6.5. I am not content to say that some music suggests that its *events* may be ordered in several different ways. Such a formulation would be too tame to connote the powerful experience of multiple directedness. I am saying that *time itself can (be made to) move, or refuse to move, in more than one "direction": not an objective time out there, beyond ourselves, but the very personal time created within us as we listen deeply to music.*

My ideas concerning multiply-directed time are like Clifton's concerning interruption and an extreme kind of interruption he calls "temporal intercut." It is not simply a stream of continuous events that can be interrupted by discontinuities, he claims, but time itself. But, Clifton wonders, "how can time be interrupted?" His answer is the powerful notion that I have borrowed as a characterization of time: "time is not an independent process but a relation between a person and an experienced event."[22] If time exists not as an objective reality but as an interaction between listener and composition, then time can indeed be interrupted or even reordered.

Just as strong is my assertion (in Section 6.4) that some music can create a type of multiply-directed time I call "gestural time." It is not enough to state that traditional music has gestures whose normal temporal placement, determined by convention, is at odds with their actual position within a composition. I seek a formulation that reflects the potent experience of encountering, for example, a closing gesture near the start of a composition. The disorientations caused by a gestural time out of alignment with absolute time are too powerful to be described simply as subverted conventions. I am saying that music creates many kinds of time, only some of which are similar to what we narrowly think of as ordinary time.

When I claim, in Chapter 6, that events appear in an order in gestural time that is different from their order in ordinary time, what I am really saying is that music offers alternatives to conventional temporal sequences. If my proposed reorderings in gestural time and multiply-directed time make the reader a bit uncomfortable, that is all to the good. One purpose of this book is to suggest that we hear music in ways very different from the ways we experience our daily lives. But music also creates remarkable likenesses of lived time (see Section 6.6) and thereby focuses our attention on ordinary discontinuous experiences we might otherwise all but miss. I am not willing to deify daily temporality by defining musical time as a distortion of it. It is only because of our habit of thinking of literal succession as the sole reality of temporal order, only because we allow ourselves to be ruled by the clock, that we may question multiple manifestations of musical time.

The difference between ordinary lived time and musical time is, according to Clifton, the difference "between the time a piece *takes* and the time which a piece *presents* or *evokes*."[23] Gestural time, for example, is created in some compositions, despite the obvious fact that they exist and are heard in absolute time as well. All the species of time discussed in this book are experienced and understood *simultaneously* with ordinary time. This duality is possible because, as mentioned in Section 1.1, time does not obey the law of contradiction: it can be many different things at once. All music is heard at first as a moment-to-moment succession, although it also creates the very different continua of musical time. Musical time exists in the relationship between listeners and music, just as ordinary time exists in the relationship between people and all their experiences, including music. Thus musical time and ordinary time lead parallel existences. When we listen very deeply, however, we begin to lose the distinction between these two kinds of time.[24] When we give ourselves totally to a performance, the peculiarities of musical time *are* experienced, whether they are the reorderings of gestural time, the stasis of what I call "vertical time" (see Section 2.12 and Chapter 12), or the discontinuities of what I call "moment time" (see Section 2.10 and Chapter 8). Deep listening allows us to transcend the time the piece takes and enter the time it evokes. T. S. Eliot referred to (in the lines quoted in Section 1.6) "music heard so deeply that . . . you are the music." If some of the species of time I formulate in this book seem to violate common-sense understanding of ordinary time, we must remember that they do enter our consciousness when we listen deeply, when we become the music.

Yet we do not as a rule totally suspend ordinary time as we listen. We are aware of approximately how much absolute time has elapsed in various sections of a composition. Without this awareness we could not perceive or understand a work's proportions (as discussed in Sections 2.7 and 2.11 and in Chapter 10). In one kind of music, however, there are *no* proportions, because time does seem to be suspended. This most radical species of musical time is vertical time (see Section 2.12 and Chapter 12): the static, unchanging, frozen eternity of certain contemporary music. Is listening to this music really a timeless experience? Certainly the time of bodily processes marches on (even if slowed down by the inducement of a mental state akin to that of transcendental meditation); certainly our watches indicate that some kind of time has elapsed during the performance. But there is a kind of musical time, not measurable by clocks or bodily processes, that *is* suspended by intense listening to vertical compositions.

My brief mention here of four varieties of musical time (multiply-directed, gestural, moment, and vertical) before I have properly defined them is a typical strategy in this book. I use this strategy because I distrust categorization, although I freely use it. Categories are all too often oversimplications created by people, rather than anything that demonstrably exists. Categories of time may suggest—erroneously—that if an event belongs to one category of time or to one timespan that it cannot also belong to another.[25] Definitions are downplayed here because general concepts are more important than their specific boundary conditions. My purpose is not so much to make definitive statements as to invite readers to take on the challenge of listening to music in new ways and/or to understand their listening in new ways.

It is tempting to think of my categories of musical time as parts of some whole. I have tried to organize this book so as to thwart any attempt to treat the varieties of temporal experience I identify as pieces of a jigsaw puzzle. The temptation to compare species of time must be resisted. The tendency to assign compositions, or even parts of pieces, solely to one category or another must be avoided. Postponing definitions in favor of talking around new concepts can help prevent an excessively literal construing of categories. For, in fact, these categories of time are not complementary; they are not always comparable; they readily overlap; and, because time is exempt from the law of contradiction, they can coexist. *They are more suggestions for listening than rigorous theoretical formulations.*

I am making categories yet implying that they should not be wholly believed. I invent new terms but am reluctant to define them. I eschew the objective, quantified methods of formalist theory, yet I also distrust musical aesthetics, opting instead for a synthesis or compromise between these extremes. What, then, the reader may well wonder, is the real purpose and stance of this book? I can explain my purpose no better than by quoting from the controversial essay "Music Discomposed" by Stanley Cavell, who attempts to explain the critic's anxiety to communicate the experience of art:

> It is not merely that I want to tell you how it is with me, how I feel, in order to find sympathy or to be left alone, or for any other of the reasons for which one reveals one's feelings. It's rather that I want to tell you something I've seen, or heard, or realized, or come to understand, for the reasons for which *such* things are communicated (because it is news, about a world we share, or could). Only I find that I can't *tell* you; and that makes it all the more urgent to tell you. I want to tell you because the knowledge, unshared, is a burden—not, perhaps, the way having a secret can be a burden, or being misunderstood; a little more like the way, perhaps, not being believed is a burden, or not being trusted. It matters that others know what I see, in a way it does not matter whether they know my tastes. It matters, there is a burden, because unless I can tell what I know, there is a suggestion (and to myself as well) that I do *not* know. But I *do*—what I see is *that* (pointing to the object). But for that to communicate, you have to see it too. Describing one's experience of art is itself a form of art; the burden of describing it is like the burden of producing it.[26]

When I wrote previously of valuing rigor yet being willing to relax it, I was assuming Cavell's critical stance rather than taking a strictly theoretical or analytical position. And I was thinking in part about my categorizations of musical time. Something is lost as well as gained by the search for rigorous delineation. Some of my categories are species of time; some are modes of listening; some are compositional strategies; some are mixtures. In this book they are named by such terms as gestural time, vertical time, multiply-directed line, moment time, absolute or ordinary time, clock time, directed linear time, nondirected linear time, nonlinear time, Stravinsky's psychological and ontological time, Langer's virtual time, Epstein's chronometric and integral time, and so forth (definitions for these terms are given in the Glossary). This multitude of labels stems from my belief that music offers myriad temporal experiences, best described by a proliferation of overlapping labels and categories.

1.3 THE DIVIDED MIND

Despite the consistency of its construction, as continually demonstrated by formalist theorists (such as Schenker and Forte), music is only partly rational, and listening is only partially logical. Or, perhaps better said, there are many kinds of logic, of which linear thinking is but one, and nonlinear logic often is foremost in music listening. The opposition of linear and nonlinear logic in the understanding of music stems from the dual nature of the human mind, which in turn is a product of the existence of two distinct hemispheres of the brain's cerebral cortex.

The duality of the human brain has been known since 1844, when British physician A. L. Wigan discovered by autopsy that a man whose behavior had appeared normal had in fact possessed only one cerebral hemisphere. It has only been in the last two decades, however, that the implications of the divided brain have been explored in depth by psychologists. They have found that the left hemisphere is the seat of linear logic. It is there that we reason, count, compute, read, and write. Right hemisphere thinking, by contrast, is holistic. The right hemisphere understands complex relationships, structures, and patterns as entities rather than as the sums of parts. Although our understanding of the divided brain is far from complete, it is reasonable to postulate that deep listening to music involves *both* cerebral hemispheres.

Every normal person has two functioning hemispheres. The two hemispheres do communicate, through the *corpus callosum,* so that both parts of the brain participate in the processing of experiential data. But the two hemispheres do view the world differently, and the conflicting time experiences described in this book stem from these differences. The following list of dichotomies should give some flavor for the differences between left- and right-brain thinking:

Left	*Right*
analytic	holistic
deductive	imaginative
discrete	continuous
sequential	simultaneous

Left	*Right*
objective	subjective
verbal	nonverbal
literal	metaphorical
exclusion	inclusion
intellect	intuition
thought as information	thought as emotion
either/or	both/and
analyzes	synthesizes
denotes	connotes
resists contradictions	accepts contradictions
understands the whole as the sum of its parts	recognizes the whole from an essential individual part
splits the world into identifiable bits and pieces	connects the world into related wholes
processes data one at a time	processes data all at once
looks at details	looks at wholes
sees causes and effects	sees correspondences and resemblances
draws on previously accumulated and organized information	draws on unbounded qualitative patterns that are not organized into sequences
has full power of syntax to string words together	recognizes sentences or words as single units
values distinctions	values connectedness
understands literal meanings	understands metaphorical meanings
knows "how"	discovers "what"
understands time as containing a sequence of events	understands time as containing a complex of events[27]

Scientists do not fully understand how the brain comprehends music. Some of my ideas on the divided brain may ultimately prove to be metaphorical. Experimental evidence may, on the other hand, confirm my speculations. There has already been considerable research into the ways the brain hemispheres divide up the process of music perception. By presenting different tunes simultaneously to the two different ears, for example, psychologists have found that the left ear (which is connected to the right hemisphere, at least in right-handed people) is more efficient and accurate in melodic perception.[28] Other research has focused on the musical abilities of patients with damage to one hemisphere, and still other experiments have artificially suppressed the functions of one hemisphere by drug injections. Most of this research asks subjects to reproduce melodies that were perceived or processed in one hemisphere only. It appears that the left brain "hears" the pitch intervals of a melody, while the right brain "hears" the contour.[29] It would be interesting (and especially relevant to the questions asked in Chapter 11) to learn in which hemisphere(s) rhythmic grouping is processed.[30]

Studies comparing musically trained and musically illiterate subjects have yielded the significant result that, as musicians are trained, they shift their musical activities to the left, analytic hemisphere.[31] The musicians studied have been classically trained, so that it is reasonable to conclude that they use their left hemispheres to process the syntactic structures of tonal music.[32] Presumably, trained musicians also retain their ability to perceive music holistically, even if that mode is no longer dominant.[33]

Music perceptions, then, uses both hemispheres.[34] As Karl H. Pribram summarizes, "Musical image processing is predominantly a right-hemisphere and musical information processing [see Section 11.6] a left-hemisphere function."[35] The immediate, emotional experience of music listening depends on the right brain, as does our ability to understand entire phrases as single units.[36] When we recognize whole compositions from one melody or even from one chord (a listener can, for example, identify the *Eroica* or the *Symphony of Psalms* from their respective first chords) we use our right hemisphere. Yet, to understand the implications of these first chords, and to comprehend subsequent events as outgrowths of these beginnings, is to use the left hemisphere.

The simultaneity of left- and right-brain mental processes in the perception of music gives rise to the seemingly contradictory species of musical time set forth in this book. The apparent distortions of temporal sequence I postulate in connection with gestural time, for example, can be understood as the conflict between right- and left-brain processing. The holistic nature of a musical gesture (the "final cadence" in the tenth measure of the first movement of Beethoven's Opus 135, discussed in Chapter 6, for example), as opposed to the atomistic nature of individual notes and durations, is recognized by the right hemisphere. A gesture's literal temporal placement (at the end of the *first* phrase pair in the Beethoven movement) is, by contrast, understood by the left hemisphere. In this example, two temporal meanings, gestural finality vs. placement near the beginning, are in conflict. Gestural time, as explained in some detail (using this Beethoven quartet as an example) in Chapter 6, is the right brain's nonlinear, nonsequential understanding of a work's total continuity. The left brain, on the other hand, processes ordinary temporal progression, in which one event follows another along the one-dimensional continuum in which we hear the music. Gestural time is a special type of multiply-directed time, which, like moment time and vertical time, depends partially on a temporal logic that is nonlinear and subjective.

I do not wish to denigrate absolute time. We in Western culture live by the clock and by causality. For us, music *does* unfold linearly. Each event of a composition clearly succeeds another event, and in most music listening (as well as most theories and analyses) there is a sense that earlier events lead to, or imply, later events. But there are other ways to understand musical time, ways having to do with the total continuum of a composition, ways in which connections are perceived between events that are not necessarily adjacent. These are holistic, right-brain ways to comprehend the meanings of music. The right brain understands events in time not as a linear sequence, not as a series of causes leading to effects, not as a progression from past to future, but as a patterned whole.[37] It may seem strange to think about connections across gaps in (absolute) time and to think of the temporal continuum of a composition as an entity rather than as a succession. The reason for the strangeness is that we are products of a society that puts a high value on absolute time and on causal connections. But there *are* cultures of this earth (discussed briefly in Section 2.3) which do not depend on either the clock or causality, cultures where thought, value, and even life itself are not primarily linear, cultures in which right-brain thought processes are predominant. Such cultures are neither "better" nor "worse" than ours, neither more nor less highly developed. They are simply different. We can learn from them. We can learn that our left-brain domination is not the only way to view the world, or our experiences, or the art we perceive.

Our society has traditionally developed linear more than nonlinear thinking. We are diligently educated to value certain activities that are left-brain: reading, writing, mathematics, logic. Areas that call upon right-brain skills, such as art and music,[38] come to be regarded as pastimes. As a result, casual listeners tend to use only right-brain perceptions. But, as this book attempts to show, deep understanding of music must involve both left- and right-hemisphere mental processes. These two types of processes can suggest quite different meanings in the same piece of music.

Both hemispheres are relevant to a deep understanding of music. Neither the affective, right-brain, holistic comprehension of the casual listener nor the analytic, left-brain, sequential understanding of the music professional (whether performer or analyst) is enough. That is why I am uneasy (as explained in Section 1.1) about music scholarship that is predominantly formalist (left-brain) or predominantly humanist (right-brain). A complex phenomenon, such as music, that requires participation of both hemispheres of the brain for full comprehension, demands to be *perceived and studied* by both hemispheres. The real richness of the musical experience comes from the conflict between and the combination of both modes of perception. It is only from an interplay between analytic and aesthetic methods of study that a deep understanding of music becomes possible. This is the challenge I attempt to address in this book.

While this book necessarily partakes of linear logic in some of its arguments, it, like much of the music it treats, uses linearity as but one possible way to proceed through time, not as the only way to do so. That is why certain key ideas return with different emphasis in different chapters. Lurking beneath the surface of these linearly connected words is a decidedly nonlinear construction (which allows me to use the word "nonlinear" before fully defining it!).

1.4 NEW CONCEPTS OF TIME IN THE TWENTIETH CENTURY

Since this book is concerned with the present—contemporary understanding of all music as well as present-day compositional aesthetics—then it must start with a consideration of new ideas on time inherent in Western twentieth-century art and culture. Critics and theorists of all disciplines have pointed to the upheavals in time concepts since 1900. I could prove my point with three chapters of fascinating quotations from a wide variety of sources. Instead, I limit myself to one author, possibly an unlikely one for a book on music, who has beautifully captured the essence of the new understanding of time. I offer two extracts from John Fowles' novel *The French Lieutenant's Woman.* (It is significant in the light of my ideas on multiply-directed time that Fowles' story has three distinct endings.)

> In a vivid insight, a flash of black lightning, he saw that all life was parallel: that evolution was not vertical, ascending to a perfection, but horizontal. Time was the great fallacy; existence was without history, was always now, was always this being caught in the same fiendish machine. All those painted screens erected by man to shut out reality—history, religion, duty, social position, all were illusions, mere opium fantasies.[39]

> Now he had a far more profound and genuine intuition of the great human illusion about time, which is that its reality is like that of a road—on which one can constantly see where one was and where one probably will be—instead of the truth: that time is a room, a now so close to us that we regularly fail to see it.[40]

It is telling that Fowles likens outmoded time concepts to a road. I would like to invoke a similar symbol for old-fashioned temporal linearity—a specific kind of road: the railroad.[41] The railroad became widespread in Europe and America in the latter half of the nineteenth century. It can be seen as a symbol for nineteenth-century linearity because it provided people with the means to move from one point in time and space to another: rapidly, without much deviation, with anticipation. Train riding was filled with purpose. Few people simply meandered the rails on a Sunday outing. A train trip represented constant and purpose-filled motion toward a foreseeable goal.

Trains still exist, even as we approach the twenty-first century. But train travel hardly seems symbolic of our age, hardly represents the forefront of today's technological achievement. While now we do have airplanes and even space shuttles, these vehicles do not symbolize progressive motion so comfortably. We are far less aware of actually moving once we are in the air or in space than we are while speeding over rails. A plane trip is internally static, not *experienced* as directed motion from the point (in space and time) of origin to the point of destination. Such stasis within a framework of almost imperceptible motion is an apt symbol for contemporary time experience.

Just as the railroad was a magnificent technological achievement that fundamentally altered our ways of thinking and even living, so in the late twentieth century there is a technological innovation that has similarly far-reaching consequences: the computer. The computer has been with us for several decades, but only recently has it become part of our daily lives. True, we have long had to fight anonymous, impersonal computers in billing offices and banks, but I refer to our direct involvement with computer-like thinking. The typical computer program does not exemplify solely linear thinking. Programming is an activity that relies on both hemispheres of the brain. A program consists of doubling back, of loops within loops, of branching off in different directions. It is thus an apt symbol for contemporary temporality. As modern artists and thinkers continually remind us, there are species of time which no longer progress toward goals, the way a train does. There are times which can branch off, return to earlier states, and loop. The totality of a temporal experience, now as always, is known only at its end. The difference between current and past understandings of time is that, because of the complexities of modern life, we can no longer confidently predict the direction, outcome, total duration, or overall meaning of many of our temporal experiences. The same can be said of computer logic. A program accomplishes its task not so much by linear logic (except within sections, or subroutines) as by a logic of the whole. Many portions of a program are interconnected in a variety of ways. The instruction which follows a given command is not always closely related to it logically.

Not everyone programs computers, just as not everyone rode trains a century ago. But computer-like thinking pervades our culture, just as the linearity associated with the railroad once did. I am not claiming that the computer has been the single determining factor in the new temporal sensibility, any more than I would claim that the railroad determined the nature of nineteenth-century thought. My idea is simply that the computer and the railroad are technological metaphors for the eras in which they became widely accepted and valued. I am certainly not suggesting any direct influence of the railroad on the art of music. Computers are prevalent in music today, though. But that is another matter, treated in Chapter 3. My only point here is that the way people interact with computers tells us more about people than about machines.

1.5 OVERVIEW OF THIS BOOK

A list of several questions served as an outline for this book during its gestation period. Some of these questions are addressed directly in the following chapters, while others are approached implicitly. The questions include:

How does music structure time? How does time structure music? What different types of time are experienced during the listening process? Is the temporal structure in the music, in the performance, or in the listening; in the composer, in the performer, or in the listener?

How does the temporal structure of a particular society's music relate to the roles and meanings of time in that culture? How have changing attitudes toward time throughout history been reflected in music? How have new meanings of time in twentieth-century Western society affected our understanding of, and response to, all music?

Why does some music suggest a vision of timelessness while other music is closed and bounded? Can stasis really be experienced in music?

How and why do compositions begin and end? How do the concepts of past, present, and future apply to music? What about earlier, simultaneous, and later? What about memory, perception, and anticipation?

What factors affect the perception of duration in music? How do perceived durations relate to durations measured by the clock? How does a listener perceive, encode, and process durations and proportions?

How many types of accent are there in music? Does accent come from the composer, the listener, or the performer?

How are goals of motion created in various styles? What is the real meaning of the metaphor of goal-directed motion? Is it imposed on music in the listening process, or does it exist in the performance?

What is continuity? Is it optional or necessary in music? Does it exist in the music or in the listener?

Many of these questions are too broad to answer in any complete way. But that is no reason not to ask them. This book is more concerned with asking difficult questions than with providing easy answers.

The present chapter discusses musical time in general terms and suggests that it is the clue to the many meanings of music. The meanings of music are temporal owing to music's unique ability to create different kinds of time, often simultaneously, which resonate with the nonlinearity (and linearity) of our inner thought processes as well as with the linearity (and nonlinearity) of our external lives in society. Through time, music's meanings become both internal (syntactical) and external (symbolic). From the conflict (discussed in Sections 1.2 and 1.3) between time taken and time evoked comes the richness of music's meanings: external vs. internal, objective vs. subjective, universal vs. personal, associative vs. syntactical,[42] designative vs. embodied.[43] This book is about how musical time creates and conveys this multiplicity of meanings, and how these meanings in turn inform contemporary compositional methods and listening strategies.

Chapter 2 introduces and discusses two fundamental concepts that underlie all of the analyses and many of the discussions found in later chapters: temporal linearity and temporal nonlinearity (abbreviated as linearity and nonlinearity, despite other uses of the term "linear" in music theory). This chapter sketches ideas on the interaction of linearity and nonlinearity, and in so doing it presents five modes of understanding time in music, new or old.

As the focus of the book is today's temporalities and modes of listening, it is appropriate for it to include a discussion of perhaps the most far-reaching influence on music today. Chapter 3, therefore, considers the impact of technology on musical time.

Chapter 4 presents an overview of several recent theories of rhythm and meter. Disagreements between different theorists are considered, and a few new suggestions are made. The purpose of this chapter is to relate some of the ideas of the book to the mainstream of music theory. Chapter 4 also lays important groundwork for Chapter 11.

The "analytic interludes" (Chapters 5, 7, and 9) offer detailed studies of particular compositions that exemplify some of the temporalities presented in Chapter 2. It is only by seeing how concepts such as directed linear time, nondirected linear time, and moment time actually work (and interact) on different hierarchic levels that they can be fully understood. Analyses exemplifying Chapter 2's remaining two categories of musical time, multiply-directed time and vertical time, form portions of Chapters 6 and 12 respectively.

There is a potential danger that these analyses may seem to assume what they set out to prove. Chapter 5, for example, assumes that the first movement of Beethoven's Opus 135 string quartet is temporally linear. The analysis then looks for—and, not surprisingly, finds—aspects of that work's linearity. If the purpose of the analysis actually were to prove that the work is linear, then my procedure would indeed be circular. But the reason for the analytic interludes is not to *prove* the appropriateness of a particular temporal aesthetic to a given piece. They *start* from an assumption, based on intuition, about time in a particular piece. This starting point in turn dictates the methodology of the analysis. The analytic interludes show *how* the postulated temporalities operate.

Each analysis demonstrates how linearity and nonlinearity (the two major ingredients of musical time, as explained in Chapter 2) interact. From their inevitable conflict come musical meanings.[44]

The discontinuities of moment time (Chapter 8) imply the importance of durational proportions, which are studied in Chapter 10. An overview of proportions in a number of composers' works leads, in turn, to the question of how large-scale durations are perceived and processed by a listener. Chapter 11 sketches an answer based on ideas borrowed from cognitive and experimental psychology.

The book ends with a discussion of the most radical, and the most nonlinear, of the new temporalities discussed here: vertical time. In its attempt to deny past and future in favor of an all-encompassing present, vertical time comes close to mystical states and to schizophrenic time "distortions."

1.6 THE DUAL NATURE OF TIME

My terms *linear* and *nonlinear* correspond roughly to the philosophical distinction between becoming and being. These two concepts have echoed throughout the philosophy of time—indeed, all philosophy—for centuries. The idea of becoming is found most prominently in the linear logic that began in ancient Greece and culminated in modern Western philosophy and science. The idea of being, while certainly explored by Western thinkers, has received its strongest statement in the "inward-looking, highly disciplined Buddhist philosophies in which Zen plays a prominent part."[45]

Being and becoming have their counterparts in the modern Western mind, as psychologists have shown. Thomas J. Cottle, for example, distinguishes, and has studied experimentally, "spatial" and "linear" conceptions of time.[46] This distinction exists also on a cultural level. Some societies favor what anthropologist Edward T. Hall calls "sacred" time, while others are dominated by "profane" time:

> Modern AE people—peoples of American-European heritage—have some difficulty understanding sacred or mythic time, because this type of time is imaginary—one is *in* the time. It is repeatable and reversible, and it does not change. In mythic time people do not age, for they are magic. This kind of time is like a story; it is not supposed to be like ordinary clock time and everyone knows that it isn't. The mistake is in trying to equate the two or act as if it were necessary to create a fixed relationship between the sacred and the pro-

fane. When American Indian people participate in ceremonies, they are in the ceremony and in the ceremony's time. They cease to exist in ordinary time.[47]

Listening to, or performing, music deeply (as discussed in Section 1.2) can involve something quite similar to Hall's sacred time. We become immersed in a kind of time different from ordinary lived time. Musical time, as this book tries to show, is like sacred time: repeatable, reversible, accelerating and decelerating, possibly stopping. The special time sense evoked by music recalls music's origins in ritual. Indeed the modern concert ritual seeks, by putting a frame around compositions as we hear them,[48] to isolate musical time from the time of our daily lives. The similarity of music to sacred ritual is beautifully expressed by T. S. Eliot's lines,

For most of us, there is only the unattended
Moment, the moment in and out of time.
The distraction fit, lost in a shaft of sunlight,
The wild thyme unseen, or the winter lightning
Or the waterfall, or music heard so deeply
That it is not heard at all, but you are the music
While the music lasts.[49]

What I am calling the time of daily life, or ordinary time, is Hall's profane time:

Profane time now dominates daily life and that part of life which is explicit, talked about, and formulated. In the Western world, profane time marks minutes and hours, the days of the week, months of the year, years, decades, centuries—the entire explicit, taken-for-granted system which our civilization has elaborated.[50]

Music reflects profane time as well as sacred time. As Chapter 4 shows, regular hierarchic meter is omnipresent in traditional music, ticking away like a clock to remind us of profane time. Yet metric regularity has faded in importance in twentieth-century music. Similarly, composers have become increasingly attracted to stasis. Thus, despite (or perhaps as an antidote to or reaction against) the ever-accelerating pace of life and the hollow obsession with progress in modern Western society, the temporality of modern music has come to reflect spatial concepts of time. Similarly, contemporary art and thought have embraced the static, the eternal, the sacred. When novelist John Fowles (quoted in Section 1.4), for example, states that existence "was always now," he is speaking of this spatial quality of being.

Arnold Hauser has written of the modern concern with being as opposed to becoming.

The time experience of our age consists above all in an awareness of the moment in which we find ourselves—an awareness of the present. Modern man is absorbed in his contemporary world as medieval man was in an other-worldly and the man of the Enlightenment in a utopistic forward-looking expectancy. Everything topical, everything belonging to the present moment is of special value to the man of today, and therefore the mere fact of *simultaneity* acquires a new significance in his eyes. The discovery that, on the one hand, the same man experiences so many different and

> irreconcilable things in one and the same moment, and that, on the other hand, the same things are happening at the same time in so many places, this universalism which modern technics have created and of which modern means of communication make us conscious, is perhaps the real source of the new conception of time and the abruptness with which modern art describes temporal phenomena.[51]

Elsewhere Hauser has written,

> Is one not in every moment of one's life the same child or the same invalid or the same lonely stranger with the same wakeful, sensitive, unappeased nerves? Is one not in every situation of life the person capable of experiencing this and that, who possesses, in the recurring features of his experience, the one protection against the passage of time? Do not all our experiences take place as it were at the same time? And is this simultaneity not really a negation of time? And this negation, is it not a struggle for the recovery of that inwardness of which physical space and time deprive us?[52]

Psychologist Robert Ornstein has succinctly stated the difference between (linear) becoming-time and (nonlinear) being-time:

> In the linear mode, time is directional, a duration carrying us from the past into the future; the present is always fleeting away behind us. . . . In the nonlinear mode, however, the present exists, and is all that exists.[53]

I do not mean to imply that change, motion, and linearity have disappeared from Western art or thought. We see in the twentieth century not a complete reversal of older Western values but rather a maximal interpenetration of the two fundamental opposing forces of existence. If some statements quoted in this book seem to be excessively strong negations of linear thinking, they must be understood as reactions against the predominance of linearity in Western thought for centuries. But we must remember that both being and becoming are fundamental to human time and to its artistic expressions. Fraser has written on the necessity of both concepts and of the inevitable conflict between them.

> That analytical component of existential tension which we describe as "being" corresponds to . . . permanent certainties. Our instinctual drives in this regard find expressions in scientific and religious laws and in philosophies of being which see the strategy of existence in unchanging continuities. The postulate of an instinctual drive for the identification of time with permanence . . . claims that we instinctively seek permanent relationships and that we are fulfilled when we believe to have identified them. . . .
>
> That analytical component of the existential tension which we call "becoming" satisfies the demands of intrinsic unpredictability. In the broadest context, the play of the unpredictable is expressed in the contingencies of science, religion, and the arts, and in philosophies of becoming which maintain that the strategy of existence resides in unpredictable qualities. The postulate of an instinctual drive for the identification of time with the unpredictable elements of experience . . . claims that we instinctively seek the unexpected and have a sense of completeness when we believe we have identified it.
>
> Thus the specific ways in which we slice temporality into being and becoming, or its corollary, the way we see the world as made up of stationary and creative processes, are characteristics of the human mind. Yet, metaphysical

> and methodological solipsism is removed if we remember that the existential tension of the mind, of which the nomothetic [i.e., nonlinear] and generative [i.e., linear] aspects of time are projections, is only one level, albeit the most advanced one, in an open-ended hierarchy of unresolvable conflicts immanent in nature.[54]

Throughout history, time has been regarded as being and/or becoming by various philosophers and cultures.[55] The arts have reflected these concerns. In music the strongest representative of becoming is tonal progression, though any movement through time, whether goal-directed or not, exemplifies becoming. I identify becoming with temporal linearity. Nonlinearity is more like being. Nonlinearity is a concept, a compositional attitude, and a listening strategy that concerns itself with the permanence of music: with aspects of a piece that do not change, and, in extreme cases, with compositions that do not change.

Musical sound both is and becomes. Music has a timeless existence apart from any performance, and yet it allows us to move through time (and allows time to move through us) as we listen. My concepts of linearity and nonlinearity are not exactly the same as philosophy's becoming and being, anthropology's sacred and profane time, or psychology's linear and spatial time conceptions, but the similarities are strong. Linearity and nonlinearity are complementary forces in *all* music, although they appear in vastly different ways. They coexist in different proportions and on different hierarchic levels. From their interaction and from their conflict arise the new temporalities of recent music and many of the meanings of all music. Chapter 2 begins to explore how this happens.

Chapter 2

Linearity and Nonlinearity

2.1 PRELIMINARY DEFINITIONS

Virtually all music utilizes a mixture of linearity and nonlinearity. Linearity and nonlinearity are the two fundamental means by which music structures time and by which time structures music. Nonlinearity is not merely the absence of linearity but is itself a structural force. Since these two forces may appear to different degrees and in different combinations on each level of music's hierarchic structure, their interplay determines both the style and the form of a composition. I hope to show how this interaction operates in different kinds of music.

First the two terms must be defined.[1] Let us identify linearity as *the determination of some characteristic(s) of music in accordance with implications that arise from earlier events of the piece*. Thus linearity is processive. Nonlinearity, on the other hand, is nonprocessive. It is *the determination of some characteristic(s) of music in accordance with implications that arise from principles or tendencies governing an entire piece or section*. Let us also define linear time as the temporal continuum created by a succession events in which earlier events imply later ones and later ones are consequences of earlier ones. Nonlinear time is the temporal continuum that results from principles permanently governing a section or piece. The many varieties of time discussed in this chapter (directed linear time, nondirected linear time, multiply-directed linear time, moment time, and vertical time) arise from different degrees and kinds of interaction between linear and nonlinear time.

Both linearity and nonlinearity hinge on the expectations of the listener, but there are crucial differences. As we listen to a tonal composition, for example, each pitch event (individual note, chord, or motive) colors, to a small or great extent, our expectations of what will follow. We hear subsequent events in the context of these expectations, which are fully or partially satisfied, delayed, or thwarted. Each new occurrence, understood and subsequently remembered under the influence of prior expectations, implies the future. Thus linearity is a complex web of constantly changing implications (in the music) and expectations (of the listener). We do not therefore expect the same kinds of events in different parts of a linear composition. A recapitulation, after all, is experientially very different from an exposition. Linearity is intimately linked to the progression of a composition.

Nonlinearity is, at least for those of us who are products of a predominantly Western culture, the less familiar and hence more problematic of my two basic concepts. It is more difficult to explain nonlinearity than linearity, in part because our very language is linear (nonlinear languages of other cultures are considered briefly in section 2.3), as are our typical processes of analytic thinking. Nonlinearity is mainly a right-brain phenomenon, yet our discussion of it inevitably utilizes left-brain logic. Furthermore, the psychological sciences have yet to develop an adequate framework for understanding nonlinear time experiences.[2] Nonetheless, I must attempt to characterize nonlinear musical time.

While linear principles are in constant flux, nonlinear determinations do not grow or change. Nonlinear principles may be revealed gradually, but they do not develop from earlier events or tendencies. A work's or section's nonlinearity is present from its beginning. The dynamic of comprehending a work's nonlinearity is learning its immutable relationships. To take an absurdly simple example, one aspect of a string quartet's nonlinearity is the fact that it is a string quartet. After we have heard a bit of the music (assuming we do not already know from seeing the performers on stage or from reading the name of the composition), we understand that it is scored for four string instruments. We expect that there will be no offstage brass band, not because the piece has implied through internal compositional logic that it is written for strings but because it simply *is* so written. Of course, it may turn out that our expectations are wrong and an offstage band may in fact play in the third movement. In that case the nonlinear expectations would be shattered by an unexpected discontinuity. But the piece's instrumentation would still be nonlinear (I am assuming that the piece does not manage to imply through internal linear logic, such as quoting march tunes in the second movement, that the strings will eventually be joined by offstage brass). The entry of the brass would not be a linear outgrowth of past events but would rather show us that a nonlinear premise of the work is that it is for string quartet joined eventually by brass. We would have to wait until the third movement (assuming that we are listening for the first time and have not been tipped off by program notes) before fully understanding this particular nonlinear principle.

Nonlinearity should not be equated with discontinuity, since discontinuities can acquire their force by violating linear as well as nonlinear implications (see Section 2.4). Furthermore, linearity depends on neither continuity nor contiguity, since an event may be implied by events that far precede it. Thus neither linearity nor nonlinearity is necessarily allied with continuity, discontinuity, or contiguity.

While these statements can serve as a point of departure, they do have potential problems as definitions: the idea of "determination" requires further explanation, as does the term "characteristic of the music." The mechanism by which expectations may or may not be aroused by preceding events or grow out of general principles must be considered. How (and even whether) a listener understands the dependence of an event on preceding music must also be studied. Given the present state of knowledge on the psychology of music perception, many of these matters of cognition must unfortunately be considered beyond the scope of this book (see, however, Chapter 11). Nor am I primarily concerned with the actual process of composition, with the way the composer came to choose B-flat rather than C. Determination has to do rather with the relationship between two events *as perceived by listeners.* If the music seems to imply B-flat as either a (linear) continuation of preceding notes or a (nonlinear) consequence of an overall logic, then the *music* can seem to have "chosen" B-flat (even if the composer actually wrote the B-flat before composing the notes that precede it).

The term "characteristic of the music" is used to refer to a concrete detail (such as an individual note or interval) or to a larger unit (such as a phrase or passage). Or a characteristic may be the duration of a section, the nature of a passage, or even a subjective mood. In short, a characteristic can be virtually anything in or about a piece of music.

Despite the vagaries of these definitions, I find the terms "linearity" and "nonlinearity" enormously useful. Although I must leave to the cognitive sciences the study of how we perceive and process these two very different kinds of musical relationships (Section 11.10 sketches some relevant ideas, however) and how we understand the dependence of one event on another, I can turn to information theory for a partial answer to the question of what sort of mechanism allows music to *determine* other music. I invoke information theory with some trepidation, however. We are, I fear, destined to encounter problems if we attempt to use anything more than some basic terminology from that science (see, however, my discussion in Section 11.6 of information content in relation to perceived duration).

2.2 LINEARITY AND MARKOV PROCESSES

Although information theory applied scientifically to the study of music has been problematic, it does provide a useful aesthetic framework for understanding the listening process. The use of Markov chains to study music has been pursued by information theorists such as Hiller, Youngblood, Moles, Meyer, Cohen, and Knopoff and Hutchinson, among others.[3] A Markov chain is, loosely speaking, a series of antecedents contributing to the probability of a consequent event. In a first-order Markov chain, an event is understood as "chosen" on the basis of probabilities suggested by the immediately preceding event. For example, the chances that a C will follow a B in a passage in C major are decidedly different from the probability of encountering a C after a B in F-sharp major. In a second-order Markov chain the probability of each event depends on the two preceding events. There is, for example, a specific probability in A minor of hearing a C after we have heard a B following an A. The higher the Markov order, the greater the linearity. Total nonlinearity corresponds to a zeroth-order Markov chain, in which each event is understood as independent of preceding events, although it may indeed be chosen in accordance with a particular statistical weighting. There is, for example, a particular probability of encountering a C in E-flat minor, regardless of the notes that precede it.

Comprehensive analysis of most linear music would require very high-order chains, since a given event may well depend on hundreds of preceding events. This is true even when events are grouped hierarchically by the listener. Therefore, as A. Wayne Slawson has remarked,[4] it is impossible in practice to specify a maximum order that would account for all meaningful probabilities in a given composition. Furthermore, it is difficult to define just what constitutes an event, even on the level of the smallest details. Is a chord an event? Or is each note of a chord a separate event? Is the interval separating two successive notes an event? Is a duration an event? Is a motive an event or a series of events? Does a permutation of familiar notes constitute a new event or is it a variant of an old event?

Not surprisingly, information-theoretic analyses have tended to focus on isolated parameters (e.g., melody) and/or have been concerned only with lower-order Markov chains. While it can shed light on certain aspects of music, I doubt that information theory will ever provide powerful analytic tools for entire pieces.[5] It does, however, offer a context for aesthetic understanding of linear musical time, as Moles suggests and as Meyer demonstrates. Events can and do imply later events; probabilities do exist for what will follow a given sequence of events. It may not be possible to calculate these probabilities objectively, but we do feel their force. If an event is an outgrowth of previous events, we understand that the music has progressed from antecedent to consequent. The piece moves through time from the music which implies to the music which satisfies (or delays or thwarts) the expectation. This sense of progression—coming from the confluence of several interlocking antecedent-consequent relationships and from a complex interaction of implications and outgrowths that takes place across various durations—is what linearity means: the higher the Markov order, the more pervasive the linearity.[6]

2.3 CULTURAL RELATIVITY OF LINEARITY AND NONLINEARITY

Apart from certain recent experimental compositions that toy with zeroth-order processes, virtually all Western music, even that with strongly nonlinear structures, is linear to a significant extent.[7] This fact is hardly surprising, since Western thought has for centuries been distinctly linear. Ideas of cause and effect, progress, and goal orientation have pervaded every aspect of human life in the West (at least from the Age of Humanism to the First World War). Proponents of technologies, theologies, and philosophies have sought to improve human life; capitalism has sought to provide a framework for material betterment, at least for the few; science was for a long time dominated by the temporally linear theories of Newton and Darwin; even Western languages are pervaded by words that refer to goals, purposes, and teleology.

In music, the quintessential expression of linearity is the tonal system. Tonality's golden age coincides with the height of linear thinking in Western culture. Having roots in the fifteenth and sixteenth centuries, tonality was fully developed by 1680; the system started to crumble in the late nineteenth century, and only remnants (plus some active attempts at revival) still function today. Tonality is one of the great achievements of Western civilization, and its development was no accident. But let us not be lulled by the pervasiveness of tonal music into believing that it is in any way universal. Many non-European cultures have produced predominantly nonlinear music, reflecting nonlinear cultural attitudes and life styles.

In Bali, for example, temporal processes are not linear. Balinese calendars are not used to measure duration. Rather, they are marked by ten concurrent cycles (of differing social meanings and degrees of importance) of from one to ten days in length. The name and character of a day are determined by its place in the more important cycles, of five, six, and seven days respectively. Thus, Balinese time exhibits a circular quality: primary cycles repeat after 5, 6, 7, 30 (5 × 6), 35 (5 × 7), 42 (6 × 7), and 210 (5 × 6 × 7) days.

> The cycles and supercycles are endless, unanchored, uncountable, and, as their internal order has no significance, without climax. They do not accumulate, they do not build, and they are not consumed. They don't tell you what time it is; they tell you what kind of time it is.[8]

Only with great difficulty can the cycles of the Balinese calendar be translated into the periods of our calendars.

Balinese music, not surprisingly, is also nonlinear. It contains rhythmic cycles which repeat seemingly (to Western ears) without end, but the Balinese do not think in terms of specific durations to be filled by "meaningful" events.[9] Balinese music, like Balinese life, is not oriented toward climax. Activities in Bali are understood and appreciated not as means towards goals but rather as inherently satisfying in themselves.[10] Thus it is not surprising that Balinese musical performances simply start and stop but have neither beginning gestures nor ultimate final cadences.[11]

The Trobriand Islands, not far from Bali, also have a nonlinear culture. The language of the Trobrianders contains few words that communicate ideas of progress, change, becoming, or continuity.[12] Objects are named by the state in which they are found (e.g., "ripe vegetable"), but their identity is lost if they change state (the "same" vegetable acquires a new name if it becomes overripe).[13] The Trobriand language contains no words corresponding to our "for the purpose of," "why," or "because." There are no words for comparison. There are no tenses. Bronislaw Malinowski found that, under persistent questioning, Trobrianders could recognize causes and relate them to effects, but the effort was foreign to their thinking. On the contrary, linear behavior, when it does occur, is despised.[14] Patterned sameness, not progressive change, is valued by the Trobrianders.[15]

There are many other peoples whose time conception is not linear—south Indians,[16] many tribes in Africa,[17] the Hopi in the American Southwest,[18] the inhabitants of Java,[19] the Quiché Indians of Guatemala.[20] What are we to make of these cultures from different parts of the world, each of which seems to put little value on some of our most accepted and comfortable concepts? It is ethnocentric simply to dismiss them as primitive. Many are highly developed civilizations with long and rich cultural heritages. Their pervasive acceptance of nonlinearity might tend to devalue the very idea of an inherited tradition, but nonlinearity does imply permanence. The existence of such cultures proves that temporal linearity is not a necessary component of human existence but rather a cultural creation: a magnificent and fruitful creation, to be sure, but nonetheless artificial. Nonlinearity is equally arbitrary: time is not an absolute reality. Rather, it means different things to different peoples. Thus, it is hardly surprising that various cultures' musics treat time differently.

2.4 LINEARITY IN TONAL MUSIC

As mentioned in the preceding section, Western culture has long been predominantly linear and its music has embodied a sophisticated system of linearity. Tonality is comprised of a set of complex hierarchic relationships between tones, supported by durations, dynamics, timbres, etc. Since the tonic is endowed with ultimate stability, tonal relationships conspire toward one goal: the return of the tonic, finally victorious and no longer challenged by other keys. Thus tonal motion is always goal-directed. The arrival of the tonic is never in doubt (in information theory, such inevitability is termed redundancy). Rather, the suspense and hence the motion are determined by just what route the music takes and at what rates it travels. Those rare pieces that end in a key other than the one in which they begin depend for their force on the denial of this expectation (or else they are products of particular stylistic conventions, as are Sousa marches, for example). The expectation of tonic return is still operative, but that implication is ultimately denied for expressive effect.

Tonal motion is, strictly speaking, a metaphor. Nothing really *moves* in music except vibrating parts of instruments and the molecules of air that strike our eardrums. But the metaphor is apt. People who have learned how to listen to tonal music sense constant motion: melodic motion, motion of harmonies toward cadences, rhythmic and metric motion, dynamic and timbral progression. Tonal music is never static because it deals with constant changes of tension. Even when there is a passage of suspended harmonic motion, we listen expectantly for the desired resumption of progression.

Knowing how to listen to tonal music is a very special skill which Westerners begin to acquire at a very young age. Most of this learning takes place subconsciously. But I maintain that even the most committed amateur, who may claim to hear only the pretty tunes in tonal music from Schubert to Richard Rodgers, does in fact understand with considerable sophistication the subtleties of tonal listening. Listening to tonal music has become comfortable to Westerners not only because we have learned a complex skill but also because the linearity of tonality neatly corresponds to many goal-directed processes in Western life. We should not be fooled, however, by the comfort of tonal listening. It *is* learned behavior, as the predominantly nonlinear arts of several different cultures remind us.

The temporal form of a tonal piece typically consists of a move towards a point of greatest tension that is usually remote from the tonic, followed by a drive back towards the tonic. The return of the tonic is an event of rhythmic importance, a structural downbeat,[21] a point of resolution, the goal. This view implies that structurally the most significant dominant is that which precedes the recapitulation tonic. According to Schenkerian thought, structural dominants tend to be found closer to the end of a piece. While I would not deny the importance of the ultimate descent of the *Urlinie,* I feel that the sense of arrival at a recapitulation is critical to the temporal unfolding of a tonal composition. A recapitulation that begins as a literal restatement of the opening can feel quite different from the actual beginning: the return of the opening music now acquires the stability of a goal reached. What remains for the music to accomplish is the prolongation of the recapitulation tonic so that its stability is anchored in an extended duration. Thus large-scale durational proportions are critical to tonal form.[22]

Composers can play on the expectation of a recapitulation structural downbeat by taking circuitous routes, by inserting false recapitulations, or by undermining the tonic downbeat at the start of a true recapitulation. Such subtleties do not weaken the linearity of the music—quite the contrary. They depend on carefully established expectations. The process of choosing when and how to undercut a recapitulation downbeat depends on implications set up earlier in the piece.

Consider, for example, the first movement of Beethoven's String Quartet No. 7 in F Major, opus 59, no. 1 (1807). After a long and complex development section, the following sequence of events occurs:

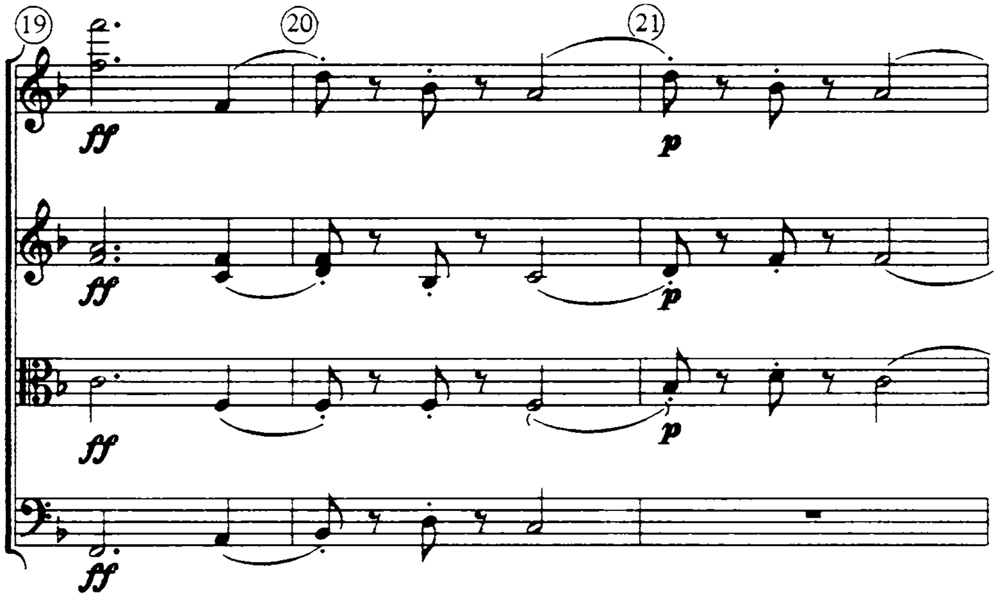
1. an F major chord returns as tonic (in first inversion, with the second theme of the first theme-group from mm. 20 ff.) in m. 242;
2. the main theme returns in the tonic in m. 254;
3. the tonic note reappears accented in the bass in m. 279 (but as the third of a D-flat chord);
4. at long last there is a strong cadence in the tonic (root position V to root position I) in m. 307; and
5. we must wait until m. 348 to hear the main theme with full root-position tonic support.

Beethoven does more than play on our understanding of the conventions of sonata form; he deals with the linear consequences of earlier events. He shapes the recapitulation this particular way because of the implications of the strange opening of the piece (see Example 2.1): not really a I chord,[23] certainly not a III^6 chord, but rather a subtly unsettling incomplete harmony. This unstable chord could never serve as a point of arrival at the start of a recapitulation. Thus, the sense of resolution is spread over five timepoints rather than residing (in the traditional manner) in the one instant of reprise. This movement is therefore a wonderful example of tonal linearity. It is a complex and sophisticated statement of the same linear aesthetic that makes us expect a tonic note after a leading tone or a tonic chord after a dominant seventh. We may not understand all the implications of the unusual opening when we first hear it,[24] but we are struck by its strangeness and we wait for an "explanation." This waiting is the essence of linearity.

Example 2.1. **Beethoven, String Quartet No. 7 in F Major, opus 59, no. 1, first movement, mm. 1–21**

Continued

Example 2.1, continued



The way Opus 59, no. 1 approaches its recapitulation is not a surprise. It is a logical, although not totally predictable, consequence of an opening that could never function unaltered as a recapitulation resolution. Surprises —events that really are unexpected and unprepared—*do* exist in tonal music, however. Surprise is often a product of linear thinking. For an event to be unexpected suggests that implications have been established. The first movement of another Beethoven string quartet, Opus 132 (1826), contains an excellent example (see Example 2.2). Following a progression which seems to move ever

Example 2.2. **Beethoven, String Quartet No. 15 in A Minor, opus 132, first movement, mm. 75-98**

Continued

Example 2.2, continued


90
91
92
93
94
95
96
97
98

more pointedly toward a definitive cadence (of which there have been precious few thus far) in C minor, there is an interrupting silence (m. 92) followed by utterly new, recitative-like material. It is true that certain intervallic connections can be drawn between this idea and earlier themes, but these correspondences are minimal compared with the stark unfamiliarity of this music. Particularly because it breaks a strongly linear continuum, the discontinuity is overwhelming. Furthermore, the continuation of this music does nothing to erase the impact of its discontinuous arrival. In fact, the recitative-like material is never integrated into the movement. It is not heard again. It is an unrelated interruption, without precedent and without motivic outcome. Yet it has linear consequences, not literally in the music but rather in the way we hear it. Once it has happened we cannot forget it. It colors our understanding of the remainder of the movement: We understand that any subsequent continuity just may be shattered.

Despite the recitative's lack of motivic precedent and despite the manner in which it interrupts a cadence-directed progression, I am not calling it a nonlinear event. This particular surprise is a *linear* occurrence. It depends on the linear expectations it subverts.

2.5 LINEARITY IN ATONAL MUSIC

I have said that tonality, the musical expression of temporal linearity, was a product of the European cultural tradition. What can be constructed, no matter how painstakingly nor how magnificently, can also be destroyed. Temporal linearity in Western music has lost its universality.

The disintegration of linearity began with its intensification. As the tonal vocabulary became richer in chromaticism toward the end of the nineteenth century, the urgency of music's goal-directedness increased. Not coincidentally, this era also saw the beginnings of modernism in the visual and literary arts. Late romantic music (such as Brahms' Intermezzo in E Minor, opus 116, no. 5 (1892) or Hugo Wolf's *Das verlassene Mägdlein* (1888) from his settings of Eduard Mörike's poems) is always searching for goals that only occasionally materialize. Such music often seems to consist mainly of structural upbeats (examples of structural upbeats are to be found in Section 4.12). Progression in this music is defined more by voice leading than by outright root movement, which is reserved for especially large articulations. Late romantic music drove root-defined continuity farther and farther into the background, as voice-leading prolongations of slowly moving structural harmonies became normative on local levels. Only rarely do we hear what was so typical of music a century earlier: harmonic root progressions in the foreground functioning as the primary support of large-scale harmonic movement.

The atonal idiom of the early music of Arnold Schoenberg (such as the *Sechs kleine Klavierstücke,* opus 19 of 1911, analyzed in Chapter 7) resulted from the disappearance of background tonal harmonies. Stepwise motion in the foreground was retained as the sole means of achieving continuity of melodic lines, but the definition of large-scale goals for this motion became problematic. As many recent theorists have shown, consistencies of set types underlie much of this music. In most early atonal music, the number of set types is limited so as to create significant pitch and/or interval class invariances that ensure consistent contexts. Most pieces, or at least movements or sections, use a relatively small number of sets throughout. *Linear* transformation of sets is relatively rare. Thus set analyses have uncovered nonlinear principles of consistency more often than they have explained linear means of progression.[25]

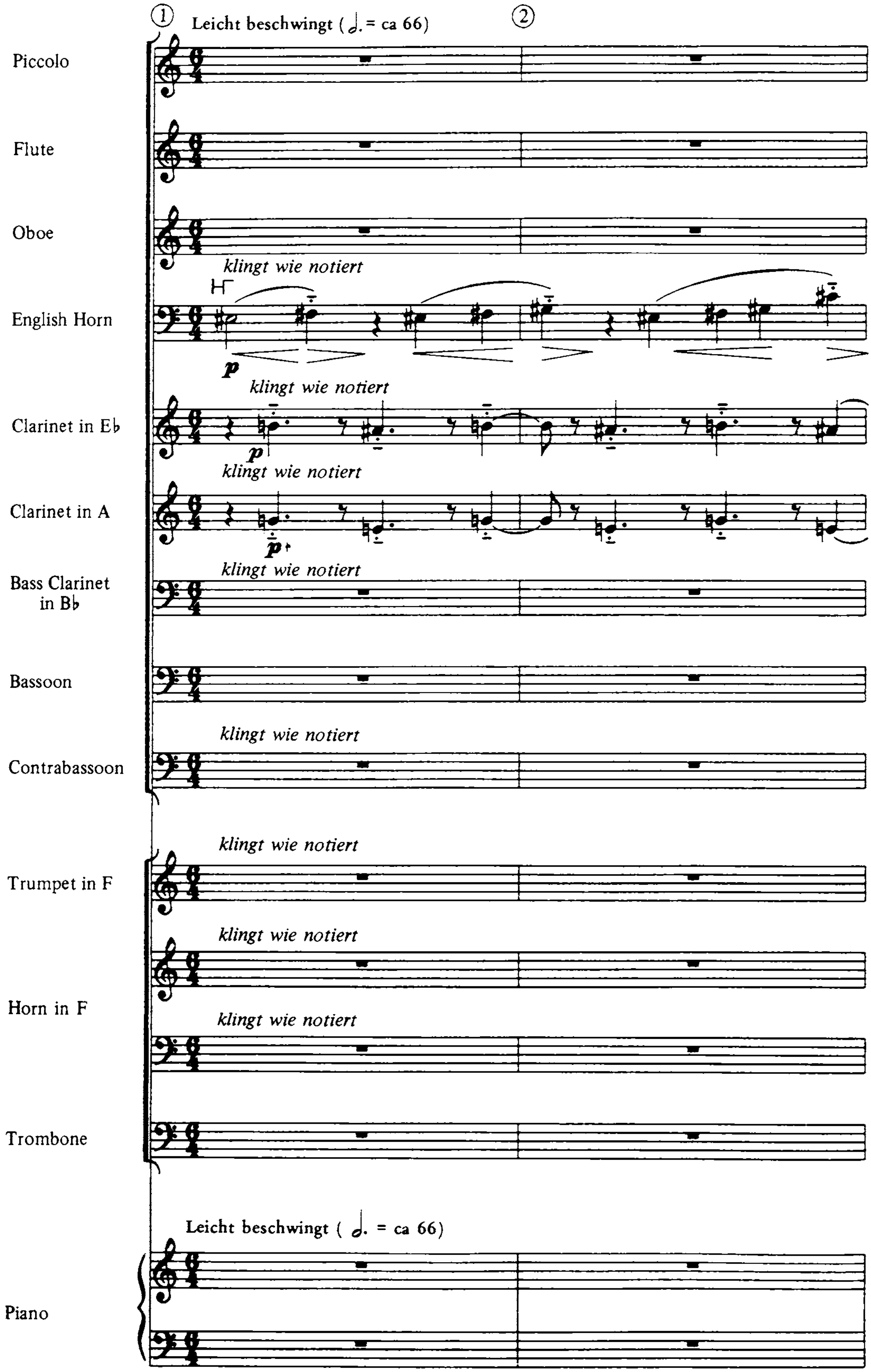
In the absence of the tonal system's *a priori* goal definition, early atonal composers faced the challenge of creating cadences contextually. Their phrases end rhythmically, possibly by slowing various motions as the cadence approaches and/or by following the cadence sonority with silence. Also, changes of texture, timbre, figuration, or register help to define contrasting phrases. My point is that the nonpitch parameters, traditionally treated as secondary support of the harmonic, linear, and rhythmic motion of tonal music, were made to act more structurally, more independently, more prominently, more as means of articulation, in order to compensate for the loss of tonality's unequivocal goal definition. Goals are defined either as they happen by rhythmic and textural factors or in context by previous reiteration and emphasis.[26]

In the former case we may not know what a cadential harmony is to be until it actually arrives, a situation quite different from tonal drives toward cadences. Consider, for example, the first phrase (excluding the introductory motto) of Alban Berg's *Kammerkonzert* of 1925 (see Example 2.3). There is no doubt that the phrase ends in m. 7. Why do we hear this measure as cadential? There *are* pitch factors. The final E–C dyad is a reasonable goal, given the preceding sustained E in the oboe and the stepwise approach to C in two voices. E and G define a harmonic area in mm. 1–6: the arpeggiated E–G in the A clarinet in mm. 1–4 takes on importance in m. 4 when the bass clarinet enters on E (lowest sounding register) below the A clarinet's G. E and G become overtly emphasized when the oboe and horn sustain those pitch classes in mm. 5–6 while the English horn, bassoon, and flute arpeggiate them in three registers. Through m. 6, then, the linear pitch logic involves an increasing emphasis on the dyad E–G. In order to progress toward a cadence, the music must begin to move harmonically. The stepwise motion beginning in m. 5 eventually causes the E–G emphasis to be replaced by E–C stability. Once the flute reaches high G in m. 6, it begins a stepwise descent through F (end of m. 6), E-flat, D-natural (in a lower register, preceded by D-flat), to the cadential C at the end of m. 7. (The flute's C-flat doubles the ascending line described below, and its A-flat doubles the horn's A-flat, which weakens the prevailing G.) Thus what the flute (and oboe) accomplish in mm. 6–7 is the linear motion of the voice containing G stepwise downward to the cadential C.

This C is also a goal of stepwise motion upward. This motion starts from the motivically significant A and B-flat, reiterated emphatically in m. 5 in the flute, oboe, English horn, and bassoon. When the flute states A–B-flat three times in mm. 5–6, we expect a stepwise continuation upward, which is provided, in both registers, by the C-flats in m. 7. The goal of this chromatic rise is the flute-oboe C. This C is thus cadential because of the careful stepwise motion to it in two directions: two voices (as shown in Example 2.4) arrive on C at the cadence.[27]

The motion to E, the other cadential pitch, is less pointed. Since E has been

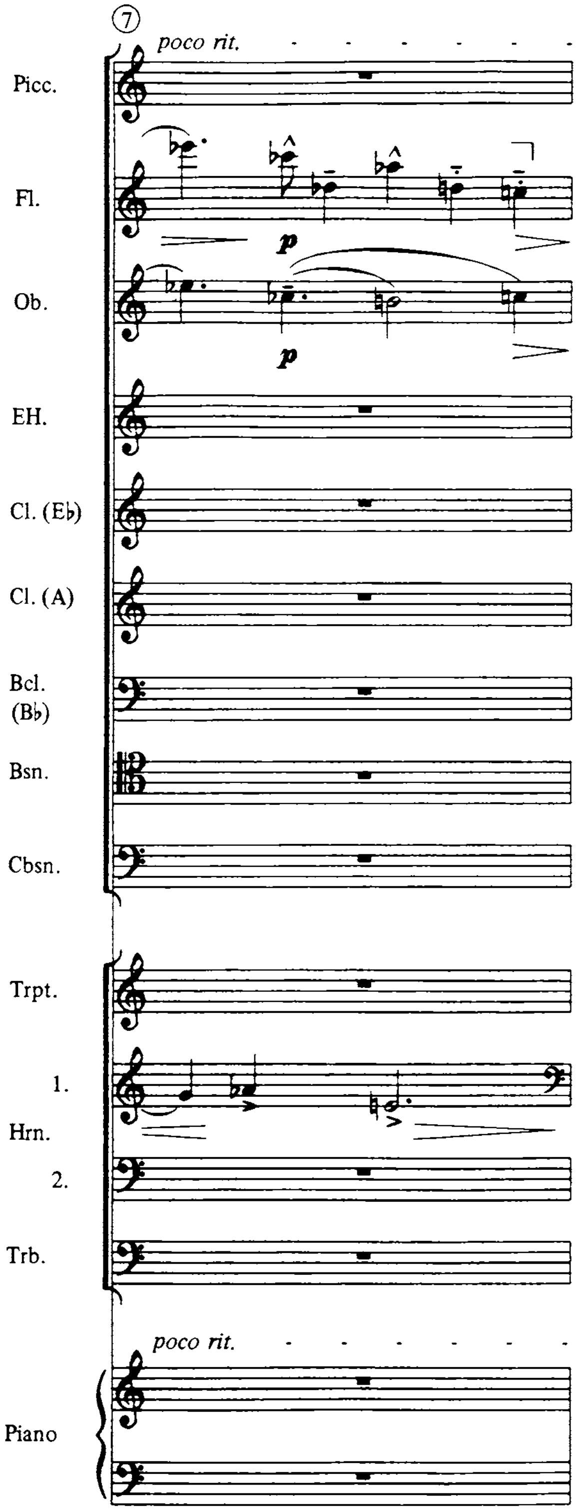
Example 2.3. **Berg, *Chamber Concerto,* first movement, mm. 1–7 (excluding introductory motto)**




③
④
Picc.
Fl.
Ob.
EH.
poco
p
Cl. (E♭)
poco cresc.
Cl. (A)
poco cresc.
Bcl. (B♭)
p
p
Bsn.
pp
Cbsn.
Trpt.
mp
1.
Hrn.
2.
mf
Trb.
p
Piano

Continued


5
6
Picc.
Fl.
Ob.
EH.
Cl. (E♭)
Cl. (A)
Bcl. (B♭)
Bsn.
Cbsn.
Trpt.
1.
Hrn.
2.
Trb.
Piano
mp
pp
p
mf
fpp
p
mf
mf
p
p


7
poco rit.
Picc.
Fl.
p
Ob.
p
EH.
Cl. (E♭)
Cl. (A)
Bcl. (B♭)
Bsn.
Cbsn.
Trpt.
1.
Hrn.
2.
Trb.
poco rit.
Piano

Example 2.4. **Voice leading of Example 2.3, mm. 6–7**

an emphasized note for the entire phrase, it does not need to be approached as a stepwise goal in order to acquire cadential status.

E–C is not the only pair of pitch classes toward which the phrase might have progressed, however. Rather than the sustained E, the horn's G might have signaled an upcoming goal, and stepwise motion toward a pitch class other than C (C-sharp, for example) is surely possible without greatly altering the material. The linear pitch motion I have described makes a cadence possible, but it does not in itself create a cadence in the manner that tonal pitch progressions can. Actually, the cadence is made by nonpitch parameters, which promote the stepwise pitch motion to the status of goal-defining: the slowing tempo; the lengthening note durations; the thinning texture; the decreasing dynamics; the downward motion after an overabundance of rising figures; the less frequent change of instrumental colors; and the freshness of the subsequent music. The cadence thus grows from the preceding music in both pitch and non-pitch ways. It is the conspiring toward a common goal in all these parameters that creates the linear motion toward the cadence.

Nonpitch support of cadences is commonplace also in tonal music. There, however, the pitch structure carries the weight of the cadence. Play the chords in Example 2.3 in even values, and do the same with a tonal cadence: the tonal skeleton still cadences, but Berg's music does not. True, the *Chamber Concerto*'s harmonic density does decrease toward the cadence, and reference is made to the motto pitches (the introductory motto is omitted from Example 2.3), but the E–C cadence is neither the least dense harmony nor the most referential sound.

As I mentioned above, some atonal compositions attempt to create predictable goals contextually by means of reiteration or emphasis. In the first movement of Webern's Cantata No. 1 a four-note chord becomes a stable sonority by virtue of frequent emphasis in a variety of settings (see Chapter 7); it comes to assume the character of a goal by reiteration, perseverance, and structural importance of its underlying set type. Similarly, Schoenberg tried to make certain transposition levels of his combinatorial row structure, in works such as String Quartet No. 4 (1937) and *Violin Concerto* (1936), more stable than others, thus creating goal transposition levels. Actually, since every row transposition is also a note permutation, a goal transposition level is experienced very differently from a goal chord or pitch. Nonetheless, linearity is at work on a large scale in a variety of ways in Schoenberg's twelve-tone compositions.[28]

These works of Berg, Webern, and Schoenberg demonstrate nontonal pitch linearity. The difference is that in the Webern cantata and twelve-tone Schoenberg works the progression is toward a goal—whether a particular sonority or a particular transposition level—known in advance (as in tonal music), while in the Berg *Chamber Concerto* excerpt and in Schoenberg's Opus 19 the goal is not predictable except as the music approaches it.

Neotonal music, on the other hand, retains the potential of *a priori* goal definition. The first movement of Hindemith's Piano Sonata No. 2 (1936), modeled on classical sonata-allegro procedures, relies on our knowledge of tonal linearity. Its tonic is not only a referential pitch (as in the Webern cantata) but also a predictable goal of harmonic as well as rhythmic motion.[29] As the sonata demonstrates, the time sense in neotonal music is linear in ways similar to those of tonal music. Walter Piston's Symphony No. 4 (1950) is another good example.

For a posttonal composition to be temporally linear *with goals*, there must be a clear sense of continuity, provided by voice leading or perhaps by other directional processes in some parameters. Furthermore, goals must either be defined contextually (by reiteration or emphasis, as in the Webern cantata) or established *a priori* (by reference to (neo)tonal procedures, as in the Hindemith sonata). In either case, the arrival of goals is usually supported by rhythmic and textural means. Not all posttonal compositions establish unequivocal large-scale goals, however. Such works as the Berg *Chamber Concerto* progress through time by a variety of means and with varying degrees of localized stability at cadences, yet they avoid the establishment of ultimately stable pitch classes or complexes. Other works move linearly through time by essentially non-pitch processes. Consider, for example, the opening progression to a structural downbeat in George Crumb's *Makrokosmos III* (1974). Further examples of works that progress to goals that are not knowable in advance include (to choose almost at random from a huge literature) Crumb's *Echoes of Time and the River* (1968), the first of Charles Ives' *Three Places in New England* (1911), Aaron Copland's *Nonet* (1960), Luciano Berio's *Sequenza III* (1963), Iannis Xenakis' *Syrmos* (1959), Edgard Varèse's *Hyperprism* (1923), and Erik Satie's *Socrate* (1919).

Thus, though much twentieth-century music exhibits a high degree of linearity, only some of that linearity is goal-directed. In other words, much atonal pitch linearity operates at shallower hierarchic levels but not on middleground and background layers. The background structure (whatever it may be—I am certainly not claiming Schenkerian *Urlinien* for atonal compositions) of such music unfolds according to low-order Markov chains determining structurally significant events. Music which is nondirected in this fashion at a background level suggests a kind of linearity different from that of tonal music. Music exhibiting this special time sense, which I am calling "nondirected linearity," is, like tonal music, in constant motion, but the goals of this motion are not unequivocal. Nondirected linearity would have been unthinkable, even self-contradictory, in earlier Western music. But it is quite appropriate in this century, given the breakdown of goal orientation in much recent music. Nondirected linear music avoids the implication that certain pitches can become totally stable. Such music carries us along its continuum, but we do not really know where we are going in each phrase or section until we get there.

2.6 NONLINEARITY IN TONAL MUSIC

I began by claiming that all music exhibits both linearity and nonlinearity, yet most of the discussion of Western music has thus far focused on linearity. Until recently, Western music *has* been predominately linear, but it has always had its nonlinear aspects as well. What could constitute a nonlinear construct in tonal music?

An unchanging context would be an example of "the determination of some characteristic(s) of music in accordance with implications that arise from principles or tendencies governing an entire piece or section" (definition of nonlinearity). Consider pieces in which the texture, motivic material, and rhythmic figuration are virtually constant. Chopin's Prelude in C Major, opus 28, no. 1 (1839) and Bach's Prelude in C Major, from the first volume of *The Well-Tempered Clavier* (1722), are good examples, as is Schumann's *Stückchen* from the *Album for the Young* (1848) (see Example 2.5). In such music the context is not a consequence of the way the piece begins, but rather it is determined by the surface of the composition, which is in certain respects unchanging. The music's

Example 2.5. Schumann, *Stückchen*, from the *Album for the Young*, entire piece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texture exists throughout the piece but does not grow or transform itself as the work unfolds.

It might be argued that a constant context invites a linear hearing. In both preludes and in the Schumann piece, the second measure's similarity to the first increases our expectation that the third measure will also be similar. Eventually the expectation for consistency turns into virtual certainty, and (in information-theoretic terms) the texture and surface rhythm become redundant. But in retrospect we realize that an unchanging principle of organization, not a progressive linearity, has been determining the texture and surface rhythm since the opening of the pieces. Once this consistency of rhythmic and textural pattern becomes a certainty, we start to notice the nonlinearity of the texture. (The music's linearity resides in other aspects: melodic contours, harmonies, registers, and possibly dynamics. I certainly do not intend to belittle the importance of middleground pitch, rhythmic, and metric linearity in this music.)[30] It is still possible for us to be surprised, of course, by an unexpected change in the pattern. In Schubert's song *Gretchen am Spinnrade* (1814), for example, just such a disruption occurs with an extraordinary impact. The constant texture, which represents the spinning wheel's endlessly mesmerizing motion, breaks at one point. Gretchen pauses from her work as she first remembers Faust's kiss. As in Beethoven's Opus 132, the impact of the unexpected is enormous, and we can no longer listen to the music as we did previously, despite the resumption of the spinning motive. But there is a significant difference between the Beethoven and Schubert excerpts: The surprise in Opus 132 contradicts linear implications of harmony and gesture, while in *Gretchen* the surprise violates nonlinear consistency of texture and rhythmic pattern.

2.7 DURATIONAL PROPORTIONS IN TONAL MUSIC

Not only contextual consistency but also formal proportions can be determined according to nonlinear principles. The respective lengths of musical segments can be a significant factor in the creation of balanced structures. We hear, store, and compare durations of timespans in order to understand their relative balance. For two sections to be proportionally balanced, it does not really matter which is heard first. Similarly, for the total time spent in the tonic to balance the total time spent in other areas does not depend on the location of the tonic and nontonic segments of the movement. Neither type of balance—of section durations or of time spent in different keys—depends on progression, and thus such proportions can be understood nonlinearly outside the music's time frame.

Significant studies have been made of proportions in Mozart's music. Jane Perry-Camp[31] has uncovered large sectional balances that work according to carefully (yet intuitively, it seems) controlled durations. Perry-Camp's work is considered again in Section 10.8. Arlene Zallman[32] has discovered similar balances of total durations spent in various tonal areas. It is interesting to compare the work of these two theorists. Consider, for example, the Piano Sonata in E-flat Major, K. 282 (1774), which both Perry-Camp and Zallman have analyzed. There are 36 measures in the first movement (or 69, if the repeats are taken). The main structural division segments the movement into 15 + 21 (or, with repeats, 30 + 39) measures; also, the total number of (non-contiguous) measures in the tonic is 21 (39 with repeats); 15 measures (30 with repeats) are spent away from the tonic—an interesting balance! In the second movement the ratio of the length of Minuet II to that of the second half of Minuet II (whether or not repeats are considered) is 5:3, precisely the same ratio that exists between the second half of Minuet I and the first half of Minuet I. Both halves of the second movement utilize the same proportional ratio, although in different ways. Since neither minuet modulates, the ratio of their respective lengths (6:5) is necessarily the same as the ratio of durations spent in each of the two tonalities. Consider also the last movement. There are 102 measures (204 with repeats), subdivided at the end of the exposition 39 + 63 (or 78 + 26); the durational ratio of these two sections is 0.61905, which is remarkably close to the golden-mean ratio 0.61803.[33] (The golden mean is considered in detail in Chapter 10.) The number of measures in the tonic in this movement is exactly equal to the number of measures not in the tonic.

Although Mozart's music is predominantly linear, it is structured in part by nonlinear forces which contribute to formal balance. Perception of balance depends on what might be called "cumulative"[34] listening: an all-encompassing, retrospective, atemporal understanding which lies beyond the piece's time frame. Cumulative listening is a right-brain phenomenon (see Section 1.2). It is the mechanism by which we come to understand, in retrospect, the nonlinear principles of a composition or passage. These principles are (by definition of nonlinearity) unchanging within their contexts, and thus they are comprehended by the holistic right hemisphere of the brain. Of course, the left hemisphere also participates in our perception of such pieces as Mozart's K. 282. The nonlinear balance uncovered by the right brain, by means of cumulative listening, is a subliminal underpinning to the work's inherent linearity, as perceived by the left brain.

2.8 THE ASCENDANCY OF NONLINEARITY IN TWENTIETH-CENTURY MUSIC

I have been discussing two among many aspects of nonlinearity in tonal music: textural consistency and durational proportions. Since posttonal music is often nonlinear in more ways and more persistently than tonal music, we should expect to find a wealth of nonlinearity in the atonal literature. Before exploring some examples of nontonal nonlinearity, however, we should consider how and why music became progressively less linear as it became less tonal. There were two enormous influences, beyond the general cultural climate, on early twentieth-century composers, that proved decisive in the establishment of an aesthetic of nonlinearity. These influences did not cause so much as feed the dissatisfaction with linearity that many artists felt, but their impact has been profound. They are, respectively, the influence of non-Western music and the impact of recording technology.

Part of the modernist aesthetic in music has been the exploration of consistencies so great that they can suspend a composition's forward motion through time. With composers such as Debussy and Stravinsky, we first encounter true harmonic stasis: no longer the tension-laden pedal points of Bach but rather segments of musical time that are stationary and have no implication to move ahead; no longer textural constancy as an overlay to harmonic motion but now the freezing of several parameters into miniature eternities.

Contributing to the increased interest in harmonic stasis was the gradual absorption of music from totally different cultures, which over centuries had evolved virtually unexposed to Western ideas. The impact on Debussy of the Javanese gamelan orchestra, which he first heard at the 1889 Paris Exhibition, has often been noted.[35] Other composers attended the Exhibition but failed to appreciate the potential of what they heard. Debussy, on the other hand, was ready for an exotic influence and was looking for an alternative to Wagnerian harmonies.[36] He understood that the strange sounds he was hearing were unfolding in a different time world. He heard sonorities that were allowed to be themselves, that did not exist primarily in functional relationships to other sounds, that were not participants in an upbeat-downbeat compositional world. The Javanese influence on the French composer was enormous. His music is really the first in the West to contain extended moments of pure sonority, events that are to be appreciated more for themselves than for their role in linear progressions.

There was another composer who heard the gamelan in Paris (during its second European visit, in 1900) and understood the implications of a new time world. Although deeply committed to Germanic linearity, Gustav Mahler was nonetheless affected by the strange music from another world. A few years later he composed *Das Lied von der Erde* (1908), in the final song of which a decidedly Oriental time sense is played off (dramatically, it must be said) against a Western linearity.[37] I am referring to more than such quaint *chinoiseries* as the pentatonic melodies. There are vast stretches of harmonic stasis, and, at the end, functional tonality gradually evaporates in favor of an all-inclusive pentatonic verticality: C, E, G, and A are literally present, while D remains in the memory, unresolved in its register. Mahler demonstrated that the Germanic temperament can construct nonlinear temporalities. But this suggestion in *Das Lied* had to wait many years before it was further explored, as German composers tried ever more desperately to retain the linearity in their heritage. The intensified linearity in the music of Schoenberg and his followers demonstrates this point.

On the other side of the Atlantic, concert music was coming into contact with less linear music of a different tradition. Charles Ives felt no allegiance to European linearity, and arguably the most radical aspect of his music is its nondirected time sense.[38] By the time Ives wrote his music, there was already a considerably body of American music (including marching band medleys, some of the eccentric symphonic works of Anthony Philip Heinrich, and some of the songs of Stephen Foster) that was only sometimes linear on the formal level.[39] But this was not the music of John Knowles Paine, Horatio Parker, Daniel Gregory Mason, or Edward MacDowell. These composers, plus a later generation that included Copland and Sessions, studied abroad in an attempt to adopt what they perceived as the mainstream musical tradition, a tradition which included the inevitable linearity of European tonality. But composers like Ives, Heinrich, and Foster had made contact with musical Americana, and future generations of Americans were to make full use of it.

As new temporalities began to offer replacements for tonality's linearity in early twentieth-century Europe and America, discontinuities became commonplace. Although discontinuity in itself does not necessarily result in or from nonlinear thinking (as Example 2.2 shows), pervasive discontinuity can destroy linear progression. Much twentieth-century music exhibits marked discontinuity. The second significant influence on twentieth-century musical nonlinearity has to do with the creation of extreme discontinuities.

This influence was technological rather than sociological. Recording has not only brought distant and ancient musics into the here and now, but it has also made the home and the car into environments just as viable for music listening as the concert hall. The removal of music from the ritualized behavior that surrounds concertgoing struck a blow to the internal ordering of the listening experience. Furthermore, radio, records, and tapes allow the listener to enter and exit a composition at will. An overriding progression from beginning to end may or may not be in the music, but the listener is not captive to that completeness. We all spin the dial, and we are more immune to having missed part of the music than composers may like to think.

As I explain in greater detail in Chapter 3, the invention of the tape recorder has had a profound impact on musical time. Tape can be spliced; events recorded at different times can be made adjacent. A splice may produce a continuity that never existed prior to recording (as in a note-perfect recording of a classical concerto spliced together from several "takes"). But the opposite effect has interested composers more: The musical result of splicing can be overpowering discontinuity. Just when a splice may occur can be as unpredictable as the nature of the new sound-world into which the listener may be thrust.

Not only electronic tape music has become progressively more discontinuous in recent generations. The time sense in much twentieth-century music (and really in all contemporary arts), like the temporality of inner thought processes, is often not linear. Our minds can follow but one branch of the tree of associations; we must return later if we wish to explore another branch. We constantly project our fantasies, hopes, and fears onto the future; we recall and juxtapose more and less remote pasts; we turn our attention from one thought chain to another, often without apparent reason. The temporality of the mind is seemingly irrational. But time in our daily lives is fundamentally ordered, by schedules, clocks, and causal relationships. It is only against this backdrop of order that the increasing discontinuities of daily life are understood as nonlinear. The conflict between the comfortable order of daily habits and the discontinuities that impinge on that order has become especially acute in recent decades, though we do become numb to it as it too becomes habit. But the conflict between the predominant linearity of external life and the essential discontinuity of internal life is not peculiar to the twentieth century. Thought was surely as nonlinear in 1800 as it is today. But now art (followed at a respectable interval by popular entertainment) has moved from a logic that reflects the goal-oriented linearity of external life to an irrationality that reflects our shadowy, jumbled, totally personal interior lives.[40]

We live in a time-obsessed culture. One symptom is that time representations in art are closer than ever before to our internal temporal processes. Our art treats time as symbolic of our internal rhythms, and it thereby brings time closer to ourselves and to our obsession. A culture obsessed with time produces art obsessed with time—and, of course, time-obsessed books and articles about that art.

2.9 MULTIPLY-DIRECTED LINEAR TIME

Pervasive discontinuities threaten the linearity of musical time. I suggest in Section 2.10 that compositions consisting wholly of series of self-contained sections set off by major discontinuities are in fact not linear at all, at least not at the level on which their sectional forms operate. Short of that extreme, however, are pieces in which the direction of motion is so frequently interrupted by discontinuities, in which the music goes so often to unexpected places, that the linearity, though still a potent structural force, seems reordered. I call the time sense in such music "multiply-directed." There *is* a sense of motion, but the direction of that motion is anything by unequivocal. Multiply-directed time is not the same as nondirected linear time. In the former, the sense of goal-direction is acute, even if more than one goal is implied and/or more than one route to the goal(s) is suggested. In nondirected linear time there is no clearly implied goal, despite the directed continuity of motion. A graphical analogy (comparable to a straight line for goal-directed linear time or a meandering line for nondirected linear time) for multiply-directed time would be a multidimensional vector field.

Consider a hypothetical example: Passage *A* grows softer. Passage *B*, which is *pianissimo*, can function as the goal of passage *A* even if *B* does not follow *A* immediately. Suppose furthermore that *A* is also becoming more dense texturally. Then either passage *B* (soft and, let us assume, sparse) or some passage *C* (loud and dense) can serve as a goal of *A*. Passage *A* progresses in two directions at once, either of which may or may not lead immediately to a goal. I am suggesting not only that some passages can progress in more than one direction at once but also that their continuations need not follow them directly. When some processes in a piece move toward one (or more) goal(s) yet the goal(s) is (are) placed elsewhere than at the ends of the processes, the temporal continuum is multiple.

This hypothetical example shows how multiply-directed time depends on underlying linearity being perceptible even when not presented in linear order. A modernist conception of time allows us to experience such multiply-directed time not only in contemporary music but in some earlier tonal music as well. Tonal music is susceptible to multiply-directed listening for two reasons: (1) tonal processes are well defined, so that their goal orientation can be understood even when the goal is not reached immediately; and (2) tonal music contains a wealth of gestural conventions such as beginnings, final cadences, transitions, climaxes, etc., which can be recognized even when they occur in the "wrong" part of a piece. Because of these two factors, we can encounter such anomalies as an ending in the middle of a piece, different continuations of a particular passage, transitions that are broken off rather than completed, multiple beginnings or endings, and so on. I discuss several examples of multiply-directed tonal linearity in Chapter 6, such as the trio of Mozart's *Jupiter Symphony* (1788), where the cadence formula repeatedly occurs at the beginning of the phrase, and the first movement of Beethoven's String Quartet in F Major, opus 135 (1826), in which a "normal" progression is thoroughly reordered, with profound effect.[41]

It is tempting to think of as multiply-directed those one-movement compositions that incorporate multi-movement structural logic. I refer to such works as Schoenberg's String Quartet No. 1 (1905) and Chamber Symphony No. 1 (1909), Franz Liszt's Piano Concerto No. 2 (1839–1861) and Piano Sonata in B Minor (1852), Alexander Glazunov's *Violin Concerto* (1904), Symphony No. 7 of Jan Sibelius (1924), Franz Schreker's *Chamber Symphony* (1916), and Symphony No. 1 of Samuel Barber (1936). (An atonal example of a similar form can be found in the 1946 *Sonatine* for flute and piano of Pierre Boulez.) I do not find truly multiply-directed time in such pieces. Their forms may be reordered with respect to traditional forms, but the musical logic in each case is straightforwardly linear. It is only by thinking of form as a mold, rather than as a process, that these composers invented their many-in-one forms. However, it is musical processes, not abstract formal molds, that are reordered in multiply-directed linear time. To have truly multiply-directed music, linear processes need to be interrupted and completed later (or earlier!).

To demonstrate what I mean, I trace the form in the Schreker *Chamber Symphony*. It begins with an extended introduction that moves from a slow, mysterious opening to music of greater and greater clarity. When the main body of the first "movement" arrives, the tempo increases to *allegro vivace*. Two themes are stated and developed somewhat, but then, instead of a full-fledged development section, Schreker brings back the mysterious opening. But this opening does not interrupt the *logic* of the development, nor does it seem like a return to the functional beginning. It is a restatement of earlier material, not a return to an "earlier" time. A truncated version of the introduction leads to a slow "movement." This *adagio* is more nearly a complete movement than the opening section, but it too is cut short when a scherzo arrives. The *allegro vivace* "movement" *is* self-contained, with a slower middle section and a return to the scherzo proper. Next comes a return to the final portion of the slow introduction, which leads to a recapitulation of the main materials of the first "movement." This recapitulation can be thought of as displaced from earlier in the piece only by comparison with the conventions of sonata form. It does not feel like a resumption of a previously interrupted progression, nor like a move back to an earlier time. It functions simply as a recapitulation, even though it happens not to come directly after a development of its materials. Next we hear another restatement of the mysterious opening, followed this time by a varied recapitulation of much of the slow "movement." The *Chamber Symphony* ends with a subdued coda.

I have tried to indicate in this description that only the *Chamber Symphony*'s abstract form, related to convention, can be thought of as interrupted or reordered. The music itself lives comfortably and linearly within this particular structure. In fact, more than hearing a scrambled three- or four-movement symphony, we perceive a linear composition with a unique form. The linearity comes from the manner in which the textures and harmonies move from the nebulous to the definite and back again. Paralleling this structure is the pattern in which each subsequent section—introduction, first "movement," slow "movement," scherzo—is more nearly an independent movement. After the self-contained scherzo, the procedure turns around, as the earlier quasi-movements are recapitulated.

Multiply-directed time depends on reordered linear progression, not on formal abstractions. A linear composition, such as Schreker's *Chamber Symphony* or any of the other pieces listed above, can refer to and alter, in a neoclassic manner, classical forms. But such a procedure does not in itself produce (nor preclude) temporal multiplicity.

Multiple musical meanings can be deeply significant to today's listeners. Temporal multiplicity does not inhere in multiply-directed tonal music: In earlier, less chaotic eras, what I am calling temporal reordering was probably heard as intriguing or witty plays on convention. But the significant fact is that today, conditioned by new definitions of temporality in our time-obsessed culture, we can find appropriately multiple meanings in certain tonal music.

If multiply-directed time calls forth a mode of perception peculiar to the modernist mind, then we might expect to find a rich body of multiply-directed music composed in the twentieth century. But in fact I find relatively few examples. The reason is that without clearly perceptible tonal linearity it is difficult to understand a reordering as such. Furthermore, gestures such as cadences (as explained in Section 2.5), beginnings, endings, etc., are far less conventionalized in posttonal than in tonal music. We might look to neotonal music for multiply-ordered linear time. But I find no examples, perhaps because the conservative aesthetic inherent in the continued use of tonal procedures precludes such radical temporal experiments. It is hard to imagine an aesthetic that would both foster Hindemith's Piano Sonata No. 2 and suggest temporal reorderings.[42]

But there *is* a significant handful of nontonal multiply-directed linear music. Consider Schoenberg's *String Trio* (1946). Gestures are continually interrupted and transitions frequently do not go where they seem to be heading, yet by the end we feel that all loose ends have magically been sewn together. This challenging piece is temporally complex, yet even here the multiplicity of time is not as clearly defined as in a reordered tonal piece such as Beethoven's Opus 135. This is largely because the linearity that is reordered is nondirected on deeper hierarchic levels. But there is no other way to understand the trio's discontinuous temporal world. Surely it does not represent a mosaic of discrete "moments" (defined in Section 2.10), because the fragments that continually interrupt each other are neither static (the piece is full of directed energy, progressing rhythms, evolving textures, and stepwise pitch connections) nor self-contained (the fragments rarely cadence internally).

Another example of multiply-directed time in twentieth-century music is Debussy's *Jeux* (1913). Actually, the discontinuities of *Jeux* are foreshadowed as far back as the first movement of the composer's 1893 String Quartet. *Jeux* became a particularly influential piece among the Darmstadt composers who were working self-consciously with discontinuous time in the 1950s and 1960s. Stockhausen paid homage to it in a widely read article;[43] Herbert Eimert analyzed it in the Darmstadt new music journal;[44] Pierre Boulez has repeatedly conducted it; and references to it are scattered throughout the Darmstadt literature. These later composers were intrigued with *Jeux*'s often fragmentary material, frequent changes of tempo, nondevelopmental form, transformation of material, and discontinuities. The discrete sections in *Jeux* are sometimes static, but often they are in motion toward goals (or from sources) that do not appear in adjacent sections and may not even appear at all in the piece. Thus *Jeux* exists in a complex and fascinating temporal world of multiply-directed time[45] that anticipates the still more radical "moment time" (see Section 2.10 and Chapter 8) of Stravinsky, Messiaen, Stockhausen, and others.

Among multiply-directed pieces of the later twentieth century are Edwin Dugger's *Intermezzi* (1969), a conscious attempt to create multiply-directed time in a nontonal idiom, and the first song in Lukas Foss's *Time Cycle* (1960). *Intermezzi* is a stunning work, and its temporal continuum is intriguing, but it requires considerable effort to hear it as a reordered linear progression. "We're Late," from *Time Cycle,* is less than obviously linear, although there are middleground pitch connections in the voice line. But the listener is struck by the finality of the cadence in m. 14. This cadence is twice echoed in weakened form, in mm. 37 and 57, and the actual close of the song seems far less an ending than m. 14.[46]

Harrison Birtwistle's opera *The Mask of Orpheus* (1970–1983) is an extended and elaborate celebration of multiply-directed time. The composer has stated:

> I'm concerned with . . . going over and over the same event from different angles, so that a multidimensional musical object is created which contains a number of contradictions as well as a number of perspectives. I don't create linear music. I move in circles; more precisely, I move in concentric circles. The events I create move as the planets move in the solar system. They rotate at various speeds. Some move through bigger orbits than others and take longer to return.[47]

David Freeman, first producer of the opera, elaborates on Birtwistle's ideas:

> The audience is given the opportunity of witnessing the same event from a number of perspectives not only in sequence but also simultaneously. . . . Possibly the most exciting thing about *The Mask of Orpheus* is the manipulation of time: flashbacks, forward projections, and the use of multiplicity—those moments when two actions which contradict one another occur simultaneously. . . . These are things you can do only in opera. . . . In film and television [timeshifts are] quite normal; on stage they're rare. In a play you might occasionally have flashback scenes, but they tend to be rather creaking affairs. Here the whole dynamic of the piece is dominated by the possibility that you might see the same event again and again and again.[48]

The multiplicity of time in *The Mask of Orpheus* depends on characters and events. The music supports, but does not really create, this multiplicity. Atonal music by itself cannot project multiply-directed time of a complexity or on a scale comparable to what we find dramatically displayed in this fascinating opera.[49]

2.10 NONLINEARITY AND DISCONTINUITY

Multiply-directed time is discontinuous time; its discontinuities segment and reorder linear time. In certain more revolutionary twentieth-century pieces, there is no fundamental linearity and yet the music is still markedly discontinuous. I call the time sense in such nonlinear music "moment time" after Stockhausen's moment form (see Section 8.1). Whereas a multiply-directed linear piece usually has a clear beginning (or several unmistakable beginnings), which may or may not occur at the start of the work, a nonlinear composition in moment time does not really begin. Rather, it simply starts, as if it had already been going on and we happened to tune in on it. A multiply-directed form can have one or several *final* cadences, not necessarily at the close of the piece (see Section 6.4), whereas a moment form ceases rather than ends. At its close we have the impression of having heard a series of minimally connected sections—called moments—that form a segment of an eternal continuum. The moments may be *related* (motivically, for example) but not *connected* by transition. Moments, then, are self-contained sections, set off by discontinuities, that are heard more for themselves than for their participation in the progression of the music. If a moment is defined by a process, that process must reach its goal and must be completed within the confines of the moment. If, on the other hand, a section leads to another section, whether adjacent to it or not, then it is neither self-contained nor in moment time. It is linked by linear means with at least one other section.

Moments are often defined by stasis rather than process. A moment, for example, may consist of a single extended harmony. Since there is no linear logic that connects moments, their order of succession *seems* arbitrary. Actually, the order may or may not *be* arbitrary, but it must seem so on the surface if the piece is to be heard in moment time. The extreme of moment form, in which the order of moments not only *seems* but actually *is* arbitrary, is "mobile" form: the composer indicates that the sections of the piece may be put together in any of a number of possible orderings from one performance to the next, perhaps within certain restraints. A clear example is Barney Childs' *Music for Cello* (1964), which contains a number of fragments scattered on the page, to be performed in any order. Also important are Earle Brown's *Available Forms I* (1961) and Stockhausen's *Momente* (1961-1972) and *Mixtur* (1964). What such pieces may lack in linear logic they regain in a nonlinear logic of consistency (for example, similarity of texture or timbre) that makes the moments seem to belong to the same piece rather than being just a jumble of unrelated excerpts.

One might expect to find mobile forms in multipy-directed time as well as in moment time, since the linearity underlying multiply-directed music should be susceptible to various reorderings. Although Stockhausen did hint that such music is possible,[50] I have had difficulty locating unequivocal examples. One of the few I have found is his *Zyklus* (1959). The temporal continuum in this percussion work is a multiply-directed linearity, because of the large number of directional processes which move throughout the whole piece, yet start and end at different points. The mobility is unmistakable, since starting at any point (the performer has the choice) on the circle of the composition will coincide with the beginning of one and the middle of several processes.

Thus, *Zyklus* fulfills its composer's ideal for mobile form that is apparent on only one hearing. Stockhausen once (see footnote 50) described an abstract model for mobile form rather different from *Zyklus* (and actually similar to the example described in Section 2.9): Several directional processes would be initiated in one section, but each of them would be completed in a different section. Only one of these different sections can immediately follow the initial section in a given performance. This ideal should indeed produce multiply-directed mobile music. However, student compositions based specifically on this model turned out sounding like moment forms, probably because of the fragility of nontonal linearity. Lacking the *a priori* motion of the tonal system, nontonal linearity readily succumbs to the forces of discontinuity. With the injection of a few large discontinuities into a nontonal linear piece, the linearity becomes transformed into either moment time or multiply-directed time. It becomes moment time if the resulting sections seem self-contained, that is, if their goals cannot be unequivocally implied in an atonal idiom. It becomes multiply-directed if either the direction(s) of motion is (are) clear despite the atonality, or else the profiles of beginnings, endings, climaxes, transitions, and so on are conventionalized strongly enough for their functional implications to remain even when they are subjected to apparent reordering.

The fragility of nontonal linearity is demonstrated in an interesting piano work by Yehuda Yannay. In the fifth (final) section of *Continuum* (1965), nondirected linearity provides continuity. The first section of the piece is identical to the fifth, except in cases where alternating passages (of differing durations) are replaced with silence. In the third section we hear only those segments that are silent during the first section. One might expect to hear an interrupted linearity in sections I and III, but in fact the nontonal continuity is destroyed by the silences, so that the music sounds distinctly like a series of moments separated by silence. Furthermore, once the segments of sections I and III have been heard as moments, they still seem to function like moments even when they are reconnected in section V. Because the linearity is not supported by any unequivocally goal-directed logic, the continuity potentially present in section V evaporates under the influence of a previously established moment-time discontinuity. *Continuum* shows that temporality depends on context. By itself, section V is heard in nondirected linear time; experienced within the context of previous fragmentation, section V is heard in moment time. The sounds and silences of the piece show how easy it is to create moment time in a nontonal idiom and how readily linear time is displaced by the (remembered) force of discontinuity. Interestingly, the underlying nondirected continuity is reinforced theatrically during sections I and III, as the pianist silently "plays" the omitted passages. This visual aspect reinforces the linear continuity which the sounds and silences seek to destroy. In this manner two different temporal structures, linear and nonlinear, are produced by the same material.

The degree of discontinuity between sections in moment time can be considerable. The contrast between moments must all but annihilate by comparison any incidental contrasts within moments. Yet the moments must still seem to belong to the same piece: There must be a nonlinear logic binding them together. Although moment time arises readily from extreme discontinuities, the contextually "correct" degrees of discontinuity necessary for a successful moment form are difficult to compose. Numerous student failures have convinced me that excessive discontinuity can destroy context. On the other hand, several pieces that retain remnants of linear thinking still can be heard meaningfully in moment time because they exhibit the requisite high degrees of discontinuity between sections and relative self-containment within sections. Stravinsky's *Symphonies of Wind Instruments* is such a work. This piece demands to be heard in moment time despite its stepwise pitch connections, climax, opening fanfare, and final cadence. It *is* a moment form, albeit an early and impure example. Its temporality belongs primarily to moment time because its sections are relatively static and because there is considerable discontinuity between them. (Chapter 9 gives a moment-time analysis of *Symphonies.*)

Other examples of the moment concept include Messiaen's *Oiseaux exotiques* (1955), the second movement of Webern's *Symphony* (1928), Roger Reynolds' *Quick Are the Mouths of Earth* (1965), Witold Lutosławski's String Quartet (1964), Frank Zappa's *Lumpy Gravy,* István Anhalt's *Symphony of Modules* (1967), Morgan Powell's *Windows,* and the third movement of Michael Gielen's string quartet *Un vieux souvenir* (1985). The variety in this brief list demonstrates that moment time is not style-dependent. It is a concept deeply ingrained in contemporary culture.

If the order of moments is seemingly arbitrary, if the piece has no beginning and no ending, then does it have form? I maintain that even music purely in moment time does have discernible form and that the form comes from the proportions and/or consistencies of the moments: both nonlinear principles. The self-containment of moments allows the listener to understand them as entities. The way these entities add up to a coherent whole is understood through cumulative listening, a mode of perception which is quite possible in the absence of large-scale linear processes. As we listen to a piece, we accumulate more and more information concerning its form. The more we hear, the more we understand the nonlinearity embodied in the consistency and balance (or lack of it) that generate the nonlinear form. Thus section proportions are likely to be even more important to an overall sense of balance in a moment form than in tonal music.

2.11 PROPORTIONS IN ATONAL MUSIC

Sophisticated balances are at work in the music of composers such as Messiaen and Stravinsky, who wrote many discontinuous compositions that utilize moment time. When in such music an ongoing structural linearity is either disguised or non-existent, we may look to its proportions for structural coherence. Proportions become a major determinant of formal coherence for music in which nonlinearity is a dominant structural force.

I have examined the proportions in a number of Stravinsky's works which exhibit moment-time discontinuities. Probably the most complex system of proportional balances is to be found in *Agon* (1954-1957). This ballet has puzzled commentators because of the high degree of discontinuity between sections and the apparent lack of unity in materials and procedures. Yet the work coheres, in part because of a set of sophisticated proportional balances. *Agon* consists of a series of more or less self-contained sections that are set off by discontinuities. These moments are characterized by consistencies of texture, harmony, compositional procedure, orchestration, tempo, melodic material, and form. Some moments are subdivided by less extreme discontinuities; moments are grouped together according to either simple adjacency or motivic similarity. Thus, moment groups, moments, and submoments represent three distinct but hierarchically adjacent levels of structure.

An interesting structure is revealed when we compare durations of moments (as calculated according to Stravinsky's metronome markings and the total number of beats per section). Except for the extremely long serial passage, we find that all sections from the longest to the shortest in *Agon* have durations approximating (to a remarkable degree of accuracy) a series of numbers related by a consistent ratio. Proportional lengths determined by this pervasive ratio extend beyond moment durations to total lengths of moment groups and up to the duration of the entire piece. Thus, three results accrue from the series: (1) the duration of almost every section is determined by this series; (2) often groups of adjacent sections correspond to the higher durations of the series; (3) and sums of durations of section groups are determined by the series. The pervasiveness of this system of proportions is impressive. Stravinsky may not have consciously calculated these section lengths, but he was clearly sensitive to proportions and he devised and executed a sophisticated system of formal balance. Details of the proportional systems in *Agon* and other Stravinsky works are given in Sections 10.3-10.5.

These systems are nonlinear. The balances of moments, submoments, and moment groups work across the whole piece so that the effect on the listener is cumulative. Lengths are determined not on the basis of preceding durations but according to a single principle that prevails unaltered throughout. As *Agon* progresses, we acquire more information that enables us to perceive the balance of *unequal* sections—this is the essence of cumulative listening. The order in which we encounter the various durations almost does not matter. (I am not suggesting that *Agon* can be performed as a mobile form without destroying the sense of the piece, although such a reordering would produce a more nearly intelligible result than would a similar experiment performed on a Mozart sonata. I am claiming only that the durations, not the materials, of sections exhibit a nonlinear organization that is understood by means of cumulative listening.)

There is a major problem underlying the quantitative analysis of section durations (exemplified by the charts in Chapter 10). If musical time really is subjective, malleable, and multiple, as I claim throughout this book, what does the *precise* measurement and comparison of durations really tell us? Is it simply something that is in the score but assimilated on a subconscious level because the listener's attention is drawn to other matters? The problem is particularly acute in objective analyses of tonal durations (such as those of Perry-Camp and Zallman, discussed in Section 2.7), since tonal music is filled with various kinds of motion, traveling at differing rates: middleground voice-leading motion, rates of harmonic change, varying degrees of harmonic stability, dissonance resolutions, the whole network of structural upbeats and downbeats. This complex of motion shapes (one might say distorts, though surely in a positive way) our perception of duration.[51] The whole question of proportions *as perceived,* particularly in tonal music, seems too complex to be dealt with by quantitative measurement. What, then, is really studied in the objective analyses of tonal durations, or even in my numerical measurements of Stravinsky's temporal lengths and ratios?

This question is not easy to answer. It is possibly the most important, and surely the most challenging, issue in this book. While I must postpone until Chapter 11 my attempt at an answer, I want to sketch a partial solution here that will, I trust, justify the quantitative study of durations in moment-time music outlined above and explored in detail in Section 9.13 and Chapter 10. Moment time, let us remember, is characterized by sections that are internally static, at least relative to context. What this means is that there is no substantial contrast, change, motion, or surprise *within* sections. There are, in other words, none of the attributes of tonal motion (listed in the preceding paragraph) that might distort our sense of absolute duration. The more static a passage, the more its perceived length agrees with its clock-time duration. More accurately, in music lacking duration-distorting motion within sections, the *perceived proportional relationships* between section lengths tend to accord with the ratios of objectively measured durations. While our actual estimate in seconds of a passage's length may not be "accurate," our understanding of the *ratios* between section lengths should agree with the "actual" measured proportions, given the absence of time-distorting contrast or motion. Thus I hypothesize that analyses which study duration ratios in static music from objective data are relevant to how such music is perceived.

I realize how speculative the preceding remarks are. I am making several bold assertions about human cognition without much evidence, beyond my own intuitions. As I explain in Chapter 11, experimental psychology has yet to provide other than superficial insight into the complex process of hearing, processing, and comparing large-scale *musical* durations. Surely the studies of duration perception in music that have appeared thus far are of little help in dealing with music like *Agon* or Stockhausen's moment forms. If the science of perception does eventually provide fruitful studies of such a complex activity as listening to sophisticated music, then I will rejoice. Until then I will borrow judiciously from experimental psychology and will continue to rely primarily on a critic's best tool: intuition.

2.12 STASIS AND ETERNITY

Just as the twentieth century has seen explorations of the subtleties of discontinuity, conversely it has seen experiments in extreme consistency. Some recent pieces seem to have adopted the requirements for moments (self-containment via stasis or process) as their *entire essence.* When the moment becomes the piece, discontinuity disappears in favor of total, possibly unchanging, consistency. Compositions have been written that are temporally undifferentiated in their entirety. They lack phrases (just as they lack progression, goal direction, movement, and contrasting rates of motion) because phrase endings break the temporal continuum. Phrases have, until recently, pervaded *all* Western music, even multiply-directed and moment forms: phrases are the final remnant of linearity. But some new works show that phrase structure is not a necessary component of music. The result is a single present stretched out into an enormous duration, a potentially infinite "now" that nonetheless feels like an instant. In music without phrases, without temporal articulation, with total consistency, whatever structure is in the music exists between simultaneous layers of sound, not between successive gestures. Thus, I call the time sense invoked by such music "vertical."

Lack of phrases is a sufficient but not necessary condition for vertical time. Iannis Xenakis' *Bohor I* (1962), for example, lacks internal phrase differentiation; its sound material is largely unchanged throughout its duration. Hence this composition exhibits vertical time. Larry Austin's *Caritas* (1969) does contain subtle changes, as the composer of this tape piece seems to move gradually from one computer-controlled electronic circuit to another, but the changes are not articulated by cadences (they do not even feel like overlapped cadences). The music stays well within the carefully defined context it creates; hence it, too, exemplifies vertical time. A work such as Terry Riley's *A Rainbow in Curved Air* (1969)[52] remains within its own world (except for one striking articulation about one-third through the piece), despite the regular rise and fall of phrases. The reason that this piece is heard in vertical time is that its phrases refuse to form a hierarchy and are therefore heard to some extent as arbitrary. Every cadence is of approximately equal weight. No distinction is made as to the degree of closure. Thus the work exists primarily in vertical time despite the presence of comfortable phrases. In linear time, on the other hand, phrases group into periods, subsections, sections, movements, etc., in a (usually) well-ordered hierarchy. Some cadences are stronger than others, and the stronger ones close off larger portions of the piece.

A vertically conceived piece, then, does not exhibit large-scale closure. It does not begin but merely starts. It does not build to a climax, does not purposefully set up internal expectations, does not seek to fulfill any expectations that might arise accidentally, does not build or release tension, and does not end but simply ceases. It approaches zeroth-order Markov music. No event depends on any other event. Or, to put it another way, an entire composition is just one large event. A vertically conceived piece defines its bounded sound-world early in its performance and stays within the limits it chooses. Respecting the self-imposed boundaries is essential because any move outside these limits would be perceived as a temporal articulation of considerable structural import and would therefore destroy the verticality of time.[53]

How does a piece define its limits? Most of us tend to listen teleologically—horizontally—given the prevalence of tonal music and linear values in our culture. We listen for, and even project onto the music, implications and progressions. Thus even advance knowledge that a piece will be internally undifferentiated does not preclude our initial, habitual response of teleological hearing. The piece starts (not begins), and at first we try to impose linearity, storing potential implications out of which to make significant causal relations later in the piece. But as the music continues, implications accumulate with a minimum of consequences, because the composition contains no changes of structural import. We become overloaded with unfulfilled expectations, and we face a choice: either give up expectation and enter the vertical time of the work—where linear expectation, implication, cause, effect, antecedents, and consequents do not exist—or become bored. Those who attend concerts of "nonteleological" music, to borrow Leonard B. Meyer's term,[54] are well aware of how many people still opt for the latter.[55] Once our habit of linear listening is deposed from its falsely universal position, however, people cease to be bored by attractive nonlinear music. Today there seems to be a number of young listeners not conditioned at an early age exclusively to tonal listening who consequently do not experience difficulty with vertical time. They have learned that the absence of implication, motion, hierarchy, and contrast need not be nihilistic. They have learned to enter a piece and revel in its sounds. Vertical time presents music of utter concreteness, unhampered by referential meaning or symbolism. It is music of pure beauty or pure ugliness, untempered by progressions in time.[56]

In giving up goal-oriented listening, we eventually forsake all expectation of meaningful change, of realized implication, of progression. We may be fooled, if a piece turns out not to be vertical at all, but we can listen for linearity only so long in the absence of a hierarchic temporal structure. Once we have entered the verticality of a composition, we have accepted its conditions. The piece has defined for us its context; it will not step outside its boundaries. Some vertical compositions have narrow limits and some have very broad limits. Some performances of John Cage's *Variations V* (1965), for example, approach the infinite ideal where *anything* can happen without upsetting the verticality of the time structure. A major challenge for a performer of such a totally open work lies in finding a way to include as wide a variety as possible of isolated, disparate, and striking events without suggesting functional or articulative relationships between them. Still, there *are* practical limits. I doubt that anyone attending even the wildest performance of *Variations V* would continue to sustain a vertical-time experience if an earthquake were to occur during the performance.

Vertical compositions themselves are not usually unstructured; rather, their *temporal continuum* is unstructured. Some pieces involve considerable structuring of the compositional process, even when it is truly zeroth-order. In Joel Chadabe's *From the Fourteenth On* (1973) for solo cello, each event is carefully composed by means of a statistically weighted computer program, but its relationship to any other event is not controlled. Other vertical pieces, such as Cage and Lejaren Hiller's *HPSCHD* (1969), involve a great density of layered sound, with myriad possible relationships between simultaneous layers. The structure, however, is vertical, not linear. Whatever structure is there (or is placed there by performers or listeners) exists, at least potentially, for the duration of the performance. The form consists for the most part of unchanging relationships between ever present layers of the dense sound-world, whereas form in linear music consists of relationships between successive events.

Listening to a vertical musical composition can be like looking at a piece of sculpture. When we view the sculpture, we determine for ourselves the pacing of our experience: We are free to walk around the piece, view it from many angles, concentrate on some details, see other details in relationship to each other, step back and view the whole, contemplate the relationship between the piece and the space in which we see it, close our eyes and remember, leave the room when we wish, and return for further viewings. No one would claim that we have looked at less than all of the sculpture (though we may have missed some of its subtleties), despite individual selectivity in the viewing process. For each of us, the temporal sequence of viewing postures has been unique. The time spent with the sculpture is structured time, but the structure is placed there by us, as influenced by the piece, its environment, other spectators, and our own moods and tastes. Vertical music, similarly, simply *is*. We can listen to it or ignore it. If we hear only part of the performance we have still heard the *whole* piece, because we know that it will never change. We are free to concentrate on details or on the whole. As with sculpture, the piece has no internal temporal differentiation to obstruct our perceiving it as we wish.

Like moments in moment time, vertical music may be defined by process as well as stasis. There is a special type of vertical music, which is sometimes called "process music," sometimes "trance music," more often (to the apparently universal disapproval of its composers) "minimal music." Compositions such as Steve Reich's *Come Out* (1966) or Frederic Rzewski's *Les Moutons de Panurge* (1969) are constantly in motion, perhaps toward a goal (as in the case of Rzewski's piece, which is analyzed in Section 12.7) or perhaps without one, into infinity (as in the Reich). One might think of such works as purely linear, but listening to them is not a linear experience, despite their internal motion. Because in such pieces the motion is unceasing and its rate gradual and constant, and because there is no hierarchy of phrase structure, the temporality is more vertical than linear. The motion is so consistent that we lose any point of reference, any contact with faster or slower motion that might keep us aware of the music's directionality. The experience is static despite the constant motion in the music.[57]

Vertical time is the most radical of the new temporalities I have outlined. Vertical music is that in which nonlinearity predominates over linearity, that which differs most from traditional Western music. Vertical music tries not to impose itself on the listener, nor to manipulate (to use a popular buzzword from the 1960s, when verticality in music was particularly strong) an audience. The context of vertical music allows a listener to make contact with his or her own subjective temporality. It is music of subjectivity and individuality. It reflects a thoroughly modernistic time sense, akin to that described by Arnold Hauser in the quotation in Section 1.5.

2.13 DIFFICULTIES WITH THE CATEGORIZATION OF MUSICAL TIME

I have mentioned several varieties of musical time, some more prevalent in tonal music and some more common in atonal styles: goal-directed linear time; nondirected linear time; multiply-directed linear time; moment time; and vertical time. Even though this taxonomy of musical time forms the basis for much of this book, it must not be taken too literally nor too rigidly. Let us consider three difficulties in turn:

1. *Discontinuity and temporal mode.* The influence of discontinuity on temporal mode is no simple matter, yet all modes except the vertical rely in some way on discontinuity.
2. *Relativity of time concepts.* The predominant variety (if there is one) of time in a composition is not always immediately obvious.
3. *Difficulties in comparing and distinguishing temporal modes.* The categories are not always comparable, and distinguishing between them is often far from a clear-cut procedure. Most compositions, in this century at least, do not consistently exhibit one species of time on every hierarchic level. Many of the examples cited in the preceding discussions are actually atypical in their single-minded adherence to one particular temporality.

Sections 2.14–2.16 consider these three difficulties.

2.14 DISCONTINUITY AND TEMPORAL MODE

Western music, except that which deals exclusively with vertical time, contains discontinuities; otherwise there would be no suspense, little information, little meaning. Each discontinuity disrupts the work's ongoing linearity and/or its nonlinear consistency. When there is sufficient disruption of straightforward goal-directed linearity, one of three temporal modes begins to replace that linearity:

1. If the implication in every section is continually frustrated by the subsequent section but is often realized elsewhere, then the musical time is multiply-directed. The multiplicity resides in the conflict between implied linearity on the foreground and realized nonlinearity on the middleground.

2. If, despite any continuity within sections, there is nothing in a subsequent section that follows from a potential implication in an earlier section, then the temporal mode is moment time; there is nonlinearity on the middleground.

3. If the implied progression from one section to another is continually realized but the deeper-level implications arising from these middleground progressions fail to be fulfilled, then there is nonlinearity on the background level while the middleground linearity is nondirected.

Thus three temporalities—multiply-directed time, moment time, and nondirected linear time—mediate between the extremes of goal-directed linear time and vertical time. This comparison shows that the distinctions between these temporal modes are anything but simple. Furthermore, rarely, if ever, do we encounter these modes in a pure state. Most music exhibits some kind of mix of temporalities, at times nebulous, at times contradictory, at times changing, at times elusive.

2.15 RELATIVITY OF TIME CONCEPTS

To what extent are these temporal modes really properties of the music, and to what extent are they imposed on a composition by listeners or performers? Consider Elliott Carter's *Duo* (1974), a convincing linear form whose opening seems at first almost without direction. When I first heard this complex music, I was perplexed: I felt the work had no direction at all. When we do not perceive a work's directionality, its time-world seems vertical. Conversely, a composition that has no inherent progression, a vertical form, can be learned so well that the listener has memorized the (random) sequence of events. A few years ago, for example, I listened so often to the recorded[58] realization of Cage's *Aria* (1958) performed simultaneously with his *Fontana Mix* (1958) that I quite literally memorized the performances. Gradually, my knowledge of what event was to follow lent a predictability to my listening experience: it seemed that event Y not only succeeded event X but also that X *implied* Y in some fashion. If there is implication, there is linearity.

If pieces as different as these works of Carter and Cage can seem nonlinear or linear depending on the number of times the work has been heard or the listener's familiarity with the style,[59] then does it not follow that the species of time experience is determined by the listener more than by the composition? Yes and no. I would not deny the power of the listener and of influences on the individual's listening experience. The creativity of listeners has too long been underrated. For example, now that we have become aware of ways our experience of time can be altered, we can, perhaps with an effort, apply the vertical listening mode to a decidedly nonvertical piece. An excellent candidate for nonlinear hearing is Schumann's *Stückchen* (see Example 2.5). This little piece can be heard as static, since it never leaves C major, never leaves 4/4 time, never changes tempo, its accompaniment rarely abandons steady eighth-note motion, its melody is mostly in quarter notes, there are only two incidental chromatic alterations, and there is an inner voice pedal on G throughout most of the piece.[60]

Stückchen is not inherently a static piece, but it can be heard as such once we know how to have meaningful static musical experiences. The effort to hear this way, though possibly rich, is considerable, even a bit perverse. Such an effort necessarily involves a contradiction with the system of the piece. We all know, if only intuitively, how tonality works. And we all hear tonality kinetically—in motion. To avoid hearing tonal motion requires special effort. So *Stückchen* is not static, and its kineticism—its linear time—*does* belong to the piece. Learning this Schumann work involves hearing its tonal implications because they are there. Listening to it in vertical time, on the other hand, requires a denial of the inherent tonal structure. This situation is different from memorizing a particular recording of *Aria* with *Fontana Mix*, because we are not substituting memorized succession for internal implication.

One might argue that an imposed linearity is an inappropriate way to listen to the Cage works. The *Fontana Mix* score is so open that quite different realizations are possible, and the sequence of events or even the events themselves can differ considerably from one realization to the next. It is therefore true that an imposed linearity does violence to Cage's concept, but so does the act of fixing the piece via the recording of one version. Once the record is available, it becomes the property of its purchaser, who may sometimes choose a linear listening mode.

Hearing a tonal work in a temporal mode which is generally associated with posttonal music can be less perverse and less difficult given a sympathetic performance. A pianist trying to project a vertical understanding of *Stückchen* would probably emphasize the continuity and lack of change while minimizing the articulations of phrase beginnings and endings. The historical accuracy of such a performance may well be questioned, but such an interpretation can be defended as a modernist view of a traditional work. I vividly remember hearing, several years ago, an extraordinary performance of Beethoven's Sonata in E-Flat, opus 31, no. 3 (1802) by pianist Joan Panetti. She chose to bring out the first movement's discontinuities, even at the (partial) expense of its underlying continuity. The result was exhilirating. It was a wonderfully contemporary, wonderfully alive account of the sonata that made an artistic statement as up to date as any moment-form composition. Perhaps it is no coincidence that Panetti is a composer.

Continuity and discontinuity coexist in the Beethoven sonata, and a performer may choose to concentrate an interpretation on one extreme or the other, or may opt for something in the middle. Surely there are too many relationships in even the simplest piece for a performer to underline them all. Similarly, both linearity and nonlinearity are inherent in Schumann's *Stückchen* and in Carter's *Duo*. Just as *Stückchen*'s nonlinearity is difficult to project, *Duo*'s linearity is similarly difficult to hear and perform. More conventional contemporary works, such as Sessions' String Quartet No. 2 (1951), possess a more comfortable linearity that is still not dependent on tonality. It depends instead on unmistakable gestures (such as openings, cadences, climaxes, and transitions) that are shaped by the composer (and, presumably, performers) to be recognized and thus to function in the composition. The linear temporal structures in these works of Beethoven, Schumann, Sessions, and Carter are very different, but they are all there to be used or not, in accordance with a listener's and/or performer's predispositions and wishes. However, the stronger the linearity the greater the effort a listener or performer must invest to deny it and to let such works' nonlinearity shine through unobstructed.

One last example: In 1974 I heard a performance of Milton Babbitt's Composition for Twelve Instruments (1948), in which the players projected a dramatic sense of phrase structure that is not indicated in the score. The result was very "musical," in the traditional sense of the term, and actually quite exciting. But I could not help wondering how faithful to the composition's apparent nonlinear temporal structure such an imposed linearity really was.

Someone unfamiliar with a style has fewer options than a performer or listener thoroughly steeped in his or her musical traditions. Listening to a style is an acquired skill: We would hardly expect a Martian to be aware of the linearity in Schumann or Beethoven, much less to be able to exercise free choice in relating to that linearity. As we come to notice more and more how naïve *our* responses have been to the highly sophisticated musics of other cultures, we should hardly be surprised at a Martian's possible failure to find linearity in the *Album for the Young*.

2.16 DIFFICULTIES IN COMPARING AND DISTINGUISHING TEMPORAL MODES

The categorization of temporal modes implied in this chapter is problematic in several ways. For the following reasons I want to repeat the caution against using these ideas in too literal or rigid a fashion:

1. The categories apply variously to compositions, to listening modes, to performing modes, to philosophies of composition, and to time itself. Thus the categories are not necessarily comparable.
2. Most twentieth-century pieces exhibit, as I have stated, characteristics of several different temporalities.
3. Distinctions between these varieties of time are not always easily made. For example, both multiply-directed and moment time present discontinuous sections. Vertical time may arise from the vast elongation of a single moment. Goal-directed linear time is often hard to define in the absence of tonality. Vertical time defined by process, like linear time, exhibits constant motion, possibly toward a goal. Goal-directed linearity and nondirected linearity are extremes of a continuum, not separate categories.[61] In multiply-directed time, middleground implications for immediate succession may be present, but they are ignored in favor of larger implications that operate on preceding (or even subsequent) but not immediately adjacent music. Moment forms can be linear on hierarchic levels up through that of the moment but not beyond. Vertical music can be, paradoxically, totally nonlinear or else so totally linear that (as in process music) predictability reigns.

Stravinsky's *Symphonies of Wind Instruments* is an example of an impure moment form in which we encounter different temporal modes on different hierarchic levels. *Symphonies* consists of a series of quasi-independent sections that are defined by consistency of harmony, tempo, and motivic material: Moment time operates on a middleground level. When the music moves from one section to the next, there are stepwise connections that suggest linearity on a larger scale. Within each section, however, the harmonies are static (or sometimes alternating) and the motivic material is permuted and repeated rather than developed. This foreground nonlinearity contrasts with consistently linear details of voice leading. Thus linearity and nonlinearity both operate throughout the work, but on different hierarchic levels. The background structure is linear, to the point of having a predictable quasi-tonal goal; the middleground level (where we find the sections laid out) is characterized by harmonic stasis and thus is nonlinear; the foreground has elements of both linearity and nonlinearity. How these different temporalities are articulated by the materials of this fascinating piece is the subject of Chapter 9.

Xenakis' *Syrmos*, which in Section 2.5 I labeled a nondirected linearity, is in a sense the opposite of the Stravinsky piece. It is nonlinear in the foreground (each note is generated stochastically),[62] linear in the middleground (as sections *do* lead to immediately succeeding sections), and nonlinear in the background (since the middleground events fail to generate larger structural implications).

In *Symphonies* and *Syrmos* different temporalities are found simultaneously on different hierarchic levels. Messiaen's *Cantéyodjayâ* (discussed in Section 8.6), on the other hand, invites not simultaneous but successive listening modes. This piano work is a well proportioned series of discrete blocks. Some of these blocks are self-contained moments, but others move toward goals found in nonadjacent sections. The piece is not a pure moment form because of such elements of multiply-directed linear time.

Another example of mixed temporalities is Ives' "Putnam's Camp" (1912), from *Three Places in New England.* The sections of this work differ considerably, and many of them are self-contained. Moment time is present. But also there is an unmistakable linear logic, having to do with degrees of information content, textural density, and contrast.

2.17 LINEARITY AND NONLINEARITY: A RECAPITULATION

We suffer the disadvantages of categorization when we choose to speak of linearity and nonlinearity; when we choose to label compositions as goal-directed, nondirected, multiply-directed, moment, or vertical forms; and even when we address progression and succession,[63] those two vague categories often encountered in elementary harmony courses. The temporality of music is far too complex to be explained in any depth solely by categorization. Still, the categories do represent useful means of making preliminary distinctions between, and assessments of, musical time structures. They must be understood in terms of their two basic ingredients: linearity and nonlinearity.

This chapter began by claiming that linearity and nonlinearity are two complementary forces. Virtually all music exhibits both. The hierarchic levels on which linearity and nonlinearity exist are crucial to the temporal nature of music, as is the degree to which they operate. The history of Western music in the past three centuries has seen a gradual increase in the importance of nonlinearity, so that today many compositions are far more nonlinear than linear. Even the most nonlinear music exists in time, however, and is therefore initially heard as a temporally ordered succession. Thus linearity can never be banished totally from the musical experience.

After considering the numerous examples mentioned in the preceding sections, the reader may find my original definitions of linearity and nonlinearity clearer. But an inevitable vagueness remains. I have applied the two terms both to compositional procedures and to listening and performing modes; I have mentioned them as aspects of pitch, texture, and duration structures; I have discussed their coexistence on the same and different hierarchic levels. Furthermore, even though linearity is defined as the choice of one event on the basis of previous events, the nature of that choice may be denial of rather than fulfillment of expectation. The ensuing contrast may be extreme, producing discontinuity; and frequent and considerable discontinuities can lead to nonlinearity.

Perhaps the following list of terms that may be associated with linearity and nonlinearity will help to clarify the two concepts still further:

Linearity	*Nonlinearity*
teleological listening	cumulative listening
horizontal	vertical
motion	stasis
change	persistence
progression	consistency
becoming	being
left brain	right brain
temporal	atemporal

The last pair of terms requires some explanation. When certain aspects of a piece exist for their own sake, not because of some larger progression, they are atemporal. Their presence in the composition is more important than their temporal position in it. Their impact is not dependent on their position along a time continuum, but they nonetheless contribute to overall temporal coherence. Thus, nonlinearity *is* an organizational force. It can be articulated by as large a variety of textures, forms, and processes as can linearity. It can interact with linearity in a variety of ways. From this interaction come many of the tensions and resolutions, and hence meanings, of music.

2.18 RECENT ATTEMPTS AT TOTAL LINEARITY AND NONLINEARITY

Even if we accept that all music exhibits both linearity and nonlinearity, we may still wonder what a totally linear or totally nonlinear piece would be like. Some music of the 1950s and 1960s approached these extremes. In music that courts total nonlinearity (such as Chadabe's *From the Fourteenth On,* mentioned in Section 2.12), each event is composed for itself, with no intended reference to preceding or subsequent events. One of the earliest computer-assisted compositions, Lejaren Hiller and Leonard Isaacson's *Illiac Suite* (1957) for string quartet, contains some passages that actually were composed according to zeroth-order Markov chains. Some sections randomize pitches while others randomize intervals of succession—with markedly different results. Using zeroth-order Markov processes does not guarantee the *perception* of nonlinearity, however. As the *Illiac Suite* demonstrates, inadvertent stepwise connections and motivic similarities may strike a listener as linear relationships, despite the total nonlinearity of the composers' conception. Furthermore, statistical probabilities can change, thus producing the appearance of progression even though each event is still generated independently. The opening of the fourth movement, in fact, utilizes a directionally changing series of probabilities, resulting in a kind of linearity once removed. Other passages, however, retain one set of probabilities throughout.[64] In such passages the order of notes quite literally does not matter, since they were composed only in accordance with an abstract system of probabilities.

If music composed using nonlinear principles can lead inadvertently to the perception of linear structures, what about music composed using linear principles? Elliott Schwartz has often stated that his compositional method is essentially linear. He always writes the events in his music in the order they are to be heard, and he never changes an event once he has composed the next event. Each section (except in his mobile music) is composed in response to a fixed preceding section, and thus the compositional *process* is emphatically linear. But is the resulting *music* necessarily linear? A composer can intend to compose an event that relates in a specifically nonlinear manner (or does not relate at all) to the preceding event. In Schwartz's *Chamber Concerto I* (1977), for example, some events (such as the dramatic pause that precedes a series of isolated raucous sounds) are linear outgrowths of what went before, while other events are there primarily because they belong to the work's nonlinear context.

These works of Hiller/Isaacson and Schwartz show that linearity and nonlinearity of compositional procedure do not guarantee linearity or nonlinearity of musical time. But what of music intended to be *totally linear?* Such music can approach excessive predictability. If every event is an outgrowth of all previous events, then the music becomes a web of implications that allows no deviation. However, even in the extremely linear process music of the 1970s (possibly a reaction against the fragmentation of total nonlinearity, possibly a desperate attempt to recapture linearity, perhaps a "neolinearity" comparable to the neomodality or neotonality that often provides the pitch language of such music), we still find nonlinear components. A process is, after all, a pervasive principle that determines several aspects of the music. In Rzewski's *Les Moutons,* for example, the linearity evident in the additive melodic process coexists with a nonlinear unchanging procedure that permeates the piece: There are no surprises, no thwarted expectations, no deviations from the compositional process (see Section 12.7). In fact, the result is vertical time.

As these examples readily demonstrate, twentieth-century music has presented real challenges to our traditional ways of listening. Critics often attribute to experimentation such formerly impossible compositional aesthetics as mobile form; music in which the first (or at least primary) act of composition has been the establishment of durational proportions; pieces in which it really does not matter how long they are played or by how many performers; as well as compositions that try to be completely predictable. To justify such radical new musics simply as creations in the spirit of experimentation is to say very little. They are deeply felt responses to new meanings of time in twentieth-century Western culture. I have tried to sketch ideas about the way these new meanings have come to be translated into such musical experiments and how these experiments have come to be profoundly expressive of contemporary ideas. To understand more deeply the relationship between cultural values and musical time, however, it is necessary to examine some of these varieties of time in greater depth.

Therefore Chapters 6, 8, and 12 explore multiply-directed time, moment time, and vertical time respectively. Chapters 5, 6, 7, 9, and 12 look at particular compositions that exemplify tonal linearity, nontonal linearity (both goal-directed and nondirected), multiply-directed time, moment time, and vertical time. But first it is useful to consider further the impact of technology on musical time (Chapter 3) and two crucial concomitants of musical linearity: meter and rhythm (Chapter 4).

Chapter 3

The Impact of Technology

3.1 RECORDING AND CONTINUITY

It is no coincidence that twentieth-century music's new temporalities, discussed in Chapter 2, arise in a technological culture. The impact of technology on music in recent decades has been two-sided. The earlier and more obvious influence was on the materials of music: on, in other words, what constitutes viable musical sound. But the influence on musical time and its perception has been more subtle. Composers have readily applied electronic technology to sound because sonorities are entities readily subjected to manipulation, expansion, and experimentation. Musical sounds unfold in time, of course, but time itself is elusive, subjective, and abstract. Although technology's impact on musical time was not acknowledged by composers as early or as pervasively as its influence on sound, the influence was nonetheless real and considerable.

Traditional concepts of musical sound and time were challenged by the development of recordings. Thomas Edison invented a crude cylinder phonograph in 1877. By the end of the nineteenth century, companies in the United States and England were manufacturing disc recordings of music. The possibility of preserving musical continua via recording utterly changed the social and even artistic meanings of music,[1] although scholars and musicians were slow to realize the degree of impact. The invention of the tape recorder a half century later made sonorities not only reproducible but also alterable. The resulting recording and splicing techniques allowed recorded sounds to be fragmented, combined, and distorted, among other possibilities. Such manipulations could affect not only sound qualities but also temporal spans. By changing recording speeds, for example, a composer of *musique concrète* could make a word last an hour or compress the Beethoven symphonies into a single second.[2]

Today we listen to unaltered music only rarely. The sounds we hear have been not only performed by musicians but also interpreted by audio engineers, who have reinforced the acoustics of concert halls, spliced together note-perfect recorded performances, created artificially reverberant performance spaces, projected sounds across the world via satellite broadcast, amplified and "mixed" rock concerts, and created temporal continuities that never existed "live." The audio engineer is as highly trained as the concert performer, and he or she can be just as sensitive an artist.

We might think conservatively of recordings as means to preserve performances, but records are far more than that. They are artworks themselves, not simply reproductions. Recording technology has forced us to reconsider what constitutes a piece of music. Thus people who buy records, cassettes, and compact discs rightly speak of owning the music.[3] "Vivaldi's Mandolin Concerto is *yours* for only $1.00," says a recent advertisement.

It is no longer reasonable to claim that the printed score totally represents the musical sounds we hear, since the score usually gives no indication of the manner in which the audio engineer should manipulate his or her variables. Thus two differently mixed, equalized, and reverberated recordings of the same performance can contrast as much as two different performances of the same work. Consider these examples that demonstrate the extent to which audio engineering can create (rather than simply preserve) musical continuities:

1. According to Walter Everett, when the Beatles recorded their song "Strawberry Fields Forever,"

> Two versions were done. It was originally recorded on November 24, 1966, and was performed in A at a tempo of ♩=92. After listening to the lacquers, [composer John] Lennon decided it sounded 'too heavy' and wanted it rescored and performed faster. A second version, with trumpets and cellos, was recorded in B flat at about ♩= 102. Lennon liked the beginning of the first version and the ending of the second, and asked Producer George Martin to splice them together. When the speeds of both tapes were adjusted to match the pitch, the tempos of both were fortuitously the same, ♩=96. The two portions were edited together in the middle of measure 24. . . . This procedure gives Lennon's vocals an unreal, dreamlike timbre, especially in the second, slowed-down portion of the song.[4]

2. I have been told of a rock record made by an unusual procedure. First the solo musicians were recorded as they improvised. An arranger then studied the taped improvisations and composed an instrumental accompaniment, which contained direct references to the recorded music. This accompaniment appears *before* the improvised solos. We listen to a paradox: The soloists seem to improvise spontaneously to a pattern that we have just heard! Furthermore, the composed accompaniment fits the improvised solos too well to have taken place in live performance.[5]

3. An odd recording was released a few years ago of George Gershwin's *Rhapsody in Blue* (1924).[6] The composer is the piano soloist and Michael Tilson Thomas conducts the orchestra. What is odd is that Thomas was born four years after Gershwin died! Gershwin had recorded the piano solo, and Thomas conducted the jazz band to coordinate exactly with the solo recording, which he monitored through headphones. The performance is somewhat strained, since the soloist never reacts to the ensemble, but the aesthetic behind the recording is fascinating. Technology has created a collaboration between two artists who could never have known each other.

4. I know of another rock recording in which one track, containing the snare drum, is played backward. The typical clichéd sound of backwards taping is not heard, because all of the other tracks were recorded and played back normally.

The total sound is intriguing, as is the idea of a performance one part of which is in reverse order.[7]

5. In the song "Another One Bites the Dust," as recorded by the rock group Queen on their album *The Game*,[8] there is a specific syntactic message which can be heard only when the record is played backwards. The title line, which is sung repeatedly throughout the song, comes out backwards as "It's fun to smoke marijuana." ("It's fun" is difficult to distinguish, but the remainder of the sentence is quite clear.) This phenomenon depends on the particular pronunciation of "Another one bites the dust." What we have is a hidden meaning, known only to initiates,[9] which is embedded within the music by means of a quirk of technology.[10]

6. The late pianist Glenn Gould retired from the concert stage at a young age in order to work exclusively in the recording studio. He was reputed to have spent only about 10% of his studio time at the keyboard. The remaining time he listened, edited, supervised splicing, and so on. His editing was as creative an activity as his playing, and the results indicate that he was after more than note-perfect performances. His recordings have an integrity and a drive that one might not have thought possible to create "artificially." These recordings are Gould's legacy, just as surely as Bach's manuscripts are that composer's testament.

7. Digital recording technology has been used to produce a collaboration between two musicians a continent apart. A digital recording of Stevie Wonder, made in New York, was transmitted instantaneously via satellite to Nile Rogers in Los Angeles. The absolute clarity of digital recording allowed these two musicians to play together as if they actually were in the same studio. Their recording session took place simultaneously in two cities, but the musical result was as close a collaboration as the two musicians would have had had they been in the same room (since Wonder is blind, the missing factor of visual contact was minimized).[11]

These examples show that recording does more than preserve. In each case a temporal continuum was created that could exist only by recording. Thus records and tapes prove what critic Walter Benjamin realized back in the 1930s: Wholesale mechanical reproduction inevitably changes the nature of art.

> For the first time in world history, mechanical reproduction emancipates a work of art from its parasitical dependence on ritual. To an ever greater degree the work of art reproduced becomes the work of art designed for reproducibility. From a photographic negative, for example, one can make any number of prints; to ask for the "authentic" print makes no sense. But the instant the criterion of authenticity ceases to be applicable to artistic production, the total function of art is reversed.[12]

Not only recording but also broadcasting removes music from the concert ritual. Today there are many viable places to hear music besides the concert hall: lounging in the living room, driving in the car, jogging in the park, or picnicking at the beach. Ambient sounds mingle freely with those emanating from the transistor radio, to the apparent delight of the auditors.[13] Many composers still create progressions that define a movement through time from beginning to end, but listeners are no longer slaves to a concert ritual that perpetuates closure. As I mentioned in Section 2.8, everyone spins the dial. Technology has liberated listeners from the completeness of musical form.[14] Is it any surprise that some recent composers have cultivated aesthetics such as moment time or vertical time that deny closure? The mosaic-like temporal logic of moment time and the stasis of vertical time acknowledge listeners' abilities to choose for themselves the boundaries of their listening spans. Composers who continue to ignore this fact are as far behind their times as are the aptly named conservatories of music that train performers without educating them about the recording techniques with which they will inevitably have to deal.

3.2 REPEATED HEARINGS OF RECORDED MUSIC

Even before audio technology became a sophisticated art, it had an impact on musical time. At the same time that music began to be recorded, composers began drastically to reduce the redundancy in their works. The intensity in much early twentieth-century music comes from the lack of repetition. Schoenberg's *Erwartung* (1909) is an extreme example, in terms of both intensity and lack of overt repetition. It seems as if composers realized subconsciously that their music would be recorded and thus available to listeners for repeated hearings. As R. Murray Shafer has remarked, "The recapitulation was on the disc."[15] Music in the early decades of this century became considerably more complicated than it had ever been before, and the trend toward ever greater densities of information has continued at least to the 1970s (with notable exceptions, surely). Gestures have been composed that are so compressed as to be fully apprehended (encoded, in the terminology of Chapter 11) only after several hearings. However, repeated listenings are feasible once the music is recorded.

There has been a reaction to the tyranny of literally repeated hearings. Many composers, by creating mobile forms, have structured their works so that each performance is different. This formal multiplicity celebrates what recording seeks to destroy: the uniqueness of every moment in time. Individual realizations of mobile forms do get recorded, in apparent contradiction of their very meaning, and thus they are inevitably heard again and again. Karlheinz Stockhausen once compared the recording of one version of an open form to a photograph of a bird in flight.[16] We understand the picture as showing but one of a multitude of shapes the bird may take. But which is the artwork, the bird or the photograph? And which is the composition we are hearing, the abstract open form that we might intuit with the aid of score or program notes, or the realization on the fixed, carefully engineered recording?

3.3 DISCONTINUITY AND THE SPLICE

Not only did tape recording bring to the audio engineer the ability to splice together artificial continuities for "perfect" performances, but it also brought to composers of *musique concrète* and those using synthesizers the possibility of working directly with sounds and continua, without the intervention of performance. The simple act of putting razor blade to tape created the most powerful musical discontinuities as well as the most unexpected kinds of continuities. A composition can now move instantaneously from one sound-world to another. Just when a splice may occur can be as unpredictable as the nature of the new context into which the listener is thrust.

Not all tape music avails itself of the potency of extreme discontinuity, but the possibility is there to be used or ignored. Stockhausen must surely have realized the implications for musical form of the new technology when he was working in the *musique concrète* studio in Paris in 1952 and in the electronic studio in Cologne in 1953-1956.[17] A composer's involvement with electronics tends to influence any subsequent return to purely instrumental media. Although Stockhausen's early tape pieces—*Etüde* (1952), *Studie I* (1953), *Studie II* (1954), and *Gesang der Jünglinge* (1956)—are not deliberately cast in moment forms, *Kontakte* of 1960 (for tape with or without instruments) was the work that opened the door for such further explorations in moment form as *Carré* (1960), *Momente* (1961-1972), *Mikrophonie I* (1964), and *Mixtur* (1964), none of which uses tape.

The aesthetic potential of the splice had been well known from the film medium many years before the invention of tape recording. Montage techniques originated in Russian and American films in the second decade of this century. By 1922 Soviet filmmaker Lev Kuleshov was conducting careful experiments into the rhythmic effects of film splicing.[18] He studied the potentials of discontinuity and implied continuity in both fast cutting (influenced by the American films of D. W. Griffith and others) and slow cutting (with which Russian filmmakers had been working). Kuleshov's experiments and theories had a direct impact on Sergei Eisenstein, whose first film, *Strike* (1924), contains many splices. Slow cutting scrambles the hitherto orderly and inviolable succession of absolute time. Time is thus redefined as a malleable present, as an arbitrary succession of moments. This new concept, born of technology, reverberates in all art of the twentieth century. According to Arnold Hauser,

> . . . the agreement between the technical methods of the film and the characteristics of the new concept of time is so complete that one has the feeling that the time categories of modern art have arisen from the spirit of cinematic form, and one is inclined to consider the film itself as the stylistically most representative . . . genre of contemporary art. . . . In the temporal medium of a film we move in a way that is otherwise peculiar to space, completely free to choose our direction, proceeding from one phase of time into another, just as one goes from one room to another, disconnecting the individual stages in the development of events and regrouping them, generally speaking, according to the principles of spatial order. In brief, time here loses, on the one hand, its irreversible direction. It can be brought to a standstill: in close-ups; reversed: in flash-backs; repeated: in recollections; and skipped across: in visions of the future. Concurrent, simultaneous events can be shown successively, and temporally disjunct events simultaneously—by double-exposure and alternation; the earlier can appear later, the later before its time. This cinematic conception of time has a thoroughly subjective and apparently irregular character compared with the empirical and the dramatic conception of the same medium.[13]

Hauser's description is essentially of the independence of or even disagreement between time used and time portrayed in film. The parallel to my ideas on multiply-directed time outlined in Chapter 6 and on the moment-form music of Stravinsky and Messiaen as discussed in Sections 8.5 and 8.6 is striking (see also Section 1.2 on time taken vs. time evoked by music). Both the film aesthetic and the multiply-directed and moment modes of hearing music are products of a modern sensibility, influenced in no small way by a technology that allows perceivers to have their own subjective understanding (and even manipulation) of time.

As technologies and, concomitantly, new aesthetic extremes developed during this century, newer degrees and types of discontinuity became available, not only in film and music but also in drama, literature, and popular culture. Discontinuity has affected the temporal texture of every Westerner's life. Consider one example: broadcasting. Radio stations present montages of advertisements, announcements, news, weather, sports, features, and music. Television can be equally discontinuous. In a flash, viewers are transported from an animated fantasy world to on-the-spot coverage of a real war in a distant land, or from the artificial (but does that word mean anything today?) world of a quiz game to the laundry room of the Typical American Housewife. And think of children who grow up watching 15,000 hours of television between the ages of two and eleven.[20] Consider the program "Sesame Street," a formative influence on children in the United States. It exhibits extreme discontinuities, as one short scene leads without transition or logic to a totally different short scene. Truly a moment form! Watching "Sesame Street" is not unlike listening to heavily spliced tape music.

If Hauser is right (and I think he is) then technological art provides us with the means to negate ordinary time, to transcend time, to make contact with our own subjective temporalities. Thus, despite often reiterated accusations, technology is the enemy of neither humanism nor humanity. Rather, it is their partner in a new sensibility. We are products of a technological culture, and our art reflects our origins. Technology has done more than provide artists with new tools: It has shaken art to its core. A new kind of art has been born, even if the majority of artists have yet to respond to its challenges. In fact, the vehemence of some artists' reactions against technology simply proves its power. On the other hand, some of those artists who fully embrace technology have really created a new aesthetic.

3.4 ABSOLUTE TIME IN ELECTRONIC MUSIC

In music, for example, technology has made duration an absolute in a far more precise way than harmonic stasis ever could. As I show in Chapter 10, sectional balances are crucial to formal coherence in some discontinuous music, particularly if it is static within sections. The nonlinear control of absolute temporal proportions in the music of Debussy, Stravinsky, Messiaen, Bartók, and some of the Darmstadt composers exemplifies a spatialization of time common in much recent music. Tape recording technology spatializes time in a literal way: 7½ inches of tape equal one second of sound. It does not matter how much or little the activity that second contains, nor does it matter whether it seems to be a long or short second. Its literal duration is measurable along a spatial dimension. Thus splicing techniques not only affect continuity but also allow for the composition of absolute durations independent of the music that fills them. Even in the absence of splices, technology favors certain absolute durations. Familiar to composers of tape music is the time interval created by tape head echo.[21] This amount of time (which is somewhat variable, given the variety of recording speeds) is an integral part of such a work as Terry Riley's *Poppy Nogood and the Phantom Band* (1970). A similar effect, but with a longer delay, comes from the use of tape loops,[22] as in Steve Reich's *Come Out* (1966).

The emphasis on absolute rather than experiential time in electronic music may strike a traditional musician as odd or even dehumanized. But music born of technology demands its own vocabulary and syntax. It demands methods and results appropriate to its equipment, not pale imitations of performance practices.

Charles Wuorinen, writing about his electronic work *Time's Encomium* (1969), states:

> In performed music rhythm is largely a qualitative, or accentual, matter. Lengths of events are not the only determinants of their significance; the cultivated performer interprets the structure to find out its significance; then he stresses events he judges important. Thus, for good or ill, every performance involves qualitative additions to what the composer has specified; and all composers, aware or unaware, assume these inflections as a resource for making their works sound coherent.
>
> But in a purely electronic work like *Time's Encomium*, these resources are absent. What could take their place? In my view, only the precise temporal control that, perhaps beyond anything else, characterizes the electronic medium. By composing with a view to the proportions among absolute lengths of events—be they small (note-to-note distances) or large (overall form)—rather than to their relative "weights," one's attitude toward the meaning of musical events alters and (I believe) begins to conform to the basic nature of a medium in which sound is always reproduced, never performed. This is what I mean by the "absolute, not the seeming, length of events."[23]

Writing nearer the beginning of the era of electronic music, Pierre Boulez expressed ideas similar to those of Wuorinen. He foresaw the potential of the electronic medium to control absolute durations with superhuman precision:

> Compared with the capacity of the performer, the machine can, at once, do very little and very much; a calculable precision is opposed to an imprecision which cannot be absolutely notated. . . . The composer can avail himself of any duration, whether or not it is playable by human interpreters, merely by cutting the tape length which corresponds to the duration. . . . [24]

3.5 PERFORMED VS. PROGRAMMED RHYTHM

Wuorinen and Boulez are perceptive in calling attention to a temporality which is peculiar to the electronic medium, in terms not only of formal proportions but also surface rhythms (and, as Boulez points out, tempo). In electronic composition, rhythms are either played on a keyboard attached to an analog synthesizer or digital computer, or they are programmed by means of a sequencer,[25] computer program, or series of control voltages.[26] Sequencers and sequencer-like digital devices have understandably given rise to clichés, but imaginative composers working with powerful systems have created rhythmic patterns of great complexity and beauty.

The sequencer or computer produces electronically generated rhythms, while the keyboard is a means to incorporate the nuance of traditional performance into the electronic medium.[27] Performers necessarily introduce slight irregularities into the rhythms of a finely conceived interpretation. Sequencers, on the other hand, produce coldly regular rhythms, far more precise than any human could perform. The result can be lifeless.[28] Compare, for example, two electronic realizations of Gustav Holst's *The Planets* (1916), one by Isao Tomita,[29] the other by Patrick Gleeson.[30] Tomita performs on the keyboard of a Moog synthesizer, while Gleeson often uses several sequencer-like memory units of an Emu synthesizer. The difference is instructive. Tomita's work, despite its electronic medium, has the stamp of human interpretation (I am not claiming that Tomita's version is particularly musical, but it *is* a performance). Parts of Gleeson's realization, however, are utterly precise, utterly cold. Holst's music demands to be performed, but Gleeson often bypasses the performer. Setting aside the intriguing question of the artistic worth of an electronic realization of a dazzling orchestral score, we can appreciate the difference between rhythms performed by a human and rhythms generated by machinery. This difference is subtle, but the implications are enormous.

There has been a considerable amount of interesting research into performance nuance. Several experiments have demonstrated the nature and extent of rhythmic irregularities that musicians naturally—indeed, unavoidably—introduce into performance. These nuances are foreign to electronically generated rhythms. Performers do not render even the simplest of rhythms exactly as notated. For example, we should expect a half note followed by a quarter note to be played in the ratio 2:1 (durations from the onset of one tone to the onset of the next). But, in fact, the 2:1 ratio is virtually never heard, except when electronically produced.[31] Psychologists Ingmar Bengtsson and Alf Gabrielsson found that, in 38 performances of a Swedish folksong in 3/4 time with most measures containing the half/quarter rhythm, the actual ratio averaged about 1.75:1. They discovered different types of systematic variations in different performers, but not one musician came close to mechanical regularity. This explains why attention to the rhythmic treatment makes it easy to distinguish between an electronic realization and an electronic performance of Holst's *The Planets*. The simple rhythmic ratios of an electronic realization, though faithful to the score, are something we simply *never* hear in performances by humans.

Unwilling to base this conclusion on just two different versions of *The Planets*, I made an electronic version of Bach's Two-Part Invention in B-flat Major (1723). The rhythms were programmed precisely by a microprocessor associated with an analog synthesizer. I programmed in some nuance—a ritard toward the final cadence. Nonetheless, the mechanical quality of the rhythms was unmistakable.

Surely, it may be argued, the precision of electronically produced rhythms cannot be totally foreign to our listening experience. A performer can choose to play in a mechanically regular fashion, if a particular kind of music demands it. In fact, the evidence is strong that a performer *cannot* play utterly regular rhythms! Fifty years ago Carl Seashore demonstrated as much by asking a pianist to produce a metronomic performance.[32] Seashore found that the pianist's rhythmic variations were smaller than when he was asked to play expressively, but that they were nonetheless present. Furthermore, the deviations in the mechanical performance were a scaled-down version of those in the expressive performance.[33] Seashore's conclusions have been verified recently by Bengtsson and Gabrielsson, working with pianist Lorin Hollander.[34]

Bengtsson and Gabrielsson continued their research by constructing a series of synthesized performances in which various mechanical deviations from rhythmic exactitude were introduced. They felt that, if they could come up with a computer program that would produce what sounded like a human performance, then they would have a reasonable model for how humans perform music rhythmically. They added small systematic time variations in not only note durations but also timespans on deeper hierarchic levels. They feel that their results have begun to approach a viable rhythmic imitation of human performance, but that they have yet to achieve a synthesis truly indistinguishable from performed music.

Bengtsson and Gabrielsson have not (yet) varied loudness, overtone spectrum, stress accent, or attack-decay envelope. Their variables were restricted to timespan between beats with a measure, measure length within a phrase, note length, and duration of silence from the decay of one note to the onset of the next. They conclude that "one actually has to *'shape' each single tone* in all these respects (which is what the performer does!) in order to give the synthesis of a 'live impression.'"[35]

In fact, a good performer instinctively shapes (at the moment of execution) timespans on many hierarchic levels: not only individual notes but also motives, phrases, phrase groups, sections, etc. Furthermore, the performer shifts emphasis in order to focus the listener's attention on different hierarchic levels. The research of Bengtsson and Gabrielsson allows us to glimpse the incredible complexity of a performer's timing.

I find this research fascinating. It may eventually lead to an in-depth understanding of a performer's rhythmic nuances and sense of pacing. But I am also concerned about the potential misuse of these experiments. I am hoping that new techniques of performance synthesis will not obsess composers and audio engineers. Considerable creative effort has been wasted in trying to synthesize existing acoustic instrumental timbres, while we have real instruments in abundance to play and record whatever music we dream up for them. I have no objection to the use of synthesis as a research tool for studying the acoustics of instruments. But I do question the creative viability of synthesized violins, *and* of synthesized performers. I am hoping that composers will instead use the new technology to do things only machines are capable of, such as modulating between human and mechanical performance rhythms, or between different performing styles, or between the human performance of simple rhythms and the mechanical performance of complex rhythms.

Just what *is* the threshold between a human performance of a simple rhythm and a mechanical performance of a complex rhythm? Computer programmers who have devised software that translates a performance into musical notation have had to deal with this question in a concrete way.[36] Composers as well as psychologists should find this question particularly fascinating. Bengtsson and Gabrielsson have written about the reciprocal relationship between performance complexity and musical complexity.

> Performances which we judge as "good," "typical," "natural," etc., are often extremely complex when we describe them in terms of *physical* variables such as durations, amplitudes, envelopes, and so on. On the other hand, physically "simple" sound sequences—mechanical duration relations, constant amplitudes, constant envelopes, spectra, etc.—are usually experientially awkward. One is almost tempted to think of an inverse relation between physical and psychological "simplicity": the physically "simple" is psychologically "unnatural/not simple," and the psychologically "natural/simple" is physically complex.[37]

Rather than trying to incorporate the complexity of performance nuance artificially into electronically generated rhythms, composers should look to the capabilities of machines to produce intrinsically complex rhythms. The electronic medium provides a context in which composers may trade in the physical complexity of performed rhythms for the conceptual complexity of composed rhythms. Flexible computer software or a versatile sequencer can perform rhythms of great complexity with no greater effort than might be expended on the simple surface rhythms of Bach or Holst. The "precise temporal control" that Wuorinen calls for to replace the lost nuance of performance is readily realizable in rhythms too complicated to be performed (although not too complex to be conceived) by a person. Such rhythms can live and sing, although their song is not of human performers. These are rhythms born of and appropriate only to electronic technology. They are rhythms that celebrate the total uniformity of the sequencer and precision of the computer. They produce a music that is a true expression of the electronic age.

As the general level of performance improves, yesterday's rhythmic impossibilities are routinely mastered by today's performers. Even if the complex rhythms of some computer compositions become playable by humans, there will remain a crucial difference. As Elmer Schonberger and Louis Andriessen have remarked, "Humans must expend much more effort and energy to accomplish what a machine, effortlessly, does mechanically."[38] The intense struggle of the performer to play the rhythms correctly is inevitably heard. The positive side of this dramatic intensity is kineticism. The sequencer or computer performs the same rhythms with ease, but what is missing is the kineticism of performance.

This difference between human and machine rhythms was once demonstrated to me dramatically. I had composed a work for percussion trio entitled *Five Studies on Six Notes* (1980). The second Study contains in its entirety only three different durations (from one attack to the next): 𝅘𝅥𝅯., 𝅘𝅥𝅯, and 𝅘𝅥𝅰. These durations are in the ratio 6:4:3. The basic "pulse"—the common denominator—is 𝅘𝅥𝅱, which moves at the rate of 1120 beats per minute. This pulse rate is too fast to be counted or even to be felt for longer than a few seconds; its frequency of 18.7 cycles per second is approximately at the threshold of pitch. Thus performers have to use some means other than traditional counting to master the rhythms, particularly in a passage such as that shown in Example 3.1, the only place in the movement where all three durational values are freely intermixed.

In order to help performers learn this passage, I made a computer realization of it on tape. I made no attempt to imitate percussion timbre, but I was readily able to render the difficult rhythms precisely. The idea was to ask the performers to learn the taped rhythms by ear, not by counting. The work was written for The Percussion Group of Cincinnati:[39]—Allen Otte, James Culley, and William Youhass. These three extraordinary musicians were eventually able to master the rhythms, but their task was not easy. By comparing their nearly perfect performance of this passage with the computer tape, I realized an important fact. The notes and rhythms are virtually identical,[40] but the musical effect is very different. The Percussion Group's very human and successful struggle to master an incredibly difficult task is utterly unlike the superhuman ease with which a programmed machine plays the passage. The computer's effortlessness in the face of complexity is the essence of technological musical rhythms.

This comparison shows, incidentally, that difficult-to-perform rhythms may not be difficult to hear. The excerpt, despite its notated complexity, does not sound forbidding. The rhythms strike the listener as irregular but nonetheless approachable and engaging. It may not be possible to tap one's foot to this music, but its rhythmic language does not come across as pulseless chaos.

Recent music of Elliott Carter beautifully exemplifies the expressive potential of complex rhythms. Carter is interested not in mechanical rhythms but in human performance. However, it is worth noting that he readily acknowledges the influence of the player-piano works of Conlon Nancarrow—music of incredible rhythmic intricacy, which can be realized only by machine. The performer has to struggle to negotiate the rhythms of a work such as Carter's *Night Fantasies* (1980) for solo piano, but a good performance is wonderfully exciting. We seem to experience vicariously the player's euphoria over mastering the challenge. By contrast, a computer-generated or player-piano realization of *Night Fantasies* would undoubtedly sound sterile, despite (or perhaps because of) the total accuracy of the rhythms. Carter's music depends on the intensity performers must invest to master it. Conversely, a human performance of one of Nancarrow's more complex Studies (if we can imagine the incredible pianist needed to accomplish such a feat) might well be less thrilling than the normal player-piano rendition. The effect of Nancarrow's music thrives not on performance mastery but on the mechanistic precision of, for example, simultaneous tempos in the ratio of $\sqrt{2}$:2. With such a complex ratio, there is no room for performer nuance. Any deviation from exactitude would sound like an error, not like an expressive interpretation. If, as Seashore, Bengtsson, and Gabrielsson have shown, it is humanly impossible to perform the exact rhythmic ratios even a simple score may demand, then it must be literally impossible to perform music (such as Nancarrow's) that incorporates ratios too precise to allow any variation.

3.6 TURNAROUND TIME

There is one further aspect of musical time that has been greatly influenced by technology. That is the "turnaround time" between composition and perfor-

Example 3.1. **Kramer, *Five Studies on Six Notes,* end of the second movement, mm. 65–78**

Continued

Example 3.1, continued

mance. As music became more and more complex and difficult to perform in the late nineteenth and early twentieth centuries, composers had to wait longer and longer to hear their works. Charles Ives is the most extreme case. He did not hear much of his music until years after he had composed it; other pieces he never heard. Many composers have suffered similarly. That Donald Martino had to wait a decade to hear his Cello Concerto is unfortunately typical.

Electronic technology, however, has cut turnaround time to zero.[41] Composers working in electronic music studios hear exactly what they are composing—not a piano reduction, not a sight-reading, not a reproduction, but the potentially finished product. They can study at once, and as often as they wish, the aural result of their possibly complex compositional ideas. Electronic composition can have an immediacy akin to that of jazz improvisation, for it in some sense can be an improvisation. In the best electronic music this immediacy is transferred into the compositions, whatever the degree of complexity in the compositional process. Listeners are engaged by composers' excitement of discovery that comes from working directly with sounds in time. Electronic composers hear exactly what they have created before they choose to preserve, edit, or destroy. Thus it is no surprise that many composers, despite vastly increased possibilities for mathematical control in the compositional process, have opted instead for the immediacy of electronic improvisation. Stockhausen, for example, is supposed to have rendered irrelevant all the precompositional timbral calculations that went into one of his early tape works when he spontaneously added the reverberations of a basement to the otherwise dry sounds.

To summarize: Technology has expanded composers' relationships to musical time in three ways. It has increased their power to regulate temporal proportions; it has enabled them to compose rhythms of a complexity commensurate with the potential of their equipment; and it has opened up the compositional process to an immediacy that comes only when there is no delay between the conception and the realization of a segment of musical time.

Nontechnologically oriented composers may well emulate the complexity, control, or immediacy of the electronic temporal continuum, but only through the use of technology are extremes of rhythmic intricacy, formal control, and sonic immediacy possible. However, they are achieved with the incurrence of an obligation to make a music that expresses the technological mentality. This is no small challenge, and composers and audio engineers are only beginning to find artistically viable solutions. Technology has changed the essence of music. It has not and will not destroy the performance tradition of vocal and instrumental music, but it has created a fundamentally new aesthetic of musical time, an aesthetic that has begun to produce beautiful and exciting music.

3.7 THE FUTURE OF MUSICAL TIME IN THE AGE OF TECHNOLOGY

Technology has become an integral part of most aspects of our lives, including how we perceive and use the art of yesterday as well as that of today, and also how contemporary art is made and preserved. This chapter has sketched some of the ways in which technology has influenced music's temporal continua. The impact has already been enormous, and it no doubt will only grow. Technology has already changed the very nature of music, more than most people realize. The new temporalities in modernist music, as elucidated in this book, owe their existence, at least indirectly, to technology. The peculiarly contemporary ways of understanding earlier music that I discuss have also been enhanced, if not actually created, by technology. At the very least, technology has handed listeners, performers, and composers new means to invent and control temporal linearities and nonlinearities.

It used to be fashionable to speak of our era as one of transition. Today we can be fooled into believing that the transition is ending, as postmodernist aesthetics have produced superficial (and more apparent than real) returns to earlier styles. I believe, on the contrary, that the transition in the arts will end only when people—artists as well as audiences—confront the full impact of the technological revolution. Thus this book is in many ways a provisional essay, as any study of its own times is destined to be. The categories of time I am proposing—whether thought of as compositional, listening, or performing modes—are subject to all manner of cultural influences, the strongest of which is currently technological. Whether our music is to be tonal or atonal, chaotic or ordered, harsh or gentle—these are not the important questions. What our music (the music we perform, hear, *and* produce) tells us about the meanings of time in our society is a far deeper indication of our culture's temperament.

The full force of technology has yet to be appreciated. Technology has given to listeners the ability to regulate the musical continua they hear. Technology is also providing instruments that, for better or worse, allow virtually anyone to compose, even those lacking the most basic of traditional music training. Indeed, I and many others who teach electronic music composition continually find students who, with no prior musical training, produce extremely imaginative compositions. The new *composing* instruments are not so fundamentally different from the electronic instruments of *listening*. Is a pre-patched, home-style digital synthesizer more like a tape player or a piano? The question is meaningless, because technology is removing the distinction between listener, performer, and composer. Avant-gardists of the 1960s sought to break down the barriers between composer and audience by such essentially sociological means as nontraditional concert environments and audience-participation pieces (see Section 12.4). Today this extremist ideal is being routinely accomplished not by a radical artistic fringe but in the capitalist marketplace. If such a fundamental aspect of music as the distinction between composer, performer, and listener is being redefined by technology, it is hardly extreme for me to suggest that the nature of time, and hence of meaning, in music is also changing radically. Technology has become, and will no doubt remain, an integral part of music, musical time, and musical meaning.

Chapter 4

Meter and Rhythm

4.1 THE IMPORTANCE OF METER

Before proceeding with analyses of compositions that exhibit Chapter 2's various temporalities (directed linearity, nondirected linearity, multiply-directed time, moment time, vertical time), and before discussing these temporalities in greater depth, it is important to consider two fundamental aspects of musical time: meter and rhythm. While it is surely true, as suggested in Section 1.1, that the study of time has been shortchanged by music theorists, it is equally true that the majority of substantive theoretical works on musical time have concerned themselves with rhythm and meter. The past four decades have seen a number of major studies of these critical aspects of music's temporality. The most important treatises in English are (in chronological order): Victor Zuckerkandl's *Sound and Symbol: Music and the External World* (1956); Grosvenor Cooper and Leonard Meyer's *The Rhythmic Structure of Music* (1960); Edward Cone's *Musical Form and Musical Performance* (1968); Arthur Komar's *Theory of Suspensions* (1971); Peter Westergaard's *An Introduction to Tonal Theory* (1975); Wallace Berry's *Structural Functions of Music* (1976); Maury Yeston's *The Stratification of Musical Rhythm* (1976); Carl Schachter's "Rhythm and Linear Analysis: A Preliminary Study" (1976), and "Rhythm and Linear Analysis: Durational Reduction" (1980); David Epstein's *Beyond Orpheus* (1979); Fred Lerdahl and Ray Jackendoff's *A Generative Theory of Tonal Music* (1983); William Benjamin's "A Theory of Musical Meter" (1984); and Joel Lester's *The Rhythms of Tonal Music* (1986). There are also important briefer studies by William Caplin, Christopher Hasty, Martha Hyde, Andrew Imbrie, David Lewin, Robert Morgan, James Tenney and Larry Polansky, Howard Smither, Roy Travis, and others, including some of the authors already mentioned. Rhythm and meter have not suffered from lack of attention from theorists.[1]

With the exception of Zuckerkandl's important and sometimes neglected study, the earlier writings tend not to be primarily concerned with meter. Cooper and Meyer, for example, scarcely mention it, although their criteria for locating low-level accents are largely metrical. On the other hand, later works, in particular those of Benjamin and of Lerdahl and Jackendoff, focus considerable attention on meter. Theorists have been slow to realize that meter is indeed a separate, though interacting, temporal structure. There used to be a tendency, still prevalent among some theorists and also among some musicologists and performers, to think of meter as somehow apart from music, as an abstract temporal grid against which rhythm operates, as the static frame of reference against which we understand musical motion. This notion is too limited. Although meter is more restricted than rhythm (the number of possible rhythms is vastly greater than the number of possible meters) meter can nonetheless be supple and artistic. While in simple contexts it may be mechanistic, this is rarely the case in sophisticated music.

Meter is not separate from music, since music itself determines the pattern of accents we interpret as meter. Nor is meter mechanical, despite its tendency to continue, even when confronted with syncopations or empty pulses, until definitely contradicted. Music not only establishes but also reinforces and sometimes redefines meter (the ways music establishes meter are considered in Section 4.9).

There is convincing psychological evidence that meter is not projected in a mechanical way in performance. Various psychologists[2] have studied the accuracy with which durations are normally performed (some of this work is discussed in Section 3.5). They have discovered that performers introduce systematic variations into the duration and placement of notes with respect to beats. While such variations in timing are not, strictly speaking, metrical (notes are displaced with respect to beats, but it is beats, not notes, that constitute meter), they do affect the musical cues from which listeners extract information about a piece's metric hierarchy.

Music psychologist Eric Clarke has demonstrated that meter is not an independent parameter in performance but rather is deeply intertwined with rhythmic nuance.[3] Clarke placed the "same" (in terms of pitch content and note durations) melody in ten different metric contexts.[4] He then had three skilled pianists practice and perform all ten versions, in random order. Each performer made significant differences in timing from one metric setting to another. Clarke found a high correlation between metric accent and performed note length. He also found other, less direct relationships between metric position and performance nuance. These experiments demonstrate that performers intuitively alter note durations, placement of notes with respect to beats, and tempo in order to project a particular meter. These changes in turn affect rhythmic grouping. Rhythm and meter are, therefore, interdependent but conceptually distinct musical structures.

What exactly *is* meter? I agree with those theorists whose definitions hinge on the notion of a succession of timepoints (as opposed to timespans) of varying intensity or degree of accentuation. But what is a timepoint? Whereas a timespan is a specific duration (whether of a note, chord, silence, motive, or whatever), a timepoint really has no duration. We hear events that start or stop at timepoints, but we cannot hear the timepoints themselves. A timepoint is thus analogous to a point in geometric space. By definition, a point has no size: It is not a dot on the page, although a dot may be used to represent a point. Similarly, a *staccato* note or the attack of a longer note necessarily falls on and thus may represent a timepoint, but a timepoint in music is as inaudible as a geometric point is invisible. A point in space has zero dimensions: Space itself is three-dimensional; a plane has two dimensions; a line has one; and a point has none. In music the temporal continuum has at least one dimension (the multidimensionality of musical time is considered in Chapter 6), but a timepoint has no temporal dimensions. Musical events give us information about which timepoints are significant (accented), but we sense rather than literally hear the degree of metric accentuation at each timepoint.

Just as there is an infinite number of points between any two points in geometric space, so there is an infinite number of timepoints between any two successive timepoints in music, no matter how closely together they occur. Not all these intervening timepoints are important, however. Meter singles out certain timepoints from the infinite succession and marks them for musical significance. It is because of the constant flow of timepoints of varying degrees of accentuation that we can feel meter as motion. This infinite series of timepoints is what Zuckerkandl calls the "metric wave" (see note 37). This patterned succession of accented timepoints, then, is meter.

There is considerable disagreement among theorists about whether this pattern has to recur *regularly* in order for meter to exist. Most tonal music (I am focusing on tonal music not only because the theorists cited did but also because it offers a particularly rich structural hierarchy) is metrically regular on the surface level. If a section starts in 4/4, it tends to remain in 4/4. On deeper levels, however, irregularities are common. Relatively rare is the piece that consists entirely of four-bar phrases grouped into eight-bar phrase pairs, 16-bar periods, and 32-bar sections. If we think that meter is by definition regular, then hierarchic levels at which *varying* numbers of measures are grouped together are not metric. This is what several theorists believe. I intend to argue otherwise.

My equating of groups of measures with phrase lengths is not strictly accurate. While a phrase may be exactly coextensive with a four-bar "hypermeasure" (see Example 4.1; only with the partially anacrustic last beat of m. 11 is there any hint of a rhythmic group crossing a barline), this situation is not often encountered. A phrase may, for example, begin with an anacrusis, or upbeat, prior to the first large-scale metric accent. Example 4.2 shows a passage with such an extended upbeat. The first metric accent occurs at the downbeat of m. 3. It is created by the overt statement of the underlying harmony, the long duration of the chord, and the subsequent clarification of the foreground meter. This metric accent comes midway through the first four-bar phrase.[5] A phrase is therefore not a large-scale measure but rather a rhythmic group.

There are two essential differences between a large measure and a rhythmic group.

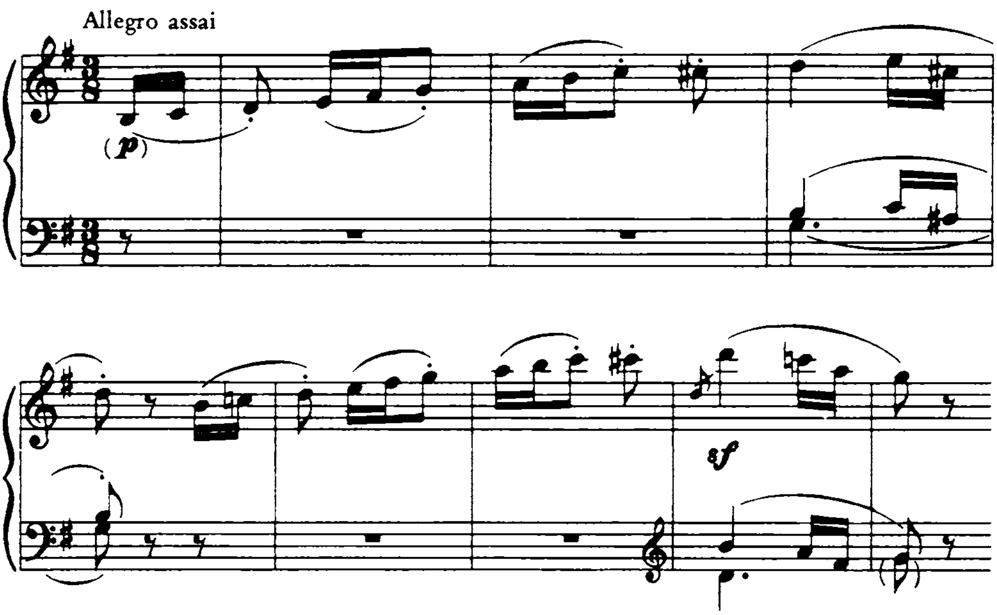
1. A measure is cyclic, in that after the music has moved through beats 1, 2, 3, and 4 (for example), it goes back to (another) beat 1. Rhythmic groups are not usually cyclic, because they vary considerably and because they are comprised of music, not just beats. It is because meter is cyclic that it is more resistant to change than is rhythm. Rhythm is a force of motion, while meter is the resistance to that force. Rhythm *can* change the meter, but only with difficulty.

2. A large measure necessarily begins with its strongest accent, while the

Example 4.1. **Schubert, third of *12 Wiener Deutsche,* D. 128, mm. 1-12**

biggest accent may occur anywhere within a rhythmic group. In Example 4.2 the largest accent of the first phrase occurs just after its midpoint; in Example 4.1 the strongest metric accents are the downbeats of mm. 1, 5, and 9. We may therefore speak of beginning- , middle- , or end-accented rhythmic groups, while hypermeasures are necessarily beginning-accented (this idea is modified somewhat below).

Are not phrases usually end-accented, though? Is it really true that the strongest accents of Example 4.1 are at the beginnings of mm. 1, 5, and 9? What about the stability of the cadence? Is not that stability a source of strong accent? Indeed, there is considerable disagreement among theorists concerning the relative accentual strength of the timepoints that begin the four measures of the typical four-bar phrase, such as the three phrases in Example 4.1. There are



Example 4-2. **Beethoven, Piano Sonata No. 10 in G Major, opus 14, no. 2 (1799), third movement, mm. 1-8**

three basic schemes that have been proposed for the relative accentual strength of the four measures of the normal four-bar unit:

1. strong-weak-weak-strong
2. strong-weak-strong-weak
3. weak-strong-weak-strong

The first scheme is favored by Edward Cone,[6] Peter Westergaard,[7] and William Benjamin.[8] The second is preferred by Carl Schachter[9] and Wallace Berry.[10] The third, the suggestion of Hugo Riemann,[11] is explored by Arthur Komar.[12] Fred Lerdahl and Ray Jackendoff[13] offer a valuable discussion of the problems inherent in each reading.[14]

If Scheme 1 properly describes the middleground metric accents of the typical phrase, then it is difficult to maintain that meter is deeply hierarchic, since a regular alternation of strong and weak beats is not normative even on a moderately deep structural level. If Scheme 2 is correct, then meter can indeed by hierarchic, but it is difficult to account for the accentual strength of phrase endings. Scheme 3 allows for both cadential accents and a metric hierarchy, but it makes phrases—even those without anacruses—necessarily out of phase with their metric units. Example 4.1, for example, would have to be understood as starting on the second "hyperbeat" of a four-beat hypermeasure. The second hypermeasure would have to begin at the downbeat of m. 4, not m. 5.

These three possible accentual readings of a four-bar unit differ from each other fundamentally. I would not argue that any of the three ideas is unequivocally useless, but rather that they depend on different understandings of accent.

4.2 THE THREE TYPES OF ACCENT

Along with Lerdahl and Jackendoff,[15] I believe that there are three distinct types of accent.[16] I am not referring to factors that cause accent, such as note length or melodic contour or tonal stability, but rather to essentially different phenomena that may result from these factors. The three species of accent are: stress accent, rhythmic accent, and metric accent.

1. Less important than the other two to the determination of hypermeasures and rhythmic groups on the four-bar level, stress is paradoxically the one commonly called "accent" by performers. It is the emphasis on a note created by a sharp attack, a high dynamic level, a small preceding silence, and so forth. Lerdahl and Jackendoff[17] call this kind of accent "phenomenal accent." Cooper and Meyer[18] and Epstein[19] and I prefer "stress." Whether provided by the performer or the composer, a stress accent is incapable of affecting meter except in the most ambiguous of situations:[20] No matter how heavy the stresses on the *fz* notes in the opening of the third movement of Haydn's 1795 D Major Piano Sonata (see Example 4.3), for example, they remain metrically weak. In other words, the stresses in Example 4.3 do not change the placement of the metric downbeat. Indeed, they emphasize the metrical weakness of the upbeats. Stress accents operate primarily on the foreground. Rhythmic and metric accents are hierarchic, however. Confusion between the two has led to some fuzzy thinking in many of the recent treatises on rhythm and meter.[21]

2. A rhythmic accent[22] may be a point of initiation or arrival or neither; it is a point of stability. It is (one of) the focus(es) of a rhythmic group, such as a motive, phrase, phrase pair, period, section, or movement. A rhythmic group often has a rhythmic accent near its end (whether or not it also has a strong rhythmic accent near its beginning). Thus a cadence is typically (on some hierarchic level) a point of rhythmic accent.

3. A metric accent, on the other hand, must be a point of initiation—but not necessarily of a rhythmic group. Thus the four-bar unit that corresponds to (but is not necessarily coextensive with—see Example 4.2) a phrase functions like a large measure. I have been calling such a unit a hypermeasure, after Cone.[23] (The term "hypermeasure" is not restricted to the four-bar level. As there are more hierarchic levels in most music than there are distinct terms to label metric units, "hypermeasure" must be used for metric units on all levels above that of the notated measure.) The four-bar hypermeasures in Example 4.1 work like large 4/4 measures, in which each hyperbeat (a "hyperbeat" is a strongly accented timepoint) coincides with the first beat of one of the foreground measures. They simultaneously operate like large 2/4 measures, in which each hyperbeat coincides with the first beat of every other foreground measure. In

Example 4.3. **Haydn, Piano Sonata No. 61 in D Major, third movement, mm. 1–15**

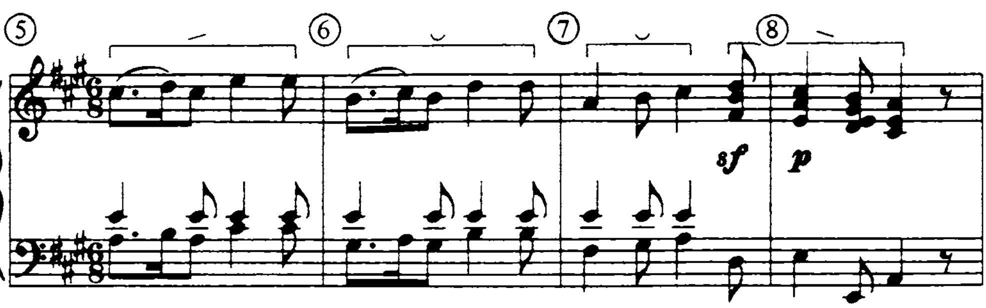
the "4/4" hypermeasure, the first hyperbeat (downbeat of m. 1) is metrically the strongest; the third hyperbeat (downbeat of m. 3) is moderately strong; and the remaining two hyperbeats (downbeats of mm. 2 and 4) are relatively weak (since they are not beats of the "2/4" hypermeasure at all), although still stronger than any timepoint lying between any of the four main hyperbeats.

Rhythmic and metric accents may or may not coincide. They are quasi-independent structures that function in different ways.[24] Until metric and rhythmic accents are clearly understood, even something as basic as the accentual patterning of a normative four-bar phrase remains problematic.

4.3 ACCENTS IN THE FOUR-BAR PHRASE: THE STRONG-WEAK-WEAK-STRONG POSSIBILITY

Keeping in mind the distinction among the three types of accent, we can consider in greater detail the three possibilities listed above for the accentual patterning of a typical four-bar phrase. The first is exemplified by Cone's reading of the second phrase of Mozart's Sonata in A Major, K. 331 (1788) (a work that is a favorite example for many rhythm theorists)—see Example 4.4. Cone differentiates initial and cadential accents, indicated respectively by the symbols ⟍and ⟋.[25] He is in effect concerned with rhythm more than meter. His rhythmic groups (shown by brackets in Example 4.4) do not always coincide with measures. The stress accent at the end of the third measure, for example, creates the beginning of a new rhythmic group but is certainly in a weak metric position. The fundamental difference between Cone's initial and cadential accents is that the initiation of a rhythmic group usually coincides with or is near the initial accent of a hypermeasure, while a cadential accent does not normally coincide with a metric accent (at the comparable hierarchic level). In Examples 4.1 and 4.4., a four-bar phrase begins simultaneously with a four-bar hypermeasure. In Example 4.2 the four-bar rhythmic and metric units do not begin together, but nonetheless the first rhythmic accent and the metric accent that initiates the first complete hypermeasure coincide in m. 3.

Part of the problem with Cone's method of analyzing accent, which he derives from Cooper and Meyer, is that he does not clearly state whether accents are applied to timepoints or timespans. Surely he does not mean literally that every timepoint in the first measure of Example 4.4 is accented with respect to every timepoint in the second measure. What he probably means is that the rhythmic group in the first measure contains an accent (at its downbeat) stronger than any accent in the second measure. The existence of a strong accent in the first rhythmic group makes the entire group function as accented. Although in basic sympathy with this notion, I am concerned with its imprecision. If we understand that accents, whether rhythmic or metric, are hierarchic, then there is no need to suggest that an entire timespan is accented. Surely we do not feel the force of accent throughout the whole first measure of Example 4.4, just as we do not constantly feel accent during the entire 183 measures of recapitulation



Example 4.4. **Mozart, Piano Sonata in A Major, K. 331, first movement, mm. 5–8**

plus coda in the first movement of Beethoven's Eighth Symphony, as Cooper and Meyer's (in)famous analysis suggests.[26]

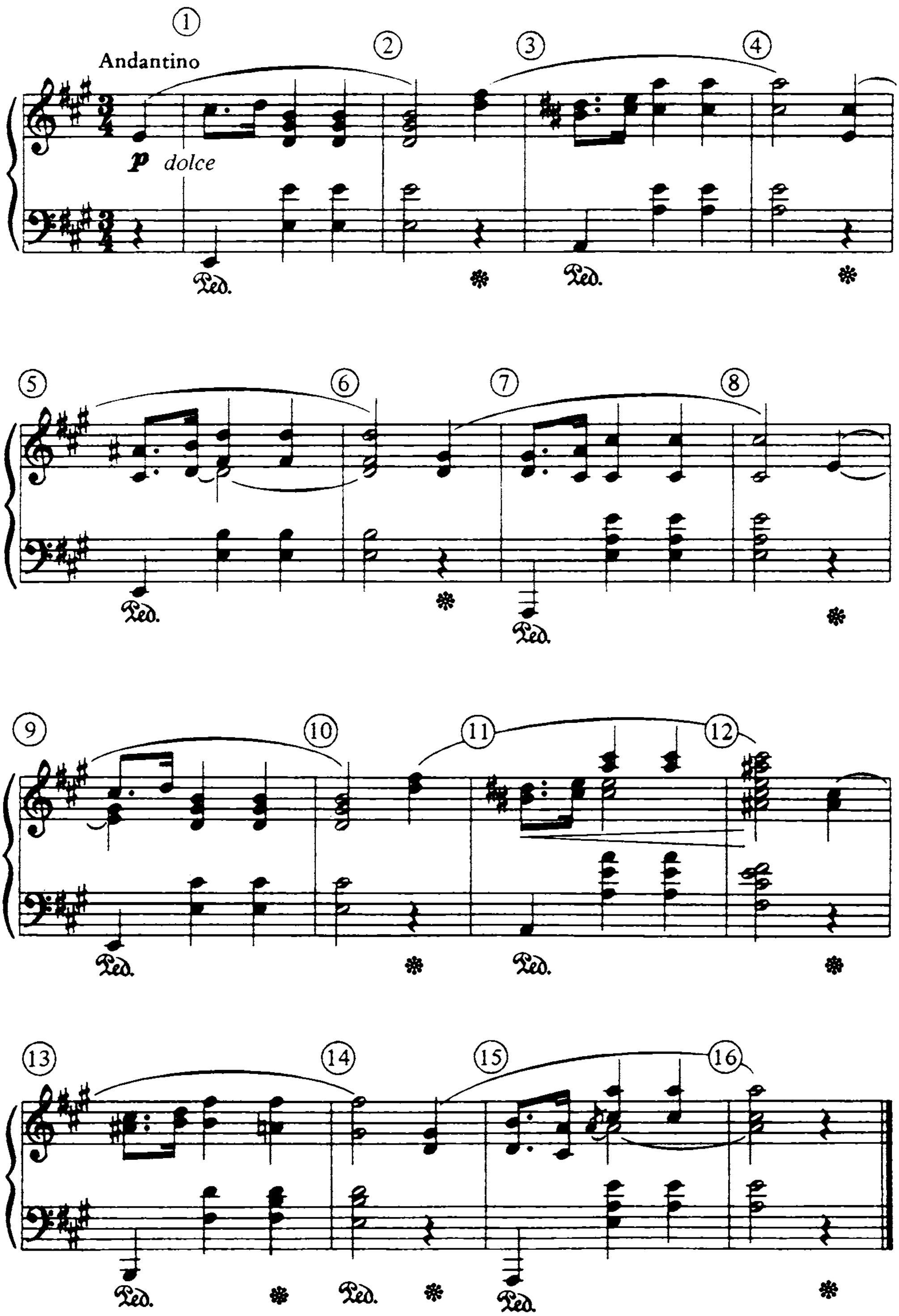
An unaccent, however, *may be* a timespan. An entire timespan may be unaccented, relative to its context, because it can be an extended upbeat (a rhythmic group leading to a subsequent downbeat or rhythmic accent) or afterbeat (a rhythmic group leading away from a preceding downbeat or rhythmic accent). The third rhythmic group of Example 4.4 is an upbeat leading eventually to the point of accent of the fourth rhythmic group (the cadence on the second beat of the fourth measure). The *entire* third rhythmic group points toward the fourth group's focal point: the instant of cadence and of resolution. The second rhythmic group, by contrast, functions as an afterbeat, leading away from the first rhythmic group (as, on a shallower hierarchic level, the later notes of the first group lead away from its initial point of rhythmic accent).

Rhythmic unaccents, then, can be either timepoints or timespans. Timepoints, let us remember, are not heard. Rhythmic accents, however, are definitely audible: They are short timespans (such as attack points of notes).[27] If rhythmic accents were timepoints rather than short timespans, how could we explain the effect of an "agogic" accent, or accent of length (such as that at the downbeat of m. 3 of Example 4.2)? Although we have not yet experienced a note's length at its starting timepoint, agogic accents are nonetheless felt at attack points. I do not think we experience such a note as unaccented and then reinterpret our perception once we know its duration. Rather, we seem to perceive an agogic accent as soon as we hear the note begin.[28] Thus we must allow for rhythmic accents of finite duration, even though we need not go so far as to suggest that entire rhythmic groups, or even entire long notes, are literally accented.

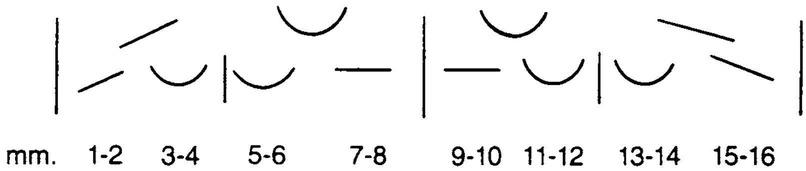
When Cone describes the accentual pattern of the typical four-bar phrase as strong-weak-weak-strong, he is really considering rhythmic accents, not hypermeter. The critical place is the third measure (see Examples 4.1 and 4.4), the downbeat of which receives a fairly strong metric accent but no rhythmic accent of comparable strength. The initial accent, though possibly not as strong as the rhythmic goal at the cadence, has some considerable strength because metric and rhythmic accents coincide at the beginning of the first measure. Meter does, therefore, have some place in Cone's scheme. But, the farther we move through the phrase, the more the analysis reflects the rhythmic structure and the less it shows the hypermetric structure.

The problems with Cone's method become evident if we look at his analysis of Chopin's A Major Prelude (before 1839) (see Example 4.5). Cone analyzes the accentual pattern of the two-bar units (he never says unequivocally whether he means two-bar hypermeasures, coinciding with every other barline, or two-bar rhythmic groups, as given by Chopin's phrase marks) on two levels, as shown in Example 4.6.

The reason, I strongly suspect, why Cone considers mm. 1-2 stronger than mm. 3-4 is that m. 1 is a metric beginning. In other words, the downbeat of m. 1 serves to start (hyper)measures on several levels: m. 1, mm. 1-2, mm. 1-4, mm. 1-8, and even mm. 1-16. It is, in fact, the strongest metric accent in this brief piece. (The prelude is unusual in commencing with its strongest metric accent. Cone is right to point out that it is probably best understood as



Example 4.5. **Chopin, Prelude in A Major, opus 28, no. 7**



Example 4.6. **Edward Cone's analysis of Example 4.5**

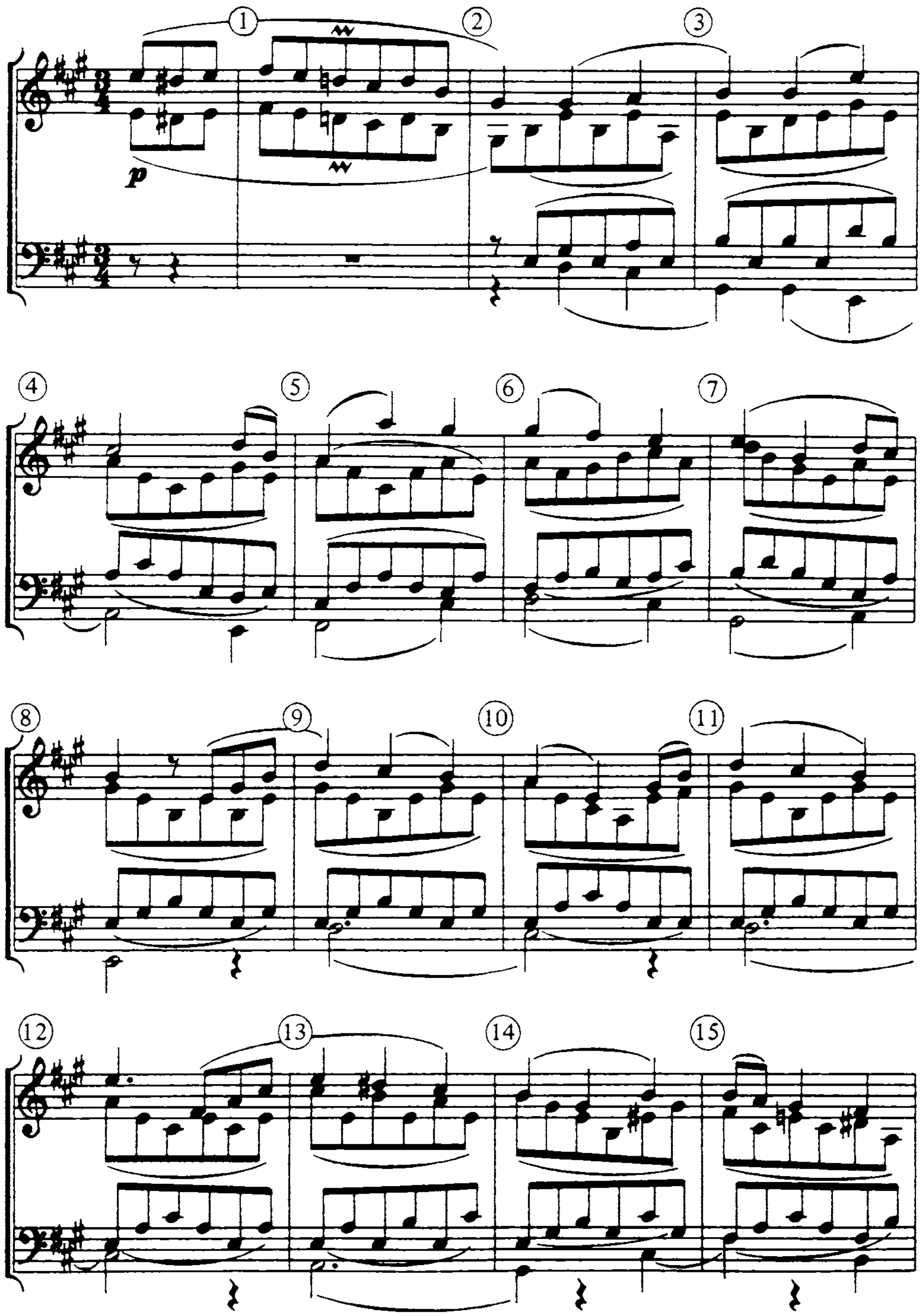
one of 24 movements rather than as an independent piece.[29] In more normal pieces, a metric accent will eventually occur that is stronger than the initial timepoint.) Rhythmically, however, mm. 1-2 are weaker than mm. 3-4. The reason is harmonic. The relatively unstable and dissonant V^7 of mm. 1-2 moves toward the stable and consonant and hence rhythmically accented I of mm. 3-4. Cone considers mm. 1-2 strong for metric reasons. But he hears mm. 7-8 as strong for rhythmic reasons; they contain the cadence harmony, the goal of motion. There is nothing metric (on the four-bar level) about the strength of mm. 7-8. Similar reasoning accounts for Cone's analysis of the entire composition as four-bar units in the pattern strong-weak-weak-strong.[30]

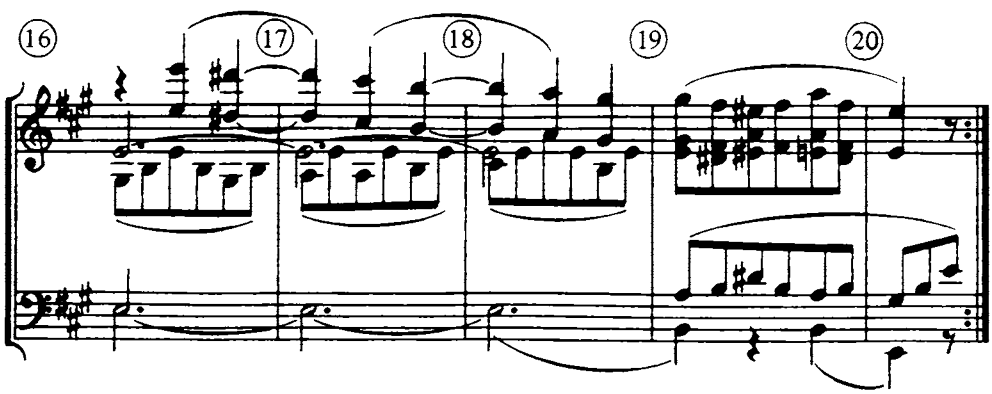
4.4 ACCENTS IN THE FOUR-BAR PHRASE: THE STRONG-WEAK-STRONG-WEAK POSSIBILITY

Scheme 2 for understanding the accents in a typical four-bar unit is essentially metric. It suggests that cadences are usually metrically weak. This formulation does not deny that phrases move toward cadences as stable goals, but assumes that such goals can be *metrically* unaccented. It is possible for rhythmic and metric accents to coincide at cadences, in the case of metrically end-accented phrases, but this occurrence is relatively rare. Mm. 1-4 of the third movement of Mendelssohn's *Italian* Symphony of 1833 (Example 4.7) comprise a metrically end-accented rhythmic group,[31] with the result that the hypermeter and the phrase structure are out of phase: A new hypermeasure begins as a phrase is ending.

We may expect a hypermetric downbeat at m. 2, because of the upbeat character of the opening eighth notes, but the lack of harmonic support denies this possibility. M. 3 cannot be heard as metrically accented, because it starts with the same harmony that began the preceding (noncadential) measure. At m. 4, however, there is a cadence, a rhythmic accent. As the only viable candidate for metric accentuation in mm. 1-4, this rhythmic arrival is heard also as the beginning of a new hypermeasure. Notice how this hypermetric structure is clarified when the section is repeated. Mm. 16-19 form an unequivocal four-bar hypermeasure, articulated by tonicized dominant harmony. The cadence at m. 20 is therefore not only rhythmically accented but also metrically accented. It is the downbeat of the hypermeasure of mm. 20, 1, 2, and 3, thus making the downbeat of m. 4 clearly (more so than the first time it was heard) the beginning of another hypermeasure.

Example 4.7. Mendelssohn, Symphony No. 4 in A Major, opus 90, *Italian*, third movement, mm. 1-20





Several theorists accept Scheme 2. Carl Schachter believes, after Schenker,[32] that cadences do not normally receive metric accents. He sees "no reason to believe that the metrical organization of a group of measures differs in principle from that of a single measure; . . . both are beginning- rather than end-accented. Within a group of measures, just as within a measure, rhythmic organization can contradict the meter and produce a stress [or rhythmic accent] on a normally weak place."[33]

Similarly, Wallace Berry argues persuasively for cadences as normatively weak. He calls the hyperdownbeat the "initiative"—it is "a *point* of action . . . , an accentual thrust, a discharge of energy."[34] The remaining hyperbeats are either "reactive *from*" the initiative, "anticipative *to*" a subsequent initiative, or a "conclusive final dispersal of the initiative accent with which the metric unit begins." In other words, each hyperbeat of a hypermeasure has its own inherent quality, which derives from its relation to the initial, strongest hyperbeat.[35] This is comparable to the quality of beats within a measure on the foreground, as reflected, for example, in a conductor's beating pattern.[36] A third beat of a four-beat (hyper)measure has its own particular feeling, dependent on its relative strength of metric accent and on the strengths of the metric accents surrounding it. It is because of the inherent qualities of beats on all levels that we can speak, as Victor Zuckerkandl does,[37] of a "metric wave," despite the fact that meter literally consists only of a series of discrete timepoints of varying degrees of accents. Let us remember that there is an infinite number of unaccented timepoints between two successive metric accents. These metric unaccents are not of equal weakness: The metric hierarchy extends to the minutest details and beyond (in the minds of listeners and muscles of performers). This patterned succession of degrees of unaccent is what we feel as metric motion or waves. And it is what allows Berry to claim that (hyper)metric beats are interrelated through "actions *to* and *from*," which create the sense of "flow, surge, and ebb in music." This metric motion, for Berry, "accounts for what is organic and dynamic in metric structure."[38]

Christopher Hasty has a similar view: "It is the directed movement away from one moment and toward another which constitutes meter."[39] Joel Lester feels the same way: "Accents within a measure both recede from the preceding downbeat and also lead toward the following downbeat."[40]

I believe that metric motion is an illusion (albeit a useful one), based on the large number of metrically patterned timepoints in any timespan. More real is the musical motion that is essentially rhythmic, not metric, since it involves the *grouping* of musical events with subsequent events (motion towards, or, in Berry's terms, anticipative impulses) or prior events (motion away from, or reactive impulses). I agree with Lerdahl and Jackendoff[41] and Yeston[42] that beats are simply timepoints, not imbued with motion but only with relative degrees of accentual strength. It is the music itself, not its beats and hence not its meter, that moves through time. Failure to appreciate this important but subtle distinction has led several theorists into unfortunate confusions.

Because we understand the degrees of accentual strength of beats hierarchically, and because we remember and compare metric accents, beats do indeed have inherent qualities. Thus William Benjamin can speak of "equivalence classes" of timepoints; the second beat of the third measure of a four-bar hypermeasure, for example, has an identity, similar (on levels up to the four-measure) to that of the second beat of the third measure of every other four-bar hypermeasure in the same piece. Benjamin makes a telling analogy to octave equivalence in the pitch domain. However, if we consider *every* level in the metric hierarchy, no two beats in a piece have *exactly* the same accentual quality.

4.5 ACCENTS IN THE FOUR-BAR PHRASE: THE WEAK-STRONG-WEAK-STRONG POSSIBILITY

Scheme 3 is Arthur Komar's suggestion for the accentual pattern of a typical four-bar phrase. Komar's formulation is an admirable attempt to compromise between the regular alternation of strong and weak hyperbeats required by a metric view and the cadential accent implied by a rhythmic view. There are problems, however. He is forced to postulate a silent strong beat prior to the start of most pieces. In his detailed analysis of the second movement of Beethoven's *Pathétique Sonata,* for example, his "bar 0" is accented on all hierarchic levels[43] (see Example 4.8). A metrically strong bar "0" makes Komar's units behave like hypermeasures, because they begin with strong initiatives (at first bar "0" and then cadential accents in mm. 4, 8, and so forth). His rhythmic units (phrases, for example) begin on the second and end on the first hyperbeats of four-bar hypermeasures. Yet, as Carl Schachter points out,[44] it is difficult to feel a strong accent a measure before the beginning of the piece. I find it anti-intuitive and actually quite awkward to hear metric accents at the ends of phrases in the second movement of Beethoven's Opus 13. Komar has pointed out[45] that an advantage of his conception of meter is that he is not forced to place hyperbarlines in the middle of middleground harmonies in the Beethoven example. For example, the first phrase pair, mm. 1-8, ends on I and the next phrase pair, mm. 9-16, begins on I. Komar's analysis places this two-bar I chord (mm. 8-9) within a single hypermeasure. Harmony is not, however, an absolute determinant of metric accent. I feel nothing strange about hypermeasures that begin with the harmony of the preceding cadence. An important harmonic change or arrival may or may not determine a metric accent (in Example 4.7 it does, because of the suppression of the harmonic arrival earlier; in Example 4.8 it does not).

Example 4.8. Beethoven, Piano Sonata No. 8 in C minor, opus 13, *Pathétique,* second movement, mm. 1–16

Another problem with Komar's method, pointed out by Lerdahl and Jackendoff,[46] is that it is essentially top-down, while our perception and understanding of meter is necessarily bottom-up. In other words, Komar starts from the premise of a metrically regular background and derives potentially irregular middleground structures from it by means of operations he calls expansion, contraction, elision, and bifurcation[47] (similar to my extension, contraction, and overlap; see Section 4.8). As Lerdahl and Jackendoff remark, it "is topsy-turvy to develop an entire metrical theory from an assumption . . . remote from the listener's actual experience." They prefer, as do I, a view of meter "based on the immediate sensation of strong and weak beats"; in other words, a bottom-up conception. Hypermeasures are perceived as comprised of measures, while larger hypermeasures encompass smaller hypermeasures. Irregularities are still understandable in terms of basic operations that transform regularities—not conceptually prior contextual regularities, but regular metric lengths expected on the basis of implications earlier in the piece and the conventions of tonal music.

4.6 RHYTHMIC VS. METRIC ACCENTS

If we understand the essential difference between rhythmic and metric accents, then there should be no confusion about the accentual pattern of a timespan, whether on the four-bar or some other hierarchic level, nor should we be forced to hear an entire section as metrically reactive to a strongly accented bar "0" that is not literally in the music. A composition's first complete (hyper)measure usually begins with an accented beat that is truly in, not prior to, the music, and it contains several subsequent timepoints, usually evenly spaced, of varying but lesser accentual strength. A rhythmic group is far more flexible and hence harder to generalize. It may start with a rhythmic accent or unaccent; it may start with a metric accent or unaccent. The strongest rhythmic accent in a group may appear at or near the beginning, in the middle, or at or near the end. Rhythmic accents may or may not coincide with metric accents. Rhythmic groups are of flexible size (see Example 4.12), while (hyper)measures usually have but a few possible lengths (at a particular level). Rhythmic groups move toward their primary accent or away from it; metric units do not move, even though their constituent music may be pushing away from the preceding or toward the upcoming rhythmic accent.

It is crucial to understand the differences between metric and rhythmic structures and accents, even though they coexist and interact. We can understand the temporal structure of Chopin's Prelude in A Major (Example 4.5) as the interaction of two regular structures on the four-bar level: metric accents at the downbeats of mm. 1, 5, 9, and 13; and rhythmic accents at the beginnings of mm. 3, 7, 11, and 15. In this particular piece, rhythmic grouping and (hyper)meter are both regular on several hierarchic levels, although their strong points do not coincide. To understand the temporal structure of the piece, we need only keep clear the distinction between rhythm and meter, between rhythmic grouping and hypermeter, between rhythmic and metric accents. We need not invoke a silent accented bar "0" nor posit an irregular alternation of strong and weak hyperbeats such as that shown in Example 4.6.

The highly variable temporality of music more complex than Chopin's brief prelude can come from the interaction of meter and rhythm. The distinction between the two parallels David Epstein's "chronometric" vs. "integral" time.[48] Chronometric time is the "essentially mechanistic, evenly spaced, and in large part evenly articulated time set up within a musical measure (and larger units). . . . Its measurements and demarcations are in the main pragmatic and convenient periodizations." I think Epstein overstates his case when he calls chronometric time mechanistic, but the essentially even articulation of time *is* an important characteristic of meter. "Integral time," on the other hand, comprises "the unique organizations of time intrinsic to an individual piece: time enriched and qualified by the particular experience within which it is framed." Integral time, like rhythm, is peculiar to each piece. Chronometric time is more general, as the metric hierarchy of one work may resemble that of another (although each piece will introduce its own irregularities).

The differentiation between chronometric and integral time allows Epstein to make an important distinction between beat and pulse.[49] Beats are timepoints. The temporal continuum of most traditional music consists of a series of more or less evenly spaced (at least at the surface level) beats: the meter of the music. Pulses, however, are flexible, and they are rhythmic. They are events (short notes or onsets of long notes) in the music that occur at or near beats. They are subject to a wide variety of articulations and stresses: *staccato, legato, sforzando,* and so forth. In other words, a pulse has a finite, though small, duration. A pulse is literally heard, not intuited the way a beat is. Pulse is susceptible to rhythmic accent, while metric accents are applied to beats.

Not only are metric and rhythmic accents different phenomena but also they are applied to different kinds of musical events. The two may or may not coincide, but they are conceptually—and *experientially*—distinct. A pulse is an event in the music, interpreted by a performer and directly heard by a listener. It occurs *at* a timepoint. A beat, on the other hand, *is* a timepoint rather than a duration in time. A pulse is movable with respect to a beat (this happens in expressive performances), but a beat is movable only with respect to absolute time (in a *ritardando,* for example). Beats acquire significance because of where they occur within their metric hierarchy. The significance of pulses, by contrast, is not created by their location along the temporal continuum but rather by their rhythmic context.

Performers and listeners use the information in a composition to understand where beats fall and how strongly accented they are, but (as argued in Section 4.1) we do not literally *hear* beats. We experience them, we feel them, and we extrapolate them—by means of mental processing of musical information. But we cannot literally hear something that is a timepoint, that has no duration. We react physically and emotionally to meter, but we do not literally sense it in our eardrums.[50] How else can we understand the phenomenon of an accented silence, such as that just after the double bar in Example 2.2? As Joel Lester has written,

> A metric accent . . . can occur on a rest; no event need mark it off. This is because meter is, in part, a psychological phenomenon. When a meter is first established, or is being reinforced, events must mark off or imply the

> metrically strong points. Once established, however, meter has a life of its own.[51]

It is because metric accents are intuited (by the mechanisms outlined in Section 4.9) rather than heard that I can postulate the perceived equality of accentual strength of noncontiguous timepoints.

We do hear pulses, motives, motive groups, phrases, phrase groups, sections, and movements; it is no coincidence that many such names exist in common discourse about music. By contrast, although we experience beats, measures, and hypermeasures, doing so is a psychological process abstracted and interpreted from perception. It should not be surprising, therefore, that there is no ready-made vocabulary for metric units on hierarchic levels above that of the measure.

As discussed in Section 4.1, by "meter" I refer to an essentially regular (I discuss metric irregularity in Section 4.7) punctuation of time by timepoints that are accented to varying degrees; all parameters of the music potentially contribute to causing the metric accents. The term "rhythm," however, has threatened to become vague. For some theorists, rhythm is the entire temporal life of a composition. Berry, for example, simply considers rhythm "the articulation of time by events of a particular class."[52] He also states: "The study of rhythm is . . . the study of all musical elements, the actions of those elements producing the effects of pace, pattern, and grouping which constitute rhythm."[53] Similarly, Benjamin Boretz believes that "the *rhythmic* structure of a piece is . . . simply all of its *musical* structure. . . . The theory of rhythm, then, is nothing more or less than the theory of musical structure in its most comprehensive form. . . . Every musical theory is in fact a contribution to the theory of rhythm."[54] In a similar vein, Cone's notion of rhythm is sufficiently flexible to allow large-scale form to be primarily rhythmic.[55] Cooper and Meyer, on the other hand, adopt a restrictive definition: rhythm is the way weak beats are grouped around a single strong beat. My own notion is similar to that of Lerdahl and Jackendoff, who determine a rhythmic group by its boundaries and not by its accent(s). I agree that rhythm is deeply connected with grouping. This does not preclude form being rhythmic, because rhythmic grouping is hierarchic, up to the largest levels. I prefer to use the word "rhythm" as shorthand for "rhythmic grouping." Lerdahl and Jackendoff's term "grouping" is confusing because not only rhythm but also meter can effect a kind of grouping—metric "groups" being delineated by recurrences of accents of comparable strength (to avoid confusion, I avoid the term "metric group").

4.7 IS METER NECESSARILY REGULAR? IS METER HIERARCHIC?

These various definitions of rhythm strike me as semantically, not substantively, different. But there is an important point of disagreement that must be considered, namely, whether meter need be regular. If regularity is part of the definition of meter, then only some music is metric on all hierarchic levels—some folk music, some popular music, some nineteenth-century music that is pervasively constructed in four-bar phrases (the first movement of Bruckner's Fourth Symphony (1874) is a typical example[56]). If regularity is a prerequisite for meter, then many compositions (for example, several by Stravinsky) are not metric at all. Most theorists who discuss this question do not question the existence of a rich hierarchy of accentual strength, but, since they generally fail to differentiate metric from rhythmic accent, they do not believe that an accentual hierarchy is necessarily linked to a metric hierarchy.

A fundamental question is rarely asked: What *is* (hyper)metric regularity and how do we recognize it? Several theorists seem implicitly to think that accent recurrence is regular if the same amount of time separates successive accents. What kind of time, though? Surely they cannot mean clock time, for no musical performance rigidly adheres to metronomic invariance of tempo. Perhaps the kind of time meant is chronometric time, in which timespans are measured quasi-objectively not by an external clock nor by an unreliable (see Section 11.8) biological clock, but by music's internal clock, the ticking away of beats (not pulses). Chronometric time, though more rigid than integral time, has elastic qualities that absolute and clock time lack. If metric regularity were inseparably connected to absolute time or to a subjective clock, then it would be destroyed whenever tempo changed. If, on the other hand, music's chronometric time is its internal clock, then we can understand how it is possible to experience a change of tempo without an attendant change of meter.

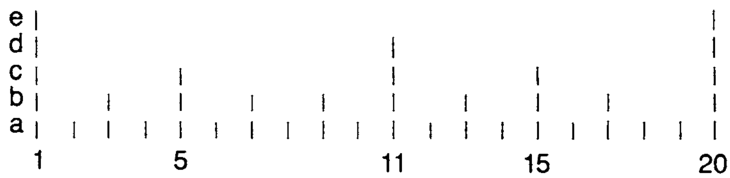
What is the unit of this chronometric clock? Is it the foreground beat, sometimes called the "primary" beat?[57] If this were simply the case, then we would count beats as we listen to hypermetric units. But surely we do not count from 1 to 16 as we hear four measures of 4/4 time. Rather, the (at least shallow-level) hierarchy gives us cues for where we are within a hypermeasure. The quality of beat (described in Section 4.4) takes the place of literal counting. Because of the hierarchy of strengths of beats, we sense that we are, for example, on the fourth beat of the third measure. We do not count 12 primary beats from the beginning of the hypermeasure to acquire this information, but rather we "count" simultaneously on several levels: 1 2 on the level of the measure pair, 1 2 1 on the level of the measure, 1 2 1 2 1 2 on the level of the half measure, and 1 2 1 2 1 2 1 2 1 2 1 2 on the level of the beat within the half measure. Metric counting goes generally 1 2 1 2 . . . or 1 2 3 1 2 3 . . . on several different hierarchic levels—and at several different integrally related speeds—at once. The focal point of metric organization is the location of the "1's" on all hierarchic levels. They are the metric accents.

Metric irregularity is recognized, therefore, not on the basis of an atypical amount of absolute time between successive accented beats at some level, nor solely on the basis of an unusual number of primary beats between accents, but also by an atypical number of intervening beats on the next-shallowest level. A five-bar hypermeasure, encountered in a context of four-bar hypermeasures, will seem irregular, not primarily because it contains five measures rather than four, and certainly not because it contains 20 rather than 16 beats (assuming a time signature of 4/4). The irregularity is understood as an aberration on one particular hierarchic level. On the level at which the music has been grouping measure downbeats into pairs (strong-weak-strong-weak) one extra weak beat is added, producing a strong-weak-weak hypermeasure. In other words, it is the number of weak beats between adjacent strong beats more than the absolute time or the number of elapsed primary beats that determines metric irregularity. If we find two weak beats between adjacent strong beats where we are accustomed to finding one (or conversely), then we hear an irregularity.

But this irregularity may be subsumed into regularity on still deeper levels. The five-bar hypermeasure, just like the four-bar hypermeasures that may have preceded it, may contain one relatively weak beat between successive strong beats. Example 4.9 comprises two-bar hypermeasures throughout, except for the three-bar hypermeasure in mm. 17-19. Each two-bar hypermeasure begins with a root-position I chord, except for the striking IV chord in m. 9. When m. 19 fails to deliver the expected root-position I (or IV), we may suspect that the length of hypermeasures has (temporarily) changed. When the expected root-position I comes a bar later, coinciding with a rhythmic accent, we understand in retrospect mm. 17-19 as one three-bar hypermeasure functioning on the level previously containing only two-bar hypermeasures. On the next deeper level, the four-bar level, we find the two-beat hypermeasure of mm. 1-4 answered by the three-beat hypermeasure of mm. 5-10. Then another four-bar hypermeasure, mm. 11-14, is answered by a longer hypermeasure, the five-bar unit in mm. 15-19. These irregularities disappear on the next level up, however, since both the ten-bar hypermeasure of mm. 1-10 and the nine-bar hypermeasure of mm. 11-19 are two-beat hypermeasures. These relationships are shown graphically in Example 4.10.

Example 4.9. **Haydn, Piano Sonata No. 61 in D Major, first movement, mm. 1-21**


cantabile



Example 4.10. **Hypermetric analysis of Example 4.9**

I do not mean to imply that the difference in length between four- , five- , and six-bar hypermeasures cannot be perceived. Such a suggestion would be absurd, and it would throw into question some of the proportional relationships explored in Chapter 10. The difference in lengths, however, is a matter of metric perception only on the level where the changes originate. Duration perception (as discussed in Chapter 11) is affected by many factors, of which meter is but one.

The problem of hypermetric irregularity is critical to the question of how deeply hierarchic meter is. Most theorists I have read believe, at least implicitly, that metric irregularities, no matter on how deep a hierarchic level they occur, are identified by absolute time or primary-level chronometric time. They therefore find that an irregularity introduced into the metric hierarchy remains on all deeper levels. But I prefer to define regularity and irregularity in terms of the *number* of elapsed beats on the *next shallower level.* In that case, an irregularity on one level need have no effect on the regularity of adjacent levels. In Example 4.10 deviations from regular two-beat hypermeasures occur only once on level c (mm. 5-10) and once on level b (mm. 17-20). All other (hyper)measures in the excerpt contain two (hyper)beats. Meter can therefore exist on several levels, some of which are regular and some not. Because we perceive several levels simultaneously, we are quite capable of understanding irregularities that are subsumed into deeper-level regularities.

The usual reason given why meter is not deeply hierarchic[58] is that it is by definition periodic,[59] while in most music metric accents are not evenly spaced on deep levels. I believe, on the contrary, that in many cases deep-level metric accents *are* evenly spaced, if by "evenly spaced" we mean having the same number of intervening weaker beats. Therefore, meter can be understood on all levels as fundamentally regular, but with frequent irregularities. And meter can be understood as deeply hierarchic, because the introduction of irregularities on one level does not necessarily destroy the fundamental regularity of deeper levels.

4.8 SOURCES OF HYPERMETRIC IRREGULARITY

One of the most common irregularities is what is sometimes called "extension." An extension occurs when a hypermeasure is longer than expected in context. In Example 4.9 we find a six-bar hypermeasure (mm. 5-10) where a four-bar unit is expected. Our expectations are based on the length of the first hypermeasure (mm. 1-4) and on the way classical hypermetric structure usually unfolds. And we find a three-bar hypermeasure (mm. 17-19) on a hierarchic level that has previously consisted solely of two-bar hypermeasures. Both these alterations are extensions: the actual lengths are longer than expected.

The opposite of extension is contraction, which occurs when a hypermeasure is shorter than expected. Example 11.10 shows a typical contraction. The eight-bar hypermeasure of mm. 41-48 becomes a seven-bar unit when it is repeated (and varied) in mm. 49-55. One measure is omitted from the regular pattern. If we compare mm. 41-48 with mm. 49-55 measure by measure, we discover that the harmonic activity of mm. 47-48—I-ii^6-V—is compressed into one bar, m. 55.

A third possibility, besides extension and contraction, is "overlap"[60]. An overlap occurs when a beat serves both as weak termination of a hypermeasure and strong initiation of a subsequent hypermeasure *at the same level.* I am not referring to the fact that a strong beat at some level is usually weak at some deeper level. Rather, an overlap occurs when a beat is simultaneously weak and strong at one level, usually the level of the measure. When listening in the context of the hypermeasure that precedes the beat in question, the beat is heard as weak. In the context of the subsequent hypermeasure, it is strong. Unless there is such a reinterpretation of a weak beat as a strong beat, there can be no *metric* overlap[61] (although there may well be a rhythmic overlap).

In Example 4.7 there is a metric overlap at m. 16: Mm. 9-12 form a regular four-bar hypermeasure, articulated by repetition of the progression V^2-I^6. Similarly, mm. 13-16 form a four-bar hypermeasure, with a metrically weak (though rhythmically strong) cadence at the downbeat of m. 16. The cadence harmony continues for several more measures, however, thus making mm. 16-19 into a four-bar hypermeasure. The downbeat of m. 16, therefore, is at once metrically weak (last hyperbeat of mm. 13-16) and metrically strong (first hyperbeat of mm. 16-19).

In the opening of Mozart's Piano Sonata, K. 279 (1774), shown in Example 4.11,[62] however, there is no metric overlap at m. 5 (nor at m. 3, nor anywhere else in the excerpt), despite the fact that the music at the downbeat of m. 5 belongs both to the preceding music (since mm. 1-4 establish a context in which long upbeat figures lead to—are rhythmically grouped with—each measure's downbeat chord) and to the subsequent music (m. 5 starts a new texture, in which rhythmic groups begin on metric downbeats). There is indeed an overlap of rhythmic groups, but not of hypermeasures. Metrically, mm. 1-4 constitute a four-bar hypermeasure, and m. 5 starts the next hypermeasure. There is no beat here that belongs to both hypermeasures.

The first part of Example 4.11 comprises a four-bar phrase with its cadence in the fifth bar. This phenomenon is not commonly called a five-bar phrase, because m. 5 belongs in its entirety to the next phrase. The associated hypermeasure, furthermore, is four bars long. The situation is different from that of mm. 1-4 of Example 4.1, where the four-bar phrase contains its cadence (in m. 4). In both instances there is no metric overlap, although in Example 4.11 it makes sense to speak of an overlap of rhythmic groups. Considerable confusion has resulted in the theoretical and pedagogical literature from failure to distinguish between a four-bar phrase that contains its cadence in the fourth measure,

Example 4.11. **Mozart, Piano Sonata in C Major, K. 279, first movement, mm. 1-8**

a four-bar phrase that leads to a cadence chord at the beginning of the subsequent phrase in the fifth measure, and a four-bar phrase that contains its cadence in the fourth bar but metrically overlaps that cadence with the beginning of the next phrase.

Example 4.12 is a passage that includes metric overlap, contraction, and extension. How does the example's hypermeasure come to contain 17 measures, rather than the "normal"16? The passage seems to begin like a regular eight-bar phrase pair, but then mm. 9-12 are not sufficiently differentiated from mm. 5-8, nor are they sufficiently similar to mm. 1-4, to function as the start of a second eight-bar hypermeasure. Rather, mm. 1-12 function as a three-

Example 4.12. Beethoven, Sonata No. 8 in C Minor, opus 13, *Pathétique,* third movement, mm. 1–17

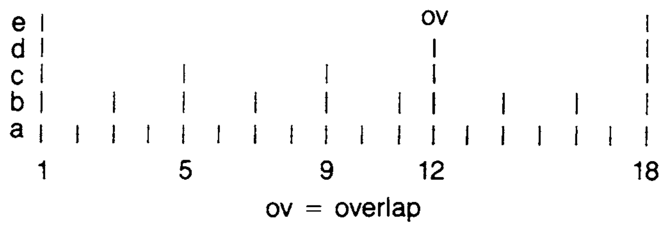
beat hypermeasure. It is better to think of mm. 1-12 as an extended eight-bar hypermeasure than as a contracted 16-bar hypermeasure, because the downbeat of m. 9 is not appreciably stronger than the downbeat of m. 5.

A metric overlap occurs at m. 12. In the context of mm. 1-12, the downbeat of m. 12 is relatively weak: It is the weak second beat of the hypermeasure of mm. 11-12, which in turn starts with the weak second beat of the hypermeasure of mm. 9-12, which in turn is (like mm. 5-8) weak with respect to mm. 1-4. In the context of mm. 12-17, however, m. 12 is metrically strong. M. 12 begins a new hypermeasure, with an accent stronger than any heard since m. 1. Since the downbeat of m. 12 coincides with the cadential rhythmic accent of mm. 9-12 (actually, of mm. 1-12), this timepoint is simultaneously a rhythmic and metric accent. Because middleground metric and rhythmic accents in mm. 1-11 do not coincide, the downbeat of m. 12 is particularly articulative because it brings together (temporarily) two accentual systems that have been acting independently. This situation is common where overlaps are found, and for this reason points of overlap are often of considerable importance both rhythmically and metrically.[63] (Notice, however, that Example 4.11 shows a point—the downbeat of m. 5—that is simultaneously a cadential accent and a hypermetric accent, but there is no metric overlap. The effect here is far less emphatic than where there *is* a metric overlap, as in Example 4.12.)

The mm. 12-17 hypermeasure starts as if it is to be an eight-bar unit: The downbeat of m. 16, because of that measure's stable harmony and textural and motivic contrast to mm. 12-15, is considerably stronger than the downbeat of m. 14. M. 16, therefore, seems to be the start of a four-bar hypermeasure that is to balance mm. 12-15. This hypermeasure turns out to be only two measures long, however, rather than the expected four. The anticipated eight-bar hypermeasure is contracted to six measures. On the two-bar level, the hypermeasure in mm. 12-17 has three beats, *contracted from an expected four*. By contrast, the hypermeasure in mm. 1-12 has six two-bar beats, *extended from an expected four*. In a certain sense, therefore, mm. 12-17 *balances* mm. 1-12 (they are both fundamentally eight-bar units, with actual durations altered by contraction and extension respectively), even though the hypermeasure of mm. 1-12 is twice as long (in absolute time) as the hypermeasure of mm. 12-17. It is this kind of balance of unequals, quite common in tonal music, that leads me to question (in Sections 2.11 and 10.1) the perceptual relevance of analyses based on absolute-time tonal proportions.

Example 4.13 summarizes the metric hierarchy of Example 4.12. Notice that the irregularities on levels b and c are subsumed into the deeper-level structure, which is regular.

I must emphasize that the analysis presented in Example 4.13 studies meter, not rhythmic grouping. It demonstrates that meter is not mechanical, but (particularly on middleground levels) flexible. The analysis also shows that it is not necessary to include regularity as a requirement of meter. The metric hierarchy of this excerpt contains hypermeasures of irregular lengths, but nonetheless the derivation of these irregularities from a normative regularity—by means of the operations of extension, contraction, and overlap—is apparent.[64] Theoretically, these three operations can occur on any level, although in tonal music



Example 4.13. **Hypermetric analysis of Example 4.12**

they most often appear as middleground phenomena. Overlaps are most often of one measure, although Benjamin gives a convincing example of a four-bar metric overlap in Schumann's *Kreisleriana,* opus 16, no. 8 (1838).[65]

It should not be concluded that every three-beat hypermeasure in tonal music is a result of extension, contraction, or overlap. It is certainly possible, though less than common, to establish three-beat hypermeasures as normative on some level. Even when a three-beat hypermeasure is exceptional, however, it is not necessarily the result of a transformation of a two- or four-beat structure. In Example 11.10, mm. 1-12 are comprised of three four-bar hypermeasures, each starting from tonic harmony and each characterized by its own texture. There is no suggestion of an extended eight-bar hypermeasure or a contracted 16-bar hypermeasure. The 12-bar hypermeasure simply and naturally consists of three hyperbeats.

In my analysis of Beethoven's Opus 13, third movement (Example 4.13), the important analytic decision is where three-beat hypermeasures occur. Whether they have essential, untransformed lengths of three measures, or whether they arise as extensions of smaller hypermeasures or contractions of larger ones, or whether they are formed from metric overlaps, can be a matter of interpretation.

It is by means of the alternation of two- and three-beat hypermeasures on various hierarchic levels, and by means of the transformations of extension, contraction, and overlap, that meter becomes expressive. In most music it is not rigid, and it is not wholly predictable. Benjamin makes a strong case[66] for meter as deeply artistic, as opposed to being a "tyrant" of barlines or a "straitjacket" of four-measure phrases. He argues "for meter's importance on the basis that, as a way of structuring music's time which is essentially independent of music's events, it allows us to characterize those events as to where they happen and not merely as to what they are in sonic terms."[67]

Although I agree with the importance Benjamin places on meter, I cannot believe that he literally means that meter is "independent of music's events." It is true that, once established in our minds, meter tends to continue unaltered until confronted with musical information that contradicts the metric organization decisively enough to force us to redefine it. But it is music's events that determine meter in the first place, and it is music's events that provide the information that can realign it. To hear m. 12 of Example 4.13 as a strong beat, initiating a hypermeasure a bar earlier than expected, requires strong musical input. We may well ask, therefore: What factors actually create metric, as distinct from rhythmic, accents?

4.9 THE DETERMINATION OF METRIC ACCENT

For this there is no easy answer: music is rarely unequivocal. Lerdahl and Jackendoff offer a series of "rules" that help determine where metric accents are found. Their rules are of two kinds: well-formedness rules, which define possible metrical structures, and preference rules, which suggest criteria by which a listener chooses one possible metric interpretation over another. The Metrical Well-Formedness Rules are:

1. Every attack point must be associated with a beat at the smallest metrical level present at that place in the piece.
2. Every beat at a given level must also be a beat at all smaller levels present at that place in the piece.
3. At each metrical level strong beats are spaced either two or three beats apart.
4. The primary and immediately deeper metrical levels must consist of beats equally spaced throughout the piece. At subprimary levels, weak beats must be equally spaced between surrounding strong beats.[68]

As I have indicated, I take exception to Metrical Well-Formedness Rule 4. I do not believe deep-level beats need to be evenly spaced for meter to exist, if by evenly spaced we mean separated by the same clock-time interval or by the same number of primary-level beats. If Rule 4 is omitted, Rule 3 can adequately prevent situations being construed as metric where no beat pattern is felt. Lerdahl and Jackendoff point out[69] that the omission of Rule 4 is necessary to understand the metrically irregular language of some twentieth-century music, such as that by Stravinsky, in which strong and weak beats are indeed felt but in which it is rare that they are evenly spaced in absolute time. For tonal music, they retain Rule 4 only on foreground levels.[70] In the middleground the rule is not ironclad but is rather a statement of a normative condition, which is frequently violated. It is therefore replaced by a preference rule (Number 10 below).

With the well-formedness rules, Lerdahl and Jackendoff define possible metrical structures, at least for tonal music. Yet, as the authors demonstrate, there may be several candidates for the perceived meter, all of which obey the well-formedness rules. By means of Lerdahl and Jackendoff's preference rules a listener or performer intuits the most appropriate metrical structure from among several correct possibilities. The Metrical Preference Rules are:

1. Where two or more patterns of note durations repeat, they should preferably receive the same metric interpretation each time they are heard.
2. A metrically accented note should be heard early within a rhythmic group, if possible.
3. Beats tend to coincide with the beginnings of notes.
4. Other factors being equal, stressed notes tend to sound on the beat.
5. Strong beats should if possible coincide with the inception of rel-

atively long pitches (whether literally present or structurally implied), durations of dynamic levels, slurs, patterns of articulation, or structural harmonies.
6. Bass lines have a stronger tendency to be metrically stable than do other voices.
7. Cadences should not violate a prevailing metric structure. In other words, if the cadence chord (whether metrically strong or weak) conflicts metrically with preceding music, then the metrical interpretation of the cadence should prevail over the entire passage.
8. Suspensions tend to be metrically stronger than their resolutions.
9. Events that are more stable and more structurally significant tend to be accented.
10. Two-beat, not three-beat, (hyper)measures are normative.[71]

Other than an occasional designation of a rule as strong or weak, Lerdahl and Jackendoff wisely refrain from attempting to establish a hierarchy of importance between the preference rules. Meter would indeed be mechanical if a weighted list of rules could be applied to any passage to discover its unequivocal meter. But music is too flexible and too complex to allow for a "foolproof algorithm"[72] that could be applied automatically to determine meters. It often happens that two preference rules suggest conflicting metrical interpretations. When this occurs, we as listeners or performers rely on our intuitions, which either allow us to make an unambiguous judgment or which tell us to preserve the ambiguity as a valid aspect of the musical expression. In either case, our intuitions are informed by an abundance of information from the piece itself, from our knowledge of its historical context, from our own musicality. It would be impossible to account for all these factors objectively. The beauty and richness of musical meter lies precisely in the impossibility of totally objectifying it. Metric ambiguities, like harmonic and rhythmic uncertainties, are a source of much of music's beauty and depth, and many of its meanings.

Lerdahl and Jackendoff are not the only theorists to attempt a listing of criteria for accent. Lester discusses note duration, pitch change, harmonic change, textural change, entrance of a voice, new register, contour change, dynamics, articulation, and pattern beginning.[73] Berry[74] mentions pronounced change of pitch (particularly when preceded by an upward leap), long note duration, change to a faster tempo, stress accent, change to a more intense timbre or texture, extreme harmonic or tonal change, dissonance, existence of a preceding anacrusis, subsequent closely spaced events that elaborate the accented note(s), primacy in a series of repeated notes, pitch proximity of subsequent notes, surprise, relationship to previous implications, and being the goal of an accelerating process. Taking his cue from Berry, Benjamin[75] lists (and numerically ranks in this provisional descending order) occurrence of a new harmony, start of a long harmony, approach by leap, dissonance, density, and primacy in a series.[76]

The problem with such lists, apart from the vagaries of numerical calculation as a model for human perception, is that they are not based on a clear notion of what accent is. Even when Benjamin discusses "kinds of accent"[77]—accent of "image-shift" (change in some parameter, such as harmony or overall dynamic level), accent of discontinuity, accent of climax, and agogic accent—he does not differentiate metric from rhythmic accents. Certainly all the factors mentioned by Lester, Berry, and Benjamin do affect some kind of accent, but which kind is rarely made clear. Lester emphasizes that metric accents are not the only kind, but his durational accents, textural accents, contour accents, and so forth, are not *kinds* of accents in the same way that metric and rhythmic accents are. Rather, duration, texture, and contour are some of the many parameters in which certain extremes can produce rhythmic, and in certain ambiguous or beginning contexts metric, accents. Lerdahl and Jackendoff's rules for meter (and for rhythmic grouping; see Section 4.10) efficiently separate kinds of accent from factors producing accent. Their rules reflect musicians' and listeners' internal mental processes.

Some psychologists have studied the perception of meter (which they often call rhythm). In a brief overview of their work, Mari Riess Jones indicates that they concern themselves for the most part with only two variables: stress (which they call accent) and duration.[78] In their search for scientific rigor, these psychologists have so simplified each stimulus that it scarcely resembles real music.[79]

4.10 RHYTHMIC GROUPS AND RHYTHMIC ACCENTS

Lerdahl and Jackendoff give separate rules for the delineation of rhythmic groups.[80] Whereas their rules for meter precisely locate metric accents (by definition a hypermeasure starts with its strongest metric accent), the grouping rules describe rhythmically accented timepoints only indirectly. This is because grouping rules delineate the boundaries, not the accents, of rhythmic units. Accents, let us remember, can occur anywhere within a rhythmic group.

Lerdahl and Jackendoff's Well-Formedness Rules for Rhythmic Grouping are:

1. Any contiguous sequence of pitch (or nonpitch) events can constitute a group, and nothing else can be a group.
2. A piece is a group.
3. A group may contain smaller groups.
4. If a group contains part of another group, it must contain all of the other group.
5. If a group contains a smaller group, then it must be partitioned into two or more smaller groups so that every portion of the larger group belongs to one and only one smaller group.[81]

Notice that Rule 4 does not allow for overlap of rhythmic groups, such as those shown in Example 4.11. In order to admit rhythmic (not metric) overlap (and also what Lerdahl and Jackendoff identify as group elision, where part of a rhythmic group seems to be omitted),[82] they introduce the idea of an "underlying grouping structure," which conforms to Rule 4, and a "surface grouping structure," in which the underlying structure is transformed to include overlaps.

The authors' Preference Rules for rhythmic grouping are:

1. Groups tend not to consist of only one event.
2. Notes close together in time, or slurred together, or not separated by a rest, tend to be grouped together.
3. Notes close together in pitch, or in dynamics, or with similar articulation, etc., tend to be grouped together.
4. The factors mentioned in Rules 2 and 3 can combine to produce larger-level group boundaries.
5. Whenever possible, groups at the same level tend to have the same duration.
6. Similar patterns tend to form separate groups.
7. Groups tend to support harmonic stability.[83]

Lerdahl and Jackendoff are not the only theorists to study grouping mechanisms. Since Cooper and Meyer define rhythm as grouping, their book is essentially a study of rhythmic groups on all hierarchic levels. They state their criteria for rhythmic groups clearly in their first three chapters.[84] Lerdahl and Jackendoff's rules are similar to those of Cooper and Meyer, except that the latter omit Well-Formedness Rule 5, with the result that their analyses often lack precision in the definition of structural levels. Cooper and Meyer also do not directly state Preference Rule 5, but it is implicit in their analyses. Overlaps are quite common in Cooper and Meyer's book, because the authors require that a group have either two or three pulses, one and only one of which is accented.

In addition to these (and other) music theorists, some psychologists have attempted to construct perceptually based rules of grouping. Paul Fraisse, for example, suggests a psychological model similar to the theoretical model of Cooper and Meyer.[85]

The slurs in Example 4.12 show my understanding of the rhythmic grouping structure in the first few measures of the finale of Beethoven's Sonata in C Minor, Opus 13. This nested structure conforms to Lerdahl and Jackendoff's rules and to Cooper and Meyer's definitions of rhythmic structure. Notice that the rhythmic groups are more fluid, more variable, and more open to interpretation than the hypermeasures of the same music (Example 4.13).

Lerdahl and Jackendoff define groups only in terms of their boundaries. Rhythmic accents are attributes but not determinants of groups. Taking their cue from Cone, Lerdahl and Jackendoff explain that a rhythmic group has a strong initial timepoint at or near its beginning and another one at the articulation of its cadence harmony.[86] It is impossible to generalize whether a rhythmic group's initial or terminal accent is stronger. Consider a hypothetical 16-bar period, divided conventionally 4+4+4+4. The first rhythmic accent is initiative not only for the first four-bar phrase but also for the first eight-bar phrase pair and for the entire 16-bar period. Thus it is stronger (other factors being equal) than the cadential accent in m. 4. The initiating accent in m. 5, however, is likely to be weaker than the rhythmic accent in m. 8 because m. 8 contains the cadence not only of the mm. 5-8 phrase but also of the mm. 1-8 phrase pair. On the deepest level under consideration (16-measure period in this case), the cadential accent is probably stronger than the initiating accent because of the goal-directed nature of tonal motion and the tonal stability of large-scale, sectional cadences.[87] In other words, while hypermeasures tend to be (there are certainly exceptions) rhythmically end-accented and rhythmic groups tend to be metrically beginning-accented (Example 4.7 shows an exception), the rhythmic accentuation of rhythmic groups cannot be rigorously generalized.

One of the pitfalls in the analysis of rhythmic groups (and the reason why I have concentrated more on meter) is that no one has yet devised a viable method for studying simultaneously sounding groups that conflict. Yet much music is polyphonic. Although polymeter is not particularly common, except in certain fairly recent and quite old music, polyrhythms (by which I mean simply the simultaneous existence of different rhythmic groups in different voices) are pervasive in music. The problem is not so much in delineating concurrent groups—that would be cumbersome on paper but conceptually straightforward—but in explaining how they interact. Is a composite rhythm created? If so, how? Not only Lerdahl and Jackendoff but also Cooper and Meyer are aware of the challenge of polyphonic rhythmic groups, but neither team provides a viable method of analysis. Lester discusses the importance of analyzing "structural polyphony" rhythmically. He offers some useful insights, but he too does not deal with the interaction of different layers, beyond discussing composite patterns of attacks.[88] My Example 4.12 is typical of most rhythmic analyses: The groups delineated are those of the melody, even though the left hand sometimes implies different groupings.

4.11 DEEP-LEVEL METER

Many of the factors that determine which beats are metrically accented work primarily in the foreground. Consider Lerdahl and Jackendoff's rules (listed in Section 4.9), or Lester's, Berry's, and Benjamin's comparable lists of characteristics of accents (also in Section 4.9). Does this mean that meter itself is weaker in the middleground and background simply because leaps, long note durations, stress, dissonant chords, series of repeated notes, pitch proximities, and so forth, are foreground phenomena? Lester would seem to think so,[89] but he falls victim to the "fallacy of hierarchic uniformity."[90] He assumes that a certain structure—meter—must operate in exactly the same way on every hierarchic level. I cannot agree with this argument, however. If there are fewer factors available at deeper levels to create metric accents, then those remaining factors—harmony and tonality in particular, but also texture and timbre—become more critical. Metric accent itself does not suffer because it has but a few large-scale structural determinants. Rhythmic grouping and structural harmony are also influenced by fewer factors on large than on small levels, but they remain thoroughly hierarchic.

When tonality and tonal harmony are also absent, as in much twentieth-century music, then the criteria for large-scale metric accents can become too few to support a multileveled hierarchy.[91] Martha Hyde's well-reasoned account of meter in Schoenberg's twelve-tone music, derived from Yeston's theories, *is* harmonically based and does encompass several hierarchic levels, but her analyses stop well short of truly large-scale metric structures. She admits that "harmonic structure in Schoenberg's twelve-tone music derives from equivalencies that are not well defined as compared to those of tonal music."[92] In my analysis of the first movement of Schoenberg's Opus 19 (Chapter 7), I suggest that hierarchic meter gradually emerges as the music unfolds. In the first movement of Webern's First Cantata (also analyzed in Chapter 7), the unambiguous metric cues are too few to create even a clear surface meter, let alone a hierarchy.

Would a hypermetric analysis (like that in Example 4.17) of Stravinsky's *Symphonies of Wind Instruments* (analyzed in detail in Chapter 9) be possible? Surely the moments in *Symphonies*, clearly demarcated by discontinuities that produce changes in large-scale harmonies, begin with metric accents of considerable weight. Submoments start with accents of somewhat lesser strength. And, on the surface, there is surely an alternation, though far from regular, of strong and weak beats.[93] (A foreground analysis of rhythmic grouping, on the other hand, might start from the cells delineated in Chapter 9.) But what about the deeper levels? Are the moment-commencing metric accents organized into patterns of weak and strong? Surely not in music unequivocally cast in moment time, such as some of the works of Messiaen and Stockhausen discussed in Chapter 8. But even with the Stravinsky *Symphonies*, there are few factors that give greater accentual strength to some moment initiatives over others. That would be contrary to the nature of moment time. Not even the return of old material creates deep-level articulation, because it is never preceded by a large-scale anacrusis. The one exception, the one strongest central point at rehearsal number [42], gains its metric strength on the basis of the unusually high degree of change in many parameters at [42] and because of a somewhat anacrustic submoment starting at [41]. But between the level at which there are 20 metric initiatives (beginnings of all the moments) and the level at which there is one (major articulation at [42]), there is no hierarchy of metric strength. Thus there are fewer metric levels in *Symphonies* than in a tonal work of comparable length (see Section 8.3 on the relatively small number of structural levels in moment-form compositions).

In music cast in vertical time, there are still fewer metric levels. Thus much twentieth-century music has foregone the richness of the metric hierarchy that tonality provides, often in favor of complex foreground temporal patterns.

Many theorists do not accept the existence of a metric hierarchy even in tonal music. Of the many arguments against deep-level metric structures, that of Lerdahl and Jackendoff is both representative and intelligent.[94] But I nonetheless disagree with them. Their argument hinges on the concept of metric regularity. They question whether, at large levels, a "listener senses a regular alternation of strong and weak beats."[95] Whether or not a listener perceives this "regular alternation" depends on what we mean by regular. I feel that Metric Well-Formedness Rule 3 plus Metric Preference Rule 10 provide sufficient regularity for the sensation of meter. If we almost always feel one (preferably) or two weak beats between successive strong beats at some level, then our expectations are closely defined and generally fulfilled.[96] It may be possible to have one-beat hypermeasures at large levels—as, for example, when a contraction makes (2+2)+(2+2) into (2+2)+(2+1)—but still the repertory of hypermeasures is limited: virtually all hypermeasures contain one, two, or three beats.

Lerdahl and Jackendoff fortify their argument against deep-level meter with an analysis of the opening of Mozart's Symphony No. 40 in G Minor, K. 550 (1788), a work to which they return throughout their book (see Example 4.14). This passage is undoubtedly irregular, but that is no reason to conclude that meter does not function on its deeper levels. Furthermore, the authors' analysis is marred by what I see as a confusion between rhythmic and metric accents. They argue for two-bar hypermeasures, at least through m. 9. When looking to the next largest level, they ask which of the downbeats in odd-numbered measures receive greater metrical accent:

> Should the beats at this level be placed at the beginnings of measures 1, 5, and 9, or at those of measures 3 and 7? The cues in the music conflict. The

Example 4.14. **Mozart, Symphony No. 40 in G Minor, K. 550, first movement, mm. 1-23 (simplified)**

> harmonic rhythm supports the first interpretation, yet it seems inappropriate to hear the strongest beats in each four-bar theme-group (measures 2–5, 6–9) as occurring at the very end of those groups (the downbeats of measures 5 and 9). Rather, the opening motive seems to drive toward strong beats at the beginnings of measures 3 and 7. We incline toward this second interpretation.[97]

As Lerdahl and Jackendoff themselves imply, meter does not drive toward metric accents. Metric beats are points in time that do not "belong" with or group themselves with stronger metric beats.[98] Music drives toward rhythmic accents, not metric accents (unless, of course, the two coincide). And grouping is far more a rhythmic than a metric phenomenon. Therefore, the downbeats of mm. 3 and 7 of the Mozart symphony are indeed accented, but as rhythmic pulses, not metric beats. The metric strong points occur at the downbeats of mm. 1 and 5.

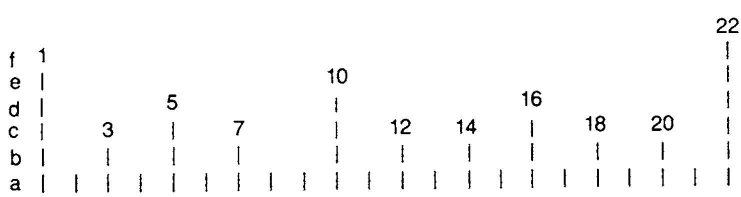
We expect, furthermore, a metric accent at the start of m. 9, and we tentatively experience it. But, while m. 9 is still in our short-term memory (the horizon of our perception of the present; see Section 11.12) we are forced by the harmonic and motivic changes at m. 10 to hear the downbeat of m. 10 as metrically strong.[99] M. 9 becomes weak in retrospect. Therefore, the hypermeasure beginning in m. 5 lasts five, not the expected four, beats. More precisely, that hypermeasure is subdivided into two smaller hypermeasures (mm. 5-6 and mm. 7-9), respectively two and three beats long.

Thus a regular four-bar hypermeasure seems to be created in mm. 10-13. We expect a new hypermeasure (on the four-bar level) to begin at the downbeat of m. 14. The eventual V chord, however, lasts six measures, from m. 16 through the end of m. 21, making mm. 16-21 one hypermeasure. Thus we must interpret mm. 14-15 as moving toward m. 16. Mm. 14-15 are necessarily part of the hypermeasure that starts in m. 10 (which, therefore, has three hyperbeats), and the arrival on an extended V in m. 16 is metrically (as well as rhythmically) strong. The three-beat hypermeasure of mm. 10-15 is therefore answered by the three-beat hypermeasure defined by the V chord, mm. 16-21.

The next metrically strong timepoint is the downbeat of m. 22, where the harmony returns to i (the downbeat of m. 21 is a passing harmony within a prolonged V) and the opening theme is relaunched. The situation is accentually different from that at the beginning, however, where the I chord begins in m. 1 (corresponding melodically not to m. 22 but to m. 20). M. 22 is a particularly strong arrival because the metric and rhythmic accents, out of phase by two measures at the opening, now coincide. The downbeat of m. 22 thereby becomes the strongest timepoint thus far in the piece. Despite their thematic nature, mm. 1-21 function like an introduction.[100] They are a large-scale anacrusis to the very large metric (and rhythmic) accent at m. 22.

These analytic remarks are summarized in Example 4.15.[101]

The chart in Example 4.15 shows that only in a restricted sense is the metric hierarchy of this passage irregular. Every hypermeasure contains either two or three beats. Two-beat hypermeasures are normative. There are actually only three three-beat hypermeasures: on level b, mm. 7-9, and on level c, mm. 10-15 and 16-21. All other hypermeasures contain two beats. If meter is conceived as a pattern of alternating strong and weak beats, in which there are usually one or two weak beats between successive strong beats at each level, then this passage is indeed metric on all levels.



Example 4.15. **Hypermetric analysis of Example 4.14**

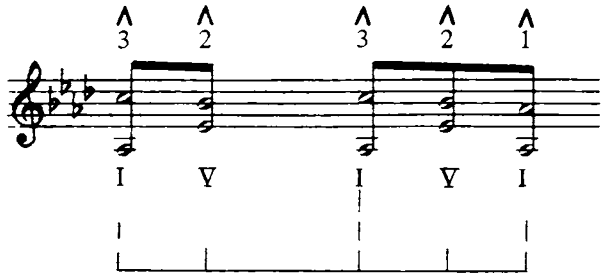
Lerdahl and Jackendoff remark that the large levels of metrical analysis are "open to interpretation whereas the smaller levels are not."[102] There are certainly some instances in tonal music where low-level barlines seem to be shifted (audibly, although not usually visibly in the score), instances which are subject to interpretation (see, for example, my analysis of one such place in the first movement of Beethoven's String Quartet in F, opus 135, Section 5.7). More to the point, whether a metrical structure is unequivocal or ambiguous has no bearing on whether or not it is a metrical structure.

The type of metric analysis I have been arguing for depends on our ability to retain metric beats in our consciousness for a few seconds (see the discussion of the perceptual present in Section 11.12) and sometimes reinterpret an understood accentual strength in retrospect. This kind of reinterpretation operates in the Mozart symphony when m. 9 first seems strong and later is felt to be weak on level b, and also on level c when m. 14 initially may seem to have downbeat strength but by m. 18 must be understood as weak. That we retain and possibly revise perceptions in short-term memory before entering them into long-term memory is part of the reason why meter can operate at large levels.

Rather than dismissing large-scale metric perception as "so hypothetical that it would seem wise to give up the attempt altogether,"[103] I suggest that we (or at least I!) really can, and readily do, hear hierarchically in the manner indicated graphically in Examples 4.16 and 4.18. And I believe that we hear on deeper levels as well, up to that of entire movements. Lerdahl and Jackendoff, in dismissing large-scale hearings as nonmetric, ask whether a listener really hears, in a sonata form,

> . . . the downbeat beginning a recapitulation as metrically stronger than the downbeat beginning the development, but metrically weaker than the downbeat beginning the exposition? We argue that he does not, and that what he hears instead at these levels is [rhythmic] grouping structure together with patterns of thematic parallelism, cadential structure, and harmonic prolongation.[104]

I, on the other hand, defend the experience of metrically accented timepoints as quite real at deep levels and as independent of rhythmic accents. In Section 2.4 I argue for a non-Schenkerian understanding of the accentual importance of the tonic after a dividing dominant (for example, the large dominant at the end of a development section) in a so-called "interruption" form (a background archetype is shown in Example 4.16), as compared with that of the final cadential tonic. Many theorists believe that the cadential dominant is decisive in the approach of the *Urlinie* to the final tonic. I would not deny this. As Lerdahl and Jackendoff elegantly demonstrate,[105] the structural dominant is indeed the cadential dominant in most tonal pieces. This is true because cadences are rhythmic, not necessarily metric, arrival points. But in another, equally real, sense the tonic return at the beginning of a recapitulation (where it is not subverted for expressive purposes, as it is in, for example, Beethoven's String Quartet in F Major, opus 59, no. 1, discussed in Section 2.4) is a strong central point, a release of the tension accumulated while the music has been away from the tonic, since (in most sonata forms) the bridge passage in the exposition. In the typical sonata



Example 4.16. **Background structure of a typical interruption form, showing large-scale metric accentual pattern**

form, I consider the start of the recapitulation to be the single strongest metric arrival.[106] This means that the entire movement consists of an anacrusis to a possibly incomplete (unless there is an extended coda) hypermeasure. The strongest rhythmic arrival, by contrast, is at the structural cadence (which may be at, or somewhat before, the actual end). As these two timepoints are not usually even near each other, it becomes evident that metric and rhythmic accents operate independently even on the deepest levels of structure. I do not deny that the start of the recapitulation can be, and usually is, a point of strong rhythmic accent, since the tonic cadence of the development generally overlaps with the initiative metric accent of the recapitulation. But a sonata movement (and many others as well) usually places its *strongest* metric and rhythmic accents at different timepoints. I disagree, therefore, with the frequently encountered maxim that metric and rhythmic structures merge on deep levels. In fact, it is precisely the noncongruence of metric and rhythmic accents, on all levels up to the deepest, that promotes musical continuity.[107]

It may be objected that, while the final cadence and the recapitulation are indeed different, there is no reason to label one a rhythmic and the other a metric accent. I would argue to the contrary. The final cadence really is the goal of the harmonic and melodic motion of the whole piece. It is only at the preceding structural dominant that the *Urlinie* finally descends to the second scale degree, and it is at the cadential tonic that ultimate tonal stability is finally achieved. Therefore, the final cadence is indeed a rhythmic arrival. The return to the tonic after the interruption, however, is a metric arrival. In cases of interruption, the surface details support the underlying harmonic similarity of the opening and the return. Since the piece must begin (on a deep level, after a possible introductory anacrusis) with a large metric initiative, the return will also begin with a strong metric initiative. The subsequent final cadence is reactive to this initiative and therefore metrically weaker, although it may have considerable metric strength on a shallower level.

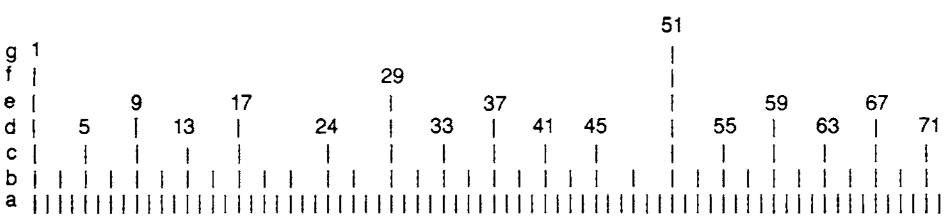
I have argued for the metric strength of the return and for the rhythmic strength of the cadence. Why, though, do I suggest the return as normally the *strongest* metric accent in the piece? Why do I insist that the largest-scale hypermeter is out of phase with the largest-scale rhythmic grouping? Why, in other words, is the beginning of the piece not heard as its strongest metric hyperbeat, thereby making the piece approximately coextensive with a single largest hypermeasure? In most tonal interruption forms, the return is prepared by considerable activity, usually focusing around the dominant. This huge upbeat makes the return an enormous structural downbeat, a tremendous release of built-up tension. The music may well have been away from the tonic for an extended period of time. Therefore the metric accent at the return is stronger than that at the beginning, where there has not been as powerful an anacrusis and where the music has not been striving for as long a time to reach the tonic.

It is possible that in some pieces the strongest metric accent occurs at the beginning, however. If there is a large upbeat introduction, or if the "development" dominant area is understated, then the entire piece can seem to be metrically reactive to the large accent at the start of the first structural tonic.

4.12 METRIC ANALYSIS OF A COMPLETE MOVEMENT

To exemplify these abstract notions, let us look at an entire movement. Although not a sonata form, this piece is nonetheless an interruption form. Example 4.17 analyzes the second movement of Beethoven's Piano Sonata, opus 13. I have chosen this movement because it is not simplistically regular nor complicatedly irregular (for a complete hypermetric analysis of a complex movement, see Example 5.1). Furthermore, Komar[108] offers a multileveled metric analysis of the same piece, and it is instructive to compare our two approaches.[109] Since he takes cadences as *metrically* strong, our points of metric accentuation tend to differ consistently. In other words, he analyzes the phrase structure of the movement so that cadences fall in different hypermeasures from their phrases, while in my analysis entire phrases—including their cadences (but excluding small anacruses, such as the final eighth note of m. 36)—tend to be contained within their hypermeasures. Exceptions occur only where (overlapped) cadences fall on large-scale metric downbeats (mm. 29 and 51).

My disagreement with Komar's insistence on cadences as metrically strong is evident in a place like mm. 36-37. He places a strong metric accent on the downbeat of m. 36, since a large-scale cadence occurs there. But then m. 37, which initiates a new section, becomes weak. Just the opposite conforms with



***Example 4.17.* Hypermetric structure of Beethoven's Sonata in C Minor, opus 13, second movement**

my intuition, and thus my analysis shows m. 36 as metrically weak (though it surely receives a strong rhythmic accent) and m. 37 as metrically strong.

For Komar, the three (equally) strongest metric accents occur at mm. "0," 36, and 66. I find this assertion problematic (although Komar is consistent in deriving these accented timepoints). Surely the cadence at m. 29 (and the similar one at m. 51) is stronger than the one at m. 36, since the music has been away from the tonic chord for a considerable duration. Furthermore, m. 29 is strong because it is delayed by the preceding extensions to three-beat hypermeasures at level b (mm. 21-23 and 26-28) and level c (mm. 17-28). M. 29 returns the music to regular two-beat hypermeasures on all levels. Similarly, m. 51 brings back hypermetric regularity after the three-beat hypermeasures on levels b and d.[110] Also, both m. 29 and m. 51 are simultaneously cadential (rhythmic) accents and metric initiatives. Therefore, strong structural downbeats[111] occur where the tonic harmony returns with a restatement of the opening theme. Large-scale rhythmic accents also occur at the beginning (coinciding with the initial metric accent in bar 1, not bar "0") and near the end (final structural cadence at m. 66, subsequently prolonged by repeated V-I cadence formulas). The latter, however, is not a hypermetric accent. It is metrically recessive despite its strong rhythmic accent.

The strongest metric accent occurs at m. 51, the return of the tonic after a modulatory, quasi-developmental passage. M. 51 is metrically stronger than m. 1 because at m. 51 the music has been away from the tonic major since m. 36, and away from the tonic minor since m. 41. Therefore mm. 37-50 drive toward a tonic return (and a thematic recapitulation). They constitute a structural upbeat, which renders the downbeat at m. 51 very strong. M. 1, by contrast, has no preparatory upbeat to lend it comparable strength.

Why not, then, hear the return at m. 29 as stronger than m. 1? After all, m. 29 is prepared by six measures of dominant, whereas m. 51 is preceded by only a half measure of V^7. The answer is that the music does not really leave the tonic area in mm. 1-28, so that m. 29 is more a continuation of the harmony (or at least the tonality) of m. 1 than a return to it. On the largest level, m. 29 is a repetition, not a recapitulation, of m. 1. Furthermore, m. 1, despite the absence of a preparatory anacrusis, is metrically strong because it is a tonally (and, on shallower levels, metrically) stable beginning.

On the largest level, then, the piece is typical. It is a single rhythmically end-accented rhythmic group. Metrically it consists of an upbeat (m. 1) to the downbeat (m. 51) of a subsequent incomplete hypermeasure. In other words, at the largest level there are two metric beats, one strongly accented (m. 51) and one less strongly accented (m. 1). The situation is analogous to the one shown in Example 4.18.

Example 4.18. **Foreground equivalent of normative background metric structure**

4.13 THE PERFORMANCE OF METER AND RHYTHM

Like most of the theorists cited in this chapter, I believe that accents and hence rhythm can be influenced, if not created, through performance. Cooper and Meyer's book is particularly useful concerning how performance emphasis can affect rhythmic grouping, especially on the foreground. Furthermore, some of the psychologists mentioned here (and in Chapter 11) are beginning to understand the ways in which performers interpret and project accents, rhythms, and meters. There are many questions that still await definitive answers, however.

I have mentioned that performers unavoidably introduce slight variations in pulse, tempo, note duration, stress, and so forth, in their attempts to produce a sensitive, meaningful, and emotionally satisfying interpretation of a composition's temporal structures. Since meter and rhythm are hierarchic, a sophisticated performer must project these small temporal variations simultaneously on several levels—no mean feat, either mentally or physically. The situation is further complicated by the existence of three different types of accent: stress, rhythmic, and metric. A performer readily stresses particular notes, in different ways and to different degrees. Stress accent is not particularly hierarchic, however, and despite the enormous subtlety that some performers are able to bring to it (for example, what pianists call "touch"), it is the most straightforward kind of accent to produce and to perceive. Rhythmic accents are inherent in the music, although a performer can influence their strength and placement, particularly in an ambiguous situation. Metric accents are still more intractable (in part because beats, in contrast to pulses, are intuited rather than heard) though in highly unstable contexts, such as the opening of Mozart's G Minor Symphony (Example 4.14), performer nuance can influence where metric accents are felt. When we consider that there are three distinct types of accent, that two of them operate on many hierarchic levels in most music, and that a performer must interpret all these structures simultaneously, then we begin to glimpse how enormously complex the process of music making can be.

What we do not know is to what extent the three kinds of accent are projected, interpreted, established, reinforced, and/or contradicted by the same means. Do performers use the same kinds and degrees of temporal adjustments for both metric and rhythmic accents? If not, then the question of the mechanisms by which performers interpret accents, as well as groupings and hypermeasures, becomes frightfully forbidding for the analyst. If the mechanisms are similar, however, there remains the question of how a particular nuance becomes channeled to metric vs. rhythmic perception.

We all have heard a performance that is a revelation, that adds new meaning to a well-known piece. Such a deeply moving listening experience depends largely on the performance's temporal parameters (in addition to sound quality and balance), since the pitches, melodies, and harmonies are usually given unequivocally in the score. But *how* do performers communicate musical meaning? It will undoubtedly take many years before psychologists and theorists can offer anything approaching complete answers to the question of how performers do it (although the research discussed in Section 3.5 is most promising). Now that scholars have begun to address such challenging questions, however, their preliminary results make us ever more intrigued to know the full answers.

Being neither a performer nor a psychologist, I am unable to offer any new insights on the performance or perception of meter, rhythm, and accent. But, before we leave this endlessly fascinating topic, it is useful to see how these elements interact—with each other and with the temporal principles of linearity and nonlinearity—in a complete movement of considerable subtlety. Chapter 5, therefore, looks in detail at the first movement of Beethoven's String Quartet No. 16 in F Major, opus 135 (1826).

Chapter 5

Analytic Interlude

Linearity, Meter, and Rhythm in Beethoven's String Quartet in F Major, Opus 135, First Movement

5.1 GENERAL CONSIDERATIONS AND THE OPENING PASSAGE

The first movement of Beethoven's Opus 135 is thoroughly tonal and therefore predominantly linear. Its linearity comes not only from its tonality, however. The music is also concerned with the step-by-step reconciliation of various conflicts. This chapter explores both these conflicts and the movement's tonal structure. Aspects of rhythm, meter, and accent on various hierarchic levels are also considered. The analysis contained herein is not Schenkerian. I leave such a task to those more expert than I. My dependence on vaguely Schenkerian thinking should, however, be obvious.

The movement suggests a neo-classic aesthetic. It looks back to the style of Haydn, but not in an attempt to resurrect the earlier composer's idiom. Beethoven views Haydn's aesthetic not with nostalgia but as an interpreter. He presents a transformation of an earlier era's music. His is a personal and idiosyncratic conception of classicism, much as Stravinsky's was to be a century later. This quartet has its own personality, dependent on yet distinct from tradition. It is, for example, cast in a reasonably traditional sonata-allegro form, but the sonata principle does not determine the structure as completely as it does for Haydn's music (or, for that matter, for most of Beethoven's earlier music). The linearity in this music relies on three procedures that have little to do with sonata form: An initial fragmented texture is gradually and pointedly replaced by continuity; the frequent disagreement between a gesture's implied meaning and its contextual function is reconciled; and hypermeasures of varying length are replaced by predominantly four-bar units.

The movement is virtually lacking in extended foreground lines. Motives and arpeggiated harmonies carry the surface interest. This fragmentation is established in the first two measures. The isolation of the first violin and the ensuing silence in m. 2 introduces a texture of discontinuity. The unexpected cessation of sound after a mere measure and a half suggests a context of interruptions, juxtapositions, and few real melodies. Thus the movement's textures are heard in retrospect as a linear consequence of this halting and discontinuous beginning.

The exposition (mm. 1-57) consists of blocks of material presented in a terraced fashion. Several short, seemingly discrete textures follow one another without transition. The first four measures are devoted to one figure, the next five to another. Mm. 10-14 introduce the *cantus firmus*, as Joseph Kerman calls it,[1] which is a totally new texture. After an unusually strong dominant cadence, another new texture, of striking rhythmic irregularity, is introduced (mm. 17-24). This irregularity is created by the variable placement of the  figure on or off the beat, and by the frequent refusal of the harmony to change over the barline (see mm. 18-19, 19-20, 20-21, and, less obviously, 17-18 and 21-22). The restoration of foreground metric regularity after the cadence in m. 25 makes the ensuing passage particularly stable. M. 25 seems to be a continuation from the structural downbeat in m. 10, which had been interrupted first by the *cantus firmus* figure and then by the metrically and rhythmically unstable passage in mm. 17-24.

The discontinuity in these first measures suggests a rhythm of textural change. Sudden changes of motivic material and texture create a greater sense of movement than does any progression (harmonic, voice-leading, rhythmic, timbral, or dynamic) within a textural block. Surely the change in texture from m. 4 to m. 5, for example, operates on a shallower structural level than that between mm. 9 and 10. Mm. 1-4 and 5-9 are connected in a way that mm. 9 and 10 are not. This is because (1) the motivic material of mm. 5-9 seems to grow out of that of mm. 1-4: The G-A-B-flat grace-note motive of mm. 1-4 generates the starting pitches of the new motive's successive statements in mm. 4-5 in the viola, second violin, and first violin respectively; and (2) The unusual beginning on a delayed (see below) dominant is answered by the several halting approaches to the tonic in mm. 5-9.

5.2 RELATIVE STRENGTHS OF ACCENTS IN THE OPENING SECTION

The accentual structure of mm. 1-2 is interesting, in that it nicely exemplifies the difference between metric and rhythmic accents (see Section 4.6). Which is more strongly accented, we might ask, the downbeat of m. 1 or that of m. 2? A case can be made for both strong-weak and weak-strong interpretations. In support of the strong-weak position, the harmony of m. 1 acts as appoggiatura to that of m. 2. In other words, the ii^4_3 is subsidiary to, and thus serves to prolong, the V^7. The V therefore starts structurally in m. 1, although we have to wait for the harmonic clarification of m. 2 before we understand what the fundamental harmony really is. The appoggiatura-resolution gesture is, by convention, strong-weak. This accentual pattern is disguised by the delay of the cello D-flat by a beat. Had the bass note entered at the beginning of m. 1, the appoggiatura effect would have been blatantly obvious. As it is, however, the strong-weak meaning is veiled.

On the other hand, there is an unmistakable motion in m. 1 leading to the downbeat of m. 2, where the harmony becomes stable and clarified. M. 2 is undeniably the goal of the motion of m. 1. If m. 1 leads to m. 2, might we not reasonably conclude that the progression is weak-strong?

These two analyses are not really contradictory. They seem so only if we make the mistake of comparing two different kinds of accent. The strong-weak interpretation is metric: M. 1 begins a four-bar hypermeasure, of which the downbeat of m. 2 represents the relatively weak second hyperbeat. The weak-strong interpretation comes from a consideration of rhythmic, not metric, accent. M. 2 is a (small-scale) goal of motion and thus provides a rhythmic accent.

Consider now mm. 1-4. This unit is, as just mentioned, a 4-bar hypermeasure, with strongest metric accent (by definition) at the downbeat of m. 1, a lesser metric accent at the downbeat of m. 3, and relative unaccents at the beginnings of mm. 2 and 4. M. 2, however, receives the strongest rhythmic accent, since it is a goal: The motion from m. 3 to m. 4 repeats that from m. 1 to m. 2 and is thus less accented rhythmically. The arrival of m. 4 has less impact because something quite like it has just been heard. M. 4 does have a certain strength, however. The V^7 chord *is* fuller than that in m. 2. All instruments play in this measure and the violin notes are marked *sf*. M. 4 (not just its downbeat timepoint but the timespan of the entire first beat) is undeniably accented, but in neither a metric nor a rhythmic manner. M. 4 contains a stress—an accent of emphasis. Thus mm. 1-4 contain three relatively strong accents, each of a different type and each in a different place.

Mm. 5-9 constitute a five-bar hypermeasure that includes (most of) the consequent phrase that answers the antecedent in mm. 1-4. In a rhythmic sense, this phrase is unmistakably end-accented. The music moves repeatedly to I. Each time it arrives at the tonic, some factor subverts the expected stability, so that it is only with the strong cadence in m. 10 that we feel full root-position accented tonic resolution. Here is the sequence of events: In m. 5 the I chord is heard first in inversion, with root position appearing only off the beat; in m. 6 we hear root position tonic, but the bass F is delayed a half beat; there is no real tonic in m. 7; m. 8 gives us I with a bass note on the beat, but it occurs on the *second* beat and the chord is again inverted; m. 9 gives us a fuller statement of the progression of m. 8, as ii^6 leads to a strong V in preparation for the true cadence; m. 10 at long last presents an accented root-position tonic. This last tonic arrives with a great sense of rhythmic accent, as it resolves the tension accumulated from the false moves to I in mm. 5-8.

But where is the strongest *metric* accent in mm. 5-10? In other words, is the second phrase metrically beginning- , middle- , or end-accented? The preceding paragraph establishes that the phrase is *rhythmically* end-accented, but this fact does not determine the placement of the strongest *metric* accent. If we hear (and perform) the metric accent in m. 5, then we must feel that the dominant of mm. 1-4 goes definitively to I in m. 5 and that the halting moves around I in mm. 5-8 are merely delaying full clarification of the tonic harmony. If, on the other hand, we hear m. 10 as containing the definitive metric downbeat, then we must feel that, on a relatively deep structural level, the dominant of mm. 1-4 is still being prolonged. The first beat of m. 5 would then be harmonically subsidiary to the second beat, and the clear V chords on the second beats in mm. 7 and 9 would be continuations of the dominant harmony established at m. 1 (though clarified in m. 2).

The real question is: Which is metrically stronger, the downbeat of m. 5 or that of m. 10? The answer is somewhat equivocal. The piece can probably be performed either way, although I tend to hear it more convincingly projected with the stronger beat at m. 10. The second phrase, unlike the first, is better treated as metrically end-accented.

Also in contrast to the first, the second phrase spills over into adjacent hypermeasures. The first phrase, lasting from the downbeat of m. 1 to the end of the first beat of m. 4, is contained within the first hypermeasure (mm. 1-4). The second phrase, starting midway through m. 4 and ending at the end of the first beat of m. 10, begins just before the second hypermeasure (mm. 5-9) and ends at the beginning of the third hypermeasure (mm. 10-16). M. 10 can be heard as a structural downbeat, a strong arrival, when performers project metric and rhythmic accents coinciding at its downbeat. This strength is underlined by something of a stress accent, as the m. 10 downbeat is suddenly *piano* after a *crescendo.*

Assuming that m. 10's downbeat is stronger than that of m. 5, we may now ask which is stronger, the downbeat of m. 1 or that of m. 10. Rhythmically, m. 10 is surely more accented, because of the tentative beginning of m. 1 and the sense of arrival at m. 10. Metrically the question is more difficult, however. If m. 1 is stronger, it could be for one of two reasons: (1) The m. 10 tonic is subsidiary on a deep structural level to a prolonged dominant that begins in m. 1 and is still functioning by m. 17; or (2) the dominant of mm. 1-9 functions as an appoggiatura to the m. 10 tonic, much in the way that the m. 1 harmony is an appoggiatura to the dominant of m. 2. The first suggestion cannot work. Where would the initial tonic be established, if not by m. 10? At m. 25? This is unlikely, since the V-I cadence of mm. 24-25 echoes that of mm. 9-10 and could hardly, therefore, be more strongly accented rhythmically. If the C major of the second theme-group, starting in m. 38, were still the initial dominant prolonged, then the piece would be in C major, not F major, clearly a nonsensical suggestion. Therefore, if the m. 10 downbeat is metrically stronger than the m. 1 downbeat, the reason must be (2) above: the V of mm. 1-9 functions as appoggiatura to I, which on a deeper level would therefore be present right from the beginning. Such a suggestion generalizes the appoggiatura idea in terms not only of structural level but also of voice leading. Whereas the chord of m. 1 leads by clear stepwise motion to that of m. 2 and can therefore easily be heard as an appoggiatura, the manner in which the prolonged dominant of mm. 1-9 leads to the tonic in m. 10 does not really suggest traditional appoggiatura-resolution, because of the absence of dissonance-consonance stepwise motion.

It would seem, therefore, that a better analysis would have m. 10 as metrically stronger than m. 1. If that is the case, then the piece begins, on a background level, with a relatively brief V. Mm. 1-9 function as introduction, despite the important thematic content of those measures and despite there being no change of tempo at m. 10. This analysis explains the structural downbeat at m. 10. The effect is like that of a slow introduction, with harmonies straining to reach the tonic, finally going to I at the beginning of an *allegro*.[2] This "introduction" is already at the movement's fast tempo and it includes the only exposition of important motivic material, but its halting gestures have the effect of delaying tonic stability. The downbeat at m. 10, as it happens, is not the start of a continuous exposition. Rather, it is interrupted, first by a brief silence and then by extremely different material.

Together, this interruption plus the definitive gesture leading up to it (mm. 9-10) sound not so much like the end of an introduction as like the end of a movement. The progression, texture, and motivic content of mm. 9-10 suggest a final cadence, despite the fact that the piece has barely begun. Final cadences are generally not metrically strong, at least on a sufficiently deep structural level (see Sections 4.4 and 4.6). The apparent finality of m. 10 is a product of its *rhythmic*, not metric, accent as well as its conventional closing gesture. Thus the cadence seems too strong to appear this early in the piece. We are faced with a disagreement between the implied function of a gesture and its placement within the piece. This is not the only such disagreement. The big half cadence in m. 17, for example, also seems premature. As the music proceeds, such discrepancies are eventually reconciled. In the recapitulation the gesture of m. 109 (corresponding to m. 10) seems more nearly appropriate to its function, because an entire development section, not just an opening nine measures, is coming to a close: M. 109 is a rhythmic accent, a big arrival. When the same music ends the movement, at last we feel total agreement between the implied function and the actual function. Similarly, the recapitulation's m. 121 (corresponding to m. 17) is now a mild deceptive cadence in a tonicized IV, not an exaggerated half cadence to V. The half cadence is eliminated because it had been too emphatic for its proper function. The deceptive cadence of m. 121, by contrast, is thoroughly appropriate for its context. As a result, mm. 121-24 have far less to accomplish than mm. 17-24, which must bring the music back from the falsely stable C-major cadence. Thus mm. 121-24 are far more regular (and utilize a hypermeasure of regular four-bar length) than mm. 17-24. (The linear process of metric regularization is explored further in Section 5.5).

5.3 BRIDGE AND SECOND THEME

Mm. 25-37 constitute a bridge, a passage that is more obviously kinetic than the surrounding textural blocks: Clear-cut motion provides the modulation. As the only real transition in the exposition, the bridge serves to set apart the block-like first theme-group from the somewhat less discrete second group. Not only does the tonal center shift decisively from F major to C major, but also there is a genuine evolution of textures, a procedure decidedly different from the previous (and subsequent) juxtapositions of textures.

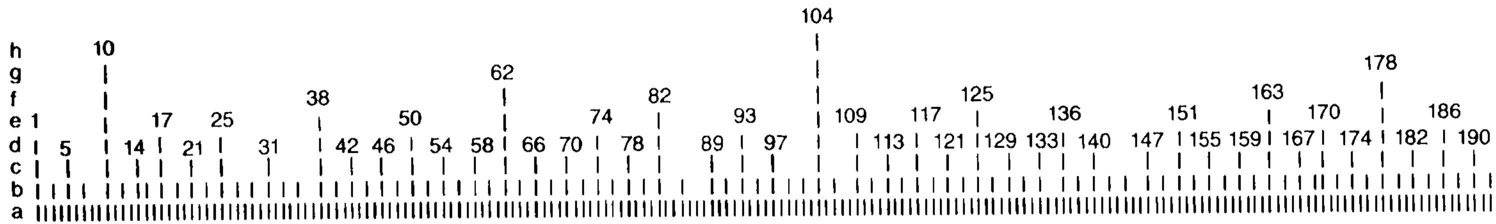
The second theme arrives in m. 38 with a well-prepared structural downbeat. This arrival is more stable than the premature half cadence on C major in m. 17, despite the manner in which Beethoven undercuts the downbeat in m. 38: by elimination of the cello, by the leap of a seventh in the second violin, and by initially omitting the third of the chord. He is divorcing gesture from function (and thereby distancing the music's profiles from its structure, in a thoroughly neo-classic manner). If we listen to mm. 15-17 out of context, we hear what we would expect to function as a strongly articulated cadence *in* C major. In context we understand m. 17 as an exaggerated half cadence *on* the dominant. The arrival in m. 38, on the other hand, is genuinely strong because its dominant preparation lasts nine measures, starting in m. 29. But Beethoven downplays the structural downbeat at m. 38. This understated downbeat compensates for, or balances, the exaggerated half cadence in m. 17. The gesture in m. 17 seems to belong with the structural function of m. 38, while the cadential profile in m. 38 seems appropriate to a half cadence such as that in m. 17.

Although the second theme-group returns to a context of discontinuity, the well-paced bridge passage has its effect: The individual blocks in the second theme are not as independent of each other as earlier, nor are their juxtapositions as sharp. In particular, following the initial stable eight-bar period (mm. 38-45) are a number of discrete textures (mm. 46-49, 50-51, and 52-53). These blocks are not enormously different from each other. This fact, plus the regularity of durations (textures last eight, four, two, and two measures respectively), helps make the second group more stable than the first. This textural and proportional stability is ultimately undermined, however, since the section is in the unstable key of the dominant.

The single block that constitutes the closing theme-group (mm. 54-57) continues the hypermetric regularity of the second group and prepares us, by the near blandness of its repeated C-major cadences, for the jolting deceptive cadence (m. 58) that in turn paves the way for the development section. This cadence seems as if it will reconcile gesture and function: mm. 56-57 seem to be leading to an authentic cadence in C major (the gesture is similar to that in mm. 15-16), now occurring in the "correct" place (end of the exposition). But we are fooled by the "wrong-note" deception in m. 58. Gesture and function have conspired to surprise us. Actually, however, the deceptive "non-cadence" in m. 62 is far more of a surprise.[3] The refusal of the harmony to change across the barline leaves us with a curiously floating, unresolved feeling (reminiscent of the unsettling passage in mm. 17-24). So strange is the nonresolution at m. 62 that the expected hyperbeat (on the four-measure level) is threatened. The expectation of a hyperdownbeat at m. 62, based on previous patterns of four-bar hypermeasures, is strong enough for the downbeat still to be felt, but the utter lack of progression across the barline tries to perpetuate the feeling of hypermetric upbeat. The situation is ambiguous: there are factors pulling toward a hearing of m. 62 as a hyperdownbeat and other factors suggesting it is an upbeat to m. 63. Because of subsequent harmonic changes at mm. 64 and 66, we understand two-bar hypermeasures all the way from m. 38 to m. 82. Therefore m. 62 is ultimately felt as more accented metrically than m. 63.

5.4 MORE ON ACCENT AND HYPERMETER

This ambiguity cannot be adequately shown in a chart such as that in Example 5.1. Furthermore, the strength of meter itself is not constant, and that fact can



Example 5.1. **Multileveled metric structure of Beethoven's String Quartet in F Major, opus 135, first movement**

hardly be shown diagrammatically. Example 5.1 certainly says something about the temporal continuum of the movement, but there is more that it cannot show. Is the large-scale meter as structurally important and as perceptible in mm. 11-24, for example, as it is in the measures following m. 38? In the earlier passage, other elements and ambiguities take our attention away from the meter, which is present but equivocal.[4] The limitation of metric graphs such as that in Example 5.1 is that they are based on binary decisions: The meter as shown is assumed to be of constant importance, and beats are shown, at a given level, as either accented or unaccented. Once such analytic choices have been made, it is all too easy to forget the ambiguities and take the decisions as unequivocal. Such a graph can show one particular interpretation of a work's metric structure, but a chart is no substitute for analytic prose that explicates the subtleties of metric ambiguities (which in turn is no substitute for a performance sensitive to these ambiguities).

Mm. 62-63 are not the only accentually ambiguous passage in the movement. If m. 63 might be heard as a four-measure hyperdownbeat, might not the parallel place in m. 11? The extreme change of texture at m. 11 could seem to initiate a new hypermeasure. The hypermeasures then would be mm. 11-14, 15-16, 17-20, and 21-24: 4 + 2 + 4 + 4 rather than 4 + 3 + 4 + 4, as shown in Example 5.1. If m. 11 is metrically accented, however, what about m. 10? Surely both m. 10 and m. 11 cannot be metrically accented on a deep level, since the timespan between them is simply too short to be assimilated on a middleground level. Hearing m. 11 as a hypermetric downbeat is, therefore, related to how we understand mm. 1-10. If m. 11 is a downbeat, then m. 10 cannot be a downbeat and thus m. 1 (as appoggiatura to m. 5) or m. 5 (as resolution, however tentative on the surface, of the introductory mm. 1-4) must, after all, contain the strongest metric accent in mm. 1-10. If, on the other hand, m. 10 is heard as a hyperdownbeat, then m. 11 cannot be accented. It is perhaps more interesting to savor than to solve this ambiguity. Binary, "either-or" analytic thinking, as I have said, cannot completely elucidate this music's complex metric structure.

The existence of such ambiguities does not mean that all possibilities are equally plausible. A performance demonstrates the choice of one interpretation of a given passage over another, or else it preserves the ambiguity by refusing to project any meter unequivocally.[5] An analysis ideally makes similar decisions. A graph such as that in Example 5.1, like most analytic charts, can show only one interpretation. The choice of what to show is not, however, arbitrary: Example 5.1 represents how one particular listener, having considered various alternatives, tends to hear the piece. I do not mean to preclude different hearings, for myself or others. The chart therefore shows *an* analysis of the metric structure of the movement, the analysis with which I feel most comfortable. But it does not distinguish between unequivocal constructs and ambiguities.

Although many of the decisions reflected in Example 5.1 are explained in Sections 5.2-5.4, several additional remarks are necessary:

1. The four-bar hypermeasure of mm. 85-88 is not subdivided 2+2 (or any other way). Mm. 86-88 constitute an extended upbeat to m. 89. It would be foolish and mechanical to place a metric accent on the downbeat of m. 88, which

begins like a repeat of m. 87 and which is part of a continuous harmony aimed toward m. 89. Cooper and Meyer offer some perceptive remarks on such "extended anacruses."[6] This effect exemplifies what Hugo Riemann calls "*Stillstand*,"[7] what William Benjamin considers a "composed-in *fermata*"[8], and what Arthur Komar labels "bifurcation."[9]

2. The emphatic arrival of the recapitulation in m. 101 does not coincide with a particular strong metric accent. This moment, the climax of the movement, is stressed, but the real metric arrival coincides with the return of the long absent tonic harmony (resolution, not climax) at m. 104.

3. As explained in Section 5.7, mm. 101-4 are more like two measures of 3/4 than three measures of 2/4. Hence the graph shows only two metric beats on the shallowest level from the downbeat of m. 101 to that of m. 104.

4. In the exposition, the strong metric accent is at m. 10, while in the recapitulation it falls not at the comparable place (m. 109) but at m. 104. The opening is so halting that we are not ready to accept a tentative move to I as structural (m. 5). The continuing fragmentation and tension make mm. 5-9 upbeat to m. 10. The recapitulation is quite different, however. The climax at m. 101 resolves back to the dominant by the middle of m. 102, thereby focusing the energy of the development section. The length, clarity, and intensity of the dominant (mm. 97-103) make the move to the tonic at m. 104 a definitive return, despite the momentary first inversion.

5. The downbeat of m. 121 is strong on the four-measure level because that bar initiates a four-measure dominant preparation for the tonic in m. 125.

6. M. 178 is a very strong metric accent, because a long dominant, present from m. 172 if not m. 170 or even m. 163, is at last resolved. This is the final cadence on a deep level and hence a strong rhythmic accent as well. All that remains is foreground prolongation of the final tonic.

5.5 LINEAR PROCESSES

After the extraordinary close to the exposition (mm. 58-62), a repeat is unthinkable. As the music proceeds into the development, it begins to reconcile the exposition's diverse textures. This process of integration begins when the *cantus firmus* is combined contrapuntally with the movement's opening figure, henceforth designated *Motive A*. Triplets from the second theme-group are also used, so that the distinctions between the two theme-groups as well as between the various blocks are weakened. The linear process of integration continues through the development section, and thus the boundaries of the recapitulation's textural blocks do not appear as distinct as those in the exposition.

There is another linear process that runs parallel to this integration of material: the regularization of large-scale meter. When the often irregular hypermeasures of the exposition (especially in the first theme-group) are replaced by more stable patterns in the reprise, the result is greater continuity. Let us trace this process.

Mm. 1-4 are unstable for a number of reasons: (1) the nebulous opening harmony; (2) the fragmentation; and (3) the implied 5/8 meter, as each of the four instruments in turn goes to a prominent B-flat at time intervals of five eighth notes (viola in m. 1, first violin in m. 2, second violin in m. 3, and cello in m. 4). The stability implied by the strong cadence in m. 10 evaporates in the face of continued hypermetric irregularities. The subsequent hypermeasure (mm. 10–16) lasts seven measures, grouped 2 + 3 + 2 (see Example 5.1): Mm. 10–11 arpeggiate vi^7; mm. 12–13 arpeggiate vii^7_o; m. 14, implying I but turning out to be vi, sounds at first like the initiation of another two-bar hypermeasure; but at m. 15 the harmony (and texture) changes, to V^4_3/V, which is sustained for two measures. I tend to hear the rhythmic accent at the downbeat of m. 17 as also a metric accent, because of the lack of harmonic change at m. 18 and because of the motivic consistency of mm. 17-24. But it is also possible to understand the m. 17 cadence as metrically weak, meaning that a new hypermeasure would begin with the downbeat of m. 18 rather than of m. 17.

A hyperbeat at m. 17 provides for subsequent four-bar hypermeasures, suggested by the nearly regular rate of stepwise descent in the first violin line: C (m. 17), B-flat (m. 19), A (m. 21), G (delayed a measure to m. 24). But it is not until after m. 25 that hypermetric regularity becomes unclouded on the two-bar level.

The downbeat that begins the bridge passage (m. 25) thus brings temporary regularity, as standard two-bar hypermeasures emerge unequivocally. A new phrase begins (m. 31) as a regular antecedent, but its consequent is compressed into three bars. Thus the nine-bar dominant preparation for the C major downbeat in m. 38 starts two measures before the end of one six-bar hypermeasure and continues throughout the entire subsequent seven-bar hypermeasure—an unusual, irregular, and unsettling procedure, created by nonalignment of metric and rhythmic accents. Thus the first theme-group and the bridge share the characteristic of seemingly regular metric groupings giving way to irregularities. By contrast, the second theme-group (as mentioned above) is regular, with metric and textural fragmentation always operating in two-, four-, or eight-bar units.

The development section first accomplishes the hypermetric regularization of the *cantus firmus*. Several four-bar hypermeasures (mm. 62-81), are heard. While the striking false recapitulation is somewhat irregular, mm. 89-100 are subdivided 4+4+4. (It is only after we hear mm. 101-4 that we realize that mm. 97-100 do not constitute a complete metric unit on the four-bar level—see Example 5.1). By regularizing the meter in this fashion, the development prepares for the still greater regularity of the recapitulation.

Compare the measure groupings in the recapitulation with those in the exposition. The opening, originally four bars, is telescoped into three (mm. 101-3), as imitation replaces repetition. The situation is actually more complex: two bars of 3/4 (see below). The subsequent passage (mm. 104-9) retains its duration from the exposition, although with a different accentual feeling (see Section 5.2). Thus a total of eight measures (rather than the exposition's nine) precedes the (metrically unaccented) cadence in m. 109. The ensuing *cantus firmus* section now begins with regular four-bar hypermeasures, recalling the regularity of mm. 89-100. The passage from m. 121 to m. 124 has lost its initial surface irregularities (cf. mm. 17-24), with the result that it is far more normal.

The bridge, previously 6+7, has been regularized to 4+4+3; mm. 29-30 are omitted from the recapitulation, resulting in mostly regular hypermeasures that bring the music back to F major for the second theme-group. That group begins (in m. 136) with an eight-bar period, as in the exposition. Now, however, the last two measures solidify the phrase structure by continuing the same texture (compare mm. 142-43 with the corresponding mm. 44-5). Mm. 144-46 are now an extension, necessary for a smooth textural transition. The remainder of the recapitulation follows the exposition closely and regularly. The coda (mm. 178-93) is regular on every structural level.

5.6 HARMONY, CADENCE, AND GESTURE

Let us return to the opening of the movement to consider harmonic movement in relation to the large-scale metric and textural considerations just discussed. As mentioned above, the cadence in m. 10 is strangely final for the completion of an opening gesture. This tonic cadence is achieved with some struggle, as a harmonically unstable situation is finally resolved. The music attempts to cadence no fewer than four times in mm. 5-10, almost succeeding in displacing the barline by one eighth-note beat. Once the struggle is won, the continuation is a surprise. The *cantus firmus* replaces the expected downbeat passage. The interruption continues to m. 25, where another strong downbeat returns us to where we left off in m. 10. In harmonic terms, mm. 10-25 are a tonic prolongation with a strong internal half cadence (m. 17); in gestural terms, m. 25 justifies, in retrospect, the exceptional strength of the early cadence in m. 10.

The premature finality of m. 10 has consequences beyond its relationship to m. 25. This cadence figure is recalled in the false recapitulation (mm. 81-88), in the reprise (mm. 103-9), and in the coda (mm. 185-93). Let us examine each of these places:

1. The quasi-fugal opening of the development section (mm. 62-77) brings the music to a half cadence on the dominant of B-flat (mm. 79-80). (This key, incidentally, is well prepared by the predominance of the tone E-flat in mm. 70, 72, 73, 74, 77, 78, and 79. The emphasis on E-flat is discussed below.) Following this half cadence, there is a false recapitulation (surprisingly early in the development for such a deception) in B-flat major, a key perhaps suggested by the Quartet's opening unaccompanied B-flat. The progression from a first-inversion E-flat minor chord at the end of m. 78 to V of B-flat in m. 79 to I in B-flat in m. 82 recalls the harmonies of mm. 1-5. Mm. 81-83 continue this parallel with their motivic correspondence to mm. 4-6. (Actually, this correspondence begins in m. 78, where the first violin parallels the viola in m. 1.) Beethoven then has the audacity or, as Kerman terms it, the wit to repeat the false recapitulation in the tonic. Although the cadence of m. 10 does not recur here, there is a clear reference to it: Mm. 84-86 constitute another place where there is undue emphasis on the tonic in the "wrong" place.
2. Mm. 103-9 correspond to mm. 4-10. M. 10 is followed by an interruption,

but the *cantus firmus* subsequent to m. 109 is less of an interruption for several reasons: *Motive A* is eventually used in counterpoint to the *cantus*, as in the development, so that there is less motivic contrast with the previous passage; the passage is extended from five to ten measures; and each tone of the *cantus firmus* is associated with a neighbor tone, so that the austere quarter-note motion of the exposition is softened[10] The lessening feeling of interruption following the cadence of m. 109 is in accord with the dramatic structure of the movement away from discrete blocks and toward greater continuity. Thus, the downbeat is not as strikingly interrupted as it is in the exposition, and the subsequent downbeat in m. 125 is, in contrast to m. 25, not a resumption of an earlier arrival. M. 125 marks a hyperbeat at a shallower structural level than does m. 25. Mm. 121-24 contain none of the surface metric ambiguities or strange harmonies that characterize mm. 17-24. Furthermore, this passage in the recapitulation is shorter and is solidified by a dominant pedal. Thus it has an entirely different feeling and function from the corresponding passage in the exposition.

3. The fourth occurrence of the cadence figure from m. 10 is at the end of the movement. At last what has sounded like an ending actually *is* an ending. The well-prepared tonic in m. 178 is followed by a variant of the closing theme (mm. 178-81). Where the closing theme has twice before led to a striking deceptive cadence (V^4_3/ii in C in m. 58 and vii^6_0/ii in F in m. 159), now a different deceptive cadence is heard (m. 182). This strange chord (hardly minor v^6, considering the doubling) reintroduces the emphasis on the note E-flat from mm. 70-79, although in a new manner. The octave E-flats in mm. 184-85 further this emphasis, and, significantly in the light of the development section, the sequel is a return to the false recapitulation in the subdominant (mm. 186-89).[11] How natural it now seems for this music to be repeated in the tonic! Mm. 185-89 correspond to mm. 81-86, with the omission of m. 84 (notice how little must be "fixed" for this omission to work). At the same time, mm. 187-93 correspond to mm. 4-10. There is an overlap of correspondences. The ending brings back the two instances where tonic emphasis seems unusual and, by means of a familiar cadence, reconciles them. A linear process reaches its goal.

Consider now the G major passage in mm. 93-96. Its simplicity and regularity seem to lull us into a complacency that is shattered by the grandiose arrival of the recapitulation (m. 101). Mm. 89-99 are a leisurely textural evolution (reminiscent of mm. 38-45) and hence the passage does not prepare us for an enormous climax, nor should it: The return to the tonic key can hardly be as triumphant as in more typical sonata forms, because (owing to the false recapitulation) it has been only 14 measures since the music was last in F major. Thus the opening of the recapitulation is not in any sense a structural downbeat. This marks the final large-scale conflict between gesture and function in the movement. There is no structural downbeat at m. 101 because:

1. the tonic key has not been long absent;
2. the dominant preparation has not been lengthy;
3. the actual point of arrival is (necessarily, given the way the quartet begins) not on a I chord;

4. the appoggiatura harmony (corresponding to m. 1) arrives an eighth-note early (end of m. 100); and
5. we are in the midst of a dominant prolongation (mm. 97-103).

The confirmation of F major in m. 104 is the recapitulation's structural downbeat, but this arrival, though metrically very strong, is not an emphatic harmonic resolution because the movement never leaves the tonic for very long.

5.7 METRIC INTERPRETATIONS OF *MOTIVE A*

This quartet is a *tour de force* of motivic manipulation, even for Beethoven. As Rudolph Reti has traced the use of motives at some length,[12] I restrict my remarks to a discussion of *Motive A* (first heard in the viola in mm. 1-2). After its initial appearances in the first few measures, *Motive A* recurs in mm. 65-66. Prior to this return, a clear middleground pattern of accentuation is established. Regular four-bar hypermeasures continue, beginning in mm. 62, 66, 70, etc. Each of these downbeats coincides with *Motive A*, presented as weak-strong. Thus the development explores one possible interpretation of the opening (mm. 1-2) conflict between weak-strong rhythmic and strong-weak metric interpretations of the motive (see Section 5.2).

The establishment of *Motive A* as weak-strong in mm. 58-80 continues in the recapitulation (m. 101). A three-bar hypermeasure, mm. 101-3, is actually subdivided $1\frac{1}{2} + 1\frac{1}{2}$, so that the sounding meter is temporarily shifted to accommodate two 3/4 measures.[13] These two "measures" perpetuate the development's weak-strong interpretation of *Motive A* (notice that the violins start on the *second* beat of m. 101). During the appoggiatura 3/4 "measure," there are actually two *A* motives in imitation. The motive in the violins is decisively weak-strong, since it ends with the change of harmony at the midpoint of m. 102. The viola's motive, by contrast, is strong-weak, since it begins with but ends during the appoggiatura harmony. Thus this moment, the climax of the movement, brings the initial ambiguity into the open by overlapping both interpretations of the motive.

The weak-strong version continues in mm. 114-17 and 164-70. In mm. 170-77 there is constant dovetailing of *Motive A*, causing the entire passage to be an upbeat to m. 178. In mm. 182-85 the strong-weak version finally establishes itself. Thus *Motive A* undergoes several metric reinterpretations: it is first heard ambiguously, then as weak-strong, then as both weak-strong and strong-weak simultaneously, then as weak-strong again, and finally unequivocally as strong-weak.

This linear development parallels the movement's progressively increasing regularity, continuity, and agreement between gesture and function. These movement-long progressions give the piece a formal thrust that works quite apart from, even against, its sonata form. While the tonal areas in the movement do make elegant sense and are well prepared, it is just as much the motivic, metric, gestural, and textural progressions that give the music its powerful linear character. It is for this reason that I have called the quartet neo-classic. It uses motives, gestures, and textures typical of Haydn. But Beethoven makes far more of them than his predecessor ever did. Beethoven creates his formal structure with progressions of metrical interpretation, gestural meaning, and textural discontinuity, values that in earlier music supported the melodic and harmonic structure but which, in Opus 135, become the essence of the music. This new usage of traditional materials is what makes this quartet an extraordinarily original statement of the neo-classic idea.

Chapter 6

Beginnings, Endings, and Temporal Multiplicity

6.1 BEGINNINGS AND ENDINGS (AND MIDDLES)

I begin this discussion of beginnings and endings with a truism: Every musical performance starts and, some time later, stops. It does not follow, however, that every composition has a beginning and an ending. Some musics, notably certain non-Western ritual compositions and many contemporary Western art works, seem like arbitrarily bounded segments of eternal continua rather than like closed statements. Although such open-ended music offers fascinating insights into the meanings of time in the societies that produce and utilize them, I want to start with another type of music: that which exhibits closure, which *does* begin and end.

Musical closure is most comfortably associated with tonality. Although some music composed prior to the tonal period does have a high degree of closure, it was only with the emergence of the multileveled hierarchy of triadic tonality that it became normative to end a piece by means of motions on deep structural levels as well as on the surface. The final cadence in a typically pretonal work of Josquin or a partially tonal work of Palestrina does not close off every level of the piece in the manner that the endings in most compositions of Mozart do. Similarly, the posttonal music which exhibits the highest degree of closure is that in which some aspects of tonal thinking still function.

Most music, whether closed or open, contains phrases. As explained in Section 2.12, phrase structure has been the most durable remnant of tonal procedures;[1] only the most extreme music of our century has sought to avoid phrases. Phrases usually have clearly defined beginnings, middles, and cadential endings. The degree to which a composition is closed depends in part on the manner in which successive phrases relate to one another. A composition in which the cadence of one phrase is appreciably stronger than the cadence of a previous phrase is a piece that exhibits a greater degree of closure than one in which each successive cadence is of equivalent finality. A strong cadence tends to close off not only its phrase but also several preceding phrases, thus creating a phrase group. The (on some level) final cadence of the piece is generally the strongest, since it must end the entire work. (It is important to remember that I am not equating strength of cadence with strength of metric accent; see Chapter 4.) Thus closure, like tonality itself, is hierarchical. Nontonal systems of pitch organization (whether pretonal or posttonal) may exhibit some degree of closure, but no music is as richly or unequivocally hierarchical as tonal music. Tonality is not necessarily the only possible system of organization that can completely order a piece, but it is the most thoroughly developed and pervasive example we have. Hence tonal pieces, more than others, demand well-defined beginnings and endings. Satisfaction of this demand has led, not surprisingly, to stylistic conventions of beginnings and endings (although there are certainly beginning and ending formulas in the pretonal literature).

The finality of cadences is an obvious, though surely not the only, nor even the most important, determinant of structural hierarchies in tonal music. There are also degrees of beginning: Does a certain gesture begin just the phrase it starts, or does it function as the beginning of a phrase group, subsection, section, movement, or entire piece? Most importantly, the relationships of the middles of such segments, their areas of greatest instability, determine the multileveled complexity of the hierarchy. Although middles are in some ways more structurally significant than beginnings and endings, they are far less conventionalized and far more piece-specific. Thus it is harder to generalize about them. That is why this chapter concentrates more on beginnings and endings.[2]

The relative finality of tonal cadences depends on rhythmic accent, orchestration, dynamics, performer nuance, textural density, text (in vocal music), and degree of tonal and rhythmic stability.[3] The degree of stability is particularly significant. Composers of tonal music utilize ready-made pitch and rhythm schemata of stability. For example, a carefully prepared authentic cadence on the tonic is far more stable, and hence able to complete music on a larger scale, than an unexpected deceptive cadence in some nontonic key. Terms like "authentic cadence" and "deceptive cadence" are simply names for some of the conventions of tonal music. They are some of the many shapes that serve so often as cadences that they can be heard as such even without reference to their context.

Tonal closure depends primarily on four factors: (1) degree of finality implied by the cadential formula; (2) local stability of the cadential chord as determined by its tonal proximity to its tonic; (3) relationship of the key of the cadence to the key of the piece or movement; (4) rhythmic strength of the cadence. The first of these four factors is independent of context. Consider, for example, the fully orchestrated closing formula in Example 6.1, which anyone even modestly well acquainted with the conventions of tonal music should recognize as an ending.

It is hardly surprising that there are conventionalized beginnings as well as endings. Stock beginnings are fewer than stock endings, because tonal pieces can start almost anywhere motivically, melodically, rhythmically, and texturally; but they all move toward the common goal of resolution and stability. While anything is possible at the beginning, by the end the nature of the piece dictates

Example 6.1. **A typical closing gesture from a romantic orchestral work**

the nature of its ending procedures. These ending strategies are suggested by the piece's internal processes; thus there are many routes to closure. A tonal composition reaches its goal—the return of the tonic as stable—before the actual close. But also, as mentioned in Section 2.4, the tonic must be subsequently extended for a sufficient amount of time for its stability to be felt fully and for the momentum that brought the music to that goal to be dissipated. This prolongation of the final tonic is often rather standard, since the ending must not wander very far from home and must not introduce new twists that would require subsequent development. The actual closing profile is often a stock convention, loosely linked or actually unrelated to the processes or materials of the composition. Some analysts call the transition from strategic ending to closing formula "liquidation":[4] the motivic, melodic, harmonic, rhythmic, and contrapuntal details are gradually simplified as the music moves from the particulars of one piece to the generalities of ending. By the very end only a slight melodic relationship to the preceding music may remain, but no disparity is felt because the liquidation process has been gradual. The purpose of simplification and convention rather than contextual reference at the end is to avoid any implications toward a future which cannot be. Perhaps the most famous example of liquidation is the ending of Beethoven's Symphony No. 5, where the thematic content gradually disappears in a triumphant alternation of tonic and dominant harmonies, followed by reiterated tonic chords and, finally, by a sustained unison tonic note—the ultimate liquidation of a piece in C.

There are more procedures of beginning than of ending, but there are more stock ending gestures than stock beginning gestures. Nonetheless, certain profiles are obviously not good candidates to open compositions. Example 6.1 would hardly do for a beginning. There are indeed typical openings, such as the assertive tonic affirmation known as the "Mannheim rocket" or the gradual growth from nothingness that commences the ninth symphonies of Beethoven (1823)[5] and Bruckner (1894). Even such conventionalized beginnings seem to operate as much by what they do as by what they are. An ending, on the other hand, must announce (first by process and then by profile) that the composition is coming to a close; the ending does not succeed as a process if we have to experience the post-composition framing silence before we realize that the piece has ended.[6] On the other hand, anything heard after the pre-composition framing silence is, tautologically, a start, whether or not it happens to be a conventionalized beginning. Virtually every tonal composition closes with a tonic-affirming profile, whereas works may start away from the tonic. Such pieces seem to be starting somehow in the middle—in the middle of a process of establishing the tonic. There are several works of Beethoven, for example, that, by opening on a nontonic harmony, seem not to be starting at the beginning. Some examples are the first movement of Opus 135; Symphony No. 1 (1800); the Piano Sonata in E-flat, opus 31, no. 3 (1804); and the *Prometheus Overture* (1801). In the last named work the first four measures distinctly suggest the conventional close of an introduction rather than its beginning. After these measures are played, the real introduction starts, with its own typical beginning, and the curious four-bar opening is never again referred to overtly.

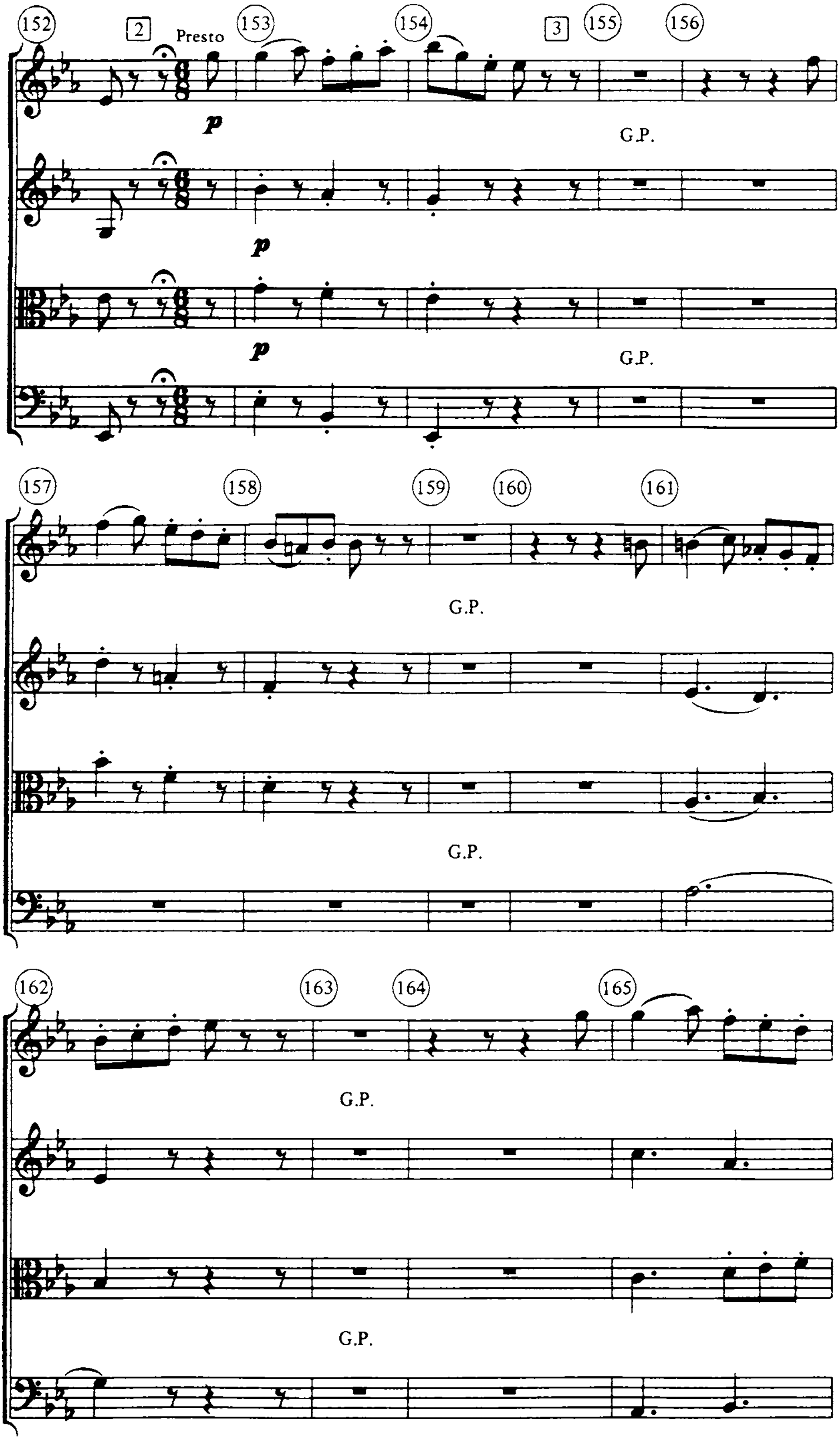
Tonal music also utilizes gestures that sound characteristically like transitions, climaxes, contrasts, and other such conventions. Experienced listeners can recognize these functions even if heard out of context.[7] In fact, a sensitive and well-educated listener hears a tonal composition as an intricate web of conventions, some considerably more subtle than those of beginnings and endings. In particular, certain themes are appropriate sources for subsequent variations; there is a recognizable character for a contrasting theme, even without our knowledge of the music with which it is to contrast; we know a development section by its tonal instability and motivic fragmentation.[8] Many compositions (usually by less than first-rate composers) are nothing but strings of conventions, while some of the more brilliant strokes in the music we value highly achieve their effect against the backdrop of convention. Many witticisms in the music of Haydn, for example, work as unexpected twists of the conventions of style. Anyone who does not know these conventions cannot appreciate the humor.

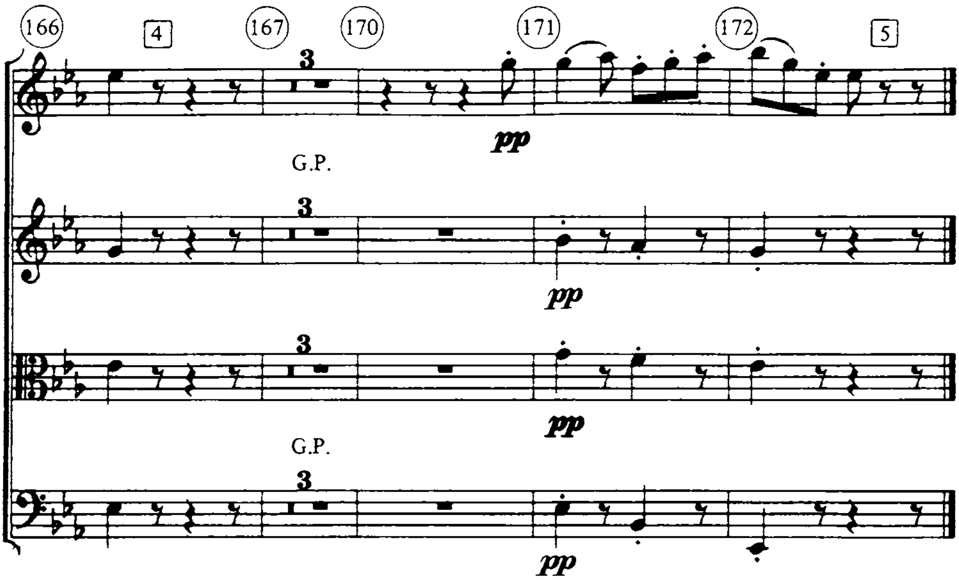
A particularly amusing example is the ending of Haydn's String Quartet in B-flat, opus 33, no. 2 (1782). The composer places so many closing formulas (at least five, numbered in Example 6.2) one after another that we do not quite believe in the finality of the last one until nothing more follows. We realize that the piece has ended not when the sound ceases but rather somewhat later, when

Example 6.2 Haydn, String Quartet in B-flat Major, opus 33, no. 2, last movement, mm. 141–72

Continued

Example 6.2, continued





we fail to hear the expected start of another fragmented phrase. The humor is underscored by the actual final phrase being a figure that has appeared repeatedly as an initiating gesture (see, for example, mm. 141-42 of Example 6.2.). A similar witty ending is found at the close of Antonio Salieri's symphony *Ilgiorno onomastico* (1775).

There are other examples of music that plays on the conventions of ending. Ives' *Over the Pavements* (1913) is a thoroughly dissonant, rhythmically complex piece that unexpectedly becomes tonal and regular for its final two measures, and here the witticism is compounded by the dominant-chord ending. Dvořák's *Carnival Overture* (1891) is an apparently unintentional exaggeration of tonal endings, as the music tries again and again to find a suitably bombastic closing. Stravinsky's *Octet* (1923), on the other hand, ends with a delightful understatement: a single *staccato* tonic chord that seems the equivalent of all Dvořák's overstatement.

A work which plays on the conventions of beginning is Berlioz's *Le Corsaire Overture* (1831). The music starts with a headlong opening figure, which soon dies away, as if the music has come to realize that it has forgotten its slow introduction. The *adagio* is then played. As expected, it leads to an *allegro,* which works its way back to the original opening. Thus the overture really has two beginnings.

6.2 ENDINGS AS PROCESS AND PRODUCT

The conventions of tonal closure allow us to explain musical beginnings and endings in two different ways: by process and by product (or formula, or profile).[9] An ending can be defined as the place where all of the piece's tensions have been resolved, where all its issues are laid to rest, where any threats to the stability of the tonic have been defeated, where the tonic has been achieved on all structural levels (process). An ending can also be the place where we hear a gesture we know by convention to be an ending shape or profile (product). In most tonal music, both a closing process and an ending formula are needed for closure.

In most pieces the ending comes last, whichever way we define it. But it is possible for the two definitions not to coincide. A conventional closing formula can, in some works, be found elsewhere than where the piece stops. The archetypal ending in Example 6.1 does not, in fact, come from the close of a piece. Example 6.3 places it in its proper context. Can this be the close of a piece? For anyone even intuitively acquainted with tonal processes in music, the answer is "no"; the closing profile is in the "wrong" place, tonally and rhythmically. I have heard audiences applaud at this juncture in the finale of Tchaikovsky's Symphony No. 5 (1888). We tend to call such audiences unsophisticated, by which we mean that they (even more than those who miss the humor in Haydn) have not learned the conventions of tonal concert music. (They may, of course, be sophisticated listeners to styles with different conventions.) In context we know that the cadence is on the dominant and hence cannot conclude the piece. Furthermore, the move into the final harmony is too rapid and its dominant too brief (see bracket in Example 6.3) for true closure. The subsequent tonic (not shown in Example 6.3) is the real arrival, the true structural downbeat.[10]

It is even possible to find a cadential formula contextually supported as an ending, even though the music continues.[11] In Carl Maria von Weber's *Invitation to the Dance* (1819, orchestrated by Berlioz in 1841), even sophisticated listeners hear an ending prior to the music's close. The rationale here is not internal to the music, as in the Tchaikovsky example, but rather lies with the story associated with the piece. The work is a grand waltz, which is framed by slower music representing the couples walking to and from the dance floor. Often radio announcers, who presumably know tonal conventions reasonably well, are fooled into back-announcing this piece after the big waltz cadence, thus eliminating the final minute of tonic prolongation.

6.3 BEGINNING AND ENDING AMBIGUITY

Mozart's *Jupiter Symphony* (1788) is a *tour de force* of meaningful manipulation of temporal expectations. We must wait until well into the finale before experiencing the immensely satisfying (because long delayed) arrival of downbeat tonic chords: mm. 20–30 of the last movement toy with tonic downbeats (in a passage that is, significantly, omitted from the recapitulation), but the horns cloud the metric structure; the recapitulation starts, in m. 225, with a subtly understated and thinly orchestrated tonic downbeat; the second theme, now in the tonic key, also starts with an understated tonic downbeat; the second theme, now in the tonic key, also starts with an understated downbeat (m. 272); at m. 292 we at least experience a fully orchestrated, loud, metrically *and* rhythmically accented tonic chord. David Epstein, who has written with considerable insight on the temporality in K. 551,[12] would probably claim, as he does concerning a similar place in the minuet, that the overlap here keeps the music moving and hence renders the downbeat ambiguous, but I find that structural downbeats often occur precisely where there are overlaps that link an extended upbeat to subsequent music which

Example 6.3. Tchaikovsky, Symphony No. 5 in E Minor, opus 64, last movement, mm. 456-71

prolongs (and hence stabilizes) the downbeat tonic. Finally, as the coda draws to a close, we hear a series of accented tonic chords, an occurrence missing since the coda of the *first* movement. The withholding of fully accented C major tonic chords for nearly three movements is an extraordinary means of creating tension, which propels musical motion across the seemingly independent movements of this symphony. The need for downbeat stability is established at the onset of the first movement, by starting each of the first eight-bar or seven-bar hypermeasures with an accented C major tonic harmony. Thus the congruence of rhythmic accent and metric acent becomes a norm in the first movement. There is no stable accented C major chord in the nontonic second movement. The third movement completely avoids accented tonics, as does much of the finale. The eventual return of accented C major tonics brings the symphony to a triumphant conclusion, and this sense of triumph can be understood fully only if we take account of the establishment, then avoidance, and finally reaffirmation of tonic structural downbeats.

How does the third movement, despite its adherence to C major and its frequent unequivocal cadences, manage to avoid structural downbeats? The manner in which the trio does this is instructive: The music cleverly plays on an ambiguity between closing profile and opening process. The trio starts with a simple statement of an archetypal ending—a V-I cadence (bracket B in Example 6.4).

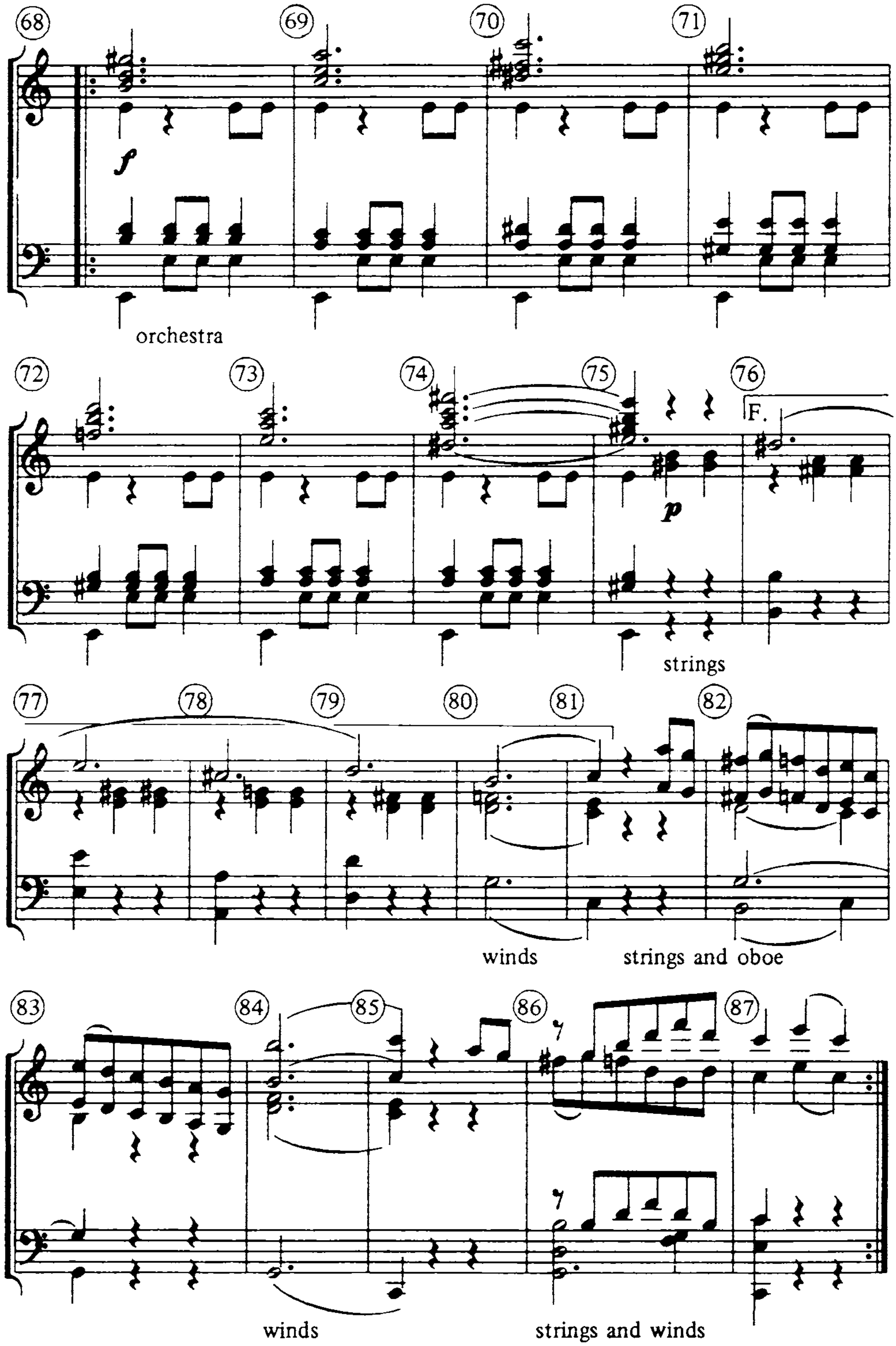
The accentual relationship of these two chords is strong-weak (from the hypermeter established in the preceding minuet). This relationship neither supports nor contradicts hearing the progression as a cadence. It is the convention of V-I, not its accentual pattern, that suggests closing.[13] The relative unaccent of the tonic in m. 61 is perfectly consistent with the harmony and with the simplicity of the figuration. These elements conspire to declare unequivocally that these two measures are a conventional ending.[14] An ending to what, though? Since the minuet has just closed, this progression is heard as a harmonic reiteration of the minuet's final cadence (bracket A in Example 6.4). Mozart's decision to cast the minuet and the trio in the same key makes this reiteration possible. But, as the music continues (bracket C in Example 6.4), we hear what seems to be the phrase whose ending we have just experienced. This paradox—first the ending, then the phrase—is further confused by the return of the ending (bracket D in Example 6.4). Is it functioning now as reiteration of the initial cadence figure (bracket B), as the real ending to the phrase just heard (bracket C), or as the start of the next phrase (bracket E)?

The answer is that it functions in all these ways. Furthermore, the delightful ambiguity Mozart has created is not yet to be resolved; there are still more games to be played. As the trio continues, we hear the cadence profile again and again (note the repeats in Example 6.4), so that we never become sure of its function as a phrase ending or beginning. Later on, the irony increases when the cadence gesture comes as a circle-of-fifths sequential outgrowth of a small developmental passage (bracket F). It functions simultaneously as the ending of the development and the beginning of a return to the trio's opening. The harmony and counterpoint follow smoothly and logically; it is only the change of instrumentation from strings to winds, plus the attendant slight change of figuration, that underlines the recapitulatory function of the cadence profile. A thoroughly charming passage![15]

Example 6.4. Mozart, Symphony No. 41 in C Major, K. 551, *Jupiter*, third movement, mm. 52–87

Continued

Example 6.4, *continued*



Another example of beginning-ending ambiguity can be found in the A Major Fugue from J. S. Bach's *Well-Tempered Clavier,* vol. 1 (1722). The opening is ambiguous: a single short note (see Example 6.5). Surely this is not a typical opening gesture, especially for a fugue. Perhaps that lone note is a closing gesture, although a single tone is probably not a gesture at all. It is followed by silence, which serves to heighten the ambiguity. The subsequent figure seems already to be the upbeat to the countersubject, which in the next measure simply

Example 6.5. **Bach, Fugue No. 19 in A Major, from *The Well-Tempered Clavier,* vol. 1, mm. 1-10**

continues the figure. Does this mean that the fugue subject is a single note? As the remaining voices enter, we come to accept the single note as a beginning, although its strangeness never disappears. Eventually the expected happens: In m. 9 the single note serves as the cadence to the preceding phrase (bracket A in Example 6.5). At last its potential as a closing is realized, but here, as elsewhere in the fugue, it has a double function. That single cadential note also initiates the next statement of the subject (bracket B in Example 6.5).

6.4 STARTING WITH AN ENDING: BEETHOVEN'S OPUS 135 REVISITED

An ending gesture placed elsewhere than at the close of a piece can be a clever play on listeners' expectations, as in the works of Tchaikovsky, Weber, and Mozart discussed earlier. Placing an ending formula at or near the beginning (as in the Bach example) may be more than a witty exercise. Such a compositional strategy can also have profound consequences for the way a piece unfolds. To be presented with an ending gesture at the very outset of a piece can be disorienting. We are faced with the incongruity of a gesture that seems nonbeginning in function yet is heard first. The development and possible resolution of such a disorientation can become a major force in the work.

Janet Levy discusses the structural consequences of starting with a closing gesture in Haydn's String Quartet in B-flat Major, opus 50, no. 1 (1787).[16] This work begins with an archetypal ending (actually used, Levy demonstrates, as an ending in the same composer's Symphony No. 89 in F Major of 1787). She shows that the refusal of this gesture to behave as an ending generates much of the movement's rhetoric.

In a similar analysis, Leonard Meyer shows how the slow movement of Haydn's Symphony No. 100 in G Major (1794) begins with a typical ending gesture.[17] This figure is actually used to close the third movement of Haydn's String Quartet in B-flat Major, opus 64, no. 3 (1790), and is also used cadentially in the minuet of Mozart's Symphony No. 40 in G Minor, K. 550 (1788). In yet another study, Meyer discusses the implications of the appearance of a final cadence gesture near the beginning of Haydn's Symphony No. 97 in C Major (1792).[18]

Let us return to the first movement of Beethoven's String Quartet, opus 135, to consider the consequences of the finality of m. 10. In Section 5.6 I explained this apparent closure as a prematurely strong cadence, as a downbeat interrupted by the subsequent change of texture and then resumed in m. 25. But it is possible to understand this phenomenon in a different manner. As I stated in Chapter 5, the cadence in m. 10 has the *gestural impact* of a *final cadence*. It feels like, and has the shape of, an ending. In a certain sense, then, *it is the end*. Only in the moment-to-moment succession of events that I have been calling "absolute time" do mm. 1-10 constitute an opening. There is another kind of time, identified not with literal succession but rather with the functions of musical gestures. Heard in what we might call this "gestural time," the movement *actually ends* in m. 10, because m. 10 is where we hear the profile of the final cadence. We subsequently proceed (in absolute time) to learn the content of the movement that has just "ended" (in gestural time). Despite the final cadence recurring in mm. 104-9 and 188-93, mm. 5-10 do close off the movement.

Absolute time, as theorist Judy Lochhead points out,[19] is Newtonian time: a linear succession of now-moments. Absolute time is measurable, whether by beats, pulses, or seconds.[20] We can think of amounts of absolute time, of durations in absolute time. As a quantifiable linear succession, absolute time is comprehended in the left hemisphere of the brain (see Section 1.2). Gestural time, on the other hand, depends on our recognizing the shapes and hence understanding the implied meanings of gestures. Gestural time depends on qualities inherent in entire gestures but not in the individual notes and durations that make up those gestures. Thus gestural time is more holistic than syntactical, and it is therefore processed in the right brain. Since both hemispheres of the brain can operate simultaneously, we can perceive both gestural and absolute time at once. Since the two hemispheres do communicate, it is entirely reasonable to suggest that many of the tensions of certain tonal compositions come from the apparent contradictions between their two kinds of time.

Lochhead provides a useful analogy for the difference between absolute and gestural time:

> After rising, one usually eats breakfast. This meal may include coffee, eggs, toast, etc. The act of "eating breakfast" is usually associated with the morning, but it is possible to "eat breakfast" at any time of day. The phrase has two meanings here. First, it may mean eating a meal in the morning [absolute time]; second, eating the types of food associated with the morning meal [gestural time]. The sort of meaning which is determined by and strictly tied to temporal place-context . . . [is exemplified by] "eating breakfast" in the morning, no matter what is actually eaten; that which can be separated from its original and defining temporal place-context while still retaining part of its original significance . . . [is exemplified by] eating the foods associated with the morning no matter what time of day.[21]

My strong suggestion that there is a sense in which the ending of the first movement of Opus 135 occurs in m. 10 is possibly a quirky idea. It questions the very meaning of musical continuity, and it directly postulates a multiple temporal continuum, the multiply-directed time described in Section 2.9. As I suggest in that section, a redefinition of temporal continuity (even in tonal music) is strongly implied by contemporary cultural values, and thus hearing Opus 135 in multiply-directed time can be appropriate today. I am not claiming that goal-directed notions of musical continuity are dead. In most tonal music we still hear agreement between the formal implications of absolute time and those of gestural time. However, just as the continuity in modern temporal arts is of a very different order from that in classical art, so multiple modes of experiencing tonal music are providing a meaningful alternative to our traditionally well-ordered and, in a sense, nostalgic time experiences.

The closing profile of m. 10 recurs in mm. 104-9 and 188-93 (the absolute-time close), yet I am still calling m. 10 an ending. Why? Is it not sufficient to say that mm. 5-10 and 104-9 anticipate the real close of the movement? The gesture of mm. 5-10 is too final to be simply an anticipation; the impact of m.

10 is too great to dismiss as a foreshadowing. Rather, the movement has three endings; or, more precisely, the movement ends three times, always using the same cadential gesture. The three closing gestures do not refer to, or repeat, one another but are precisely the same moment (in gestural time) experienced thrice (in absolute time). Each successive time this closing profile is heard, the listener has acquired more information about just what is being ended. Conversely, each time the ending gesture itself contains less information, since it is better known. By m. 188 the entire content of the movement is known, and the cadence is (in information-theoretic terms, as explained in Section 2.2) virtually redundant. Only a few details are new, to underline the ultimate finality created by agreement (at long last) between absolute time and gestural time: a fuller and somewhat differently distributed orchestration, a touch of subdominant harmony at the end of m. 189, a fermata in m. 191, and a third in the final chord (resolving the arpeggiated B-flat in m. 192). These changes make the last ending more final than the previous two but do not alter the essential identity of the three closing gestures.

Implicit in my separation of function from placement of gestures is an absolutist view of function. The conventions of traditional music are so well defined that absolute, or inherent, meanings are associated with various profiles. These meanings interact with context. I am not saying that we ignore context, but only that there are two separable aspects of gestural function. M. 10 is not *simply* an ending, not *solely* an ending. The tension in this quartet opening comes from the disagreement between the inherent function of an ending gesture and the fact that it is encountered in a beginning context. The difference is between time as used (absolute time, governed by the inevitability of succession and the syntax of tonal progression) and time as portrayed (gestural time, as suggested by inherent temporal functions of gestures). This difference is somewhat similar to that in narrative film between time used (the literal frame-by-frame sequence of events) and temporal order and pacing of the events within the plot (see Section 1.2 on time taken vs. time presented or evoked).

Lochhead suggests[22] that the absolute-time close (mm. 188-93) is equivocal, because we remember that we have heard the closing profile near an absolute-time start (in mm. 1-10). The closing gesture also appears near the *beginning* of the recapitulation (mm. 101-9). Thus, by the third time it is heard, its previous placement near a start is remembered and we cannot completely accept its finality. Lochhead's basic point is a good one: Gesture and its temporal placement may be separable, but they do not function in isolation. Our memory of gestures at odds with their absolute-time placement influences our subsequent understanding of these same gestures when they recur in new contexts. Thus the temporal meaning of a gesture is influenced by its absolute-time placement(s) in context.

A further instance of multiply-directed time in this movement is the central climax (mm. 101-3), which is prepared by no fewer than three separate upbeat passages. This surprising climax is too large, too emphatic, to be a consequence only of the transition leading directly to it (mm. 97-100). It *is* adequately prepared by other upbeats (rhythmic more than metric), placed elsewhere in the (absolute time of the) movement: mm. 62-79 (see Example 6.6) and mm. 163-75 (see

Example 6.6. Reconstruction of Beethoven, String Quartet No. 16 in F Major, opus 135, first movement, showing first upbeat leading (in gestural time) to central climax

Example 6.7).[23] Although in absolute time one of these upbeats far precedes the climax and another comes considerably later, in gestural time all three upbeats lead *directly* to the climax.

Lochhead objects that, although the upbeats shown in Examples 6.6 and 6.7 are open and thus seem to be leading somewhere, there is no reason to hear them as leading specifically to the central climax.[24] I agree that it is possible for a passage to be moving toward a goal which never appears in a piece. But in Opus 135 the upbeats in mm. 62-79 and 163-75 connect so smoothly (in terms of pacing, voice leading, harmony, and instrumentation) to mm. 101-3 that we can indeed understand the implied gestural connections of Examples 6.6 and 6.7 as underlying continuities. We feel mm. 61-79 and 163-75 as upbeats, because they lead somewhere; we hear mm. 101-3 as an insufficiently prepared rhythmic accent. Thus we can make the associations shown in the examples, by means of cumulative listening (see Section 2.7).

As explained in Section 5.5, m. 25 resumes the interrupted downbeat of m. 10. This is equivalent to saying that, in gestural time, m. 9 leads directly to m. 25 (see Example 6.8). That m. 10 is continued by m. 25 does not contradict my assertion that the movement ends in m. 10. The first theme-group contains a delightful paradox: An ending gesture *near the outset* is *followed* by an interior arrival. This paradox establishes a context of multiply-directed time, in which it is fitting to encounter three upbeats to a single climax and in which a final cadence can be experienced thrice. In addition, the paradox tells us that the movement's gestural time is circular. Once the end is reached, we find ourselves back in the middle. Furthermore, since mm. 104-9 and 188-93 contain the same gestures as mm. 5-10, m. 25 continues m. 109 and m. 193 as well as m. 10!

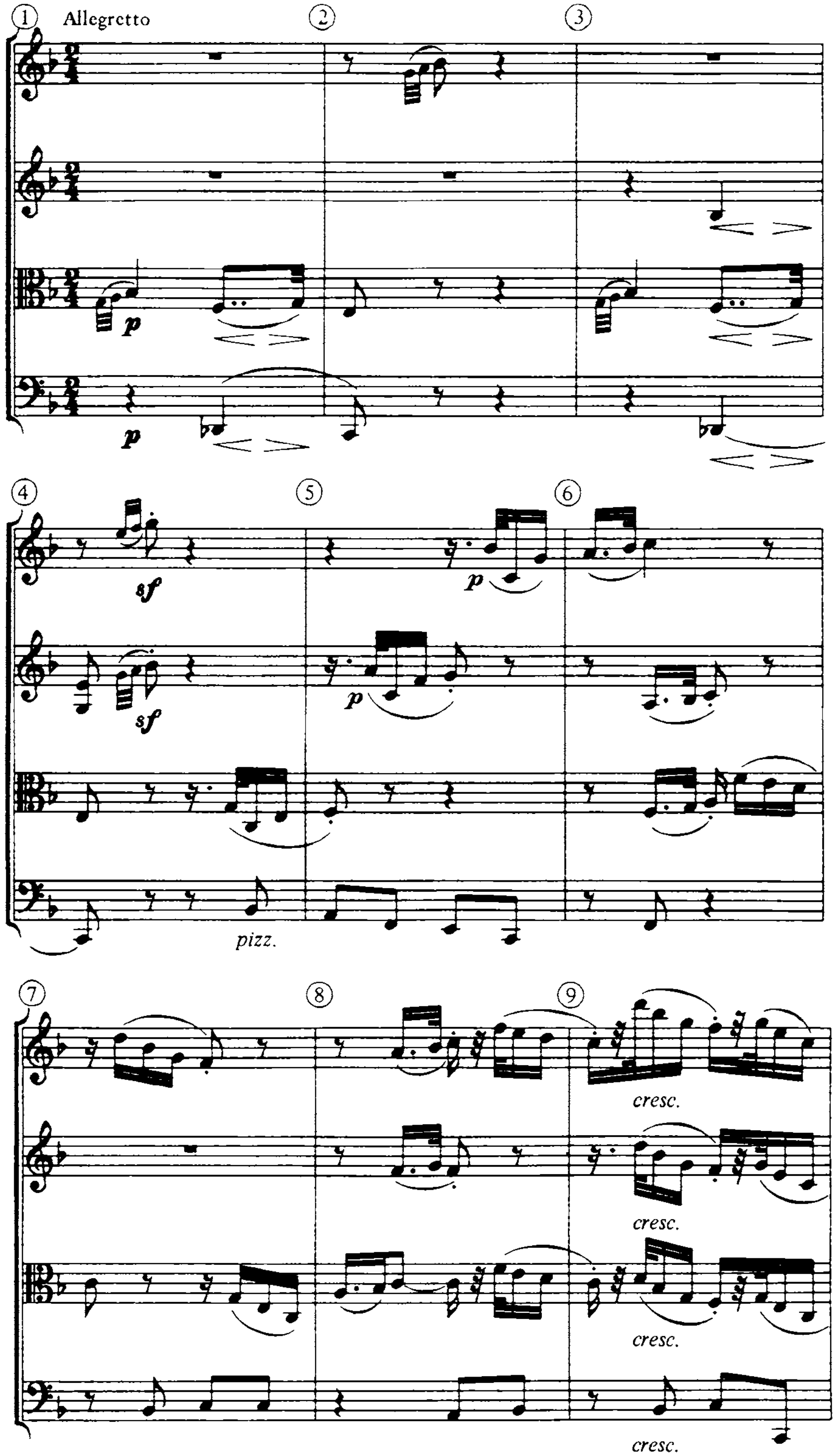
Appropriately, this multiply-directed movement contains a second continuity intertwined with that shown in Example 6.8. The *cantus firmus* in mm. 10-14 is a section-commencing profile. Example 6.9 traces in gestural time the passage this profile begins.

Example 6.9 is neither earlier nor later than Example 6.8. As explained in Section 6.5, the earlier-simultaneous-later qualities of events can, in music, be separated from their past-present-future qualities. The latter may be determined by gestural shape while the former depend on the order in which the events are heard (in absolute time). Thus Examples 6.8 and 6.9 represent different time frames, each progressing from its own past to its own future, without either time frame being earlier than, simultaneous with, or later than the other.

As mentioned in Section 5.2, the dominant cadence in m. 17 is an exaggerated half cadence, mm. 10-17 being antecedent to a disguised consequent (mm. 17-25) that realizes overtly the harmonic implications of the *cantus firmus*. This exaggeration occurs because mm. 15-17 sound, out of context, like a strong arrival *in* C, not *on* C as V in F. In absolute time this arrival happens too soon: The music is not ready to modulate to C yet. Gesture, however, need not bow to absolute time. "Too-soon-ness" arises from the disagreement of gesture with the seeming dictates of absolute time. Mm. 15-17 seem to be leading to a stable section in C, not to a transition back to the tonic in F, as happens in mm. 17-25. Not by chance, there *is* a stable C major section: the second theme group, which begins in m. 38. Thus, in gestural time m. 16 leads not to m. 17 but to

Example 6.7. Reconstruction of Beethoven, String Quartet No. 16 in F Major, opus 135, first movement, showing third upbeat leading (in gestural time) to central climax

Example 6.8. **Reconstruction of Beethoven, String Quartet No. 16 in F Major, opus 135, first movement, showing first continuity in exposition**



m. 38 (see Example 6.9). In absolute time the second theme does not begin with the usual definitive arrival, but rather the music slips into C major (mm. 31-37). Thus, in gestural time, the preparation for the downbeat of m. 38 is mm. 15-17, not mm. 31-37.

The figuration in mm. 38-45 gradually evolves toward the predominance of triplets, which is established finally in mm. 52-53. Thus mm. 46-51 function in absolute time as an insertion. These six measures occur elsewhere in the movement's gestural time. Of course, the harmonies of mm. 44-45 lead directly to those of mm. 52-53 (see Example 6.9): I can hardly postulate a connection across a gap in absolute time on the basis of texture alone.

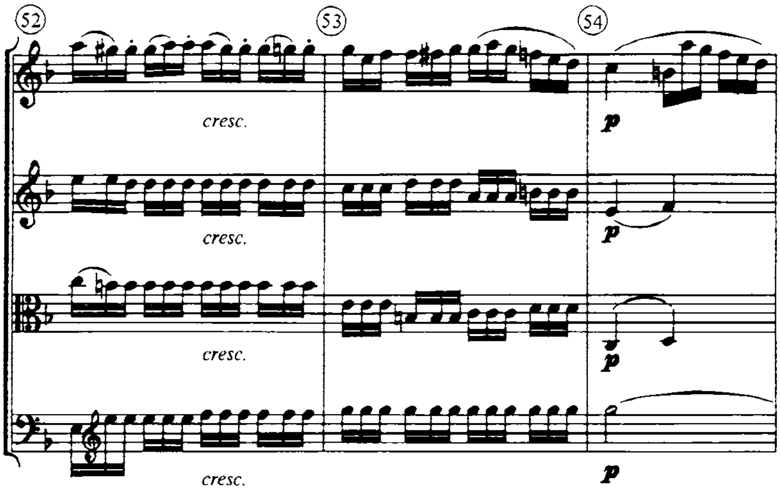
At m. 58 we expect a strong cadence to I in C major, but instead the harmony is V^4_3/ii. Mm. 54-57 lead toward I in C major, probably to be followed by a modulatory transition away from C (since by this point the music has been in the dominant key long enough). Such a passage does occur, starting not at m. 58 but at m. 17: a strong C major tonic followed by a modulation to another key, F. F major is a fresh tonal area on this gestural continuum (see Example 6.9). F is (re-)established at m. 25, where the continuity of Example 6.9 joins (in gestural time) that of Example 6.8, thereby underlining the strong accent at m. 25.

A few consequences of the multiple-time analysis suggested in Examples 6.6-6.9 should be discussed:

1. Each of the gestural-time excerpts shown in these examples is less interesting than what actually happens in absolute time. Opus 135 is not a random reordering of underlying continuities. More significant than this music being heard as a series of interlocking reordered continuities is *how* they are reordered. Beethoven allows us to hear (or, more accurately, to imagine with the aid of cu-

Example 6.9. Reconstruction of Beethoven, String Quartet No. 16 in F Major opus 135, first movement, showing second continuity in exposition


43
44
45
pp
pp
pp


52
53
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cresc.
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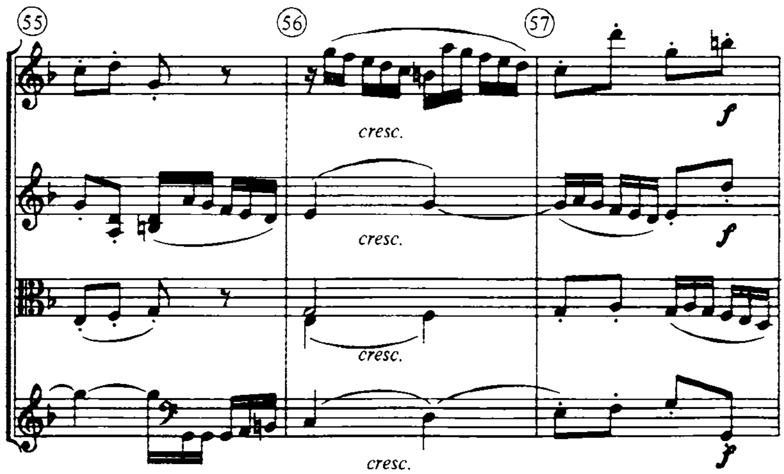
cresc.
p
p
p
p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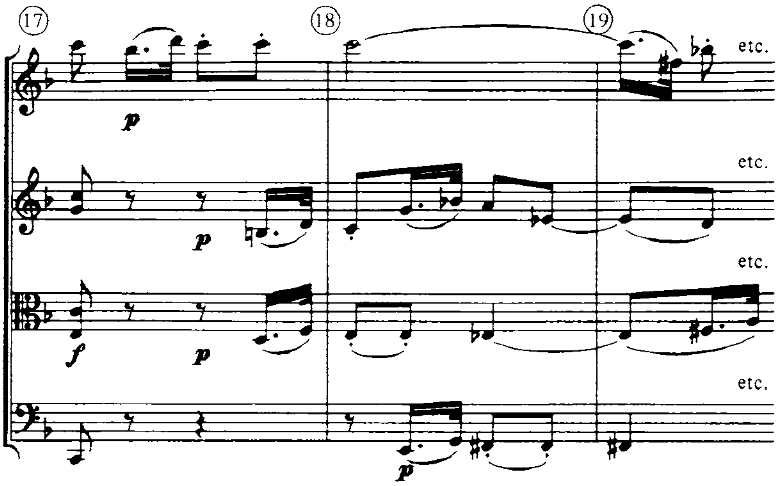
56
57
cresc.
cresc.
cresc.
cresc.
f
f
f

Continued

Example 6.9, *continued*



mulative listening) the relatively ordinary linearity that he has reordered in a wonderfully imaginative manner. The pacing (in absolute time) of discontinuities, surprises, and continuations of gestures from elsewhere in the movement is what makes this music special.

2. It is significant that four excerpts are given rather than an entire movement "unscrambled." It is most unlikely that a meaningful piece can be created by taking a simple linear prototype and reordering it. A large part of what makes Opus 135 endlessly fascinating to modern ears is the multiplicity of its temporal continuum: *three* endings, a climax prepared by *three* upbeats, and *two* intertwined continuities that lead in different directions.

3. Expectations associated with events and gestures in absolute time can be contradicted by the order of gestural conventions. To understand a function that is at odds with its absolute-time placement, we must recognize it for itself, apart from its specific context. We must understand m. 10 as a final cadence, even when it is heard not at the close of the (absolute time of the) movement. The more obvious conventions are those practiced by all tonal composers. I am convinced, however, of the existence of a few fundamental conventions in Western music that transcend style. How else could we explain the nontonal multiply-directed time discussed at the end of Section 2.9?

The ability of sophisticated listeners to understand even nontonal gestural function apart from context was demonstrated to me in two composition seminars, one in which I was a student and one that I briefly taught.[25] Each student was instructed to compose a few fragments. The students listened to everyone's fragments and considered how they might fit into large forms. Some of the composed gestures seemed capable of being used in more than one way (this fact supports my ideas on multiple time), but every fragment was clearly inappropriate for certain functions. Each gesture had function without the benefit of context. Although it is difficult to define this out-of-context functionality, I am convinced of its existence and of the human ability to perceive it, remember it, and follow its implications.

6.5 AESTHETIC CONSEQUENCES

I argued in Sections 1.2 and 1.5 for the multiplicity of time. Since time exists within ourselves, there are other species of temporality beyond the simple moment-to-moment succession I have been calling absolute time. Gestural time is one of these species. I do not of course believe that we literally experience gestural time. Rather, we understand when a gesture seems to be misplaced in absolute time, and we await the consequences of this misplacement. Then, eventually, through the mechanism of cumulative listening, we reassemble the essential continuity of the work. This continuity *exists* and it *is* a force in our understanding of the music. But *where* does it exist? Not objectively, not "out there," because time is primarily subjective, as argued in Section 1.2. It exists where all music we hear exists: in our minds. It is placed there by our experiences. Our minds process the data received, and thus events heard in absolute time can, in retrospect, be understood also in gestural time.

Thus all music has at least two temporal continua, determined by order of succession and by conventionalized meanings of gestures.[26] This duality makes musical time quite special: The past-present-future qualities of events are determined by their gestural shapes as well as by their placement within the absolute-time succession of a performance. While we are listening to a piece, its past is represented by its beginning profile(s) and its future by its ending profile(s). These temporal conventions retain their identities no matter where in the piece we encounter them: M. 10 of Opus 135, for example, *is* (in gestural time) the ending of the first movement. As we enter (in absolute time) m. 11, we start to hear a present whose future we have already experienced: a future earlier than a present! Such a paradoxical statement is possible because music can divorce the past-present-future from the earlier-simultaneous-later. The earlier-simultaneous-later depends on absolute-time mental processes: memory, perception, and anticipation. The past-present-future, on the other hand, can be determined by strongly stated conventional profiles of beginning, middle, and end. Thus, a (gestural-time) future can be earlier (in absolute time) than a present, just as a past may succeed a future. The time structure of music, at least of tonal music, can thus be profoundly multiple, paradoxical, and contradictory.

This contrast between two temporal qualities—past-present-future vs. earlier-simultaneous-later—recalls the ideas of British philosopher J. M. E. McTaggart.[27] According to McTaggart, there are two essentially different ways we understand time. The past-present-future is in constant flux, as events pass from being anticipated as future through being perceived as present to being remembered as past. Every event was once future and will eventually be past: The identification of an event as past, present, or future necessarily changes. But there is also a static quality of time. If one event is earlier than another, it will always be so. Earlier-simultaneous-later relationships between events therefore do not change.[28]

McTaggart was concerned with the incompatibility of static and dynamic conceptions of time. He believed that this dichotomy entails a philosophical paradox which in turn denies the very existence of time. A significant number of twentieth-century philosophers have grappled with solutions to McTaggart's paradox, trying to reconcile his *A-Series* (events ordered from past to future) with his *B-Series* (events ordered from earliest to latest).

Music provides a special context for understanding McTaggart's paradox. If A-Series qualities are defined not (only) by events' literal positions on the continuum from past to future but (also) by gestural shape, then the A-qualities of musical events are not necessarily constantly changing. A final cadence, such as that in m. 10 of the Beethoven Quartet, represents the first movement's future whether it is upcoming (while we are hearing, say, m. 9), whether it is being heard (when we are in m. 10), or whether it has already been experienced (when we are in m. 11). Since the cadence does eventually become past even in gestural time—as we go into the second movement—its A-quality changes with the time position of the listener. But the cadence's A-quality is not wholly dependent on the movement's B-Series.

What does Beethoven's music really have to do with McTaggart's ideas? This philosopher's thought has had tremendous resonance in the twentieth century, not only among philosophers but also in the way ordinary discourse treats time.[29] As McTaggart first published his ideas in 1908, he was at the forefront of thinkers dealing with new conceptions of time. It is no small coincidence that he was working contemporaneously with composers such as Ives, Debussy, and Stravinsky, who were forging new temporal languages in music. The ideas of McTaggart (and others) became part of a new temporal sensibility that has affected virtually every twentieth-century Western person. The ideas I have presented on multiply-directed time in Opus 135 are a product of that sensibility. We can understand Beethoven's music in this way in part because of the continued relevance of McTaggart's thought.

In earlier eras a characterization of musical time as multi-dimensional might not have occurred to critics or listeners.[30] But the obsession of our culture with time and ideas about time has sensitized us to perceive temporal multiplicity not only in our own temporal arts but also in older music. Furthermore, because of the nature of time in *our* culture, we are drawn to those works of past generations whose temporality *seems* contemporary in spirit. The music mentioned in this chapter certainly does not exhaust the examples of tonal music that invoke multiply-directed linear time: Such works form a significant minority in the tonal literature. For gestures to become conventions, most music must use them in a normal, consistent manner, with A- and B-Series in agreement. But works like Mozart's *Jupiter Symphony* and Beethoven's Opus 135 are important exceptions, in which contextual and absolute-time meanings of gestures do not coincide, and in which past-present-future qualities may be contradicted by the earlier-simultaneous-later continuum. Such music today seems strangely prophetic, because it appears to deal, as does much contemporary music (though by fundamentally different means), with the seemingly irrational logic of inner thought processes, where A- and B-determinations can in fact seem independent.

Actually, the A-Series is not a true series at all. Although the B-Series is completely ordered (since any event will necessarily be either earlier than, simultaneous with, or later than another event), the ordering of the A-Series is problematic. Knowing that two events are past tells us nothing about their relative order. If the A-Series tells us that the events are both past, we can understand their chronological order only by reference to the B-Series. Future events, present events, and past events comprise three unordered collections. Only the earlier-simultaneous-later quality of events can unequivocally order them.[31]

In ordinary physical existence, governed by absolute time, the B-Series is always available to order events, while in musical time the situation is more complex. Under the rigidity of absolute time, past-present-future is governed by memory-perception-anticipation, while in music absolute time does not reign solely: Music's earlier-simultaneous-later unfolds in absolute time while its past-present-future can occur in gestural time.[32] Music thus frees us from the tyranny of absolute time. In its ability to create unique temporalities (Langer's virtual time—see Section 1.2), music makes the past-present-future exist on a plane other than that of the earlier-simultaneous-later.

6.6 TEMPORAL MULTIPLICITY IN TWENTIETH-CENTURY CULTURE

As I have said, time is something very different for us from what it was for people living in the culture that invented tonality. We are preoccupied with time, but it does not seem to be an immutable force. We manipulate (or are made to manipulate) time rather than submit to it. Clocks are everywhere, declaring the pervasiveness of "real" time. We structure our daily lives around innumerable schedules. We make business appointments; we take fifteen-minute coffee breaks; we always know just how much time we have to "kill" (a particularly telling phrase).[33] Not only are we concerned with compartmentalizing and manipulating the pervasive "now," but also we are more oriented toward the future and the past than were previous generations. An inordinate effort goes into arranging upcoming holidays, providing adequate retirement plans, buying insurance, planning what will happen, preparing for what may happen. The future has invaded the present. Yet our age is also steeped in historical consciousness, from nostalgic reminiscences to reactionary politics to scholarly interests in the past. What does it mean to say that Beethoven is past, Leonard Meyer asks, "when the world history of music can be purchased in any record shop?"[34]

Our society knows a multitude of life styles, each with its unique blend of past, present, and future.[35] Every person knows a variety of environments, which are experienced alternately more than progressively. Psychologist John Michon writes about "several more or less independent times, one for each of the major areas of activity: family life, work, community activities, and the public arena as it is reflected in the news media. Connecting these times into one global time scale may be quite difficult and exceed people's cognitive capacity."[36] To cite an extreme example, someone can, with the help of jet-age travel, carry on different lives in different places, without each life ever touching. I heard about a man who spent a year teaching in three different American universities, one on the East Coast, one on the West Coast, and one in the Midwest. Each week he gave classes at all three. His airplane flights were not really transitional, since life in an aircraft—static and uneventful—does not directly lead to or from life in a classroom. This professor became an established member of three academic communities, and his presence in each no doubt came to seem (to him) more continuous than interrupted. On each visit he would pick up various continuities left hanging the preceding week. These continuities were not moment-to-moment but continually interrupted. The logic by which one of his environments followed another must have seemed at best elusive. It surely seemed by the merest chance that one event followed another in absolute time, while there were no doubt clear causal relations between, say, East Coast events occurring in successive weeks.

Thus linear cause and effect can come to seem arbitrary. It is not so much that they have ceased to exist as it is they have lost their universality.

You puncture a balloon. It breaks. Cause and effect. But is the relationship of the breaking to the act of puncturing critical? The answer is subjective. Perhaps the puncturing is, for whatever reasons, a significant event in your life, but the broken balloon means nothing. Perhaps for you the puncturing is more significantly tied to some totally unrelated event. The cause and effect relationship matters little to you and thus the adjacency of the two events in absolute time seems arbitrary. Traditionally, social convention, governed in no small amount by absolute succession, has singled out cause and effect from myriad possible (yet unnamed) relationships between events, and has raised it to an artificial supremacy. In the increasingly subjective worlds of contemporary culture and art, this supremacy is questioned, both by values that acknowledge the multiplicity of time and by artworks that are purposefully discontinuous. It seems askew to single out, from the vast network of relationships in our overly complex culture, only those which define causes and effects, which depend on absolute temporal succession. There are other kinds of relationships, other temporalities, which might suit our personal tastes, desires, needs, or neuroses better than cause and effect. Absolute temporal order *does* matter, yet that order is only one kind of relationship in time.

A culture that has deposed cause and effect is one that is disaffected with the ultimate causal succession: progress. Progress, particularly in technology, still continues at an ever faster pace, but more and more are people disillusioned with the results: overpopulation, poverty, pollution, loss of individuality. Because society does not value the individual, people (and their art) have turned inward. The subjectivity of time in the modernist world is an affirmation of the mind. Individuals control, and even create, their own internal rhythms, successions, and tempos. Only in the social arena must we submit to an external, absolute time. Thus, what contemporary arts do with time is no mere experiment but both an expression of liberation from the linearity of cause and effect and a celebration of the subjectivity of time.

Beethoven, on the other hand, lived in an age of transition, when ideas of stasis were giving way to ideas of progress, when Newtonian absolute time was being supplanted by Kantian "intuitive time," when a well-ordered social hierarchy of time was falling into conflict.[37] Although I am wary of finding in the music of a period too direct an expression of its times,[38] it is plausible that the development of contrast as an expressive dimension in music, reaching dramatic extremes in the compositions of Beethoven, could be a reflection of the birth of conflict in the social time structure. This conflict originated in the social upheavals of the day: the political revolutions in America and France and the Industrial Revolution. A by-product of these revolutions was that time began to be freed from its previous absolutism. Since this liberation of time permeated all aspects of society, it is not surprising that we can feel in Beethoven's music a new freedom in, and mastery of, the time dimension. What Beethoven seems to have discovered is that time need not be accepted simply as an absolute succession but that it can be manipulated, formed, sculpted.

Beethoven's music took advantage of a social paradox. As man became aware of the idea of progress, he began to be liberated from absolute time. That very progress, however, resulted in the Industrial Revolution, which wrought changes in social time that seemed to imprison man. The new technology produced machines that enabled society to control individual lives in unprecedented ways. Beethoven's music also seeks to imprison, but, once it has captured (or captivated) its listeners, they are offered a temporal experience with tempos and rhythms quite different from those of daily life. If the social and cultural changes of the late eighteenth century produced a liberated time that paradoxically imprisoned man, then music provided an antidote: It imprisoned listeners in order to free them. Thus some art became more than a reflection of its cultural environment. Artworks began to offer an alternative to, or compensation for, social tensions.

The art from that period that is often most deeply meaningful to us today is that which *still* seems to act as a counterbalance to the "gigantic externalization of life within modern society."[39] For today's listeners, Beethoven's music is more than a nostalgic reminiscence of a simpler era; it can function as if in revolt against *our* social time. Time for us can be discontinuous, multilayered, subjective, and irrational. These adjectives also describe time in some of Beethoven's music *as we can understand it today*. We crave order, having all but given up belief in a rational temporal structure. Beethoven's music provides such order, not simply by making listeners revert to older concepts of temporal continuity but rather by providing an approach to time that neither negates it nor compromises our modern understanding of it. A well-ordered yet temporally multiple piece, such as Opus 135, provides an alternative to the tyranny of absolute time without retreating into the essentially subjective time structures (such as vertical time and moment time) created by contemporary composers.

Society seems to demand that we either accept absolute time, with all its limitations and contradictions, or else that we remove ourselves from the social conventions we call reality and enter a schizophrenic world with its own time. Temporal arts, whether works of today or those creations of the past with peculiarly contemporary relevance, provide a third possibility: We submit to an external time, which represents not the objectivity of absolute time but the artist's disciplined yet subjective view of the irrational. This view provides an escape from absolute time while simultaneously reflecting the contradictions inherent in it. Music allows us to experience subjective time without having to remove ourselves from the time experiences we share with other people.

Beethoven's music has contextual goals that are achieved, its effects seem caused, and it proceeds with purpose. Therefore we can understand its multiply-directed time as a distortion of linear time. Were Beethoven's music less goal-oriented, the effects of its temporal multiplicity would be less powerful. But this music is unequivocally goal-directed on every hierarchic level. Modern music, like much of modern art, *starts* from the multiplicity and irrationality of time, whereas Beethoven's achieves these qualities as an artistic goal. His art and modern art deal in their own very different ways with temporal discontinuity. Thus it is useful to glance at temporal multiplicity in twentieth-century art, in order to understand both its differences from, and similarities to, tonal music's capacity for multiply-directed time.

6.7 TEMPORAL SUBJECTIVITY IN MODERN ARTS

> The eternal has disappeared from the horizon of . . . our everyday life; and time thereby becomes all the more inexorable and absolute a reality. The temporal is the horizon of modern man, as the eternal was the horizon of man of the Middle Ages. That modern writers have been so preoccupied with the reality of time, handling it with radically new points of view, is evidence that the philosophers of our age who have attempted a new understanding of time are responding to the same hidden historical concerns, and are not elaborating some new conceptual novelty out of their heads.[40]

William Barrett is writing not about music but of literature. But the new temporal ideas he describes have pervaded all art forms in the twentieth century. Consider film. It manipulates time more explicitly than can the more traditional arts. Few films accept absolute time;[41] nearly all narrative films use myriad devices (e.g., montage and flashback techniques) to convey the compression, elision, or discontinuity of time. In many movies time becomes a major element, perhaps to the extent (and here I readily confess a musician's prejudice) that their temporal parameters surpass in importance their visual, dramatic, and literary aspects. Consider a few examples: Alain Resnais' *Hiroshima mon amour,* where past and present are at first confused and eventually equated; Resnais' *L'Année dernière à Marienbad,* in which the time sense seems "to follow the mind, which goes faster, or slower, than reality—dodges, skips, doubles back, lingers, repeats, and creates imaginary scenes, parallels, and possibilities";[42] Laslo Benedek's *Death of a Salesman* (after Arthur Miller's play), where past, present, and future are freely intermixed; Walerian Borowcyzk's *Renaissance,* in which the entire film is in reverse motion;[43] Federico Fellini's *8½*, in which reality, fantasy, memory, and anticipation are merged; Paul Fejo's *The Last Moment* (after a story by Ambrose Bierce), in which nearly the entire film takes place within a fraction of a second;[44] Luis Buñuel's *The Exterminating Angel,* in which a sequence is literally repeated and in which the characters are imprisoned by time.

Film, more capable than any other medium of reproducing an artist's temporal fantasies, manipulates absolute time more directly than other arts can. Few narrative films,[45] however, are really *about* time. And fewer novels and dramas take time as subject matter. Narrative works consider people and objects existing in time; time itself is too elusive for the logic of language[46] or visual representation.

Nonvocal music is the only art that has for centuries been largely unencumbered by plot, character, or representation (abstract painting and nonnarrative film are, of course, twentieth-century phenomena). Nontexted music really *is* about time. Music entails tonal relationships existing and transforming in time. But I am saying more than that. If music is a communicative art, then what it expresses is not just love or joy or sorrow, much less the adventures of a Don Quixote or a Till Eulenspiegel, but time, with its attributes of rhythm, building and releasing of tension, and fulfillment or frustration of the expectations it creates. This anti-romantic view of music would have been unlikely in earlier eras, but it is appropriate to today's time-obsessed sensibility.

While earlier composers most likely treated time intuitively, today's composers are conscious of its potential.[47] Discontinuities in modern music are at times so extreme that the most readily apparent and meaningful connections are *not* between events immediately adjacent in absolute time. The thread of discourse in many contemporary compositions is broken off as unrelated events pass by, only to be picked up later. Messiaen's *Cantéyodjayâ*, which I discuss in Section 8.6 as a mixture of moment time and multiply-directed linear time, proclaims the multiplicity of time in such a manner. Although this work is not cast in a mobile form, it sounds like a series of sections strung together in one of many equally viable orders. *Cantéyodjayâ* feels like several intertwined continuities, each interrupting another so often that the effect becomes, as with our jet-set professor, not so much interruption as a counterpoint of different continuities.

Consider other examples of contemporary music that directly confront new meanings of time. In Stockhausen's *Zyklus* (mentioned in Section 2.10) motion is circular and may begin anywhere on the circle, progressing until the music returns to the starting point chosen for the particular performance.[48] The score actually is spiral-bound so that a performer may begin anywhere and proceed until he or she returns to the point of origin. The same composer's elaborate celebration of temporal mobility, *Momente* (1961-1972), includes brief references to what may be the past in one performance but the future in another. The *deuxième formant* of Pierre Boulez's Third Piano Sonata (1957) contains several parenthetical structures, which may be played or omitted, thus altering the realization of but not the logic of the serial structure. In Cage's *Piano Concert* (1957) the inclusion or omission of most of the material quite literally does not matter.

The logic of such music is like that of contemporary life. In both we do not isolate one of countless possible relationships between events and deify it as cause and effect. Instead, things merely happen. As more things happen, we get a clearer view of an emerging whole. One instant does not progress to another so much as each instant provides fresh information that contributes to the definition of a totality that will be known completely only at its close. These temporal experiences are not static, but their kineticism is of a new order. It is the dynamic of coming to know, through cumulative experience, a whole that might well be static in itself. Stockhausen refers to this overall stasis as a "directionless time field, in which individual [events] have no particular direction in time (as to which follows which)."[49] I refer to it as temporal nonlinearity.

In past ages life was directed toward philosophic, religious, or material ends, and tonal music reflected this goal-orientation. Tonal goals were also global goals because the motion in all parameters of tonal music tended to support tonal progression.[50] Today, while we can have a sense of direction in our daily lives, it is difficult to maintain belief in large goals held by all of humanity. The goal-orientation we do feel is more like the motion of a molecule within the static totality of a gas—the whole volume of gas has identity, but not the individual molecules. It is therefore fitting that modern multidirectional music should lack unequivocal goals, despite innumerable small-scale processes and progressions in individual parameters.

6.8 BACKWARD AND FORWARD LISTENING

In the art of a culture which lacks universal goals, where time is fragmented and irrational, where past, present, and future interpenetrate one another, where the order of events can seem arbitrary, what becomes of the traditional concepts of beginning, middle, and end? Much of the power and meaning of traditional music comes from our ability to listen both backwards and forwards. We hear a later event clarifying an earlier one and an earlier event implying a later one. What happens when the very concepts of earlier and later are called into question in multiply-directed time? Does a multidirectional music have beginning(s), middle(s), and end(s)? Can it have climaxes, can it build and release tensions, can it make transitions?

As we have seen, a multidirectional piece like Opus 135 can indeed have these traditional attributes, although they are defined by gestural shape as well as by placement in absolute time. Such recent multiply-directed works as *Cantéyodjayâ*, *Zyklus*, and Boulez's Piano Sonata No. 3 can also have beginnings, endings, climaxes, tensions, resolutions, and transitions. The difference is, as I have stated, that the reordering of such events in Opus 135 both seems and is with purpose, while in contemporary music order can seem, if not actually be, arbitrary.

What happens to a listener's capacity to remember and anticipate when confronted with such music? When a composition blurs the distinctions between past, present, and future, backwards and forwards become in some sense the same. This is particularly true in a mobile piece, such as *Momente*, where a flashback in one performance becomes on another occasion a flash forward. Even in nonmobile multiply-directed music, the gestural distinction between implication and reminiscence is not obvious. Gestures that refer forward and those that refer back may be indistinguishable out of context. They do not differ in the unequivocal manner of, say, thematic statements vs. transitions. It is in absolute time, not gestural time, that we make distinctions between foreshadowing and reminiscence. In some music such a distinction is more confusing than illuminating. For example, we have seen that in Opus 135 mm. 1-4 constitute not only an absolute-time opening but also a gestural-time penultimate event. This phrase refers motivically to other music in the movement. Thus it is both an absolute-time anticipation *and* a gestural-time reminiscence—*of music yet to be heard!* Thus Opus 135, even while operating within a goal-oriented tonal system, equates implication and reminiscence.

6.9 VARIETIES OF TIME IN THIS CHAPTER: SUMMARY AND DEFINITIONS

This chapter (and its predecessors) has used several temporal terms. Definitions should now be reviewed, and underlying concepts should be summarized briefly.

"Absolute time," as I have explained, is a linear succession of now-moments, sometimes called "real time," "ordinary time," or (but not in this book) "lived time" and "world time." "Social time" is the ordinary time imposed on us by timetables, schedules, and deadlines. "Clock time" is a specific kind of absolute time:[51] that which is totally objective, even scientific, and is not subject to interpretation through human perception. "Virtual time" (see Section 1.2; it is more or less synonymous with "musical time," although Susanne Langer does argue for other art forms creating virtual time) is subjective and not quantifiable. It is the special type of time we experience when deep listening to music removes us from our everyday world. "Gestural time" is a special and extreme type of virtual time. Because it is defined by gestural connotation and not by duration or literal succession, it has its own peculiar continuity and order. Occasionally I use the general term "multiple time" (or "temporal multiplicity"), referring to any musical temporality that entails several directions, continuities, linearities, progressions, or species of time.

Music may exist in clock time but is rarely perceived in such an objective fashion as by precise measurement. Music does unfold in absolute time, however, and absolute time is linear. Gestural time can be a reordering (but not a destruction) of music's absolute time, and thus gestural time is also linear: There are implications and progressions in gestural time. Because some music has very different linearities, defined on the one hand by literal succession and on the other by gestural shape, we can speak of linear musical time as being multiply-directed. The music may well be moving toward predictable goals, but it is moving in more than one way and in more than one direction at once. Multiply-directed time thus entails discontinuity, but discontinuity is only a necessary, not a sufficient, requirement for multiply-directed linear time. Moment time is also discontinuous, but it is not linear. The way linear and nonlinear musical time interact, in both continuous and discontinuous music, is explored in the analyses in Chapters 7 and 9.

Chapter 7

Analytic Interlude

Linearity and Nonlinearity in Schoenberg's Opus 19, No. 1, and Webern's Opus 29, First Movement

7.1 NONDIRECTED LINEARITY IN SCHOENBERG'S OPUS 19, NO. 1

In Chapter 5's study of Beethoven's Opus 135, I examined several linear processes that unfold across the entire first movement: the reconciliation of opposing textures; the concomitant establishment of continuous textures; the emergence as stable of a strong-weak metric interpretation of the principle motive; the regularizing of the hypermeter; the resolution of the opposition of tonic and dominant tonal areas; and the coming into agreement of gesture and function (see Sections 5.5–5.7). These textural, motivic, metric, tonal, and gestural processes give the movement a sense of forward motion through time (which gestural time in turn contradicts; see Section 6.4). It is important to understand that only some of these linear processes come from triadic tonality.

Since linearity in tonal music can result in part from structures that do not operate in a tonal manner, we may reasonably expect to find linear processes that operate in textural, motivic, metric, and other domains of atonal music as well. The following analysis of the first of Schoenberg's *Sechs Kleine Klavierstücke,* opus 19, focuses on that movement's linearity. Voice-leading, textural, and metric motions are traced, as is a large quasi-tonal progression. Considerations of set consistency, which are essential to understanding the work's context, are touched on, but less thoroughly. Here I am more interested in how this music moves than in why different parts of it belong together.

The linearity in Opus 19 is *nondirected* (this term is defined in Section 2.5). Although the pitch area arrived at in the final cadence of the first movement is logical, it is not preordained. The music does not progress unequivocally toward the particular collection of pitches with which it ends. Furthermore, although the *nonpitch* linear processes move directly from beginning to end, they too are essentially nondirected. The voice leading and foreground meter become gradually less ambiguous; the texture simplifies; and a hint of tonal root movement emerges; yet there is no single arrival point for any of these progressions. We never experience an instant when we feel that the voice leading has achieved total clarity, the meter has become completely straightforward, the texture has reached maximal simplicity, or the root-derived progressions have been unequivocally established. Once the movement ends, we understand that voice-leading, metric, textural, and even quasi-root progressions have helped to create motion, but they do not define goals of motion nor do they aim toward a particular final cadence.

7.2 STEPWISE LINEARITY IN OPUS 19, NO. 1

One important means of linear progression is stepwise pitch connection. Not every theorist acknowledges the importance of stepwise motion in nontonal music,[1] nor am I arguing for its *a priori* significance in all atonal music. Stepwise connections do not strike me as particularly prominent, meaningful, or common in, for example, Boulez's *Structures* (1952) or Xenakis' *Herma* (1961). But Schoenberg's Opus 19 exhibits striking linear pitch progressions. For example, consider the D-sharp in m. 1. It is isolated in register: higher than anything else in mm. 0–1 and unconnected by step to the rest of the music in those measures. It remains in memory, as we move into m. 2, like an unanswered question. We await a response, a connection, an explanation. The subsequent music carefully avoids the register of that D-sharp, thereby heightening our expectations. Midway through m. 3, a new high register opens up, and tucked into the thirty-second-note flourish is a brief E which makes a tentative connection to the remembered D-sharp. The expected explanation, the answer to the question, has begun to appear. The only moving voice in the first half of m. 4 rises stepwise from D-natural through the same E to F (which, incidentally, continues the high-register stepwise descent of m. 3: B–A–G finally to F in m. 4). The foreground stepwise ascent (D–E–F in the first half of m. 4) reflects the middleground stepwise rise from D-sharp (m. 1) through E (mm. 3 and 4) to F (m. 4). By the cadence in the middle of m. 4, the initially puzzling D-sharp has been explained. It is understood in retrospect as the beginning of a line rising by step. Had the D-sharp not been initially isolated, it would have been less memorable, and the subsequent stepwise connections from it would have been less significant.

This stepwise ascent implies continuation. The line wants to go higher. When the next phrase starts on G-flat (midway through m. 4), the connection is clear, as is the subsequent step up to A-flat at the end of m. 5. The initial D-sharp can thus be understood as beginning a line that rises stepwise throughout mm. 1–5 and that becomes gradually more prominent and more structurally significant.

It may be argued that, in chromatically dense music, stepwise connections are statistically likely, and that all I have done is to notice an initially unconnected D-sharp and then look for any subsequent note registrally near it. If the short E in m. 3 were the only step connection to D-sharp, then the relationship between the two notes would not be particularly important. But this connection is indeed significant, because of the way the line continues to unfold and becomes more and more prominent. There may actually be a degree of truth, however, in the accusation that such an analysis simply looks for candidates for

Example 7.1. Schoenberg, *Sechs Kleine Klavierstücke,* opus 19, first movement, complete


flüchtig
0 1 4 7
ppp
0 1 4 7
0 1 4 7
0 1 4 7
fpp trem.
0 1 5
r.H.
pp
flüchtig
0 1 4 7
0-1-4 7
rit.
(mit Ton)
mf
p
molto rit.
014
0 1 5
ppp
pp 0 1 4
0 1 5
molto rit.
0 1 4
ppp

stepwise connection to isolated or prominent notes. But that is how we actually listen to atonal music linearly! The very isolation of the D-sharp alerts us to listen for an eventual step connection that will in retrospect integrate the note into the music. The E in m. 3 may be too brief to fulfill that function completely, but the D–E–F ascent in m. 4—followed by m. 4's G-flat and m. 5's A-flat—surely constitutes a functional linear motion. That stepwise ascent (D–E–F–G-flat) is reiterated by a variant in the bass in mm. 4-5 (D–E-flat–F–(A)–F-sharp; the first three notes of this version are also recalled in the lowest voice of m. 6).

The ascending stepwise motion from D-sharp is a structural line. There are other such lines intertwined contrapuntally throughout the movement. Some of them are traced in the following analysis. Because of the absence of goal-directed harmony, these lines would seem to meander if heard by themselves. There is, for example, no way to know where the line that starts on m. 1's D-sharp is ultimately heading. It is only as the context defines itself, by nonpitch as well as pitch means, that we begin to understand certain classes of events as goal candidates. This is one reason why I classify the music as a nondirected linearity.

I am not suggesting that D-sharp is prolonged to m. 3 in a manner analogous to a tonal prolongation. It is simply remembered and in need of subsequent integration and connection. The harmony of this music, particularly in the opening passage, is too nebulous for me to say unequivocally that D-sharp is a structural pitch prolonged throughout the first two phrases (see Section 9.1 on the inappropriateness of the prolongation concept to posttonal music).

The isolated D-sharp is hardly the only unstable element in the opening phrase. There are other ambiguous pitches, and the meter is quite fluid (meter is studied in Section 7.7). These elements of instability are starting points of important linear progressions. But the opening phrase also has aspects of stability which stand out against the vagueness of line, meter, and texture. For example, two reiterated dyads give coherence to the first phrase. The C–G in the m. 0 (the incomplete measure before the first full measure) arpeggio returns vertically toward the end of m. 1 (and again midway through m. 2), and the melodic opening B–D-sharp is immediately repeated chordally in the lowest register. Furthermore, an important set, set type or prime form 015, is introduced in m. 0 (C–G–G-sharp) and restated as m. 1's low-register verticality D-sharp-B-E.[2]

When the second phrase succeeds the first, the initial A of m. 2 replaces by step the prominent B of mm. 0-1. This motion initiates a linear process that works itself out across the whole movement. The expectation is strong that the line will continue down to G or G-sharp, especially in the light of the G–G-sharp under B in m. 0. The right hand of m. 3 projects this line into a higher register, reiterating the B–A motion. This line progresses tentatively to G, but it returns to A: The motion further down has been aborted, and we are still on A. In m. 5 an inner-voice B moves through B-flat to A, which is then decorated by the lower neighbor A-flat in m. 6. The B in m. 5 is preceded by A-flat–G, which makes a strong parallel with the melodic B at the start of m. 6, also preceded by A-flat–G.[3] There is at first no stepwise motion from the B in m. 6. After it is reiterated in the first chord of m. 7, however, it does progress downward yet again to A, in the second chord of m. 7. But the line returns (after a brief but tentative move A–G-sharp) to B in the middle of m. 8. It seems to be stuck on B, unable to move definitively beyond A to either G or G-sharp. We are tantalized by the prominent A to G in the bass (right hand), mm. 9–10. But this is a bass motion, not a melodic motion. The solution (and resolution) occurs as the melodic C-flat of m. 14 (reinforced by B an octave lower) moves pointedly to B-flat (octave displaced for emphasis) at m. 15. This B-flat is an extraordinarily beautiful note in context. It is the resolution of the accumulated tension associated with B, which originates at the very opening. Since the motion from B to A has continually led to frustration, not resolution, the B resolves neither to nor through A but instead to B-flat. Thus this lovely B-flat is sustained throughout mm. 15–17, and at the very end is decorated by B-natural, now reduced to the subsidiary function of an upper neighbor. The B-flat has acquired the stability of a cadential chord tone (there are other factors, explained below, that make this B-flat particularly stable).

Let us look at another long-range linear process. The D–E-flat–F–A–F-sharp bass figure in mm. 4–5 is, as explained above, a variant of the melodic D–E–F–G-flat in m. 4. The bass C-sharp–D–F-sharp at the end of m. 5 is a further derivative of this figure. Suddenly, at m. 6, the bass register is abandoned. We await, in a linear fashion, a connection to these bass figures. When the low register returns in m. 11, the first two notes are the spanning pitches of the figure at the end of m. 5, C-sharp and F-sharp. Thus a strong connection is made between mm. 5 and 11, across the intervening measures. The subsequent stepwise progression in mm. 11–12 therefore not only brings mm. 7–12 to a cadence but also concludes the opening section, which is only partially closed by the cadence in m. 6: G (low register, m. 10) moves down through F-sharp to the bass E in m. 12, while the C-sharp in m. 11 moves up through D-sharp to this same E.

7.3 HARMONIC AND REFERENTIAL THIRDS IN OPUS 19, NO. 1

The first phrase (mm. 0–1) is based on the unfolding of one "harmony." This is made clear when m. 2 starts with what sounds unmistakably like a new "harmony." Although I am not arguing for a tonal understanding of this opening music, the harmony of mm. 0–1 is undeniably third-oriented. The historical reasons for this may be important, but the internal structural consequences have little to do with triadic tonality.[4] M. 0 suggests an arpeggiation up by thirds: A–C–(E temporarily omitted)–G (immediately replaced by G-sharp)–B (held throughout). The registrally isolated D-sharp can thus be understood as the next third up in the arpeggiation. We expect another third up: not G, since we have already heard G, but F-sharp. Thus the cadence note, delayed by the appoggiatura-like F-natural, is implied by the arpeggiation logic of mm. 0–1. The lower notes of m. 1 reiterate the arpeggiation's pitch classes, B–D-sharp and C–G (the G coming an octave lower than in m. 0 suggests a stepwise connection with the initial A in m. 0, a relationship that recurs prominently in the right-hand bass of mm. 9–10). The one new note in m. 1 is E, which is pointedly omitted from the arpeggiation by thirds in m. 0.

This opening establishes the prominence of thirds and of harmonies built from thirds (see, as one example among many, the first half of m. 14), but the thirds do not necessarily create root-oriented triads, although triadic harmonies are a distinct possibility in a music that builds harmonies by superimposing thirds, no matter how chromatically. And this implication does indeed become significant, where the third-oriented verticality in m. 12 feels like a V/V with a root E, progressing to a chord on A (notice how different this A feels from the appoggiatura-like A in m. 9) in m. 13 and eventually to a tonic-like D in m. 15. This fleeting tonal reference is neither the only nor even the most important relationship in mm. 12-15, nor is this the only way to understand the motion from m. 12 to m. 15. But the feeling of tonality is unmistakable, even if clouded and not really structural, and it can be understood as a linear outgrowth of the prevalent harmonies constructed from thirds.

The harmony of mm. 0-1 suggests that we listen for subsequent chords in thirds. Thus the A in m. 2, an unmistakable linear connection to the B of mm. 0-1,[5] is the source of a descent (balancing the first phrase's ascent) in thirds. A is first decorated by a neighbor B-flat (foreground motion by half-step, reminiscent of G-G-sharp in m. 0 and F-F-sharp in m. 1, is a prominent motive in the movement), after which the line descends by thirds through F-sharp to D-sharp (relating to the D-sharp and F-sharp of m. 1's arpeggiated harmony).

The set type for the right hand of m. 2 is 0147. Similarly, the first four lefthand notes form a 0147 tetrachord transposed a fourth lower (an important interval of transposition, as we shall see, as well as a further reference to tonal procedures). The 0147 tetrachord resurfaces often, becoming an important determinant of contextual consistency. Prominent statements of 0147 are boxed in Example 7.1.

The pitches of m. 2 that do not belong to either of the two 0147 tetrachords include the low B-D, which connects stepwise with the low B-E of m. 1. The B in m. 2 comes immediately after the vertical dyad G-C, just as the same B immediately precedes the G-C dyad in m. 1. The B-D dyad is a strikingly fresh sound in the context of m. 2. Once this dyad is presented in this prominent way, it becomes an element of consistency throughout the movement. Thus the nonlinear structures of the movement include not only reiterated sets but also referential pitch classes (PCs), such as B-D. This dyad is repeated a bar later an octave higher. It is then reinforced by a rare octave doubling in the penultimate lefthand chord of m. 3. This instance of B-D is preceded prominently in the right hand by B-E, recalling the manner in which the low B-E in m. 1 progresses by step and common tone to the first B-D, in m. 2. The B-D dyad reappears in an inner voice at the end of m. 5. It is heard melodically at the start of m. 6 and then reiterated in register at the top of the first chord of m. 7. It is heard again melodically at the end of m. 7 (now a sixth rather than a third), and then it spans the tremolo chord of mm. 8-12. It forms the top of the first chord of m. 14. And, finally, the octave B at the end of m. 14 (low-register B followed by melodic C-flat) is succeeded by the melodic D in the bass of m. 15.

B-D is thus prominent in the two strong interal cadences, mm. 6 and 12. The harmony of the m. 6 cadence is permeated by thirds: In fact this measure, like mm. 0-1, can be understood as an elaboration of a single chord in thirds, spelled (from the bottom) D-F-A-C-sharp-E-G-B-D-F-sharp. The cadence of m. 12 is also third-oriented. The chord tones have been sustained for a number of measures, a gesture quite different from the veiled harmonies of the first section (mm. 0-6). As already explained, the cadence chord's B arrives in m. 7 (spelled C-flat); the G is sustained from near the beginning of m. 8; and the D first appears at the very end of m. 7. The G is reinforced an octave lower in m. 10. In m. 11 (as already mentioned) this lower G moves down through F-sharp to the root-like cadential E of m. 12 (also approached from below). The cadential chord also contains an understood F, remembered from mm. 10-11 and reiterated at the beginning of m. 13. The chord is, therefore, a series of thirds stacked: E-G-B-D-F. The E-flat, an added pitch, is part of neither a large-scale line nor a chord of superimposed thirds. Rather, it is grafted onto the D as a verticalization of the D-E-flat bass motion at the end of m. 6. The association of these two pitches becomes horizontal again in m. 13.

7.4 THE GRADUAL EMERGENCE OF FOREGROUND STEPWISE MOTION IN OPUS 19, NO. 1

Although the stepwise progressions in mm. 0-2 are disguised, by m. 3 they begin to be more obvious. I have already mentioned the descent B-A-G, which then turns around to G-sharp and A, in the right hand of m. 3. This figure is accompanied by a chordal progression in which each voice moves by semitone and then returns (this chromatic neighbor motion is recalled at the end of mm. 6 and 17). I have also pointed out the stepwise melodic ascent D-E-F-G-flat in m. 4, reiterated (with changes) in the bass of mm. 4-5. The clearest statement of stepwise motion thus far occurs in the melody of mm. 4-5: G-flat moves down to F (octave displaced to avoid excessive chromaticism), and then down through E, E-flat, D, D-flat (the A added for variety forms a 015 trichord with the surrounding D and D-flat), C, and then (changing voices but not register) B, B-flat, and A. This A moves tentatively to A-flat in m. 6 and definitively (after B-flat) in m. 7. The stepwise descent is completed when this inner voice reaches G in the first half of m. 8, sustained in the tremolo chord of mm. 8-12. In the subsequent section (mm. 13-17), this voice turns around and ascends through A-flat and A (m. 13) to the important B-flat of mm. 15-17.

By the end of the first section (end of m. 6), the step connections have progressed from being long term and veiled to being overt in the foreground. The stepwise outer (and inner as well) voices in the second half of m. 4 and in m. 5 function as a catalyst in this transformation. By m. 6 every voice moves by step progression. These stepwise connections produce an unambiguous cadence. The second section, mm. 7-12, continues to use the overt stepwise motion that the first section achieves as a goal. The B-flat that starts m. 7, itself a linear consequence of the chromatic inner voice rising from A-flat and A-natural in m. 6, moves downward in a completely straightforward manner. B-flat in m. 7 goes chromatically down to A and A-flat and, at the bottom of the flourish in m. 8, to G. This G also functions as the previously denied goal of the downward motion from the G-flat that appears in the melody midway through m. 4 (as explained above, the "line" moves down to A in m. 5 before turning around to ascend). Since this G is an important goal, it remains through m. 12.

The B-flat of m. 7 also progresses up a semitone within that measure. The resulting C-flat is decorated both by the lower neighbor B-flat in the first half of m. 8 and also by the motion C-sharp–D–C-natural. This line returns to B-natural in the tremolo, second half of m. 8. This important pitch is sustained through the end of m. 12.

The two righthand chords in m. 7 also participate in clear stepwise progressions. The notes of the first chord—D, B, and E-flat—are picked up from m. 6. These three notes progress smoothly by step. D moves to D-flat in the second chord and then on down a step to B in the middle of m. 8. This outlined B–D then moves down a semitone to B-flat–D-flat in m. 10. The high register is next heard in m. 15, where the top G-sharp and D-sharp are step connections respectively from the B-flat and D-flat of m. 10. On a deeper level, the D-sharp in m. 15 connects with the high F-sharp–F-natural motion in m. 6.

The E-flat in the first chord of m. 7 moves up a step to F in the second chord. After this F moves to F-sharp in the flourish of m. 8, the F-sharp is decorated by a brief G-sharp, which returns to F-sharp at the end of m. 8. The F-sharp is then replaced by F-natural in the flourish of m. 10. F returns after a double neighbor figure (G-flat and E-natural in m. 10). This F is an important note, as the melody of the third section begins with this pitch (start of m. 13). Downward motion continues on two levels. On a large scale, F moves down a semitone to the cadential E in m. 15. On a smaller scale, F progresses down through E-flat to D-flat in m. 13. This motion is reiterated an octave lower by the F–D-flat of m. 14. The D-flat then progresses down to C-flat and then to the cadential B-flat (back in the line's original register) of m. 15.

Thus each of the four notes of the sustained cadence chord (mm. 15–17) is the goal of a long stepwise line beginning at least as far back as m. 6. This chord sounds like a goal also because all four voices arrive simultaneously on a downbeat. These goal pitches are not predictable in advance, however. Stepwise motion could have continued a bit further or stopped somewhat sooner. Thus, while the stepwise linearity is unmistakable, it is not directed toward an unequivocal tonal goal.

The process by which the voice leading becomes gradually clearer culminates at the start of the third section. Every pitch of the first chord of m. 13 connects by step or common tone with a note of the preceding cadence, except that the bass A is a pseudo-root-derived progression by fifth from the previous bass E. Each of these five chord tones moves by overt step connection through mm. 13 and 14 and into m. 15.

1. the bass A goes up to B-flat and C, then down to B and, by octave displacement, down another semitone to B-flat at the beginning of m. 15;
2. the tenor G-flat, connecting by step with the preceding bass E, moves down to F and E, then back up to F, finally landing (two octaves higher) on E;

3. the middle voice D–E-flat joins the upper voice in m. 14 by moving down to D, then D-flat–C-flat and, by octave displacement, to m. 15's B-flat;
4. the alto motion A-flat–A-natural in m. 13 drops an octave in m. 14 to continue B–G-sharp, with those two notes both progressing to the B-flat of m. 15;
5. the top voice of mm. 13–15 has already been traced.

Thus the cadence chord of m. 12 moves logically and clearly through mm. 13–14 to the cadence chord of mm. 15–17. It is fully appropriate that this chord should be decorated by stepwise neighbors in all four voices in m. 17. This closing gesture is a distillation of the overt stepwise motion that the movement has struggled to achieve.

7.5 ANOTHER PROMINENT DYAD IN OPUS 19, NO. 1

The melodic motion F-sharp–F at the end of m. 6 is significant. It recalls the end of m. 1, as well as the bass of the first half of m. 5. But its significance is more than referential. Which note is more stable, F or F-sharp? In m. 1, the cadential F-sharp is more stable because it, not F-natural, belongs to a harmony in thirds. The stability of F-sharp is reinforced in m. 2, where F-sharp (right hand) is preceded by a brief F-natural (left hand). F-natural is capable of stability, however, as we hear at the cadence in the middle of m. 4. This F completes a chord in thirds: C–E-flat–(G understood)–B-flat–D–F. Significantly, the F moves immediately to F-sharp (spelled G-flat). This stepwise connection is recalled in the bass in m. 5. At the end of m. 6, F-sharp moves to F, reversing the motion of mm. 1, 4, and 5 and thereby anticipating the bass in m. 17. But which pitch is more stable in m. 6? The answer is not obvious. Either tone fits a superimposition of thirds from the low D, although the F-natural duplicates a lower-register pitch. The lefthand dynamics suggest that D is chordal and E-flat is already moving on toward m. 7, but the righthand dynamics imply the opposite. I tend to hear the high F-sharp as chordal, replaced by F in anticipation of the high F in m. 8. The important realizations to be derived from m. 6, however, are that either note may be chordal, may be the goal of stepwise motion from the other, may be stable.

Subsequent reference is made to the F–F-sharp relationship. The F at the bottom of the second righthand chord of m. 7 moves up a semitone to F-sharp at the beginning of m. 8. The high F in m. 8 moves immediately to F-sharp (octave displaced to emphasize F over F-sharp). F is prominent in the flourish in m. 10, with F-sharp (spelled G-flat) clearly subordinate. The melodic F held across the barline from m. 10 to m. 11 is picked up in register in m. 13 (hearing F-sharp as a passing note in m. 11 helps establish F-natural as stable). This emphasis on F begins to suggest that it, not F-sharp, is destined to be the more stable pitch. Furthermore, the tenor-voice turn around these notes in mm. 13–14 ends on F. When the final cadence, like the one in m. 6, moves from F-sharp to F, the primacy of F is firmly established.

To summarize: The first cadence of the piece (m. 1) treats F as subordinate to

F-sharp. The remainder of the movement works to contradict this opening and to establish F-natural as stable. The melodic cadence on F in m. 4 begins this linear process. Ending m. 6 on F-natural is equivocal, because of the harmonic ambiguity. By m. 12, however, F is remembered as prominent and stable, in part because of the clear registral connection between the F's in mm. 11 and 13. By the final cadence, F-natural is unquestionably the more stable pitch.

7.6 IS THERE A RECAPITULATION IN OPUS 19, NO. 1?

The foregoing analysis has focused on elements of (in the terms of Section 2.5) consistency and progression. Consistency is created by certain prominent sets (in particular 0147, its subset 014, and 015; see Example 7.1), by pitch references (the frequent conjunction of B and D, for example), and by construction of verticalities by superimposed thirds. Progression depends on, among other factors, large- and small-scale stepwise motion, the gradual clarification of that motion as it becomes more and more evident on the foreground, and (as we shall see) the emergence of unequivocal foreground meter. Yet these aspects of consistency and progression have little to do with the actual shapes of melodies, motives, and gestures. At the level of the *material* of the piece, the movement is extremely varied. There is also a wide variety of *textures* for a movement lasting a mere 17 measures. Is the music really through-composed, as it seems on the surface?

The movement *is* largely nonrepetitive. Yet there is something vaguely recapitulatory about the final phrase (mm. 15-17). If the movement had a greater number of thematic references, then this subtly disguised recapitulation might scarcely be noticed. But, in a context apparently devoid of melodic and gestural return, we search for some kind of transformation of earlier materials. And we seem to find it in mm. 15-17. What makes this coda reminiscent of an earlier passage? To which music does it refer?

Mm. 15-17 constitute a partial, transformed, and transposed restatement of mm. 0-1. The interval of transposition is the perfect fourth. Thus, the prominent melodic B-D-sharp of mm. 0-1 (part of an arpeggiated harmony in thirds) appears as E-G-sharp in the righthand simultaneity of mm. 15-17. The three-note melodic figure of m. 15 is a transposition of the first, second, and fourth lefthand notes of m. 0. The cadential neighbor motion F-F-sharp at the end of m. 1 becomes, a fourth higher, B-flat-B-natural-B-flat in m. 17. The melodic figure D-A-C-sharp in m. 16 is a transposition (up not one but two fourths) of the low chord in m. 1. The move from F-sharp to F-natural in the lowest voice of m. 17 is a reversal of the cadential F-F-sharp in m. 1. This time the reference is at pitch, as if to compensate for the preceding transposition by two fourths. Another at-pitch reference is the PC identity between the penultimate chord B-D-sharp-G-E and the left hand of m. 1 (both these tetrachords are furthermore associated with a sustained F).

This "recapitulation" is certainly unlike any return in a tonal piece. The pitch level is not preserved, and the materials are considerably varied. Furthermore, the transposition level is not constant: mostly the reference is up a fourth, yet the final F-sharp-F-natural is at pitch (while another voice suggests the same motion a fourth higher), as is the top D-sharp (corresponding to the isolated D-sharp of m. 1). The three-note figure in m. 16 is up two fourths. Despite these alterations, this ending reference to the opening phrase does help to close the movement, in the absence of more explicit correspondences. The interval of transposition is appropriate, since the most obvious earlier transposition (the two hands at the beginning of m. 2) is by the same interval, although in the opposite direction.

Also, the ending makes somewhat more explicit the tonal reference discussed in Section 7.3. After the big "V/V" cadence in m. 12 and the "altered dominant" suggestion in m. 13, mm. 15-17 function analogously to a tonic resolution. The "key" is D minor, with the sustained chord providing added notes. A triadic root of D with chromatic pitches added on is reminiscent of the cadential pitch complex in m. 6, although there is no hint of tonal root progression at that point. In mm. 15-17, however, D minor is actually implied, not only by the quasi-harmonic progression in mm. 12-15 but also by the melodic figure in the lowest voice of mm. 15-17. This line at first outlines D minor, which becomes D major momentarily at m. 17 before settling back finally into D minor.

Once again, I am not really calling this movement tonal. There are, however, unmistakable references to tonal procedures. They go beyond the use of verticalities and arpeggiations constructed in thirds. As the movement progresses, functional tonality becomes more and more possible to hear. True root functionality is never fully established, but its increasing plausibility is a linear process that propels the movement forward in time.

7.7 THE EMERGENCE OF FOREGROUND METER IN OPUS 19, NO. 1

Just as functional tonality seems to materialize gradually throughout the movement, and just as stepwise motion becomes more and more obvious, so the meter is gradually clarified during this movement. The opening is metrically nebulous. It is impossible to hear beats unequivocally as downbeats or upbeats in mm. 0-1. Does the tied-over B at the beginning of m. 1 really sound like a downbeat? Surely not. Schoenberg probably barred the music as he did to suggest to the performer that the thirty-second notes in m. 0 should be played as if leading somewhere, with a slight push forward. The end of m. 1 is cadential, in part because of the slowing motion and in part because of the overt stepwise motion from F to F-sharp. But the phrase that cadences has no clear relation to a hypermeasure, or even to a measure. The clear delineation of strong vs. weak beats is reserved for later in the movement. Foreground meter is a goal, not an assumption, of this music.

By comparison, the A that starts m. 2, despite being written off the beat, is a reasonable candidate for metric accent. Yet Schoenberg wrote that note on a weak beat for a reason, and a sensitive performer will not allow it to sound accented. The overlapped phrases in mm. 2-3 further obscure the meter.[6] There is an attack on the written downbeat for the first time at the start of m. 4. However, it is the fifth eighth-beat of m. 4 that receives the only unequivocal metric accent in the first third of the piece.

This metric fluidity does not obscure rhythmic grouping. With the possible exception of the phrase overlap in the first half of m. 3 (exactly where does the phrase that starts in m. 2 end, and exactly where does the subsequent phrase begin?), all phrases have clearly demarcated boundaries. They occur in mm. 0-1; starting in m. 2 and ending at the rest in m. 4; from midway through m. 4 to midway through m. 5 (with connecting material to the subsequent phrase in the alto voice); and from midway through m. 5 to the end of m. 6.

The second section (mm. 7-12) starts with the clearest meter thus far. The rhythmic repetition in m. 7 creates an unambiguous 2/4. The way the final D of m. 7 is held into m. 8, while nothing happens on the downbeat of m. 8, detracts from the clarity of this meter, however. By m. 9 the barline has become obscured, so that the low A sounds like an appoggiatura downbeat, despite its notation off the beat. The subsequent crescendo works against hearing the A as metrically accented, however. With the note of resolution, the G in m. 10, metric clarity begins to resurface. The meter is firmly re-established by the even eighth-note motion in m. 11, landing on the downbeat of m. 12. Thus the middle section has three clear hyperbeats, at the beginnings of mm. 7, 10, and 12.

The beginning of m. 13 is more strongly accented metrically than the large half cadence in m. 12, however. M. 13, which initiates the third section, is the movement's structural downbeat: It is the strongest metric accent, and it is also accented rhythmically. These accents are further supported by foreground stress: M. 13 and the fifth eighth-beat of m. 4 are the only places where a many-voiced chord is attacked simultaneously after a preceding silence. Also, the downbeat of m. 13 is the only place in the movement where the critical notes F and F-sharp (see Section 7.5) are sounded simultaneously.

Subsequent to the focal point of the movement in m. 13, the foreground meter remains unchallenged. The written meter becomes the sounding meter, whether it is 2/4 or 6/8. Thirty-second-note flourishes disappear in favor of an even eighth-note pulse. Not only foreground meter but also a metric hierarchy emerges unequivocally. Mm. 13-17 constitute a three-beat hypermeasure, with hyperbeats falling on the downbeats of mm. 13, 15, and 17. Whereas a multileveled graph of the metric hierarchy (analogous to Example 5.1) would be unthinkable in mm. 0-6, it could faithfully represent the metrical relationships in mm. 13-17. The middle section (mm. 7-12) is the middle stage in the evolution toward metric clarity: There are hyperbeats and hence hypermeasures, but shallower levels of organization are ambiguous. Is, for example, the high dyad midway through m. 8 metrically stronger than the downbeat of m. 8? Is the appoggiatura A in m. 9 more or less strongly accented than the unarticulated downbeat of m. 9?

The emergence of a clear foreground meter and of a concomitant metric hierarchy is a linear process. It moves parallel to, and thus reinforces, the growing clarity of voice leading, the emergence of an embryonic root-defined tonality, and the simplifying of textures (even eighth-note rhythms replacing more florid writing). These processes constitute the work's linearity. Because of them, the music moves through time until the final cadence. As stated initially, however, this linearity is essentially nondirected. As the music begins without clear meter, there is no necessary implication that the meter will become obvious, nor is there a single instant where we feel that metric clarity has been achieved. Similarly, the emergence of foreground stepwise motion cannot be predicted from the more disguised step connections of the opening. And the florid textures in the first two sections do not make us expect simpler textures. Nor are there any early implications of the eventual appearance of pseudo-tonal references and progressions. Therefore, although several factors conspire to create a powerful and unmistakable linearity, it is nondirected. We cannot feel where the music is ultimately heading.

It is theoretically possible to build into atonal linear processes implications about their goals. Nontonal directed linearity *is* possible. I turn now to the analysis of a rather different atonal work, in which linear goals are predictable and in which we therefore *can* feel where the music is heading. The forces of linearity are neither stronger nor weaker in Webern's Cantata No. 1 than in Schoenberg's Opus 19, but the two pieces feel very different because of the contrast between goal-directed and nondirected linear motion.

7.8 TWELVE-TONE ROWS: LINEAR OR NONLINEAR?

The presence of a twelve-tone row does not in itself guarantee (or preclude) either linearity or nonlinearity. The temporal structure of a serial composition depends, at least in part, on how the row is used. Nonlinearity, let us recall, is "the determination of some characteristic(s) of music in accordance with implications that arise from principles or tendencies governing an entire piece or section" (Section 2.1). A row *is* a structure—even a "principle"—that exists unchanged throughout a piece, but it does not necessarily "govern" the piece. It does not *determine* anything. A particular row makes certain intervallic combinations easier to obtain on the foreground than others, and hence some set types may be statistically more likely, but a row cannot preclude any sets or insure that others will be structurally important. Furthermore, rows can be deployed in numerous ways: melodically, contrapuntally, chordally, and so forth. Thus the rigid adherence to a particular row does not in itself result in musical consistency. It is theoretically possible (as many composition teachers can attest) to create a piece that is strictly twelve-tone yet that does not cohere.[7] All that a row really guarantees is the frequent turnover of the total chromatic—strictly speaking, a nonlinear principle, but no more special in itself than the use of tonality in Baroque, Classical, and Romantic music. Beyond total chromaticism, the row creates nothing by itself. The *ways it is used*—sometimes linearly, sometimes nonlinearly—determine the structures of a twelve-tone work.

Webern, as opposed to Schoenberg and Berg, was particularly interested in symmetrical deployments of rows. The freezing of seven of the twelve pitch classes in register for the entire second movement of the Piano Variations, opus 27 (1936) is a well-known example. That movement also uses a limited repertory of quasi-motivic cells (similar to the cells in Stravinsky's *Symphonies of Wind*

Instruments; see Section 9.1). To create a sense of linear motion within a style that favors such nonlinear symmetries is a compositional challenge, which Webern met in various ways in different pieces.

The opening movement of the Cantata No. 1, opus 29 (1939) abounds in symmetries, yet it moves unmistakably toward a *harmonic* goal. Before discussing how this linearity operates, we should consider the nonlinearity against which the forward motion works.

7.9 ROW SYMMETRIES IN WEBERN'S OPUS 29, FIRST MOVEMENT

Like the series in most of Webern's twelve-tone compositions, the row in Opus 29 has certain inherent symmetries. It has 24, rather than a full 48, distinct forms, because each inversion is also a retrograde. Since both inversion and retrograde serve important functions in the first movement, it is difficult to decide whether to omit I or R row labels. I have chosen to follow George Rochberg, whose 1962 analysis of this movement is the first to label the rows.[8] Rochberg omits all I labels in favor of R designations.

An additional row symmetry is its restriction to only three interval classes between adjacent notes: IC1, IC3, and IC4.[9] Since Webern uses the row in a predominantly horizontal fashion, these three ICs function as melodic intervals (these ICs also have harmonic significance; see Section 7.10). The remaining three ICs rarely appear melodically. They are reserved for other functions. IC6 is a transpositional generator, while IC2 and IC5 are mainly vertical intervals. IC1 and IC3, as we shall see, also appear in chords, but IC4 is only occasionally a component of a simultaneity. Thus two ICs have consistent functions: IC4 is used almost exclusively horizontally and IC6 is mainly employed for transpositions. This separation of ICs according to function is as much a determinant of the nonlinear consistency as is the intervallic content of the row.

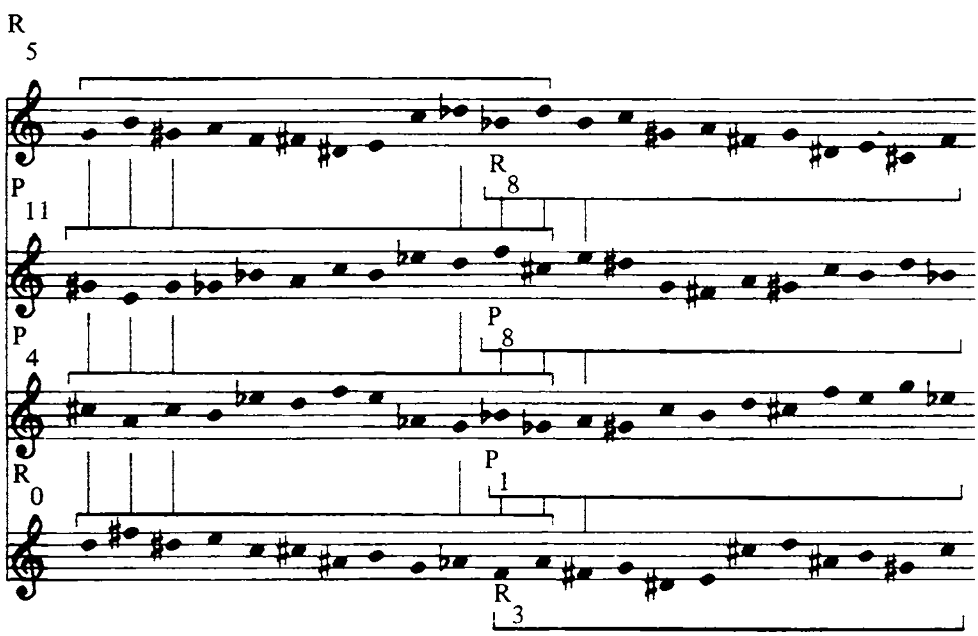
***Example** 7.2.* **Webern, Cantata No. 1, opus 29, primary row form P_0**

The interval content of each trichord of the row is the same. That is, the prime set form of each trichord is 014. Also, since the row begins and ends with the same interval, the final two PCs of one row form can overlap with the first two PCs of another form. Thus, P_i overlaps with P_{i-3} and R_j overlaps with R_{j+3}. Successively overlapped row forms produce a closed system, since after four overlaps the original row form returns ($3+3+3+3=0$ mod 12 and $-3-3-3-3=0$ mod 12).

7.10 NONLINEARITY IN OPUS 29, FIRST MOVEMENT: MM. 1-13

The music unfolds four row forms more or less simultaneously. In the first section, mm. 1-13, these forms are R_5, P_{11}, P_4, and R_0. These four forms are overlapped to, respectively, R_8, P_8, P_1, and R_3 (see Example 7.3). These four row strands would produce, if actually sounded simultaneously, a limited repertory of chords: two tritone-related transpositions of 0158, two tritone-related transpositions of 0257, one form of 0167, and two tritone-related forms of the perfect fourth 05. These sets (the four-PC sets can be referred to as "tetrachordal verticals")[10] are shown in Example 7.4. This chordal system is economical; only four set types appear in the 22 chords of Example 7.3. Each of these set types occurs in only two transpositions (related by the IC6, the interval class associated with transposition), except that 0167 (which is its own tritone transposition) occurs in one form only. Thus there are seven distinct PC collections—five tetrachordal verticals and two perfect fourths—distributed among the 22 verticalities. Only a few of these sets are actually sounded as chords, however. The vertical lines in Example 7.3 indicate the simultaneities that actually are heard; see mm. 1, 6, and 7. These measures are a textural and harmonic anticipation of the chorus material. Since the remaining measures are characterized instead by a hocket-like pointillism, the system of limited simultaneities remains only an embryonic force.

The four set forms that provide the total potential harmonic material of mm. 1-13 contain few tritones. The only set in Example 7.4 with any tritones is 0167



Example 7.3. **Webern, Cantata No. 1, first movement, row forms in mm. 1-13**

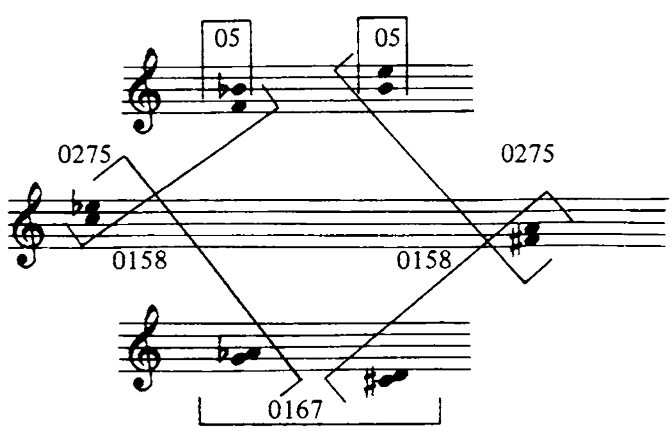
Example 7.4. **Webern, Cantata No. 1, first movement, tetrachordal verticals available in mm. 1-13**

(after m. 13, no tetrachordal verticals contain tritones). This fact helps Webern reserve the tritone for transposition. It is rarely heard vertically or horizontally. (IC2 is also rare in the harmonic system of mm. 1-13, but this fact is less significant, given the prominence of IC2 in the verticalities of mm. 14-47.)

The seven PC collections that form the closed harmonic system of mm. 1-13 are interrelated, as Example 7.5 shows. Each staff in Example 7.5 contains two tritone-related intervals: IC1, IC3, and IC5. The six dyads of Example 7.5 exhaust the total chromatic without duplication.

Each of the seven PC collections of Example 7.4 appears twice in each of the two row statements of mm. 1-13 (Example 7.3), except that the two 05s appear once each. This is appropriate, since these two 05s combine to form a 0167, and there are only two 0167s in each row form while there are four 0158s and four 0257s. The number of times each set type appears as a verticality in the first row forms equals the number of times it appears in the second row forms (of Example 7.3): twice for 0167 and 05, four times for 0257 and 0158. Furthermore, by replacing all 0167s by 05s in the first statement, all 05s by 0167s, and similarly exchanging 0158s and 0257s, we obtain the exact *order* of set types in the second row statements.

The relationships and symmetries mentioned thus far form a tight, restricted, economical structure that is not particularly audible on the surface. This struc-



Example 7.5. **Webern, Cantata No. 1, first movement, interrelationships between tetrachordal verticals in mm. 1-13**

ture is nonlinear in that it is unchanging throughout the section. But it is not really a strong force in the music. The music is predominantly linear, although its underlying nonlinear structure does provide certain consistencies and does, moreoever, connect with the more directly audible nonlinear harmonic structure of mm. 14-47.

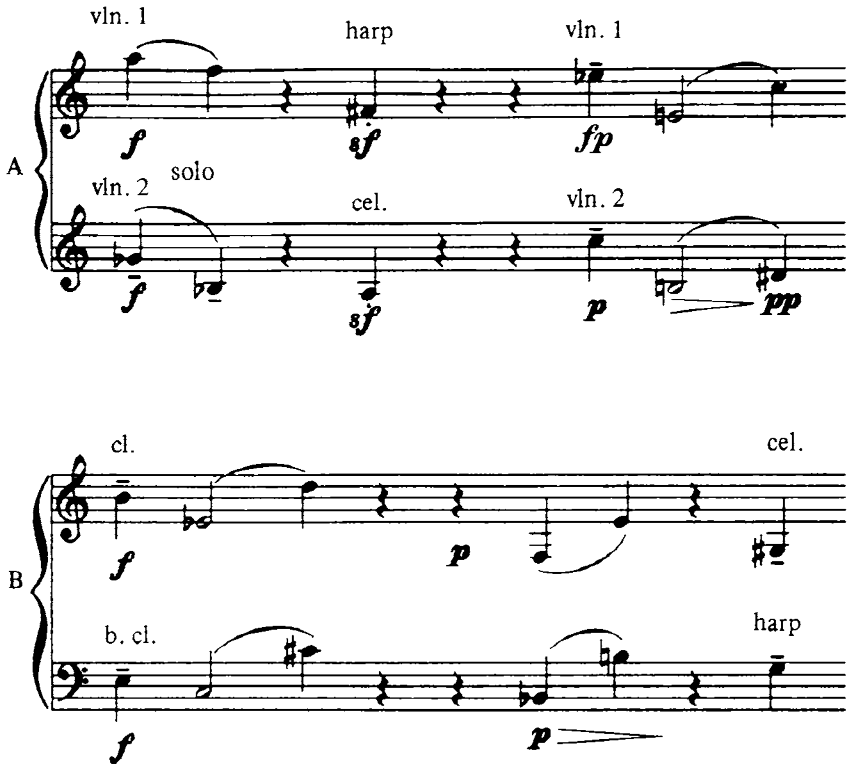
There is one further symmetry operating in mm. 1-13, however. This relationship is functional on the surface of the music, and it is linear. One of the striking features of m. 1 is the voice-leading exchange of G and G-sharp from the first to the third chords in the brass. This exchange is repeated (significantly transposed by a tritone) in m. 6. These relationships are important, because the row strand (in Example 7.3) starting with R_5 is an inversion *about the axis G-G-sharp* of the row strand beginning with P_{11}. The other two row strands of Example 7.3 are inversionally related around the tritone-related axis D-D-flat.[11] Actually, when we consider pitch classes rather than actual pitches,[12] we realize that inversion around an axis is equivalent to inversion around a tritone-related axis. In other words, if we invert R_5 around G-G-sharp, we get the same PCs, those of P_{11}, that result from inverting R_5 around D-D-flat. These axes of symmetry are preserved, despite the change in the harmonic system, when the chorus enters in m. 14. At that point they become audibly significant, since most of the verticalities actually sound (see the vertical lines in Example 7.8) in inversionally invariant chords (see Section 7.14). Thus the nonlinear harmonic system in mm. 1-13 contains a linear anticipation of the (also nonlinear) harmonic system that arrives in m. 14.

7.11 LINEARITY IN OPUS 29, FIRST MOVEMENT: MM. 1-13

The music between the chordal refrains, mm. 2-5 and 8-13, is canonic. The PCs and durations are strictly imitative. One line, R_5, moves from first violins to harp and back to first violins in mm. 2-5. This line is echoed two quarter beats later by its PC inversion P_{11}. The durations and (to a large extent) the articulations, dynamics, and timbres support the imitation: second violins to celeste to second violins. The contours do not support the inversional canon but rather suggest prime-form imitation. Thus the *descending* major third in the first violins, m. 2, is answered not by an ascending major third in the second violins but rather by another *descending* form of IC4, a minor sixth (m. 2).

This canon is presented simultaneously with a second canon, which uses the same motivic figures in permuted order. The clarinet and bass clarinet in mm. 2-3 correspond motivically to the violins in mm. 3-5; the clarinets in m. 4 echo the violins in m. 2; the celeste and harp in mm. 4-5 echo the harp and celeste in mm. 2-3. This second canon is also at the time interval of two quarter beats. The PCs are again imitated in inversion, while the contours suggest straight imitation. The two canons are shown in Example 7.6. The voices are aligned vertically (and barlines are omitted) to show canonic correspondences. The labels "Canon A" and "Canon B" are adopted from Graham Phipps' analysis.[13]

The double canon resumes in m. 8, after the chordal refrain in mm. 6-7 (see



Example 7.6. **Webern, Cantata No. 1, first movement, double canon in mm. 2-5 with voices adjusted horizontally to show canonic correspondences**

Example 7.7). The beginnings correspond to m. 2: The violins start two quarter beats apart with the fourth and fifth notes of their respective row forms (the same row strands from which their music is derived in mm. 2-5); the clarinets also begin in a comparable place in their row forms two quarter beats apart; both clarinets and violins use their motivic figures from mm. 2-3; contours are again preserved (but not inverted). Because of the overlap of row forms in m. 6, however, the pitch relationship between the violins and between the clarinets is changed. Thus, for example, the first violins start a major third higher in m. 8 than in m. 2, while the second violins begin a minor third lower. As a result, Webern is able to utilize register to produce a momentary harmonic stasis. The first clarinet A-flat-C (mm. 8-9) echoes the first violins' C-A-flat (m. 8), and the second violins similarly echo the bass clarinet (G-E-flat in m. 8) *in register.* The registral identity of the harp and horn F-sharps in m. 9 furthers the effect of harmonic stasis. The result is a gradual transition from the slow motion (*getragen*) of mm. 6-7 to the *lebhaft* of mm. 8-11. By the time the dyad G-E-flat returns a third time (clarinet in m. 10), the register is fresh to signal that the music is again moving. Similarly, the second violins' A-flat-C occurs in m. 11 in a different register from the first violins' and clarinet's statement in mm. 8-9.

Example 7.7. **Webern, Cantata No. 1, first movement, double canon in mm. 8-13 with voices adjusted horizontally to show canonic correspondences**

A consequence of the gradual, rather than sudden, return to fast motion is the intrusion of the *getragen* tempo on the *lebhaft* music, in m. 9. As Webern indicates in mm. 1-2, the quarter beat remains the same from *getragen* to *lebhaft,* although the perceived pulse changes from the half to the quarter beat. The effect in m. 9 is the slowing down of the motivic figures. This occurs simultaneously in all sounding voices, despite the canonic structure, so that the canon is no longer rhythmically strict. It is as if, as Robin Hartwell explains, "Webern has taken the canonic texture and cut across it homophonically; he has rhythmically augmented bars 9 and 12 by a factor of two."[14] Resulting from this interpenetration of tempos and harmonic rhythm is the breakdown of the rigid timbral distinction between canonic voices. While, for example, the line that starts in the second violins (m. 8) does return to the seconds (m. 11), the canonic partner that starts in the first violins (m. 8) finds its way to the clarinet by m. 10.

Despite the underlying closed harmonic system, the musical surface is distinctly linear, in part because of the nearly constant renewal of combinations of timbre, register, and pitch, and in part because of the progression from clearly delineated slow and fast motion to the interpenetration of the two.

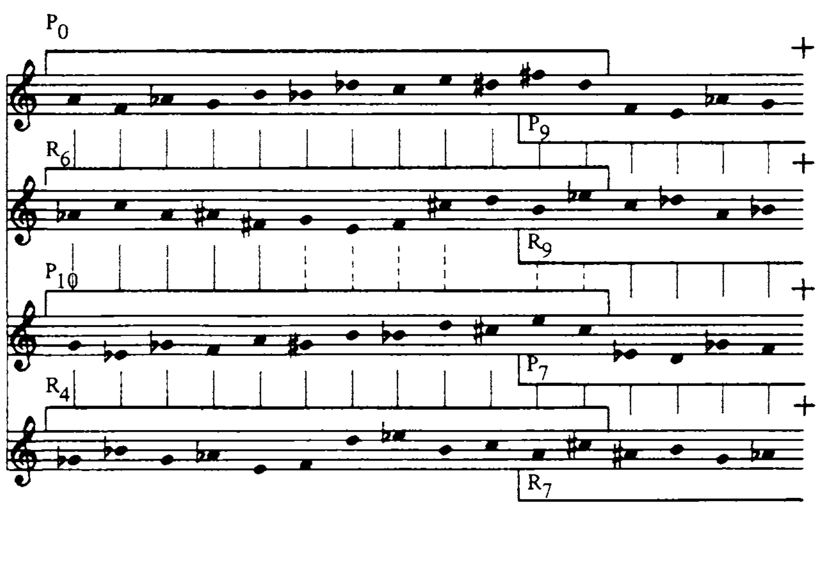
7.12 NONLINEARITY IN OPUS 29, FIRST MOVEMENT: MM. 14-47

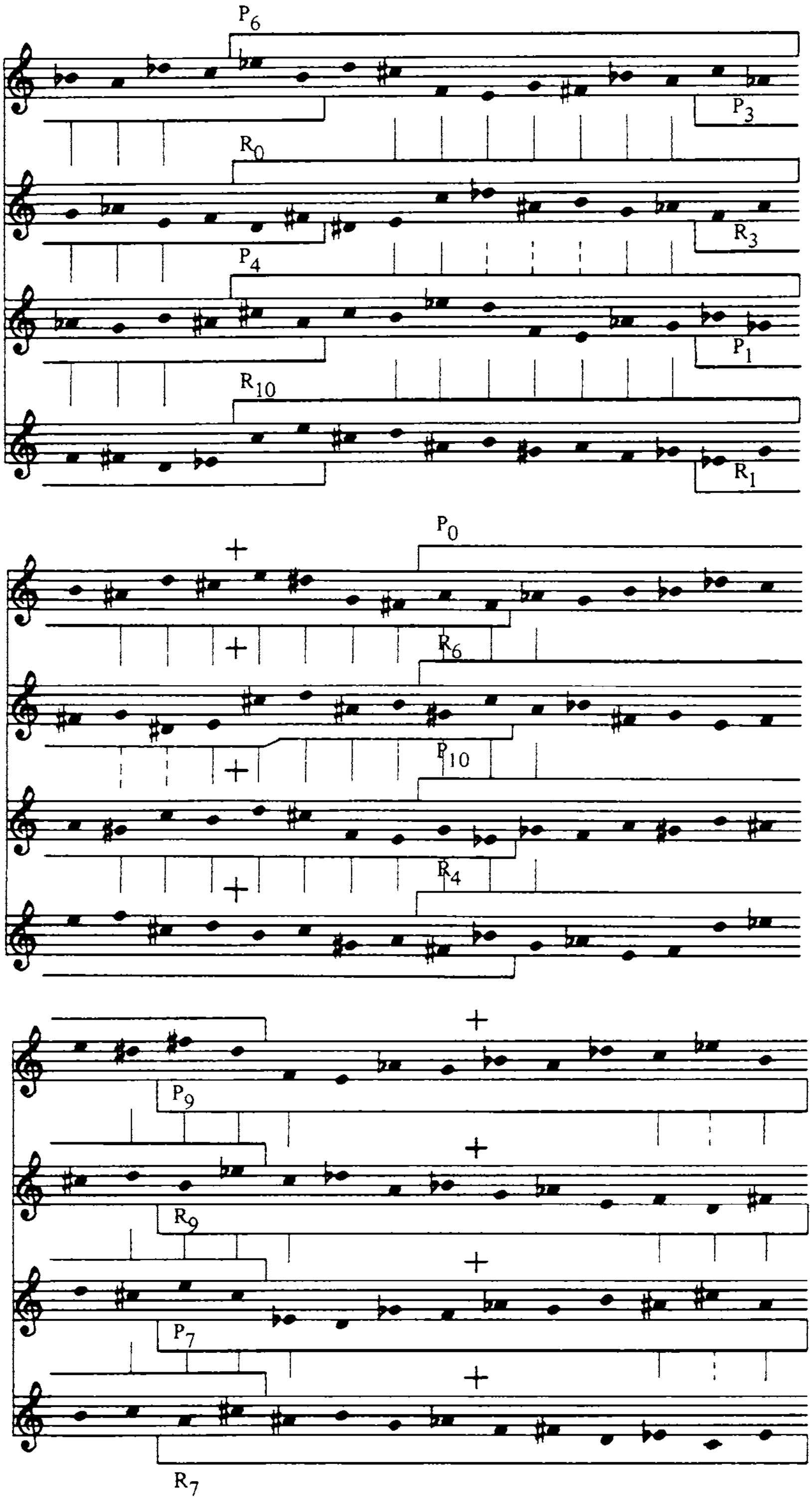
The serial structure in the first section does not continue for a full cycle of four row forms. Instead, the chain is broken at its midpoint for the chorus entrance, which initiates a new, but similar, construction. The remaining half cycle would have used row forms R_{11}, P_5, P_{10}, and R_6. The new system starts with the latter two forms (in the tenors and altos respectively), but their partners become P_0 and R_4 respectively. The interval of parallel motion (soprano-tenor, and also alto-bass) is now IC2, whereas it was previously IC5 (see example 7.3). This is significant in light of the usage of IC2 and IC5 primarily as vertical intervals. The new system turns out to be more economical than the original system. Furthermore, since the chorus is nearly always homophonic, the verticalities are indeed audible. The chordal structure becomes an important organizing principle of the music.

The full cycle-and-a-half of row strands, mm. 14-47, is shown in Example 7.8. As in Example 7.3, the vertical lines indicate actual simultaneities. Dotted lines show nearly simultaneous sonorities that still function as harmonic units. The large number of vertical lines in Example 7.8 attests to the perceptual importance of the closed harmonic system in the second and third sections of the movement.

In the entire presentation of four row strands, only three set forms appear as tetrachordal verticals: 0123, 0257, and 0235. Each appears in two transpositions, related by IC6. Thus there are only six chords (shown in Example 7.9) available by sounding simultaneously the PCs that occur in the same order position in each of the four row strands of Example 7.8. Each of the 62 verticals in these row strands is one of these six chords. Furthermore, 43 of the 62 verticals

Example 7.8. **Webern, Cantata No. 1, first movement, row forms used in mm. 14-47**



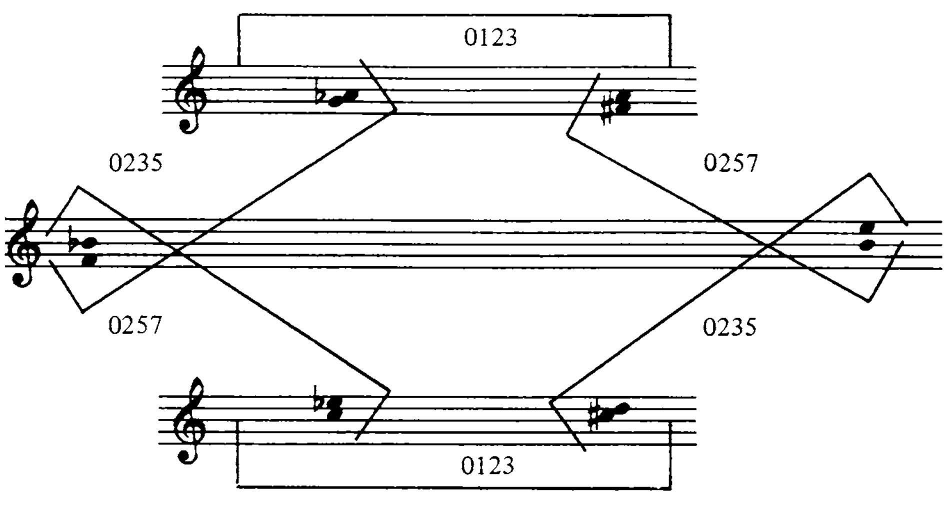

P_6
P_3
R_0
R_3
P_4
P_1
R_{10}
R_1
P_0
R_6
P_{10}
R_4
P_9
R_9
P_7
R_7

Example 7.9. **Webern, Cantata No. 1, first movement, tetrachordal verticals available in mm. 14–47**

actually appear as chords. Significantly, none of these verticals contains either IC4, the primary linear IC of the movement, or IC6, the primary transpositional generator.

These six PC collections are interrelated in a manner similar to that of the first section (Example 7.5). The six dyads of Example 7.10 are the same as those of Example 7.5.

Each of the six statements of four simultaneous row forms in Example 7.8 contains four 0123s, four 0257s, and four 0235s. The order of these set forms for the first row statements is 0123, 0257, 0123, 0235, 0257, 0235, 0235, 0257, 0235, 0123, 0257, 0123. This ordering is retrograde-invariant, which is significant in the light of the movement's retrograde structures (see Section 7.13). Furthermore, this order is repeated in the third and fifth row statements of Example 7.8. By interchanging 0123 and 0235, we obtain the order of set types in the second, fourth, and sixth row statements. 0257 remains in the same order positions in each row statement. This order invariance is appropriate, given other invariances of the set type 0257. It is the only tetrachordal vertical common to the two closed harmonic systems of the movement (in mm. 1–13 and in mm. 14–47). It appears in the same two transpositions throughout the work, one of which, as demonstrated in Section 7.15, comes to assume the role of harmonic goal.



Example 7.10. **Webern, Cantata No. 1, first movement, interrelationships between tetrachordal verticals in mm. 14–47**

Each group of three successive tetrachordal verticals has the same first and last members, the middle vertical being 0257. In the first, third, and fifth row statements, this microscopic retrograde symmetry of set types is supported by transposition levels (in other words, the retrogrades are articulated by PCs, not just by configurations of intervals). Consider, for example, the first three chorus chords, m. 14. The first and third chords have exactly the same PC content; the middle chord is based on set 0257. The relationship between the first and third chords derives from the voice exchanges (already noted in Section 7.10) in mm. 1 and 6. Now these exchanges operate in four, not two, voices, and they often occur overtly. See mm. 14, 15-16, 17, 18-19, 26-27, 28-29, 36, and 41.

7.13 RETROGRADE SYMMETRIES IN OPUS 29, FIRST MOVEMENT

The three-vertical symmetries of mm. 14-47 relate to larger retrograde relationships. The second, fourth, and sixth statements of four simultaneous row forms in Example 7.8 each contains a repeated PC collection at its midpoint. These repeats (marked with crosses in Example 7.8) are the only immediately reiterated PC-collections in the movement. Each of these reiterations marks the center of a large-scale retrograde structure, covering, respectively, 32, 52, and 12 tetrachordal verticals. The repeated verticals occur in mm. 21, 33-34, and 44-45. The large-scale retrogrades are not always overtly articulated on the foreground. Rather, they form a backdrop against which the music is articulated into phrases (see Section 7.16). The retrograde structures come into and go out of focus, just as they sometimes agree with and sometimes contradict the phrases.

The center of the first retrograde occurs between the second and third chords of m. 21. The retrograde structure extends from m. 14 to m. 31. The equivalence of mm. 18 and 25 (except for the absence of the chorus from m. 25 and of the percussion from m. 18) underlines this retrograde in a nonserial manner (each PC in m. 18 occupies the same order position of its respective row form, as does each PC of m. 25). The intervening PC retrograde is not, however, supported by register or note durations. The total duration of mm. 18-21, however, equals that of mm. 21-25. The harmonic similarity of m. 17 and mm. 26-27 is unmistakable, although m. 27 sounds like the third vertical of m. 17 when it in fact corresponds to the first. This exchange of reference is possible because of the three-PC-collection retrograde symmetries discussed at the end of Section 7.12.

The retrograde centering around the barline between mm. 33 and 34 is the longest. It extends from m. 19 through m. 47. Since this retrograde structure crosses over a major formal articulation (the recapitulation begins in m. 36) it is less functional than the one just described. The reiterated central chord (mm. 33-34) is surely striking, but the only other strongly articulated correspondence is at the extremities of the retrograde, which are heard more as chords referring to one another than as boundary points of retrograde motion. The homophonic passages usually reappear in retrograde as fragmented orchestral lines, so that the surface significance of this structure is minimal.

The remaining retrograde is relatively brief. It covers the one row form used last, since it extends from m. 41 to m. 47. The center, which falls in the neighborhood of mm. 44-45, is obscured because the verticals are not stated as chords. Several IC4 dyads correspond (although not generally in register or timbre), however: G-B in the cello (m. 43) and clarinet (m. 46), A-C-sharp in clarinet (mm. 43-44) and viola (m. 46), D-F-sharp in bass clarinet (m. 44) and cello (m. 46), and E-G-sharp in first violins (m. 43) and bass clarinet (m. 46). The three chordal verticalities in m. 47 correspond not to the three in m. 41 but to the last two in m. 41 and to the harp chord in m. 42 (the timbral and intervallic equivalence of the harp chords in mm. 42 and 47 has nothing to do with the retrograde structure but has a lot to do with the process of cadencing; see Section 7.15).

This small final retrograde is the most clearly perceptible of the three. The process of retrograde, which has been present but not fully articulated throughout the movement, comes more into the open for cadential purposes. Earlier in the movement, retrogrades work against the phrase structure (see Section 7.16), whether they are the literal PC retrogrades discussed here or textural symmetries, such as the correspondence of mm. 1 and 6 around the intervening contrasting measures. The conflict between phrases determined by cadence and closed retrograde structures provides an undercurrent of tension and a fluidity sometimes lacking in Webern's earlier serial music, where retrograde structures often define phrases. This tension is resolved, in linear fashion, when the end of the final (and most obvious) retrograde coincides with the final cadence.

7.14 INVERSIONAL SYMMETRIES IN OPUS 29, FIRST MOVEMENT

All of the PC sets in Examples 7.3 and 7.8 are inversionally invariant, except 0158. Such inversional symmetry need not be articulated registrally, of course. For example, 0257 appears in an inversionally symmetrical voicing in the latter half of m. 15 but in an inversionally nonsymmetrical disposition in m. 7. An isolated instance of inversional invariance, as in m. 6, is not so striking that it stands out from the surrounding nonsymmetrical chords. The consistent use of symmetry tends to be noticed, however. When several simultaneities are inversionally invariant, we can hear them as fanning out from their inversional centers. Any remnants of harmonic bass orientation fades when centers of inversion are used consistently. I am not suggesting that the centers of inversions form a melodic line, analogous to a tonal bass. As the centers are often not even sounded, their function is quite different from that of a tonal bass. Yet, inversional symmetry is an organizing principle that can compensate for the loss of functional bass lines in much atonal music. When the axis of inversion is constant for much of a passage, inversional invariance can be particularly prominent. Such a situation is potentially present in mm. 14-47, since every tetrachordal vertical in Example 7.8 can be represented as a chord that is symmetrical about the axis C-sharp-D (or G-G-sharp).

Mm. 1-13 consistently avoid inversionally invariant sonorities. The only symmetrical tetrachordal verticals in the opening section are heard at the beginning, and at the start of m. 6. But the entrance of the chorus in m. 14 brings inversional invariance to prominence. The voices consistently sing verticals symmetrical about the axis C-sharp–D, except in three places. The axis is a tritone higher on the last beat of m. 14 through the first beat of m. 15, m. 20 through the first beat of m. 21, and the first half of m. 34. The first of these exceptions helps provide a smooth transition into a context that uses predominantly a single axis of inversion. The higher register of mm. 20–21 helps to stress the thematic relaunching of the material first introduced at m. 14. Furthermore, this transposed center of inversion prevents the retrograde structure centering in m. 21 (see Section 7.13) from becoming too obvious. The first chord of m. 34 has a transposed axis to avoid too obvious a reiteration of the preceding vertical (this is the turnaround point of the largest retrograde structure).

At the recapitulation (m. 36), the introductory orchestra and central chorus material are brought together. Instruments play three chords that are symmetrical about the same axis that dominates the choral music. Similarly, the string chords in m. 41 are inversionally invariant about C-sharp–D. The first two chords of m. 47 are symmetrical about an axis a tritone lower than the main axis, perhaps as a balance to the occasional axes a tritone higher in the middle section.

The consistent use of inversionally invariant pitch structures is typical of Webern. His approach to harmony in such contexts is decidedly different from that of most earlier composers, and even of his contemporaries. In Schoenberg's Opus 19, as we have seen, there are times when the bass line acts quasi-functionally, even in the absence of tonality. Webern's conception of harmony from the middle out rather than from the bottom up is a radical redefinition of tonal space. The result can be (in pieces like the Piano Variations, opus 27, or the Symphony, opus 21) static pitch structures, suggestive of moment (Chapter 8) and even vertical (Chapter 12) time. It is no coincidence that many later composers openly embraced inversional symmetry as a means to create a language of static harmony. Composer Jonathan Harvey has written:

> The bass moves into the middle: this is our musical revolution. Several composers after Webern, myself included, have been fascinated by harmonic structures which radiate out from either side of a central axis in reflecting intervals. Unless a strong contrary line is taken in atonal music, the bass will remain at the bottom of what sounds like dissonant music. But in symmetrical mirroring structures, it is *forced,* focal attention is forced, into the axial middle, because all relationships converge there: the sounds *point* to it. . . .
>
> Omni-directionality was seized upon by Webern—it suited . . . his sense of space, serenity, and timelessness (manifest also in his love of mountains, with their vast vistas and monumental immobility). That he often spoke of floating feelings in connection with both mountain heights and axially symmetrical music is perhaps . . . most important. . . . [He wrote,] "There is not a single center of gravity in this music [the First Cantata]. The harmonic construction is such that everything remains in a floating state."
>
> He used the omni-directionality to inform many aspects of his thought, not only inversion around an axis vertically, but palindromic symmetry around an axis horizontally.[15]

What many contemporary composers, such as Harvey, found in Webern's music was an aesthetic that pointed toward the stasis of moment and vertical time. And they found sophisticated techniques that enabled them to compose timeless moments. Harvey has also written:

> To be liberated from the bass with its dynamic tonal shifts necessitates a more static, *undynamic music,* fixed for longer periods by its axes. . . . The music is more contemplative than active in spirit; more concerned with space than time, with being rather than becoming, with the Absolute rather than the Relative; closer to Palestrina, with his de-emphasized floating curves, and modal oriental music, rather than its own recent past. If music shifts away from frenetic teleologies and obsessive dynamism, well, this may reflect the spirit of the ending of the late capitalist phase of the West, the awakened interest in inner space and transcendental states of consciousness.[16]

Webern's music may suggest timelessness in many ways, but it does not fully embrace stasis. The first movement of Opus 29, for example, is linear as well as nonlinear. It bespeaks Webern's extraordinary craft that he was able to use such potentially nonlinear constructions as inversionally invariant chords, retrograde structures, and limited repertories of chords, and achieve within these restrictions an unmistakable sense of linear harmonic motion toward definable goals.

7.15 HARMONIC LINEARITY IN OPUS 29, FIRST MOVEMENT

Much of the analysis thus far has focused on nonlinear aspects of Opus 29's opening movement. Nonetheless, the music's linearity is striking. It is created contextually rather than serially, although it necessarily derives from the underlying row structure. What this linearity consists of is the emergence of a particular transposition of 0257 (F-sharp-E-A-B) as a stable harmonic goal. I am saying considerably more than that we hear many 0257s and therefore expect more. I am claiming that this particular chord is expected in such contexts and in such ways that it assumes the role of *goal.* The music seems to move toward it, and tension is resolved when the piece cadences on this chord. I am not suggesting that the first movement of Opus 29 is tonal, just as I stopped far short of asserting an underlying tonal structure in Schoenberg's Opus 19. Nonetheless, despite the nonlinear symmetries that create a consistent and fascinating context in the cantata's opening movement, the work *is linear.*

Before discussing the emergent harmonic stability of 0257, I want to consider another linear process: the increased prominence of IC4 as a melodic interval. IC4 is the first melodic interval in the piece. Each of the four voices in m. 1 moves simultaneously by major third. Furthermore, the last chord of m. 1 contains two vertical IC4's. The subsequent double canon (mm. 2-5, Example 7.6) is a mosaic of points, dyads, and trichords. Half of the dyads use IC4, and every trichord states IC4 melodically. Thus mm. 2-5 are a linear outgrowth of m. 1. Each of the IC4s in mm. 2-3 has one and only one PC in common with one of the IC4s in m. 1. The two IC4s in the strings, mm. 4-5, reiterate the two wind IC4's of mm. 2-3. M. 6 ends as m. 1 begins; each voice plays an IC4. By the end of m. 6 we have heard ten of the twelve IC4's melodically and the other two (E-flat-G and A-flat-C) chordally at the end of m. 1. These remaining two dyads are emphasized melodically in mm. 8-11.

The manner in which mm. 8-13 grow out of mm. 1-5 suggests the large-scale structure of the movement. Just as a closed harmonic system is presented in mm. 1-13, only to be replaced by an even more rigorous system in mm. 14-47, so mm. 8-13 present a stricter version of the compositional logic introduced in mm. 1-5. The four IC4 dyads introduced last melodically (B-flat-D, D-flat-F, A-flat-C, and E-flat-G) are reiterated to the complete exclusion of all other IC4s. B-flat-D is heard only once in mm. 8-13 (bass clarinet, mm. 10-11). D-flat-F is sounded twice (first violins in m. 11 echoed in register by the horn, m. 12). A-flat-C and E-flat-G are presented thrice (twice in register; see Section 7.11), thus making mm. 8-11 seem to grow harmonically out of the 0158 chord (E-flat-G-C-A-flat) at the end of m. 1.

When the chorus enters in m. 14, four melodic IC4s are sung simultaneously: the previously emphasized E-flat-G and A-flat-C, and the two that are sounded once but not reiterated in mm. 1-5, F-A and G-flat-B-flat. The chorus entrance satisfies the implication for reiteration of all IC4s.

Because of the melodic deployment of row forms in the choral music, IC4s continue to predominate. The orchestral statement of A-flat-C (in the high first violins) and E-flat-G (cellos) in mm. 30-31 is particularly important, however, as these dyads prepare the upcoming recapitulation by recalling the most emphasized IC4s of the exposition. This reference is intensified by the chorus in m. 32, which sings the exposition's four most emphasized IC4s. The connection to the recapitulation is completed by the clarinets' E-flat-G and A-flat-C at m. 36.

Throughout the canonic portions[17] of the recapitulation, IC4 permeates as a motive. But it no longer makes specific PC reference to the most emphasized major thirds. IC4 has done its work. It has established a background sonority in mm. 8-13 (E-flat-G plus A-flat-C) and kept it foremost in memory throughout the middle section. This specific reference gives way in the final section to a more structurally important reference: the increasing stability of the 0257 tetrachordal vertical (in particular, F-sharp-E-A-B).

When we hear this chord as the final sound, it is unquestionably stable. It sounds like a tonic. We know that the movement has ended, not only because of the phrase structure and the rhythm but also because of the completion of a linear, quasi-tonal process. How has this 0257 come to assume the role of "tonic"?

The chord is first heard as the middle member of the opening progression. Although certainly prominent in m. 1, it is not yet stable. It results from a melodic push of IC4 in each voice, which then relaxes back to the third chord (0167). When the opening gesture returns (m. 6), apparently transposed down a tritone, we expect the tritone transposition of the 0257 from m. 1 as the second chord. The staggering of brass and strings is significant. During the instant when we hear the brass F-B-flat, our expectation seems about to be satisfied. But then the strings play not the expected E-flat and C but rather a reiteration of the brass notes. Instead of the expected chord, we hear a hollow perfect fourth. As a result, the third chord feels less closed than does its counterpart in m. 1. More music—another chord—is needed. When that chord turns out to be 0257 (m. 7) in its original transposition (not the tritone-related pitch level expected and denied in m. 6), F-sharp-E-A-B begins to be understood as stable. Significantly, the final arrival of this chord, m. 47, is spaced exactly as in m. 7.

This vertical contrasts with its surrounding context. Five of the six intervals contained in 0257 are either IC2 or IC5, two intervals noticeably absent from the predominantly horizontal music of the double canons (mm. 2-5 and 8-13). Thus 0257 stands out as a harmonic entity, in contrast to the surrounding melodic music, which is pervaded by IC4 and IC1.

By the chorus entrance, then, 0257 has become an important referential sonority, which is understood as a harmonic entity. Furthermore, a particular transposition of this tetrachord is emphasized in mm. 1 and 7. It is significant, therefore, that the opening chorus phrase ends on this same transposition of 0257 (last chord of m. 15). Harmonic reference to 0257 can continue because it is the only tetrachordal vertical common to both harmonic systems, the one in mm. 1-13 and the new one in mm. 14-47. M. 15 begins to suggest that this chord is not only frequent and stable but also cadential. Thus it begins to acquire its status as goal. The harmonic linearity of the movement begins to form itself. We begin to understand that the movement may be headed toward a final cadence on F-sharp-E-A-B.

This chord relaunches the chorus in m. 19, and it is again cadential in m. 28. By this point its role as harmonic goal is undeniable. This is proved in m. 32, where it is an expected and denied goal of what works very much like a deceptive cadence. Because of previous voice-leading patterns, we expect the goal chord after the first two verticalities of m. 32. Instead of 0257, however, we hear 0235, with two PCs (B and E) in common with the expected harmony. Tension is heightened when the deceptive chord is repeated (this is one of the centers of large retrograde structures), with its axis of symmetry transposed up a tritone for emphasis. When we finally hear the suppressed 0257 in m. 35, the sense of cadence is strong. A previously denied goal is now achieved. This deceptive cadence and eventual resolution demonstrate Webern's incredible compositional technique: He was able to create and deny harmonic expectation within a strictly serial, and harmonically very restricted, context.

The sense of resolution in m. 35 is appropriate for the end of the middle section and the exit of the chorus. In fact, the stability is so complete that Webern has to cut the chord short (the orchestral recapitulation intrudes sooner than expected) to avoid premature finality. The interruption is only partial, however, because of harmonic similarity between the chord of m. 35 and the first chord of m. 36—the outer voices exchange PCs.[18] Thus, by m. 35, F-sharp-E-A-B is a stable goal, almost a tonic. When the chord returns at the end, it does far more than refer back to these earlier occurrences. It forms the cadence—the *harmonic* cadence—of the movement. We might not expect a piece so limited in its vertical structures to move to a quasi-tonal goal. Rather, we might anticipate a static alternation between the few available chords. But Webern shifts the balance of those verticalities so that one in particular emerges as a cadential goal.

M. 47 recalls the other three-chord motives: mm. 1, 6, 14, 36, and 41. For the first time, F-sharp-E-A-B is the final member of the progression.[19] Because it is heard in the harp, it also refers back to its tritone transposition in m. 42 (reiterated at the beginning of m. 47). We might also call this tritone-related 0257 a "dominant." After all, a tonal dominant is a transposition up a perfect fifth (the predominant tonal interval of transposition) of the tonic triad. Here the "dominant" is a transposition up a tritone (the predominant interval of transposition in this movement) of the "tonic" 0257.[20]

7.16 PHRASE STRUCTURE IN OPUS 29, FIRST MOVEMENT

The referential IC4s and the emergence of 0257 as goal are two linear processes in Opus 29's opening movement. There are others. In discussing retrograde structures, Section 7.13 mentions the way they are played off against the phrase structure. The phrases operate in a linear fashion, with well-defined beginnings, middles, and ends. The retrograde structures, on the other hand, are nonlinear. In order to understand this interplay of linear and nonlinear, we must look at the phrases and also at contextual, as opposed to serial, retrogrades.

Consider the opening phrase. The harp G in m. 5 is cadential, with m. 6 (parallel to m. 1) starting a new, consequent phrase. In addition to this surface articulation, however, there is an underlying symmetry that groups the measures differently. Because of the textural similarity of mm. 1 and 6, mm. 1-6 form a unit, an approximate retrograde supported by the prevalent IC4s in mm. 2-5 (see Section 7.15). Perceiving mm. 1-6 as a unit is surely clouded by the cadence in m. 5. Mm. 1-6 are neither a rhythmic group nor a hypermeasure. Nonetheless, particularly since the movement deals with retrograde symmetries, the potential of conceiving mm. 1-6 as some kind of group is real. The nonalignment between the potential retrograde grouping of mm. 1-6 and the clear phrase in mm. 1-5 establishes a subtle tension that is resolved only when retrograde units and phrases end together. Thus mm. 1-13 form a large, closed structural unit. For, if mm. 1-6 form some kind of unit, so do mm. 8-13; these two units are balanced around the central m. 7. This quasi-symmetrical structure ends in m. 13, coinciding with a firm cadence. The agreement of quasi-retrograde symmetries and phrases creates a large-scale articulation.[21]

The recapitulation is structured similarly. Mm. 36-47 are balanced around the central m. 42, which functions analogously to m. 7. The fact that both measures contain a single 0257 chord is significant. The first half of the recapitulation is also symmetrical, since it begins and ends with two similar measures, mm. 36 and 41 (analogous to mm. 1 and 6). Yet m. 40, not m. 41, is cadential, just as m. 5, not m. 6, ends the first phrase. The harp D in m. 40 works like the G in m. 5. The tension of nonalignment between symmetrical horizontal units and phrases awaits the resolution in m. 47, where both structures coincide. The chordal final measure balances m. 41 around mm. 44-45 (also the center of a serial retrograde; see Section 7.13). M. 47 also balances m. 36 around m. 42, thus providing the shape of the recapitulation. And m. 47 balances m. 1 around the central section, mm. 14-35. Not only does the recapitulation balance the exposition, but also the recapitulation *ends* as the exposition *begins*.

The middle section also exhibits horizontal symmetries, but they are in closer agreement with the phrases than in the outer sections. Mm. 14-35 are balanced around the orchestral interlude in mm. 23-25. Mm. 14-22 in turn are balanced around the striking m.18, while the midpoint of mm. 26-35 is the orchestral interlude in mm. 30-31.

The orchestra and chorus constantly interrupt one another. The pattern of interruptions tends to emphasize the horizontal symmetries. In particular, m. 13's *fortissimo* not only cadences mm. 1-13 but also propels the music onward. The chorus interrupts at once, with the orchestra returning in m. 18 to reiterate (with the chorus) m. 13. The orchestra continues in m. 23. The orchestra phrase that begins in m. 18 is suspended but eventually continues in m. 23 to a cadence in m. 24. M. 25 starts an answering phrase, which is similarly interrupted immediately. This orchestral phrase is picked up again in m. 30 and brought to a cadence in m. 31 (the rare eighth-note motion functions as liquidation, not intensification).

The process of interruption works in reverse as well, with the orchestra continually interrupting the chorus. The last chord of m. 22, just before the orchestral interruption, returns at the beginning of m. 26: the chorus finishes an interrupted cadence. Also, m. 29 is hardly completed when the orchestra again interrupts. The chorus phrase, which begins from the first chord of m. 29, ends in m. 32. No sooner has the chorus reached a stable, final cadence in m. 35 than the orchestra interrupts, for the final time. With these constant interruptions, the phrase structure becomes unstable, so that the horizontal quasi-retrograde symmetries determine the rhythmic grouping more than in the outer sections.

To summarize: There are important linear forces operating in the first movement of Webern's Cantata No. 1, along with the nonlinear structures studied earlier in this chapter. With intentionally restricted materials, Webern created a movement that moves through time toward specific goals. Despite its atonality, this music's linearity is directed toward those goals. The limited number of available chords produces a nonlinear context, a sound-world peculiar to this movement. Yet, within this context Webern creates referential sonorities and even a stable harmonic area. Thus there is a certain kind of functionality in the music. The process of defining the functions of various structural elements (the basic set types, referential IC4s, "tonic" chord, tritone transpositions, retrograde and quasi-retrograde symmetries, inversional invariance, three-chord motive, phrases, row itself) is the process of composition. Each element has its own life, its own evolution. By the end, they come into alignment to produce the final cadence. Thus the linearity consists in the gradual agreement of initially divergent elements and structures. This process is not row-derived and is not really systematic. The row provides a basis for the musical logic, but that logic comes as much from extra-serial constructs that become primary perceptual forces, creating the linear processes as well as the nonlinear consistencies of this beautiful movement.

Chapter 8

Discontinuity and the Moment

8.1 MOMENT TIME IN THE WRITINGS AND MUSIC OF STOCKHAUSEN

Karlheinz Stockhausen first formulated the concept of moment form in the article "Moment Form,"[1] in which he explicates the compositional procedures in *Kontakte* (1960), his first self-conscious moment form. His ideas were expanded and slightly modified a year later in "Invention and Discovery."[2] The procedures expounded in these two articles can be traced back through several earlier articles and compositions,[3] but they derive ultimately from techniques of Debussy, Webern (particularly in his variation movements), Varèse, and, above all, Stravinsky and Messiaen.[4]

In "Moment Form," Stockhausen articulates the aesthetic of moment time:

> Musical forms have been composed in recent years which are remote from the scheme of the finalistic [goal-directed] dramatic forms. These forms do not aim toward a climax, do not prepare the listener to expect a climax, and their structures do not contain the usual stages found in the development curve of the whole duration of a normal composition: the introductory, rising, transitional, and fading stages. On the contrary, these new forms are immediately intensive, and the main point which is made at once remains present at an equal level to the very conclusion. They do not induce constant waiting for a minimum or a maximum, and the direction of their development cannot be predicted with certainty. *They are forms in a state of always having already commenced, which could go on as they are for an eternity.* . . .
>
> Every present moment counts, as well as no moment at all; a given moment is not merely regarded as the consequence of the previous one and the prelude to the coming one, but as something individual, independent, and centered in itself, capable of existing on its own. An instant does not need to be just a particle of measured duration. This concentration on the present moment—on every present moment—can make a vertical cut, as it were, across horizontal time perception, extending out to a timelessness I call eternity. This is not an eternity that begins at the end of time, but an eternity that is present in every moment. I am speaking about musical forms in which apparently no less is being undertaken than the explosion—yes—even more, the overcoming of the concept of duration.[5]

Stockhausen's ideas reflect the influence of non-Western aesthetics. Japanese art, for example, emphasizes every object and every moment of time rather than an entire structure. Japanese art is nondramatic, and, similarly, the elimination of the dramatic curve is a prime prerequisite for moment time in much recent Western art. Stockhausen is not alone in his concern for the flattening out of climaxes. As William Barrett explains, this theme is common in Western modernist art:

> The flattening out of climaxes . . . occurs both in painting and literature. In traditional Western painting there is a central subject, located at or near the center of the picture, and the surrounding space in the picture is subordinate to this. In a portrait the figure is placed near the center, and the background becomes secondary to it, something to be blended as harmoniously as possible with the figure. Cubism abolished this idea of the pictorial climax: the whole space of the picture became of equal importance. Negative spaces (in which there are no objects) are as important as positive spaces (the contours of physical objects). If a human figure is treated, it may be broken up and distributed over various parts of the canvas. Formally speaking, the spirit of this art is anticlimactic.
>
> When we turn to observe this same deflation or flattening of climaxes in literature, the broader human and philosophic questions involved become much clearer. The classical tradition in literature, deriving from Aristotle's *Poetics,* tells us that a drama (and consequently any other literary work) must have a beginning, middle, and end. The action begins at a certain point, rises toward a climax, and then falls to a dénouement. One can diagram a classical plot of this kind by means of a triangle whose apex represents the climax with which everything in the play has some logical and necessary connection. The author subordinates himself to the requirements of logic, necessity, probability. His structure must be an intelligible whole in which each part develops logically out of what went before.[6]

Barrett proceeds to explain how modern literary works, such as James Joyce's *Ulysses,* destroy the beginning-middle-end logic of the dramatic curve. Likewise, modernist composers have for decades been writing music devoid of global climax.[7]

Stockhausen arrived at his concept of the musical moment from a disillusionment with the idea of historical continuity. Dieter Schnebel, in his early article on Stockhausen, explains:

> The decay of historical continuity has a further corollary. Events are no longer simply equivalent to their genesis, the gradient from past to present—they appear disconnectedly, as moments containing not only the past but also the future. Future events pervade the present, the future is pervaded by what is in a real sense past, and time shoots abruptly together when the intentions of form bring past and future to fulfillment. . . . Each complex of works, each work, in fact each part of a work and each event therein is the fixing of a moment.[8]

Because moment forms verticalize one's sense of time within sections, render every moment a present, avoid functional implications between moments, and avoid climaxes, they are not beginning-middle-end forms. In contrast to the possibly displaced beginnings and endings of multiply-directed time (see Sections 2.9 and 6.4), a composition in moment time has neither functional beginning nor ending. Although the piece must start for simple practical reasons, it does not begin; it must stop, but it does not end.[9] Stockhausen continues:

> I have made a strict difference between the concepts of "beginning" and "starting," "ending" and "stopping." When saying "beginning," I imply a process, something that rises and merges; when saying "ending," I am thinking about something that ends, ceases to sound, extinguishes. The contrary is true with the words "start" and "stop," which I combine with the concept of caesurae which delineate a duration, as a section, out of a continuum. Thus "beginning" and "ending" are appropriate to closed development forms, which I have also referred to as dramatic forms, and "starting" and "stopping" are suitable for open moment forms. That is why I can speak about an infinite form even though a performance is limited in its duration because of practical reasons.[10]

A distinction may be made today between beginning and starting, and between ending and stopping; but the nonlinearity of moment time blurs the difference between starting and stopping. Gone are the striking contrasts in gestural profile between the beginnings and endings of tonal music (see Sections 6.3 and 6.4). In moment time, a starting gesture is not very different from a stopping gesture. Starting and stopping functions may not be indistinguishable, but they have become far more similar than the tonal conventions of beginning and ending.[11]

A proper moment form will give the impression of starting (at least on a middleground level) in the midst of previously unheard music. It will break off without reaching any cadence that provides total closure, as if the music goes on, inaudibly, in some other space or time after the cessation of sound. Any attempt to force a moment-time work into a traditional beginning-middle-ending mold can be artificial. Stockhausen explains:

> For me, every attempt to bring a work to a close after a certain time becomes more and more forced and ridiculous. I am looking for ways of renouncing the composition of single works and—if possible—of working only forwards, and of working so "openly" that everything can now be included in the task in hand, at once transforming and being transformed by it; and the questing of others for autonomous [bounded] works seems to me so much clamor and vapor.[12]

Yet, as Stockhausen admits (in the quotation immediately preceding this last one), the infinity of moment time must be bounded for practical reasons. A work which *suggests* infinite duration cannot literally *be* eternal. It requires a sophisticated compositional craft to close off an endless form without creating a real ending. In his book on Stockhausen, Robin Maconie writes:

> Ending a permutational form is nearly always a matter of taste, not design. While the listener may be satisfied with a sensation of completion, the composer knows that though a series of permutations may eventually be exhausted, it does not automatically resolve. The ending's essential arbitrariness has to be disguised.[13]

Maconie wants an arbitrary ending to be disguised because he is describing an early, nonmoment permutational form: *Kontra-Punkte* (1953). His basic idea applies equally well, however, to Stockhausen's later moment forms and to still earlier works by other composers, such as Stravinsky and Messiaen, which evoke moment time without attempting to suggest an endless eternity. Stockhausen's formulation of moment form comes from the celebration, rather than the disguise, of the arbitrariness of closing a permutational form. By abruptly stopping rather than artificially ending, Stockhausen attempts to make overt his portrayal of eternities.

Much of Stockhausen's music of the 1960s fully partakes of moment time. Particularly impressive are *Mikrophonie I* (1964), *Mixtur* (1964), and *Momente* (1961-1972). The use of moment time in *Mixtur*, scored for orchestra ring modulated by sine waves, is straightforward, natural, and less self-conscious than in *Kontakte*. The work's 20 moments are differentiated by texture, timbre, type of ring modulation, type of indeterminacy, use of internal silence, and pitch definition. In the score the moments are given names that refer to (some of) their static defining characteristics: "Mixture," "Percussion," "Blocks," "Direction," "Change," "Stillness," "Vertical," "Strings," "Points," "Woodwinds," "Mirror," "Transposition," "Tutti," "Brass," "A440," "Intervals," "Dialogue," "Strata," "Pizzicati," and "High C." Because of these moments' self-containment and the discontinuities that separate them, they *seem* to occur in an arbitrary order. Actually, there *is* partial mobility of form (mobile form is discussed in Section 2.10).

Momente, for soprano, four choirs, and 13 instruments, is a long and elaborate essay in moment time and mobile form. Robin Maconie describes the aesthetic of the work:

> Events recollected order themselves by association, not by temporal sequence, and the pattern of association, which may vary, derives its coherence from values attributed to them in isolation, not from a general pattern they may collectively reveal. These events are the "moments" of *Momente*. . . . Stockhausen's delicate structure of associations expresses a new set of principles of musical form, compatible with serial thought, answering a need, for a long time widely felt by composers, to break free from an alien (because illusory) causality in both electronic and instrumental music. Stockhausen recognized the need in the randomized sequence of *Klavierstück XI*, and the problem continued to harass him in *Carré* and *Kontakte*. In *Momente* he proposes a remedy, and the laws of moment form, based on perceptual rather than numerical association, are what give the work its special didactic importance.[14]

8.2 OPPOSITION TO THE MOMENT CONCEPT: CARTER

Not every composer of today embraces moment time. Contrary to what might be expected, the opposition to the moment concept does not come exclusively from conservative circles. Elliott Carter, for example, has argued against the viability of moment time. While he is just as disenchanted as Stockhausen with traditional approaches to large-scale form, Carter has remained a linear composer (see the brief discussion of his *Duo* in Section 2.15). He has sought very different solutions than those of Stockhausen, Messiaen, and Stravinsky to the challenge of creating an appropriately contemporary temporal language.

> Around 1944 . . . I suddenly realized that, at least in my own education, people had always been consciously concerned only with this or that peculiar local rhythmic combination or sound-texture or novel harmony and had forgotten that the really interesting thing about music is the time of it—the way it all goes along. Moreover, it struck me that, despite the newness and variety of the posttonal musical vocabulary, most modern pieces generally "went along" in all all-too-uniform way on their higher architectonic levels. That is, it seemed to me that, while we had heard every imaginable kind of harmonic and timbral combination, and while there had been a degree of rhythmic innovation on the *local* level in the music of Stravinsky, Bartók, Varèse, and Ives particularly, nonetheless the way all this went together at the next higher and succeeding higher rhythmic levels remained in the orbit of what had begun to seem to me the rather limited rhythmic routine of previous Western music.[15]

Carter has distanced himself both from the stasis of much early twentieth-century music and from contemporary compositions that fully accept the discontinuity of moment time. He insists that moments can be understood only in the context of immediately preceding and succeeding sections. Carter does not reject or minimize discontinuity, but he is more concerned with underlying continuities.

> My interest and thinking about musical time were also very much stimulated by the kinds of "cutting" and continuity you find in the movies of Eisenstein, particularly *Ten Days that Shook the World* and *Potemkin,* and such as are described in his books, *Film Sense* and *Film Form.* I was similarly interested by the onward-moving continuity in the ballets of George Ballanchine—every individual momentary tableau in the best of his ballets is something that the viewer has seen interestingly evolved, yet is also only a stage of a process that is going on to another point; and, while every moment is a fascinating and beautiful thing in itself, still what's much more fascinating is the continuity, the way each moment is being led up to and led away from.[16]
>
> What contemporary music needs is not just raw materials of every kind but a way of relating these—of having them evolve during the course of a work in a sharply meaningful way; that is, what is needed is never just a string of "interesting passages," but works whose central interest is constituted by the way everything that happens in them happens *as* and *when* it does in relation to everything else.[17]

Carter recognizes the importance of the moment concept in the music he criticizes. Yet he argues that music cannot escape the linearity of absolute time. I agree. Since events necessarily follow one another in a particular order, Carter believes that the order necessarily influences, if not constitutes, the meaning of a composition. Again I agree. But what Carter discusses is but one aspect of musical time, the linear. What I disagree with is his denial of the importance, if not the existence, of cumulative listening, which not only illuminates but also makes a potent force of nonlinear structures. Since music cast predominantly in moment time is essentially nonlinear, understanding it relies to a large degree on cumulative listening.

Carter's exclusively linear thinking is evident in his comparison of music's temporality to the one-dimensional succession of letters and words in language.

But there is far more to language than letters and words, just as there is far more to musical time than the succession and progression of adjacent events.

> Much of the confusion that has arisen in recent discussion of this matter of musical time and, still more, in connection with the many and various mistaken compositional attempts to deal effectively with time in an actual work, has resulted from a refusal on the part of many composers to distinguish between, on the one hand, the given and inescapable structures of experiential time in accordance with which *alone* [emphasis added], the listener hears and grasps a piece of music (if he hears and grasps it at all); and, on the other hand, certain widespread secondary theorizings about time, of a kind that deny the irreversibility and even the very existence of time. It is certainly a question whether music, as the time-structure it is, can be made to present concretely such theorizings about time and still remain music, any more than a verbal language, say by the introduction of "blanks" or resorting to retrograde word-order, can convey a concrete idea of "nontemporal existence" or an experience (!) of "time going backwards." All verbal expressions and accounts of anything whatever, including time, require one letter and then one word after another for their presentation, and depend for their meaning on the specific ordering of the words, no matter how unconventional this ordering may be, just as music requires one sound after another in a determinate order for its presentation and for its particular effect on the listener, if any.[18]

On one level it is impossible to argue with Carter's common-sense description of musical succession. The events of a performance do necessarily follow one another, and each event is heard in the context of previously experienced events. But, as Robin Maconie points out (in the passage quoted at the end of Section 8.1), memory does not simply retain events in the order they were experienced. In memory we can find connections between nonadjacent moments. Furthermore, we can relate what we are currently experiencing to many different remembered events. When discontinuities seek to destroy the connectedness of successive moments, we are led to search our memories for other viable connections, which we may or may not find. Our memory of a discontinuous piece can become an unordered reconstitution of the totality of its moments and of their possible interrelationships (or lack of relationship) across absolute time. Cumulative listening enables us to appreciate moments for their contribution to the whole.

My remarks (in Section 6.5) on how cumulative listening makes gestural time real can be paraphrased to apply to moment time:

> Since time exists within ourselves, there are other species of temporality beyond the simple moment-to-moment succession I have been calling absolute time. Moment time is one of these species. Through the mechanism of cumulative listening, we can assemble continuities (and discontinuities) from temporally nonadjacent events. These continuities and discontinuities *exist* and they *are* a force in our understanding of the music. But *where* do they exist? Not objectively, not "out there," because time is primarily subjective. They exist where all music we hear exists: in our minds. They are placed there by our experiences. Our minds process the data received, and thus discontinuous events heard in absolute time can, in retrospect, be understood as related in moment time.

Carter does appreciate the historical evolution of the moment concept, and he does understand the impact of non-Western music, which he at one point studied in considerable depth but which he finds temporally simplistic on deep structural levels. His failure to appreciate the power of moment time comes rather from his refusal to place sufficient importance on memory as an unordered cumulative process.

> Debussy and Schoenberg became interested for a while in the possibilities of a musical language which would live mainly "in the moment," so to speak, and be based on tension-release periods of relatively short duration. . . .[19]
>
> [Furthermore,] we were very aware in the twenties and thirties of contemporary music that was very repetitious and attempted to produce an effect of static hypnosis, somewhat similar to that of some Oriental music. This was something to which, as an adolescent, I was particularly sympathetic, but soon felt the desire to break from. What I most wanted to do, subsequently, was to find new kinds of musical motion.[20]

I am sympathetic to Carter's desire to create linear structures of a complexity and newness that lie beyond the linearity of traditional music. Several of Carter's compositions attest to his success at meeting this formidable challenge. But I feel that his dismissal of moment forms is prescriptive. His linear time conceptions may work for his own compositional process, but they are not the only way to understand musical time.

8.3 MOMENTS, MOMENT TIME, AND MOMENT FORM

I have defined moments (in Section 2.10) as self-contained entities, capable of standing on their own yet in some nonlinear sense belonging to the context of the composition. The self-containment of moments is provided either by stasis or by process. Stockhausen has written, "Each moment, whether a [static] state or a process, is individual and self-regulated, and able to sustain an independent existence."[21] A moment, for example, may use but one extended harmony, or it may be characterized by a single process, which reaches its goal during the moment. Stockhausen has also written,

> In the genesis of moment forms, I was trying to compose [static] states and processes in which every moment is something personal and centered; something that can exist on its own, which as something individual always can be related to its surroundings and to the entire work.[22]

Since (as explained in Section 2.10) in a pure moment form there can be no linearity connecting moments, their order of succession seems arbitrary. This requirement of apparent arbitrariness of moment succession extends even to the return of previous moments. The return of earlier material is not antithetical to the concept of moment time. Although Stockhausen forbids return in his articles, it can be found in *Kontakte*[23] and even more overtly in other works of his. There is no reason why a previous moment cannot return, provided such return is not prepared by a structural upbeat, which would render the return a recapitulatory goal of the previous section, thereby destroying its self-containment. If no moment ever returned, the requirement of constant newness would in itself imply a kind of progression, because the listener could expect that the next moment would always differ from all previous moments. Yet progression is impossible in pure moment time.

A return must *seem* arbitrary. Seeming arbitrariness pervades, for example, Stockhausen's *Kontakte,* Stravinsky's *Symphonies of Wind Instruments,* and Messiaen's *Chronochromie* (1960). Great artistry and compositional craft are needed to make purposefully ordered events seem random, even when they repeat earlier events. Coherence and continuity must be tucked away in the background (in both senses of the term), so that their force is felt only subliminally as a nonlinear phenomenon.

True (as opposed to seeming) arbitrariness, coming from an aesthetic that denies the singularity of artistry and craft, is something quite different (such music is the subject of Chapter 12). Compositions ordered by chance do not generally contain surprises. Similarly, if every new section is unexpected, the impact of surprise is lost. But carefully ordered pieces can work with the surprise of placing an old moment in the midst of new moments. In a completely mobile piece, like Stockhausen's *Klavierstück XI,* neither the return of an old section nor the occurrence of a new section is dependent on background continuity (there is none). As a result, we are not particularly surprised by the return of an old moment, except perhaps the very first time it happens in a given performance. The truly arbitrary is actually less striking than the artificially arbitrary.

Considerable compositional shrewdness is necessary to guarantee that a moment's being old (or, for that matter, new) will *seem* unexpected. If we have no particular expectation about whether an old or new moment will come next, then there is not much import attached to which actually happens. But this is not the same as saying that anything can happen in a moment form. The moments must belong together in some way. They must reveal a consistent totality, even though they do so by nonlinear means.

In an interview given in 1984, Stockhausen clarified his ideas on the need for consistency in a moment form:

> There *can* be moments which have no common elements, or as few common elements as possible, and there are other moments which have a lot in common. Moment-forming simply means that there is also the extreme of no common material, and that every given moment has a certain degree of material that has been used before, and of material that is going to be used next. And I say "a certain degree." And I choose these degrees very carefully from moment to moment, between zero and maximum. So the maximum means there is a moment so full of other influences of the past and the future that it is hard to identify this moment.[24]

Since moments are defined by internal consistency, the overall scale of a composition is unrelated to the lengths of its moments. Thus, moment time is very different from linear time. In tonal music, for example, pacing and total length are closely related to the durations of individual sections. When we listen, for example, to the *Jupiter Symphony,* we understand early in the performance about how long its movements and sections must last. Nothing like this happens as we listen to *Mixtur*. We have no expectations about overall length in a piece that is destined to stop rather than end. Therefore, moments in a single piece can be of vastly different lengths. Proportions are thus important to the overall coherence of a moment form. A sense of completeness and balance cannot come from large-scale progression, because there is none. Generating the form instead are (1) the proportional interrelationships between moment lengths, and (2) the order in which the moments occur. In pure moment time, the (apparent) arbitrariness of succession renders the second factor possibly nebulous and probably less significant in determining formal coherence than the first factor. It is hardly surprising, therefore, that Stockhausen and other Darmstadt composers often plotted the proportions of their works prior to deciding the actual sounds that would articulate those proportions. It is also not surprising that theorists and analysts have discovered subtle systems of proportions operating in some of the works of earlier composers who explored discontinuities and mosaic-like forms: Debussy, Stravinsky, and Bartók in particular (these matters are taken up in greater detail in Chapter 10).

All moments operate on the same hierarchic level. Thus they are in some sense equivalent, because they are separated by discontinuities of comparable strength. In some less austere moment forms, there may well be internal subdivisions of a moment into what we may call "submoments," and moments may be grouped together in some way. But these levels do not constitute a particularly rich hierarchy, especially considering the often considerable length of a moment-form piece. Asking a listener to assign equivalent formal significance to a moment of four seconds and a moment of over two minutes (both extremes occur in *Kontakte* and in Stravinsky's *Symphonies of Wind Instruments*) demands a nontraditional mode of listening. The duration of a section in moment time, in marked contrast to linear time, does not indicate its structural significance, despite the possible importance of the duration to the work's proportions.

If moment time provides only a minimal hierarchy, is it ultimately a denial of form? Jonathan Harvey, in his book on Stockhausen, would seem to think so:

> If music is injected *into* form, the moment-to-moment "content" is liable to come up with some curious things, as opposed to the logic and coherence of the global forms. . . . On the one hand we have blue-prints works like *Plus Minus*, . . . which offer form without content; on the other, works in "moment" form, of which the composer has stated that all that matters is the "now" . . ., offer content without form. Needless to say, in practice the performer supplies the content in the first case, and the listener instinctively supplies the form in the second.[25]

This view, however, ignores proportions. The idea of listener-supplied form is appropriate to totally static pieces, to works that contain no significant internal contrast or discontinuity, to pieces that have no structural hierarchy at all. I am thinking of vertical-time music, such as (to choose at random from a huge repertory) Cage and Hiller's *HPSCHD* (1967-1969). This work is in effect one gigantic moment, without beginning or end. In such music it really does not matter if the listener misses some of the performance, since it might have gone on for a longer or shorter time without really altering the piece. No portion of the music is an essential component of its totality (see Chapter 12 for more detailed discussions of vertical time). But in moment time, all parts are not the same, and missing some of the moments means missing both some of the material and some important component(s) of the proportional scheme that may define the total coherence.

8.4 STASIS

Although a moment-form composition is not totally static, moment time does depend on stasis within moments. But can stasis in music really be perceived? After all, human beings and their perceptions are in constant motion. But I am really concerned not with absolute stasis but with stasis relative to context, with sections that appear static because their degree of internal activity is considerably less than the degree of contrast between them.

But let us consider first the ideal of total stasis. How would a truly static moment be heard? Suppose a vertical-time composition, such as La Monte Young's *Composition 1960, Number 7* (in which the notes B and F-sharp are sounded "for a long time") were to be encountered as a section within a moment form. Would even this sound be experienced as static? Our mental processes would never become frozen, but we would eventually realize that the sound was not about to change. How long must an unchanging sound go on before a listener gives up expectation of change and accepts the stasis? The answer depends in part on the richness of the sound. Presumably Young's perfect fifth would be understood as static sooner than would a dense sound, like that in Larry Austin's *Caritas* (1969) or Iannis Xenakis' *Bohor I* (1962). Informal (though certainly not controlled) experiments with students have borne out this assertion, and they have also suggested that the threshold of static perception is somewhere between two and three minutes. By this time, we understand the narrow limitations of a static piece or section (whether sparse or dense). We stop expecting change beyond those limits. If there is any motion, it does not matter, because either it takes place within these narrow limits or it is predictable, as in process pieces (see Section 2.12).

The threshold of perceiving stasis also depends on context. If there are large contrasts between sections, a moderately high degree of internal motion or contrast will not disturb the perceived (relative) stasis. Where the contrast between sections is small, the perception of stasis within sections will not tolerate much motion or contrast. The threshold ultimately depends on the rate of information flow. In a given context a certain amount of new information per unit time creates a static impression, while more information produces motion.[26]

My suggestion that perceived stasis is relative to context is supported by some stylistically eclectic music, even that which does not utilize moment time. I am thinking of such compositions as William Bolcom's *Frescoes* (1971), George Rochberg's String Quartet No. 3 (1972), or, to go back two generations, several works of Ives, such as the two piano sonatas, "Putnam's Camp" from *Three Places in New England,* or parts of the Fourth Symphony. In all of these pieces, there are tonal sections alongside nontonal passages. Tonality is heard as a possibility of the particular composition, but surely not as its universe of discourse. The result is that the tonal sections are rendered static by contrast with the various nontonal surroundings. Tonality is robbed of its inherent kineticism, but it retains its associations, so that we experience a moment of history frozen in the midst of a modernist sound-world. It is impossible to enter the world of tonality when it occurs in such a context. It is also impossible to experience tonality as a system, because we encounter it in a world that has different laws. Tonality becomes a foreign object, and thus one tonal passage in an eclectic work relates to another simply because the two are tonal. This can hardly be claimed of a truly tonal composition. Since tonality seems foreign in such nontonal contexts, its conventions lose their acquired meaning. The context denies the inner logic of tonality, and thus the very kind of music that is the most kinetic is rendered static.[27]

Rochberg's String Quartet No. 3 plays on the dual nature of tonality—system vs. material—in a way that emphasizes my point. The middle movement is a fifteen-minute set of variations in A major. We almost forget, we try to forget, that the quartet lives in the expanded world of atonality plus tonality. The movement tries to lure us into the world of tonality as system, but the comfortable associations of tonality (continuity, progression, goal direction, resolution) are never quite as comfortable as they would be in an entirely tonal quartet, because the language of the variation movement can never completely erase that of the two earlier movements (a language that is to return in the final two movements). There is therefore a contradiction between movements 1, 2, 4, and 5, in which triadic tonality is used as musical material, and movement 3, in which it is the system, the bounded world, of the music. The central movement is a pocket of gravity, so to speak, in a universe without gravity. This provocative and haunting paradox lends the quartet its special appeal. The piece really probes the consequences of stylistically eclectic music. It seeks to re-establish tonality as the music of kineticism despite its tendency to behave statically in an atonal context.

8.5 ANTECEDENTS OF MOMENT FORM: STRAVINSKY

I have mentioned Stravinsky's *Symphonies of Wind Instruments* as an early instance of moment time. What is fascinating about this work is its confrontation between traditional concepts of temporal linearity and its mosaic-like form. The work exhibits different kinds of time structures on different hierarchic levels. On the middleground, extreme discontinuities divide the work into moments. These sections are self-contained, complete, and (relative to their context) static. By this last characteristic I mean that their internal level of activity is relatively low while the discontinuities between them are relatively great. It is hard to feel how long a moment will last while we are listening to it, nor can we predict what kind of moment, new or old, will come next. Nonetheless, there is an underlying background continuity of voice leading that operates in contradiction to this moment structure. Furthermore, there is a fascinating nonlinearity operating in the proportional balance of section lengths within the middleground's moment time. To understand these structures and their interaction, it is necessary to study the work in considerable detail. Its combination of different species of time structures is the reason I have chosen it, rather than a pure moment form by Stockhausen or some other later composer, to study in the "analytic interlude" devoted to moment time (Chapter 9).

The discontinuous form of *Symphonies* is a culmination of Stravinsky's earlier methods, as found in such pieces as *Petrouchka* (1910), *Les Noces* (1917-1923), and the second and third of the *Three Pieces for String Quartet* (1914). Stravinsky did not abandon his explorations of proportioned stasis after composing *Symphonies*. The techniques in that work suggest the procedures, although not the materials, of neo-classicism. Stravinsky was ready to embrace the profoundly kinetic music of tonality. He was able to strip tonal sounds of their implications of motion and to freeze them in nonprogressions. For a demonstration of neo-classic stasis, compare Stravinsky's 1956 "orchestration" of Bach's *Von Himmel hoch* variations with the original. Bach's version is contrapuntally dense, yet the goal-directed harmonic motion is unmistakable. Stravinsky, considering triadic tonality as but one possibility within a broad universe of sound, added new melodic lines, stylistically consistent in themselves yet obscuring the triadic orientation of the verticalities. The new lines, it would seem, should increase the polyphonic density and thus complicate the music, but in fact they almost freeze the harmonies and thereby simplify the situation. Even though the new lines (as well as the old) move toward tonal goals, so many of these lines are piled upon one another than the harmonic progression is obscured and the music moves far less than does Bach's version. With harmonic direction no longer a prime factor, there is in a sense less information. Similar additions are made to the original tonal models in Stravinsky's 1920 ballet *Pulcinella,* written just prior to *Symphonies,* and in *Le Baiser de la fée* (1928).

There is usually background motion in Stravinsky's neo-classic works, and they do have beginnings, middles, and ends. But these gestures are generally created by other than tonal-triadic means. The music of neo-classicism is like that of *Symphonies* with an added complexity: the material implies a motion (by tonal root movement) that never (or at least rarely) occurs *on a foreground level.* There is irony in this music: The tonal materials suggest movement, but they do not move; on the background level the pieces do move, but by nontonal means (such as the kind of nontonal stepwise voice leading mentioned in Section 2.5 and studied in Chapter 7's analysis of Schoenberg's Opus 19).

Stravinsky's move into neo-classicism was in no way a retreat from his temporal explorations. He may have adopted the outlines of forms that originally dealt with motion, but he often used them as assemblages of static, or at least self-contained, sections. In his use of sonata form, for example, he often transformed the traditional kinetic sections into moments. Because of its references to classical style, the resulting music is less aggressively discontinuous on the surface than *Symphonies.* But the sections do tend to be defined by self-contained processes or by static harmonies. To take one of many possible examples, consider the first movement of the Sonata for Two Pianos (1944). (The proportions of the sonata are studied in Section 10.2.) The movement is full of Stravinsky's typical superimposition of tonal functions. The opening, for example, combines lines simultaneously outlining I and V^7 chords. The result is a static harmonic complex, of the sort sometimes referred to as pandiatonic. The texture remains as constant as the harmony, until the "bridge" section starts abruptly. This section brings a new static harmony area, arriving with minimal preparation. The texture is also new and unprepared. Just as suddenly, the second theme arrives, which is static by virtue of ostinato figures. The exposition section, then, is really a series of three apparently unrelated and unconnected moments (actually there are half-hidden relationships, as there are in *Symphonies*). The development section is also a series of moments, but of shorter duration. The increased rate of succession of these static moments is analogous to the increased harmonic rhythm of a Classical sonata's development. The recapitulation brings back the exposition's moments: while its gentle character precludes extreme discontinuities like those in *Symphonies*, the movement is nonetheless a product of the same time consciousness.

Stravinsky's late serial works include examples of moment time. The discontinuities in *Agon* give rise to a very sophisticated proportional system, as explained in Section 10.2. *Huxley Variations* (1965) consists of several discrete moments, three of which are consistently dense textures reminiscent of the procedures (and ideas) of Ligeti (see note 8.4).

8.6 ANTECEDENTS OF MOMENT FORM: MESSIAEN

Olivier Messiaen has shared Stravinsky's interest in static blocks, discontinuity, and sonata forms. While his earliest mature works are considerably influenced by Stravinsky (and Debussy) he eventually created music of sufficiently arresting originality to make him the father figure of the Darmstadt school. His music forms a link, then, between early Stravinsky and the Stockhausen circle.

Like the neo-classic Stravinsky, Messiaen approached sonata form as a static object rather than as a self-generating process. As Robert Sherlaw Johnson remarks "He is thinking of the sonata sectionally rather than organically, and, as a result, the forms he derives from it have very little to do with its real spirit."[28] Johnson feels that a more promising form in Messiaen's early music is the "Variations of the First Theme Separated by Developments of the Second" (found in, for example, the second movement of *L'Ascension* of 1931-1935). Johnson finds, in Messiaen's alternations, "a sense of continuity and growth across the contrasting sections of the form."[29] This description sounds very much like Edward Cone's "stratification, interlock, and synthesis" (discussed in Section 9.12).

In his later music Messiaen's sectionalized forms become more organically coherent.

> In his later works the musical thought *demands* a sectional treatment. The stark juxtaposition of ideas in earlier works eventually becomes sophisticated in the '40s, with superimposition as well as juxtaposition being involved. The eventual outcome is a refined collage structure such as used in *Couleurs de la cité céleste,* where not only melody and harmony but also rhythm and timbre interact to form the total collage.[30]

These sectionalized collages (in my terminology, moment forms) suggest a species of musical time quite different from that of classical tonality:

> He arrives at a position which is analogous to Eastern music because of his attitude to harmony as a static element. A sense of time, marked by an evolving texture, is fundamental to Bach and Beethoven, but it has always been Messiaen's aim to suspend the sense of time in music (except in those works which are based on birdsong in relation to nature), in order to express the idea of the "eternal"—in which time does not exist—as distinct from the temporal.[31]

Paul Griffiths succinctly summarizes Messiaen's special approach to musical time:

> The removal of [chordal] distinctions obscures the arrow of time, and the same thing happens in the rhythmic domain. Instead of a meter, which gives each moment in the bar a different significance and hence fosters a sense of orderly progression, Messiaen's music is most frequently tied to a pulse, which insists that all moments are the same, that the past, the present, and the future are identifiable [identical?]. Sometimes the pulse is so slow that causal links are sufficiently distended not to be felt: in these extreme adagios the possibility of eternity becomes actually present in the music. But Messiaen's presto toccatas can be equally removed from any progressive experience of time: the race is around a circle joined by repetition (repetition of pulse, repetition of structural unit) in an ecstasy of stasis. . . .
>
> It is . . . the denial of forward-moving time that is the generative and fundamental substance of Messiaen's music.[32]

Embryonic moment forms, adulterated by occasional goal-directed passages, can be heard in such pieces as *L'Ascension* (1931-1935), *Visions de l'Amen* (1943), *Turangalîla-Symphonie* (1946-1948), *Cantéjodjayâ* (1948), and *Livre d'orgue* (1951). Moment time in later works, such as *Chronochromie* (1960) and *Couleurs de la cité céleste* (1963), is nearly pure.

Composed while Messiaen was in his twenties and deeply involved in his study of the cellular construction of *Le Sacre du printemps, L'Ascension* already displays features of moment construction, of permutational techniques, and a downplaying (though certainly not a denial) of goal-directed processes. Developmental processes (such as the composer's typical durational additions) tend to be localized. Despite the tonal sound of harmonies and melodies, the sections are self-contained and do seem like moments. Consider, for example, the entire brief first movement. Also suggestive of moment time is the patterned alternation (with textural additions on each repetition) of two contrasting static sections in the second movement.

Although *Visions de l'Amen,* for two pianos, is overtly sectionalized, many of the sections are not self-contained. We realize this when returning sections feel like recapitulations. The return of old material is not an arbitrary occurrence, as it would seem to be in moment time, but rather the goal of linear processes. When a returning section arrives with a structural downbeat, as it does in the second movement, then we understand the sections as related by ongoing motion. The relatively brief first movement (which is concerned with only one type of permutational process throughout) could be a moment, as could the sixth movement. But Messiaen was not ready in 1943 to pursue the structural and temporal implications of such sections within larger contexts. His continued interest in real recapitulations, despite the self-containment of certain sections, is a conservative aspect of a body of music that, in other ways, is quite radical. In this sense, Stravinsky's music was more experimental. Most of his Russian-period works, *Symphonies* in particular, do not have recapitulations. Old material does return, but not as a resolution of processes of motion.

The fourth movement of *Visions de l'Amen* exhibits moment time more consistently. Returns are still *potentially* recapitulations, but there are so many such returns, starting early in the movement, that they tend to cancel the large-scale rhythmic effect of recapitulatory downbeats. Moments here are defined not only by their materials but also by the types of processes to which those materials are subjected. Particularly stunning is the final moment. Recapitulatory only at the outset, it is rendered static by a pervasive G pedal.

The *Turangalîla-Symphonie* is a large (76-minute) work predominantly in moment time. Moments last from a few seconds to almost 12 minutes. This wide range of moment durations, plus the great length of the composition, allows Messiaen to work with proportions in a meaningful way over the entire work. Only two of the symphony's ten movements are single moments: the long, static, internally undifferentiated sixth movement and the 4½-minute ninth movement, which is characterized by a self-contained process. Each of the other movements contains several moments that are defined by stasis or internal processes, such as evenly paced stepwise motion in one direction or simple alternation of material.

Ending a moment form is a difficult compositional challenge. The composer must decide how to bring to a conclusion a work that has denied the possibility of ending. The final moment of Stravinsky's *Symphonies of Wind Instruments* moves internally to a cadence that is related only motivically to earlier moments. The last section of *Turangalîla* is not itself a moment, because it brings together (at long last) several of the preceding moments and because the final F-sharp major triad is tonally appropriate to the entire work. Thus Messiaen's symphony, a more discontinuous work, undermines its moment time and ends paradoxically with greater closure than does Stravinsky's *Symphonies*.

Works that exist exclusively in the world of moment time cannot truly end. Stockhausen's *Mixtur*, for example, does not end but simply stops. It presents its vision of timelessness by seeming to be an arbitrarily chosen segment of an infinitely long composition. *Turangalîla*, by contrast, may suggest timelessness, but it does end. It may be "about" eternities, it may suggest endlessness, but it does so within a bounded framework. *Symphonies*, a partially open-ended composition that uses both moment time and linear time, occupies a middle position between the timeless and the bounded. Therein lies the fascination which that work engenders.

Several of the moments in Messiaen's *Cantéjodjayâ*, which are clearly differentiated in texture, are characterized by self-contained processes that complete themselves within the moment. Some moments return; some do not. There is only one real recapitulation, although this return of the opening near the end is not prepared by a structural upbeat during the preceding moment. This final return feels recapitulatory because of its symmetrical placement within the form. As such recapitulatory gestures became increasingly foreign to Messiaen's aesthetic, his treatment of moment time became increasingly sophisticated and persuasive. The lack of preparatory upbeat to *Cantéjodjayâ*'s recapitulation gives it a quality of seeming arbitrariness thoroughly appropriate to the work's moment time. But this section *is* a recapitulation, not simply a returning moment.

In *Livre d'orgue* Messiaen uses techniques that might readily define moments: additive processes, retrogrades, regular permutations, pitch modes, duration modes, dynamics modes. Each movement is defined by a process, or the alternation of two processes, but the movements do not relate in any structural, melodic, or proportional manner. Rather than a moment form, we hear a set of character pieces. In the fourth movement, however, the pseudo-serialism is suspended for a walk through a forest of bird calls, set off by silences. Interestingly, Robin Maconie sees this movement as an influence on Stockhausen's *Klavierstück XI:*

> The structures vary in length, and repetitions of the same structure may also vary. . . . The sequence of events . . . was designed to give an impression of randomness. . . . In such a piece time is not felt as measure, but as place: each event is a self-contained moment of awareness, and its duration expresses the intensity of awareness.[33]

Written virtually concurrently with Stockhausen's *Kontakte,* Messiaen's *Chronochromie* is the work in which the composer first fully confronted moment time. Gone are the recapitulations, cadences, and structural downbeats of the earlier pieces. Moments stop rather than end, and they are juxtaposed without mediating transitions. They are defined by a rich palette of textures, instrumental colors, compositional techniques, and, in addition, the use or avoidance of various birdcalls. Proportions are important to the form, as is the placement of particularly long and especially short moments (this idea is developed in Section 8.7). The formal division into movements is less significant than the moment structure, since some movements (played without pause) contain one and some contain several moments. The placement of returns contributes to the overall coherence, although there is no feeling of prepared recapitulation.

The first movement of *Chronochromie* has several moments. Some are only a few seconds in length, and none is long. The second movement is internally undifferentiated and it is static. Despite its greater duration (86 seconds),[34] it too is a single moment. The placement of a long moment after a series of shorter ones is particularly satisfying.

The longest moment, the sixth movement, comes late in the composition and thereby serves as the major structural focus. Although in theory climax is antithetical to moment time, in practice composers forsook the dramatic curve with great reluctance. We find remnants of it here in the placement of the weightiest moment at the traditional climax point; we find a climax similarly placed in Stravinsky's *Symphonies.* It remained for a younger generation to create totally antidramatic music that is fully faithful to moment time. The nonclimactic nature of a work like Stockhausen's *Momente,* for example, makes difficult listening for someone brought up on art that respects the dramatic curve.

(We must remember, though, that the dramatic curve is peculiar to Western art. It is not a universal of mankind, as much Eastern music readily demonstrates.[35] Hence we should not lament its deposition from *a priori* status in Western music.) Our expectation of finding dramatic curves remains strong, and listening to pure moment time requires an effort and a commitment.

The weighty 3′36″ moment in *Chronochromie* is a dense texture of birdsongs, with little internal differentiation of texture. According to Griffiths,

> . . . this section marks an extreme of stasis in Messiaen's music. Time stops because the forward movement of the music thoroughly baffles any attempt to comprehend it: there is no direction here, only a tissue of motivic connections operating horizontally and vertically, forwards and backwards.[36]

This moment has no phrases, and it finally breaks off without reaching any conclusion. It is a self-contained, static section, an undifferentiated block of fascinating sonority whose main formal significance lies in its duration and its placement within the whole.

The close of *Chronochromie* is a short moment that does not cadence but rather drops away: an open ending, fully appropriate to moment time. Nonetheless, on a background level there are ample reasons to conclude with this moment, reasons having to do with the pacing of moment returns and the placement of moment durations within the span of the piece. *Chronochromie,* like many of Stravinsky's most discontinuous works, uses moment form to create a balance between unequal durational spans. Griffiths mentions the

> . . . equality of treatment to slices of time that range from the few milliseconds of a quick staccato to the lazy minutes of the "Epode," all being arranged as distinctive episodes (Stockhausen would by this date be calling them moments) in a balance of symmetries. Time is thus colored, and in that coloring lies the music's claim to be operating in a time where time is still.[37]

Couleurs de la cité céleste is another discontinuous work, with moments defined by very different types of writing, including such Messiaen staples as birdsongs, sonic depictions of colors, Hindu and Greek rhythms, quotations from chant, and rhythmic permutations. The piece includes several short moments, which often return, plus a few extended moments, which function as centers of gravity (rehearsal figures [62]-[67] in the 1966 Leduc publication, for example). *Couleurs* is "close-ended" (as opposed to "open-ended") with a chorale (possibly a reminiscence of *Symphonies,* since the instrumentation is also similar) that has been heard previously.

The foregoing overview of some of Messiaen's music is presented as the history of its evolution toward moment time. This is a purposefully skewed view of this composer's remarkable output. The gradual approach to moment time is but one of many ways in which he grew and developed. I certainly do not mean to imply that Messiaen's works that do not fully embrace the moment concept are flawed, nor that his embracing of moment time acted as a culmination of his development. His late music appears to return to linearity. The opera *Saint François d'Assise* (1975–1983), for example, strikes me (on the basis of one hearing of three scenes) as a frequently linear work.

8.7 PARADOXES OF MOMENT TIME

Does the order in which we hear the moments, as Elliott Carter claims (see Section 8.2), really matter? I have suggested that the proportional balance of moments does not depend on their order of succession. I have stated that the order of moments is not crucial because a nonlinear form depends not on the way one event leads to the next but on the totality of what is there. Yet I have alluded to the satisfaction we feel when the nervous energy of a series of short moments in *Chronochromie* is resolved by the extended stasis of a longer subsequent moment. Furthermore, in a moment form where earlier moments return, surely there must be some significance to the placement of their recurrence. Just when the opening fanfare returns in Stravinsky's *Symphonies of Wind Instruments,* for example, surely matters, even if partially in a negative sense: Since it is never heard in the second half of the piece, the chorale can replace it as the work's refrain.

Film theorist Victor Grauer, in apparent agreement with Carter, speaks of an unmistakable dynamism that comes from the rhythm of juxtaposition of static shots in the films of Eisenstein.[38] Similarly, much of the music discussed in this chapter can be *exciting,* despite its frequent stasis within sections. How can we reconcile excitement with nonlinearity, or dynamism with cumulative listening?

The nonlinearity of moment form is fully comprehended only after the piece is in memory. Only then can we understand the proportional balances (if any) between moment durations, because only then will we have perceived, remembered, and (subconsciously) compared section lengths. Only then can we understand the degrees of similarity and difference between moments located in different parts of the piece. Only then can we understand the import of the occurrence of similar vs. different moments. But, once the piece is in memory, so is the excitement it generates. Do we not also hear durations *while* we are listening to its engaging surface?

Prior to that instant (at or near the end of a performance) when we have sufficient data to understand a composition's entire form, we will certainly have already formed some tentative impressions of its structure. We do not await the end of the piece to feel the impact of a long moment after a series of short moments, nor the meaning of a familiar moment after a group of new ones. These impacts and meanings are immediate. They are a source of dynamism and excitement. But what, in turn, is *their* source?

Paradoxically, they come from linearity. Even in moment time, where musical form is predominantly nonlinear, an inescapable linearity is operative. Implications can arise in a series of short moments. We can have expectations, which may or may not be fulfilled, from a pattern of moment recurrences. We may even form expectations for moment lengths based on a tentative understanding of the proportional ratios (discussed in Chapter 10) between the first few moments heard. If, for example, the lengths of the first four moments are, respectively, 10, 5, 80, and 20 seconds, we may expect eventually to hear a section of 40 seconds in order to complete the (reordered) series of 2:1 proportions. Whether or not such a duration actually does occur does not determine the existence of our expectations for it.

Moment time brings up three critical paradoxes:

1. It is impossible to separate totally linearity and nonlinearity. This is because these terms refer both to musical structures and to listening modes. Our listening process is always linear, yet we always come away from a piece with a nonlinear memory of it. If the music's structure is predominantly nonlinear, as occurs in moment time, then our nonlinear memory will contribute more critical information about the form than our absolute-time listening. This is the ultimate paradox of moment time: Its musical continuum *is* nonlinear, yet it is unavoidably first heard as a succession in absolute time. As we move through a piece (or, as the piece moves through us), we cannot avoid hearing it as a linear presentation, no matter how strong its inherent nonlinearity. Moment time may deny the waves of tension and release, of upbeats and downbeats, that are the essence of linear musical time. But in their place moment time offers its ultimate paradox: *Moment time uses the linearity of listening to destroy the linearity of time.*

2. Moment time also tries to defeat memory. A continuation that is a logical outgrowth of an event is a "rehear-sal" of that event. While linear music prompts us to remember it by rehearsing important events, many moment-time works refuse to "rehearse." If a given passage generates no continuation, development, or return, then the music offers no subsequent structural cues to help us remember. On the one hand, a tonal sonata-allegro form's development section "rehearses" its exposition. That is one reason why expositions tend to be remembered more accurately than developments (another reason is that the rhythmic hierarchies in expositions tend to group more simply). On the other hand, moment music does not "rehearse" its materials and thus is more difficult to remember. A moment-form composition, in which sections are never outgrowths of earlier sections and in which moments only occasionally repeat other moments, seeks to deny memory. Instead, moment music focuses our attention on the now: It places a priority on perception above memory. In the still more extreme music of vertical time (see Section 2.12 and Chapter 12), "rehearsal" of past events is completely eschewed in favor of celebrating the sensuous present.

3. But, if moment time thwarts memory, how can a moment composition rely on remembered section lengths in order to convey a sense of balanced proportions? The answer is that, because of the self-containment of (usually static) sections, moment time divorces duration from content. A moment form may challenge memory, but it can simultaneously operate on the assumption that a feeling for the lengths of moments *is* remembered even when specific materials are not. Thus the predilection of certain moment-form composers to plot out durational schemes prior to composing the music that fills them is not a quirky or artificial compositional technique. It is a reasonable strategy for creating music which demands attention to present perception even while generating its form primarily from large-scale remembered proportions. It is also reasonable that analyses of proportions, such as some of those presented in Chapter 10, should look at durations apart from their musical context.

I do not mean to imply that moments *cannot* be remembered. Striking events remain in our consciousness, whatever their context. Moment time may turn our attention toward the present, but it cannot literally destroy the past. What makes events in moment time remain in our memories is their inherent nature, not subsequent developmental outgrowths of them. Memorable events transcend the present orientation of moment time in order to survive in the past.

Thus we do compare events across time with other events, in our memories. We do this while we listen as well as in retrospect. Once we have risen to the challenge to remember, neither the most pointedly kinetic nor the most discontinuous music can prevent our stepping back and uncovering relationships that may exist between nonadjacent events or that may work by means other than temporal implication. Linearity and nonlinearity as listening strategies are always in operation, and the temporal continuum of every composition has both linear and nonlinear aspects. We can have both *linear perceptions of nonlinear structures* and *nonlinear understandings of linear structures.*

A composition in moment form offers a mosaic of discrete sections. The nonlinear relations (or lack thereof) between segments of the mosaic are essential to the structure. However, there are also inevitably linear relations between these segments, in the perception of them if not actually inherent in them. Moment time represents a denial of these linear relations. But we (at least we of Western culture) are beings whose process of perception necessarily involves finding linear structures in, or even imposing linear structures on, our temporal experiences.

The confrontation of linear and nonlinear temporal constructs in music can be fascinating. The richness of many of the compositions mentioned in this chapter comes from the juxtaposition of linear and nonlinear continua. Thus, the next chapter looks in considerable detail at the extraordinarily complex interweaving of moment time and directed linear time in one of these works: Stravinsky's *Symphonies of Wind Instruments.*

Chapter 9

Analytic Interlude

Linearity, Nonlinearity, and Moment Time in Stravinsky's Symphonies of Wind Instruments

9.1 ANALYTIC ASSUMPTIONS

Every musical analysis rests on assumptions—at the least, on the analyst's intuitive impression of what methods of analysis are appropriate for the given work and for his or her particular reading of it. Some analytic assumptions are so widespread that we tend to forget that they actually are assumptions. For example, we tend to take for granted that any piece worth analyzing is unified, and thus a methodology aimed at the eludication of unity (as virtually all commonly employed analytic techniques are) is automatically assumed to be useful. But what of music that is pointedly disunified? Some of the purposefully chaotic scores of Ives, for example, do not yield their secrets to traditional analysis. It is not surprising that few analysts have turned their attention to Ives and that those few who have done so have not had marked success. Although critics have studied the fascinating aesthetic issues raised by Ives, the methodology does not (yet?) exist for studying disunity *analytically*. We can only note it, perhaps be awed by it (if accomplished effectively), and move on. To take a more modest example, Example 9.17 in the analysis below is an attempt to demonstrate the lack of predictable duration patterns in the passage from rehearsal numbers [6] to [8][1] of Stravinsky's *Symphonies of Wind Instruments*. There is little more I can do than show several sequences of durations where one might ordinarily expect to find some regularity and then state that regularity is not there. Similarly, it is hardly surprising that analyses of certain avant-grade works of today, in which unity cannot be taken for granted, tend to recount compositional procedures or simply describe what is there rather than *explicate* the finished product. This fact has frustrated or delighted a number of critics,[2] some of whom take this failure of analysis as an indictment of the music.

The unavoidable circularity of analysis should not be overlooked. We intuit that a piece is unified and we therefore analyze it to find its methods of unity, which our analytic methods find in abundance, and then—*violà*—we have "proved" that the piece is unified. Similarly with continuity and consistency: If we invoke Schenkerian analysis, for example, to study a tonal composition, it should not be surprising when we discover continuity; if we utilize a set theoretic approach to a posttonal work, we should not be amazed to discover consistency of set usage.

Most traditional analytic methods assume that music is linear. The less linear the music, the more resistant it is to analysis. Given the biases of analysis, I would expect not to be able to say nearly as much about a predominantly nonlinear work as I can about a primarily linear one. Thus, this book has no chapter-long "analytic interlude" about a work exhibiting vertical time. In part because of the primitive state of analytic tools for the study of nonlinear music, I have chosen to study not an example of pure moment time but rather a piece in which linearity is played off against nonlinearity. The analysis should not seem totally strange, therefore. But it does not assume beforehand wherein reside the work's continuities and discontinuities. It proceeds from the premise that the music is predominantly (but not exclusively, as several of the analytic remarks below demonstrate) nonlinear on the middleground, despite pitch linearity of details (e.g., stepwise motion) and of underlying structure. This middleground is divided into discrete moments which are analyzed in relationship to other moments, though they may not necessarily be adjacent to each other. Thus the order of presentation is by moment type, not according to the chronology of the music. Only after the details of moments and their interrelationships have been discussed do I consider the underlying formal linearity. I do, however, frequently point to specific instances of linearity within the largely nonlinear middleground structure.

Parts of the following analysis look like Schenkerian graphs. The resemblance is superficial, however. The multileveled pitch structure in Stravinsky's *Symphonies* is more obvious than the hierarchies uncovered by Schenkerian analyses of tonal music. Since the work consists of static blocks, with occasional small transitions, and since the stepwise pitch connections between successive moments are generally unambiguous, a reductive[3] analytic procedure can be applied even in the absence of a consistent theory establishing nontonal pitch hierarchies or prolongations. My graphs do not indicate prolongations so much as consistency and stasis of sonorities within moments. While it is often true that intervening "harmonies" relate by step to the prevailing chords, I would not want to claim that these subsidiary "harmonies" are prolongational in the Schenkerian sense. In an important paper, Joseph Straus argues that prolongation depends on, among other factors, a clear distinction between consonance and dissonance (which means that dissonant notes can stand in for consonances not literally heard), a well-established hierarchy of scale degrees, and a distinction between horizontal and vertical normative pitch combinations (a distinction, in other words, between harmony and counterpoint).[4] Stravinsky's *Symphonies* exhibits none of these requisite conditions for prolongation. Yet each moment is dominated by a particular sonority. My graphs show both how these "harmonies" are decorated by intervening pitch structures and how they are connected. But that is all the graphs show.

It is a consequence of the music itself that *Symphonies* can be readily studied by means of harmonic and voice-leading reduction, despite the rarity of unequivocally root- and triad-defined verticalities. There is a purposeful impoverishment in the number of structural levels, caused by the fact that the piece rarely moves in any substantial way within moments. The static harmonic areas are well defined within moments and clearly connected between moments. The analysis thus demonstrates how a succession of static moments can embody background motion. This confrontation between stasis in the middleground and kinesis in the background gives *Symphonies* its peculiarly abstract quality.

After presenting a detailed study of just one piece, I cannot really offer rules for nontonal reductive analysis, nor can I even suggest to what extent the methods used here can be applied to other works. My purpose is decidedly not to invent an analytic methodology appropriate to moment time, however useful such an effort might be. My intention is more modest: to devise a procedure to elucidate how moment time works in this particular composition, and how it relates to the linearity that exists at points of transition and in the underlying structure.

I rely not only on reductive graphs but also on cellular analytic techniques, as devised by Messiaen and reported by Boulez and Jean Barraqué.[5] Since this analytic method is concerned with permutation more than with development, it is particularly useful in studying a nondevelopmental work. A cell is a small configuration of pitches and durations, much like a motive. Most cells are rhythmic groups, although in some instances (such as Submoment D_{11}) cells run continuously one into the next. Cells are strung together into larger units, which I call cell sequences. In any extended section with a cellular construction, the composer makes clear the ways in which cells combine—in other words, their typical order of succession within a cell sequence. Certain orderings come to be understood (via cumulative listening) as possibilities within the limits set by the context; other orderings are excluded. In other words, cell sequences establish their own principles of inclusion. After we have heard a number of sequences of the same cells, we understand which orderings are "permissible" and which ones are not. But we cannot usually predict which ordering, which sequence, will come next. We learn the permutations allowable by a context, but not their succession. This is why I call the music nondevelopmental. We cannot even reliably predict that cell sequences will always contain new permutations of familiar cells, because a particular cell ordering may be repeated. What we have, then, is a narrow range of possibilities, within which unpredictability reigns.

The difference between a cell and a motive lies in its usage rather than its identity. There are, indeed, two pervasive motives in *Symphonies,* labeled X and Y in the analysis. They function like Beethoven's motives: They recur in a variety of contexts to lend a possibly subliminal unity to otherwise contrasting materials. According to Section 2.10 and Chapter 8, moments must (despite the discontinuities that separate them and the contrasting materials that differentiate them) somehow coalesce into a unified whole. The existence of two motives that appear in different moments is one way *Symphonies* achieves this ideal. These motives are not systematically permuted the way cells are. A motive in *Symphonies* does not combine consistently with cells or other motives, just as it does not reside in any particular moment type exclusively. Thus we do not find orderings of motives as we do of cells, because motives tend to appear in isolation from one another.

The cellular language of *Symphonies* is enriched in two ways:

1. Occasionally, just before predictability might set in, the music steps beyond its self-imposed limits. Depending on the extent of this deviation, such a move might appear an exception to or an expansion of the range of possibilities. Thus we can never totally trust our knowledge of the music's boundaries. This fact, plus the constant unpredictability concerning which sequence of cells will come next, makes this music exciting.

2. Stravinsky allows variation within cells as well as variation in their order of succession. The notes and/or durations of a cell can be changed slightly without weakening its identity. Or, there may be more than one version of a cell used consistently. We cannot readily predict which version is to occur next, just as we never know the cells' order of appearance. Thus, unpredictability within carefully defined boundary conditions exists on two adjacent hierarchic levels: between and within cells.

In a moment form like *Symphonies*, we understand the range of possible *moment* types, just as we learn the *cell* types, but it is impossible to predict with assurance which moment type will actually be heard next. Given the lack of internal motion, how long a moment will last is also unpredictable. These unpredictabilities of moments parallel those of cells and cell sequences. Just as Stravinsky will inject a new cell (or cell version) at a strategic point, so he introduces new moment types when the context is in need of expansion or renewal. This happens in *Symphonies*, at [42].

9.2 MOMENTS AND SUBMOMENTS

In this particular piece, moments are differentiated by contrast in three parameters: tempo, harmony, and cellular material. Other parameters (orchestration, for example) support the structural activity in these three fundamental areas. At every point in the piece (with one exception, discussed presently) where there is a change of tempo, a new moment arrives. Harmonically, moments are characterized either (1) by consistent pitch configurations, (2) by the alternation of two harmonies, or (3) by the constant use of certain notes in particular registers. Each moment type is also characterized by particular cells. Each individual moment permutes those cells in a manner consistent with the contextually determined "rules" of cell sequences. In some moments the manipulation of cells is obvious, while in others it is disguised.

A pure moment form is nonhierarchic. In *Symphonies*, however, there are two levels of discontinuity, since moments are often partitioned into "submoments." When a new submoment replaces an old one, there is substantial change in some but not all of the three basic parameters. Because of the consistency with which moments and submoments are defined, we learn as we listen (cumulatively) what degree of change ushers in a new moment and what degree creates an articulation within a moment, thus creating a new submoment. Once we understand these degrees of change, we can comprehend exceptions to the requirement for change in three parameters to announce a new moment. At first glance, for example, the change at [8] may seem of comparable weight to that at [15]. However, I am calling [6]-[8] one moment and [8]-[9] another moment, while I am labeling [11]-[26] a single moment. It is important to stress that this partitioning feels correct, aurally and intuitively. It may be tempting to label [6]-[9] a single moment and thereby make tempo an inviolable demarcator of moments. But to do so would go against intuition and common sense.

Still, my claim for a new moment beginning at [8] needs more justification than simply my own intuition. The passage [6]-[8] has strong cellular and harmonic definition. The possibilities for variation in both these parameters are narrow. The same is true of [8]-[9]. Because of this narrowness, change in only two parameters is sufficient *in this particular context* to mark a new moment. At [15], however, the situation is far less clearcut. There is indeed a striking change of cells, but the previous cells intrude upon the subsequent passage, after [21] and after [23]. Furthermore, though the harmonies are more complex than in [6]-[9], they do not change in any major way at [15].

It is tempting, then, to suggest that change in any two of the three basic parameters is sufficient to define a moment. But consider [40]-[42]. Are we confronted with one moment or two? Intuitively, I would respond "one," despite the marked change in harmony and cells after [41]. The reason, it must be emphasized, has nothing to do with the short duration, as we do find four very short moments between [42] and [46]. Rather, the cellular process started at [40] is not completed and hence not self-contained. Therefore [41]-[42] appears as a (quite surprising) substitute conclusion to the moment beginning at [40].[6]

How do we know that [40]-[41] is incomplete? The easy answer is to refer to the previous occurrence of this moment type in [6]-[8]. But also, more significantly, the implied permutational and variational possibilities within the cellular material of [40]-[41] are not explored fully enough to allow [41]-[42] to seem separate or self-contained.

What we are essentially concerned with is the hierarchic level at which certain changes take place. A change of submoment, for instance at [41] or [15], is a contrast of a lower order than a change of moment. But we are also talking about an absolute construct, for a moment (in context) is an identifiable entity, not simply a projection onto a deep level of a change in certain parameters. This assertion is central to my argument. Moments are entities, self-contained to the extent that they appear static *in context.* The criteria necessary to delineate moments can be discovered, always allowing for occasional exceptions. Once these criteria are understood and individual exceptions explained, we have in effect defined what creates moments within a given piece. By so doing we discover the contextual limits of a work's stasis.

There are seven moment types in *Symphonies,* labeled respectively *A, B, C, D, E, F,* and *G.* Submoments of a given moment are labeled with the appropriate letters. Subscripts indicate the rehearsal number at which the (sub)moments occur. For example, *Submoment* D_{15} is a submoment of *Moment* D_{11}; *Submoments* A_0 and A_4 are submoments of *Moment* A_0, where [0] indicates the beginning of the piece. In the following analysis, moments are discussed by types, and within type according to temporal order. For the more complex (sub)moments, a harmonic reduction shows the static chord(s) plus any transitional motion. For simpler (sub)moments, see Example 9.58, which is a first-level reduction of the entire piece. Cells and cell sequences are shown for all (sub)moments. Analytic remarks are included for most submoments, moments, and moment types.

The following symbols are used in the harmonic reductions:

Open note heads represent notes of principal harmonies (at the level of the graph).

Closed note heads indicate subsidiary notes or pitches transitional to a subsequent harmony.

Beams connect pitches that return prominently, either in register, or at the extremities (top or bottom) of successive verticalities, or in new registers.

Broken beams represent stepwise progressions (shown only where particularly important or not obvious, as in transitions from one (sub)moment to the next); not all beams (solid or broken) are shown, in order to avoid undue clutter. Those omitted represent obvious connections.

Three beams indicate alternating harmonies.

9.3 MOMENT *A*

Submoment A_0.

Cellular analysis:

Cell Sequence 1

Example 9.1. **Cell sequence of *Submoment A_0***

Analytic remarks:

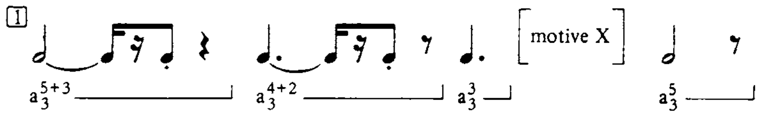
1. *Cell sequence 1* establishes the structurally important associations of the minor third with *Moment A:* the melodically central pitch D is surrounded on both sides by minor thirds.

2. Superscripts in this particular cellular analysis indicate the total duration of a cell in eighth-note beats. Subscripts differentiate cell types within the same family of cells.

3. The final duration of each cell sequence of the *A* Moments is variable and, strictly speaking, external to the final cell (it occurs after the last attack point). Therefore, the total duration of each *Cell a_2* is considered irrelevant to the cellular analysis.

Submoment A_1.

Cellular analysis:



Cell Sequence 1

Example 9.2. **Cell sequence of *Submoment A_1***

Analytic remarks:

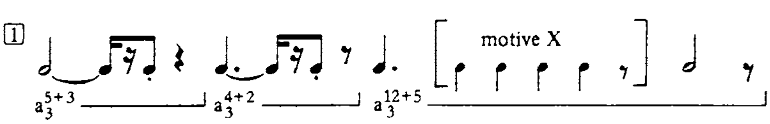
1. *Motive X* (two measures before [2]) works as neighbor to the basic harmony of the submoment. It is also set apart from the pitch context of [1]-[3] because it contradicts the otherwise purely octatonic[7] character of the submoment. The strongly emphasized E-flats, G-flats, and Cs of *Motive X* are foreign to the prevailing octatonic scale on G.

2. *Cell a_3* is characterized by a long chord followed optionally by a *staccato* reiteration. Superscripts here show the durations (in eighth-note beats) between successive attack points. Notice the progressive shortening in durations of both the long chords and the *staccato* reiterations prior to *Motive X:* long chords 5, 4, 3 and short chords 3, 2, 0 (we expect a duration of 1 but instead the *staccato* chord is omitted). After *Motive X* the long chord returns to its original duration of 5, while the short chord is again suppressed.

3. *Cell a_3*, in contrast to *Cells a_1* and *a_2*, is of local importance only. It appears solely in *Submoments A_1* and *A_4*, although we do hear it echoing harmonically in *Moment E*, where *Cell e_1* is associated with *Motive X* (see, for example, [42]-[43]).

4. The disappearance of the *staccato* chord from *Cell a_3* leads us to expect, linearity, its eventual return, which does happen in *Submoment A_4*.

5. The first chord of *Cell a_3* is written initially on the third beat of a 3/4 measure, then three successive times after the first beat of a 3/4 measure. At first it is next to impossible to perceive the written meter. The metric shift from on-the-beat to off-the-beat seems to suggest, if anything, a tentative attack in performance. But *Motive X* establishes the pulse clearly, although the written meter is not so clearly articulated. Then the return of the chord the measure before [2] is heard unequivocally as a syncopation. Thus an alternate cellular analysis is suggested, in which the chord before [2], because it finally *sounds* off the beat, is a delayed and elongated second impulse in the *Cell a_3* that begins three measures before [2][8] (see Example 9.3). The ambiguity created by these two alternative hearings suggests (in a linear fashion) that we have not heard the last from *Cell a_3*.

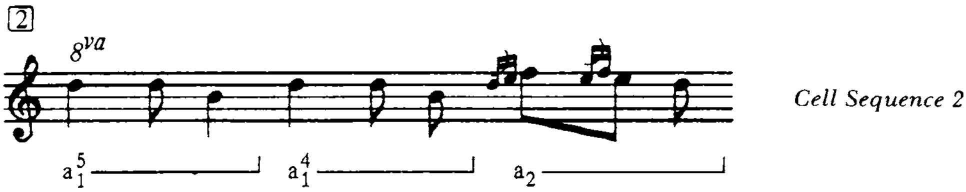


Alternate Cell Sequence 1

Example 9.3. **Alternate cell sequence of *Submoment A_1***

Submoment A_2.

Cellular analysis:



Example 9.4. **Cell sequence of *Submoment A_2***

Submoment A_3 (G_3).

Cellular analysis:

Refer to the discussion of the complete *Moment* G_{46} (in Section 9.10), and to Examples 9.53 and 9.54, for an explanation of the superscripts.

Example 9.5. **Cell sequence of *Submoment A_3***

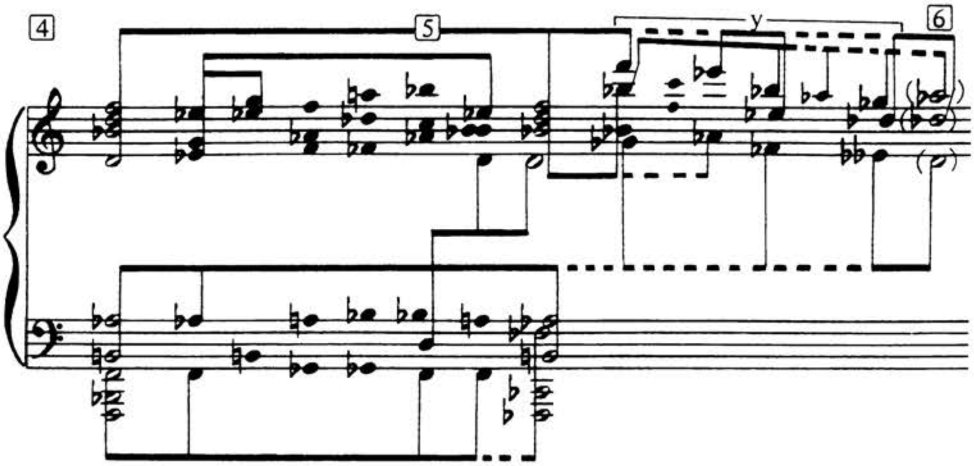
Analytic remarks:

1. In the context of *Moment A_0*, *Submoment A_3* is an intrusion, possibly attempting to act as transition to *Submoment A_4*, although the material is too highly profiled and too new. In some ways it does fit in, however. It fills out by stepwise motion the minor third D-B from *Cell a_1*. (The other initially important minor third, F-D (see *Cell a_2*) is also the basis of a subsequent line. Consider the bass line descent F at [0]-F-flat at [5]-D at [6].) Thus the submoment's pitch content does clearly fit into *Moment A_0*. Ultimately, however, it looks forward to, and is a linear implication toward, the *G* moments.

2. The melodic descent D-C-sharp-B foreshadows the progressive transpositions of the *A* moments.

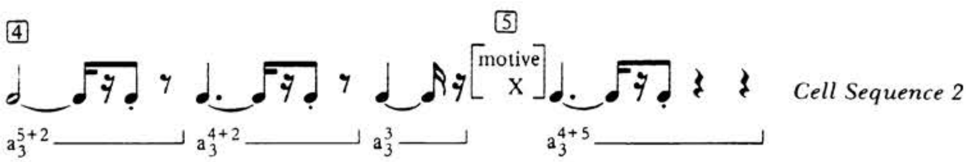
Submoment A_4.

Harmonic reduction:



Example 9.6. **Basic harmony of *Submoment* A_4 and transition to *Moment* B_6**

Cellular analysis:



Example 9.7. **Cell sequence of *Submoment* A_4**

Analytic remarks:

1. The two measures before [6] contain the first real transition in the piece, *Motive Y*. Brief, to the point, and unequivocal in its function, it does not disturb the essential stasis of the two moments it connects. It functions, as Example 9.6 shows, by means of three stepwise descending structural lines that connect the harmonies of *Submoment* A_4 and *Moment* B_6: the B-flat–A-flat–G-flat of the second oboe going to the A-flat of the first flute; the F–E-flat–D-flat of the first oboe going to the D-flat of the second flute; and the English horn G-flat–F-flat–E-double-flat going to the D-natural of the third flute.

2. The long chord in *Cell* a_3 progressively shortens, as it does in *Submoment* A_1, and the *staccato* chord disappears, this time to reappear. This re-emergence two measures after [5] is cadential. It furthermore satisfies a linear implication from *Cell Sequence 1* in *Submoment* A_1 (see analytic remark 2 in the discussion of

Submoment A_1 above). The long chord becomes progressively shorter: 5, 4, and 3 eighth-note beats respectively, followed by a duration of 4 after *Motive X*.

3. The second measure after [5] contains the first real change of harmony thus far in the piece: the bass voices progress stepwise from the fourth F-B-flat to the fifth F-flat-C-flat. This linear move occurs as the bass seems to complete its neighbor motion too soon, returning to F before the upper voices return to their original pitches. The bass then proceeds on by step to F-flat, although the remaining pitches of the harmony remain unchanged (notice second and third clarinets, however). This bass motion slightly disturbs the stasis of the moment, in preparation for the transition to the next moment. Also, a bass register connection is made with the next occurrence of *Moment A*, at [9].

4. *Motive X* is expanded quasi-sequentially here. We expect and miss a melodic A-flat after the E-flat-G in the first oboe. This pitch does arrive eventually, at [6]. Thus *Moment* B_6 is subtly—and linearly—prepared, a fact that, along with transitional *Motive Y*, tempers the work's first moment-to-moment discontinuity.

5. The increased length and inner complexity of *Motive X* precludes hearing the chord at end of the first measure of [5] as part of the cell begun two measures before [5]. Thus an alternate hearing, similar to that shown in Example 9.3, is impossible here. The fact that the final cell of the cell sequence is complete underlines the lack of ambiguity and makes, in retrospect, Example 9.2 a more appropriate way to understand the cell sequence of *Submoment* A_1 than Example 9.3.

Complete Moment A_0.

Harmonic reduction:

Example 9.8. **Basic harmony of *Moment*** A_0**, also showing transition to *Moment*** B_6

Cellular analysis:

1. See *Summary of A Moments* below for analysis of the cell sequences of *Cells* a_1 and a_2.
2. The cell sequences for *Cell* a_3 are:

a_3^{5+3}	a_3^{4+2}	a_3^{3}	[Motive X]	a_3^{5}	*Cell Sequence 1*
a_3^{5+2}	a_3^{4+2}	a_3^{3}	[Motive X]	a_3^{4+5}	*Cell Sequence 2*

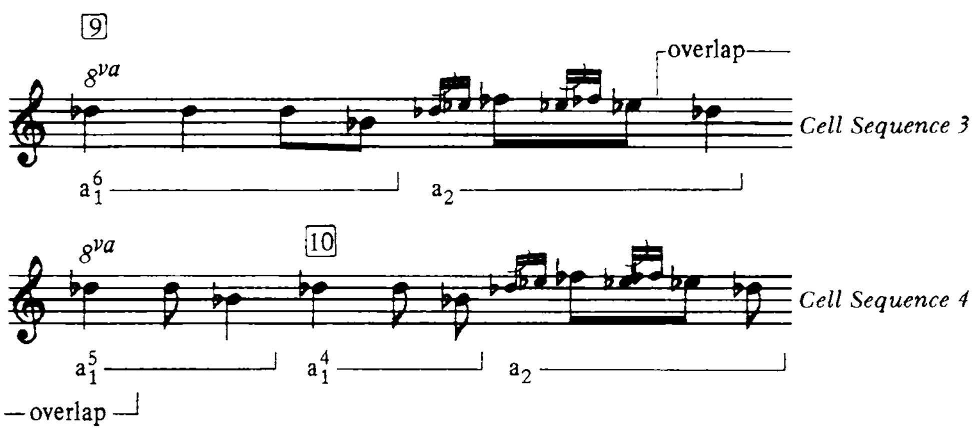
Example 9.9. **Cell Sequences of *Moment*** A_0**, *cell*** a_3

Analytic remark:

Moment A_0 immediately presents an alternation of severely contrasting textures, suggestive of the discontinuous nature of the entire piece. But the two (or three, if we count *Submoment* A_3) textures are continuous in non-textural ways: the F-B-flat on the bottom of harmonies at [0], [1], [2], and [4] (see Example 9.8); the constant F-D at the top of the same harmonies (the D is present also at [3]); and the constant tempo. Thus [0]-[6] is heard as one moment, partitioned into five submoments. The contrast between these submoments, though considerable, is not as large as that between *Moments* A_0 and B_6, where, paradoxically, there is a small transition.[9]

Moment A_9.

Cellular analysis:



Example 9.10. **Cell sequences of *Moment*** A_9

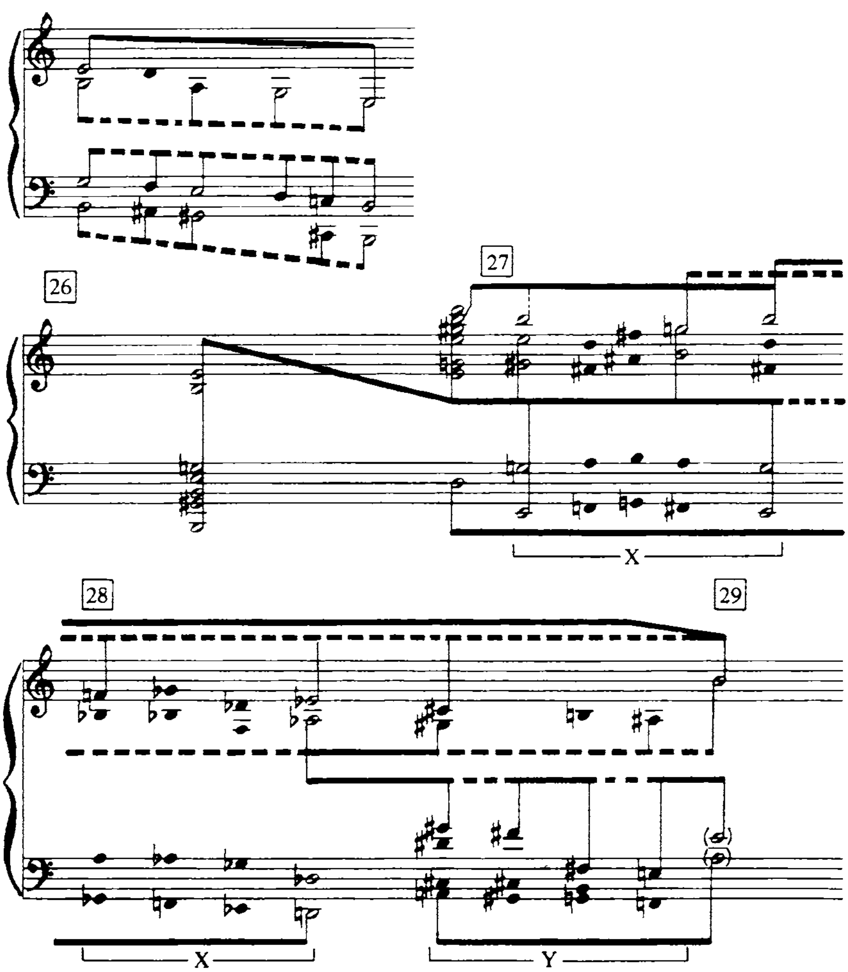
Analytic remarks:

1. *Motive X,* here as at [5], moves out of phase with itself: it is a circular figure, tending to return to its opening harmony, but the lower voices return sooner than the upper. Thus, the penultimate chord of the motive is not the same as the first chord.

2. *Cell Sequence 3* overlaps with *Cell Sequence 4,* the final note of *3* serving simultaneously as the first note of *4.*

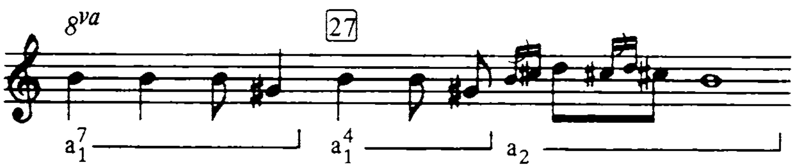
Moment $\boldsymbol{A_{26}}$.

Harmonic reduction:



Example 9.11. **Basic harmonies of *Moment*** $\boldsymbol{A_{26}}$**, plus transition to *Moment*** $\boldsymbol{D_{29}}$

Cellular analysis:



Example 9.12. Cell sequence of *Moment* A_{26}

Analytic remarks:

1. The English horn and bassoon figure that starts at [26] is an arpeggiation (filled in largely by stepwise motion) of the treble harmony of the moment (see two levels of reduction in Example 9.11). Thus the harmony stated in the third measure of [26] is implied from the beginning of the moment.

2. Although the cell sequence returns to that of *Submoment* A_0 (a_1^7 a_1^4 a_2), the accompaniment differs rhythmically. The trumpets and third clarinet now start an eighth-note beat before the melodic fanfare, and the trombones articulate not only the first but also the second afterbeat. These changes, retained in all subsequent occurrences of *Moment A,* are discussed below in the *Summary of A Moments.*

3. For linear reasons (having to do with voice-leading, motivic (*Motive X*), and harmonic implications) we expect the oboes' D and F-sharp a beat before [28] to ascend to E and G-sharp respectively. The horns and tuba interrupt, however, carefully avoiding any stepwise or pitch identity connections to the D and F-sharp (the tuba G-flat connects too readily in register with the immediately prior E in the third trombone to be heard as an octave transfer of the F-sharp in the second oboe). The ultimate stepwise connection, made more obvious by the return of the double reed sonority, comes two measures later, to D-sharp (out of register) and G-sharp (in register) in the first bassoon. That stepwise connection is not to the expected pitches. They are saved for the oboes at the end of the third measure of [33], thereby creating a linear connection between *Moments* A_{26} and D_{29}.

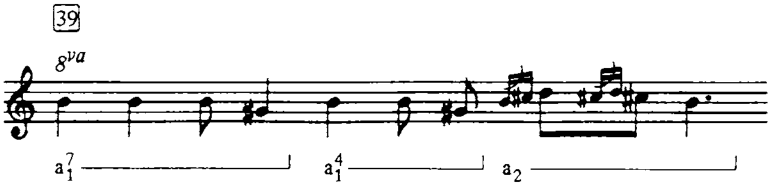
Moment A_{37}.

Cellular analysis:

Example 9.13. Cell sequence of *Moment* A_{37}

Moment A_{39}.

Cellular analysis:



Cell Sequence 7

Example 9.14.* Cell sequence of *Moment A_{39}

Summary of A Moments.

The cell sequence a_1a_2 is presented seven times in *Symphonies.* Let us consider these seven cell sequences in detail as a prime example of Stravinsky's technique of cellular permutation. The following description of the cells and sequences constitutes a listing of their rules of inclusion. *Cell a_1* begins with two or three repeated notes, all quarters except for the final eighth, followed by a single pitch a minor third lower, which may last an eighth note or a quarter note. *Cell a_2* starts from the same pitch as the previous *Cell a_1*, rises octatonically (whole step, half step) a minor third through two grace notes, and then descends again through the same pitches. The middle note is decorated, as is the first, by two grace notes, in this case the middle pitch and its upper neighbor. The final note, the same pitch as the first note, is of variable length.

This definition of *Cells a_1* and *a_2* delineates their consistency. Their variability comes from the number of repeated notes (two or three) in *Cell a_1* and less significantly from the length of the final note in *Cell a_2*.

Thus far I have described the internal construction of the two cells. The following rules determine the combination of cells into cell sequences:

1. each cell sequence begins with *Cell a_1* and ends with *Cell a_2*;
2. there are either one or two *Cells a_1* per cell sequence;
3. there is one and only one *Cell a_2* per cell sequence;
4. when there are two *Cells a_1*, the second invariably lasts 4 eighth-note beats;
5. when there are two *Cells a_1*, the first has a duration of either 5 or 7;
6. when there is but one *Cell a_1*, it invariably has the duration 6.

There are, therefore, only three possible cell sequences under these rules: a_1^7 a_1^4 a_2; a_1^5 a_1^4 a_2; or a_1^6 a_2.

As we hear the *A* moments, we learn the above rules and thereby come to understand the identity and possibilities for combination of the cells. What we do not know is which of the three allowable cell sequences will come next. This situation is a classic example of Stravinsky's technique of unpredictability within narrowly defined limits. The situation is actually rather subtle, since the order of cell sequences is patterned, but not in a manner that would allow us to predict the next sequence. Thus, there are three hierarchic levels on which the principle of unpredictable variation operates within limits: the internal structure of cells, the combinations of cells into cell sequences, and the order in which the cell sequences occur.

Example 9.15 summarizes the seven cell sequences of the *A* moments.

MOMENT OR SUBMOMENT	CELL SEQUENCE	CONSTITUENT CELLS
A_0	1	$a_1^7\ a_1^4\ a_2$
A_2	2	$a_1^5\ a_1^4\ a_2$
A_4	3	$a_1^6\ a_2$
A_9	4	$a_1^5\ a_1^4\ a_2$
A_{26}	5	$a_1^7\ a_1^4\ a_2$
A_{37}	6	$a_1^6\ a_2$
A_{39}	7	$a_1^7\ a_1^4\ a_2$

***Example 9.15.* Summary of cell sequences of all *A* moments**

A glance at Example 9.15 reveals that there is indeed patterning, though we cannot accurately predict the next event as this array unfolds in time. The order of cell sequences is unpredictable because seven cell sequences is too few to reveal unequivocally the algorithm for ordering. By simple inspection of Example 9.15, we can reasonably posit any of three different rules for ordering, based on groupings of the three types of cell sequences:

1 234 567, since in 234 and 567 the outer members are identical, and they surround the unique two-cell sequence $a_1^6\ a_2$;

1234 56 7, since the return of the initial cell sequence can be heard as articulative;

123 456 7, in which case the two-cell sequence is seen as the ending of a group, in which the first two members are permuted in the second group (the incomplete third group starts as a return to the original order).

When we add factors beyond cell identity, we come up with additional grouping possibilities:

12 34 567, defined by the transposition levels of the cell sequences;

12 34 / 5 67, defined by the temporal placement of the cell sequences in the music;

12 34567, defined by the underlying harmony, the difference being determined by the register of the second pitch class in the trumpets (admittedly not the most striking criterion for grouping);

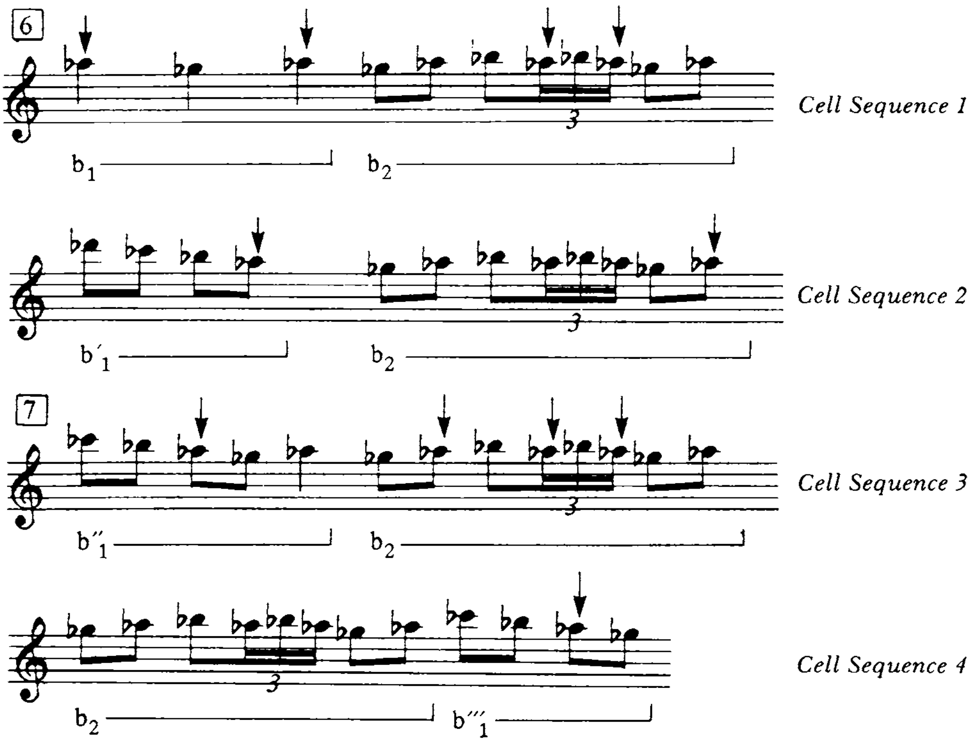
1234 567, defined by the accompaniment, the difference lying in two factors: (1) the number of notes per cell in the trombones, and (2) whether the trumpets and third clarinet begin with or before the first cell.

The listener is given not too little but too much information to be able to predict the order of cell sequences. But the situation is not chaotic; five of the seven grouping schemes shown above have a division between *Cell Sequences 4* and *5*. This partition is supported by the longest timespan without an A moment. There is thus a balance in this work between predictability and chaos, between order and unpredictability, between narrowly defined limits and quasi-random variation within them. Stravinsky was a master at using order to create the impression of arbitrariness.[10]

9.4 MOMENT *B*

Moment B_6.

Cellular analysis:



Example 9.16. **Cell sequence of *Moment B_6***

Analytic remarks:

1. *Cell b_2* is never altered. In each cell sequence, *Cell b_2* is associated with a different version of *Cell b_1*. The typical order is b_1b_2, but this order is reversed in the fourth cell sequence. This change in order signals the end of the moment.

Cell b_1 consists either of a turn about A-flat or a descending eighth-note figure aiming toward A-flat.

2. The cell sequences are permuted regularly, and their durations are regular: 5 or 6 quarter-note beats. To offset this potentially excessive regularity, Stravinsky places the nearly periodic cell structure against an aperiodic accompaniment. The sequences of durations in *Moment* B_6 (shown in Example 9.17) are less predictably patterned than anywhere else in the composition.

---

durations in eighth-note beats between successive attack points of the complete structural chord (see arrows in Example 9.16)

$$4\ 5\ \tfrac{2}{3}\ 5\tfrac{1}{3}\ 6\ 3\ 5\ 2\ \tfrac{2}{3}\ 10\tfrac{1}{3}$$

durations in eighth-note beats of vertical dyads in lower parts (arrows indicate the structural dyad D-natural–D-flat; brackets indicate the gradual emergence of the durational pattern 2+4)

5 3 2 2 2 2 4 6 1 1 1 3 2 4 2 4
↑ ↑ ↑ ↑ ↑ ↑

durations in eighth-note beats in the second flute (arrows indicate structural D-flats; notice the lack of patterning in the durations of the D-flats and of the intervening neighbor notes)

5 3 4 2 2 4 7 1 4 2 4 6
↑ ↑ ↑ ↑ ↑ ↑

durations in eighth-note beats in the third flute (arrows indicate structural D-naturals; notice the lack of patterning in the durations of the D-naturals and of the intervening neighbor notes)

10 2 2 2 4 6 3 3 2 6 4
↑ ↑ ↑ ↑ ↑

successive eighth-note durations of each neighbor note in the second flute

C-flat: 3 4 1 4 E-flat: 2 2

successive eighth-note durations of each neighbor note in the third flute

C: 2 4 3 6 D-flat: 2 F-flat: 2

number of neighbor notes between successive D-flats in the second flute (a pattern here!)

1 1 1 1 2

number of neighbor notes between successive D-naturals in the third flute (a similar pattern here!)

2 1 1 2

***Example 9.17.* Sequences of durations in the accompaniment voices of *Moment* B_6, showing lack of predictable patterns.**

The total number of neighbor notes in both the second and the third flutes is 6, a lone consistency in a context that contains surprisingly few patterns. The accompaniment is a free-flowing, nonmetrical, elusive undercurrent to the almost rigid unfolding of the cell sequences, a kind of counterpoint of degrees of predictability.

3. The accompaniment's pitches are highly restricted and its durational values few, yet within these limits it is extremely unpredictable. There is enough leeway, though, for its limits to be upset (slightly) at three points. The vertical dyads in the second and third flutes use interval class 1 (minor ninths and major sevenths) in every case but two.[11] The second measure of [6] contains the sixth (notated as a diminished seventh) D-natural–C-flat. This interval occurs too early in the moment to seem an exception, but it does serve to underline the different character of *Cell* b_1 as compared with *Cells* b_1', b_1'', and b_1'''.

4. The other unusual interval is the major ninth at the beginning of the second measure before [7]. This sonority is striking for a number of reasons: (1) for the first time in *Moment* B_6, all three voices move together; (2) only at this point in the entire moment is there pitch class duplication between voices; (3) D-flat, which occurs in the first and third flutes, is the only pitch class that appears in all three voices someplace in the moment; (4) the first flute's D-flat completes *in register* the first oboe's descent F–E-flat in the two measures before [6] (this motion is completed *out of register,* as Example 9.8 shows, at [6]); (5) the total pitch content of each of the three voices (including the first notes at [8]) is pitch class set 0135, *except* for the foreign D-flats two measures before [7] in the outer flutes (more on the importance of 0135 in *Symphonies* below); (6) the simultaneity with the two D-flats is less dissonant than the three-note chords around it; (7) this verticality serves to mark the beginning of the *Cell Sequence 2.*

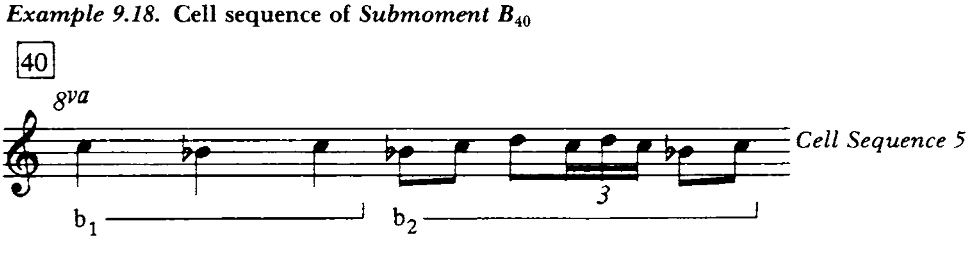
5. The last of the three violations of *Moment* B_6's limits occurs on the last beat of the third measure before [8]. Here is found the only F-flat (or E-natural) in the moment. This new pitch is emphasized by the unique subsequent skips in both lower voices. Thus, the final (permuted) cell sequence is set off from its predecessors, and the upcoming end of the moment is subtly signaled.

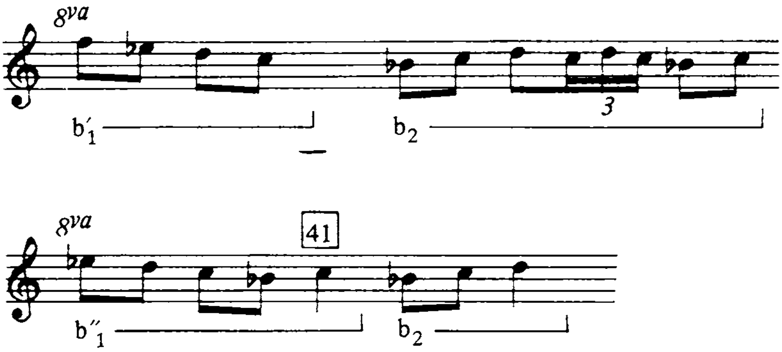
6. The barlines tend to follow the cellular construction, except for the last two measures, which are puzzling. It would seem that they should be 3/4 2/4, rather than 2/4 3/4, in order to coincide with the cells of *Cell Sequence 4* and with the final return of the structural harmony.

Submoment B_{40}.

Cellular analysis:

Example 9.18. **Cell sequence of *Submoment*** B_{40}





Cell Sequence 6

Cell Sequence 7

Analytic remarks:

Submoment B_{40} is literally the same as *Moment* B_6, transposed up a major third, with the exception that it breaks off during *Cell Sequence 7.*

Submoment $\boldsymbol{B_{41}}$ **(**$\boldsymbol{F_{41}}$**).**

Cellular analysis:

Cell Sequence 1

Example 9.19. **Cell sequence of** ***Submoment*** $\boldsymbol{F_{41}}$

Analytic remarks:

1. Each cell ends with a quarter note, with or without *fermata*. Superscripts indicate the number of eighth notes preceding this final quarter.
2. *Submoment* B_{41} presents new material, but with no jarring discontinuity. Stepwise pitch connection provides continuity, as do the pervasive vertical fifths, a previously important harmonic interval.
3. The cells of *Cell Sequence 1* expand progressively by the addition of two new notes onto the beginning of the cell.

9.5 MOMENT *C*

***Moment C*$_8$.**

Cellular analysis:

Cell Sequence 1

Cell Sequence 2

Cell Sequence 3

Cell Sequence 4

Cell Sequence 5

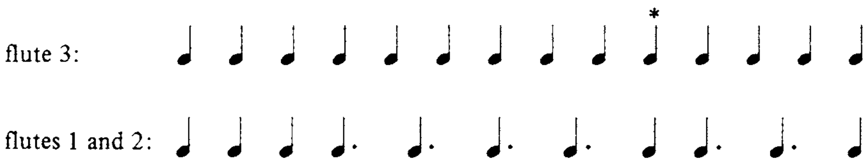
Cell Sequence 6

Cell Sequence 7

***Example 9.20.* Cell sequences of *Moment C*$_8$**

Analytic remarks:

1. In contrast to that in *Moment B*$_6$, the accompaniment here is quite regular. The alternating F and G continue at a consistent quarter-note rate, while the constant vertical dyad E-F-sharp leans toward a dotted-quarter duration after initially supporting the third flute's quarter notes.[12] See Example 9.21.



Example 9.21. **Accompaniment attack points in *Moment* C_8**

2. The lone interior quarter-note duration in the first and second flutes (marked * in Example 9.21) is a typically Stravinskian antidote to predictability. It offsets the otherwise regular durations.

3. *Cell c* moves from B to C-sharp, with an optional decoration by an intervening D, possibly preceded by C-sharp. In Example 9.20 subscripts denote cell durations in eighth-note beats. Superscripts indicate the number of notes in the cell. *Cell* c^3_4 is distinguished from *Cell* $c^{3'}_4$ because the former begins with its quarter note while the latter ends with it.

4. The pattern of cell durations is 4 3 4 4 4 4 5. The 3 irregularity displaces the quarter-note beat. The final 5 restores agreement of cells and meter.

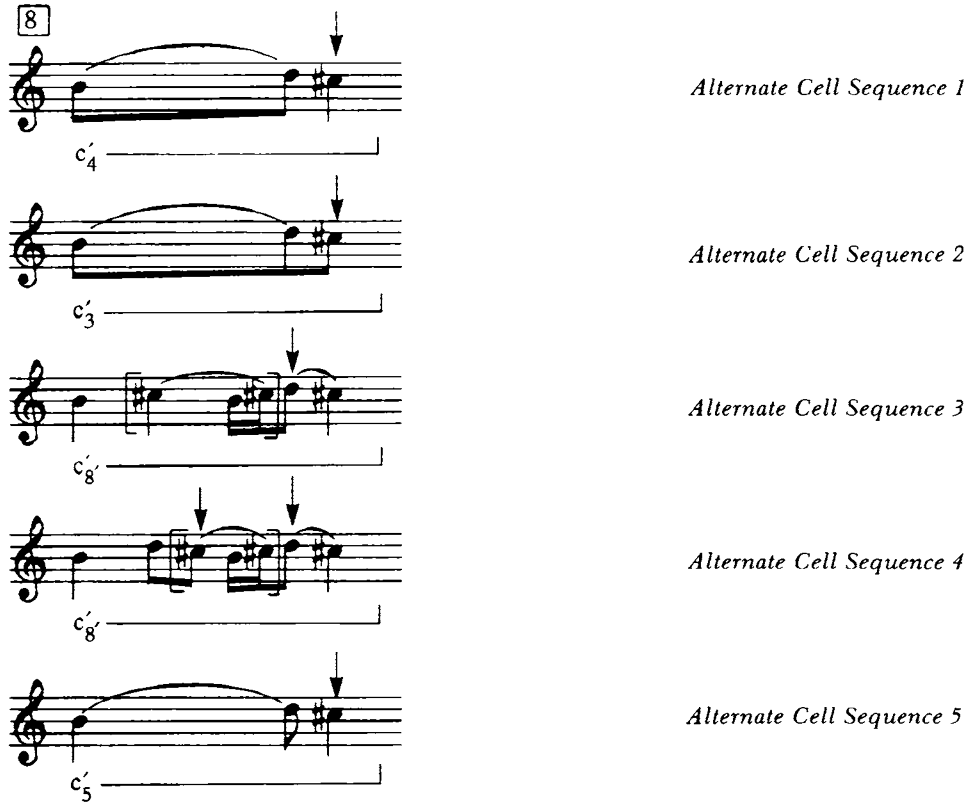
5. The pattern of notes per cell is 3 3 2 4 3 4 3. The repeated 4 3 at the end of this pattern serves to increase regularity for cadential purposes.

6. The cell patterning in Example 9.20 is obscured in performance by the slurs, which sometimes remain within and sometimes connect the cells. These slurs suggest a somewhat different cellular analysis (see Example 9.22). The arrows in Example 9.22 indicate points of stress accent caused by simultaneous attacks in all four voices. Notice how these accents unite the cells: In *Alternate Cell Sequences 1* and *2*, the beginning B is accented; in *Alternate Cell Sequences 3* and *4*, the middle D is accented; in *Alternate Cell Sequences 1, 2,* and *5*, the final C-sharp is accented. This use of the accompaniment to underline the similarity of the alternate cell sequences explains the special added quarter note three measures before [9], marked * in Example 9.21. This irregularity creates the second accent in *Alternate Cell Sequence 4*, which corresponds to the accent in *Alternate Cell Sequence 3*.

7. Each *Cell c′* is based on the figure B–D–C-sharp. In *Alternate Cell Sequences 4* and *5*, disregard the bracketed portion (which in each case is grouped by a slur). The slurring supports the identity of cells; B–D is slurred if there is no bracketed insert, and otherwise D–C-sharp is slurred.

8. Subscripts in Example 9.22 indicate the duration of the cell in eighth-note beats.

9. Two different analyses, Examples 9.20 and 9.22, both appear to explain the music, though differently. One system is more economical, while the other is supported by phrasing and accompaniment accents. We need not choose between the two analyses. A single phenomenon is not necessarily fully explained by a single analysis. The alternate system (Example 9.22) seems to codify the way Stravinsky heard the moment, since it accounts for the surface articulation and



Example 9.22. **Alternate cell sequences of *Moment* C_8**

since it explains the one exception to an otherwise regular accompaniment (the * in Example 9.21). The original system cannot explain this rhythmic aberration very well, beyond my glib statement that it serves as an antidote to predictability (see analytic remark 2 above). But the original system does show that there is a more basic cellular procedure at work. The molecules of the alternate system are built from the atoms of the original system. In other words, cells can be either surface features, well articulated and readily perceptible (as in the alternate system), or they can be constructive materials that work beneath the surface.

This distinction may not seem crucial in the context of *Moment* C_8. After all, three of the five alternate cell sequences are identical with original sequences. But it is important to keep in mind the distinction between clearly marked cells (typical of Stravinsky's Russian period) and cells used as raw material, not really articulated on the foreground (as in some of Stravinsky's late row pieces). This distinction is particularly significant in *Moment D,* where a seemingly free-flowing melodic line can be shown to have an underlying cellular logic that is not always apparent.[13]

***Moment* C_{38}.**

Analytic remarks:

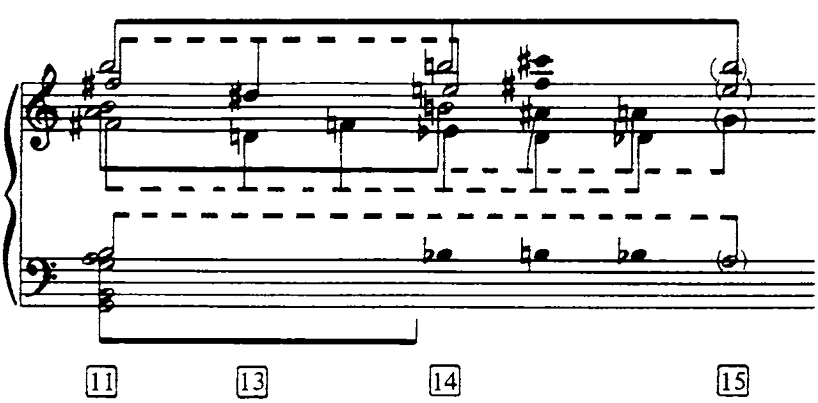
1. The cellular analysis is exactly that shown in Example 9.20. The accompaniment durations are identical to those in *Moment* C_8. The harmony is similar.

2. Arriving at *Moment* C_{38} is an extreme discontinuity. Not only is there the expected change in the three basic parameters, but also there is a substantial shift of timbre. Furthermore, *Moment* A_{37} is unique among the *A* moments in having no softening transition at its end. Incidentally, in his recording,[14] Robert Craft (who surely brings some authenticity to his interpretation) takes *Moment* C_{38} not at Tempo II (same as *Moment* C_8) but at Tempo I, continued from the preceding *Moment* A_{37}, thus preserving a connecting link in one parameter and thereby softening the discontinuity. The Belwin-Mills and Kalmus publications of the original 1920 version indicate Tempo II, however, as does the Boosey and Hawkes edition of the 1947 revision. While an interesting variant, Tempo I is ultimately problematical, because it creates a unique situation, in which a moment returns at a new tempo.

9.6 MOMENT *D*

***Submoment* D_{11}.**

Harmonic reduction:



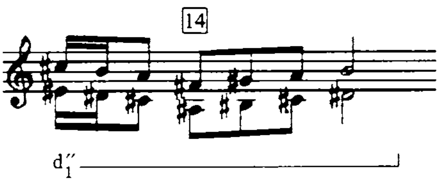
Example 9.23. **Basic harmony of *Submoment* D_{11}**

Cellular analysis:

Cell d' basic shape

Minor variants of *Cell d′* (see score), labeled respectively *Cell* d'_1, *Cell* d'_2, *Cell* d'_3, and *Cell* d'_4.

Cell Sequences 1–4



Cell Sequence 5

Cell Sequence 6

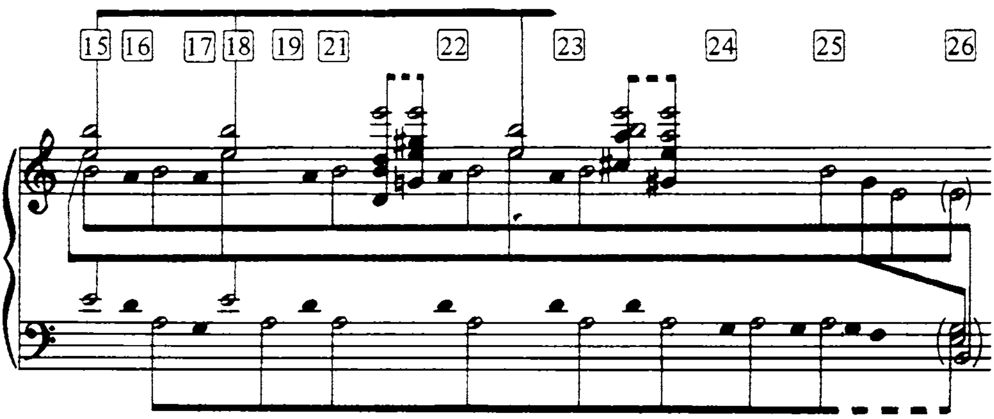
Example 9.24. **Cell sequences of *Submoment*** D_{11}

Analytic remark:

At first there are three layers of material, differentiated timbrally: double reed plus third trumpet chords; *Cell d′* in trumpets accompanied by clarinets and horns; and a trombone counterpoint from *Motive* X (first presented as five chords, then repeated omitting the first chord, then repeated omitting the second chord). The interpenetration of these three layers begins just before [13], where two *Cells d′* overlap with *Motive* X. In the second measure of [13], the function of the double reed sonority is altered, as oboes, English horn, and bassoon take over *Cell d′*. The subsequent passage, [14]-[15], uses a new cell, *d″*, similar to *Cell d′*. The underlying harmony is altered somewhat, although there are prominent common tones (see Example 9.23), but the frequency of nonchord tones is increased. The result is the most kinetic, least static passage in the work, prior to the final chorale at [65]. Motion is caused not only harmonically but also by the modulation from a dotted-quarter-note to a quarter-note pulse.

Submoment D_{15}.

Harmonic reduction:



which reduces to:

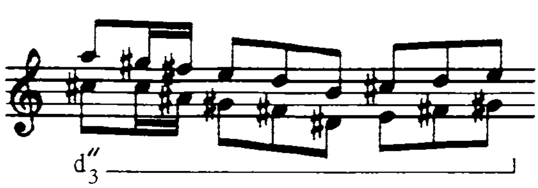
Example 9.25. **Basic harmony of *Submoment D_{15}***

Cellular analysis:

1. Interjections after [21] and [23]:

Cell d'_3 transposed up a perfect fourth

Cell Sequence 7



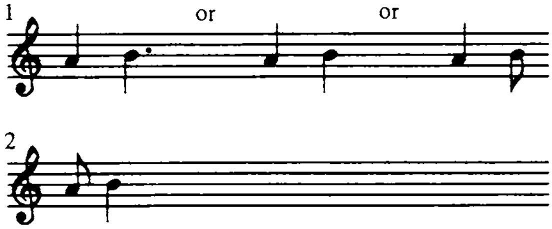
Cell Sequence 8

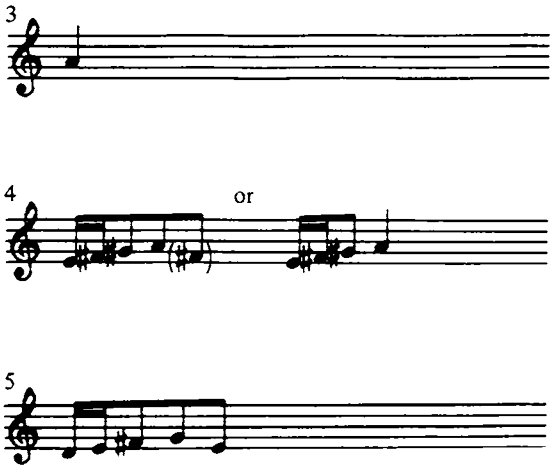
(up a perfect fourth from pitch level of *Cell d''_1*)

Example 9.26. **Cell sequences of interjections in *Submoment D_{15}***

2. The cellular construction of the flute and clarinet is more complex than in other moments' melodic lines, despite the seemingly amorphous surface. For this reason, the cells of the two lines (top, first flute or first clarinet; bottom, second clarinet; when the first clarinet plays, the first flute has noncellular filler) are labeled separately.

Example 9.27. **Cells in top melodic voice of *Submoment* D_{15}**





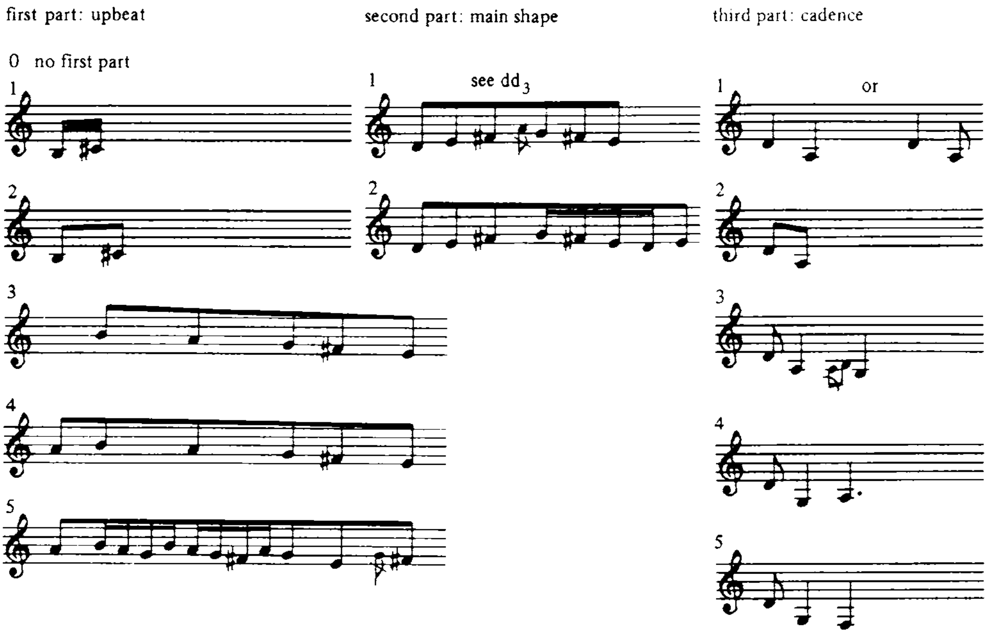
third part: cadence

Example 9.28. Cells in bottom melodic voice of *Submoment* D_{15}

Continued

Example 9.28, continued

Cell dd_4



3. *Cells* d_4 and dd_4 are subdivided into three parts each. Superscripts indicate which version of each of the three parts is used in a given instance (refer to Examples 9.27 and 9.28). An illustration is given in Example 9.29. The superscript notation differs for *Cells* dd_1, however. In these cases each digit refers to one of the seven fragments shown in Example 9.28, no matter where in the superscript it appears. (On the other hand, in the notation for *Cells* d_4 and dd_4, a particular digit refers to a different fragment, depending on whether it is found in the first, second, or third order position.) See Example 9.30 for a sample *Cell* dd_1.

Example 9.29. **Typical** ***Cell*** d_4 **in** ***Submoment*** D_{15}

Example 9.30. **Typical *Cell dd*$_1$ in *Submoment D*$_{15}$**

4. The cell sequences for *Submoment* D_{15} are shown (both voices) in Example 9.31.

Cell Sequence 1:	[15] $d_1^1\ d_1^2\ d_1^2\ d_3$ $dd_1^{154567}\ dd_3^1$	[16] d_4^{131} dd_4^{421}	 d_4^{222} dd_4^{112}	[17] d_4^{214} dd_4^{113}
Cell Sequence 2:	[18] $d_1^2\ d_1^2\ \ d_2^1$ $dd_1^{2567}\ dd_2^1$	[19] $d_2^2\ \ d_2^1$ $dd_2^2\ dd_3^2$	[20] $d^3\ d_4^{132}$ dd_4^{511}	[21] d_1^{231} dd_4^{311}
Cell Sequence 3:	[22] $d_1^2\ d_1^2\ d_4^{221}$ $dd_1^{535}\ dd_4^{111}$	[23] $d_4^{214}\ \ d_2^1$ $dd_4^{113}\ dd_2^1$	[24] $d_2^2\ d_2^1$ dd_2^2	[25] $d_3\ \ d_4^{115}$ $dd_3^3\ dd_4^{015}$

Example 9.31. **Cell sequences of *Submoment D*$_{15}$**

***Complete Moment D*$_{11}$.**

Analytic remarks:

1. *Cell d′* appears after [21] transposed up a fourth from its pitch level in *Cell Sequences 1-4* of *Submoment* D_{11}. *Cell d″* appears after [23] a fourth higher than in *Submoment* D_{11}. How can I claim, then, that *Cell Sequences 7* and *8* belong to the same static moment as *Cell Sequences 1-6,* if the materials are transposed? Part of the answer lies with the nonharmonic nature of *Cells d′* and *d″* as they appear in *Submoment* D_{15} (*Cell Sequences 7* and *8*). Example 9.25 shows how *Submoment* D_{15} is essentially a single harmony, with *Cell Sequences 7* and *8* functioning as interruptions. The nonchordal pitches of these two cell sequences come from nowhere and go nowhere in their immediate context. The notes of *Cell d′*$_3$, after [21], do connect (by step or common tone) with those of *Cell Sequences 1-4* in *Submoment* D_{11} (see Example 9.26). Similarly, the dyad A-C-sharp both concludes *Cell d″*$_2$ just before [15] and commences *Cell d″*$_3$ in the third measure of [23]; in addition, these two interjections have voice-leading connections to each other. Thus, *Cell Sequences 7* and *8* do not really participate in (are not linearly related to) the prevailing harmony, but they do have linear connections in the larger context of *Moment* D_{11}.

2. Another reason that the transposition of *Cells d′* and *d″* does not contradict the stasis of *Moment* D_{11} is that the interval class (5) of transposition is also the main internal interval class of the underlying harmonies. The treble fifth B-F-sharp at [11] is transposed down a fifth to E-B by means of the stepwise move F-sharp-E (taking place under B) by [14]. When the next transposition down a fifth takes place to introduce A (second clarinet at [15] and, more decisively, three measures before [17]), the B is retained to complete the stacked-fifth harmony basic to *Submoment* D_{15}. The introduction of this A is hardly startling, nor does it signal a new harmony, because (1) A has been present in register during *Submoment* D_{11}; and (2) A is an expected note because of the transposition of fifths by fifths. Therefore the "new" harmonic context of *Cells d′* and *d″* is not really new, so that their expected transposition up a fourth (= down a fifth)—which is also, incidentally, the interval through which *Cell d′* moves internally—does not result in a vastly different harmonic area.

3. The melodic cadence A-B (three measures before [17], at [17], at [21], at [22], and at [23]) is reminiscent of the neighbor motion B-A-B at the start of *Moment* D_{11} (notice the B-A-B motion at [11] in the English horn going to the second oboe, then going to English horn, and also in the third trumpet, going to English horn, and then going to the third trumpet). The dyad A-B is verticalized in the horns and clarinets two measures before [13], and the dyad spans the harmony basic to *Submoment* D_{15} (see Example 9.25). These identities are support for my contention (see Section 9.2) that [11]-[15] and [15]-[26] must be heard as parts of the same moment.

4. The cellular analysis of *Submoment* D_{15} is more complex than the analyses of other moments' cells. The clarinet and flute lines disguise their cellular structure by means of largely stepwise motion, smooth articulations, and small repertory of note durations. Nonetheless, Stravinsky's typical cellular logic is evident, and its force can be fully appreciated only after the cellular structure of *Submoment* D_{15} is compared with that of *Moment* D_{29} (see Example 9.33). The many versions of most of the *d* cells necessitate subdividing the cells in the analysis. I have decided against calling the constituent parts individual cells, however, in order to point out the usual permutations and variations of cells. The differences between versions of a single cell are often minor, although significant (Stravinsky, as usual, keeps the listener's attention by means of small, unpredictable variations). Each *Cell* d_1, d_2, d_3, and d_4 (as well as each *Cell* dd_1, dd_2, dd_3, and dd_4, although to a lesser extent because of their subsidiary roles) does indeed have its own distinct character, created in the cases of *Cells* d_4 and dd_4 by the segment labeled "main shape." While the cells' individuality is unmistakable, there is also a strong family resemblance between all *d* cells that smooths over the cellular partitions. The result is a system of cells that is basic to this moment, but which is not markedly perceived. In studying *Moment C*, by contrast, I put forth two slightly different cellular analyses, one to explicate the construction, and the other the aural result. With *Moment D* the situation is more subtle: A subsurface cellular construction is treated on the foreground as if to deny cellular partitioning in favor of freely flowing, nearly undifferentiated melodic lines.

5. Choosing a notation for a cellular analysis can be tricky. Notation tends to influence analytic decisions by making some potential conclusions appear more

elegant or economical *in the context of the particular analytic system chosen* than others. I will not overburden an already lengthy analysis by recounting numerous rejected methods of labeling *d* cells. But working with alternatives has shown me that there are several levels of variation in this moment. If every individual variant were given its own label, similarities that are nearly identities would not be apparent in the analysis. Thus, for example, the two cells shown in Example 9.32 would have to have different labels, whereas they are in fact virtually identical. Even if the two cells in Example 9.32 were labeled similarly, except for one superscript digit, it still seems excessive to differentiate them at all, given the range of possible variants in the *d* cells. Some variants, therefore, while significant in preventing predictability, are too minor to mention at all in the labeling. Such variants include the presence or absence of a final pitch, the inclusion or omission of a grace note, and the two chromatically related versions of *Cell* dd_1^2 (see Example 9.28). In addition, some cells with different superscripts are not vastly different. Compare, for example, *Cell* d_4^{222} (before [17]) with *Cell* d_4^{221} (before [23]): The only difference (apart from the grace note omitted from the analysis) is the length of the penultimate note. Still, I consider this difference more important than a change of duration in a final note of a cell. On the other hand, compare *Cell* d_4^{231} (after [21]) with *Cell* d_4^{221} (before [23]). The differences are considerable, though only one superscript digit has changed, as is also the case in the previous example of the similar *Cells* d_4^{222} and d_4^{221}. I have tried to use a system of labeling that indicates important identities, near identities, and variants. But the limitation of such a system must not be forgotten. It suggests a few discrete levels of difference between cells. (The levels are, in order of increasing difference: identical labels; superscript slightly different; superscript totally different; subscript different; letter name [*d* vs. *dd*] different; letter type [*d* vs. *c*] different.) Yet there are actually far more degrees of difference. We must remember that each degree of difference in labeling may actually correspond to several degrees of difference between the cells. My superscript notation allows similar cells to be differentiated. There are two versions of *Cell* d_1, clearly related but with significant harmonic and rhythmic differences; *Cell* d_2 has two variants, of similar but not identical contour, rhythm, and pitch; there is but one version of *Cell* d_3 (the presence or absence of the grace note is not considered sufficiently significant to justify introducing a difference in superscripts); all the d_4 cells

Example 9.32. **Two sample cells from *Submoment* D_{15}**

have a family resemblance, determined by the second segment's stepwise descent (which, in the case of variant 3, can lengthen the cell considerably by presenting the main shape twice), while the initial upbeat and cadence, though variable, remain small. Refer to Examples 9.27 and 9.28. In *Cell* dd_1 the three- or four-note stepwise descent is reiterated on identical or stepwise lower pitch levels. The two versions of *Cell* dd_2 clearly belong together. *Cell* dd_3 has a characteristic rise, with a fall toward the end (but there is less similarity between the three versions than in other cells). *Cell* dd_4 has a well-defined main shape, but the cell can be considerably altered by the omission of an upbeat, the use of a small upbeat, or the inclusion (as in version 5) of an elaborate descent. Since the *dd* cells are accompanimental, they are less clearly differentiated from each other than are the *d* cells. Stravinsky makes the accompaniment smoother than the melody by choosing cells with less individual character and by embedding within one version (*Cell* dd_3^3) of one cell the main shape of another. This embedding helps to blur the distinction between cells. Listen to the line of the second clarinet alone and notice how noncellular it seems.

6. The cellular analysis accounts for nearly every note from [15] to [26]. The few exceptions are the first flute's A and B in the two measures before [16], and the second clarinet's G and F at the end of the second measure of [22].

7. I am aware that the analysis given above may be dismissed as an elaborate method of slicing up that which is understood whole. The full thrust of this analysis, however, is yet to come. Once a similar analysis has been performed on the cells of *Moment* D_{29}, we should be able to see the limits of the system within which unpredictability runs free. In other words, we have yet to discover the logic behind the cell sequences. The thrust of the subsequent analysis is to show that *Moment* D_{29} is not merely similar to *Submoment* D_{15} but is actually a condensation of it, and a condensation in a most interesting ratio.[15]

Moment $\mathbf{D_{29}}$.

Cellular analysis:

1. *Cells d′* and *d″* operate exactly as in *Submoment* D_{15}.
2. *Cells d* and *dd:*

	[29]	[30]	
Cell Sequence 4:	$d_1^1\ d_1^1\ d_1^2$	$d_3\ d_4^{131}$	
	$dd_1^{15\times567}$	$dd_3^1\ dd_4^{424}$	
	[31]	[32]	[33]
Cell Sequence 5:	$d_2^1\ d_3$	d_4^{132}	d_4^{231}
	dd_3^2	dd_4^{521}	dd_4^{311}
	[34]	[35]	[36]
Cell Sequence 6:	$d_4^{214}\ \ d_2^1$	$d_2^2\ d_2^1$	$d_3\ \ d_4^{115}$
	$dd_4^{113}\ dd_2^1$	dd_2^2	$dd_3^3\ dd_4^{015}$

Example 9.33. **Cell sequences of** ***Moment*** $\mathbf{D_{29}}$

Summary of D Moments

An abstract analysis may have less to do with the sounds of a composition than with hidden structural relationships. In pitch class set theory, for example, set types are abstracted from pitch class sets, which in turn are abstracted from motives, chords, etc. As John Rahn has written, "each step up the ladder of abstraction loses particular distinctions but gains generality. . . . Relations that may lie obscured in the thicket of the full particularity of things can be perceived clearly when a process of generalization has pruned away the underbrush of reality."[16]

The analyses of cells and cell sequences given in Examples 9.27, 9.28, 9.31, and 9.33 represent a particular degree of abstraction. It is now useful to strip away some of the particulars and generalize to a higher level of abstraction. By ignoring superscripts, we can concentrate on larger-scale differentiations of cell types. The pattern of types of *Cell d* (supported by versions of *Cell dd*) is given by the subscripts alone, as shown in Example 9.34. The basic pattern within the cell sequences shown in Example 9.34 is 1 2 3 4. The beginning of a cell sequence may be articulated with two or three *Cells* d_1, or *Cell* d_1 may be omitted. In the final cell sequence of each moment, *Cell* d_4 is inserted once or twice before *Cell* d_2; *Cell* d_2 is presented once or thrice, but it is omitted from the first cell sequence of each moment. An inviolable *Cell* d_3 comes next; the cell sequence invariably closes with one, two, or three *Cells* d_4. *Moment* D_{29} is more continuous than *Submoment* D_{15}, owing to the omission of the articulating *Cell* d_1 from the interior of the moment. Thus the existence of three cell sequences in *Moment* D_{29} is not immediately apparent. But they are there, as comparison with *Submoment* D_{15} shows. The order of cells in *Moment* D_{29} closely follows that of *Submoment* D_{15}, except for the omission of certain repetitions (a classical procedure: Omit the repeats the second time through). Thus *Moment* D_{29} is indeed a compression of *Submoment* D_{15}. This observation is supported by the placement of the interrupting *Cells* d' and d'' (see arrows in Example 9.34).

Submoment D_{15}													
Cell Sequence 1:	1	1	1						3	4	4		4
Cell Sequence 2:		1	1			2	2	2	3		4	↑	4
												d'_3	
Cell Sequence 3:		1	1	4	4 ↑	2	2	2	3				4
					d''_3								
Moment D_{29}													
Cell Sequence 4:	1	1	1						3				4
Cell Sequence 5:								2	3		4	↑	4
												d'_3	
Cell Sequence 6:					4 ↑	2	2	2	3				4
					d''_3								

Example 9.34. **Pattern of cell sequences for the *D* moments**

Submoment D_{15}:	131 421	222 112	214 113	132 511	231 311	221 111	214 113	115 015
Moment D_{29}:	131 424			132 521	231 311		214 113	115 015

***Example 9.35.* Versions of *Cells* d_4 and dd_4 in the *D* moments**

The *d* cell that allows the greatest internal variation is *Cell* d_4 (likewise *Cell* dd_4). Example 9.35 shows the pattern of recurrence of versions of *Cells* d_4 and dd_4 only, as they appear together. In other words, the digits in Example 9.35 correspond to superscripts in previous examples. As Examples 9.27 and 9.28 show, the following cells are quite similar: dd_4^{421} and dd_4^{424}; d_4^{222} and d_4^{221}; dd_4^{112} and dd_4^{111}; and dd_4^{511} and dd_4^{521}. Thus Example 9.35 demonstrates another way (having to do with details rather than abstracted structures) in which *Moment* D_{29} is a condensation by selective omission of *Submoment* D_{15}.

9.7 INTERRELATIONSHIP BETWEEN THE FIRST AND SECOND PARTS

After [42], the largest break in the piece, we encounter not only the typical changes of tempo, cells, and harmony but also new material. Rehearsal number [42] also marks the replacement of *Moments A, B, C,* and *D* by *Moments E, F,* and *G*. Two of these moment types substitute, in specific ways, for two of the old types. *Moment* E_{42}, for example, is texturally similar to *Submoments* A_1 and A_4. The harmony of *Moment* E_{42} recalls that of *Moment* A_0, since the G major treble-register triad in trumpets at [42] corresponds to the clarinets' and flutes' opening triad. The four remaining pitches at [42]—D, A-flat, F, and B in trombones and tuba—are present (in the same instruments, but not in the same registers) in the large chord at [1] and [4]. Also, the chord at [42] is a transposition down a minor third of the chord at [1] and [4]. (Transposition down a minor third is significant with regard to *Moment A,* which at [26] is heard a minor third lower than at [0].) As in *Submoments* A_1 and A_4, the block chords at [42] are followed by *Motive* X. And *Moments A* and *E* share Tempo I. One type of moment, which, in a nonlinear manner, returns periodically as a refrain, is replaced by another moment type, which also returns frequently but somewhat unpredictably. Thus the chorale replaces the fanfare.

Similarly, *Moment F* replaces *Moment D. Moment F,* first heard at [41], relates harmonically and texturally to [13]-[15]. Furthermore, *Moments F* and *D* share Tempo II.

It would be tidy if *Moment G* replaced *Moments B* and/or *C* in some fashion. But Stravinsky is rarely so predictable. The material of *Moment G,* let us remember, is first heard at [3], where it is part of *Moment A*. Furthermore, *Moment G* is similar to *Moment D* in that it provides the largest moment in its half of the piece (prior to the final chorale, *Moment* E_{65}). Thus *Moment G* is associated not with *Moments B* or *C* but with *Moments A* and *D*. Furthermore, *Moment* G_{44} brings a new tempo indication, Tempo III.

Thus there are three notated tempos in *Symphonies*. What the indications Tempo I, II, and III define is the note value that moves at 72 beats per minute. For example, Tempo II at [11] is given as ♩. = 72, while at [6] Tempo II is marked ♩ = 108. These two speeds are the same tempo notationally, but not perceptually. At [26] the beat is given as 72, as at [11], but with the beating unit notated as a dotted-quarter, not a quarter. But the speed at [26] (Tempo I) *sounds* the same as that at [11] (Tempo II). How many different tempos do we actually hear?

The tempos of all moments are summarized in Example 9.36.

Moment A has a beating unit of ♩ = 72, but there are frequent 3/8 measures that necessitate a beating unit of ♪ = 144 (♩. = 48 is too slow to be a primary level pulse in this context). *Moments B* and *C* share a beating unit of ♩ = 108; *Moment* D_{11} starts at ♩. = 72, but in the passage starting two measures before [14] the pulse changes by mixing two speeds to ♩ = 108. This 108 is undercut, however, by the frequent 3/8 measures of *Submoment* D_{15} and *Moment* D_{29}, which require a pulse of ♩. = 72 (♪ = 216 is too fast to be the beating unit). *Moment E* moves consistently at ♩ = 72. *Moment F*, like *Moment D*, travels fundamentally at ♩ = 108, but with 3/8 measures at ♩. = 72. *Moment G* has the new tempo notation of ♩ = 144. Tempo III is therefore twice as fast as Tempo I. When *Moment G* is hinted at during *Moment* A_0, no new tempo indication is needed. The note values at [3] are simply halved. Thus [3]-[4] has the only time signatures in the composition with a denominator of 16. We *perceive* Tempo III at [3], although it is not present in the notation. The fundamental pulse of Tempo III is 144. *Submoment* G_3 and *Moment* G_{44} are too brief to produce much momentum at

Moment A
Tempo I: ♪ = 144 (♩ = 72)

Moment B
Tempo II: ♩ = 108

Moment C
Tempo II: ♩ = 108

Moment D
Tempo II: ♩ = 108 (♩. = 72)

Moment E
Tempo I: ♩ = 72

Moment F
Tempo II: ♩ = 108 (♩. = 72)

Moment G
Tempo III: ♩ = 144 (♩. = 96)

Example 9.36. **Summary of tempos of all moments**

144, but the extended passage in *Moment* G_{46} does build considerable excitement since its 144 pulse *is* fast. *Moment G* contains 3/8 measures, heard at ♩. = 96, a decidedly new rate. Thus, Tempo III is indeed fresh.

We actually hear four rates of speed in *Symphonies:* 72, 108, 144, and 96. 96 is never an independent tempo, however, because we never encounter more than two consecutive 3/8 measures at ♩. = 96 (although the music in [51]-[54] seems to be trying to establish this new rate, an additional factor contributing to the excitement of *Moment* G_{46}). There are thus five of what we may call "tempo complexes": pure 72 (*Moment E*), 72 mixed with 144 (*Moment A*), pure 108 (*Moments B* and *C*), 108 mixed with 72 (*Moments D* and *F*), and 144 mixed with 96 (*Moment G*).

9.8 MOMENT *E*

Moment E_{42}.

Cellular analysis:

[42]
Cell Sequence 1: e^{201} (see Example 9.41 for explanation of *Cell e* superscripts)

Example 9.37. **Cell sequence of *Moment*** E_{42}

Analytic remark:

In the fourth measure of [42], *Motive X* takes over from what seems to be a second *Cell e.* The motive provides the expected melodic C. We further expect a final melodic return to D, because of the shape of both *Cell e* and *Motive X*. That D finally arrives, in the proper timbre and register, with the next *Moment E,* at [56]. Thus a linear connection is made across the discontinuities of [43]-[56].

Moment E_{56}.

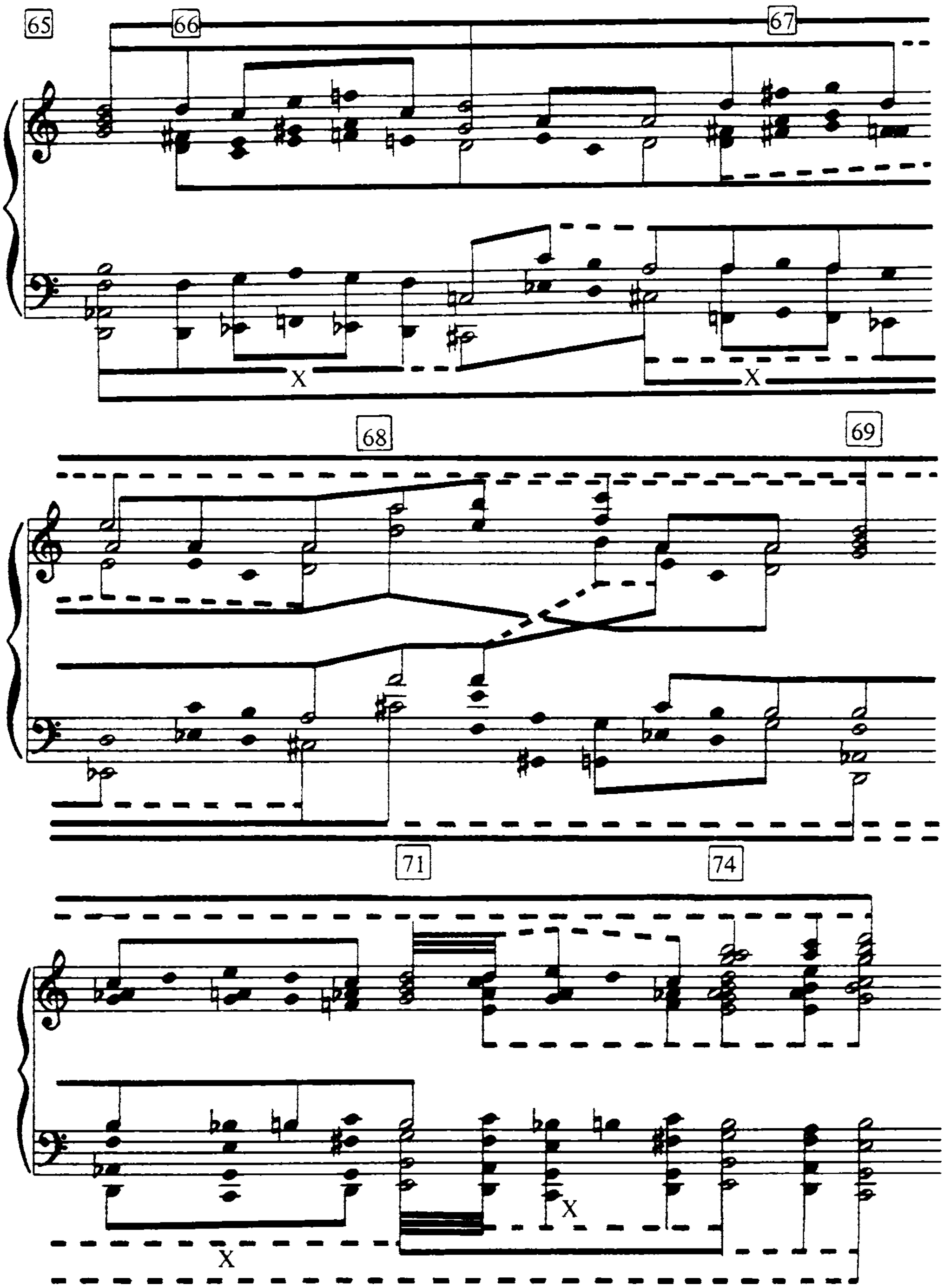
Cellular analysis:

[56]
Cell Sequence 2: e^{101} e^{101} (see Example 9.41 for explanation of *Cell e* superscripts)

Example 9.38. **Cell sequence of *Moment*** E_{56}

***Moment E*₆₅.**

Harmonic reduction:



Example 9.39. **Reduction of *Moment E*₆₅**

Example 9.40. **Further reduction of *Moment* E_{65} to its basic harmonies**

Cellular analysis:

Cell e consists of two or three parts: (1) a possibly reiterated G major treble triad (for complete harmonies, refer to the score); (2) contrasting harmonies; and (3) an appoggiatura chord with its resolution to the G major treble triad. Either but not both of the chords in part 3 may be repeated. Part 1 is always present; parts 2 or 3, but not both, may be omitted. There are several versions of each part.

Example 9.41. **Cells of *Moment E***

Example 9.41. continued
second part:

0 no middle part

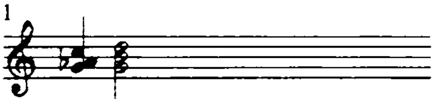
1


2


3


third part:

0 no third part

1


2


3


4


	[65]				
Cell Sequence 3:	e^{401} e^{302}				
	[69]			[70]	[71]
Cell Sequence 4:	e^{401}	e^{101}	e^{513}		
				(the second and third parts of *Cell* e^{513} overlap)	
	[72]		[73]		
Cell Sequence 5:	e^{630}	e^{620}			
	[74]	[75]			
Cell Sequence 6:	e^{704}				

Example 9.42. **Cell sequences of** ***Moment*** E_{65}

Summary of E Moments and Analytic Remarks.

Moment E_{65} is the longest and the final moment. It is not overtly partitioned into submoments. Instead, it is continuous, leading to the final cadence. The need to bring the entire composition to a conclusion thus makes this final section different from the preceding moments: The harmony is not really static and the cellular usage is more developmental than permutational.

At first the *e* cells seem permuted in the normal manner. *Cell Sequence 3,* for example, contains two cells, the second ending (as in *Cell Sequence 1*) as if starting a third *Cell e* (see Example 9.42). These two cells of *Cell Sequence 3* introduce the possibility of repeating the first chord. *Cell Sequence 4* begins like *Cell Sequence 3,* but its *Cell* e^{101} drops the initial quarter-note chord of *Cell* e^{302} (of *Cell Sequence 3*). This *Cell* e^{101} recalls the two *Cells* e^{101} of *Cell Sequence 2.* With *Cell Sequence 4* the developmental process starts, as the middle part of *Cell e* makes its first appearance. The melodic neighbor motion D-C-D (see [70]-[71]) is reinforced in the bass, but out of phase (no parallel octaves here!). This kind of out-of-phase motion in the outer voices has been heard often, notably in *Motive X.* During *Cell Sequence 5,* just before [71], the bass line returns to D before the treble lines return to their prevailing G major triad. But the bass line continues to move, so that the resolution of the extended appoggiatura (to the expected G major treble triad) is "harmonized" by a new pitch collection, a bass-register E minor triad. Since this new harmony is to be treated, at least locally, as stable, *Cell Sequence 5* ends with an extended third part (in *Cell* e^{513}). This long cell is followed by *Cell* e^{630}, in which the appoggiatura chord is changed (although the important melodic C is retained). A further complication occurs: After the appoggiatura resolves back to the (new) basic harmony, the music reverts immediately to the appoggiatura chord (slightly changed; notice that the English horn A at [72] is replaced by E three measures later). The reasons are: (1) The figure in the first three measures of [72] is really a version of the middle part of *Cell e* (this becomes clear upon its elaborated repetition in the four measures before [74]; and (2) the enlarged *Cells* e^{630} and e^{620} are more open-ended (because the third part is withheld) and hence more connected to their subsequent cells. *Cell Sequence 5,* because of the suppression of the two constituent cells' third parts, does not allow the appoggiatura to resolve. To underline the force of this omission, Stravinsky inserts the only two-beat silence of the moment. When the final cell sequence starts with the chord of resolution (with an added A) at [74], we appreciate the previously withheld harmony. But we realize that a new cell sequence (a new phrase) has started, since the preceding silence is too long (in context) to function within a phrase. Thus *Cell Sequence 5* is a phrase whose cadence chord is well known yet omitted. The duration of the omitted chord is present, however. Silence becomes the cadence.

The final cell sequence still adheres to the cell patterning, but we realize how far the music has developed from the original versions of cells at [65]. *Cell* e^{704} is given from [74] to the end. The appoggiatura, now more a passing chord, lasts two measures at [75], and it is extended by its own internal appoggiatura (more accurately, an accented neighbor, as originally). Paradoxically, this passing harmony recalls [74], thus reminding us of the original shape and duration of *Cell e*. The chord of resolution, the final chord of the piece, has a new bass note, C instead of E. Nonetheless, this chord functions as resolution of the passing/appoggiatura chord because the G major treble triad is common to both the first chord used in *cell e* (in *Cell Sequences 1-4*) and its subsequent replacement chord (in *Cell Sequences 4-6*). It is this G major treble triad, more than the variable bass harmonies, that defines the stability of the moment and serves as the harmonic focal point of the entire piece.[17]

As the music approaches the end, cells and cell sequences become (with a few exceptions) progressively longer. This slowing down toward the final cadence is a time-honored procedure, although here the rhythm that decelerates is of cell sequences more than of harmonies. Stravinsky had used comparable procedures in earlier compositions. In *Le Sacre,* for example, the cells lengthen for cadential purposes,[18] despite the regularization of the previously aperiodic bass alternation of A and C. *Les Noces* ends similarly.

The increasing length and complexity of cells in *Moment* E_{65} is linear. In order to close off a piece that has been static and permutational on the middleground level, Stravinsky introduces a cadential progression. Not only are the cells developed in a drive toward the cadence, but also the harmonic rhythm operates differently in *Moment* E_{65} than elsewhere. The harmonies move toward the cadence, although their rate of change is no greater than the previous rate of harmonic succession of shorter moments. From [65] almost to [71], one harmony predominates, despite greater foreground activity than in other moments. Thus the harmonic analysis in Examples 9.39 and 9.40 requires two levels of reduction. At one measure before [71], a new harmony arrives. It alternates with the appoggiatura chord. A third harmony arrives at the very end.

These three harmonies share the G major treble triad, which is also the harmonic point of origin for the piece. It is this identity, more than the bass register final C, that creates the tonal stability needed for ending. The piece is not in C major, nor is C either a centric or a goal pitch for the whole composition. The C major resolution at the end is local. It is an implied cadential area in the context of *Moment* E_{65} but not of the whole composition. The final arrival of the bass C occurs too late in the piece for the C major bass triad to acquire tonic finality. How, after all, can an extended piece end convincingly if its final background harmony is withheld until the final chord of the entire work? Surely more than six sustained beats[19] are needed for such a chord to have ultimate cadential weight. This is particularly true since the only previous instances of C as a bass note are as a neighbor to D (three measures before [71] and three measures before [74], where the D in turn is neighbor to the structural E). The bass D is established as early as [26]. Subsequent neighbor or arpeggiated motions away from D return soon enough. Hence the bass D governs about two-thirds of the piece. The move to E a measure before [71] signals that at last the D is being displaced. When the actual stepwise displacement—the final C—arrives, it needs far more weight, far greater duration as the bass note of the chord, to balance the very long D. Since this does not happen, there is a degree of open-endedness in *Symphonies.* This not totally conclusive ending is appropriate to a piece that is largely permutational rather than developmental, that is sectional more than progressive, that exists to a certain extent in moment time.

The internal harmonic progression of *Moment* E_{65} makes it function like a self-contained miniature composition. Actually, it was originally published in just such a form, as a piano work composed in memory of Debussy.[20] Although the generally accepted notion that this section was the first composed has recently been challenged,[21] the fact that Stravinsky did at one point think of *Symphonies'* final chorale as an independent work *is* significant.[22] In the context of the chorale as a separate piece, the final chord is indeed a tonic goal, and it is indeed foreshadowed by the neighbor C major bass triads earlier in the fragment (mm. 33-4 and 44-5 in the *Revue musicale* publication). Although the harmonies are somewhat clouded by added notes, there is no question that the little piece is in C major. It is largely a white-note piece, with most exceptions being chromatic leading tones. M. 22 of the piano piece, which occurs three measures before [69] in *Symphonies* (for some strange reason Stravinsky changed the piano piece's B to the G of the first bassoon), functions unequivocally as a dominant half cadence (the upper C is added to the V^7 chord). Two measures later the dominant is reiterated by a V^9 chord, which is followed by a return to the opening harmony, now clearly understood in context as an inverted dominant ninth. These dominants create a linear implication toward the final tonic, which functions as a tonal cadence when it finally arrives.

How the piano fragment's tonal forces do and do not operate in the expanded context of the entire *Symphonies* is instructive. The dominant-tonic relationships within the final moment do not function on a global level. As Pieter van den Toorn explains,

> . . . the final, culminating toniclike resolution on C [is invested with a] curiously incidental, "distinctly parenthetical" quality. . . . The "resolution" surfaces . . . as a *terminating convenience*, an expedient, a "device." (Baroque or Classical C-scale tonally functional schemes of modulation or definitions of key are . . . irrelevant here.). . . [The dominant-like harmonies shared by *Moments E* and *A*] are likely to be heard and understood with reference to . . . prior contexts (and to the self-enclosed nature of these contexts as blocks), not as a sustained "dominant" awaiting impending "resolution" to the "tonic" C. (Note the remarkable constancy in chordal disposition that marks off the successive [instances of these moment types]. It is to the inert, self-enclosed, and largely symmetrically devised compound nature of this constancy that the concluding chorale relates and to which by adhering it refers—not to some truly informed dominant which, in tonal, C-scale fashion, anticipates a gradual and terminating progression to a tonic.) Hence, only in the final measures—and only *retroactively*, strictly speaking—does the chorale's (G B D F/D A-flat F D) articulation acquire the characteristic "feel" of a "dominant seventh" (or of a "dominant minor ninth" if the A-flat is included) "resolving" to its "tonic," the (C E G) triad."[23]

I agree that it is misleading to posit a dominant-tonic relationship between the first and last harmonies of *Symphonies*. Both sonorities contain the G major treble triad, and the ensuing circularity is an important structure of the work. Yet at the beginning the bass note is F, which initiates a piece-long stepwise descent to the final C. This motion outlines F–E–D–C, a large-scale unfolding of the work's basic 0135 tetrachord. The C is a linear goal because it completes the tetrachord.[24] (The very short C after the very long D accounts for the open-endedness.) Neither the stepwise bass descent toward C as goal nor the treble circular motion around the G major triad suggests tonic-dominant relationships functioning on a large scale. Dominant-tonic progressions emerge in the final moment as a local feature (as the internal cadential logic) of the chorale.

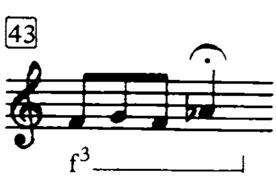
Because of their harmonic stasis, earlier moments, even earlier *E* moments, do not lead us to expect such tonal progressions, despite the prevalence of registrally partitioned triads within dense sonorities. Therefore, once the final chorale was completed, Stravinsky must have faced the intriguing challenge of creating a noncontinuous, nontonal composition that could use as a cadential force the acquisition of harmonic motion and tonal functionality, without making either the motion or the tonality a large-scale linear force earlier in the piece. The music had to be made to welcome tonality as a *local* force. And the music had to welcome motion—slow motion, to be sure, but real harmonic motion nonetheless.

In solving this problem, Stravinsky created an elegant and unusual form. He increased the sectional discontinuities in the second half of the piece, where some of the moments are extremely short and where transitions between moments are abandoned. The second half begins with four incredibly short, adjacent moments: E_{42}, F_{43}, G_{44}, and F_{45}. The longer *Moment* G_{46} provides an antidote and makes contact with the remembered moment durations of the first half. But two very short moments follow, E_{56} and F_{57}. Greater length and greater continuity are needed as antidote to the almost excessive discontinuity that has saturated the piece. *Moment* G_{58} *almost provides such continuity*, but it is cut short by the brief *Moment* F_{64}. Finally, the chorale brings continuous music that transcends moment construction in order to admit a degree of harmonic motion and goal directedness. *Moment* E_{65} cadences by means of internal harmonic progression, yet it does not contradict the discrete, permutational nature of the moment form. It is appropriate that this work, nonlinear in the middleground yet linear in the background, should close with a cadence that does not contradict the work's structural open-endedness.

9.9 MOMENT *F*

Moment F_{43}.

Cellular analysis:



Cell Sequence 2

Example 9.43. **Cell sequence of *Moment*** F_{43}

Moment F_{45}.

Cellular analysis:

Cell Sequence 3

Example 9.44. **Cell sequence of *Moment F_{45}***

Analytic remarks:

1. *Moment F_{45}* is harmonically a transposition up a fifth of *Moment F_{43}*.
2. *Cell f'^5* is a permutation of *Cell f^5* (see Example 9.19).
3. Once we have heard in close succession *Submoment F_{41}*, *Moment F_{43}*, and *Moment F_{45}*, we might understand *Submoment F_{41}* in retrospect as a full-fledged moment, although it still feels like a submoment in the context of the first half of the piece. Henceforth I call it *(Sub)moment F_{41}*.

Moment F_{57}.

Cellular analysis:

Cell Sequence 4

Example 9.45. **Cell sequence of *Moment F_{57}***

Analytic remarks:

1. The harmony is transposed up another fifth.
2. Notice the subtle orchestration (here especially, but also in other *F* moments) of the cellular melodic line.
3. *Cell Sequence 3* duplicates *Cell Sequence 1* (see Example 9.19) of *(Sub)moment F_{41}*.

Moment F_{64}.

Cellular analysis:

Cell Sequence 5

Example 9.46.* Cell sequence of *Moment F_{64}

Analytic remarks:

1. The harmony returns to the original transposition level of *(Sub)moment F_{41}* and *Moment F_{43}*. Thus, *Moment F,* like *Moment A,* is successively transposed by internally significant intervals.

2. The cell sequences of *(Sub)moment F_{41}* and *Moment F_{57}* are identical except for the added value in *Cell f'^1* of *Cell Sequence 5*. This slight elongation helps prepare the cadence at the end of *Moment F_{64}*. The piece is starting to end.

3. The delayed start of *Moment F_{64}*, a beautiful and fresh pause on a single note, also contributes to the sense of impending finality.

Summary of F Moments.

Based on the pentatonic set type 02479, the harmony of the *F* moments can be thought of as five pitch classes differing by IC5 (the actual sonorities resemble stacked fifths). Successive transpositions of the moment are by the same interval class. Thus, the *F* moments emphasize fifth relations. This interval class is important elsewhere in *Symphonies,* as, for example, in the opening chord (with the G–D fifth in the treble and the B-flat–F fourth in the bass). In *Moment D_{11}*, let us recall, there are prominent transpositions by IC5. The *F* moments overtly use IC5 both harmonically and transpositionally. This interval thus looks forward to the end of the piece (discussed in Section 9.8), where the ubiquitous G major treble triad is at last given lower fifth support by the bass C.

The cells of the *F* moments are deployed in a straightforward manner, with but a few unpredictabilities. The logic is a sequence of three cells per cell sequence: f^1, f^3, f^5. This pattern occurs in *Moments F_{41}, F_{57}*, and *F_{64}* (in the last case we find the slightly extended *Cell f'^1*). *Moments F_{43}* and *F_{45}*, taken together, share a permutation of this order: f^3, f^1, f'^5. This stretching of what amounts to one cell (although it would be confusing to label it so in Examples 9.43 and 9.44) is readily perceived, since *Moments F_{43}* and *F_{45}* are both short and close together (they are separated by the equally short *Moment G_{44}*). These three adjacent moments—*F_{43}, G_{44}*, and *F_{45}*—push to the limit our perception of moments as discrete entities. Their combined duration is less than that of many single moments. Yet they are perceived in some sense as structurally equivalent to the other moments. The extreme contrast between these three short moments, heightened by the newness of Tempo III in *Moment* G_{44}, plus the *fermata* endings of the *F* moments, work to preserve their independence.[25]

Ending with a *fermata* is peculiar to *Moment F*. Since there are five *F* moments, each ending with a *fermata*, this new gesture casts a rather different character over the second half of the piece. It is more discontinuous than the first half, but less aggressively so, because of the momentary repose of the *fermate*.

9.10 MOMENT *G*

Moment G_{44}.

Cellular analysis:

Refer to the discussion of the complete *Moment* G_{46} below, and to Examples 9.53 and 9.54, for an explanation of the superscripts.

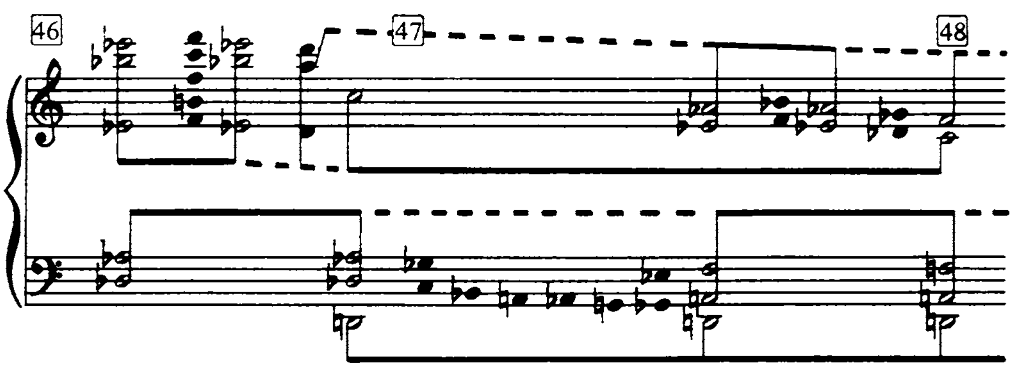
Cell Sequence 2

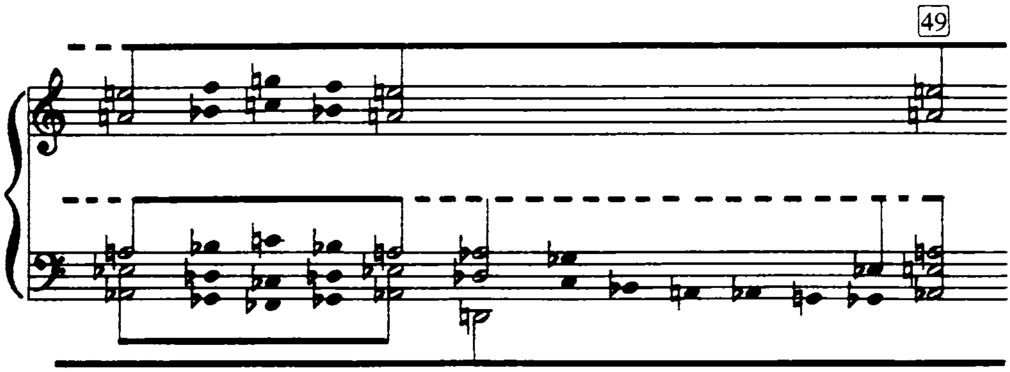
Example 9.47. **Cell sequence of *Moment* G_{44}**

Submoment G_{46}.

Harmonic reduction:

Example 9.48. **Reduction of *Submoment* G_{46}**



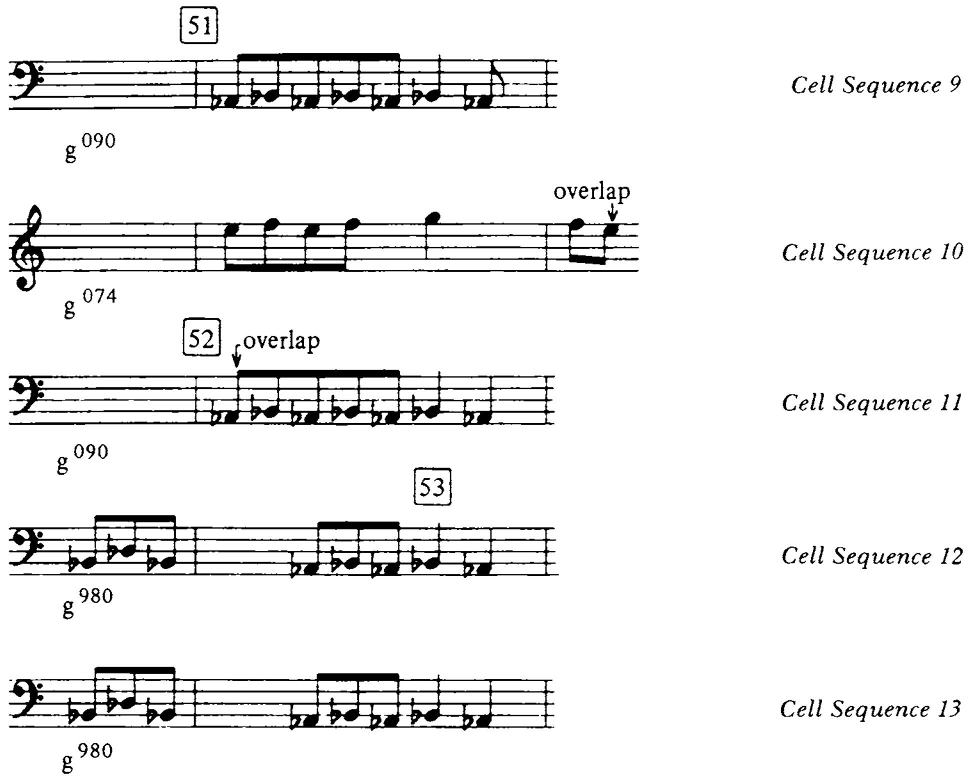


Cellular analysis:

Example 9.49. **Cell sequences of *Submoment* G_{46}**

Submoment G_{51}.

Cellular analysis:



Example 9.50. **Cell sequences of** ***Submoment*** G_{51}

Analytic remark:

The bass line is chosen to represent the cellular activity in *cell sequences 8, 10, 11,* and *12* because it is where the most striking melodic profile is found.

Submoment G_{54}.

Cellular analysis:

Example 9.51. **Cell sequences of** ***Submoment*** G_{54}

Cell Sequence 15

Cell Sequence 16

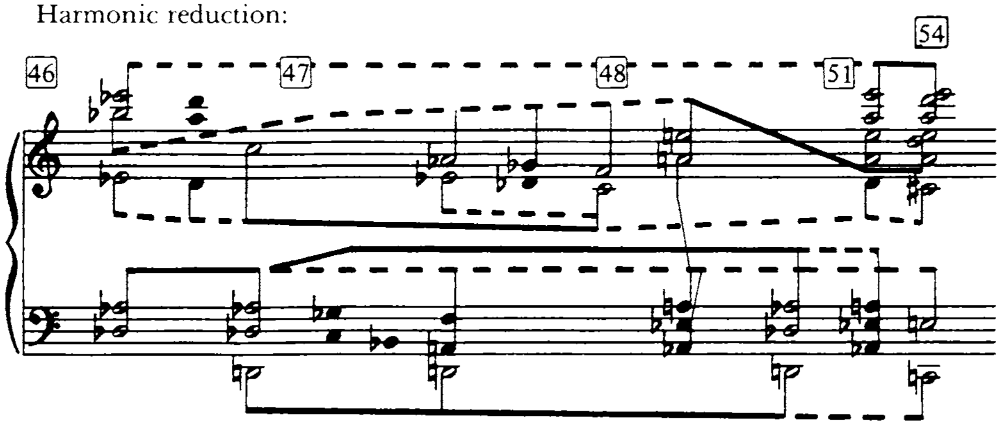
Cell Sequence 17

Analytic remark:

Notice the syncopated counterpoint that develops gradually from the initial rhythmic unison of upper and lower brass.

Complete Moment G_{46}.

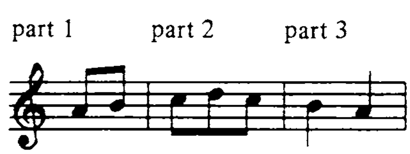
Harmonic reduction:



Example 9.52. **Reduction of *Moment* G_{46}**

Cellular analysis:

Example 9.53 shows the archetypal *Cell g*, as subdivided into three parts.



Example 9.53. **Archetypal *Cell* g from *Moment* G_{46}**

The pitches of the archetypal cell comprise a 0235 tetrachord. The contour is best thought of as a stepwise rise of a third, followed by an upper neighbor, followed by a stepwise descent to the original pitch. Eighth-note motion prevails, until the cadential third part of the cell. There is a large number of variants, which can be grouped into families (as shown in Example 9.54). *Family a* concentrates on the upper neighbor. *Family b* retains the single rise fall shape. (N.B. In part 2, versions 1, 2, and 3 belong equally well to *families a* and *b*; in the analysis they are notated consistently in *family a*.) *Family c* uses a 0135 tetrachord (or, more often, just a 013 trichord) instead of a 0235 tetrachord; the neighbor-note motion occurs between the lowest and second lowest notes. *Family d* has increased emphasis on the upper note of the neighbor-note alternation. Differences within families are slight compared with differences among families. These freely transposable cells are shown, for consistency, as starting on A in Example 9.54. Parts 1 and/or 3 of a cell may be omitted, but part 2 is the main identifying shape and is always present. Overlap is possible between the last note of one *Cell g* and the first note of the subsequent *Cell g*. Stemless final notes in part 3 (or in part 2 where part 3 is omitted) indicate variable duration of the final note of the cell. A "0" superscript indicates an omitted part. The internal analytic partitioning of *g* cells does not necessarily reflect foreground articulation.

Example 9.54. **Cell families in *Moment* G_{46}**

family *c* 

family *d* 

PART 3

family *a* 0

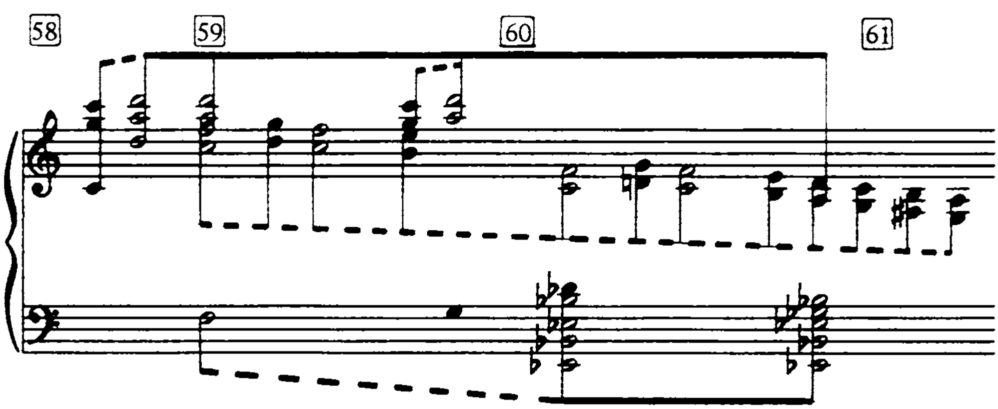
family *b* 

family *c* 

family *d* 

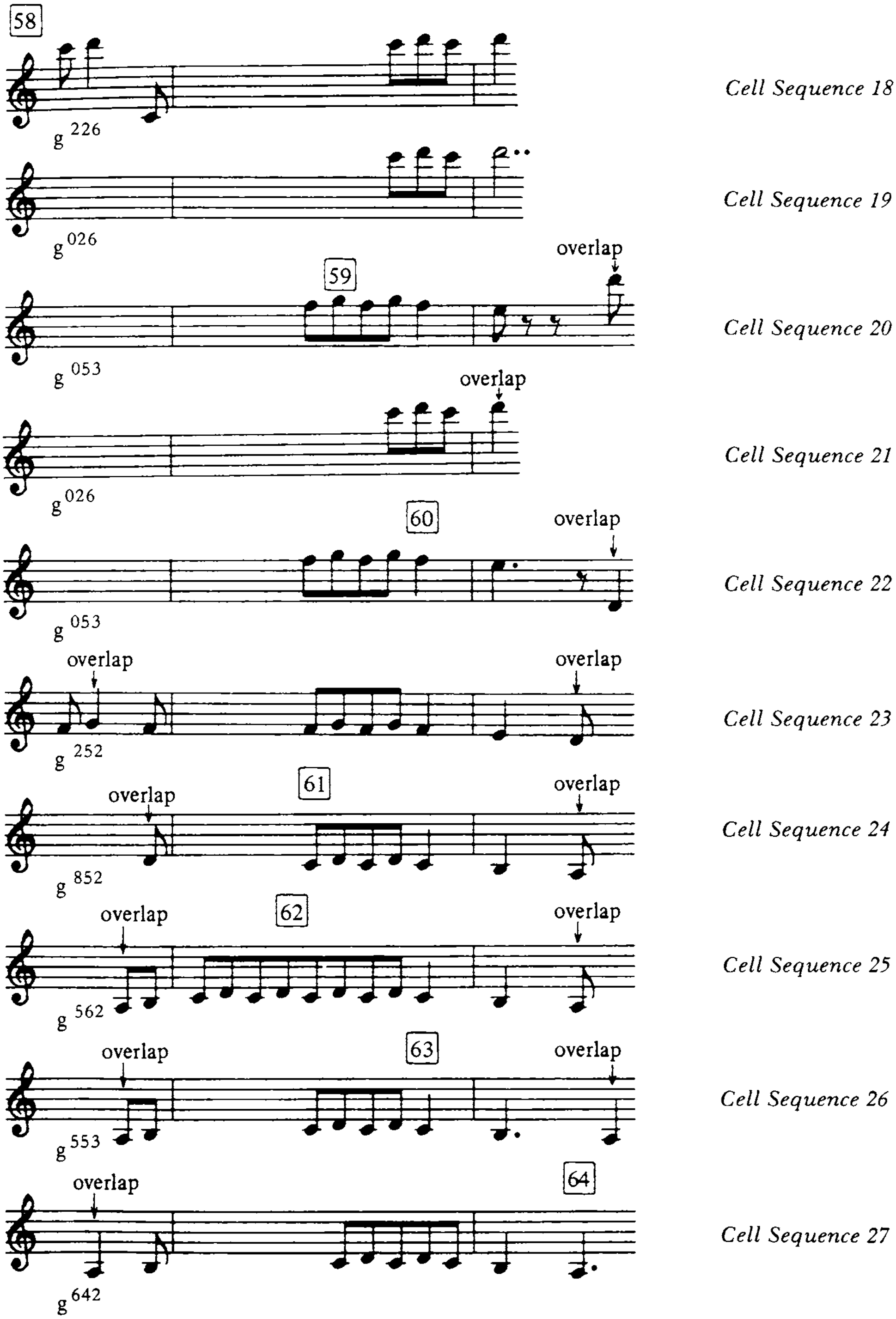
Moment G_{58}.

Harmonic reduction:



Example 9.55. **Reduction of** ***Moment*** G_{58}

Cellular analysis:



Example 9.56. Cell sequences of *Moment* G_{58}

Analytic remarks:

1. *Cell Sequences 20* and *21* are incomplete within their instrumental color (trumpets). The reason is to link *Cell Sequences 18, 19,* and *21* (which are even less complete, since they end on the unstable highest pitch of the 0235 tetrachord) with the subsequent overlapped *Cell Sequences 22–27.* In the latter cell sequences, what may be heard as an incomplete part 3 is invariably completed by overlap with the first note of the subsequent cell sequence.[26] As it happens, the "missing" final note of the cell is in each case present in another color (oboe). These subliminal completions are indicated in the cellular analysis. The compositional strategy is to create the urgency of incompleteness and then to resolve it with the continually overlapped *Cell Sequences 24–27,* all contained within one instrumental color (clarinets). This welcome continuity, vaguely reminiscent of the smooth *Cells d,* is, as it turns out, a cadential outgrowth of the cellular fragmentation both earlier in the moment and, significantly, in the previous long *Moment* G_{46}. The growth of continuity and completeness from instrumental discontinuity and cellular incompleteness gives *Moment* G_{58} a somewhat developmental cast, as does its middle-register stepwise descent (see Example 9.55). The reason is to prepare the overtly progressive final chorale. A further cadential gesture is the lengthening of notes in *Cell Sequences 26* (the first note of part 3), and *27* (the first note of part 1). The latter elongation is particularly arresting, since the bassoon accompaniment stops briefly, along with the clarinets (across the barline one measure after [63]).

2. The bassoon arpeggio is cleverly handled. It starts unobtrusively and tentatively, basically in quarter-note values, after [60]. By [61] it is regularized to continual eighth-note motion, and the D-flat is replaced by G-flat, so that the outlined triad becomes E-flat minor. The arpeggio is not totally regular, however. The four-note descent G-flat–E-flat–B-flat–E-flat either may or may not be followed by the rise B-flat–E-flat prior to the next four-note descent. The number of descents before an ascent are, respectively, 2, 3, 1, 3, a typically semi-patterned sequence. But the logic of this semi-pattern is not independent of the clarinet *Cells g.* A bassoon G-flat almost invariably coincides with the second or fourth C of part 2 or with the first B (in unison with the second clarinet's F-sharp) of part 3 of *Cell g.* I say "almost" because the strikingly elongated B after [63] is further emphasized by a break of the pattern. (Stravinsky could easily have struck the G-flat simultaneously, by omitting the bassoon ascent.) We must wait until the third (extra) eighth-note beat of the clarinet B to hear the expected G-flat in the bassoon. This small but striking event has consequences: The pattern is now broken, so that the remaining G-flats underline the first and third (not second and fourth) C's of the cellular melodic line. What is retained by this change is a B-flat underlining the start of *Cell Sequence 27* (as it does in *Cell Sequences 25* and *26*). The resulting simultaneity, B-flat–E–A, is, as I have mentioned, also highlighted by being held in both clarinets and bassoon. Had the expected G-flat come with the B at [63], the result would have dictated an E-flat simultaneous with the A that starts *Cell Sequence 27.* Presenting the centric A of the cellular line simultaneously with the centric E-flat of the bassoon arpeggios is reserved for the end of the moment, just prior to [64].

Summary of G Moments.

In the course of all *G* moments and submoments (including *Submoment* G_3), we encounter no fewer than 29 instances of *Cell g*, comprising 20 separate versions of the cell. We also hear three instances (two versions) of subsidiary *Cell gg*. The richness of the cellular system, plus the extended duration of *Moment* G_{46}, might suggest an interrelationship between moments comparable to that found in the *D* moments. Such is not the case, however, partly because the cells are shorter and more clearly articulated, and partly because there is a less overriding permutational logic here. Rather, different versions of the *g* cells delineate different (sub)moments. But 20 superscripts would be too unwieldly to provide much information about the patterning. Indeed, no version of *Cell g* is heard more than twice. In order to see the consistencies within (sub)moments, we must consider the families of cell types, as summarized in Example 9.57.

By considering families of cell parts, as in Example 9.57, we reduce the number of distinct *g* cells from 20 to 11. Furthermore, some interesting consistencies emerge. For example, *family c* of part 1 (the isolated lowest pitch of trichord 013)

(SUB)MOMENTS	CELL SEQUENCES	FAMILIES OF PARTS 1, 2, 3
G_3	1	*aab*
G_{44}	2	*0ac*
G_{46}	3	*aab*
	4	*aac*
	5	*0cc*
	6	*ccc*
	7	*ccc*
	8	*0cc*
G_{51}	9	*0d0*
	10	*0cc*
	11	*0d0*
	12	*dd0*
	13	*dd0*
G_{54}	14	*bab* (or *bbb*)
	15	*bab* (or *bbb*)
		bab (or *bbb*)
	16	*bab* (or *bbb*)
		bab (or *bbb*)
	17	*bab* (or *bbb*)
G_{58}	18	*0ad*
	19	*0ad*
	20	*0ab*
	21	*0ad*
	22	*0ab*
	23	*aab*
	24	*dab*
	25	*bab*
	26	*bab*
	27	*bab*

Example 9.57. **Families of cell sequences of *G* moments**

is peculiar to *Submoment* G_{46}, giving it its particular personality. The use of the secondary tetrachord 0135 (or its trichord subset 013) is restricted to the adjacent *Submoments* G_{46} and G_{51}. *Family d* of part 2 (in which part 2's penultimate highest tone is a quarter note) is restricted to *Submoment* G_{51}. *Family d* of part 3, which ends a cell unstably on the highest note of tetrachord 0235, is found only in *Moment* G_{58}. The first two occurrences of *Moment G—Submoment* G_3 and *Moment* G_{44}—are recalled as soon as *Moment* G_{46} starts, since *Cell Sequences 1* and *3* are both *aab* and *Cell Sequences 2* and *4* both end *ac*. After these two reminiscences, the submoment settles down to its characteristic cellular shape, cells ending *cc*. *Submoment* G_{46} is also differentiated from other G moments by the presence of subsidiary *Cells gg*. *Submoment* G_{51} has its own characteristic version of *Cell g*, ending *d0* except in *Cell Sequence 10*, which, being *0cc*, recalls *Submoment* G_{46}. *Submoment* G_{54} has its own consistent version of *Cell g: bab*. *Moment* G_{58} contains many versions of *Cell g*, but they do have a family resemblance since they all end *ad* or *ab*. Furthermore, the final three *bab*'s recall *Submoment* G_3 and *Submoment* G_{54}.

When we consider only parts 2 and 3 of the g cells (which seems reasonable, given how the relations of similarity mentioned in the preceding paragraph often operate in terms of parts 2 and 3), we find only five cell types: *ab* (15 occurrences), *ac* (2), *cc* (5), *d0* (4), and *ad* (3).

We need not have gone through an elaborate cellular analysis to notice that each *G* (sub)moment has its own character. The cellular differences between (sub)moments are supported texturally and by the orchestration. But there is also an undercurrent of similarity, caused not only by the pervasiveness of *Cell g* but also by the similar families of variants. This careful balancing of consistency and variety is achieved by means of a large array of cell versions. Stravinsky seems less interested in deeper-level patterns of cellular combinations and permutations here than he does in the *D* moments.[27]

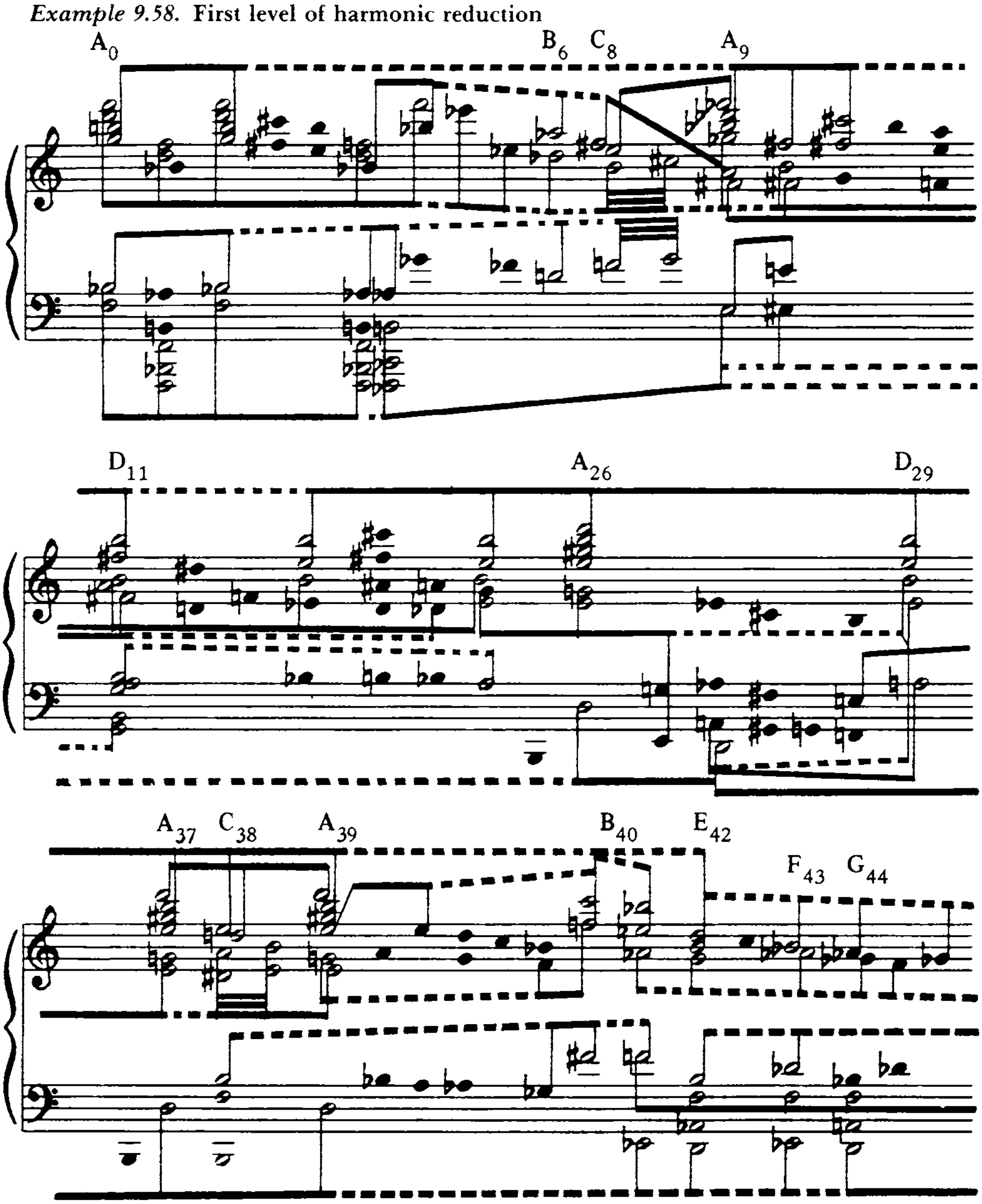
9.11 BACKGROUND CONTINUITY

Examples 9.58-9.61 show successive reductions of *Symphonies*. These graphs should be studied as the work is listened to carefully, for they reveal the underlying linearity of the work. They attempt to show the mechanisms by which both the background bass descent from F to C and the treble register circular motion around the G major triad operate. It would be needlessly tedious to discuss every analytic decision that went into making these graphs. A few general remarks are in order, however.

Stepwise motion is considered structurally significant, as the harmonic analyses of individual (sub)moments have attempted to show. Octave equivalence also operates in this music. Once we admit octave transfer, however, a multitude of possible step connections emerges; in harmonically dense music, step connections are statistically probable. My task is to select the significant connections and make them the basis for the successive reductions. I have located relatively few step connections across registers, and I have reserved octave transfers for the deeper levels of reduction.

An interesting relationship emerges in Example 9.58. The treble lines move stepwise down a minor third from the G major triad (with the nonstructural seventh F) at [0], through the F-sharp (G-flat) major triad at [9] to the E major triad at [26]. These successive transpositions of *Moment A* are foreshadowed in *Submoment* A_3. The treble lines then return to the G major triad at [42] by passing motion through the fifth F-C at [40]. This large-scale motion is then mirrored as the upper register moves up a minor third to the fifth B-flat-F at

Example 9.58. **First level of harmonic reduction**



[45], returning stepwise through the fifth A–E at [51] to the G major triad, which returns at [56] and remains through the end of the piece. Thus, the minor third, present at the outset in the prominent *Cell* a_2 and in the opening harmony (two fifths a minor third apart), governs not only successive transpositions of *Moment A* but also the circular progression in the treble register of the entire work.

Example 9.58 shows that the harmony of a moment nearly always connects in an obvious manner to that of adjacent moments. Example 9.59 demonstrates the emergence of background continuity, shown more obviously in Examples 9.60 and 9.61. Example 9.59 also shows the moment structure, in that the harmony remains fundamentally unchanged for long stretches. The nonlinear stasis of harmonies within moments contradicts the ongoing linearity of stepwise motion on the foreground (Example 9.58) and background (Example 9.61). From this contradiction comes the strange tension that pervades *Symphonies* and, because of the work's partial open-endedness, remains after the final sounds have died.

In Example 9.60 the bass descent is clearly set forth. Interestingly, Joseph Straus finds the same stepwise unfolding of tetrachord 0135, operating in two ways.[28] He points out the successive transpositions of *Motive X*, centered on F before [2], on E before [28], and moving to D after [28]. He does not mention that the motive is repeated on F at [5] and repeated on D before [43] and at [66]. These reiterations support his argument. But *Motive X* is also heard moving to F before [11], on G between [11] and [13], and moving to E-flat at [67].

Example 9.59. **Second level of harmonic reduction**

These transpositions do not fit into Straus's scheme of descending transpositions articulating a large-scale bass unfolding of 0135. Furthermore, the final C which completes the tetrachord, he takes from the final bass note of the piece, where *Motive X* is not heard.

Straus finds the stepwise descent F-E-D-C in another, more convincing, way, as a background bass progression, comparable to that shown in Example

Example 9.60. **Third level of harmonic reduction**

9.61. He shows the E first arriving at [9] rather than after [5]. This represents no major disagreement with my analysis. The bass does move decidedly to E (spelled F-flat) at the end of the first measure of [5], but then that register is abandoned until [9]. A more significantly different reading has to do with the bass C at [54]. I have taken it as a neighbor to a very long D, since I feel the accumulated force of that static pitch. Because of the emphatically climactic nature of [54], Straus views the C as completing a preliminary descending motion F-E-D-C, which in turn prolongs the initial F (returning at [57]). The more deeply structural descent then occurs as the bass line moves to E at [74], D at [75], and C at the end. I have analyzed the F at [57] as part of a (minor third!) decoration of the D, and the E at [74] as an upper neighbor to the pervasive D. Straus's view is more like a traditional Schenkerian conception, while mine reflects the high degree of stasis caused by the bass D that arrives after [26] and remains through [75].

Example 9.61. **Fourth level of harmonic reduction**

9.12 EDWARD CONE'S ANALYSIS

Edward Cone has written persuasively on *Symphonies*.[29] Reacting to the discontinuities in this piece (and others), he formulates a compositional method called "stratification, interlock, and synthesis." "Stratification" refers to the discontinuities, usually but not exclusively the moment junctures discussed above.

> When the action in one area is suspended, the listener looks forward to its eventual resumption and completion; meanwhile action in another has begun, which in turn will demand fulfillment after its own suspension. The delayed

> satisfaction of these expectations occasion the second phase of the technique: the interlock. To take the simplest possible case, consider two ideas presented in alternation: A-1, B-1, A-2, B-2, A-3, B-3. Now one musical line will run through A-1, A-2, A-3; another will correspondingly unite the appearances of B. Although heard in alternation, each line continues to exert its influence even when silent.[30]

Cone seems to promise a multiple-time analysis of *Symphonies,* similar to my study of Beethoven's Opus 135 in Chapter 6. But his examples actually show something else. He suggests, for example, this continuous stratum: [0] to [1], [2] to [4], two before [6] to [6], [9] to two after [10], the two beats before [11], three after [26] to two after [27], three after [37] to [38], [39] to [40]. If we put these fragments together, we hear a series of similar excerpts linked by smooth voice leading, but surely not an unbroken continuity. There is no musical *line* uniting the stratum. What Cone seems to mean is that each stratum is created by similarity of material (and tempo) and by voice leading. It is not true, however, that each stratum provides continual resumption of previously suspended activity. Each stratum heard by itself does not make musical sense. Thus, despite Cone's description, his analysis is not a multiple-time view of *Symphonies.*

The third phase of Cone's analysis, "synthesis," is the unification of previously separate strata. Two (or more) independent strata lead to the same fragment. There surely are connections across intervening moments that seem to bring together different strands of activity. Cone shows, for example, that the sonority at [75] returns to the flute timbre (absent since [65]) and high register of *Moment* F_{64}. Thus the closing measures are understood not only as an outgrowth of the final chorale but also as concluding the *F* moments.

The heart of Cone's article is a reduction of the entire piece, divided into six strata, which shows connections between and within strata. In several instances Cone's connections across intervening moments are not really voice leading, since there are more obvious step connections to the interim moment(s). Stratum definition is more a matter of identity—of tempo, melodic material, type of harmony, or instrumental color—than of progressive continuity. To hear some of the connections Cone posits, there need to be not only voice-leading connections but also careful registral and/or timbral segmentation—keeping, in other words, the abandoned registers and/or timbres inactive in the interim. Otherwise, Cone's interrupted continuities can be problematic.

I do not hear, for example, Cone's synthesis at [11]. [11] is prepared by the preceding two beats at the end of *Moment* A_9, a connection shown in Cone's graph. But the other leg of the synthesis, the connection back to *Moment* C_8, is forced. Cone suggests that the C-sharp and F-sharp of the harmony of *Moment* C_8 move respectively to the B in the English horn and F-sharp in the second oboe at [11]. But those pitches are first subsumed by the F-sharp major treble triad at [9] (Cone acknowledges this connection for the F-sharp but not the C-sharp, which is octave displaced), along with the E of *Moment* C_8 (which becomes, an octave higher, the F-flat of *Cell* a_2, three measures after [9]). The remaining harmonic pitch of *Moment* C_8, the G in the third flute (coming repeatedly stepwise from F), moves on another step to A in *Moment* A_9 (trumpets in the third measure of [9]), but Cone places this A an octave too low and hence misses this obvious step connection. Since the harmony of *Moment* C_8 progresses so clearly to that of *Moment* A_9, it is hard (at least for this listener) to expect an eventual resumption and completion of activity. Furthermore, *Moment* D_{11} arrives with equally smooth voice leading from *Moment* A_9, so we are hardly tempted to listen for voice-leading connections from further back. Cone's connection from before [9] to [11] seems forced, then, because the voice leading is continuous and because there is no obvious cellular or timbral progression. Furthermore, while both moments are notated in Tempo II, in *Moment* C_8 we hear ♩= 108 while at [11] we hear ♩. = 72.

Another problematic synthesis is at [41] (indicated in Cone's graph but not discussed in the article). If I read the graph correctly, he would have us hear the activity of the *A* moments subsumed (along with the activity of the *B* and *C* moments) by the *F* moments (which, curiously, are placed on the same stratum with portions of the *D* moments). He does this simply because there is a B-flat on top of the final harmony of *Moment* A_{39} and on top of the harmony of *(Sub)moment* F_{41}. The B-flat before [40] is a preparatory neighbor to the C of *Moment* B_{40} (Cone indicates as much). But it is really nothing more.

Cone claims that the final C tonic is foreshadowed by dominant-like chords at [42], [56], and [65]. Oddly, he omits reference to [69], which is also missing from his graph. This chord *could* function as dominant to the final chord and could progress to it via smooth voice leading, but that is insufficient reason to claim that we expect a C major tonic when we hear [42], [56], and [65]. As I suggest in Section 9.8, we do not hear [42] as the dominant of C until C appears at the end.

Cone also hears C finality implied by the English horn C in *Submoment* G_3. I find this idea arbitrary. There is nothing particularly tonicized about that C, nor is it especially stable.

I have a few more differences to discuss. Cone misses the bass move to F-flat at [5]. He suggests that the bass, incorrectly shown as F, connects with the E-sharp a measure before [11]. The connection obviously should be from the F-flat at [5] to the E-natural at [9]. Cone also invents an A (presumably in the third flute, by analogy with [23]) at [21], and even makes a voice-leading connection to it. For no apparent reason the English horn F is omitted from the harmony at [38].

These objections should not detract from the importance of Cone's path-breaking and influential article. He is reacting to the extreme discontinuities of *Symphonies*, and his method is not far removed from mine. I owe his article a considerable debt. Without its useful perceptions I could not have formulated my ideas on moment time in Stravinsky's *Symphonies*.[31]

9.13 PROPORTIONS

The analysis of *Symphonies* in Sections 9.3–9.11 is meant to elucidate the fascinating and complex interaction of linearity and nonlinearity in the work. Nonlinearity, articulated through moment time on a middleground level, is reflected in the very format of the analysis. Self-contained sections, clearly set off by means of substantial discontinuities, are studied at first for their inherent characteristics. Each moment is characterized by an underlying static harmony by a constant tempo, and by consistency of melodic cells, which generally unfold by means of permutation rather than goal-directed development. Nonlinearity is thus a strong determinant of the middleground: The moments are strung together in what almost seems like an arbitrary succession. But the moments are really not unordered. This is not so much because of the linearity of foreground details as because of the background progressions unveiled in Section 9.11. In other words, the discontinuities on the middleground level are strong enough to suggest a temporal mosaic, despite the strong linearity on the background, as provided by the pattern-completing bass motion stepwise down to C and the circular treble motion around a G major triad. Thus the middleground arbitrariness of section order is only apparent. But is the linear background shown in Examples 9.60 and 9.61 sufficient to make the piece cohere formally? Is there no *nonlinear* structure operating on the middleground? In fact there is, and it pertains to the relative lengths—the proportions—of the moments.

Symphonies' confrontation between stasis and motion, between nonlinearity and linearity, is not totally new in Stravinsky's *oeuvre,* but it is more refined and pervasive here than in such earlier works as *Le Sacre, Les Noces, Renard* (1915), and *Le Rossignol* (1914). Each of these works does begin, progress, and end, though they do not really develop and are therefore not essentially dramatic, despite their link with the theater. Yet they do sometimes linger in extended moments, defined by unchanging or continuously alternating harmonies. In *Symphonies* the technique of activated stasis reaches a pinnacle, as it really generates the form. No longer does Stravinsky rely on a text or scenario (the curiously static quality of the text in the latest of the previously mentioned works, *Les Noces,* suggests the next step of abandoning the text completely), and so the burden of cohesiveness falls entirely to the musical form. In *Symphonies* this form is carried off by the confluence of stasis and motion, through the catalyst of proportions. Just how long each moment lasts in relation to the others is crucial in a work both lacking in extramusical reference and static within sections. These proportions are fascinating and convincing. By means of consistent proportional ratios, Stravinsky promotes the method of stasis-within-motion to the status of musical form. The elegance of this form is a product of the proportions, which are critical precisely because the moments are self-contained and set off by considerable discontinuities.

Moment time does exist in *Symphonies.* We should not dismiss it because of the coexistence of linearity, as found in transitions, a partially closed ending, an opening fanfare, background continuity, and a clear climax ([54]-[56]). Despite such traditional elements, *Symphonies* represents a considerable break with tradition, not only because it is an early example of moment time but also because of its extraordinary confrontation between linear and nonlinear time structures. It is an expression by a composer well aware of the new meanings of time simmering in the minds of modernist artists. These meanings are really what the piece is about, and this subject was powerful enough to force the creation of a unique musical form, articulated by the nonlinearity of durational proportions.

The durations of each moment and submoment are given in Example 9.62.[32] The proportions in the first half of *Symphonies* (up to [42]) emanate from a consistent usage of the ratio 3:2. This ratio is approximated (to well within 10% accuracy, probably a sufficiently close range for the proportions to be perceived)[33] by comparing lengths of several adjacent or similar (sub)moments. The following computations use the absolute durations (shown in the analyses of each moment and submoment above), as calculated according to the score's metronomic tempos.

Consider, for example, the relationship between *Submoment* D_{15} and *Moment* D_{29}. Recall that *Moment* D_{29} is a condensation by omission of certain cells of *Submoment* D_{15}. The proportional ratio of these two sections approximates $3{:}2 = 1.50$:

$$D_{15} : D_{29} = 1.53$$

Moment A_0		49.58
Submoment A_0	7.92	
Submoment A_1	12.92	
Submoment A_2	5.21	
Submoment A_3 (G_3)	3.54	
Submoment A_4	20.00	
Moment A_9		14.17
Moment A_{26}		22.50
Moment A_{37}		9.58
Moment A_{39}		10.83
Moment B_6		12.22
Moment B_{40}		16.10
Submoment B_{40}	8.61	
Submoment B_{41} (F_{41})	7.49	
Moment C_8		7.78
Moment C_{38}		7.50
Moment D_{11}		80.00
Submoment D_{11}	26.11	
Submoment D_{15}	53.89	
Moment D_{29}		35.28
Moment E_{42}		12.23
Moment E_{56}		8.61
Moment E_{65}		115.83
Moment F_{43}		4.33
Moment F_{45}		4.96
Moment F_{57}		6.85
Moment F_{64}		8.47
Moment G_{44}		3.61
Moment G_{46}		41.88
Submoment G_{46}	20.42	
Submoment G_{51}	9.79	
Submoment G_{54}	11.67	
Moment G_{58}		20.28

Example 9.62. **Durations of (sub)moments**

Similarly, the subdivision of *Moment* D_{11} approximates 3:2, since

$$D_{11} : D_{15} = 1.48$$

Moment D is not the only moment whose internal partitioning reflects a 3:2 proportion. Consider the relative lengths of the submoments of *Moment* A_0:

$A_4 : A_1 = 1.55$ (similar submoments)
$A_1 : A_0 = 1.63$ (adjacent submoments)
$A_0 : A_2 = 1.52$ (similar submoments)
$A_2 : A_3 = 1.47$ (adjacent submoments)

The ratio 1.63 is rather large to be an approximation of 1.50 (it is actually closer to 5:3 = 1.67), but the pervasiveness of the 3:2 partitioning probably allows the 1.63 ratio not to seem too far out of line.

There are several other instances of 3:2 proportions in *Symphonies.* As shown in detail in Example 10.3, every moment in the first half of *Symphonies* participates in a "meaningful" 3:2 approximation (meaningful because of adjacency or because of similarity of moment type), and almost every moment containing submoments is partitioned into durations related by 3:2. The exception is *Moment* B_{40}, which is unusual anyway because *Submoment* B_{41} has new material. The impressive pervasiveness of this ratio helps to account for the formal balance in this music. Although a listener comes to appreciate this proportional balance in retrospect, through the mechanism I have called cumulative listening, and although the specific ratio probably cannot be identified aurally, the consistency and elegance of the proportions do add to the coherence of the discontinuous middleground form.

One intriguing aspect of the proportions in *Symphonies* is the vast variety of section lengths at the *same* hierarchic level. Moments range in length from 7.50 seconds to 80.00 seconds. The moment construction asks us to hear these sections as of equivalent structural weight, despite their very different durations. The relationship between a 7½-second moment and an 80-second moment, that are somehow equivalent, is like the difference between a pound of gold and a pound of feathers. Both substances weigh the same, despite their considerable difference in size. The structural equivalence of sections of unequal duration makes moment time very different from linear time. In tonal music a short section is usually subsidiary to a long section. But the relative stasis within moments, and the considerable discontinuity between them, renders the time sense of *Symphonies* very different from temporal linearity. The interaction of different species of musical time (linear vs. nonlinear) and the structural equivalence of sections of vastly different length are two original and prophetic features of the *Symphonies of Wind Instruments.*

The music after [42] is not as simply proportioned as the first half of the piece. In addition to 3:2 approximations, there are important proportions that approximate equality (1:1) or doubling (2:1). The change of proportional system reflects the changes of material at [42]. But what are we to make of a less economical, a less tidy, system of proportions? Are the proportions in the second half of *Symphonies* in some way less satisfying than those in [0]-[42]? Surely not. Proportions need not be susceptible to straightforward analyses to function structurally.

Starting with an overview of Stravinsky's music, Chapter 10 takes up in some detail the intriguing question of just what temporal proportions do and do not mean. Chapter 10 also shows how Stravinsky's approach to proportions became progressively more elegant and economical throughout his long career. *Symphonies* was a critical work in his development, but he eventually went considerably beyond its proportional subtleties.

Chapter 10

Duration and Proportion

10.1 Stravinsky's Approach to Proportions

As suggested in section 9.13, the *Symphonies of Wind Instruments* is not the only work of Stravinsky to exhibit an elegant system of durational proportions. Upon investigating much of his music, particularly works with large-scale discontinuities suggestive of moment time, and after studying analyses by other theorists, I have begun to understand Stravinsky's progressively growing concern with proportions. It is interesting to discover not only the gradual emergence of proportional consistencies during the composer's long creative life but also the apparent lack of pervasive systems in certain highly sectionalized early works.

In Section 2.11 I equated the importance of proportions measured in absolute time with the existence of harmonic stasis, which in turn is related to moment time. Because Stravinsky's harmonically static sections unfold more through permutation and variation than through progression and development, the lengths of his moments tend not to be *internally* predictable. In other words, when we sense the impending end of a harmonically static passage, the reason has more to do with the context of the entire piece than with processes internal to that moment. Thus, Stravinsky usually ends a section at what seems to be exactly the right instant, despite the impossibility of forecasting the arrival of the next moment on the basis of what happens during the preceding one. The unpredictability comes from the lack of goal-directed development within sections; the sense of rightness, as I have implied in Section 9.13 and hope to show in greater detail here, comes from the proportions of an entire piece. Just as moment time's purposeful impoverishment of structural levels (see Section 8.3) induces us to hear all moments as having equivalent importance regardless of their length, so in Stravinsky's sectionalized music formal coherence comes from the balance between relatively static sections heard as having equivalent weight, no matter what their durations.

Thus the proportions in Stravinsky's music operate in a way quite different from those in tonal music. B. M. Williams has written:

> Whereas the romantic composer, like Beethoven, uses sonata form to comment upon personal and public emotions and to catch up his listener in a

> continuum of swiftly changing events, Stravinsky's purpose seems to be to restrict, if not wholly to suppress, anything in his music which will beguile and conjure up a wholehearted response in his listener. Music which is as static as commentators agree [Stravinsky's is], or gives the illusion of being so, is closer to the truly static arts of sculpture and architecture than music which is dynamic, whose parts are constantly on the move in a kaleidoscope of change.[1]

Although we do perceive various kinds of balances between sections in tonal music, it is difficult to offer *convincing* quantitative evidence to support our intuitions (but see Section 11.8). But much of Stravinsky's music lacks tonality's kineticism. Furthermore, Stravinsky's metric irregularities deny us the clock-like beat that ticks throughout most tonal pieces. In the absence of a regular metric hierarchy of timespans, we focus our perception of duration on something akin to absolute time. Since we cannot find a reliable sequence of evenly spaced strong beats on any hierarchic level but the shallowest, we react, instead, to pure duration. As explained in Chapter 4, meter in tonal music is a fundamentally regular alternation of strong and weak beats. Exceptions to the regular pulsation are understood as deviations from, not destroyers of, the essential regularity. But Stravinsky's music often has so little regularity that we cannot extrapolate a normal beat, except on a subprimary level. Thus we turn to absolute duration (imperfectly perceived, to be sure) as the only reliable source of information about elapsed time. (Meter and information are two aspects of duration perception. Chapter 11 considers the different ways we perceive lengths.)

Edward Cone has compared proportions in Stravinsky's music to those in tonal music:

> Classical balance, even when apparently rigid, controlled contrasting events moving at varying speeds, so that the listener's experience usually belied the exact parallel of timespans and defeated most attempts to measure one against the other. Stravinsky's sections—rhythmically persistent, harmonically static, melodically circular—not only invite the hearer to make the comparisons leading to just such measurement, but also reward him for doing so. Far from exploiting the sonata form as the traditional vehicle for realizing the musical and dramatic potentialities of tonal conflict and progression, he adapts it to his own perennial purpose: the articulated division of a uniform temporal flow.[2]

Thus, in many of Stravinsky's compositions, the problem of duration perception is simpler than in tonal music. His music's articulated uniform temporal flow allows for quantitative analysis. For this reason my discussion of temporal proportions begins with this intriguing body of music, which does not greatly distort our sense of duration. Experiential time closely approaches (but is never identical with) absolute time because of the stasis and consistency of moments, the high degree of discontinuity that separates them, and the lack of a regular metric clock in most pieces. Thus we can (with some confidence that we are studying the way Stravinsky's music is perceived) investigate proportional lengths of sections by measuring their clock-time durations, an analytic procedure not so comfortably applicable to tonal music (although section 9.8 does discuss briefly some quantitative studies of tonal proportions).

As. B. M. Williams points out,[3] Stravinsky's concern with carefully proportioned harmonic stasis relates to his ideas on ontological vs. psychological time. Psychological time, exemplified by the motions of tonality, passes "at a rate which varies according to the inner dispositions of the subject and to the events that come to affect his consciousness. . . . It dislocates the center of attraction and gravity and sets itself up in the unstable; and this fact makes it particularly adaptable to the translation of the composer's emotive impulses."[4] But Stravinsky was after something quite different. He sought a music that presents ontological time (essentially the same as my absolute time) in a nearly pure state, undistorted by music or by a listener's, composer's, or performer's emotions. Such music induces "in the mind of the listener a feeling of euphoria and, so to speak, of 'dynamic calm.'"[5]

It is in this music of "dynamic calm" that objectively conceived proportions are most readily perceived and are crucial to formal balance. When those proportions relate static sections that are starkly set off by discontinuities, the balances become vital to overall coherence. It is appropriate therefore that we begin this discussion of objectively measured proportions with the music of the one composer whose aesthetic seems to invite measurement and comparison of absolute durations.

10.2 Analytic Overview of Proportions in Stravinsky's Music

Stravinsky was apparently first attracted to sectional discontinuity more for its dramatic impact than for its potential for articulating proportions. The need for individual dances in a ballet was also decisive. Thus, while discontinuity is fully present in *Le Sacre* (1913), for example, formal balance is apparently not created by overall proportional consistencies in absolute time. There are some approximate large-scale balances at work in *Petrouchka* (1910), however, although it was several years before the composer began to realize the enormous potential of a multilevel nested proportional system, a development that paralleled his increasingly classical aesthetic.

Petrouchka contains several large-scale symmetrical structures: The outer sections of various tripartite forms are of more or less equal duration. Stravinsky subsequently experimented with small-scale durational proportions in Three Pieces for String Quartet (1914). The first movement consists of several simultaneously repeating cycles of different lengths. In the second and third pieces, Stravinsky created well-proportioned embryonic moment forms. Since the composition is a set of miniatures, the lengths of moments vary in accordance with typical additive rhythmic procedures, similar to those shown in the cellular analysis of *Symphonies of Wind Instruments* in Chapter 9. Each time certain figures return, they are extended or compressed by a beat or two. Thus we begin to feel in this music a sense of balance between unequals. More sophisticated is the first tableau of *Les Noces* (1914-1917, but revised through 1923), where sections vary in length from 6 to 35 seconds.[6] Stravinsky invites us to hear some of these moments as of equivalent weight by giving several independent, nonadjacent sections the same duration. Not all the moments, however, participate in relationships of durational equality with other moments.

The real breakthrough piece is *Symphonies of Wind Instruments.* Here the composer moves beyond additive durations and identity relationships. He discovers a principle that he was to develop and refine during the remainder of his career: the use of a single multiplicative ratio to determine most of the moment durations of an entire (or at least a major portion of a) piece. As explained in Section 9.13, the ratio in this case is 3:2, probably the most readily perceived relationship beyond identity (1:1), doubling (2:1),[7] and the golden section. The economy and consistency of a system that determines proportional lengths from the smallest (7½ seconds) up to the largest (80 seconds) moment has much to do with why the first half of *Symphonies* seems elegantly balanced despite frequent discontinuities and extremely disparate section durations.[8]

Stravinsky's neo-classical music is often less overtly discontinuous than are his Russian works, and it is not always blatantly static within sections. Nonetheless, the pieces are often sectionalized, and the sectional lengths are usually determined by consistent proportions. The Symphony in C (1940), for example, utilizes several interlocking arches of proportions, and 3:2 proportions are important on the deepest level. The Sonata for Two Pianos (1944), especially in its first movement, is concerned with ratios slightly greater than 1:1. To generate proportions from a ratio such as 1.1:1.0 is to create a compromise between additive and multiplicative procedures.

The most pervasive and elegant proportioning I have found in Stravinsky's music is in *Agon.* This highly discontinuous work has puzzled commentators by its disparity of materials yet unmistakable unity. Part of the reason for its unity is the incredible sense of balance Stravinsky creates by utilizing one ratio to determine virtually all the important durations, from the level of the submoment (as brief as 14 seconds) to the entire 18-minute composition. The sections in *Agon* are delineated by a great variety of means, including but not limited to harmonic stasis. Even the compositional methods (serial vs. neotonal) vary. Yet *Agon* magically coheres. The pervasiveness of one proportional ratio is the key to the unity that is not readily apparent on the work's surface.

Before exploring in detail the proportions in these works, we must consider the question of approximation. Stravinsky's proportional consistencies are never exact, which implies that he did not consciously calculate sectional durations (the first of Three Pieces for String Quartet is probably an exception; see Example 10.1). It is surely not surprising that a composer as sensitive to surface rhythms as Stravinsky should also have possessed a finely developed intuitive sense of temporal middleground and background. His intuition operated within the limits of (his) perception. Thus a section lasting 20 seconds can be heard as equivalent to one of 20½ seconds, in the appropriate context. While it remains an open question what degree of deviation is so slight that it cannot be perceived, it is surely significant that Stravinsky's choice of tempo as a performer often only approximated his metronome indications.[9] His recordings do, however, tend to observe tempo modulations (and thus durational proportions) accurately.

Stravinsky's sense of timing became more acute as he matured, so that the deviations from exactness are smaller in later than in earlier works. This refinement allowed him to work with increasingly more complex ratios. In *Symphonies,* for example, most deviations from 3:2 are within a range of 7%. In other words, proportions in the range from 1.40 to 1.61 function as approximations of

1.50. Thus a 30-second moment (in 3:2 relationship to a 20-second section) can be approximated by durations lying between 28.0 and 32.2 seconds. This range of approximation is acceptable *in context* because other simple ratios do not fall within the range 1.40 to 1.61—4:3 = 1.33, 5:3 = 1.67, 5:4 = 1.25, and the golden section = 1.62.

In *Agon* Stravinsky uses a more complex ratio, which is not expressible by small whole numbers: 1.19:1. No longer is a 7% deviation acceptable, since this percentage deviation would allow ratios ranging from 1.11 to 1.27. It is unreasonable to suggest in such a context that durations ranging, for example, from 18.7 seconds to 21.4 seconds can approximate 20.0 seconds, since durations in the proportion 1.19:1 to 20 seconds are 16.8 and 23.8 seconds; 21.4 (7% approximation of 20.0) is not so far from 23.8, after all. Almost all of the approximations in *Agon* are within 2.7% accuracy, and thus 20.0 seconds is approximated by durations between 19.5 and 20.5 seconds, which are considerably closer to 20.0 than to, respectively, 16.8 and 23.8. Such close approximations are surely well within the limits of perception.

It is remarkable that *Agon* utilizes its proportional ratio as consistently and on as many structural levels as it does. It is amazing that it does so to such a high degree of precision. Stravinsky's sensitivity to formal proportions is impressive.

10.3 Proportions in Stravinsky's Early Compositions

In *Petrouchka,* the three large sections of the first tableau and each of the four tableaux are divided into three parts, the outer of which are approximately equal. Sections are delineated tonally, with supporting data from the music's textures, densities, melodic material, and orchestration. Middle sections of these tripartite structures vary considerably in their percentage contribution to the movement's total duration, but the outer sections are quite consistent in their equality.[10] Stravinsky's sense of balanced proportions was not nearly as sophisticated in 1910 as it was destined to become. He had not yet come to the idea of using a consistent proportional ratio forcefully and pervasively to balance unequal timespans. It is significant, however, that this early attempt at formal balance operates on large-scale proportions. A few years later the composer worked with controlled proportions in a smaller context. The first of the Three Pieces for String Quartet is thoroughly static harmonically and repetitive melodically. It is an apparently deliberate exploration of proportional control, although differing from that found in *Petrouchka* and in subsequent works. The third and especially the second movements are experiments in extreme discontinuity. The composer's later methods develop from the implications of both the quantitative durations in the first and the discontinuities in the other movements.

Example 10.1 explains the unique approach to duration in the opening movement. There are three cycles that repeat continually. The 23-beat melodic pattern in the first violin (B) and the second violin's 21-beat duration (C) are completely regular, while the other second-violin span (A) varies irregularly within narrow limits. There is also a 7-beat pattern, but three successive viola-

A	15	22	19	21	22	13						
AB	7	8	15	7	16	3	20	1	22	13		
B	7	23	23	23	23	13						
BC	4	3	18	5	16	7	14	9	12	11	10	3
C	4	21	21	21	21	21	3					
AC	4	11	10	12	9	10	11	10	11	11	10	3
A	15	22	19	21	22	13						

There are three main ideas of differing lengths that cycle continually throughout the movement. "A" is the duration initiated by 4 (but *not* 8) eighth-notes in the second violin; the average length of this slightly varying cycle is 21 beats. "B" is the first violin's melodic line, which repeats literally after 23 beats. "C" is the duration initiated by 8 (not 4) eighth-notes in the second violin; the length of each of these cycles is 21 beats, supported throughout by the 7-beat cycles in the viola and cello. The chart shows the cycles and their mutual interaction throughout the 112-beat movement.

"AB" shows where within the B-cycle each A-cycle starts (and conversely, where within the A-cycle each B-cycle begins); in other words, "AB" shows how many beats after each melodic relaunching in the first violin the second violin plays 4 eighth-notes: 8, 7, 3, 1, and 0 beats respectively. "BC" shows where within the B-cycle each C-cycle commences; in other words, "BC" indicates that respectively 18, 16, 14, 12, and (theoretically) 10 beats after the first violin begins its melodic statement the second violin plays 8 eighth-notes. Conversely, after the second violin starts its 8-eighth-note figure, the first violin begins its next melodic cycle respectively 3 (theoretically), 5, 7, 9, and 11 beats. "AC" shows where within each A-cycle a new C-cycle begins (and conversely). In other words, the duration from the start of one 8-eighth-note figure in the second violin to the start of the next is approximately evenly subdivided by the start of a 4-eighth-note figure, also in the second violin. The slight exception occurs in the second C-cycle, which is subdivided 12+9 rather than the more nearly even 11+10 or 10+11. It is difficult to explain this anomaly in an otherwise quite regular scheme, other than by suggesting a slight (and typical) degree of unpredictability. Or was this exception an oversight during the compositional process?

The basic additive duration is 2 beats, which derives from the difference in length between the two regular cycles B (23 beats) and C (21 beats). This duration accounts for the gradual lengthening in the time between the start of an 8-eighth-note cycle and the start of the subsequent melodic cycle.

The cycles are potentially repeatable to infinity. The movement starts so that it avoids the overlapping of the end of an 8-eighth-note figure and the start of a melodic cycle (shown theoretically in the chart). The movement stops after the 4-eighth-note and the melodic cycles ("A" and "B") have begun together.

***Example 10.1.* Stravinsky, *Three Pieces for String Quartet,* proportions of concurrent cycles in the first movement**

cello cycles coincide with and thus support each second-violin 21-beat cycle. The number of beats between the relaunching of different spans varies, since they are of unequal length, according to an arithmetic series.

Perhaps the experimental first movement taught Stravinsky that carefully controlled durations can generate a form. The use of simultaneous cycles of different lengths must have proved too constricting, however, and he never again used such a procedure. Instead he began to control durations of separate sections, such as those created by the discontinuities in the last two movements.[11]

In *Les Noces,* one of the first works to control section durations, Stravinsky does not yet relate different lengths by means of consistent ratios, but his concern with overall formal balance is evidenced by a tendency to make disparate moments (those that are neither adjacent nor motivically similar) equal in length. Thus *Les Noces* extends the techniques of *Petrouchkha.* As Example 10.2 shows, the first tableau has eight motivically distinguishable submoments: A, B,

SECTION	REHEARSAL NUMBERS	DURATION IN SECONDS
whole tableau	0 to 27	293.3
moments		
A0+B1+C2	0 to 4	69.5
A4+B5+C7	4 to 8 (+3 meas.)	68.2
A8	8 (+3 meas.) to 9	10.5
D9+E10+F11+G12+D14+H16+D18	9 to 21	82.9
A21+C24	21 to 27	62.2
submoments		
A0	0 to 1	20.2
B1	1 to 2	28.1
C2	2 to 4	21.2
A4	4 to 5	27.8
B5	5 to 7	27.4
C7	7 to 8 (+3 meas.)	13.0
D9	9 to 10	6.0
E10	10 to 11+	7.0
F11	11+ to 12	10.0
G12	12 to 14	14.2
D14	14 to 16	13.0
H16	16 to 18	12.2
D18	18 to 21	20.5
A21	21 to 24	35.2
C24	24 to 27	27.0

Submoment durations have a tendency to cluster around certain values (6.5, 10.2, 12.7, 20.6, and 27.6 seconds), but consistent proportional ratios are not in evidence. This clustering indicates a concern with approximate equality of durations for different sections:

D9 = 6.0	F11 = 10.0	H16 = 12.2	A0 = 20.2	C24 = 27.0
E10 = 7.0	A8 = 10.5	C7 = 13.0	D18 = 20.5	B5 = 27.4
		D14 = 13.0	C2 = 21.2	A4 = 27.8
		D9 + E10 = 13.0		

A0 + B1 + C2 = 69.5
A4 + B5 + C7 = 68.2

A0 + B1 + C2 + A4 + B5 + C7 + A8 = 148.2
D9 + E10 + F11 + G12 + D14 + H16 + D18 + A21 + C24 = 145.1

Example 10.2. **Stravinsky, *Les Noces,* moment and submoment durations and proportions in the first tableau**

C, D, E, F, G, and H. These submoments are grouped into five moments: ABC ABC A DEFGDHD AC. Several distinct submoments share lengths. These equalities unify a movement that contains 16 sections ranging in length from 6.0 to 35.2 seconds. Moments as well as submoments are balanced by durational equality: The first two ABC moments (respectively from the beginning to [4] and from [4] to three measures after [8]) are of equal duration. Furthermore, the largest internal discontinuity (at [9], where a new tempo and new motivic materials are introduced) divides the tableau into two virtually identical durations.

These equalities lend a subliminal sense of balance to this collection of harmonically static sections. As in *Symphonies*, there is an underlying sense of progression, and return of materials from earlier submoments does round out the form. Nonetheless, the equality of (sub)moment durations is more important to the form than the order of succession of these durations, and thus the proportional structure, more nonlinear than linear, is best understood via cumulative listening.

Petrouchka's and *Les Noces'* equalities of durations proved to be a viable but restricted solution to the problem of static form. In the first half of *Symphonies of Wind Instruments* Stravinsky relates lengths of sections not by identity but by the ratio 3:2, which allows him to project a sense of relatedness between quite different durations. To make such balances perceptible, he applies the proportional ratio to sections whose relatedness is already suggested by adjacency or similarity. As in *Les Noces,* transitions are minimized, so that discontinuity is maintained. The result is a work of stark contrasts, that is nonetheless elegantly balanced and economical. This is an achievement of stunning imagination and originality. Stravinsky created a music in which proportions not only matter to the form but actually generate it. While tonal music traditionally concerns itself with rates of motion, in *Symphonies* we feel—and understand cumulatively—proportions of static blocks. Example 10.3 summarizes the proportions of the first half of *Symphonies* (see also Section 9.13).

10.4 Proportions in Stravinsky's Middle Compositions

Stravinsky's neo-classical music is in some ways more subtle than his Russian music. When it is discontinuous, juxtapositions are less stark; when harmonies seem static, they are not necessarily totally unchanging; often the harmonies are not static at all.

In a widely read article,[12] Edward T. Cone finds proportional balances in the first movement of the Symphony in C (similar to those in *Petrouchka*). Remarking on Stravinsky's purposeful distortion of sonata form, Cone notes the proportional balance between the exposition (151 measures) and the recapitulation plus coda (149½ measures).[13] A crescendo to silence is heard twice, before the second theme group in the exposition (mm. 73–93) and before the coda (mm. 293–309). Although this gesture occurs in different places respectively in the exposition and recapitulation, Cone feels that it is so striking that it constitutes the major subdivision of both the exposition and the recapitulation plus coda. Thus it divides the exposition into 93 + 58 measures and the recapitulation plus

SECTION	REHEARSAL NUMBERS	DURATION IN SECONDS	DEFINING CHARACTERISTICS
moments			
A0	0 to 6	49.6	F and B-flat in bass
B6	6 to 8	12.2	modal flute tune with static harmony
C8	8 to 9	7.8	3-note bassoon melody with static harmony
A9	9 to 11	14.2	clarinet and trumpet fanfare
D11	11 to 26	80.0	consistent high register B
A26	26 to 29	22.5	clarinet and trumpet fanfare
D29	29 to 37	35.3	flute and clarinet duet with punctuations
A37	37 to 38	9.6	clarinet and trumpet fanfare
C38	38 to 39	7.5	3-note bassoon melody with static harmony
A39	39 to 40	10.8	clarinet and trumpet fanfare
B40	40 to 42	16.1	modal tune with new continuation
submoments			
a0	0 to 1	7.9	clarinet and trumpet fanfare
a1	1 to 2	12.9	block chords
a2	2 to 3	5.2	clarinet and trumpet fanfare
a3	3 to 4	3.6	foreshadowing of 44, 46, and 58
a4	4 to 6	20.0	block chords
d11	11 to 15	26.1	ascending motive
d15	15 to 26	53.9	flute and clarinet duet with punctuations
b40	40 to 41	8.6	modal flute tune with static harmony
b41	41 to 42	7.5	cadential harmonic stasis

The "defining characteristics" listed in the chart indicate some, but never all, of the factors that suggest hearing the indicated sections as moments or submoments. The transitions that appear at the ends of some moments are too brief to upset either the essential discontinuity of the form or the stasis of the harmony within each moment. "Meaningful" proportions are those between adjacent or similar (sub)moments. The pervasive ratio of proportions is 3:2 = 1.50. In other words, the longest moment is one and a half times the length of the next longest moment, which in turn is one and a half times the length of the third longest moment, and so on. Each moment and every submoment except those of B40 is in an approximate 3:2 relationship with an adjacent or similar (sub)moment. These approximations are usually, but not quite always, close. The relevant 3:2 approximations are:

ratios of lengths of submoments of A0
a4 : a1 = 1.55 (similar submoments)
a1 : a0 = 1.63 (adjacent submoments)
a0 : a2 = 1.52 (similar submoments)
a2 : a3 = 1.44 (adjacent submoments)

ratios in a chain from large to small involving all A and D moments except A39
D11 : A0 = 1.61 (longest moments)
A0 : D29 = 1.41
D29 : A26 = 1.57 (adjacent moments)
A26 : A9 = 1.58 (similar moments)
A9 : A37 = 1.48 (similar moments)

ratios of lengths of submoments of D
D11 : d15 = 1.48 (subdivision of D11)
d15 : D29 = 1.53 (D29 is a condensation by omissions of d15)

ratios of lengths of the last three moments
B40 : A39 = 1.49 (adjacent moments)
A39 : C38 = 1.44 (adjacent moments)

ratios of lengths of the only adjacent moments with same tempo
B6 : C8 = 1.56 (adjacent moments)

ratios approximating 3:2 and involving groups of adjacent moments
(B6 + C8) : A9 = 1.41 (three adjacent moments)
(A9 + D11) : (A26 + D29) = 1.63 (both D moments and their respective preceding A moments)
(A39 + B40) : (A37 + C38) = 1.57 (last four moments)
(A0 + B6 + C8) : (A37 + C38 + A39 + B40) = 1.58 (first three compared to last four moments)
(A0 + B6 + C8 + A9 + D11) : (A26 + D29 + A37 + C38 + A39 + B40) = 1.61
(all moments, partitioned after longest moment)

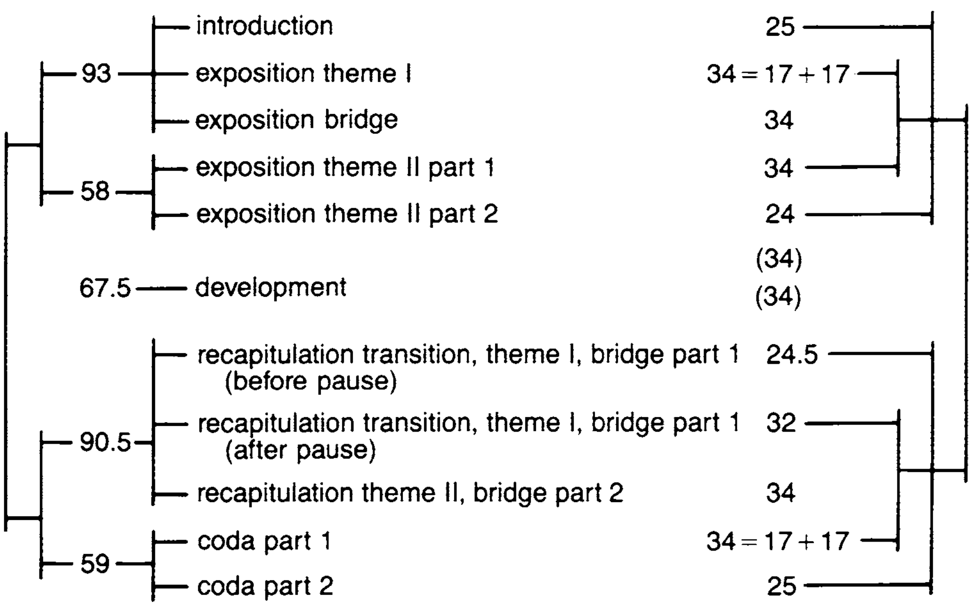
***Example 10.3.* Stravinsky, *Symphonies of Wind Instruments,* durations and proportions up to [42]**

coda into 90½ + 59 measures. Furthermore, the second theme-group in the exposition is subdivided harmonically into 34 + 24 measures, while the coda is similarly subdivided, by the reappearance of the first theme, into 34 + 25 measures.

Cone also identifies a symmetrical proportional structure in the exposition. The introduction (25 measures) balances the second part of the second theme (24 measures), while the intervening three sections—first theme-group, bridge, first part of second theme-group—are each 34 measures long. This arch structure is projected onto the level of the entire movement, since the 25-bar introduction is balanced by the 25-bar second part of the coda, and also since both the first theme-group in the exposition and the first part of the coda are divided by pauses into two groups of 17 measures. The development section lasts 67½ measures, virtually twice the 34 measures of the three parts of the exposition. The development is approximately bisected by the false recapitulation (mm. 181-90). These relationships are summarized in Example 10.4.

B. M. Williams (see note 10.1) extends Cone's analysis to the entire symphony, noting the pervasiveness of 3:2 proportions between lengths of movements and also within movements, where timespans are often compressed in that (or another) ratio. The finale replaces the tension of compression with the equilibrium of equality: That movement's four sections are virtually identical in length.

Like the Symphony in C, the Sonata for Two Pianos is a typically neoclassical work. As explained in Section 8.5, the first movement is cast in moment time despite its adherence to the outlines of classical sonata form. The proportions of the moments are given in Example 10.5. As the pervasive ratio is 1.1:1.0,



Example 10.4. **Stravinsky, Symphony in C, Edward T. Cone's proportional analysis of the first movement**

Example 10.5. **Sectional durations and proportions in Stravinsky's Sonata for Two Pianos**

SECTION	DURATION IN SECONDS	PITCH CENTRICITY (static sections only)
movements		
I	242.4	
II	262.5	
III	100.4	
main sections		
I. exposition	124.8	
development	38.1	
recapitulation	64.3	
coda	15.2	F
II. theme	96.0	G
variations	166.5	
III. theme 1	41.6	
theme 2	28.7	
transition	4.2	G
recap. theme 1	25.9	
subsections		
I. exp. theme 1	27.6	F
exp. bridge	4.3	G
exp. theme 2	30.5	C
recap. theme 1	33.3	C
recap. bridge	4.3	C
recap. theme 2	26.7	F
II. variation 1	41.1	G "root"; "key" of D
variation 2	40.0	
variation 3	49.4	
variation 4	36.0	D

Proportional ratios slightly greater than 1:1 (first two movements only):

(exp. repeated) : (devel. + recap. + coda) = 1.06
(exp. theme 1 + bridge) : (exp. theme 2) = 1.11
(exp. theme 2) : (exp. theme 1) = 1.11
(recap. theme 1) : (recap. theme 2 + bridge) = 1.07
(recap. theme 2 + coda) : (recap. theme 1 + bridge) = 1.11
(exp. theme 1) : (recap. theme 2) = 1.03 (both themes "in" F)
(recap. theme 1) : (exp. theme 2) = 1.09 (both themes "in" C)
(recap. without coda) : (exp. not repeated) = 1.03
(static "in" C) : (static "in" F) = 1.02
(theme + var. 4) : (var. 1 + var. 2 + var. 3) = 1.01
(var. 3) : (var. 1) = 1.20
(var. 1) : (var. 2) = 1.03
(var. 2) : (var. 4) = 1.11
(mvt. II) : (mvt. I) = 1.08

The third movement, which is not harmonically static, uses different proportions — 3:2 (1.50), 5:4 (1.25), and golden mean (1.62):

3:2: (mvt. III) : (theme 1 + recap. theme 1) = 1.49
(theme 1) : (theme 2) = 1.45
5:4: (theme 1) : (theme 2 + trans.) = 1.26
(theme 2 + trans.) : (recap. theme 1) = 1.27
(theme 1 + theme 2 + trans.) : (theme 2 + trans. + recap. theme 1) = 1.27
golden mean: (theme 1 + recap. theme 1) : (theme 1) = 1.62
(theme 1) : (recap. theme 1) = 1.61
Also, interestingly: (mvt. II + mvt. III) : (mvt. I) = 1.50

The following durations indicate the total time spent in each centricity through the sonata. Durations take into account both harmonically static *and* active passages. The decision of what pitch class (if any) governs a passage in a chromatic and/or transitional context is sometimes difficult to determine; thus the following durations should be considered approximate:

Mvt. I	"in" F	97.1
	"in" C	120.0
	"in" G	4.3
	"in" A-flat	21.0
Mvt. II	"in" G	131.8
	"in" D	89.8
	"in" C	40.9
Mvt. III	"in" F	67.5
	"in" G	32.9

Proportional ratios of time spent in main centricities (both slightly greater than 1:1):

("in" G) : ("in" F) = 1.03

("in" F) : ("in" C) = 1.02

the proportions are close to equality. The actual ratios range up to 1.11 (with one exception at 1.20). The general feeling is of moments slightly greater in length that other related sections.

This proportional idea is carried over into the second movement, a set of variations. The theme and the first and fourth variations are harmonically static, while the second and third variations are not. This introduction of harmonic motion is significant, since the finale is rarely static. Thus internal proportions in the last movement are not as important to formal coherence as in the earlier movements; progression takes over as the form becomes more linear. It is not surprising that the proportions between the clearly delineated large sections of the finale do not continue the ratio of the first two movements: It is difficult to hear such a subtle proportion as 1.1:1.0 in a context where motion may influence our perception of duration.

There is one further consequence of the "slightly greater than 1" ratio. As Example 10.5 shows, this ratio is reflected in the total amount of time spent in each of the three main pitch centricities[14] of the sonata, and "keys" of F, G, and C. Applying the basic ratio to total amounts of time spent in tonal areas seems to be a new development for Stravinsky. It depends directly on neither stasis nor sectional sectionalization. Rather, it is a consequence of the tonal centers present in his neo-classical style as well as the possibility of hearing this music's tonal and durational plans cumulatively. The sonata thus extends the principle of proportional balance into a new realm, and the result is an elegantly proportioned work.

10.5 Proportions in a Late Composition of Stravinsky

Agon is possibly Stravinsky's most discontinuous conception. Moments (which do not always coincide with the movements as labeled in the score) are differentiated by instrumentation, tempo, compositional procedure, harmony, recapitulation, and melodic material. Many moments contain submoments, and moments are grouped into five moment types; some of these groups are contiguous, while others include sections from different parts of the piece (see Example 10.6).

Example 10.7 shows the proportional system. The basic ratio is 1.19:1. This ratio is not as strange as it may at first seem, as it is really $\sqrt[4]{2}$:1. The first column of Example 10.7 is a series of numbers increasing according to the basic ratio. The musical significance of $\sqrt[4]{2}$:1 is that the series doubles every fourth term (for example, the subseries 40.2, 80.4, 160.8, 321.6, 643.2 is in the ratio 2:1). Thus sections twice as long as other sections are often encountered in *Agon*. The composer is therefore able to utilize a sophisticated series that also provides readily perceivable doubled durations.[15]

The series in the first column of Example 10.7 is a reference. The second column gives actual durations of all moments (except the longest one, *E411*) plus selected moment groups. Comparison of these two columns shows how very close to the $\sqrt[4]{2}$:1 series the sectional durations are (the fourth column gives the percentage of deviation); only one approximation is poor. Equally amazing is the range of the series. Durations from 40.7 to 1109.5 seconds approximate terms of the reference series.

The series in Example 10.7 does not explain durations of submoments. Another series, using the same ratio $\sqrt[4]{2}$:1 but starting from a different number, determines the durations of submoments from moments *A61* and *E411* (see Example 10.8). The approximations are as close as in Example 10.7, and the series is carried onto large structural levels by the durations of groups of adjacent submoments. The series of Example 10.8, like that of Example 10.7, contains several doubling relationships. There are also a number of significant equalities of durations shown in Examples 10.7 and 10.8. Example 10.9 shows additional manifestations of the basic ratio, several equalities of durational lengths, and further doublings of durations.

Careful study of Examples 10.7, 10.8, and 10.9 should indicate the impressive pervasiveness of the basic ratio. Stravinsky's choice of this particular ratio proved fruitful, as it allows for two long chains of proportionally related durations and since it includes several 2:1 ratios. The closeness of approximation is strong evidence that these series do indeed operate structurally. The participation of every moment (except the single longest moment, the twelve-tone *E411*, which is carefully set apart) and many submoments in one of the two series testifies to the thoroughness of Stravinsky's system. The fact that both series are projected onto high levels, thus determining durations up to that of the entire composition, is further proof of the significance of this construction. It is important to realize that the higher order terms of both series are approximated by groups of moments chosen not randomly but in accordance with temporal adjacency and/or motivic similarity.[16] *Agon*, Stravinsky's most mosaic-like, most discontinuous, seemingly least consistent work is in fact unified by a tight system of durational proportions. What results from his great sensitivity to sectional lengths is a beautifully balanced composition.[17] The composer's achievement is extraordinary; it bespeaks both an incredibly well developed intuition and a deep understanding of the implications of discontinuity.

Example 10.6. Delineation of sections in Stravinsky's *Agon*

SECTION	MEASURES	DURATION IN SECONDS	NAME IN SCORE	DEFINING CHARACTERISTICS
moment groups				
A	1-121; 561-620	296.0		framing fanfares
B	122-145; 254-277; 387-410	122.1		refrain
C	146-253	194.4		neo-classical dances
D	278-386	161.6		"ABA" forms
E	411-560	335.4		serial
moments				
A1	1-60	81.5	Pas-de-Quatre	fanfare-like
A61	61-121	133.7	Double and Triple	attacca between Double and Triple
B122	122-135	40.7	Prelude	
C146	146-163	65.8	Saraband-Step	solo vln., xyl., 2 trb.
C164	164-184	60.6	Gailliarde	fls., solo strings, harp, mand., piano
C185	185-253	68.0	Coda	chamber orchestration
B254	136-145	40.7	Interlude	return of B122
D278	278-309	47.6	Bransle Simple	"ABA" form
D310	310-335	47.0	Bransle Gay	castanets ostinato; "ABA" form
D336	336-386	67.0	Bransle Double	"ABA" form
B387	387-410	40.7	Interlude	return of B122
E411	411-560	335.4		serial
A561	561-620	80.8	Coda	recapitulation
submoments				
a61	61-80	41.9	Double Pas-de-Quatre	4/8 time
a81	81-95	38.3	Double Pas-de-Quatre	5/8 time, more pointillistic
a96	96-121	53.5	Triple Pas-de-Quatre	4/8 time, coda
b122	122-135	20.7	Prelude	overlapping figures
b136	136-145	20.0	Meno mosso	high cb., low fls., etc.
c146	146-153	29.8	Saraband-Step	ends with strong cadence
c154	154-163	36.0	Saraband-Step	answering section
c164	164-170	17.6	Gailliarde	
c171	171-178	28.3	Gailliarde	add piano and timp., repeat
c179	179-184	14.7	Gailliarde	recapitulation of c164
b254	254-267	20.7	Interlude	overlapping figures
b268	268-277	20.0	Meno mosso	high cb., low fls., etc.

Continued

Example 10.6. continued

SECTION	MEASURES	DURATION IN SECONDS	NAME IN SCORE	DEFINING CHARACTERISTICS
submoments				
d278	278-287	13.9	Bransle Simple	trumpets fanfare
d288	288-298	15.7	Bransle Simple	pointillistic orchestration
d299	299-309	18.1	Bransle Simple	recapitulation of d278
d310	310-320	21.5	Bransle Gay	flutes and bassoons
d321	321-331	17.9	Bransle Gay	flute solo
d332	332-335	7.5	Bransle Gay	recapitulation of d310
d336	336-351	25.7	Bransle Double	tpt., trb., strings
d352	352-364	13.9	Bransle Double	add flute and piano
d365	365-372	12.9	Bransle Double	recapitulation of d336
d373	373-386	14.5	Bransle Double	coda
b387	387-400	20.7	Interlude	overlapping figures
b401	401-410	20.0	Meno mosso	high cb., low fls., etc.
e411	411-451	121.7	Pas-de-Deux	violin solo with strings
e452	452-462	16.5	Pas-de-Deux	strings; irregular meters
e463	463-494	44.8	Pas-de-Deux	"ABA" form
e495	495-503	16.5	Coda	energetic
e504	504-511	45.0	Doppio lento	mand., harp, solo strings
e512	512-519	13.9	Quasi stretto	first real transition
e520	520-538	33.0	Four Duos	lower strings pizz., trbs.
e539	539-552	27.5	Four Trios	string fugato
e553	553-560	16.5	Four Trios	transition to recap. of A1

"Moment groups," "moments," and "submoments" represent three distinct but adjacent levels of structure. Moments are self-contained sections defined by some of the following characteristics: static harmony, texture, compositional procedure, orchestration, tempo, melodic material, form. The analytic decision of what constitutes a moment in the context of *Agon* is perceptual and (initially) intuitive. Justifications for such decisions can be given; "defining characteristics" indicate some, but never all, of the pertinent factors that suggest hearing the sections on the indicated structural levels. Moments that share common materials, textures, and/or procedures are grouped together into moment groups, whether or not the constituent moments are temporally adjacent. Distinct sections that are not as strongly delineated as moments are labeled submoments. Most, but not all, moments contain submoments.

"Duration" is calculated according to Stravinsky's metronome indications, from the first attack point of a section to the end of the final sound of that section (if it is followed by a between-movement pause of indeterminate length) or to the first attack point of the subsequent section (if it follows *attacca*). *Fermate* are estimated to add one second.

1.19:1 SERIES	DURATION IN SECONDS	MOMENTS	% DEVIATION FROM SERIES	REMARKS
40.2	40.7	B122	1.2%	
	40.7	B254	1.2%	
	40.7	B387	1.2%	
47.8	47.0	D310	1.7%	
	47.6	D278	0.4%	
56.8	60.6	C164	6.7%	poor approximation
67.6	65.8	C146	2.7%	
	67.0	D336	0.9%	
	68.0	C185	0.6%	
80.4	80.8	A561	0.5%	
	81.5	A1	1.4%	
95.6	94.6	D278+D310	1.0%	two adjacent moments
113.6	114.0	D310+D336	0.4%	two adjacent moments
135.2	133.7	A61	1.1%	
160.8	161.6	D	0.5%	moment group D
191.2	194.4	C	1.7%	moment group C
227.2	235.1	B122+C or C+B254	3.5%	group C + one framing B moment; weak approximation
270.4	275.8	B122+C+B254	2.0%	group C + both framing B moments
321.6	321.7	A1+A61+B122+C146	0.0%	first four moments
382.4	376.1	B387+E411	1.6%	two adjacent moments
454.2	456.9	B387+E411+A561	0.6%	last three moments
540.8	537.7	D+B387+E411	0.6%	five adjacent moments
643.2	631.4	A+E	1.8%	two moment groups
764.8	753.5	A+B+E	1.5%	three moment groups
908.4	915.1	A+B+D+E	0.7%	four moment groups
1081.6	1109.5	A+B+C+D+E	2.6%	five moment groups (entire composition)

All moments other than the exceptionally long E411 have durations approximating those of a 1:1.19 reference series (all approximations are remarkably close, except for C164). This series is shown for comparison with the actual durations. It has no direct relevance to *Agon* except by such comparison. This series is interesting, however, because its ratio is $1:\sqrt[4]{2}$; in other words, the $(n+4)$th term of the series is twice the nth term. Thus, many moments are twice as long as other moments (e.g., A561 and A1 are twice B122, B254, and B387; A61 is twice C146, D336, and C185; etc.). Such nearly exact doublings of duration have a decided impact on the sense of formal balance in *Agon*. Also important are certain virtually identical durations of A1 and A561, the framing moments of the entire composition; B122, B254, and B387, the virtually identical Prelude and Interludes; adjacent moments D278 and D310, whose combined duration is also significant in the proportional scheme.

The chart goes well beyond the three structural levels of submoments, moments, and moment groups. It goes to the ultimate background, the duration of the entire piece. It is remarkable that this one proportional scheme governs durations from the individual moments through perceptually relevant, "meaningful" groupings (i.e., adjacent or similar) of moments to the total span of the work.

Notice the tendency of certain durations to cluster around certain terms of the reference series (40.2, 47.8, 67.6, 80.4). This further indicates the pervasiveness of the ratio. The duration of every moment except E411 is determined by the series; every term of the series approximates at least one significant duration; many chains of adjacent moments figure in the higher durations of the series; sums of durations of moment groups are also determined by the series. These facts go a long way toward explaining the mysterious sense of unity in *Agon,* despite the disparity in materials and compositional procedures and despite the extreme discontinuity between moments.

Example 10.7. **Stravinsky, *Agon,* proportional relationships between mom[illegible] moment groups**

artok,
, Fauré,
chaikovsky,
Haydn, Bach,

1.19:1 SERIES	DURATION IN SECONDS	SUBMOMENTS	% DEVIATION FROM SERIES	REMARKS
13.7	13.9	e512	1.5%	
16.3	16.5	e452	1.2%	
	16.5	e495	1.2%	
	16.5	e553	1.2%	
19.3	19.6	e495+	1.6%	includes preceding silence
23.0	22.5	e504	2.2%	not counting repeat
27.4	27.5	e539	0.4%	
32.6	33.0	e520	1.2%	
38.7	38.3	a81	1.0%	
46.0	44.8	e463	2.6%	
	45.0	e504	2.2%	
54.8	53.5	a96	2.4%	
65.2				no meaningful approximation
77.4	77.0	e520+e539+e553	0.5%	
	75.4	e495+e504+e512	2.6%	preceding three submoments; "Coda"
92.0	91.9	e504+e512+e520	0.1%	three adjacent submoments
	90.9	e512+e520+ e539+e553	1.2%	last four submoments
	91.8	a81+a96	0.2%	two adjacent submoments
109.6				no meaningful approximation
130.4				no meaningful approximation
154.8	152.8	e495+e504+ e512+e520+ e539+e553	1.6%	last six submoments
184.0	182.9	e411+e452+e463	0.6%	other submoments of E411
219.0	215.2	A1+A61	1.8%	first three submoments
260.8	256.0	A1+A61+B122	1.8%	first three moments

All submoments of moments A61 and E411 are involved in this series of approximations of a 1:1.19 series (a series different from but having the same ratio as the approximation series for moments shown in Example 10.7). All approximations are remarkably close, although three terms of the series do not correspond to perceptually meaningful durations in *Agon.* Most submoments (except a61 and e411) appear in the chart as entities. For approximations of larger durations, adjacent submoments (usually from the beginning or ending [except for the recapitulatory coda] of the piece) are summed. This procedure reflects the framing nature of the opening and closing of the work: not only the material but also the proportions reflect an arch-like structure. As in the above analysis of moment lengths, we find doublings of length (e.g., e539 is twice e512; e520 is twice e452, e495, and e553; etc.). Also important are such identities of duration as e452, e495, and e553; e463 and e504; the successive groups of submoments e495+e504+e512 and e520+e539+e553; the interlocking groups of submoments e504+e512+e520 and e512+e520+e539+e553; also significant is the fact that e539+e553 = e504.

Example 10.8. **Stravinsky, *Agon,* proportional relationships between submoments of *A* and *E***

As the analysis of *Agon* in particular demonstrates, Stravinsky's formulation of moment time deals with the formal implications of discontinuity. He went
follows d. simply the creation of discontinuities and static forms. He found a
convincing the ear of the functional equivalence of sections of different
erein lies his great originality. He invented a compositional tech-
ntly intuitively, that allowed him to create structures that cohere

Moments A1 and A61
a61 = a81, to within 1.6 seconds
a61 + a81 = A1, to within 1.3 seconds
(a81 + a96) : A1 = 1.13

Moments B122, B254, and B387
b122 = b136 = b254 = b268 = b387 = b401, to within 0.7 seconds

Moments C146, C164, and C185
C185 = C146, to within 2.2 seconds
c164 + c179 = c154, to within 1.7 seconds
c154 : c146 = 1.21 (adjacent submoments of C146)
c164 : C179 = 1.20 (similar submoments of C146)
(c164 + c179) : c171 = 1.14 (all submoments of C146)

Moments D278, D310, and D336
adjacent submoments increasing in duration according to ratio:
d288 : d278 = 1.13
d299 : d288 = 1.15
d310 : d299 = 1.19
d321 = d299, to within 0.2 seconds
d352 + d365 = d365 + d373 = d336, to within 1.7 seconds (all submoments of D336)
d336 : d310 = 1.20 (first submoments of two successive moments)
(d321 + d332) : d310 = 1.18 (adjacent submoments)
d310 : d321 = 1.20 (adjacent submoments)

Moment E411
e463 = e504 = e539 + e553, to within 1.0 seconds
e539 is twice the length of e512, to within 0.3 seconds
e520 is exactly twice the length of e452, e495, and e553
(e411 + e452 + e463) : (e495 + e504 + e512 + e520 + e539 + e553) = 1.20 (subdivision of E411 at largest silence)
e520 : e539 = 1.20 (adjacent submoments)
(e411 + e452) : e411 = 1.14
e452 : e512 = e495 : e512 = e553 : e512 = 1.19

Example 10.9. **Stravinsky, *Agon,* other significant proportions in submoments**

despite vastly different durations and extreme discontinuities. This technique allowed him to compose pieces that are beautiful statements of the aesthetic of nonlinear time.

10.6 The Golden Section in the Music of Bartók

Stravinsky was not the only composer to use a proportional ratio consistently throughout a piece. Theorists and analysts have been studying the use of the ratio 1.62:1 by composers as diverse as Barber, Hindemith, Schoenberg, Bartók, Webern, Berg, Prokofiev, Debussy, Ravel, Delius, Rachmaninoff, Fauré, Scriabin, Saint-Saëns, MacDowell, Dvořák, Wolf, Brahms, Wagner, Tchaikovsky, Schumann, Mendelssohn, Chopin, Schubert, Beethoven, Mozart, Haydn, Bach, Handel, Sermisy, Jannequin, Gibbons, Binchois, Dunstable, Ockeghem, Obrecht, Dufay, and Machaut. 1.62 represents the golden section, or golden mean. If a segment of musical time is subdivided such that the ratio of the entire segment to its larger component is identical to the ratio of the larger to the smaller component, then that ratio is the golden section. Example 10.10 gives a spatial analogy.

x + y = total length
x = larger subdivision
y = smaller subdivision

$$\frac{x + y}{x} = \frac{x}{y} = 1.62$$

This ratio is the same whether the larger segment comes first (shown above the line) or second (below the line).

Example 10.10. **Spatial representation of the golden section**

The golden section is closely related to the Fibonacci series,

0 1 1 2 3 5 8 13 21 34 55 89 144 233

This sequence of numbers is a summation series. In other words, each term is the sum of the previous two terms.

$$F_{n+2} = F_{n+1} + F_n \text{ for } n \geq 1$$

In this formula, F_1 is the first term of the series, F_2 the second term, F_n the *n*th term, and so forth. The Fibonacci series is the particular summation series whose first two terms, F_1 and F_2, are 0 and 1. This series is a remarkably good approximation of a series of golden means. In other words, for any three consecutive terms F_{n-1}, F_n, and F_{n+1}, the largest term F_{n+1} is to the middle term F_n as the middle is to the smallest F_{n-1}, to within 1. In particular,

$$F_n^2 = F_{n-1}F_{n+1} + (-1)^{n+1}$$

Proof of this assertion is given in Appendix 1. For comparison, Example 10.11 lists the first few terms of a true series of golden means and the corresponding Fibonacci numbers.

0.72	1.17	1.89	3.07	4.97	8.02	12.98	21.01	. . .
1	1	2	3	5	8	13	21	. . .

Example 10.11. **Comparison of golden mean and Fibonacci series**

Thus the Fibonacci series provides composers with the means to approximate golden-mean proportions closely while using the integer values convenient for traditional meters and note durations.

The golden mean series shown in Example 10.11 is a geometric series in which the constant multiplier is the golden ratio 1.62. Such a series can be used in ways analogous to the manner in which the left-hand columns of Examples 10.7 and 10.8 generate proportions in *Agon*. The Fibonacci series thus can provide durational proportions, from small to large scale, that consistently utilize one ratio.

It should not be surprising that golden-mean proportions and Fibonacci numbers appear in music. Numerous mathematical properties[18] of the Fibonacci series have appealed to artists and scientists for centuries, and golden-section proportions are frequently found in nature, human or otherwise. There is experimental evidence, for example, that the golden mean determines the ratio of people's positive to negative value judgments[19] (potential ramifications of this interesting idea are considered in Section 10.11). There is also experimental evidence that rectangles (cards, mirrors, pictures, etc.) proportioned according to the golden section (ratio of the longer to the shorter side is 1.62) appeal to our sense of symmetry.[20] The golden proportions in Greek vases and the poetry of Vergil were apparently created by Fibonacci numbers,[21] as were some of the proportions in Minoan,[22] Greek, and Gothic architecture. Fibonacci numbers were used in mosaic designs in several ancient countries.[23] The Fibonacci series is found in patterns of shell growth[24] and in phyllotaxis, or leaf and petal arrangement. Various types of flowers, for example, tend to have Fibonacci numbers of petals; and, in trees with spiral arrangements of leaves or branches, the Fibonacci series determines the number of rotations before a leaf or branch is found directly above a given one. Also, there tends to be a Fibonacci number of leaves or branches in such spirals.[25] The Fibonacci series influences the number of spirals of eyes (fruitlets) in pineapples[26] and pine cones. It determines the number of ancestors for each generation of bees.[11] Fibonacci numbers are used in certain electrical networks,[28] and they are approximated in the structures of atomic and subatomic particles.[29] The ratios of the distances of the satellites of Jupiter, Saturn, and Uranus from their parent planets approximate 1.62, as do (in a weaker approximation) the distances of the planets (including the asteroid belt) from the sun.[30] Fibonacci numbers have been used in the branch of cancer research that attempts to construct a mathematical model for the movement of malignant cells,[31] and they have been used in water pollution control to determine where best to place sewage treatment plants for cities on the same river.[32] Fibonacci numbers relate to the numbers of years in cycles between peaks and peaks, peaks and lows, and lows and lows of the stock market.[33] It has even been suggested that Fibonacci numbers determine the lengths of cycles of grasshopper abundance, automobile factory sales, the ratio of male to female conceptions, advertising effectiveness, sunspots, tree ring size, rainfall in India, Nile floods, financial panics, and furniture production![34]

The study of the mathematical properties of the Fibonacci series and its manifestations in nature and technology have filled nearly a hundred issues of the *Fibonacci Quarterly*. It would be surprising were no one to have found examples of the series or of golden-mean proportions in music. Several theorists have been combing various bodies of music assiduously for instances of the golden section. Some of this research is fascinating and provocative. Some of it is marred, however, by a mysticism or fanaticism about the Fibonacci numbers. If you set out to discover Fibonacci durations, eventually, with sufficient juggling of the data, you will probably find them. The crucial question is of what musical relevance such proportions are. Some analysts have made convincing, or at least plausible, arguments for the importance of golden proportions, and it is to their work that we turn in search of *relevant* findings.

Perhaps the best known musical analyses according to the golden mean are Ernö Lendvai's studies of the compositions of Bartók.[35] Lendvai finds isolated instances of golden-section proportions in a number of Bartók's works, and he also offers several analyses of multi-leveled proportions (somewhat analogous to my work on Stravinsky's *Symphonies of Wind Instruments* and *Agon*) in entire works or movements. Because of the widespread availability of Lendvai's work and the existence of a number of criticisms and/or extensions of his ideas,[36] I limit myself to discussing two works. As an introduction to Bartók's Fibonacci durations, I consider the *Allegro barbaro* (1911) from a viewpoint similar to Lendvai's. Then I look at Lendvai's controversial analysis of the first movement of the *Music for Strings, Percussion, and Celeste* (1936).

Although Lendvai acknowledges the historical importance of the *Allegro barbaro* and offers extensive analyses of this work,[37] he has little to say about temporal proportions beyond observations about its nontraditional phrase lengths and the Fibonacci-derived numbers of measures of the "throbbing F-sharp minor ostinato."[38] In fact, there are two proportional systems set in opposition. The passages which contain this sustained, activated F-sharp minor chord are respectively 5, 8, 5, 5, 3, 13, and 8 measures long. The remainder of the piece is structured more traditionally: Proportions determined essentially by the geometric series 2, 4, 8, 16, with extensions and elisions created by adding or subtracting durations from the arithmetic series 1, 2, 3, ... Because the Fibonacci measures are internally undifferentiated and static, we are not led to subdivide them according to the geometric series.

Much of the tension in this piece comes from the conflict between and eventual resolution of the two proportional systems. The two series do share some terms. Coinciding on the small value 2 (and, theoretically, 1, if we begin the geometric series with 1 rather than 2) is not remarkable, since we do not associate the duration of a two-bar group with one series or the other. The coincidence on 8, however, is striking. Toward the end of the piece, the series' convergence on 8 is made audible. An 8-bar phrase—whose material associates it with previous (2+2)+(2+2) geometric structures—is followed, after a 5-bar (!) interlude, by an 8-bar phrase based on the F-sharp minor material. The latter eight bars are associated motivically with Fibonacci phrase lengths, the former with geometric phrase lengths; yet they both clearly have the same duration. The two proportional systems are thus reconciled, and the piece ends.

These remarks on the *Allegro barbaro* are reasonably straightforward. Lendvai's large-scale proportional analyses are more problematic and controversial. One reason is that sometimes he counts beats and sometimes measures, even when these vary considerably in length. His analysis of the first movement of *Music for*

Strings, for example, counts measures, despite the free intermixing of time signatures 5/8, 6/8, 7/8, 8/8, 9/8, 10/8, and 11/8. Lendvai's procedure is defensible, as Roy Howat points out,[39] since the measures are quite audible as delimiters of phrase lengths. Lendvai is measuring not absolute time but time as marked off by hyperbeats. Howat[40] also mentions that Larry Solomon[41] finds similar proportions by calculating absolute temporal lengths on the basis of numbers of beats and Bartók's metronome markings. In addition to these three methods of counting durations (by measures or hyperbeats, by beats, and by absolute time), there is a fourth method, suggested by Clive Pascoe:[42] timing duration in specific performances.[43]

Another frequently cited problem with Lendvai's analyses is the notorious inaccuracy of some of his calculations. Lendvai adds a hypothetical silent bar (a questionable analytic license) to the end of the first movement of *Music for Strings* in order to obtain 89 measures. This 89-bar span is subdivided according to Fibonacci numbers. There are 55 measures before the main climax, subdivided when the strings remove their mutes and the timpani enter in bar 34. The final 34 measures are partitioned after 21 bars by the replacement of the mutes and by the first full statements of the theme in inversion. The initial group of 34 measures if further subdivided when the fugal exposition ends in measure 21. The final 21 bars are subdivided 13 + 8 by a change in texture and the disappearance of the celeste arpeggios and string tremolos. An interesting feature of these proportions is that timespans are subdivided long + short before the climax and short + long afterward, so that events cluster around and thus emphasize the movement's highpoint.

This use of nested golden-mean proportions to structure the entire movement is not as impressive as it at first seems, since some of Lendvai's calculations are off by a measure. The climax, for example, occurs *after* 55 measures (in other words, in m. 56), while the mutes are removed and the timpani enter *in* m. 34 (after 33 measures). Also, a major textural change, underlined by the celeste entrance, occurs at m. 78, but Lendvai does not mention it. It does come within one measure of satisfying a Fibonacci relationship, however, since there are 22 measures from the arrival of the climax in m. 56 to the celeste entrance in m. 78. Since I have accepted a modest level of approximation in my own Stravinsky analyses (in Sections 10.3-10.5), I should not argue too strenuously with Lendvai's one-measure inconsistencies.[44] Howat[45] provides a chart that compares Lendvai's analysis to the actual proportions of the movement; the discrepancies, while real, are not considerable. Howat also gives his own proportional analysis of the movement, in terms not only of Fibonacci proportions but also Lucas numbers (the summation series 1 3 4 7 11 18 . . .) and Fibonacci numbers doubled.

Lendvai and Howat also offer extensive golden-section analyses of the third movement of *Music for Strings* and the outer movements of the Sonata for Two Pianos and Percussion (1938). In addition to these two theorists, Bartók analyses along the lines suggested by Lendvai have been offered by Tibor and Peter J. Bachmann. Their article, "An Analysis of Béla Bartók's Music through Fibonacci Numbers and the Golden Mean," includes several examples of short timespans partitioned according to the golden section. Howat calls attention to two golden-mean analyses by George Perle. András Szentkirályi offers a golden-mean analysis of one of the violin-piano sonatas, and Edward A. Lowman gives an analysis of the third movement of *Music for Strings* that differs from those of Lendvai and Howat. (See note 10.36 for these references.)

10.7 THE GOLDEN SECTION IN THE MUSIC OF DEBUSSY

The importance of the golden ratio in Bartók's music has been well documented. Bartók was not, however, the only composer to use the golden mean extensively to generate temporal form. Roy Howat's book *Debussy in Proportion*[46] contains several thorough and well-documented analyses of Debussy's proportions according to the golden section. Howat offers detailed studies of *Reflets dans l'eau* (1905), *L'isle joyeuse* (1904), and *La Mer* (1905, but revised in 1909), as well as briefer comments on other works.

Essential to Howat's analyses is his idea that different processes in Debussy's music (for example, unfolding tonality, shaping of motivic material, changing dynamics, and evolution of textures) can be articulated at different places. When such elements move out of phase with one another, they may exhibit independent proportional systems. The eventual coinciding of these proportions can create large-scale cadences.

In *Reflets dans l'eau*, for example, the dynamics form an arch over the 94-measure piece. Starting from *pp*, the music reaches its loudest level (greater than *ff*) at the beginning of m. 58 and begins to recede at the beginning of m. 62, reaching *ppp* by the end. M. 58 is the bar closest to the work's golden mean, since $^{58}/_{94}$ is equal to $^{23}/_{47}$, which in turn is derivable from the Lucas series 3 4 7 11 18 29 47 . . . (all summation series, not just the Fibonacci, approximate the golden ratio). The climactic passage in mm. 57–61, as Howat points out, "lies over" the golden section, which occurs after 58 measures, in other words at the beginning of m. 59. The passage is marked by the reappearance of one of the work's two principle motives, which Howat labels *B*. The first appearance of motive *B* occurs after 23 measures, subdividing the 58 measures prior to the golden section according to the golden ratio (to within one bar). Motive *B* makes its final exit at the end of m. 80; m. 80 partitions the final segment, mm. 58–94, according to the golden ratio. Thus, allowing for the one-measure exception, the dynamic-motivic shape of the piece is consistently governed by Lucas proportions, which approximate golden sections.

The other main motive, *A*, recurs throughout the piece in a rondo-like manner. Its first reappearance occurs after 34 measures, where the harmony returns to the tonic D-flat after a long dominant pedal. 21 measures later the music modulates to E-flat major in preparation for the climax. The remaining 39 measures are subdivided 15 + 24 ($^{15}/_{24} = {}^{5}/_{8}$) by the final appearance of motive *A* (not initially supported by a tonic return). Thus there is a tonal-motivic shape, based on Fibonacci proportions, that runs parallel to, but slightly out of alignment with, the Lucas-derived dynamic-motivic shape. Howat suggests that Debussy made the first entry of motive *B* occur after 23 rather than 22 bars in order to keep these two shapes initially separate. A division of the dynamic-motivic pattern (based on motive *B*) after 22 bars might have been confused for an approximation of a Fibonacci subdivision (21) of the initial 34-bar segment of the tonal-motivic shape (based on motive *A*).

Howat also analyzes the proportions in a third realm: tonality and harmony. He suggests that the chromaticism after 42 measures marks the largest-scale departure from the tonic area, and that the change of key signature back to five flats indicates the cadential return to the D-flat major tonality after 68 measures. These two points, dividing the work's 94 measures 42 + 26 + 26, create the Fibonacci ratio 21:13:13. Also interesting is the fact that the return after 34 measures to the tonic chord within the opening tonic section (mentioned above) marks the halfway point to the final return of the tonic key after 68 measures.

Furthermore, the 58 measures up to the climax golden section are subdivided 16 + 26 + 16 (Fibonacci ratio 8:13:8) by the two departures from the tonic area: the first modulation away from D-flat (marked by the chromaticism after 16½ measures of the piece) and the large-scale modulation after 42 measures. The 26-bar segment, from the large-scale modulation in m. 43 to the return to five flats at m. 69, is partitioned 16 + 10 (Fibonacci ratio 8:5) by the work's climactic golden section after 58 measures.[47] Also, the change to whole-tone harmony in m. 48 subdivides the 13-bar segment from the large-scale modulation in m. 43 to the E-flat modulation in m. 56 according to the Fibonacci numbers 5 + 8.

Howat gives a few more details of golden sections in *Reflets dans l'eau,* some of which are somewhat questionable. He tends to label a timespan as, for example, 29 measures, even when the critical boundary event (in this example, a small dynamic peak) occurs at the end rather than the beginning of m. 30). Furthermore, he interprets as the climax point the work's golden section, at the beginning of m. 59, even though three details contradict this view: The modulation to E-flat occurs at the beginning of m. 56; the return of motive *B* occurs just after the start of m. 57; and the maximum dynamic level is first reached at the end of m. 57.

Howat's analysis uncovers many instances of golden-mean proportions in *Reflets dans l'eau.* He also finds examples of equal durations. For example, the 26 measures from the large-scale modulation in m. 43 to the change of key signature at m. 69 balance the 26 measures from that key change to the end. He believes that such symmetrical subdivisions of timespans create cadential relaxation, while golden-mean partitions create dynamism by their imbalance. Some of Lendvai's analyses have a similar flavor. As mentioned in Section 10.6, Lendvai differentiates between the forward thrust of long + short golden-mean partitions and the relaxation of short + long proportions.

If proportions are understood primarily in retrospect (cumulatively) how can they cause forward thrust or relaxation? Consider two hypothetical adjacent sections in a context that has conditioned us to perceive proportions as balanced by 1.62:1 and 1:1 ratios. Once we have heard the duration (let us call it x) of the first, we may expect the second section's duration to be $1.62x$, x, or $0.62x$. But we will not *experience* the total length of the second section until it has been completed. Only then will we understand the proportional balance. We have a nonlinear understanding of proportions, even though we may well come to realize, as the second section ends, either that it has been longer or shorter (possibly creating a structural upbeat or, according to Lendvai but not to Howat, a structural afterbeat) or that it has been equal (creating, according to Howat, a relaxation).

But music's progressions, upbeats, afterbeats, tensions, and relaxations cannot be created by proportions alone. They can be supported or even contradicted by the proportions and pacing, but that is another matter. If dynamism or the lack of it were created solely by proportions, we could not know whether the music's tension was increasing or decreasing until the end of the second hypothetical section. Howat has written:

> If . . . the relation of two events by GS [the golden section] can produce a feeling of proportional correctness or inevitability, it will be clear that this would be perceived only when both events have occurred. If this hammers the obvious, the purpose is to clarify here that the GS relationship of the climax to the entire length would, by itself, give no sense of such "correctness" to the arrival of the climax, but only at (and to) the end of the piece. Hence [in *Reflets dans l'eau*] . . . the entry of *B* in bar 24, itself proportionally unprepared, proportionally determines the position of the climactic focus at bar 59 [or possibly at bar 37, if mm. 1-23 turn out to be the larger subdivision of a golden-mean partitioned timespan], and the combination of these two events then proportionally prepares the entry of the coda and finally the end of the piece. The piece's form is now demonstrably involved in its dramatic gradation.[48]

Howat offers analyses of several other Debussy compositions. The methods are similar to those described above, although some of the music is considerably more complex. A careful reading of Howat's book is rewarding, not only for his insights into Debussy's art but also for his brief analyses of the proportions in the first movement exposition of Schubert's Sonata in A Major, D. 959 (1828), Ravel's *Oiseaux tristes* from *Miroirs* (1905), and Fauré's *Reflets dan l'eau* (1919).

10.8 THE GOLDEN SECTION IN EARLIER MUSIC

I began this chapter by suggesting that quantitative proportional analyses are appropriate only to static music. Stravinsky's music has this prerequisite, as does that of Stockhausen (see Section 10.9). That of Debussy and Bartók, while more problematic, still has areas of stasis. The works of Schubert, Ravel, and Fauré that Howat studies, and the remaining music to be mentioned in this section, however, are in no way static. Yet a number of analysts have found proportional balances in tonal and pretonal music. What relevance such proportions may have to the way the music is heard, as opposed to the way it was made, is considered in Chapter 11. For the present I simply report briefly on some of these theorists' findings.

Kenneth Kirk has made a careful study of Chopin's 24 Preludes, Opus 28 (1836-1839).[49] He defines the "turning point" as that instant in each of these small pieces when we understand that it is moving back toward the home key and final cadence. The turning points in most of the preludes occur at or very near the golden sections. Kirk's careful statistical analysis shows that the turning points cluster around the 0.62 point of their respective preludes. He furthermore shows that the turning points do not cluster around any other values, even those reasonably close to 0.62. Kirk also finds nested golden-mean proportions of subsidiary turning points in the longer preludes.[50]

In a wide-ranging and provocative article, Jane Perry-Camp[51] reports that several of the Mozart piano sonatas exhibit simple proportions. She considers only the largest-scale proportions, examining the ratio between the exposition and the development-recapitulation in the 31 movements in sonata form. All her findings are within 1% of accuracy. Calculating all movements both with and without designated repeats, she comes up with 62 ratios, of which 14 approximate the golden section. Nine ratios approximate 7:12 and another nine 2:3.

It is hard to assess the importance of these findings, or of Perry-Camp's analyses of non-sonata-form two-part movements and sections, nearly all of which show ratios of 1:1, 1:2, 2:3, or 4:5, with no deviation. She does conclude that the prevalence of golden-mean proportions in sonata movements and the total absence of such ratios in the non-sonata movements may indicate a different attitude on Mozart's part to the proportions of sonata forms vs. other structures. Beyond that intriguing observation, however, Perry-Camp offers no clue about what kind of music is appropriate for the various ratios. Furthermore, what are we to make of the movements that do not exhibit simple ratios? Surely they are not misproportioned. Is there some particular character associated with simply proportioned movements? Or with those movements that do not have simple proportional ratios? Why, in sum, are some movements proportioned one way and others another way? Surely the character and information content of a passage determine and are determined by its proportions. The relationship between content and proportion has to do with pacing, an important aspect of musical time that is too complex to be studied quantitatively. The analysis of tonal proportions needs considerably more study before these important questions can be answered.

An often cited article by J. H. Douglas Webster[52] mentions large-scale golden sections in sonata forms by several tonal composers, but his calculations are often quite approximate, and he offers little rationale for the use of the golden ratio. Certain pretonal music has been analyzed for golden proportions, with more convincing results. Newman W. Powell,[53] after giving a lucid exposition of the mathematical properties of the Fibonacci series, offers analyses of complex works by Cornelius Heyns, Machaut, and Dufay that are proportioned on many levels by the Fibonacci series. Similarly, Margaret Sandresky has made thorough golden-section analyses of Dufay[54] and Brian Trowell has provided an interesting proportional study of music of Dunstable.[55]

Clearly, much music has yet to be studied and many questions remain. A very tentative conclusion, which accords with my idea that static music is more susceptible to precise numerical proportions than kinetic music, is that pretonal and posttonal music exhibit a higher incidence of, or at least less equivocal usage of, simple-ratio proportions, particularly those of the golden section. Partial support for this claim comes from the large number of recent compositions that utilize the Fibonacci series to determine lengths of timespans.

10.9 THE FIBONACCI SERIES IN THE MUSIC OF STOCKHAUSEN

A number of composers after 1950 have deliberately used the Fibonacci series to generate golden proportions. While several composers may have been drawn to the series because of the folklore surrounding its pervasiveness or simply because of number mysticism, the series does have musically viable properties that have helped insure results satisfying to these composers. At least five properties of the Fibonacci numbers have musical relevance. These properties provide something like the economy of the geometric series 1, 2, 4, 8, 16, . . . , which in traditional music often determines hypermetric lengths on successive levels, with deviations (contractions, extensions, overlaps) provided by the arithmetic series 1, 2, 3, 4, 5, ... The Fibonacci properties are:

1. *The additive property.* Although the Fibonacci series is not arithmetic, it is a summation series. The fact that any term is the sum of the next two smaller terms can be made audible.
2. *The golden mean property.* As discussed above, the Fibonacci series approximates a series of golden means (see Example 10.11).
3. *The proportional property.* Since the Fibonacci series approximates a series of golden means, it can be used as a geometric series with the ratio (multiplier) 1.62.
4. *The 3:2 "property."* Stockhausen claims to be interested in Fibonacci proportions because they approximate a geometric series with the ratio 1.50, hence providing a "perfect fifth of duration."[56] The Fibonacci series is not, however, a particularly good approximation of a 3:2 series. Example 10.12 compares the first few Fibonacci numbers with the terms of a 3:2 series chosen for its reasonably close fit. I suspect Stockhausen finds Fibonacci proportions satisfying more because of the golden-mean and proportional properties than because of their alleged ability to unify frequency and duration proportions by a single set of ratios.
5. *The relatively-prime property.* Any two successive terms of the Fibonacci series have no common divisor other than 1. This assertion is proved in Appendix 2. Thus, despite the useful symmetrical properties 1-3, aperiodicity is evident on the term-to-term level. The series provides symmetries and asymmetries simultaneously, thus appealing to composers eager to find new rhythmic, metric, or proportional systems that avoid the symmetries of the classical geometric and arithmetic series but retain their balance, unity, flexibility, and versatility.
6. *The top-down property.* Large segments of musical time can be subdivided, theoretically into infinitely small segments, by repeated application of the golden ratio. Similarly, by subtracting progressively smaller Fibonacci lengths

1.32	1.93	2.98	4.46	6.69	10.04	15.11	22.67	34.00	51.00	76.50	114.75	. . .
1	1	2	3	5	8	13	21	34	55	89	144	. . .

***Example 10.12.* Comparison of 3:2 and Fibonacci series**

from a long timespan, an infinitely regressive series of durations can be generated. Thus the series maximizes variety within unity. Using a single ratio or single series, an infinitely large number of subdivisions of a whole can be generated.[57]

To see how these properties interact let us look at Stockhausen's *Klavierstück IX* (1954). (We will not consider the top-down property, because this particular piece builds up large timespans from small ones, not small from subdividing large; the bottom-up version of property 6 is embodied in properties 1 and 3.) Most of the time signatures are Fibonacci numbers. Consider, for example, the 13 (!) measures 1.2.1–1.3.4.[58] The denominators are consistently 8; the numerators are, respectively: 13 2 21 8 1 3 8 1 5 13 2 5 3. Significantly, only at the end of this passage is a duration either preceded, succeeded, or surrounded by durations which sum to it. Stockhausen saves overt use of the additive property for the cadence, although he does select a sequence of time signatures that maximizes the relatively-prime property. Never is 3 adjacent to 21; never is 2 adjacent to 8. Furthermore, there are two measures each of 1, 2, 3, 5, 8, and 13 eighths; there is one measure of 21. Of each pair of measures with the same time signature, one measure contains attacks and the other contains only sustained (via the pedal) sounds. This symmetry is undermined by the measure of 21 attacks, which is not balanced by an equal duration of sustained sound. It is typical of Stockhausen to create a symmetrical pattern and to distribute its elements over a timespan without apparent regard for their order. The near balance of this passage is understood cumulatively. The pitch stasis reinforces the nonlinearity of the durational construct. The order of the measures matters less (beyond the fact that attacks and sustained sounds must alternate) than the totality of measure durations. The emergence of the additive property for cadential purposes gives a touch of linearity to this otherwise distinctly nonlinear music.

The symmetry of this early passage, with its clear Fibonacci proportions, is expositional. The work's later Fibonacci proportions relate to this and to the subsequent passage, in which Fibonacci durations are presented at the slower of the two tempos that alternate throughout most of the piece. This passage, 1.3.5 to 2.3.5, is also pervaded by Fibonacci time signatures: 21 3 1 13 2 8 5 13 3 2 8 5 1 8 3 5 1 2 4 2 3 1 2 3 2 1 2 1 1. The exceptional 4/8 interjection, m. 2.2.6, is subdivided 3 + 1 (Fibonacci numbers); it is further justified as a foretaste of similar events at 4.1.4, 4.2.3, 4.3.1, 4.3.5, and 4.3.8. The additive property is more obvious than in the preceding passage, since these sets of three adjacent time signatures are encountered: (8, 5, 13), (8, 3, 5), (2, 3, 1), (3, 1, 2), (1, 2, 3), (3, 2, 1), (1, 2, 1), and (2, 1, 1). Notice that these triples are rarely in series order or in retrograde series order, which would have made the golden-mean property more noticeable. The relatively-prime property is undermined somewhat, as we encounter the following non-prime pairs of measures: (21, 3), (2, 8), (2, 8), (2, 4), (4, 2).

Prior to these two passages are three measures which serve to introduce several important aspects of the composition: periodicity; the static referential chord; stepwise chromaticism; the two main tempos (♪= 60 and ♪= 160); and Fibonacci proportions applied to note values (other than the grace notes, the durations in the third measure are respectively 3, 8, 5, 13, 5, and 8 eighths). This sequence of note durations maximizes both the additive and the relatively-prime properties. The time signature of the first measure is 142, which is the sum of the Fibonacci numbers $1+2+3+5+8+13+21+34+55$; the second measure, 87/8, is the sum of these same numbers without 55.[59]

Something like a recapitulation starts at 5.1.3. The passage beginning at 5.2.1 corresponds to 1.3.5–2.3.5. The recapitulation version contains the work's most overt realization of the additive property. The time signatures—8 1 5 3 2 5 2 3 1 3 1 2 2 1—contain the following triples of durations, some two of which sum to the third: (5, 3, 2), (3, 2, 5), (5, 2, 3), (2, 3, 1), and (3, 1, 2). The relatively-prime property is maximized, as 2 is never adjacent to 8.

The coda, with its new tempo of ♪ = 120, presents the most intricate yet clearest use of the Fibonacci series in the piece. The coda is articulated in groups of 7, 5, 3, 1, 2, 4, 6, and 8 measures respectively, as indicated by heavy barlines.[60] Each of these groups contains one and only one measure of each Fibonacci time signature. For example, the group with six measures, 7.1.5–7.2.3, contains one measure each of 1, 2, 3, 5, 8, and 13 eighths. Furthermore, the groups contain the following total numbers of eighths:

group with 1 measure contains 1 eighth
group with 2 measures contains 3 eighths
group with 3 measures contains 6 eighths
group with 4 measures contains 11 eighths
group with 5 measures contains 19 eighths
group with 6 measures contains 32 eighths
group with 7 measures contains 53 eighths
group with 8 measures contains 87 eighths

Each term of the series 1 3 6 11 19 32 53 87 is 2 less than a Fibonacci number; each term of this series is the sum of consecutive Fibonacci numbers from 1; the differences between successive terms of this series are the Fibonacci numbers 2 3 5 8 13 21 34.

Each measure in the coda contains either 1, 2, 3, 5, 8, 13, or 21 attack points.[61] Interestingly, the longer measures do not necessarily contain the greater number of attack points. For example, 7.1.4 is a 5/8 measure with 21 attack points, while 7.3.2 is a 13/8 measure with only 8 attack points. Thus the silent duration at the end of each measure, while not a Fibonacci length in itself, results from applying the Fibonacci series to the durations of measures and to the number of attacks per measure.

The penultimate measure is 34/8. This is the only place where this time signature occurs. Since we have heard a piece with measure durations related by the golden-mean property, this duration is a logical extension of the proportions to a new high level. Furthermore, the 34 duration is the sum of the previously longest (other than the three introductory bars) measure lengths: 21 and 13. Having heard nearly an entire piece with consistent durations related by the proportional property, we find this penultimate 34/8 a satisfying and logical duration. It *feels* right, at least to this listener. To test this while hearing the piece, I have tried to predict without counting just when the final impulse would occur, and I have usually been close. My success has convinced me that, in *Klavierstück IX* at least, a limited repertory of measure durations, related by a consistent ratio and operating in a small number of basic tempos, can become perceivable and even predictable. The duration 34 is cadentially satisfying even though it has never before been heard in this music.

A larger-scale usage of Fibonacci proportions is found in Stockhausen's *Adieu* for wind quintet (1966). All time signatures, except for those of the five bars containing tonal references and the four with unmeasured silences, are Fibonacci numbers, from 1 to 144. The properties of the series are readily heard, because each measure contains a largely static, or at least slowly changing, sonority. These sonorities change with the barlines. The tonal references start and end the piece, and they subdivide it into four sections, each with a total duration (still not counting the tonal references and unmeasured pauses) of 144. The pauses further subdivide these sections, so that the work consists of eight subsections, with respective total durations of 144, 55, 89, 144, 34, 21, 34, and 55. Notice that these durations contain the following triples, which exhibit both the additive and the golden-mean properties (slightly disguised by the order of terms in the first triple only): (144, 55, 89), (55, 89, 144), and (21, 34, 55). Fibonacci durations in series order occur occasionally on the measure-to-measure level as well, most notably at the end, where Stockhausen uses a segment of the series in order, for cadential purposes: 5 8 13 21 34. There are two types of "cells" of measure durations in *Adieu:*

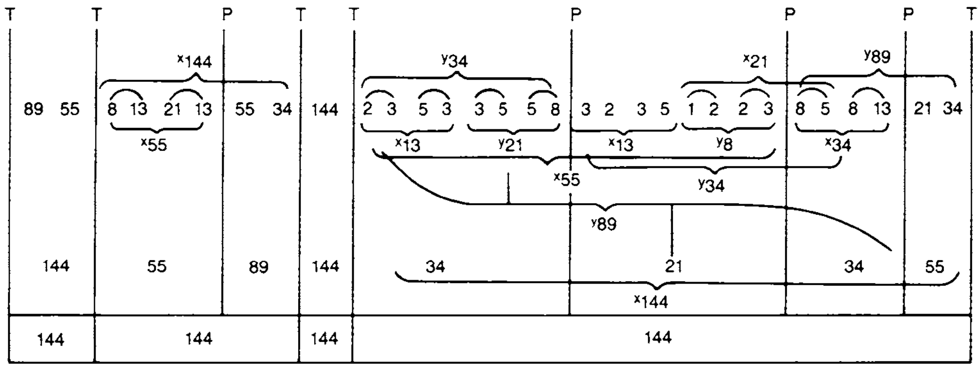
type x: $F_n\ F_{n+1}\ F_n\ F_{n-1}$ or its "inversion" ($F_n\ F_{n-1}\ F_n\ F_{n+1}$)
or its retrograde or retrograde inversion
type y: $F_{n-1}\ F_n\ F_n\ F_{n+1}$ or its inversion (which equals its retrograde)

Type y is a permutation of type x. The total duration of each cell is a Fibonacci number, F_{n+3}. Except for the first two measures (89 and 55 respectively) and the single measure of maximum duration 144, every bar is a member of several x and y cells on various levels. Once we allow for the summing of adjacent durations, we find the durational scheme of the entire piece to be an elaborate interlocking of x and y cells on many levels. Some of the more obvious manifestations of these duration cells are shown in Example 10.13.

Stockhausen has used Fibonacci proportions in a number of other works. These include, but are not limited to, *Telemusik* (1966) and *Hinab-Hinauf* (1968),[62] *Mikrophonie II* (1965),[63] *Zyklus* (1959),[64] *Klavierstück XI* (1956),[65] *Stop* (1965),[66] and *Mixtur* (1964) and *Tierkreis* (1975).[67]

10.10 FIBONACCI PROPORTIONS IN OTHER RECENT MUSIC

Several other postwar composers have used the Fibonacci series to produce golden-mean proportions. Luigi Nono, for example, serialized Fibonacci note durations in the second movement of his *Il canto sospeso* (1956). He takes the



T = tonal reference

P = unmeasured pause

Example 10.13. **Stockhausen, *Adieu,* Fibonacci durations of cells and Fibonacci proportions (only the most obvious are shown; others can be found)**

values 1, 2, 3, 5, 8, and 13 and places them in a particular order. This row is then transformed by rotation. Each term of the row is multiplied by a different basic pulse unit in each of four independent contrapuntal voices.[68] Fibonacci durations are particularly useful for "rhythm" serialization because they avoid the problem of arithmetic durations (e.g., 1 2 3 4 5 6 . . .): The ratio between adjacent small durations of an arithmetic series is far greater than that between adjacent large durations. As a practical result, not all terms of the series are differentiated with equal ease.[69] Serialized Fibonacci durations also avoid the problem of a simple geometric series, such as 1 2 4 8 16 32 . . . , in which the difference between a small and a large duration can be too great. Fibonacci durations have both additive and proportional properties, and thus they retain some of the qualities of simple arithmetic and geometric series while avoiding their pitfalls.

In Richard Bunger's *Pianography: Fantasy on a Theme of Fibonacci* (1970), Fibonacci durations usually appear in series order. The piece begins with an essentially unpitched voice playing durations of 1, 2, 3, 5, 8, 13, 21, 34, and 55 in order. Simultaneously another unpitched voice plays the same durations in retrograde order. These duration series are presented as the basic thematic material of this aptly named work. Fibonacci proportions appear in subsequent passages in many ways, but their identity and thus their relationship to this opening are always clear.

Lorelei (1969) by Robert Morris ends with Fibonacci proportions used cadentially. The prominent four-hand piano part in this ensemble work alternates measures with attacks and measures with sound sustained by the piano pedal (somewhat in the manner of Stockhausen's *Klavierstück IX*). After 21 measures with attacks we hear 1 measure of sustained sounds; then 13 measures of attacks are followed by 2 of resonance; then 8 + 3, 5 + 5, 3 + 8, 2 + 13, and finally 1 + 21. By means of Fibonacci proportions resonance gradually replaces activity, and the piece ends.

Large-scale Fibonacci proportions are at work in David Mott's *Tube* (1978) and in some music of Rolf Gehlhaar. Silences are proportioned according to the Fibonacci series in Jean-Claude Eloy's *Equivalences* (1963)[70] and Michael Gielen's string quartet *Un vieux souvenir* (1985). Also noteworthy are Ernst Krenek's *Fibonacci-Mobile*[71] and several works of Per Nørgaard, Krzysztof Penderecki, Scott Huston (who is more interested in large-scale golden sections than in using specific Fibonacci numbers), and Hugo Norden. Norden offers a method of composing in which the proportional scheme of an entire piece is laid out in advance according to the Fibonacci and other summation series.[72] This list of composers is hardly complete and probably not even representative, but it does serve to hint at the wide extent of contemporary interest in the Fibonacci series as a determinant of temporal proportions.

10.11 HOW IMPORTANT *ARE* PROPORTIONS?

Norden, who has amassed several volumes of (unpublished) analyses of tonal music according to Fibonacci and Lucas numbers, believes that "the more profound the composer the stricter is his application of [such] proportions in his musical structures."[73] While Norden and other theorists[74] cited in this chapter have indeed uncovered intriguing proportions in numerous works by composers we probably agree are "profound," I am unwilling to make an ironclad correlation between 1.62 proportions and musical significance.

Whether or not there is anything inherently satisfying about the golden section experienced temporally *is* a fascinating question. Most psychological experimentation on the perception of golden proportions has taken place in the visual domain, and we should not glibly assume that what appeals to us as spatially balanced will also seem balanced when translated into the temporal world. After all, we experience spatial proportions at once, or at least in accordance with our own pattern of perception, while temporal information comes to us in a fixed order and at a given rate. I am not denying the existence of golden-mean proportions in *some* of the music of Bartók, Debussy, Chopin, Mozart, and Stockhausen. Many of the analyses cited or presented in this chapter *are* convincing. But I am asking just how relevant those proportions are relative to our perception of formal balance, particularly in kinetic music (such as the Chopin preludes or the Mozart piano sonatas), where cumulative listening is subjugated to the music's linear propulsion and changing rates of motion. Clearly there is *some* significance, because the composers went to the trouble, *whether consciously or intuitively,* of using the golden section. But I am not prepared to accept the golden section as the sole factor creating a sense of balanced formal proportions. As Roy Howat states, "Proportional structure is only one of many ways of ensuring good formal balance, and even then only if it is well matched to the musical content; it could do little to help music that is deficient in its basic material or other formal processes."[75]

Are proportions established consciously or intuitively? This is another fascinating question, albeit a fundamentally irrelevant one. If a composer did in fact work intuitively, then the existence of golden proportions in his or her music confirms their perceptibility, at least to the sensitive ear of their creator. If, on the other hand, a composer consciously calculated a work's proportions, it is safe to assume that the results appealed to his or her sense of balance and were, therefore, perceived. In either case the results are what count, not the intentionality. We should not commit what William K. Wimsatt and Monroe C. Beardsley call the "intentional fallacy":[76] What matters is the way the music is proportioned, not the way it came to be so proportioned. Do we ask whether Beethoven consciously intended the third movement of the Ninth Symphony to be a set of variations?

Still, there is a strong mania to know whether the proportions were consciously planned, and whether the composer realized how they operate (two distinct questions). Howat's studies of Debussy and Bartók, Perry-Camp's of Mozart, Lendvai's of Bartók, and Kirk's of Chopin all spend many pages sifting through evidence, both external and internal to the music, in search of clues pointing to the composers' conscious knowledge of the golden section in their music. The detective work is interesting, but the results are as inconclusive as they are unimportant. Those particular composers, at least, covered their tracks well.

A more fundamental question is: What is so special about the golden section? It is surely true that the majority of analysts studying musical proportions have found golden sections, but they may have been enticed by the mysticism of the golden mean into searching for 1.62 ratios. What about other ratios? Furthermore, is it the ratio itself, or the consistency of its application, that appeals to composers, analysts, and (presumably) listeners? Not every work by the composers studied in this chapter uses the golden mean. Some pieces that do use it do so extensively, others superficially. Some composers seem to have used it but little. When I began to wonder about the source of the balanced proportions in Stravinsky's works, I started, by habit, to look for Fibonacci durations and 1.62 ratios. Assuming what you want to prove does not always work:[77] I found few golden sections in Stravinsky. But I gathered sufficient evidence to be convinced, in some of his music, of the use of a single ratio, not necessarily even close to 1.62, to determine formal proportions on several hierarchic levels. I am certainly unwilling to suggest that Stravinsky's sense of proportion was inferior to that of Bartók or Debussy, who used 1.62 ratios extensively, but only that it was different. His works *feel* different because they are proportioned by different means and use different ratios.

I ask again, what is special about the golden section? The properties of the Fibonacci series listed in Section 10.9 point to the appeal which the golden section has had for recent composers. The tendency of the climax in a narrative or dramatic curve to partition the whole according to the golden section is another clue to the ratio's pervasiveness: Golden-mean proportions are endemic to the entire tradition of Western temporal art. Furthermore, as Kirk has demonstrated and Howat remarked,[78] the golden section is the only ratio which can be nested repeatedly: if x, the larger segment of $x+y$, and y, the smaller segment of $x+y$, are in the golden ratio, then the golden section divides x into two parts, the larger of which is y. Thus the same proportional ratio can be used to segment timespans on all levels.

There is something else special and fascinating about the golden section. Benjafield and Adams-Webber (see note 10.19) have shown that people making bipolar value judgments of other people (for example, pleasant vs. unpleasant, strong vs. weak, fair vs. unfair) tend to use favorable adjectives 62% of the time and negative adjectives 38% of the time. The proposed explanation is interesting:

> Berlyne (1971, p. 232) suggests that the popularity of the golden section may be due to the fact that "it allows the minor element to occupy a proportion of the whole that makes it maximally striking." This idea derives from the work of Frank (1959, 1964), who showed that when subjects are asked to arrange colors so as to make one color stand out against the others, that color is used between 0.37 and 0.38 of the time. In other words, in order to make a figure maximally striking, the proportion of figure to background is very close to the golden section. As Berlyne and Frank have pointed out, there are good information-theoretic reasons why this should be so. . . . The contribution a particular category of events makes to average information is a maximum when the relative frequency of that category is equal to approximately 0.37.
>
> The implication of our . . . findings would then be that subjects tend to organize their interpersonal judgements along bipolar dimensions so as to make negative events maximally striking. The person tends to construe others in such a way that negative events, *taken as a whole,* "stand out" as "figure" against a positive "background." . . . Thus an information-processing strategy which, at an abstract level, made negative events maximally striking, would make considerable adaptive sense. By arranging his judgements in the golden section ratio, the person is able to pay special attention to negative events *considered as a whole.*[79] [emphasis added]

In another study, Benjafield and T. P. G. Green demonstrate that people tend to classify 62% of their acquaintances as typical and 38% as atypical. Benjafield and Green offer a model, based on the Fibonacci series, for the psychological process by which we make such judgements.[80] While these psychologists were studying people's reactions to other people, it is probably not farfetched to suggest that other bipolar judgements are also proportioned according to the golden section. Benjafield and Christine Davis, for example, found, in an elaborate study of the 585 characters that appear in the 125 fairy tales of Grimm, that 62% of the characters have positive qualities.[81]

I would not suggest that there are direct analogues in music of positive and negative feelings or qualities (although, interestingly, Lendvai uses these adjectives to differentiate long-short from short-long golden-mean partitions).[82] But there certainly are opposites in music: tonic vs. nontonic keys; upbeat vs. afterbeat from a climax (whether local or global); different kinds of sections in moment time, and so on. Benjafield and Adams-Webber's reference to the figure-ground idea is suggestive. In music, certain kinds of events stand out from others: high notes, low notes, loud notes, sudden silences, drastic change of harmonic rhythm, other surprises, and so forth.[83] It would be interesting (though difficult, since figure and ground are extremes of a continuum, not discrete categories) to study the ratio of prominent events (figures) to normative events (grounds) cumulatively throughout entire pieces. Would this ratio approximate the golden section?

If people have the ability—perhaps even the need—to organize at least some of their bipolar opposites so that the ratio of one category to the other is 1.62, then it stands to reason that composers and listeners may be aesthetically satisfied by temporal proportions that accumulate (see added emphasis in the quotation above) opposites across a whole piece or section in the same 1.62 ratio. I realize that I have made a large leap from Benjafield's controlled study of people's attitudes to my own speculations on music, but the implications of his ideas for the universal appeal of the golden section are strong, far more so than the visual analogies usually found in the literature on the psychology of golden proportions.

Not all music uses the golden ratio, and a considerable number of pieces, even those that strike us intuitively as well balanced, seem to have no consistent proportional schemes at all. What does such music tell us? That proportions are, after all, irrelevant? Surely not, for all music (except some vertical compositions; see Chapter 12) has proportions of some sort, whether representable by simple and consistent ratios or not. We do react to proportions that seem just right, and to proportions that seem wrong. As a composition teacher, I often find myself criticizing a passage in a student's work as too long or too short for its materials and/or context. Perhaps the reason is that the questionable passage violates the proportions or pacings the piece has established, or perhaps there are other reasons, but the problem is usually unmistakable. My confidence in making such criticisms convinces me of the importance and perceptibility of proportions, although it tells me nothing about how "good" a particular proportional matrix or ratio may be in itself. It is the *context*, not the abstract ratios, that make proportions succeed or fail.[84]

We must conclude that there are many viable ways to proportion music but only some are represented by such simple and consistent arithmetic as that discussed in Sections 10.1–10.6. There have not yet been sufficient studies of musical proportion to suggest otherwise.[85] Until there is evidence that all balanced music exhibits systematic proportions, I will maintain my skepticism of universals and assume that simple and consistent proportional ratios are a possibility but not a necessity, nor even an *a priori* goal, of all music.

For example, consider the second half of the *Symphonies of Wind Instruments*. Are we to conclude that it is structurally less successful than the first half simply because of the apparent absence of consistent proportions? Surely this is absurd. But what is the point of consistently worked out proportions, if they are merely an option? Why should a composer "bother" with proportions if a satisfying piece can be created without systematic ratios? That is like asking, why "bother" with a row when successful music can be written without one? Or, why "bother" with a tonal center? Again, the answer is that music proportioned differently works differently, but no proportional system (or lack thereof) is inherently better than another. The first half of *Symphonies* is more frozen, more obviously a mosaic. Thus its use of a single ratio consistently creates a sense of static, almost spatial, balance. The second half moves more overtly. It starts with the juxtaposition of very short moments, so short that we can scarcely comprehend them as static; it contains a convincing climax; it ends with a tonal chorale that moves toward a final cadence. Thus proportions understood statically, via cumulative listening, are not the only contributors to formal balance in the second half. Its changing rates, types, and degrees of motion bring in other factors, more challenging to measure but no more difficult to hear. Similarly, as the Sonata for Two Pianos becomes more kinetic in its third movement, it abandons its severely economical proportional scheme in favor of a greater repertory of ratios.

We do *like* simple proportions and consistent ratios. As analysts, we rejoice when we find them and despair that we have not discovered the key to the music if we do not find them. David Epstein has argued forcefully that we prefer simple tempo ratios.[86] Scientists seem pleased when they discover laws expressible by simple equations. So why should music theorists, and perhaps even listeners, not be pleased with simple proportions? But we should not conclude that all music *must* have simple or consistent proportions, any more than that all music must be tonal, or metrically regular, or equal tempered.

We should not believe that the simple ratios we do find in many compositions are the only factors creating their formal balance. The understanding of proportions, let us remember, is nonlinear, a right-brain phenomenon, while most music has linear factors as well. Linearity is both subject to and creative of pacing, changing rates of motion, changing amounts of information and redundancy, tensions and releases, and so forth, all factors critical to the temporal structure of most pieces. Thus not only amounts of time but also changing rates of time contribute to temporal form. To understand the latter quantitatively, however, would require some sort of calculus of musical time, the nature of which I can only dimly imagine.

The relevance of proportions to musical time depends on the degrees to which time is perceived and on the ways in which time is perceived.[87] The proportional analyses reported and offered in this chapter hinge on a basic assumption about perception; namely, that with reasonable accuracy we can hear, process, store, and recall durations. Is this really true? And if it is, what are the mechanisms of our cognition? Or, from the creator's viewpoint, by what means does the composer know or decide how long a passage should be? Neither music theory nor music psychology has offered many answers to these intriguing questions, but the questions must be considered if we are going to claim any perceptual relevance for systematic musical proportions.

Chapter 11

The Perception of Musical Time

11.1 LIMITATIONS OF THE PSYCHOLOGY OF MUSIC

Many of the ideas presented thus far in this book (such as the taxonomy of musical time offered in Chapter 2) are conceptual models or descriptions of complex mental processes, whether manifest in compositions or in listening. These constructions have been based on what I have called a critic's best tool: intuition. My intuitions rely on my perceptions and understandings of music, which are informed by my experiences as listener and as composer and by my knowledge of what other listeners, composers, and performers have said. Although I offer my ideas as suggestions for understanding and experiencing music, they are ultimately nothing more than one person's description of how (he believes) his ear and mind work. Yet to come up with a model for musical cognition that is objective and specific enough to be proved or disproved—to be tested, in other words—is a formidable challenge. Psychology has studied the musical experience experimentally, but only with vast simplifications. The typical way most psychologists approach music suggests a disjointed view of musical structure and experience. It is difficult to conceive of music as a holistic experience while studying how we remember melodic contours or how we differentiate timbres.

The unity of the total experience, as appreciated by our right cerebral hemispheres, seems to be beyond the purview of left-brain psychological studies. In real music (as opposed to the "music-like" stimuli that psychologists present to their subjects) there are no isolated events, no independent parameters, no single processes. We must not, therefore, fool ourselves into thinking that what experimental psychologists study forms the essential musical experience. The parameters of compositions or mechanisms of perception they study are not *literally* combined into the complex activity of music listening. An appropriately human analysis must consider the isolated parts (of music and of people) as metaphorical, not literal, contributors to the ongoing unity of the musical experience. This is because whole people listen to entire compositions. Neither an aspect of behavior isolated for study nor a parameter of music analyzed by itself ceases to participate in a complex artistic totality.[1]

Another impediment to the development of a holistic or "ecological" (a term cognitive psychologists use in reference to the study of stimuli as encountered in their normal contexts) approach to music cognition, according to psychologist John A. Sloboda, has been

> the view that one must understand the most peripheral and simple aspects of intellectual functioning as a prelude to the study of more central and complex aspects. Although this view is now accepted to be largely misconceived, a vast amount of so-called "music" research has concentrated on the processes involved in the perception of single tones. Topics such as the representation of large-scale musical structure, performance, and composition, have received comparatively little attention. Yet these are the topics which are of most direct relevance to musicians.
>
> A . . . related reason [why the psychology of music has failed to tackle questions of central musical importance] is that psychologists have, rightly, wished to conduct their research with rigorous control and measurement. It is much easier to construct brief auditory stimuli to exact specifications whilst constraining subjects to simple yes/no responses, than it is to allow subjects the freedom to indulge in some complex but musically interesting behavior in response to complex musically structured conditions. Yet the latter *can* be done with rigor, and is beginning to be done with increasing frequency.[2]

Problems similar to those Sloboda cites as hampering the development of a broadly-based psychology of music have also plagued the psychological study of time. John A. Michon and Janet L. Jackson explain:

> Little attention has been paid to the fact that time is more than just a dimension in which to express reaction times or the persistence of certain events. . . . It is somewhat surprising to find that in most psychological research time is still being treated as if it were applied to a physical system. Subjects are not supposed to have temporal awareness.[3]

The sentiments of Michon and Jackson are echoed by time scholar J. T. Fraser:

> The growing emphasis on quantitative methods that characterizes experimental psychology demands increasing precision in the analysis and interpretation of perceptual processes and tends to direct attention away from epistemological and ontological questions related to perception. For the study of time this trend has a distinct disadvantage and has led to a curious situation. Whereas, on the one hand, we find repeated emphasis on the fact that time perception has no obvious sense organ through which time may enter as light enters the eyes, on the other hand there is an ever increasing body of experimental work on an assumed perception of time. Consequently, much of the psychology of time has been directed to fragmentary issues which do not fit together as would pieces of a jigsaw puzzle, nor do we have any assurance that they are parts of the same single and coherent picture.[4]

Stated succinctly the problem is, to quote psychologist Mari Riess Jones, that "psychology *measures* while people and other living things *experience*, and measurement [alone] cannot reflect experience."[5]

Even if we accept, with appropriate misgivings, psychologists' traditionally fragmented view of music and time, we still encounter difficulties in attempting to apply their experimental results to the perception of musical time. One problem is the simplistic understanding of music that many psychologists harbor. As composer Robert Erickson has complained, in his article in Diana Deutsch's *The Psychology of Music,* "I have found over and over that the implied definition of music within which the writer [psychologist] has conducted his or her discussion has been so primitive, so narrow, that it could only have been formed in childhood, probably during a period of study of some instrument, commonly the piano."[6]

Consider, for example, the question of accent. That there exists more than one kind of accent in music has been recognized by music theorists for a number of years. Since the appearance in 1983 of Lerdahl and Jackendoff's *A Generative Theory of Tonal Music,* it has been generally accepted that there are three distinct types of accent (see Section 4.2). Yet numerous psychologists blithely continue to test for accent perception or for the use of accent as a cue to the encoding of "music-like tone sequences," apparently unaware of the very different musical and perceptual phenomena subsumed by the single word "accent."[7]

Also common is the failure to differentiate between rhythmic grouping and meter. To take one of many possible examples, Andrea R. Halpern and Christopher J. Darwin begin a report on some experimental studies of duration discrimination with a simplistic notion of "rhythm," by which they seem to mean meter. Perhaps their oversimplification is necessary for laboratory purposes, but I am concerned about psychologists who may really believe that musical rhythm can be adequately described in this manner:

> One of the easier components of Western music to describe and conceptualize is its system of rhythm. The division of a unit beat into two or three equal parts and the same divisions of the subunits create most of the building blocks of our rhythmic system.[8]

Are we really supposed to accept that that is all there is to Western musical rhythm?

I make these observations not to condemn psychology, but to sound a cautionary note as I turn to that science in search of answers to important questions about the perception of musical time. I fully realize, however, that music theory and analysis have their own methodological shortcomings and blind spots, not the least of which is their failure to differentiate between structures as they appear in a score, as they are performed, as they are perceived, and as they are remembered. True understanding of the perception of musical time cannot come from psychology or theory alone. Perhaps it can come from a marriage of these two imperfect disciplines.

11.2 ARE PROPORTIONS PERCEIVED?

I look to psychology in search of answers to several nagging questions, that may well have become troubling to anyone reading the preceding chapters. If time is primarily a relationship between people and experiences (as claimed in Section 1.2) rather than an objective reality, then what significance can Chapter 10's objective measurements of durational spans possibly have? How can we reconcile analysis based on measurement of absolute time with experienced musical time that is influenced by the continually changing contexts of most compositions? How can we reconcile the idea of meter as a clock (Sections 4.7 and 11.8) with the idea that perceived duration depends on information content (Section 11.6)? For example, are two eight-bar phrases, in the same tempo and (hyper)meter but containing very different kinds of music, perceived as having equal durations (because of their metric equivalence) or unequal durations (because of their contrasting amounts of information)? What about two contrasting movements of, say, three hundred measures each?

I stated (in Section 2.7 as well as Chapter 10) that proportions are understood nonlinearly by means of cumulative listening. *Do* listeners really perceive, understand, and remember proportions? Is it really possible to listen in a nonlinear fashion? Is there really such a mechanism as cumulative listening, or is the concept a metaphor? If cumulative listening exists, how does it operate?

And *when* does it operate? As we listen to a composition, we hear sections only in their order of performance. We experience their durations one at a time. In fact, we know the total length of a passage only once it ends, although in linear music we usually have clear expectations of how long the section will last prior to its final cadence. When the context suggests that we compare section lengths (as, for example, when we hear a condensed version of an earlier passage), we begin to do so immediately. Thus we compare a remembered duration with one that is being experienced, even if we do not yet definitely know when the current section will end.

Two cognitive processes must therefore be differentiated: (1) the experience of duration in passing, which is concerned with the apparent length of time from a past timepoint to a present one; and (2) the experience of duration in retrospect (memory, in other words), which refers to the remembered interval between two past timepoints.[9] These two processes take place on several hierarchic levels. As we listen, we come to understand the equality vs. inequality of hypermeasure durations, phrase lengths, section durations, movement lengths, and so forth.

Are the proportions that we understand and feel in retrospect (the second process of duration perception) the *same* ones we may have intuited, albeit tentatively, while listening (the first process of duration perception)? Furthermore, if proportions *are* available to our perceptual apparatus, are they perceived as they are, or are they changed in the process of entering our memories? How do we compare in memory different durations, heard at different times and in different contexts? Moreover, how accurate is our sense of duration in passing? And how accurate is our memory for duration? How do the degrees of accuracy of our perception and memory relate to the degrees of variability in the proportions themselves?

Even while we compare remembered and experienced durations, we are continually acquiring new information. More structural durations are stored in our memories as new passages are experienced, and proportions understood early in a piece become available for comparison with later ones. Thus we may gradually build up an understanding of the consistent proportions (if any) operating in the piece we are hearing. We may understand the durations of later timespans as related (or unrelated) to the proportions established earlier in the work. Although earlier lengths may not *determine* later lengths in the same way that earlier materials or tonal relations *generate* later ones, the simple fact that the music is heard in sequential order may cause us to compare later durations to earlier ones. In other words, although there may be no clear *implications* about proportions early in the piece, we may still form *expectations* about durational spans based on the way the piece initially unfolds. Our listening strategy, then, may well be linear even if the music is nonlinear.

Proportions themselves are not linear, however. They do not constitute a processive phenomenon. Although, as Howat and Lendvai claim, it can matter whether the longer or shorter segment of a particular partitioning comes first, the proportional schemes presented in Chapter 10 are timeless systems which operate on entire pieces. A later duration does not develop from an earlier one. Instead, all durations are generated by the proportional system. Since we necessarily come to understand this system gradually, we may form expectations about it in a linear manner. These expectations then may be satisfied, thwarted, or altered, despite the nonlinearity of the system itself. Although the order in which we hear the sections of most music certainly matters, the proportional systems would make sense even if the order of presentation were scrambled. If the durations of sections X and Y are in a particular ratio r, then r is the same whether X precedes or follows Y and whether X and Y are adjacent or separated.

The materials that fill the abstract lengths of X and Y certainly influence subjective impressions of duration, so that information content is as relevant to the perception of musical time as are abstract proportions. Measurable proportions and unmeasurable information (see Section 2.2) are fundamentally different aspects of perceived duration.

The farther along we are in listening to a composition, the more durational information we have acquired (we have experienced and remembered a greater number of structurally significant lengths) and therefore the more nearly complete is our knowledge of and feeling for the work's proportional system (or lack thereof). By the final cadence, all timespans have been presented, and we are theoretically in a position to understand the entire system. (Whether we actually *do* understand it is a separate matter.) We know which of our linear expectations have been satisfied, and we know how we have had to revise those that were frustrated. By the end our linear mechanisms for dealing with proportions *as they unfold* no longer matter. We are left with, as part of the lingering aura of the performance, a feeling for the nonlinear proportional system that we have gradually come to know.

11.3 THE PSYCHOLOGY OF TIME PERCEPTION

To attempt answers to the questions posed in the previous section necessarily leads us into the realm of psychology, where we encounter still more challenging questions. In what ways, for example, *do* we perceive, encode, remember, and retrieve information about duration and proportion? And, is music somehow special, or is information about timespans in music processed in the same manner as all durational information?

Psychologists have shown that subjective time does not generally equal clock time. In the process of experiencing and then remembering lengths of time, we alter them. It is misleading, however, to think of subjective time alterations as distortions. Subjective duration is *more* relevant to the understanding of music than is duration measured by a clock. Furthermore, the issue of duration in memory is complicated by the potential difference between the apparent duration of a timespan that is in memory and the memory of the duration the timespan seemed to have when originally heard. In other words, our experience of duration in retrospect may not agree with our experience of duration in passing.[10] Furthermore, neither of these subjective lengths necessarily corresponds to that of the clock.

Experimental psychology places considerable importance on clock time. Yet, as this book has tried to make clear, there are many kinds of time, of which clock time is but one. Psychologists raise clock time to a false supremacy when they make it the absolute measure to which temporal experiences are compared or, worse yet, the basis by which they are judged. When psychologists compute the "accuracy" of a subject's time estimates, they are tacitly allowing the clock to measure subjective durations which may have little to do with absolute time.

Yet many of the proportional analyses in Chapter 10, particularly my own of Stravinsky's music, rely on clock time. One purpose of the current chapter is to investigate psychological mechanisms that may explain the *perceptual* relevance of objectively measured musical durations. I have tried to justify some of my clock-time analyses on the basis of musical stasis: In the absence of large-scale changes in any parameter, there is little to make subjective time seem faster or slower than clock time. Even with proportional analyses of nonstatic music, though, there is an important distinction to bear in mind. Proportions are *ratios of durations.* Perceived lengths may differ considerably from clock-time lengths, but if—a big "if"—they differ to a consistent percentage, then the perceived ratios may still correspond approximately to the measured ratios. But do subjective proportions differ *consistently* from objective ratios? And, above all, can psychology explain the relationship between numerically balanced proportions in printed music and the satisfaction of hearing a balanced performance?

It may not be fair to expect psychology to answer these challenging questions, most of which lie well beyond the scope of traditional music analysis. Psychology has its own limits and methods, which do not usually include asking or answering speculative questions. But psychologists are becoming less cautious and less narrow, especially now that *cognitive* psychology has established itself as a viable subdiscipline. Cognitive psychologists and music theorists are beginning to study the same subject matter, albeit with very different methodologies.

The most promising area of contact between music theory and psychology lies not with the analyzed musical structures that psychologists may test for perceptibility. More useful is the potential correspondence between the syntactic structures of music, which are organized to communicate musical meanings, and the cognitive structures in the listening mind, which extract and understand those meanings. Until recently, relationships between properties of musical structure and properties of mental representation remained largely unexplored,[11] because music psychologists suffered from inadequate understanding or even knowledge of musical processes. There is now emerging a new breed of psychologists, whose musical knowledge is sophisticated enough for the challenging tasks at hand.[12] Music theorists have similarly suffered from incomplete understanding of the workings of the perceiving mind, although finally some theorists are admitting the fundamental importance of such knowledge.

Despite their *rapprochement,* psychology and theory remain distinct. A crucial difference is that music analysts postulate an ideal listener, who hears all levels and numerous complex relationships simultaneously, while psychologists are interested in the capacities of real listeners. As Thomas Stoffer has written, a music analysis "may describe *potential* representational units, but it cannot give any hints as to those units actually being processed by a listener at a certain time."[13] Most theorists find it uninteresting to attempt verification of the extent to which people hear the structures uncovered by analysis. Potentially far more useful than laboratory verification is to understand the cognitive processes that allow practiced listeners to perceive, encode, and remember some of those structures. Such a study should be of interest to music theorists and cognitive psychologists alike, for, as Jonathan Dunsby has written, "just how perception underlies analysis is never so clearly spelled out as are theories of perception and theories of analysis."[14]

11.4 THE ANALYSIS OF MUSIC VS. THE ANALYSIS OF HEARING

I am not a psychologist and I am not therefore attempting to offer verifiable hypotheses (although it is possible that some of my ideas may lend themselves to experimental proof or refutation). If this book is taken as a theory of perception or cognition, then its subjective methods become little more than a starting point, a set of speculations. But if the book is instead taken as offered, as criticism—as suggesting some of the meanings of music and some ways listeners can confront these meanings—then the need to "prove" my assertions objectively becomes less imperative.

Nonetheless, cognitive psychology can help with the fundamental question of music analysis: "How is it heard?" Answers have varied not only from one body of music to another but also from one analyst to another. A perceptive analyst's insights can be interesting and useful to other listeners. Yet such an analyst is hardly the average listener with whom psychologists usually concern themselves. Thus the analyst's verification "experiments" use but one subject: him or herself. But his or her purpose is to study music as potentially perceived, not to study the perceiver as processor of musical information. The analyst is concerned with the partially or imperfectly heard, with relationships between musical elements as well as the elements themselves, and with musical contexts. He or she realizes that some things which cannot literally be "heard"—that is, cannot be accurately identified, named, or notated—may still have discernible musical reasons for being in a piece. A psychologist may dismiss as irrelevant structures that a listener cannot specifically identify: structures such as the rhythmic complexities in a typical score of Brian Ferneyhough; the multi-parameter serialization in a Luigi Nono piece from the 1950s; or the proportional ratios in a Stravinsky composition. But it does not follow that there is no reason for such pieces to be structured the way they are.

Since the late 1970s, some music psychologists have come to appreciate the complexities of real music (as opposed to fragments manufactured specifically for experiments) and to understand the importance of musical contexts. Perhaps it is no coincidence that, as these psychologists have become more interested in questions of *music* perception (as opposed to contour, timbre, accent, or pitch perception), some music analysts have become less concerned with music as it is heard and more intrigued by its abstract structures. I am not thinking about prescriptive analyses, such as those that appear in the Darmstadt journal of the 1960s, *Die Reihe*. Those analyses explain neither how music is heard nor how it is structured but rather how it was made. I am thinking instead about, for example, set-theoretic analyses of atonal music. It seems relatively rare that set theorists wonder whether the relationships they uncover *are* heard, even less whether they *can be* heard. If the relationships are demonstrably present in the score, the analysts rest their cases. Disagreements I have witnessed between such analysts over differing readings of a piece do not often appeal to the ear for support. Yet, whether or not a transposed complement relationship, for example, can be heard, particularly considering that one set may be presented melodically across several different instrumental colors while another may be presented chordally, *is* a big question.

There is a continuum between the directly audible and the wholly inaudible. Thus it represents an oversimplification even to try to know whether relationships and elements can or cannot be heard. It has been demonstrated that most listeners, including many highly trained musicians, cannot aurally extract the twelve-tone row in many serial passages. Yet it would be a mistake to conclude that the row and its manipulations are irrelevant. The row itself may not be heard, but its effects are. For example, rows used combinatorially to produce levels of transposition analogous to tonal areas, as in many of Schoenberg's later works, do contribute substantially and audibly to the structure and experience of such music. How can I say this? Not because of any experiments in perception I have read about or even imagined, but because I am convinced that this is how I, plus several other analysts I respect, hear the music. Or at least that is how I *think* we hear the music. Similarly, we do not directly or literally hear the *Urlinie* in a long, complex tonal work, yet its existence does have much to do with the way the work unfolds on the foreground. Stephen Walsh compares the *Urlinie* to the skeleton of the human body:[15] We do not directly see a man's bones, but we know he would move and behave rather differently if he had no bones or if they were shaped in another way.

The same kind of argument can be used to defend proportional analysis. Although the proportional systems outlined in Chapter 10 may not be heard directly, they may well be perceived subconsciously, just as atonal sets, twelve-tone rows, and tonal *Urlinien* are. The music is the way it is in part because of its proportions.

I cannot imagine perception experiments aimed at testing whether or not such proportional systems can be heard. Even if some tests were devised that were ecological, I would still be suspicious of their results, because the science of psychology asks questions that beg for unequivocal answers. Is there a way psychology could test the idea that, although proportions are perceived (in some way, to some extent, and at some times) subconsciously and imperfectly, they *do* matter to music comprehension?

Traditional psychology does not work comfortably with the subconsciously, partially, or indirectly heard. Most experimental stimuli are presented away from actual musical contexts. If a subject cannot recognize, for example, the differences between two "music-like melodic sequences," then it is assumed that he or she has not heard that they are different. Yet a musical context can provide cues as to what the differences between two melodies are and why these differences deserve our attention. Furthermore, a context may cause a listener to "rehearse" (the psychological term for going over a stimulus several times mentally, so that it is better remembered) a melody by presenting variations on it, repetitions of it, or developments from it (see Section 8.7 on the lack of rehearsal in moment time). In the process of rehearsing, the listener may come to realize, whether consciously or subconsciously, that two similar tunes do differ. Thus in some circumstances a listener's abilities may be greater in a musical context than in the artificial setting of the laboratory. Conversely, an experimental environment may enable a listener to focus his or her attention on a particular variable with a clarity that would be impossible in the concert hall.[16]

I do not mean to imply that time psychologists' insights and discoveries are not useful, nor that musicians have nothing to learn from them. Quite the contrary. This chapter cites several interesting and relevant studies. But music theory must be cautious about adopting these findings uncritically. As I read countless reports of psychological experiments in preparing to write this chapter, I became increasingly uneasy about the application of psychological models to music perception. Relatively few of these articles are ecological studies of the perception of *real* music. Not only do many studies rely on clock time as somehow fundamental (surely an untenable position for music listening) but also most of them study artificially simple laboratory situations. While it may be necessary to limit variables in order to obtain quantifiable results, the removal of context and complexity limits the relevance of these experiments to the perception of real music. A similar accusation may be leveled at a music analyst's postulating an ideal listener, ignoring the effects of repeated hearings, and discounting a real listener's moods, preferences, or abilities. Yet we accept what analysis does in its attempt to arrive at an informed reading of a composition.

With these caveats in mind, we should likewise (cautiously) welcome psychological studies of the artificially separated components of listening and time perception, in the hope that an integrated picture will eventually emerge.

11.5 THE SUBJECTIVITY OF MUSICAL TIME

Music theory usually ignores the considerable variance in the ways different people perceive both music and temporal relationships. The subjectivity of time *is*, however, a central concern of cognitive psychology. We must confront that concern here, if we hope to answer the question of whether and how large-scale proportions are perceived. I start by reviewing several psychological demonstrations of that subjectivity, which, taken together, may at first seem to hold little hope for the importance to perception of objective temporal measurements, such as those in Chapter 10. Eventually, however, I hope to suggest that there are mechanisms which lend some perceptual relevance to such quantitative analyses.

The human sense of time succumbs readily to outside (and inside) influences. We all know, for example, that enjoyable experiences seem short, while boredom can seem endless. Empirical support for this phenomenon is offered by psychologist Lorraine Allan, who shows that, at least for short durations, filled intervals tend to be perceived as longer than empty intervals of the same clock-time duration.[17] Wayne Hogan demonstrates that not only empty but also maximally filled time intervals are perceived as longer than moderately filled intervals of the same clock duration.[18]

If there are so many stimuli impinging on our senses at once that we cannot sort them out, then it may seem as if virtually nothing is happening. Maximally filled time can equal empty time (see, however, the quotation from James J. Gibson in Section 11.8 about problems with the concepts of filled and empty time). The effect of musical stasis, for example, can be achieved not only by sustained tones but also by constant, dense activity, as numerous thickly textured compositions by such composers as Xenakis and Ligeti demonstrate. (I am not suggesting that texturally dense music has to be boring, although people who have not developed appropriate listening strategies sometimes find it so.) Robert P. Morgan observes that some of Ives' textures are so dense that

> one is forced to reduce everything to one level again: the passages are so complex in regard to their internal relationships that the ear perceives them as totality—a single sound event bordering on chaos. They *must* be heard simultaneously—spatially—since the ear is unable to differentiate sequential connections among the individual components.[19]

When *many* events are perceived as *one* texture, the information content of the passage as a whole is not great, despite the manner in which musical space is crammed full of sounds.

The "distortion" of absolute time by minimally or maximally filled intervals is far from the only circumstance in which experienced duration differs from measured duration. Psychologist R. D. Meade has demonstrated that perceived duration seems longer relative to absolute duration as we approach completion of a goal-directed task, whereas there is no distortion of measured time when goal direction is absent.[20] As explained in Sections 2.10 and 8.3, moments are often characterized by stasis, so that we cannot predict on the basis of internal processes when or whether a moment will reach a final goal. Linear music, however, provides important cues about the lengths of sections. As explained in Section 2.4, linear listening involves forming expectations about where the music is heading and when it will arrive there. Linear progressions (harmonic, rhythmic, voice-leading) move the music toward goals (cadences) at more or less predictable rates. Our predictions may turn out wrong, since most music is not wholly predictable, but linear music nonetheless does have implications. If Meade's findings apply to music listening (the tasks he presented his subjects were not musical, but I see no reason why his results cannot be generalized), then we sense duration expanding as we approach a goal, such as a cadence or structural downbeat. This instance of time lengthening is just one of many factors supporting my contention that linear progressions make musical time different from absolute time. Because of increases in apparent duration as goals are approached, the absolute durations in tonal music may not be directly perceived. I am not arguing against the existence of tonal proportions in the printed score; rather, I am questioning the extent to which (and by what mechanisms) they are comprehended. In moment time, on the other hand, there is no goal direction, and thus the lengthening effect Meade studied should not arise. Thus his work gives indirect experimental support for my belief that perceived proportions are close to clock-time proportions in moment time.

Another time-lengthening effect, the "watched-pot" phenomenon, has been studied by Richard A. Block. Actually using the old adage "a watched pot never boils" as the impetus for his experiments, Block tested the subjective time experiences of observers watching a pot of water as it was heated slowly to the boiling point. One group of subjects, told that they would subsequently be asked for a time estimate, attended carefully to the passage of time. They felt that the time interval was long. A second group, instructed that the experiment involved visual perception, attended to time less carefully and therefore estimated the duration to be shorter.[21] One of Block's conclusions is that attention to time has a strong influence on perceived length. This finding is surely relevant to music listening. There are many variables that may affect a listener's attention to musical duration: attitudes or moods; the nature of the social situation in which he or she is listening; the physical environment; and cues in the music. Only the latter can be taken into account in an analysis of a composition's proportions, yet all of these factors may affect perceived durations.

Researchers studying the perception of duration must also consider the "time-order error." This term refers to the tendency to perceive the first of two durational spans as either longer or shorter than the second simply because it was experienced first. The time-order effect can, in various conditions, work to elongate or compress subjective duration.[22] (Time-order error is discussed further in Section 11.7.)

The findings mentioned thus far in this section concern factors that cause equal durations to seem unequal. What conditions, on the other hand, can cause two durations that differ in clock time to be perceived as equal? According to Françoise Macar, researchers have found that two time intervals, both more than 4 but less than 30 seconds long, can be distinguished only if their lengths differ by more than 16%.[23] A. B. Kristofferson places the figure at 8%.[24] The factors which account for the discrepancy include the nature of the stimulus, the experimental procedures, the context, and psychological variables.

Psychologist Hannes Eisler reviewed more than a hundred experiments, conducted on four continents over more than a century, and concluded that there *is* a specific relationship between subjective duration and clock time. Eisler hypothesizes that subjective length is proportional to[25] physical length raised to an exponent of about 0.9.[26] This means, for example, that a 10-second interval should seem slightly less than twice as long as a 5-second interval. However, Eisler's hypothesis appears to conflict with experimental findings (including some by Eisler himself) that people can readily double or halve durations[27] (an idea surely relevant to some of the proportional analyses of Chapter 10, in which doubled durations are shown to be structurally significant.) Does this inconsistency point to a special perceptual status of 2:1 proportions, or to experimental problems, or to a too vaguely formulated hypothesis?

There are instances of time alteration more extreme than those I have so far mentioned. The considerable effects of various drugs on perceived duration, for example, are well documented.[28] Furthermore, enormous time compression and lengthening have been found in studies of sensory deprivation and overload respectively (see Section 12.2 for a specific instance of sensory overload). People suffering from mental illnesses may experience severe time distortions. Psychiatrist Frederick Melges relates a case of a manic woman asked to produce a 30-second interval actually producing one of nine seconds.[29] Anthropologist Edward T. Hall mentions the influence of different emotional and mental states on perceived duration.[30] He also explains the surprising manner in which the brain compensates temporally for a change in physical environment size:

> Under proper conditions, subjects will increase interaction rates in an environment to stay in agreement with the scale of the environment. An environment reduced to 1/6 of normal size can actually program the central nervous system in such a way that subjects who project themselves into that environment will hold their own internal time perception constant. This adjustment process results in a compensating speedup in the processing of information by a factor of six. What is experienced as one hour's work in the model is actually only ten minutes by the clock.[31]

Underlying all these studies of the subjectivity of time perception is the fundamental question of *how* durations are perceived, remembered, and recalled. If we understand the mental mechanisms of time perception, then we can hope to comprehend in part what accounts for various discrepancies between subjective time and absolute time. Cognitive psychologists have proposed several answers, some of which are directly relevant to the process of music listening. Let us turn first to one of these ideas—the encoding of temporal information—which, despite some problems, holds great promise as a model for the perception of musical time. The information-processing model of time perception can explain such well-known experiences as a sonata-form exposition seeming shorter when it is literally repeated; a passage with fast harmonic rhythm seeming longer than a passage of equal duration with slow harmonic rhythm; and a piece feeling shorter once we know it well.

11.6 TIME AS INFORMATION

Consider the three melodies in Examples 11.1, 11.2, and 11.3. Example 11.1 is clearly the easiest of the three to remember, because it contains fewer notes, has a smaller repertory of pitch classes, and is patterned. Which of the other two is

Example 11.1. **Easily memorizable melody**

easier to remember? Obviously Example 11.2 requires fewer rehearsals (in both the psychological and the musical senses of the term) and less time to memorize than Example 11.3. (If you are skeptical, try it. How many times must you hear—or play—Example 11.2 before you can reproduce it exactly? How many times for Example 11.3?)

The reason why Example 11.2 is easier to memorize than Example 11.3 (despite their equivalent numbers of beats and notes and the fact that they contain exactly the same notes permuted) is that the former is patterned in an obvious, hierarchic way. It is, in psychological jargon, easily encoded, or "chunked."[32] To remember Example 11.3 we may have to memorize the sequence of 129 notes (or 128 intervals), one at a time—a laborious task. This passage seems able to be understood only as a zeroth-order Markov chain (see Section 2.2). We may recognize some figures as similar to motives in pieces we know, a fact which may aid chunking and thereby reduce the number of "instructions" slightly. Nonetheless, Example 11.3 requires about 100 "places" for "bits of information"

Example 11.2. **Easily memorizable elaborated melody**

Example 11.3. **Melody difficult to memorize**

to be entered into our memories. I am using computer memory as a convenient analogy:[33] we need a hundred "memory locations" to "register" the entire melody. At each location there is a single instruction for the (re)construction of the next part of the melody. For Example 11.3 each memory location will usually contain either the next note or the next interval. But an instruction for (re)constructing Example 11.2 might generate several succeeding notes, because the earlier notes of this passage seem to generate the later ones (according to high-order Markov chains). Therefore Example 11.2 requires considerably fewer memory positions. One way of encoding Example 11.2 would be something like this:[34]

1. Start on G.
2. Go down a semitone.
3. Go up a semitone.
4. Go up a diatonic step.
5. Repeat the unit encoded in instructions 1-4, starting on each of three successively higher notes of a dominant seventh chord built on G.
6. Repeat the sequence encoded in instructions 1-5.
7. Repeat the unit of instructions 1-4 starting on E.
8. Repeat the unit of instructions 1-4 starting on each of two diatonically stepwise lower notes.
9. Start the unit at the original pitch level.
10. Replace the fourth note of the unit with G an octave higher.
11. Repeat the sequence encoded in instructions 7-10.

12. Repeat the sequence encoded in instructions 1–11.
13. End on C.

Notice that some of these encoding mechanisms rely on a listener's knowledge of the conventions and relationships of tonal music, while some do not. It is necessary to know something about harmony in order to carry out instructions involving such notions as "dominant seventh," "stepwise," "semitone," and "diatonic." Naturally, the listener does not have to know these precise terms, but he or she must be able to hear the relationships they generate. Understanding arpeggiated dominant and tonic harmony, plus neighbor and passing notes (the latter on more than one hierarchic level), also helps the memorization process. Such knowledge allows the listener to hear this melodic line, which contains 11 of the 12 chromatic pitch classes, as nonetheless fundamentally diatonic, whereas Example 11.3, which uses the exact same pitches, sounds atonal. Some instructions for memorizing Example 11.2 involve more basic musical ideas, not dependent on prior experience in any particular idiom: down, up, repeat, octave. Also, a reasonably well-developed tonal memory helps the listener perform Instruction 9, although the instruction could be rewritten, "start the unit a fourth lower."

Thirteen instructions are easier to remember than a hundred. Because it does not display any obvious pitch hierarchy, Example 11.3 requires for memorization that we remember individual notes or intervals and that we impose artificial chunking as a mnemonic aid. It is impossible to process a hundred bits of information without chunking them in some manner. In memorizing Example 11.2, on the other hand, we enter not the notes or intervals themselves into memory but rather a combination of notes and instructions (comparable to a computer program's data statements and commands) that will, when "played back" in order, reproduce the original tune. As most music is patterned—chunked—in some manner, the 13-instruction task is more like traditional music listening than the 100-instruction task. We hear and remember not simply a series of individual notes but a melodic line consisting of notes and relationships between them. Some of these relationships become memorization cues. (It should be possible to hear and choose, as demarcators of chunks, somewhat different relationships between the tones of Example 11.2.) This is one reason we hear melodies as ongoing entities rather than as successions of single tones.

Example 11.3 is vaguely like certain kinds of posttonal melodies, not only in its chromaticism but also in its lack of repetition and obvious pattern. If the melody is going to be assimilated, the listener has to work at providing a usable chunking. Cues for the boundaries of chunks are not unequivocal. It is not surprising, therefore, that a greater listening effort must be invested to understand nontonal pitch sequences than to encode tonal melodies. (The lack of pattern also makes Example 11.3 more difficult to sightread than Example 11.2.) This, more than alleged "dissonance," is why many listeners, particularly those who do not know how to recognize the often subtle or even contradictory encoding cues provided by non-pitch parameters, have considerable difficulty understanding and remembering some kinds of modernist music.[35] One reason I can say that music in vertical time (see Section 2.12 and Chapter 12) is a celebration of the now is that, in its refusal to offer clear chunking cues, it seeks to defeat memory and focus attention on the present (see Sections 8.7 and 11.7 for discussions of how moment time similarly thwarts memory).

What exactly does memory have to do with the perception of musical time? Proportions, such as those discussed in Chapter 10, depend on the comparison of *remembered* durations. There are three possible mechanisms for entering durations into memory: (1) we may memorize the subjective duration of a passage as we encode and store the music; or (2) we may remember how much time was required to chunk and store the music; or (3) we may acquire a feeling for the duration directly from an already encoded and remembered segment. In any case, chunking is critical to the subjective sense of length. Thus Example 11.3 should be both experienced and remembered as longer than Example 11.2, because 11.3 is more difficult to chunk, takes more time to encode, and requires many more memory positions.

Example 11.1 seems shorter than Example 11.3 not only because 11.1 is easier to chunk but also because it contains fewer notes. Even if Example 11.1 were somehow not chunked by a listener, the maximum number of positions it would require in memory would be 17, one position for each note. But Example 11.1 can be encoded by considerably fewer than 17 units of information, since it has a high degree of internal redundancy. Because it requires fewer instructions to encode than even Example 11.2, Example 11.1 should be experienced as the shortest of the three melodies.

The amount of memory required is dependent therefore on two factors: the amount of information in the stimulus and the codability of that information.[36] These factors, then, affect the "storage size" in memory and hence the remembered duration. *The more "storage space" a passage requires, the longer its subjective duration.* Thus a two-minute pop tune will probably seem shorter than a two-minute Webern movement. And a florid passage that prolongs one harmony will seem shorter (and be easier to perform) than one with a rapid harmonic rhythm.

I have conducted informal experiments that support this hypothesis. I did not use melodies like those of Examples 11.1, 11.2, and 11.3, because of the added complications of hierarchic meter (discussed in Section 11.8). I played for several groups of students two sequences of evenly spaced (four notes per second) synthesized tones in a middle register. "Sequence C" (C for "chunked") was clearly partitioned, as it consisted of a series of 16 notes repeated continuously. "Sequence R" (R for "random") was non-repeating. Sequence C lasted 62 seconds, while Sequence R lasted 55 seconds. I asked the students to draw lines proportional in length to the relative durations of the two sequences.[37] This method of time representation is more useful than asking for verbal estimates in terms of seconds. The reason is that the second, a specific construct that has nothing to do with the task at hand, may introduce extraneous psychological factors. Sequence R was consistently represented as about 15% *longer* than Sequence C, despite its shorter clock-time duration. If the two sequences were much longer than a minute, however, the repetitiousness of Sequence C might well have induced boredom, making it seem longer than Sequence R.

It is important that we not conclude from this result that chunking *distorts* time. A more useful formulation is that subjective time is *different from,* not less reliable or accurate than, clock time. As psychologist Robert Ornstein quips, calling clock time " 'real time' is like calling American money 'real money.' "[38] Ornstein, one of the strongest and earliest advocates of an information-processing concept of time, also writes that duration should

> . . . be studied without reference to any sort of external clock, "biological," "chemical," or the ordinary mechanical clock. The experience of duration of a given interval may be meaningfully compared only with other experiences. If duration is considered solely as a dimension of experience, it is then unnecessary to determine whether this experience is "accurate" or not with respect to the clock. Lumping time experience into two simple categories of "accurate" and "inaccurate" has seriously impeded the flow of work on time.[39]

I call my experiment "informal" for several reasons. Since it was sometimes conducted in seminars on musical time, the students' suspicions of what I was trying to demonstrate may well have influenced their responses. Furthermore, I did not take into account any possible time-order error (the apparent lengthening or shortening of one of two durations relative to the other simply on the basis of which was experienced first). To do so, I should have tested the students in two separate groups, playing the sequences in the opposite order for each group. Furthermore, I made no attempt to discover what clock-time proportions produced the subjective impression of timespan equality. Nonetheless, the results of my "experiment"—that readily chunked melodies seem shorter than unchunked melodies of the same or even slightly greater clock-time duration—certainly agree with musical intuition and with psychological experiments that have studied the relationship between chunking and experienced time.

For example, Ornstein played two five-minute tapes for several groups of subjects. Each tape contained 200 sounds: ten instances each of such sounds as tearing paper, blowing across a bottle, and striking a typewriter key. On one tape each sound was heard ten times in succession before the next sound occurred. On the other tape the 200 sounds appeared in random order. The average estimated duration of the random tape was 1.33 times the average estimated duration of the structured tape.[40]

In Ornstein's experiment, as in mine, the random sequence contains more *information* (in the sense of information theory; see Section 2.2) than the structured sequence. Similarly, my Example 11.3 contains more information than Example 11.2, which has a higher degree of redundancy. It appears reasonable to postulate that an auditory sequence with higher information content will seem longer than one of the same clock-time duration that presents less information, more redundancy.

The amount of information encoded is not the only influence on perceived or remembered duration, however. The manner of encoding also has an influence. The 13 instructions needed to memorize Example 11.2 are not like the 100 instructions needed to encode Example 11.3. The latter is little more than a list of intervals or notes, with occasional instructions referring to small note-groups. Is one unit of information in the 100-instruction list (an interval name plus direction) really the equivalent of an entire sophisticated instruction, such as Instruction 5 on the 13-instruction list? If the units of information on the two lists were really equivalent, then might not the duration of Example 11.3 seem about $^{100}/_{13}$, or more than seven times, the length of Example 11.2?

Richard Block takes the "storage size" idea one step beyond Ornstein's formulation. For Ornstein, different stimulus sizes and complexities result in different encoding, but, once the input is registered in memory, the apparent duration is set (except for shortening due to forgetting).[41] Block remarks that the *organization* in memory of an encoded stimulus may be as relevant to its apparent duration as the *size* of the encoded information.[42] Thus not only the information content but also the complexity of the stimulus and of its representation in memory are related to subjective time.[43] This hypothesis supports my claim (in Sections 2.11 and 10.1) that changing amounts, rates, or complexity of information can alter subjective impressions of duration.

Is it therefore impossible to perceive objectively measured durations, especially for a piece in which the information content or complexity frequently changes? Are the analyses cited in Chapter 10 therefore irrelevant to the way we listen? Except for static compositions, such as Stockhausen's *Adieu* and possibly Stravinsky's *Symphonies*, this conclusion would appear inescapable. But is it?

11.7 LIMITATIONS OF THE STORAGE-SIZE MODEL

As argued in Sections 2.2 and 11.6, real music is usually too complex to permit the unequivocal identification of a single unit of information. The question of chunking is relatively straightforward, though, in an artificially constructed pitch sequence like Example 11.2. What would happen if the note values were not all identical, however? Would temporal partitioning aid in the encoding process, or would different note values constitute additional information that itself requires encoding? This question cannot be given a general answer. The answer depends on the particular note values chosen and to what pitches they are assigned. Chunking, in other words, is the psychological mechanism that responds to music's rhythmic groupings. Psychologist Diana Deutsch took a structured melody, similar to but shorter than Example 11.2, and inserted brief pauses.[44] Not surprisingly, she found that pauses aid memorization and recall when they are inserted between the melody's natural chunks (in our example, between the four-note groups), and hinder encoding when they are inserted elsewhere. In her experiments she used "structured tone sequences" (similar to Example 11.2) and "unstructured tone sequences" (similar to Example 11.3). She found that the best recalled were structured sequences temporally segmented according to their inherent chunking. The next best recalled were structured sequences not temporally segmented. Considerably less well remembered were structured sequences with temporal segmentation at odds with inherent chunking (such as those resulting when rests are inserted after every fifth note of Example 11.2). Still less well recalled were temporally segmented unstructured sequences (similar to Example 11.3 with rests inserted after every fourth note). The least well remembered were unsegmented unstructured sequences.[45] Confirmation of the idea that temporal segmentation reduces apparent duration also comes from Joy Yeager, who showed that uninterrupted "melodies" seem slightly longer than interrupted "melodies" of the same clock-time length (her "melodies" consisted simply of the alternation of two pitches).[46]

Similar observations could be made for other parameters besides note values: timbre, register, dynamics, and so forth. Example 11.4 is a version of the melody of Example 11.2 in which dynamics have been added to support the structure—the grouping—already implicit in the melody. These changes in loudness carry little independent information and should therefore not affect the perceived duration.

In Example 11.5, however, the dynamic changes add a separate structure and imply a different grouping, which operates in counterpoint to the inherent melodic grouping. The dynamics add considerable information, and the effect should be that the melody seems longer. Notice the tendency to perform Example 11.5 more slowly than Example 11.4, not only because of the greater performance skill needed to realize Example 11.5 but also to give listeners adequate time to process the added information conveyed by the dynamics.

The carefully constructed examples we have thus far considered represent extremes of codability. The structures of most real melodies lie somewhere between the redundancy of Example 11.2 and the high information content of Example 11.3. It is not at all clear in what way ambiguous or partially structured melodic lines are encoded.[47] I would be reluctant to assert, without experimental evidence, that a melody such as that in Example 11.6 (another permutation of the same notes, intended to have a codability midway between that of Example 11.2 and that of Example 11.3) would be perceived as shorter than Example 11.3 or longer than Example 11.2. With a melody of this degree

Example 11.4. **Dynamics added to Example 11.2 without greatly increasing its information content**

Example 11.5. Dynamics added to Example 11.2 thereby substantially increasing information

Example 11.6. Moderately patterned melody

of complexity and variety, unmeasurable factors such as listener interest and performer interpretation begin to become extremely pertinent.

I have been suggesting some *musical* difficulties with accepting the "storage-size metaphor," as Ornstein calls it, as the sole mechanism of duration perception and remembering. There are *psychological* problems as well. For instance, we do not *really* know how information is encoded. My list of instructions for memorizing Example 11.2 is a reasonable suggestion for that particular melody but nothing more. The more formalized models mentioned in Note 11.34 are offered by their authors without proof that they represent how we actually chunk music. When we consider less simple melodies, such as those usually found in real music, we find a multitude of often conflicting cues in the domains of note duration, contour,[48] and metric and grouping hierarchies. When we add musical context, we are forced to consider additional cues from the harmony, counterpoint, timbre, texture, and loudness. Thus my original black-and-white distinction between patterned and unpatterned melodies is far too crude for the chunking of real music.

We again face the dilemma of information theory (mentioned in Section 2.2). Music is too complex and musical information is too elusive to form the basis for a quantitative theory of perception. This does not mean that the concepts of information and chunking are useless or that they have nothing to do with the perception of musical duration, however. They remain extremely useful aesthetic descriptions of ways we understand musical time, and they do constitute a viable model of how our minds (but not necessarily brains) actually process the music we hear. Problems arise only when we try to *calculate* subjective durations, or *isolate* units of musical information, or *specify exactly* how real music is chunked.

Another problem is therefore that the storage-size metaphor ignores the effects of context on coding, memory, and retrieval. I mean not only psychological context, such as a listener's background, mood, ability, or attention,[49] and not only physical context, such as room acoustics or distractions, but also the music's own internal context. I realize (as does Richard Block)[50] that context is a nebulous concept, but that is no reason to ignore it. In fact, Block identifies four different kinds of context, all or any of which may affect perceived duration:

1. characteristics of the observer (personality, interests, prior experience, etc.);
2. contents of the duration perceived (filled or empty, and if filled, with what kinds of stimuli);
3. activities while experiencing the duration (active participation to varying degrees, passive attending, passive nonattending);
4. types of durational information demanded by the situation (estimates of absolute duration, simultaneity, successiveness, order, etc.).[51]

Block's first type of context is particularly critical for a theory of perception. It is quite possible that different people encode the same series of stimuli in different ways, with the differences having more to do with the observers than with the observed. Someone inexperienced in listening to tonal music, for example, will probably use more than 13 instructions to chunk Example 11.2. Various observers use different encoding strategies,[52] which may produce different subjective durations, when confronted with complex musical stimuli. We ought not forget, particularly as we consider statistically based findings of experimental psychology, the wonderful variety of ways people respond to music. Not only is music more complex than the oversimplified stimuli used in most experiments on music perception, but also people are more complex than is implied by the artificial tasks they are asked to perform in the antiseptic environments of psychologists' laboratories. And time itself is more complicated than many psychological studies allow. Music, people, and time are all complex entities that comprise the context in which musical time is perceived. As Thomas Clifton writes in his criticism of Ornstein's ideas, "It is not possible to formulate a general rule about the fullness of time and experienced duration because of the complexity of the relation between feelings, cognition, and volition, and the form of time."[53]

Ornstein has also been criticized for not going deeply enough into the differences between encoding and retrieving information.[54] Chunking, representation in memory, and retrieval are separate processes.[55] What happens to the impression of duration when some of the music has been forgotten? A listener to a dense passage of a moment-form composition, for example, may attend diligently to encoding the music, so that (according to Ornstein) the subjective duration should seem long. But subsequent passages may also be dense and yet unrelated to the original moment, so that there is no opportunity to rehearse the remembered segment either mentally (in memory) or structurally (in the subsequent music). Despite the encoding, the memory image of much of the first passage may not remain accurate. It is possible that we subconsciously try to reconstruct it, leaving "blank spaces" to stand in for the forgotten information. In this manner we may regain an approximation of the original subjective duration.

On the other hand, the storage-size hypothesis predicts that remembered duration will diminish as some of the stimulus is forgotten. But is it not possible that part of the encoding process involves entering into memory a mental representation of the subjective duration—a representation that may itself be remembered and retrieved even once some of the information on which it was based has decayed? If we posit an ideal listener, such questions do not arise, because an ideal listener does not forget. In the real world, however, there is an obvious mechanism to combat forgetting: repeated hearings. We are less likely to forget a passage if we have heard the piece a number of times.

It is possible, therefore, that elaborately hierarchic proportional systems, such as those outlined in Chapter 10, become totally relevant only as we get to know a piece well. With proportions as with any other parameter of music, some instances are more obvious than others. The details (of my Stravinsky proportional analyses, for example) may become perceivable only as we rehear pieces and thus improve our mental image of their durational spans. Surely repeated hearings should minimize time-order errors (defined in Section 11.5), over which several psychologists have puzzled.

Ornstein, for example, explains a "negative" time-order error, in which the second of two intervals, equal in clock time, is remembered as longer simply because it was experienced second. He suggests that certain items drop out of storage in the first interval because it is older, because it has been in storage longer, and because the mind turns its attention to encoding the second interval.[56] Thus selective forgetting makes the earlier duration seem shorter.[57] However, as Block points out, there is no way that the storage-size model can account for a "positive" time-order error (in which the duration experienced first increases length in memory), which arises at least as often as a negative one.[58] However, as the stimuli (the music) are experienced again and again, our memory of them improves and perhaps our "errors" in duration judgement diminish.

If familiarity minimizes time-order errors, it does so not only for listeners but also for a composer. As sketches show, a composer often works over passages for quite a while, living with them in a variety of musical contexts and possibly even out of context.[59] A piece may not be composed from beginning to end. Sections may be worked on in an arbitrary order. While working in such a manner, a composer undoubtedly gets to know the materials extremely well, including the subjective durations of sections. Time-order errors are diminished in a composer's mind, because he or she has rehearsed the music thoroughly and no doubt has "heard" sections in different orders. The composer may proportion materials sensitively because of knowing them well and therefore having a relatively complete mental encoding, which is resistant to forgetting (at least while the piece is being written) and to distortions caused by context, such as time-order errors. The "distortions" of musical context are important to the total meaning of a piece, ultimately more important than objective proportions. But both objective proportions and subjectively distorted proportions are there to be heard and understood (at least once the piece is thoroughly learned), thereby enriching the meanings of the music.

If a composer can sense proportions, listeners should be able to do so also. Despite the potential difficulties cited in Section 11.5, I strongly suspect that listeners can perceive even complex proportional structures. Perhaps such perception is available only with repeated hearings, after the music is sufficiently well encoded in listeners' memories for time-order errors and other inaccuracies to disappear. The effect of repeated hearings on listeners' understanding is a question normally ignored by music theorists and analysts[60] (psychologists have not done much better, although one can imagine an experimental approach to the problem). Perhaps one reason listeners return again and again to certain pieces is that they are trying to assimilate temporal structures, to appreciate fully and nonlinearly the music's proportions. I do not deny that on first hearing a listener may pick up considerable proportional information. But hierarchical proportional systems of the sort presented in Chapter 10 do require repeated hearings before their subtleties become perceptual realities.

Moment time seeks to build into music the negation of time-order errors. Music which gives the impression that the order of its sections is arbitrary tries thereby to minimize the importance of time-order. It should not be surprising, therefore, that music in moment time lends itself particularly well to conveying proportional systems. I stated in Section 2.11 that the proportional system in *Agon*, for example, would work even if the durations were heard in a different order. Any musical structure that suggests mobility of timespan durations invites listeners to circumvent the effects of time-order.

The most commonly voiced criticism of the information-processing model is that it is curiously static for a theory of time perception. Surely as we experience an extended duration, information is encoded step by step, not all at once. You read these words one (or a few) at a time, gradually building a mental image of what I am saying; the meaning does not suddenly leap into your consciousness as you finish each paragraph or sentence.

When are we supposed to acquire from encoded information a feeling for total duration: while it is being encoded, as soon as it is encoded, once it is stabilized in long-term memory,[61] or when it is recalled? Furthermore, the storage-size model does not admit the influence of expectation on encoding or on subjective time. In other words, the earlier events of a sequence being encoded give rise, while they are still in short-term memory, to expectations which in turn may influence our perception and encoding of subsequent events. Without expectation, the theory makes the listener out to be a passive receiver of musical information, whereas, as we all know, deep listening requires mental activities beyond the encoding of information, activities that may involve the listener in the music's pasts and futures. Any theory purporting to deal with the experience of musical time must take into account not only the encoding of the music's present and the memory of the music's past but also the active anticipation of what will happen.[62]

Mari Riess Jones, in her plea for a model of time perception that includes expectation, calls the passive manner of perceiving time suggested by the storage-size model a "still-spectator mode."[63] She feels that there are other, more active modes of attending to (of participating in) time.[64] The still-spectator mode corresponds to cumulative listening, in which the listener stands back from the temporal thrust of the music in order to apprehend consistencies of structure, such as overall durational proportions. But music involves the listener with time in more than one way. We have quite different cognitive mechanisms for nonlinear (still-spectator, information-processing) and linear (active, timing) listening modes. Sections 11.8 and 11.9 consider how the more active mode may operate, and Section 11.10 takes up the relationships to be drawn by the listener between these two modes of time perception.

11.8 TIMING AND METER

Ornstein formulated his "storage-size metaphor" as an alternative to what he calls the "sensory-process metaphor," which had dominated research into the perception of time for generations. Prior to the publication of his book *On the Experience of Time,* most

> . . . serious theories postulate[d] some sort of "time base," a repetitive, cumulative, pulse-dispensing mechanism which delivers internal time signals, an "organ" of time. The "time base" is identified either with a specific periodicity which is then usually called a "time quantum" or with a specific bodily process called the "biological clock."[65]

Psychologists' search for time quanta and biological clocks have come up with contradictory and variable results.

There is also a philosophic problem with the sensory-process mechanism, in that time does not have an objective reality and therefore cannot itself be sensed. James J. Gibson states in his article "Events Are Perceivable but Time Is Not":

> Time and space are concepts, abstracted from the percepts of events and surfaces. They are not perceived, and they are not prerequisite to perceiving. They do not give meaning to percepts and they are not imposed by the mind on the deliverances of sense. Time and space are intellectual achievements, not perceptual categories. They are useful in the study of physics but not in the study of psychology.
>
> Isaac Newton's famous assertion that "absolute, true, and mathematical time, of itself and from its own nature, flows equably without relation to anything external" . . . leads to the idea of empty time which, like the idea of empty space, brings with it insoluble problems for ecology and psychology. This implies that events are what "fill" time, as if time were a container into which events can be put. But this metaphor is surely wrong for the psychology of event perception. Time is not a receptacle for events, just as space is not a receptacle for objects. . . .
>
> William James in the *Principles of Psychology* . . . wrote a chapter headed "The Perception of Time," but he understood very well, despite the title, that the mere passage of time, empty time, is not perceived. The fact is that our experience is never empty.[66]

Ornstein's reasons for rejecting the sensory-process model are similar to Gibson's:

> If time were a sensory process like vision, then there would exist a "real" time independent of us, and we would have an "organ" of time experience such as the eye. . . . A concept of a "biological clock" may have some relevance in the explanation of periodic physiological rhythms *per se,* . . . but these rhythms do not seem to provide any useful explanation of time *experience.* . . . The old notion of an internal time "keeper" rooted in a periodic biological process is not a *useful* concept for an analysis of *duration* experience, although various aspects of this "time base" approach have relevance for other dimensions of time experience.[67]

Despite its problems, the sensory-process, or timing, idea has not been decisively replaced by the information-storage model of Ornstein, Gibson, and others. The storage-size metaphor, as we have seen, is fraught with problems of its own, while the timing model does have the advantage of simplicity and does lend itself readily to experimental verification. Timing can account for many of the subjectively altered time experiences reported in Section 11.5. A biological clock is assumed to have a variable rate which can be changed in any number of ways, internal and external.[68] The major problem, it seems, is not so much with the way biological clocks work as with how they correlate with each other and how consistently they operate. Musicians seem to have one particularly stable biological clock, which regulates the perception of tempo. As mentioned in Section 10.5 (see note 10.17), several cases have been studied in which performers repeatedly play the same piece at virtually the same tempo, even after an interval of several years. Eric Clarke believes that this same clock may be available for making accurate judgements of timespan length.[69]

Most music contains its *own* internal clock, a means of measuring which may provide listeners with important cues to large-scale duration. Music's clock is meter. I am not suggesting that we literally count beats as we listen to a lengthy stretch of music. But let us remember that meter is hierarchic (see Section 4.7). Two adjacent beats have different accentual qualities because there is some hierarchic level at which one of the beats is accented but the other is not.[70] We have a feeling for the number of beats (and thus the amount of time) that has elapsed between successive strong beats on several different levels. There are many different qualities a beat may have, depending on its accentual strength (how deep in the metric hierarchy it persists) and on its context (the strengths of surrounding beats at its level). Example 5.1, for example, is a picture of the metric clock of the first movement of Beethoven's Opus 135. As music's internal clock, meter can provide the data that we transform into perceived proportions.

When discussing (in Section 11.6) the isolated, periodic, unaccompanied, unorchestrated, unnuanced sequences of Examples 11.2 and 11.3 (and of Sequences C and R), I ignored meter. But meter does influence duration perception. Consider the first 17 notes of Examples 11.2 and 11.3. Does 11.3 seem longer even in this truncated form? The answer is no longer obvious. Example 11.2 has a built-in metric hierarchy, provided by harmonic implications, pattern repetition, and contour. The fastest beats (marked by sixteenth-note pulses) are alternately strong and weak because of pitch returns (the third note of each group of four sixteenths is the same as the first). The intervening notes are nonharmonic and fall on beats that are metrically unaccented on all levels. At the next level up in the metric hierarchy, the primary level, we hear groups of four notes, articulated by pattern repetition, with each pattern starting on an at least slightly accented beat. The half-measure level is chunked by the relatively strong metric accents on the root and fifth of the dominant harmony. The level of the notated measure is articulated by the consistency of the harmony, which changes at the metrically accented 17th note. As we listen to these 17 notes, we *feel,* whether or not we literally count, the clear and regular $2 \times 2 \times 2 \times 2$ metric structure. Psychologists label this feeling for duration on the basis of number of elapsed pulses (even when they are not literally counted) "timing."

The first 17 notes of Example 11.3, by contrast, lack contour or pattern cues (apart from the 4/4 notation) suggesting this or any other meter. It is a well-documented fact that, in the absence of clearly articulated meter, we impose it in the process of listening or performing. In other words, chunking is inescapably part of our encoding mechanism. We ourselves chunk, metrically if possible, a stimulus that lacks its own coding principles. We as listeners (or as performers responding to the 4/4 time signature) impose a regular $2 \times 2 \times 2 \times 2$ meter on Example 11.3, since the excerpt begins with *17* evenly spaced notes (one 4/4 measure plus the subsequent downbeat).

In short sequences, meter (whether inherent or imposed) is likely to be a stronger determinant of subjective time than information content. Thus the durations of the first 17-note timespans of Examples 11.2 and 11.3 are likely to sound equal. As the sequences go on, however, their content becomes better understood. Meanwhile the excessively regular meter, while still underlining the equality of the two passages, fades in prominence because of its predictability.

Thus information, more than meter, influences the perceived duration of the entire 129-note sequences, which is why Example 11.3, despite the identical metric hierarchy, is heard as longer than Example 11.2.

In real music the situation is not nearly so clearcut. For one thing, rhythmic grouping rarely coincides with metric units for very long, so that rhythmic and metric accents, and hence chunking, may be out of phase. Furthermore, information rates change. And the metric hierarchy is seldom completely regular. Thus information encoded in memory and the measurement of duration by metric accents are quasi-independent contributors to our understanding of large-scale lengths. Each of these two factors may in fact suggest very different subjective durations from the other. Either a large or a small amount of information can be presented during a particular timespan, as Examples 11.2 and 11.3 show. In one sense these two spans are equal, because they contain the same number of metric accents on each hierarchic level. In another sense they are unequal, because they have considerably different information content. Thus the two mechanisms of duration perception in music—information and meter—can be in conflict.

The fact that subjective musical duration is determined by two quasi-independent factors (they are not totally independent, since meter contains musical information) has considerable ramifications for the perception of proportions. Some of the proportional systems examined in Chapter 10 operate by means of meter, others through absolute time. No proportional analysis depends on information content alone, however relevant information may be to duration perception, because it is impossible to specify what constitutes a single unit of information in a complete musical context (see Sections 2.2 and 11.6). Try to imagine the encoding instructions (far more complex than the 13 instructions listed above for chunking Example 11.2!) that would be needed for eight measures of real music, complete with changes of harmony, counterpoint, note durations, rhythmic grouping, melodic contour in all voices, degree of dissonance, loudness, texture, performance nuance, density, and timbre, plus changes in the rates of change of all these variables.

In music where the metric hierarchy is fully developed and reasonably regular, duration perception by timing may be quite "accurate"; that is, it may approximate absolute time. In music where there is no meter, or meter is restricted to the surface level (metrically irregular or static music, in other words), information processing takes over, but with a minimum of time-distorting data. In these two cases, objectively measured proportions are related to heard proportions. In other music, however, information processing and metric timing may offer conflicting impressions of duration. The conflict between metrically determined durations and durations influenced by information coding is a particularly difficult problem for music analysis.

Actually, there is a third factor that influences perceived duration, and that is tempo. If the number of elapsed beats (on some level) plus the amount of memory space required to encode the music's information were the only determinants of subjective duration, then two performances of the same piece or passage that differed only in tempo would be perceived as having equal duration. Such is surely not the case. We experience and remember Klemperer's recording of Beethoven's Symphony No. 7 as longer than Toscanini's, although the metric hierarchies are necessarily identical and the information contents are *similar* (not *identical,* because performance does add information to the written score). Consider, for a second example, two different performances of Stravinsky's *Symphonies of Wind Instruments:* one in which the tempo modulations are strictly observed; and another in which they are violated (as is actually the case on several recordings). Let us assume that the tempo differences between the two performances are not inordinate (huge changes in tempo could affect chunking and hence alter information content), yet they are sufficient to make the proportions of the two performances perceptually different. The two versions have the same information content and the same metric hierarchy, yet their perceived durations are different. The difference must come from tempo. I remain convinced that information processing and metric timing are more important and more complicated mechanisms, but, as the examples described in this paragraph show, tempo *is* a factor in duration perception.

What *is* tempo? It is typically defined as the number of beats per unit time. Unit of what kind of time, we may well ask. Metronome markings are given in units of clock time, but is tempo *felt* in such a manner? Surely absolute time is a factor, but so is subjective time. We all know the experience of two passages that seem to have different tempos, probably because of different information rates, even though their underlying beat rates are identical. If Examples 11.1 and 11.2 are performed at the same literal tempo, will not Example 11.1 seem the slower of the two? Like meter and information, tempo is no simple matter. All three can influence each other. If we consider tempo as both the rate of beats and the rate of information, then we can incorporate into this broad concept both the objectively measured and the subjectively felt.

Tempo affects our efficiency at encoding and rehearsing, since sequences of tones that are presented too fast or too slowly are difficult to chunk effectively.[71] Actually, tempo affects rhythmic grouping as well: When a performer slows the tempo of a performance, he or she instinctively starts to project rhythmic groups on a shallower hierarchic level than the primary perceptual units.[72]

If tempo is to be thought of as the rate both of metric beats and of information transmission and reception, then it does not have to be addressed here as extensively as do the perception mechanisms it supports: meter and information. And since much has already been stated here about information processing, we turn now to the remaining factor in duration perception.

11.9 METER AS A HIERARCHIC CLOCK

Eric Clarke has explained how the metric hierarchy functions as a perceptual clock:

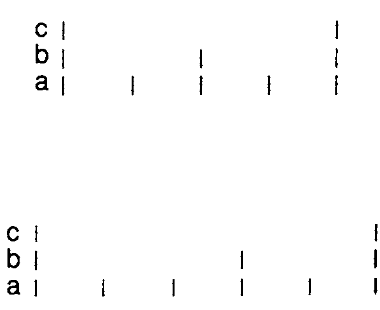
> The strictly hierarchic organization reduces the need to track the number of such units that have elapsed as long as the listener can retain an awareness of the hierarchic depth to which units are embedded. In short, hierarchic organization employing units with constant or simply related durations resolves the need for an additive counting process.[73]

Meter, however, is not always regular. Irregular music (such as Stravinsky's *Symphonies,* for example) offers fewer hierarchic levels than regular music. Some nonmetric music (considered in Chapter 12) is simply not hierarchic. In such cases, the music has no internal clock, and mechanisms other than metric timing must be used in our pursuit of the music's time structure. A simple tonal composition, on the other hand, has sufficient regularity throughout its metric hierarchy for us to understand irregularities as distortions of norms. Alterations of metrically delineated timespans, through such common mechanisms as extensions, contractions, or overlaps (see Section 4.8), add or subtract one (hyper)measure at some hierarchic level. What is needed to make meter sufficiently multileveled for such alterations to be understandable within the hierarchy is not only a degree of regularity but also some principle(s) that enable us to distinguish between strong and weak timepoints on several hierarchic levels. In a metric hierarchy that is sufficiently developed to serve as a clock, we must be able to tell, for example, that a four-bar and a five-bar hypermeasure are in some ways different, and in some ways the same.

Compare the hypermeasures of Example 11.7. Let us assume that the five-bar hypermeasure is subdivided 3 + 2. If we consider absolute time as the determinant of length, then the five-bar hypermeasure is $5/4$ the length of the four-bar hypermeasure. If we consider not absolute time but rather the number of unaccented beats between accented beats on the deeper levels shown, then the two should be heard as equal, since they both contain the same number of hyperbeats on levels b and c. How is the duration actually perceived, however?

I conducted informal experiments with several groups of students. I asked them to draw lines proportional to the apparent durations of two musical excerpts, shown in the first part of Example 11.8 and in Example 11.9: the 20-bar opening of Brahms' *Variations on a Theme of Haydn* (1873),[74] and a recomposed 16-bar version of the same. The ratios of the students' line segments were between 5:4, which we might expect if absolute time length were the sole determinant of perceived duration, and 1:1, which we might expect if number of hyperbeats were the sole determinant.

I chose two similar passages in an effort to minimize differences in context, information content, and possibly even attention. My purpose was to try, as much as possible, to isolate the effects of meter as durational clock. The experiment was not rigorous, however, since I did not attempt to take into account the



Example 11.7. **Hierarchic metric clock for hypothetical four- and five-bar hypermeasures**

Example 11.8. **Brahms, *Variations on a Theme of Haydn*, opus 56, mm. 1-29**

Continued

***Example 11.8**, continued*

effects of prior knowledge of the piece nor of possible time-order errors. It may have helped that I presented the experiment as a study in the perceived relative durations of two different performances of the identical passage, but the fact that the subjects were musically sophisticated may have mitigated the effects of that ruse. I chose to present 20 measures rather than five in an attempt to make available more levels of the metric hierarchy. It would be interesting to test the metric clock more rigorously, comparing apparent relative durations of longer passages (such as Examples 11.10 and 11.11).

What are the implications of my "experiment" for proportional analysis? How can I claim that listeners respond to the nested 3:2 proportions in Stravinsky's *Symphonies*, for example, when they apparently do not accurately perceive the simple 5:4 relationship between the Examples 11.8 and 11.9? We should not assume that 5:4 is the "real" proportion and that we are testing how accurately it is heard. I have argued that only in one sense is the ratio between the two excerpts 5:4; in another, equally musical, sense the ratio is 1:1. My "experiment," in trying to find what the perceived proportion is, discovered that it lies between 5:4

Example 11.9. Recomposition of Example 11.8, mm. 1-10

and 1:1. In the Stravinsky *Symphonies*, meter is so irregular on all levels, and the number of metric levels is so small for a piece of such length (see Section 4.11), that (hyper)meter cannot contribute very strongly to perceived proportions. The proportions can be meaningfully measured in only one way, not in the two ways suggested for the Brahms excerpt. I expect that the measured proportions in the Stravinsky piece approximate the perceived proportions because of the minimal influence of meter (and, as I have repeatedly stated, of intra-moment contrasts in other parameters). In the Brahms piece, there are two viable ways to calculate the proportions (hypermeter and information), and the perceived ratio seems to average the two. In the Stravinsky piece, there is only one viable way (information) to calculate the proportions, and the perceived ratio is therefore close to the calculated ratio.

Let us consider another passage in which both information content and the hypermetric clock are strong influences on perceived durations. Example 11.10 is the exposition section of the first movement of Mozart's Piano Sonata in F Major, K. 332 (1778). This section unfolds at a leisurely pace, for at least four reasons:

1. There is a large number of varied repetitions. Mm. 17-20 comprise a varied repeat of mm. 13-16; mm. 49-55 form a varied (and contracted) repetition of mm. 41-48); mm. 77-81 repeat mm. 71-75; and mm. 84-85 repeat mm. 82-83. These repetitions have less information content (in context) than the segments they repeat, since the underlying harmonic, melodic, rhythmic, and metric structures are essentially the same. Additional information resides only in the details of elaboration.

2. The exposition also has a number of extensions, which add metric but not harmonic information. Mm. 21-22 reiterate the tonic cadence in mm. 19-20. The cadence in mm. 81-82 is extended through m. 86. The large cadence in mm. 89-90 is extended by mm. 90-93.

3. The bridge section is unusually long, stretching a modulation from tonic to dominant over 18 measures (mm. 23-40, almost as long as the first theme-group).

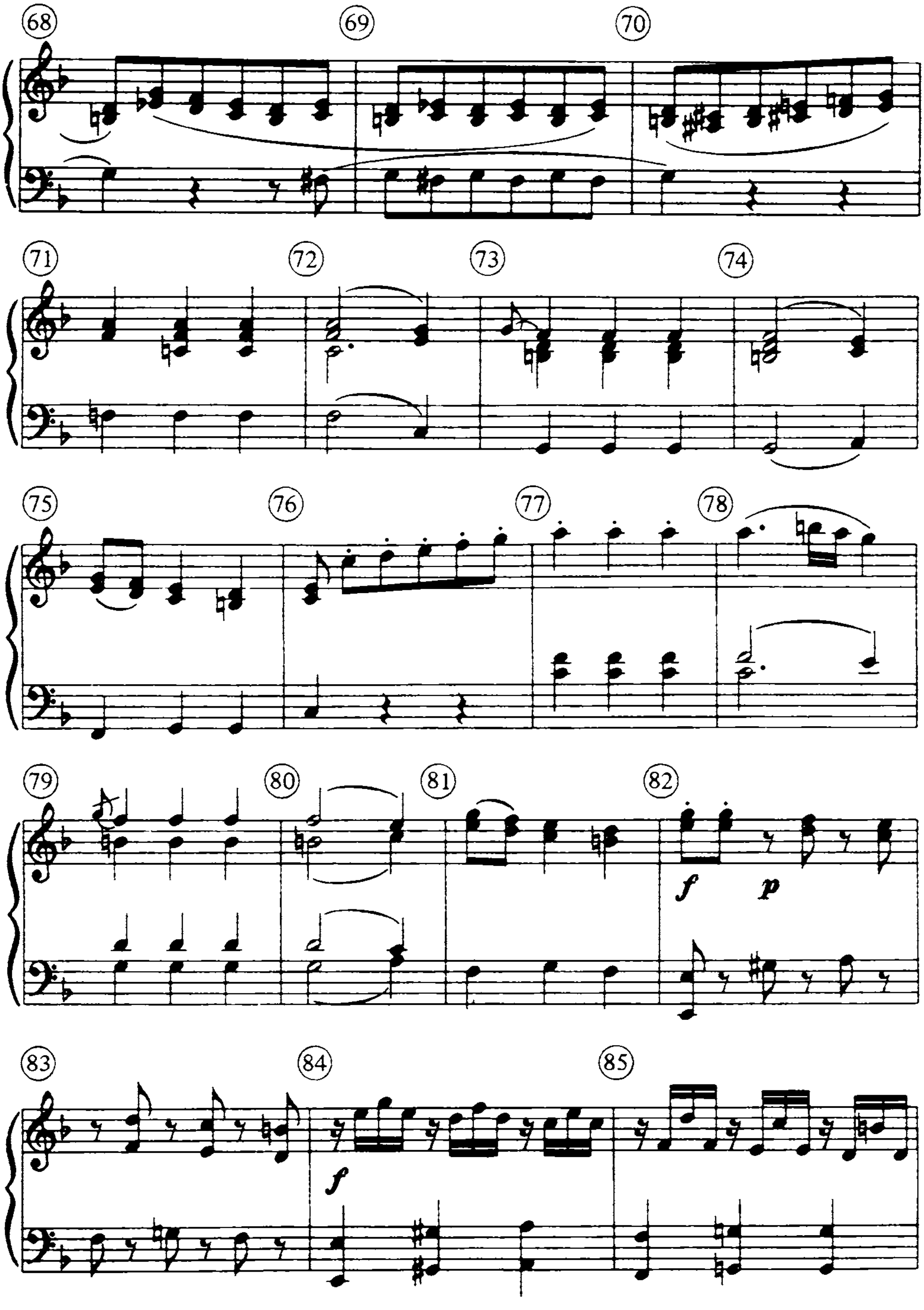
4. There are several places where a single harmony is held for a number of measures. The tonic pedal in mm. 1-7 establishes the leisurely mood from the outset. In fact, the entire first theme-group (mm. 1-22) is pervaded by tonic, with every phrase beginning and ending on I. The modulation to V is prepared by a four-bar V/V pedal (mm. 37-40). Mm. 60-65 comprise a circle-of-fifths sequence that prolongs another V/V, which is held through m. 70. Mm. 86-90 take place over another pedal.

Example 11.11 is a hypothetical recomposition of Example 11.10, with many of the leisurely passages tightened (the bridge section, for example), and several repeats and extensions removed. The purpose is certainly not to suggest that the omitted passages are superfluous; the compact nature of Example 11.11 is at odds with its slowly unfolding materials. But Example 11.11 *is* a coherent, if somewhat strange (particularly for listeners who know Example 11.10), exposition section. My purpose in constructing Example 11.11 is to consider the relative proportions of the two passages.

Example 11.10. Mozart, Piano Sonata in F Major, K. 332, first movement, mm. 1–93

Continued

***Example 11.10**, continued*



Continued

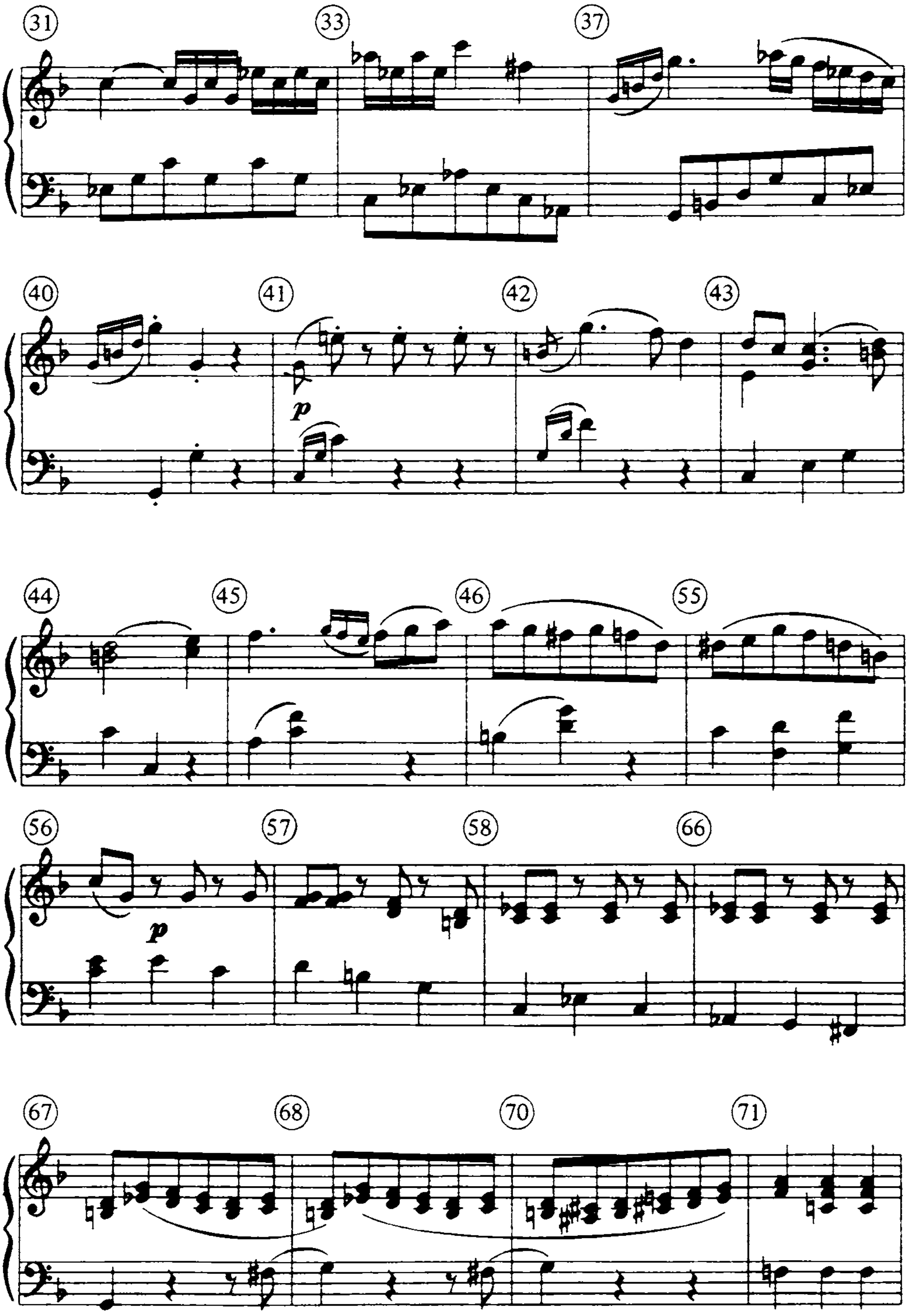
Example 11.10, *continued*

Example 11.10 contains 93 measures. Example 11.11 contains 54 measures. As we listen to the two versions, does 11.11 really seem $^{54}/_{93}$, or 58%, the length of 11.10?[75] I think not. 11.11 seems longer than 58% of 11.10, because all of the structurally essential information (the underlying harmonies, the themes, the form) is still there. In other words, the information content of Example 11.11 is only slightly less than that of Example 11.10. To memorize the portions of Example 11.10 omitted from Example 11.11 (in the fashion suggested in Section 11.6 for memorizing Example 11.2), only relatively few instructions (about varied repetition, elaboration of consistent harmonies, and cadence reiteration) are needed. An instruction list for memorizing Example 11.11 would surely be longer than 58% of that needed for Example 11.10. Therefore, Example 11.11 requires more than 58% the mental storage space needed for remembering Example 11.10. The duration of 11.11 is perceived and remembered as considerably longer than 58% that of 11.10.

Example 11.11. Recomposition of Example 11.10

Continued

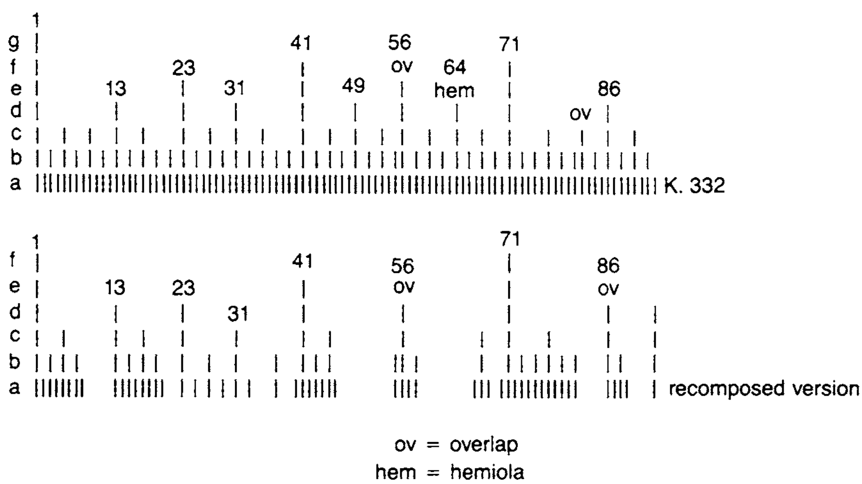
***Example 11.11**, continued*



Now compare the apparent length of Example 11.11 with that of the second and closing theme-groups of Example 11.10, mm. 41-93. The C major portion of the original exposition is 53 measures long, virtually the same length as Example 11.11. But the two passages do not seem the same length, because of the considerably greater information content of Example 11.11. Example 11.11, literally 58% the length of Example 11.10, is perceived as substantially longer than mm. 41-93 of Example 11.10—literally 57% the length of Example 11.10.

Now consider the hypermeter of Examples 11.10 and 11.11, shown in Example 11.12. First, a few comments are necessary on the analysis of Example 11.10. There is an overlap at m. 56, which serves simultaneously as the weak fourth beat of the hypermeasure of mm. 53-56 and the strong first beat of mm. 56-59. There is another overlap at m. 82, which is simultaneously the weak sixth beat of mm. 77-82 (2+2+2) and the strong first beat of mm. 82-85. The hemiola in mm. 64-65 is analyzed as three measures of 2/4. Thus, mm. 56-70 are quite regular: four hypermeasures of four measures each. The irregularity exists below level a, since three of the measures have two rather than three primary-level beats. It may seem that m. 35 is weak with respect to m. 37 (because of the quasi-sequential nature of mm. 31-36), but I suggest that the augmented sixth harmony in m. 35 functions as an appoggiatura to the V/V that arrives overtly in m. 37. In other words, mm. 35-40 constitute a six-bar prolongation of V/V. Similarly, m. 64 is appoggiatura to the V/V which is heard at the second beat of m. 65 (downbeat of the third 2/4 hemiola measure) and more emphatically at m. 67. Therefore, m. 64 contains the strongest metric accent in mm. 64-70.

There are substantial differences between the metric hierarchies of Examples 11.10 and 11.11 (compared in Example 11.12), but there are also some similarities. Mm. 1-12 become a 2- rather than 3-beat hypermeasure at level c; otherwise mm. 1-12 are metrically unchanged. The only difference in mm. 13-22 is the change of the 3-beat hypermeasure of mm. 17-22 (level b) to a 2-beat hypermeasure. By the elimination of every other measure, mm. 23-30 remain regular but on a shallower level. The appoggiatura in mm. 35-36 is omitted, so that the strong beat on level c comes directly on the foreground V/V (m. 37). The omission of the



Example 11.12. **Metric hierarchies of Examples 11.10 and 11.11 compared**

repeat of the first phrase of the second theme-group eliminates a strong metric accent at m. 49. Similarly, the accent at m. 64 is omitted. Therefore mm. 41-70 feel considerably different metrically in Example 11.11. Mm. 71-85 become a 2- rather than 3-beat hypermeasure on level c. The final measure is more strongly accented metrically when the cadence at m. 90 is omitted.

William Benjamin hints at a view of meter and proportion similar to mine in his discussion of the "Capriccio" from J. S. Bach's keyboard Partita in C Minor (1731), which has two parts with equal numbers of measures. Benjamin is unwilling to see meter as operative on deep levels, because he insists on regularity as part of the definition of meter. But he is on the right track in his differentiation between meter and proportion:

> It could not possibly make much difference to a listener unfamiliar with the music were the second part of the piece to be a measure or two longer or shorter. He hears the parts as being roughly in balance, a relationship not sensitive to minor differences in actual length. To hear metrically, on the other hand, is to react to any departure from absolutely regular lengths and distances as something disturbing and in need of explanation. This kind of sensitivity is possible at very broad levels, but only if these are the deepest in a hierarchy of partitioning which is also metrical at all more immediate levels.[76]

I believe that music with unequivocal metric accents *is* metrical at all levels, even when those accents are unevenly spaced. Just as the number of hyperbeats in a hypermeasure is critical to the perceived duration of the hypermeasure, so the quality and strength of metric accents is a determinant of the metric hierarchy. Accentual strength is therefore just as important a timing cue as is the absolute length of the timespan between accents. Thus I believe that the kind of metrical hearing Benjamin mentions *is* possible on all levels for metric music.

It is the metric clock that enables us to compare timespan lengths. Meter does activate our sense of proportion. However, I agree with Benjamin that we are sensitive to large-scale proportions in themselves (and as influenced by information content), not only as built up from shallower-level metric timespans. I am contrasting a "top-down" hearing (the proportions perceived subjectively as fundamental temporal units, possibly subject to subdivision) and a "bottom-up" hearing (the metric hierarchy giving cues to durations of successively larger timespans). Some contexts may focus our attention on a top-down appreciation of durations, while other contexts may cause us to attend more to a bottom-up hearing, but we probably use both mechanisms during most of our listening.

11.10 THE DUALITY OF MUSICAL TIME PERCEPTION

As explained in Section 11.7, one serious drawback to the information-processing model of time perception is that it minimizes the influence of context and attention. Surely we shift our attention (under the influence of personal, environmental, and musical contexts) as we listen to music. Under appropriate conditions we shift from (1) a nonlinear or still-spectator listening mode, which includes (among other mental processes) the cumulative perceiving, encoding, storage, and retrieval of musical information, to (2) a linear or active listening mode, which includes (among other processes) the ongoing timing of metric data. I am not suggesting that information processing is always nonlinear or that it takes place only in the still-spectator mode. Information theory can profitably be applied to active expectation (see Section 2.2). Patterns of musical information can carry implications toward the future of a piece and hence give rise to linear expectations in the listener. But, when we consider how *durational* data are perceived and processed, it does seem reasonable to make the distinction (though not in a overly rigid way) between the nonlinear encoding and processing of temporal information and the linear timing or estimation (to use that term in an extremely broad sense) of time itself.

In our discussion of the storage-size model (Section 11.6), we saw that much of the information processed is not in itself temporal, although it nonetheless influences the perception of duration. The encoding instructions for Examples 11.2 and 11.3, for example, are not directly concerned with time, but rather with pitch patterning. As this kind of nontemporal information is chunked, it influences perceived duration according to the storage-size mechanism.[77] Thus, in addition to the temporal parameters of music (rhythm, meter, note durations, pacing, and so forth) there is a lot of nontemporal information in music (pitch, melody, harmony, counterpoint, timbre, texture, loudness, and so forth) that is encoded during the listening process and that therefore contributes to the perception and memory of timespan durations.

Psychologists Louis Gomez and Lynn Robertson hypothesize that we are led by context to turn our attention to one or the other of two modes of duration perception: active-attending and still-spectator.[78] The more nontemporal information in the stimulus (harmonically complex music, for example), the more we attend to the information-processing mode and the more our understanding of durations relies on the storage size of the remembered information (as well as on our memory of the time required for encoding). The more prominent the meter (as in what is paradoxically called "rhythmic" music), the more we attend to timing. In static music, where the information rate is relatively constant and meter is (usually) not hierarchic or not regular or even nonexistent, we have no choice but to attend to information (since there is no timing clock). But in that case the variety in information encoding is diminished, with the result that objective proportions are less altered by subjective encoding mechanisms.

Gomez and Robertson's ideas are based on the work of E. A. C. Thomas and Wanda Weaver, who postulate a reciprocal relationship between the two mechanisms of time perception.[79] In other words, if we attend more to a work's materials and their interrelationships, then our impression of subjective duration will depend more on information processing. If we attend more to the metric hierarchy, then our impressions of subjective duration will depend more on timing. Thomas and Weaver believe that both mechanisms influence the perception of duration, but that their relative degrees of influence are determined by where we direct our attention. In laboratory situations, either mechanism can be suppressed and/or rendered unreliable. In listening to music both processes operate, although the balance between them may change depending on the context.

The perception of large-scale musical durations and proportions is a more complex phenomenon than many music psychologists have realized. It involves (at least!) two different mental processes: information encoding and timing. Different people in different listening situations may use these strategies at different times and in different ways. This fact accounts for variability of time perception from one listener or listening occasion to the next. Which mechanism is used at any given point is related to how our attention is focused; and that in turn is subject to personal, environmental, and musical influences.

Music listening is a mixture of active participation and still-spectator observation. The still spectator in us builds up a mental representation of the piece, which becomes gradually more complete as we move through the music and as we learn it better with subsequent hearings. Our mental representations are not in themselves dynamic but are more or less static, except when we discover (or are led by a critic's or analyst's insights to uncover) structurally important relationships we had not previously encoded. The gradual accumulation of encoded information in the form of a mental representation of a piece is what nonlinear perception, or cumulative "listening," really is. (Notice that I am differentiating nonlinear listening from nonlinear music, since we form mental images of all music, whether predominantly linear or largely nonlinear.) Cumulative "listening" is a memory process and, as such, creates an image of past events. It is like the trail left by a jet.

The active listening mode, on the other hand, involves participation in continually changing materials and relationships. Even when we revel in the sensuous beauty of a nonlinear composition, our active linear listening mode is available. This kind of listening is concerned with expectations, anticipations, and projections into the future. It is less involved with forming representations in memory and more involved with the immediacy of the piece and where it is going (or not going).

Both linear expectations and nonlinear memory images feed back into present perceptions. Events are retrieved from memory for comparison with other events, and the ways new events are understood are influenced by expectations. The present is not simply the place where perception happens, not simply the place from which linear and nonlinear perception are projected respectively into the future and past. It is also the meeting ground of memory and anticipation, both of which color perception. More, therefore, needs to be said about music's present. But first, it is useful to summarize some of the ideas developed thus far.

11.11 SOME ANSWERS AND SOME UNANSWERED QUESTIONS: A SUMMARY

At the beginning of this chapter, I posed several challenging questions. Now I would like to reconsider some of them, to see to what extent they have been answered.

Is there really such a mechanism as cumulative listening? The word "listening" is metaphoric, but we really do encode and accumulate information about unchanging aspects of music. Cumulative "listening" is essentially the construction in memory of a mental representation of the nonlinear (and also linear) aspects of a piece.

How does cumulative listening operate? The mechanism consists of the chunking and storing in memory of musical information. Data from timing may also contribute to the cumulative process, but information storage is the prime mechanism.

When does cumulative listening operate? It operates both during the listening process and in memory. As we encode additional information, our mental image of the piece becomes more complete. Subsequent hearings of the same piece provide additional information. By the time the music is quite familiar, a large portion of its events and syntactical relationships are in memory. This occurs even though the mental image is no doubt incomplete, given both the instability of memorized information and listeners' less-than-perfect powers of perception.

If time is primarily a relationship between people and experience rather than an objective reality "out there," then what relationships do Chapter 10's objective measurements of proportional spans in printed music have to experienced music? As our understanding of a work's information patterns and metric hierarchy becomes more complete in our memory, we become better able to form a mental image of proportions, that is, of the relationships between the durations of two timespans. Even though durations themselves remain subjectively understood, the proportional ratios between them may approach objectively measured proportions, particularly in music with static, self-contained sections and in music that has been thoroughly learned. Time may not be "out there," but the music *is*. But, as we hear and rehear music, we form a mental image, so music also becomes internalized. Through cumulative listening, our internalized proportions become an approximation of the external proportions of the music.

Are durations and proportions perceived, understood, and remembered? Yes, although they remain susceptible to subjective influences of context, personal abilities, moods, and so forth. Even under ideal conditions of perception, memory, and familiarity, perceived and remembered durations only approximate measured durations.

How can we reconcile proportional analyses based on objective measurement with the changeable experience of musical time? The metric hierarchy provides a quasi-objective timing of musical duration (though our perception of it may be influenced by all manner of subjective factors). We listen to meter in a bottom-up fashion, so that meter makes us aware of equalities and inequalities of small timespans and then, on the basis of those small durations, of longer timespans. Perception of meter is complicated by the fact that it measures durations in two ways: by number of primary-level beats (akin to absolute time) and by number of (possibly unevenly spaced) accents of the same relative strength.

How can we reconcile the idea of meter as a clock with the idea that perceived duration depends on information content? There are two separate mechanisms of time perception. The musical context (in addition to personal and environmental factors) leads us to attend to musical duration in one of two ways (actually three, if we include tempo): by timing (listening to the metric hierarchy) and by information processing (listening to codable information). The interaction between these two mechanisms, both in the perception process and in memory, has yet to be studied thoroughly.

Are the proportions that we understand and feel in retrospect the same ones we may have intuited, albeit tentatively, while listening? Memory is volatile, subject to forgetting and to change. Thus music remembered is not the same as music heard. Beyond the question of what information is likely to be forgotten, we may wonder whether the way a piece is chunked in (long-term) memory is the same as the way it is chunked while it is being heard (in other words, while it is in short-term memory). For large musical segments the answer is easy, since it is apparently all but impossible to *perceive* more than about eight seconds at once. Therefore, large-scale proportions are never perceived at once but are only understood in retrospect by means of cumulative listening. For proportions of shorter durations, it remains an unanswered question whether the way the music is encoded in long-term memory corresponds to the way it is encoded in short-term memory.

Are proportions perceived as they are, or are they changed in the process of entering our memories? Any perceived information can be altered as it is perceived or encoded. Whether there are systematic mechanisms that transform proportions subjectively remains an open question.

How do we compare in memory different durations, heard at different times and in different contexts? Our impressions of time lengths may come from a variety of sources: the remembered duration of a passage as it was heard; the sensed duration of the passage as it exists in memory; the memory of the duration required to encode the passage. It is not clear under what conditions these different mechanisms operate. Once we have mental representations of durations, however, they can be retrieved from memory. Once the encoded duration information re-enters consciousness, it is available for comparison. It is not the literal duration, however, that re-enters consciousness, but an image of it. Similarly, two durations cannot be compared as they are experienced, unless they are quite short. But two remembered durations can be compared, and a remembered length can be compared to one that is being experienced.

How "accurate" is our sense of duration? There is disagreement among psychologists, but figures in the range of 8% to 16% have been suggested for moderately long durations. These figures do not take into account the manner in which a musical context may sharpen our perception of duration, nor how distractions may dull it. But it is misleading to evaluate "accuracy" on the basis of a comparison with clock time, since clock time has no real place in music listening. If listeners' time estimates differ from measured clock time by 8-16%, we may just as well say that the clocks are wrong—wrong, at any rate, if they are being used to tell us anything about the ways we experience musical time.

Does the degree of agreement between perceived and measured proportions relate to the degree of variance in the proportions themselves? We should not be misled by the fact that the range of variance in most of the proportions studied in Chapter 10 is considerably less than 8-16%. The 8-16% figure represents accuracy of *duration* perception, not *proportion* perception. This wide range of approximation does not mean, therefore, that Stravinsky's proportions, for example, cannot be heard. Stravinsky presumably knew his materials very well and was therefore quite sensitive to durations as well as proportions, more so than the out-of-context 8%–16% figure implies. Composers' abilities to estimate proportions in their own compositions are surely well within an 8% consistency. Once listeners become very familiar with a piece of music, they too should be able to sharpen their abilities to measure its durations and proportions.

Is music somehow special, or is information about timespans in music processed in the same manner as all durational information? Metric music is special in that it contains its own internal, hierarchic clock. In this sense music listening is unlike any other human activity. Listening to nonmetric music, however, requires attending to other elements. But the type of stimuli encountered in any kind of music may well suggest different information encoding procedures. For one reason, the lack of direct reference to things outside itself (as means of measurement and comparison) and the lack of unequivocal semantic content make music special. It is not known to what extent the uniqueness of music leads to unique information encoding strategies.

Just how do subjectively experienced durations relate to objectively measured lengths? There may be a mathematical relationship between the two (see the discussion of the findings of psychologist Hannes Eisler, in Section 11.5), but subjective factors make such a relationship little more than an average. In individual instances, the relationship between perceived and objective durations may differ considerably from Eisler's formula. For practical purposes, all we can say is that musical durations tend to be estimated differently from other durations. This does not mean, however, that experienced proportions must differ vastly from measured proportions. Proportions are the *ratios* between durations. Subjective and objective proportional *ratios* may be closely related, even if the durations that create the ratios differ considerably.

This summary shows that psychological research has produced some theories and some verifications of direct relevance to music perception. But it is equally clear that many of the answers psychology offers are tentative, incomplete, or speculative. Furthermore, some questions have yet to be considered. As suggested in Section 11.3, there is reason to believe that cognitive psychology has worthwhile things to say about the perception of musical time, but it has only begun to do so.

11.12 THE LENGTH OF THE PRESENT

One area in which psychological speculation and research have produced musically relevant results is in the perceptual definition of the present. The present is not simply a point in time but rather a unit of finite duration. We perceive rhythmic *groups,* not just successions of isolated notes. We hear notes moving to other notes because the perceptual present stretches out in both directions from the instant of now. But it does not stretch indefinitely. It blends into the past as information moves into memory. Does this idea of the present accord with psychological facts, or is it a philosophic construct?

Metaphorically, we can call the present a horizon (a term borrowed from phenomenology) fading at its extremities into the past and future. In music the distance to the horizon is different on each hierarchic level. On the ultimate foreground, for example, the horizon has the size of a note. We understand an entire note (except perhaps for very long notes in contexts that focus our attention on shorter timespans) as a unity. That is why we can feel an agogic accent (accent of length) at a note's point of initiation (see Section 4.3).[80] Hearing a note as its own context is akin to listening by means of a zeroth-order Markov process.[81]

On deeper levels horizons correspond to motives, phrases, phrase groups, sections, movements, and so forth. Although these are elements of rhythmic grouping, it may be reasonable to conceive the length of a horizon in terms of meter: The present on any given hierarchic level is approximately equivalent to the timespan of a (hyper)measure.

But is this idea *perceptually* valid? We do not really perceive an entire section at once. By the time an extended section ends, its beginning is no longer in any experiential way part of the present. It has been encoded into memory, where it may be very much alive. But to understand the section as a unit, it is necessary to retrieve the beginning (and the middle) and to relate it to the ending that is being experienced. This process, which goes on all the time in listening, creates broad horizons. Literally, however, perception is not hierarchic. The perceptual present is flexible, but not infinitely so. We cannot go beyond the limits of short-term memory. Because of the inevitability of the chunking process, we group short stimuli and segment long stimuli to form durations that are manageable by our perceptive mechanisms.

How long, then, *is* the perceptual present? Psychologists have shown that it is somewhat variable (and they have disagreed), depending on the nature of the stimulus, but there seems to be an upper limit of about eight or ten seconds (or up to twenty seconds under extreme conditions). This duration corresponds to the longest musical phrase we can process mentally without having to chunk it into two or three smaller units. Most phrases cadence short of this maximum. A phrase is therefore a basic unit of musical structure, more fundamental than the motives that constitute it or the phrase groups that it generates. These other levels are meaningful, and there are musical structures that create horizons at these smaller and larger levels; but the level of the phrase contains the fundamental perceptual units of music. All the information in a musical phrase remains active and available to the listener until a cadence closes the unit and causes us to send it into long-term memory, in order to make way for the next unit.[82]

Following William James, psychologists call the perceptual present the "specious present."[83] In his excellent article "The Making of the Present," John Michon defines the term (borrowing his ideas from psychologist Paul Fraisse and phenomenologist Edmund Husserl):

> The process of discovering or constructing the temporal pattern of a sequence of events is consciously experienced as the *specious present*. The specious present is understood in the sense defined by James (1890) as the time interval, a few seconds in length, in which we experience the flow of events as being simultaneously available to perceptual or cognitive analysis. . . . The information contained in a present is a discrete segment; its boundaries are determined by various temporal and nontemporal structural properties. When

> no external structure is present in the stimulus, segmentation will be imposed subjectively (grouping). The contents of a present are simultaneously available and are as such continuously open for restructuring; that is, the information contained in it is open to revision under different cognitive (or at least higher order) interpretative hypotheses.[84]

A few examples may help to clarify the idea of the specious present. Imagine hearing this sentence spoken: "Rapid righting with his uninjured hand saved from loss the contents of the capsized canoe."[85] When we hear "capsized canoe," we revise our understanding of the meaning and context of the *entire* sentence. "Rapid righting" is still present in our consciousness, so that its meaning can be modified without our having to call it up from long-term memory. The word "righting," initially understood as "writing," is still present even after the four or five seconds required to say the entire sentence.[86]

Leonard Meyer gives a similar example (although he is demonstrating not the unity of the present but the increase of meaning when an unexpected bit of information occurs): "She is as tall as Bill is wide."[87] When we hear "wide," we revise our understanding of the entire sentence, which is still part of our present.

Consider certain kinds of typing errors.[88] For example, I might have typed the final word of the previous sentence as "eroors." The instruction "type a double letter" would have been part of the same present that contained all the letters of the word. My error would have been to apply the instruction to the wrong letter. Or, I might have typed "errosr," another indication that all the letters are part of my present. In this case I would have taken in the wrong order two letters from the pool available for typing "errors."

The performance of music offers examples of the finite duration of the present. In reading and playing a rapid piano arpeggio, for example, we take in—we encode—the entire notation as a single unit. We tend not to read the individual notes, unless we notice something unusual about the details (a note not belonging to the overall harmony, for example). We perform the arpeggio as a unit. We do not think of each note, or of each finger motion, as a separate present. And we listen in the same manner: The perceptual unit is the arpeggio, not each individual note.[89]

Similarly, a skilled sightreader (or secretary taking dictation, or student taking lecture notes, or typist copying a document) reads ahead of where he or she plays. The timespan from the place being performed to the spot being read is simultaneously part of the performer's now. It is surely wrong to suggest that he or she is performing from long-term memory. The music being played and the music being read, though possibly several measures apart, are both part of the present.

One final example: The existence of the specious present is evident when, for example, we are concentrating on some task and someone says something to us. We have not been paying full attention to the speaker, yet we can—if we do so within a brief interval—"replay" in our minds what was said and "listen" to it a second time.

The notion of the specious present contrasts with Clifton's ideas on horizon. For Clifton, the duration of a horizon is highly variable, depending on context.

His ideas relate the perceptual present to the reorderings of multiply-directed and gestural time:

> The horizon refers to the temporal edge of a single field, which itself may enclose a multitude of events interpreted by the experiencer as belonging to this field. . . . In everyday language, we speak of "the business day," "the work week," or "the fiscal year." These terms help define the limits of what we mean by "now." Rather than defining "now" by how many random numbers we can repeat without error (or by similar psychological tests), the "now" is determined by the work of consciousness receiving the meaning of a situation. . . . The temporal horizon, in extending the size of the present, never completely covers the past and future. Rather, it still couples the present to these latter temporal modes, and we can still say that the identity of the present is established by what the past and future "see" of it. . . . I could not experience a melody if it did not also push back the borders of the present to include itself, as a singular event, in a single present. We say that we are listening to the *Waldstein Sonata;* we do not say that we are listening to this moment, then this moment, then this moment, etc., of the *Waldstein Sonata.* If we did listen that way, the sonata would not be identifiable. . . . The filling-out of any particular horizon is occasioned by reflection on the object itself. The content of any temporal horizon we care to inhabit is itself therefore determined by the particular object. . . . It seems not unreasonable that we can have . . . horizons within horizons.[90]

The essential difference between Michon's and James' nonhierarchic view of the present and Clifton's ideas of nested presents is that between perception and consciousness. The specious present is a perceptual fact, but there is more in consciousness than the present. Consciousness can turn its attention to the present, or even to some small segment of the present. But it can also include (parts of) the past and future. Memory and anticipation as well as perception are available to consciousness. But perception itself is limited by our biological capabilities. It does not have the flexibility of consciousness. The psychological present is the window of consciousness, through which much more is seen than what perception encloses within the window's frame.

Consciousness can include the past, as activated in the psychological present by retrieval mechanisms. Consciousness can even include the future, as made available through anticipation and expectation. The coexistence of past and future can make consciousness nonlinear. Clifton's nested, or interrupted, or alternating, or interpolated horizons are subsumed in the timeless present that I have been calling nonlinearity. Consciousness can be a patterned timeless whole, or it can attend linearly to unfolding events. It can, in other words, focus on either right- or left-brain perceptions of the world and the self. When it uses information from memory and anticipation as well as perception, consciousness functions nonlinearly, in a timeless present. In this mode it is able to process and understand unchanging musical structures, such as large-scale proportions. Consciousness accomplishes this understanding by an interplay of perceived present, encoded past, and, to a lesser extent (since expectation is a predominantly linear process), anticipated future. This chapter has attempted, among other goals, to explore some of the mental mechanisms by which memory and anticipation can be subsumed in perception.[91]

The next chapter considers music that calls directly upon the nonlinearity of consciousness. Music in vertical time tries to blur the distinction between past, present, and future. It does this by suppressing their boundaries, by refusing to offer cues for chunking, and by suggesting horizons that extend to infinity. It is a nonhierarchic, timeless, holistic music that challenges traditional perception and invokes a right-brain consciousness.

Chapter 12

Time and Timelessness

12.1 MODERN VALUES, TIME, AND SCHIZOPHRENIA

We live in a schizophrenic age, as social commentators have often told us. Modernist art, which discovered the subjectivity of the unconscious early this century, has traditionally taken the irrational mind as its prime subject matter. The most extreme modernist music, that which unfolds in moment time, mobile form, and particularly vertical time, gives voice to the schizophrenia of contemporary Western culture.

I am not, of course, accusing experimental composers of actually suffering from mental illness.[1] If there is a sickness involved, it exists in the society that produced these composers, not in the musicians themselves. I find avant-garde composers as a group neither more nor less sane than other composers. Nonetheless, I *am* suggesting that there are certain specific ways in which the temporal structure of "nonteleological" music (Leonard Meyer's term—see Section 2.12) does parallel that of schizophrenia. My use of psychiatric terminology, and my references to the theories of certain psychoanalysts, should be taken as "descriptive and not diagnostic"[2] of the time experiences of nonteleological music.

In his book *Time and the Inner Future,* psychiatrist Frederick Melges quotes an acutely schizophrenic patient: "Time has stopped; there is no time. . . . The past and future have collapsed into the present, and I can't tell them apart."[3] This time "distortion," as psychoanalysts call such experiences, is typical of people suffering from certain mental illnesses. Critical left-hemispheric functions of the schizophrenic's brain are suppressed, so that much of the information he or she receives is not indexed as past, present, or future.[4] In a remarkably similar manner, the holistic music of vertical time telescopes past, present, and future by minimizing the significance of the sequential order of events (this is not strictly true of process music; see Sections 2.12 and 12.7). Vertical music denies the past and the future in favor of an extended present. The past is defeated because the music is in certain fundamental ways unchanging, nonlinear, and ongoing. It appears to have come from nowhere other than where it presently is. Its refusal to provide cues for chunking makes remembering specific events or information difficult, if not irrelevant.[5] Such music tries to thwart memory in order to focus on the present, the now. Similarly, there is little implication toward the future in this music, other than that it will continue, largely as it has been, without major change or articulation. Future as well as past orientation is minimized. The future, to the extent that it is anticipated at all, is expected to be the same as the present. This kind of music tries to create an eternal now by blurring the distinction between past, present, and future, and by avoiding gestures that invoke memory or activate expectation.

Composer Philip Glass describes the temporal continuum in his 4½-hour work *Music in Twelve Parts* (1974):

> When it becomes apparent that nothing "happens" in the usual sense, but that, instead, the gradual accretion of musical material can and does serve as the basis of the listener's attention, then he can perhaps discover another mode of listening—one in which neither memory nor anticipation (the usual psychological devices of programmatic music, whether Baroque, Classical, Romantic, or Modernistic) have a place in sustaining the texture, quality, or reality of the musical experience. It is hoped that one would be able to perceive the music as a . . . pure medium "of sound."[6]

The more deeply we listen to music in vertical time, the more thoroughly we enter the timeless now of the extended present. But, however much we become part of the music, we do not totally lose contact with external reality. We listen, after all, in a concert hall, or living room, or loft, or some other environment normally associated with experiences that involve past and future, memory and expectation. This is the crucial difference between vertical time experiences and schizophrenic time experiences. The latter can be terrifying, because a person's sense of absolute time actually disappears as the future and past become not simply unimportant but nonexistent. Music in vertical time can provoke intense and unusual responses, but it does not destroy the temporal continuum. Rather, it offers an alternative. It gives us the means to experience a moment of eternity, a present extended well beyond normal temporal horizons, without forcing us to lose our grip on reality. The extended present of vertical time can offer a different reality, distinct from yet similar to the social unreality of schizophrenia.

Schizophrenia and vertical music are not the only areas of human life in which the experience of an extended or timeless present is encountered. According to Freud, both dreams and the unconscious are timeless.[7] Events occur in unpredictable, illogical sequence in dreams. Linear causality is absent. Past, present, and future are telescoped together. Similarly, the unconscious mind does not operate according to linear principles. Freud wrote, "the processes of the [unconscious] . . . are timeless; i.e., they are not ordered temporally, are not altered by the passage of time; they have no reference to time at all."[8] Meditation also leads people to focus on the present.[9] Psychiatrist Melges believes that meditation, dreams, certain mental illnesses, hypnosis, psychedelic drugs, and sensory deprivation are all able to create feelings of timelessness. They do so by diminishing linear thinking and goal orientation.[10]

It is important to distinguish the feeling of timelessness invoked by these mental states (and by vertical music) from the feeling that time has slowed to a standstill. *Time frozen* temporarily in an eternal present is not an exaggeration of *time slowed.* People who have not cultivated the ability to enter deeply into vertical music tend to experience the latter: time slowed down, the time of boredom. They become acutely aware of time, as it seems to imprison them. All they can think about is escaping an all-consuming time that has ceased to move. Listeners more sympathetic to vertical music are more likely to experience *timelessness*—the lack of time—than *stopped time.* In his explanation of the difference between these two species of temporal experience, psychoanalyst Peter Hartocollis writes about extremely

> . . . slow time, when consciousness becomes dominated by the sense of time. Then time becomes one with the wish—time is the wish and the wish is time. As such, time becomes an affect of its own, disposing of all other affects. Indeed, when a person becomes preoccupied with the idea of time, he is no longer able to experience affects in a meaningful way. . . .
>
> On the contrary, when one is not concerned with time, one is likely to see oneself as happy—timelessness or the sense of eternity being identified with the condition of ecstasy. . . . The essence of [this] mystical experience . . . is in its complete freedom from any sensual or aggressive wish, the freedom from internal pressure and perception of the surrounding world as devoid of any exciting elements, threatening or promising possibilities. The concept of time as a dimension of reality that defines self from object ("succession of events") is canceled and replaced by a sense of unity. . . . The remarkable thing about such a condition is that the person who experiences it does not lose consciousness of either himself or the surrounding reality. On the contrary, he is allegedly able to have a broader sense of reality concerning himself as well as the world around him.[11]

A contrasting view is that of Thomas Clifton, who does not accept the notion that musical stasis can create the experience of timelessness. His argument, though problematic, needs to be answered:

> Consider a single tone, prolonged without any change of dynamics, vibrato, or timbre. Now one might be led to believe that under such circumstances, which involve an absence of spatial transformation and hence movement, we encounter a condition of timelessness. But this is to commit a twofold error: (1) the first is to equate the absence of spatial transformation with the absence of time; (2) the second is to omit the activity of consciousness from the discussion. With reference to (1), there are other kinds of transformation than spatial transformation. Time, as prolonged in a tone, is such a transformation. There is still activity: the tone *is being* prolonged; it *is* enduring. The prolonged tone is not given all at once, nor does what is given remain as such. To the extent that even a prolonged tone reveals, within itself, a past, a present, and a future, it also reveals itself as a changing event, and hence as a temporal process. And when one brings the activity of consciousness into the picture, this allegedly static prolongation becomes a swarm of activity. Even with a single prolonged tone, one can freely direct one's consciousness to its "insides," and listen now to its bottom edge, now to its top edge, or again to its overtone content, or its pitch level, its intensity, and its timbre. One can listen primarily to its pastness, or to its presentness, or to its future. One's conscious attitudes can vary from lively anticipation, to a more neutral act of awaiting its termination; or again, our response can become one of extreme

> pain, as the prolonged tone becomes a form of torture. Finally, the tone can range from being the focal point of consciousness to a point on the horizon of consciousness, providing a setting for other thoughts, feelings, or volitions which may or may not have anything to do with the tone itself. With all this activity going on, we can hardly say that a prolonged tone approaches the condition of timelessness![12]

Clifton understands that unchanging music can invoke active responses in a listener. His discussion is similar to my sculpture analogy (Section 2.12): The listener, like the viewer of sculpture, determines his or her own time experience and directs his or her own attention. Where Clifton goes wrong is in setting consciousness in opposition to timelessness. The mind is certainly free to turn itself toward different stimuli in an extended present. The critical factor is the absence of large-scale and/or linear change in the music. Musical stasis, if it endures long enough, does indeed induce a state of timelessness. How we mentally explore this timelessness can vary considerably during the course of a performance, but there will be no linear connection between one listening attitude and another (or, more accurately, if there is such a connection, it will be created solely by us and within us, not by or in the music).

Clifton says that the lack of motion or of "spatial transformation"—change of one musical event into another—does not lead to the absence of time. I agree. The avoidance of motion leads to a special kind of time, which I am calling vertical. Vertical time does exist. It can induce in a listener a feeling of timelessness. But the term "timelessness" does not, despite its etymology, imply that time has ceased to exist, but rather that ordinary time has become frozen in an eternal now. Freud's definition of timelessness, quoted above, is apt: no temporal order, nothing altered by the passage of time, no reference to (absolute) time at all. The extended present can exist. When it does, only one kind of time is suspended while another kind, that we may call (paradoxically) the *time of timelessness,* replaces it.

Thus Clifton's "swarm of activity" is not ignored by the concept of musical timelessness. Quite the contrary. Since vertical music refuses to offer motion, contrast, or progression, it demands that consciousness be particularly active. The alternative is boredom. Anyone who cannot or chooses not to listen creatively and intensely (whose consciousness, in other words, does not participate actively) cannot make sense of nonteleological music. The consciousness that understands vertical time attends, as Clifton explains, to the music's "insides," top and bottom "edges," overtones, timbre, and so forth.

12.2 PERSONAL EXPERIENCES WITH TIMELESSNESS

Let me attempt to explain the feeling of timelessness by relating two personal experiences. I attended about three hours of an 18-hour performance of Erik Satie's *Pages mystiques* (1893) the middle movement of which is the infamous *Vexations.* This movement consists of four eight-bar phrases (the barlines are not notated), each with the same bass line (two of the phrases consist of the bass alone). Satie indicates that the movement is to be played 840 times in succession.

Although this instruction may have been one of the composer's cryptic witticisms that he typically wrote in the margins of his scores, several present-day musicians have decided to take it quite seriously and literally. Thus a team of pianists agreed to play *Vexations* at the Oberlin Conservatory, in 1971. Every twenty minutes a new pianist took over, as unobtrusively as possible. The performers tried to play evenly and to imitate each other totally, so that every repetition was close to being the same.[13]

The piece, and in particular this performance of it, invokes the nonlinearity of vertical time. Whatever linearity is inherent in the four phrases soon gives way, after numerous repetitions, to an extended present in which the music neither grows out of earlier events nor implies later events. When I first entered the concert, I listened linearly. But I soon exhausted the information content of the work. It became totally redundant. For a brief period I felt myself getting bored, becoming imprisoned by a hopelessly repetitious piece. Time was getting slower and slower, threatening to stop.

But then I found myself moving into a different listening mode. I was entering the vertical time of the piece. My present expanded, as I forgot about the music's past and future. I was no longer bored. And I was no longer frustrated, because I had given up expecting. I had left behind my habits of teleological listening. I found myself fascinated with what I was hearing. The music was not simply a context for meditation, introspection, or daydreaming. I was *listening*. True, my attention did wander and return, but during periods of attending I found the composition to hold great interest. I became incredibly sensitive to even the smallest performance nuance, to an extent impossible when confronting the high information content of traditional music. When pianists traded off at the end of their twenty-minute stints, the result was an enormous contrast that opened a whole new world, despite their attempt to play as much like each other as possible. What little information I found in the music was in the slight performance variability, not in the notes or rhythms.

I never lost touch with myself or my surroundings. Although I listened deeply enough to the music to accept its extended present, I never ceased to be aware of my mental and physical environment.

After what seemed forty minutes I left. My watch told me that I had listened for three hours. I felt exhilarated, refreshed, renewed. I had been deeply affected by simple, repetitive, largely nonhierarchic, predictable music—music with little information content, a performance exhibiting no attempt to be expressive. This impersonal music had enabled me to create for myself a very personal feeling of timelessness.

Was this a schizophrenic experience? Like a mental patient, I lost touch with past and future as I became engulfed by the present. It became not so much difficult as irrelevant to distinguish past, present, and future:[14] The music of each was the same. Yet, on another plane, I remained aware of my own past and future beyond this performance. I never completely forgot that I was a person sitting in a concert hall listening to an unusual piece of music. I never completely lost consciousness of my linear body processes (which is why I had to leave after three hours). What the performance provided was a temporal experience akin to that of schizophrenia, but in a less extreme form and with none of the attendant fears. The nonlinearity of the *Vexations* performance offered an alternative to, perhaps even an antidote for, a sometimes excessively linear lifestyle. But my linear time still existed before and after, and even during, the performance.

In this experience with vertical music, my subjective time appeared to contract with respect to clock time. Three hours seemed like forty minutes. Yet this reaction is not the only possible one. Let me relate another experience, in which vertical time resulted in an apparent dilation of clock time.

At the Bennington Composers Conference in August 1970, a group of composers decided to present a happening. We were interested in superimposing many different experiences, in order to create a dense fabric of constant stimuli. I contributed the tape of a half-hour electronic composition. I also projected various abstract and surreal slides on several screens. There was an organ performance, a film projected on the organist, a magician, traditional musical performances, actors, and all manner of spontaneous additions. All these events went on simultaneously and continuously. Any linearity that may have been present in any one layer was obliterated by the collage of other layers. The performance was an extravagant embodiment of vertical time.

The event was presented without rehearsal. If there had been a rehearsal, then my time distortion during the performance would no doubt have been less extreme. The production began at 7:00 p.m. The noise level was consistently high, and the visual panorama was dizzying. I found myself, although performing, focusing my attention on one layer, then another, and then various combinations of layers. I had planned to coordinate my projections with my tape, but I could scarcely make out its sounds in the din.

After what seemed to be a couple of hours, everyone spontaneously agreed that it was time to stop. Most participants and audience left. I remained behind to help put the hall back in order. When I went to the tape deck to retrieve my tape, I discovered that someone had stopped my piece at about the three-quarters point. I assumed that the engineer had rewound it and started it over several times.

I loaded my tape and slides into my car. Only then did I glance at my watch. It was not yet 8:00! What had seemed like a two-hour performance must have lasted under 25 minutes by the clock. My tape had not been rewound; it had not played all the way through even once.

My experience of time dilation had resulted from sensory overload. So many stimuli were present, and my attention to them (probably because of the emotional energy I was investing as a participant in and planner of the happening) was so intense, that I had processed far more information than I do in a normal 25-minute period. Thus, according to the information-processing model of duration perception (see Section 11.6), my sense of duration was expanded accordingly. Because of my involvement in the performance, I took it not as one undifferentiated mass of stimuli, such as can be heard in thickly textured orchestral compositions (see Robert Morgan's description of Ives' dense textures, quoted in Section 11.5). I was instead induced to find, perceive, and somehow encode a tremendous amount of information, so that my perceived duration was enormous. I experienced a vastly extended present, approaching timelessness.

These two experiences show that, once a stimulus in vertical time frees a listener/viewer from the habits and constraints of linear progression, the resulting nonlinearity can produce temporal experiences that are far removed from those of the clock. But (as demonstrated in Section 11.5) we cannot generalize about how subjective duration relates to objective lengths. In timeless experiences, subjective time may seem either contracted or dilated with respect to clock time, depending on whether the amount of information in the stimulus is large (as in the happening) or small (as in the *Vexations* performance). What matters is not whether time seems to have been short or long (once we consult our watches) but rather the quality of our timelessness. My experience with the happening and my experience listening to Satie's *Vexations* were similar, in that clock time ceased to matter. It became a factor of interest only once the experience had ended and I began to wonder how long it had "actually" taken. But the internal temporal qualities of both experiences were remarkably similar: I was on both occasions in an extended present in which progression, cause and effect, memory and anticipation, and linearity were suspended. I was able to focus my attention on various details of the music, with the understanding that they were constant.

12.3 ALTERED STATES

What I experienced at the Bennington happening is remarkably similar to the way Melges describes "the prolongation of the present" that characterizes the early stages of certain psychoses:

> When mental sequences become mildly disconnected, present experiences seem to last longer since they are relatively isolated from past and future events. That is, they seem to "stand alone." Rather than the future continually becoming present and then fading into the past as in normal consciousness, the disconnection of sequences makes the present seem relatively isolated from the past and future. Moreover, the inability to sustain a continuous train of thought [= the absence of musical linearity] prompts the person to attend to a variety of present stimuli that ordinarily would be excluded from consciousness. As a result, for a given amount of clock time, the person is aware of many more events than usual . . . , [and this gives] rise to the prolongation of the present.[15]

Melges points out that such experiences are common not only in psychosis but also in the initial stages of THC (marijuana) intoxication. I am not suggesting that the participants in the Bennington happening were "high" (one may have been, but most certainly were not), nor that composers and/or performers of vertical music are necessarily drug users. My point is that the experience of the extended present, or timelessness, is available to the human mind from a number of sources: drugs, mental illnesses, and vertical music, among others. As psychiatrist Roland Fischer points out, drugs "only provoke symptoms which are already present within the cerebral organization."[16] Tautologically, we must inherently have the capacity for psychedelic experiences if drugs are going to be able to induce them. And, if we have the capacity through such means to experience timelessness, then it is certainly possible that other stimuli, such as vertical music, can also call forth a similar experience.

While it is surely no coincidence that vertical music had its greatest popularity at the height of the 1960s' drug culture, it would be a mistake to postulate a causal relationship between drugs and nonteleological music. If that were the case, then vertical music would be no more than a sidelight to music history. On the contrary, nonteleological music is a statement of an important twentieth-century aesthetic that existed long before drug use became widespread. The relationship to drugs is tangential, as is the relationship to mental illness. It is partly because drugs[17] can induce and schizophrenia can produce it that we know timelessness to be a real human experience.

Timelessness is not simply a metaphor. Nonlinear music can induce in a dedicated and sympathetic listener a truly extended present, a real dissociation from the past and future, a now that is eternal even though it is destined to stop. It is not necessary, nor even desirable, to be intoxicated with drugs or to be a schizophrenic in order to appreciate such music. Numerous people have told me that it is not pleasant to listen to vertical music while "high," probably because a person in a drug-induced extended present will not find sufficient information in the already timeless stimulus of a vertical composition. Similarly, I wonder whether a schizophrenic would be able to concentrate intensively enough to give him or herself over to such a piece of music.

12.4 THE FUSION OF MUSIC, PERFORMING, LISTENING, AND ENVIRONMENT

Another relevant feature of some drug intoxications and certain mental illnesses is the fusion of the self with the environment. The person feels a unity with his or her surroundings, a mystical oneness with the universe.[18] This experience is common in certain Eastern religions, but in Western culture it comes more often from chemicals, mental problems, and nonteleological art. During the 1960s many experimental musicians sought by various means to diminish the distinction between composers, performers, and listeners, and between piece and environment. Their object was to destroy the difference between art and life.[19] The motto of the influential Fluxus group, formed in New York in the early 1960s, was "Art Is Life, and Life Is Art."[20]

Thus we find music that intermixes performance and listening spaces. In Xenakis' *Terretektorh* (1966) and Donald Erb's *Prismatic Variations* (1983), for example, members of the orchestra are scattered throughout the audience. Other music uses environmental sounds where we expect traditional music sonorities. Cage's famous *4′ 33″* (1952), in which the performer sits without making any sounds for the prescribed duration, is *not* a silent piece. When performed in a normal concert setting, it leads us to expect musical sounds. When the only noises to reach our eardrums are the incidental sounds inside and just outside the performance space, we hear those sonorities *as the music*. Similarly, whenever Luc Ferrari's tape piece *Presque rien no. 1* (1971) is played in a conventional concert, we hear as music the recorded but largely unaltered sounds typically heard at a beach.

Some compositions parody the concert ritual in an attempt to erase the distinction between the piece and its setting. In Stanley Lunetta's *Music for Bandoneon and Strings* (1967), for example, the "strings" are wires attached to a performer, preferably David Tudor, pretending to be a marionette. The performance starts when the "David Tudor" is carried into the performance area, holding his bandoneon (an accordion-like instrument). The strings are attached, and then the performer is physically manipulated by three "string players."[21] The concert setup is an integral part of this piece. It is artificial to distinguish between the performers, the staging, and the work.

Some music blurs the distinction between audience and performers. In a work of Ken Maue,[22] for example, the audience is instructed, "Say the name of every person you have ever known." I have asked various groups of people to perform this composition. At first there is an awkward silence, followed by a few tentative names spoken quietly and hesitantly. As people become more accustomed to the task, the volume of sound increases. A steady level of sonority is reached. Each person hears a unique version of the piece, as he or she listens to names being spoken nearby but cannot distinguish names across the room. Also, the chain of associations built up in each person's mind forms a personal counterpoint to the external piece. This is one work where it is necessary to let one's mind wander. Eventually, people begin not to remember any more names, and the sound mass becomes sparser. Soon there are ensemble silences, punctuated by isolated names. Names heard tend to remind performers/listeners of people they had forgotten, and thus the mass of spoken sound returns. The wave-like alternation of sparse and dense sound continues for a considerable period of time.[23] There is no distinction between performers and audience in this piece. Yet it is not a chaotic work. It has a definite *musical* structure, which is more or less constant from one performance to another.

In several live electronic works of the 1960s, the score consists primarily if not exclusively of a circuit diagram. The instrument becomes the piece. To perform such a work you need to construct the circuit and then simply turn it on and let it produce its sounds.

Other works seek to provide personal sound experiences which can be heard by no one else. In Daniel Lentz's *Hydro-Geneva: Emergency Piece No. 3* (1969), each willing member of the "audience" has hydrogen peroxide poured into an ear and then listens to the sound of earwax melting. Each audience member becomes performer, listener, and even musical instrument; each person hears only his or her own private performance.

Such pieces set up musical/theatrical situations and explore them in nonlinear ways. The situations *are* the pieces. They start and continue but do not change. The pieces make strong, if obvious, statements about the essential identity of the listener, the performer, the piece, and/or the space. It is appropriate that much of this music (the "Names Piece" is a possible exception, in part) invokes vertical time, since the destruction of the self-other dichotomy leads, as psychoanalysts have demonstrated, to a feeling of timelessness. We may laugh at first at the whimsicality of *Music for Bandoneon and Strings,* but the piece lasts far longer than the joke. We may be amused or annoyed by the refusal of the performer to play anything in *4′ 33″*, but we soon get beyond that feeling and get on with serious listening. Each of the pieces offers an unchanging sound/sight world, that includes music, performer(s), and audience. The pieces may at first take advantage of listeners' expectations of what a concert should entail, but after the initial impact is gone their world remains as an unchanging entity to be explored during the extended present.

Not all vertical music seeks in so obviously theatrical a fashion to destroy the difference between the self and the work. Even in vertical music performed by traditional instruments in traditional settings, however, the audience is invited into the special world of the extended present. The listener may come to a piece expecting expression, progression, linearity, variation, development, contrast, themes, motives, and so forth. A vertical piece refuses to provide the comfortable elements of traditional composition. The music is not really "composed," in the traditional sense, but simply exists. Earle Brown feels that "one should compose as little as possible, because the more one composes the more one gets in the way of time becoming the governing metaphor of music."[24]

A vertical piece is therefore not usually grouped rhythmically (or at least not in any sophisticated way), not hierarchic (or at least has very few hierarchic levels),[25] and not expressive (of anything other than the aesthetic reasons for its existence). Nonteleological music, far from the distant abstraction it is sometimes accused of being, is utterly concrete. That is, it is "about" nothing other than itself; it *is* nothing other than itself. It does not refer to extramusical ideas; it does not communicate any ideas at all.[26] Philip Glass has said:

> Music no longer has a mediative function, referring to something outside itself, but it rather embodies itself without any mediation. The listener will therefore need a different approach to listening, without the traditional concepts of recollection and anticipation. Music must be listened to as a pure sound-event, an act without any dramatic structure.[27]

Nonteleological music has only its present, but no past and no future. It simply *is*.[28] Its purpose, according to Cage, is to be perceived, not to communicate.[29] "The wisest thing to do is to open one's ears immediately and hear a sound suddenly before one's thinking has a chance to turn it into something logical, abstract, or symbolical."[30]

If a nonteleological piece is to be appreciated and enjoyed, the listener must become a creative participant in making the music. He or she must chunk it, according to individual criteria (since the music usually lacks unequivocal cues). He or she must create its hierarchies. He or she must provide contrast, by focusing attention on different aspects. The listener can thus become *more* important to the music than the composer. In this way he or she becomes a part of the music, and thus the distinction between the self and the other, the listener and the music, is minimized.

12.5 THE AESTHETICS OF VERTICALITY

Why, then, do we need vertical music at all? Cannot a person select any sound, or even any situation, and treat it as music? Ideally, the answer is yes. Cage believes, according to composer Wim Mertens, that "music fulfills itself when it teaches people how to listen, so that they may end up preferring the trivial noises of daily life to music."[31] What nonteleological music shows us, then, is our own creativity. We should be able to take many of life's experiences, ignore their referential and semantic content, and mentally treat them as music. It may be difficult to experience a production of *Hamlet* as a series of isolated, nonreferential sounds and images—to ignore, in other words, the meanings of the words and to hear them just as sounds. But it is certainly possible to hear traffic noises, for example, or words in an unknown language (sounds with no semantic content) as music.

Music is what we hear as music. Literary critic Morse Peckham, whose 1965 book *Man's Rage for Chaos* has been important to several composers of vertical music, defines art in a behavioristic manner. We can adapt his definition to music: Music is that which causes people to perform the role of music perceiver.[32] The advantage of this definition is that it does not give a checklist of attributes that all music is supposed to possess. Thus it works equally well for traditional and experimental music, which may have virtually nothing in common. We know how a music perceiver traditionally behaves, both externally (attending a concert, for example) and internally (mentally encoding a passage, for example). If recorded traffic noise is played through onstage loudspeakers in a concert hall, we are *supposed* to (whether or not we actually do) listen to it as music. If the same noise is encountered on a busy street, it may well not be (used as) music. Thus the same stimulus can be music on one occasion and not on another. When we listen to traffic noise as (vertical) music, we use primarily holistic right-hemisphere mental processes, in contradistinction to the left-brain, analytic, sequential processes we may use to understand the traffic as traffic.[33]

I am not prepared to say that the nature of the stimulus does not matter, however. We may be able to hear traffic noise as music, but the experience will not be the same as when we hear a carefully composed vertical piece. If vertical time brings us into a timeless present in which we begin to merge with the music, what happens within our minds must depend deeply on the nature of that music. Thus, although nonteleological music permits us to make almost anything into music, each stimulus and each piece provides a unique experience.

The sound-worlds of two vertical pieces, or even of two performances of the same vertical piece, can differ considerably, as can the physical environments in which those performances are heard. The temporal forms are similar, however. A work that elongates the present is necessarily unchanging in most of its dimensions. Otherwise, it would move toward a future, or at least replace one present with another. As a celebration of the present, a vertical composition must be sonically and/or conceptually static. According to composer Christian Wolff:

> The music has a static character. It goes in no particular direction. There is no necessary concern with time as a measure of distance from a point in the past to a point in the future, with linear continuity alone. It is not a question of getting anywhere, of making progress, or having come from anywhere in particular.[34]

A composition in which each sound exists for itself, rather than as participant in a progression, is a work without beginning or end. There can be no processes, nor even gestures, of beginning or ending (see Section 6.2) because each instant is equally related (through similarity) to each other instant. One event does not lead to another (whether adjacent to it, as in linear time, or removed from it, as in multiply-directed time). Each event exists only for itself. Therefore no event can be the unique culmination, or ultimate source, or final resolution, of the piece. A performance needs to start and stop, but in the absence of an overriding linearity, starting and stopping become arbitrary. The performance might have started, or stopped, earlier or later. Because the music is substantially unchanged throughout, and because it is without distinct gestures, we listen to an arbitrarily bounded segment of a potentially eternal continuum. The present that the work extends suggests itself as infinite. Past and future disappear as everything in the piece belongs within the horizon of now. Mertens has written:

> Any sound can be the beginning, the continuation, or the end, and no sound is more important than the next. The exclusive musical perspective found in dialectial teleology has been replaced by a randomly selected perspective, a phenomenon Cage called "interpenetration." By this he meant that every musical element in time and space is related to every other musical element, has an equal value, and works in all directions at the same time, without the existence of cause-and-effect relationships. The fact that each sound has the same value implies equally that each sound has no value. Cage sees sound only as a fragment in the time-continuum.[35]

12.6 THE SOURCES OF VERTICAL TIME

Vertical music reached a pinnacle in the third quarter of this century. This period saw the production of such uncompromisingly vertical pieces as Stockhausen's *Stimmung* (1968), which sustains one chord for 75 minutes; the conceptual works of La Monte Young[36] and Philip Corner; early minimalist music like Steve Reich's *Violin Phase* (1967), Philip Glass's *Music in Fifths* (1969), and Frederic Rzewski's *Les Moutons de Panurge* (1969); and numerous works of Cage, including the *Variations* pieces, *Cartridge Music* (1960), and *Atlas Epicticalis* (1962). The composer whose music perhaps best epitomizes vertical time was Morton Feldman. While Cage has remained concerned with the compositional process, which can be linear even when the resulting music is not, Feldman simply put down one beautiful sound after another.[37] Feldman's aesthetic had nothing to do with teleology: "I make one sound and then I move on to the next."[38]

Vertical music was not invented in the 1950s. There are hints of vertical time in the frozen harmonic world of Webern (see Section 7.14) and in the stasis of Stravinsky (see Section 8.5) and Messiaen (see Section 8.6). Satie's *Vexations* is not the only early vertical piece. Ives' *In the Night* (before 1911), for example, refuses to progress and thereby suggests a timeless present. This piece is part of the *Set for Theater Orchestra* (1906-1911), which also includes *In the Cage*, a movement with neither functional beginning nor ending.

More recently, the aesthetic of vertical time has become less a statement and more a compositional tool. In the eclectic music of the 1980s, vertical nonprogressions are often combined with other, more linear species of temporality. In some pieces, linear middleground and foreground progressions may be played off against a static background.[39] Vertical time no longer necessarily entails a one-dimensional aesthetic statement: It has become a compositional possibility. It no longer needs to be used to educate listeners about their own creativity (see Section 12.5).

Pieces such as those mentioned in Section 12.4 may be thought of as eccentric or extremist. Such an opinion is culture-bound, however. Because Western culture is dominated by left-hemisphere processes, we are often uneasy with holistic music. Other societies, however, favor the right brain. Section 2.3 mentions several cultures where nonlinear thinking prevails. The music of such societies, not surprisingly, is often vertical, appealing to the right hemisphere.

Musicologist Alexander Ringer has studied Macam improvisations in the Middle East. He has discovered that there are no logical connections between phrases. A performance has no distinct beginning (although sections may), as warming up and tuning of instruments blur into the actual performance.[40]

Ethnomusicologist Ruth Stone has found in Kpelle music from West Africa structures that resemble Western vertical and/or moment time. She describes the performance in which "drama, narrative, and music integrate in the creation of time":[41]

> The . . . epic has neither a precise starting nor a precise concluding episode. . . . The teller is free to begin and end with any episode. The absence of a necessary linear progression between episodes in some African epics is very reminiscent of the situation Alton L. Becker describes for Javanese shadow theater (*wayang kulit*). A *wayang* plot is built on coincidence and may begin at any temporal point in the story. . . . Dramatic moments [in the African epic] when the enemy is defeated are downplayed and muted, . . . blunting linear progression. . . . The episodes created within this epic are developed into what I have . . . termed *expandable moments*. At a variety of structural levels, moments envelop action with variable propensity to expand outward but not linearly. Such an approach to temporality recalls Georges Gurvitch's definition of time as a "continuity of heterogeneous moments." . . . As these moments expand, they at some point reach a limit. The participants leap conceptually to another moment and they proceed to expand this new moment.[42]

The nonlinear mode of thinking is present to some degree in everyone and in every culture. Our left-brain society has tried to suppress it. But, in reaction against the excessively linear values of our technological society, vertical music has become an important force in recent years. It is a holistic music that offers a timeless temporal continuum, in which the linear interrelationships between past, present, and future are suspended.

Temporal verticality is not peculiar to music. The creation of extended, static, nonlinear nows is common to many artworks of our century. The plays of Samuel Beckett, for example, create an extended present without past and future. Ruby Cohn explains that each Beckett play "seems to open in a time without beginning."[43] Her description is remarkably similar to mine of vertical music: "Beckett's plays are unfinal. Rather than [having] Aristotelian beginning, middle, and end, Beckett's plays are endless continua."[44] Cohn explains that *Waiting for Godot* (1949), *Endgame* (1956), and *Krapp's Last Tape* (1958) abandon absolute time, which governs most traditional dramas (at least within scenes), in order to create an "unending present."[45] In *Waiting for Godot,* repetition makes the play seem to go on indefinitely.[46]

> Human time is usually said to consist of past, present, and future, but in *Waiting for Godot* tense becomes tension. The present is thick and ubiquitous. Infinity threatens with its darkness and silence. Brave little incidents glisten briefly, but they are soon absorbed into the long gray wait.[47]

12.7 ANALYTIC INTERLUDE: *LES MOUTONS DE PANURGE*

Cohn's penetrating criticisms of Beckett's plays, only briefly excerpted here, exemplify the only viable way to analyze the extended present in temporal artworks.[48] A structural analysis of time in an artwork is not really possible when the time that work creates is a timeless present.

Similarly, music cast in vertical time can scarcely be analyzed, in the usual sense of the term, since our normal analytic methods are products of left-hemispheric thinking (see Section 12.8). It is essentially pointless to explicate a holistic, timeless experience in terms of sequential logic. Thus most discussions of nonteleological music are more descriptive—or prescriptive—than analytic.[49] It is not simply that adequate analytic tools have not been developed. There is a fundamental incompatibility between the nature of vertical time and the process of music analysis, at least as it is traditionally construed. Many of the things analysis values most are what vertical time pointedly denies: tonal, rhythmic, and metric hierarchies; contrast; closure; development. Most analytic methods are hierarchic, implicitly if not explicitly, but vertical music is antihierarchic.[50]

Edward Cone, who is not especially sympathetic toward it, succinctly explains the impossibility of analyzing nonlinear music, whether it is composed by chance or serial methods:

> When chance plays the major role in the writing of a work, as in Cage's *Music for Piano 21-52* [1955], logic . . . can take only an accidental part. The same is true of music written according to a strictly predetermined constructivistic scheme, such as Boulez' *Structures* [1952]. In neither case can any musical event be linked organically with those that precede and those that follow; it can be explained only by referring to an external structure—in the one case the laws of chance and in the other the predetermined plan. The connections are mechanistic rather than teleological: no event has any purpose—each is there only because it has to be there. In a word, this music is composed prescriptively, and the only possible or appropriate analytic method is to determine the original prescriptive plan. This is not analysis but cryptanalysis.[51]

Traditional analysis has little to say about vertical music, whether it is aleatoric or serial, or whether it is—to invoke once again the terminology of information theory (see Section 2.2)—highly redundant (a static work like, for example, Stockhausen's *Stimmung*) or largely nonredundant (a thoroughly serialized work, such as Boulez's *Structures* or Babbitt's *Composition for Twelve Instruments* of 1948).[52] Nonlinear principles govern entire works that exist at either extreme of the redundancy/nonredundancy continuum. Each event is a product of those principles, whether they generate a surface consistency (of considerable redundancy) or an elaborate compositional system (which may have internal redundancies of its own, despite the nonredundancy of the resulting music).[53] While linearity exists in the middle of this continuum (between the extremes of redundancy and high information, of stasis and determinism) the extremes are nonlinear. They generate the music of vertical time—predictable, undeviating, inevitable.

In practice, much vertical music retains vestiges of linearity, that can be analyzed both for themselves and in relation to a work's overriding nonlinearity. This is particularly true of process compositions (see Section 2.12), which move at even rates toward foreseeable goals. Such works are nonlinear because they are not hierarchic, and because their motion results from unchanging global principles. Their motion is so evenly paced and so predictable that it is not perceived as progression. As Lewis Rowell explains, continuous motion can easily imply stasis.[54] Because there are no (important) deviations from the music's predictable course, listening to a process composition can be a vertical time experience.[55]

In the score of Rzewski's *Les Moutons de Panurge,* the nonlinear principles of predictable motion are found in the instructions that accompany a 65-note melody (given in Example 12.1):

> Read from left to right, playing the notes as follows: 1, 1-2, 1-2-3, 1-2-3-4, etc. When you have reached note 65, play the whole melody once again and then begin subtracting notes from the beginning: 2-3-4- . . . -65, 3-4-5- . . . -65, . . . , 62-63-64-65, 63-64-65, 64-65, 65. Hold the last note until everybody has reached it. Then begin an improvisation using any instruments. In the melody above, never stop or falter, always play loud[ly]. Stay together as long as you can, but if you get lost, stay lost. Do not try to find your way back into the fold. Continue to follow the rules strictly.[56]

Les Moutons is a beautiful and fascinating piece. Its success depends on the melody itself as well as on the process of repetition. The same additive-subtractive principle applied to another melody might not produce as satisfying results. Compare *Les Moutons* to Rzewski's 1972 composition *Coming Together,* in which the melody has less character than Example 12.1, perhaps so that it will not take undue attention away from the spoken text, which unfolds by means of an additive repetitive process. In both works the melody itself is linear, although its manner of presentation soon transforms the composition into a nonlinear piece.

The melody of *Les Moutons* includes, prior to the final C, only two durations: eighth and quarter notes. Beginning with an eighth rather than a quarter helps to disguise repetitions, since no new beginning is articulated. The first two eighths tend to group rhythmically with the preceding music. It is, in fact, only after several repetitions that we understand aurally what the process of repetition entails. Example 12.2 shows how the opening sounds in performance. We hear five eighth notes in a row at the outset and again when we hear notes 4-5-6-1-2,

Example 12.1. **Rzewski, *Les Moutons de Panurge,* basic melody**

(end of the sixth and beginning of the seventh repetitions). Indeed, eighths tend to predominate in the early stages. Quarters begin to become prominent after a while. The maximum number of successive eighths eventually increases to six (notes 21-22-23-24-1-2). The greatest eighth-note intensity occurs when we hear seven eighths: 27-28-29-30-31-1-2. After that, no more than five successive eighths are heard.

Hearing successive eighths is important because it gauges activity. Successive quarters are also significant, but for a different reason: They imply the emergence of an even quarter-note pulse, which in turn leads to a certain degree of metric

Example 12.2. **Rzewski, *Les Moutons de Panurge,* opening**

regularity. At first we hear only isolated quarters (note 3). Once notes 7 and 8 are heard successively, at the end of the eighth repetition, we experience two quarters in a row. In the following repetition, notes 7-8-9 provide three successive quarters. Once these three successive quarters have been introduced into the melody, they remain for each subsequent repetition, until they are eventually eliminated during the second, subtractive half of the piece. Still later, at the end of the fortieth repetition (and remaining in subsequent repetitions), four quarters are heard in succession: 37-38-39-40. These four quarters imply the emergence, toward the end of the melody, of a largely regular 4/4 meter (notes 50-65), in which each measure has the same pattern of note values. This meter is established gradually, because each new note of the pattern is introduced in a successive repetition (the melodic repetitions are quite long by this point) and because each repetition also includes the metrically irregular earlier parts of the tune. It is only once the subtractive process has brought the melody down to only notes 50-65 that the 4/4 becomes pervasive. Example 12.3 shows the metrically explicit ending.

By the time Example 12.3 is reached, however, the musicians have undoubtedly gotten lost (see performance instructions above). I have been told by performers that it is virtually impossible to remain in unison for an entire performance (which lasts nearly twenty minutes), without writing out, and reading from, the entire sequence of melodic repetitions. Thus Example 12.3 is likely to be heard against itself in canon. If several musicians are performing, the canonic density may obscure the emergence of 4/4.

Paralleling the establishment of more or less regular meter is a change of mode. A-flat (last heard as note 36) is replaced by A-natural (first heard as note 46). Because of the repetition scheme, the mode with A-flat interpenetrates the F major mode until the latter emerges (during the subtractive phase) as pure (notes 37-65). The mode with A-flat starts as a four-pitch mode, until note 7 adds the pitch class E. Because of the considerable intervening time, the gradual addition of new pitch classes becomes quite important. The E (end of the seventh repetition) is followed by D (end of the twelfth repetition). The mode is completed (as an ascending F melodic minor scale) much later by the addition of G (end of the 37th repetition).

E functions as leading tone. Three times the melody arrives at E (notes 7, 26, and 40) without going on to F. F finally appears at the end of the 51st repetition. This important note resolves a leading tone that has been left hanging for perhaps five minutes. The note of resolution, reinforced at the lower octave (note 50) by an F that resolves several Gs (notes 33, 37, 42, and 45), is critical in the establishment of the 4/4 meter. Because of the repetition scheme, we hear three successive Fs (notes 50-51-1), which reinforce that pitch as modal center.

The rate at which we hear new notes—new information—decreases throughout the first half of the piece (there are no new notes at all in the second half). In the second repetition half of the notes are new; in the fourth repetition one-quarter are new; by the 32nd repetition we listen to 31 old notes before hearing a new one; by the 65th repetition only one note in 65 is new. The increase in the amount of time that elapses before we hear new notes is unusual:[57] In traditional music, repetitions tend to be shortened, because of the increased fa-

Example 12.3. **Rzewski, *Les Moutons de Panurge,* ending (barlines added)**

miliarity of the material. It is the large number of repetitions, plus the fact that they gradually increase in length, that makes the temporal continuum of *Les Moutons* vertical. A greater and greater percentage of the music becomes redundant as we listen through the first half. Less and less often do we hear something fresh. We perceive ever lessening information content. The music becomes more predictable, which is why the few strikingly fresh pitches (notes 33, 46, and 51) seem particularly significant. The linearity inherent in the melody is gradually replaced by the nonlinearity of predictability. While this process unfolds, the unison performance is likely to be replaced by canon, eventually having perhaps as many separate voices as there are participating musicians. Thus the carefully structured tune becomes submerged in a wash of attractive sounds. We hardly perceive the start of the subtractive process, which puts an end to the process of adding new notes. The gradual shortening of repeated segments is also scarcely noticed at first. Only once the A-flat disappears, and the F major mode takes over, do we begin to feel the impact of the shortening of timespans.

When, in addition to the F major, the 4/4 is established, a degree of linearity returns. Even in a densely canonic texture, the shortening of the timespans of repetition is striking. The repetitions in Example 12.3 get progressively shorter, but not at a perceptually even rate. The rate seems to accelerate as, for example, the 116th repetition (notes 50–65) drops one note out of 17, while the 127th repetition (notes 61–65) drops one note from only six. The ending can be quite exciting, despite the lack of new information and despite the predictability. Thus the ending, like the beginning, is somewhat linear. The timelessness of nonlinearity exists only in the work's interior.

Much of the foregoing analysis has focused on linear factors: the gradual addition of new notes; the increase in the number of successive eighth notes; the emergence of metric regularity; the long-range stepwise pitch connections; the progressive buildup of one seven-note mode that is then contradicted and eventually replaced by another seven-note mode; and the emergence of canons and the increase in their number of voices. Despite all this inherent linearity, listening to *Les Moutons* is a nonlinear experience, at least once we get beyond the beginning and before we are caught up in the drive toward the final cadence. This is so because of both the predictability and the thick texture (in performances with several musicians).

There is a more significant reason why *Les Moutons* is a vertical piece, however. Because all the progressions described in the analysis take place within very narrow limits, the piece strikes us as far more consistent than developmental, as more static than dramatic. After all, there are only two note values, the 4/4 meter toward the end is not vastly different from the earlier irregular meters, the total range of the melody is only an eleventh, there are only eight pitch classes in the piece, and there are not very many levels in the metric, rhythmic, or harmonic hierarchies.

It is not by accident that this analysis has studied the minimal linear aspects of the piece in considerable detail yet has had only general things to say about the nonlinearity. Once the three large nonlinear structures—the additive-subtractive process, the canonic procedure that results when the players get lost, and the melody itself—are described, what else can be said? Since these three structures are laid out in the score itself, the analysis really has nothing to add of large-scale significance. It must look instead to the smaller linear processes and details. They matter, since they make the piece a richer listening experience than many uncompromisingly nonlinear compositions. But it is a curious analytic situation when the less structurally important aspects receive most of the attention.

This situation is inevitable, however, as indicated at the beginning of this section. Traditional music analysis is most comfortable finding and explicating linear, not nonlinear, structures.[58]

12.8 TIME AND TIMELESSNESS IN THE PHYSICAL AND MENTAL WORLDS

The feeling of timelessness invoked in the middle of *Les Moutons de Panurge* is not an experience unique to vertical music. As stated earlier, it can be aroused not only by music but also through other art forms, certain mental illnesses, dreams, unconscious mental processes, drugs, and religious rituals. Vertical music does not create its own temporality but rather makes contact with a deeply human time sense that is often denied in daily living (at least in Western cultures). The significance of vertical compositions, and of many modernist artworks, is that they give voice to a fundamental human experience that is largely unavailable in traditional Western music.[59]

If timelessness is so widespread and important, then it is appropriate to ask what it really is. I have suggested (Section 12.1) that it is not simply the absence of time. There are too many facets of time, too many species of time, for the idea of its nonexistence to make much sense. The purpose of this section is to consider the concept of timelessness in relation to time in both the physical and mental worlds.

To do so I invoke the hierarchical theory of time, as developed by J. T. Fraser. This theory offers significant insights into the nature of timelessness and of other temporalities. As Fraser's theory is complex and multifaceted, it is impossible to give more than a sketchy account of it here.[60] It is relevant to our discussions because it places timelessness in a conceptual framework that includes other temporalities, which are in turn reflected in the musical time structures outlined in Chapter 2. Fraser's theory therefore allows us to understand not only vertical time but also many of the other temporalities of music as metaphors for time in the external and internal worlds.

Fraser believes that time has evolved throughout the history of the universe. He does not mean simply that man's concepts of time have grown and changed, but that time itself has progressed onto ever higher levels. This evolution has taken place in the physical and biological worlds, and it is recapitulated in human development from birth to maturity. Fraser distinguishes a number of specific evolutionary levels of time, each of which has its own characteristics. The lower levels are more concerned with *being*—with the unchangeable, with the eternal—while the upper levels involve *becoming*, the changeable and the temporal (recall Fraser's idea, discussed briefly in Section 1.1, that being-time and becoming-time can coexist, since time does not obey the law of contradiction). Each level, or Umwelt,[61] has its own temporal horizon, its own laws, and its own "mood." As time, the world, man, and civilization have evolved to higher Umwelts, the lower (earlier) levels have not disappeared. Thus man today can find himself in environments or contexts that suggest not only nootemporal (linear) but also atemporal, prototemporal, eotemporal, and biotemporal Umwelts.

The levels are, from lowest to highest:

1. *Atemporality.* In the atemporal Umwelt, the concepts of past, present, and future do not exist, nor do those of before and after. The only possible temporal relationship between events is simultaneity. In the physical world, atemporality exists on the level of particles that travel at the speed of light and have no mass if at rest: photons, neutrinos, and possibly gravitons.[62] The science that studies atemporality is Einstein's special theory of relativity. The "mood" of atemporality is one of chaos and emptiness.[63] In the context of the mind, the Umwelt of atemporality is extreme schizophrenia (see Section 12.1). In music, the most uncompromisingly vertical compositions suggest the timelessness of atemporality.

2. *Prototemporality.* In the prototemporal Umwelt, events are not necessarily simultaneous, but their temporal position is distinguished only statistically. This is the world of nonrelativistic particles,[64] in which we can locate not individual particles but rather where (in space as well as time) collections of them tend to be. The science of prototemporality is quantum mechanics. In quantum mechanics, the concepts of before and after have meaning only in a probabilistic sense. Events need not be simultaneous, but it is not meaningful (nor, in fact, possible) to determine which of two specific occurrences happens first. Similarly, causation is probabilistic: One event cannot be said to cause another, yet causes can exist in the totality of prior events. The prototemporal mood is not chaotic, yet order is not completely determined. The musical metaphor for prototemporality is moment time, in which there *are* separate events (in pure vertical time, on the other hand, an entire composition is a single extended event). These moments are heard in what seems to be an arbitrary, rather than a determined, order, yet there are global reasons—statistical causes—for their presence in a particular composition. Form is understood cumulatively as the totality of constituent events.

3. *Eotemporality.* In the third temporal Umwelt, direct causation does exist. Two events can be in a cause-and-effect relationship, but this relationship is symmetrical. In other words, it is impossible to tell which of two events, linked as cause and effect, is the cause and which is the effect. Thus succession is meaningful but its direction is not. A past-present-future ordering is indistinguishable from a future-present-past ordering. The physical world of eotemporality is that of Newtonian mechanics, in which each action is necessarily wedded to an equal and opposite reaction. In any action-reaction pair, either event may be thought of as the action and either as the reaction. The time variable t of physicists' equations, philosophers of science tell us, has no direction. Thus time is treated by classical physics like a fourth spatial dimension. The sciences of eotemporality are classical mechanics and general relativity. As physical laws are supposed to be eternal, there is no concept of the now in eotemporality. The now depends on consciousness, which resides on higher levels than the eotemporal. Fraser makes the telling analogy between eotemporality and those visual arts in which different perspectives, "normally" experienced in succession, are presented to the viewer at once. He mentions ancient Egyptian reliefs (each portion of the body is

depicted from its own best angle) and several cubist paintings from this century.[65] He also feels that the Umwelt of young children is predominantly eotemporal. The musical analogue of eotemporality is multiply-directed time, in which the order of events is important, but several different successions, moving in different directions, are presented as it were at once, in the same composition. There is no single present, since position on a temporal continuum may be defined, for example, by absolute-time progression and by gestural profile (remember that gestural time is a special type of multiply-directed time; see Section 6.5).

4. *Biotemporality.* At the fourth level a rudimentary consciousness is introduced. This consciousness recognizes the present, distinguishes the past from the future, and differentiates (although it may not fully understand) between beginnings and endings. Biotemporal beings are born and die in time, whereas eotemporal beings are the theoretically eternal objects of physics. The sciences of biotemporality are biology and physiology. Biotemporality is the Umwelt of animals. They have memory, but it is not well developed. Their anticipation of the future is tied to need fulfillment and danger avoidance. Their Umwelt lacks rational thought, long-range prediction, and hierarchically organized memory. In biotemporality there is no overview of a temporal totality, whether a single experience, a lifetime, or an eternity. Events progress from past to future, but an overall logic of progression does not exist. The mood of biotemporality is like that of the dream world[66] and the unconscious mind. The musical metaphor associated with biotemporality is nondirected linear time, in which one event progresses to another yet there is no large-scale sense of direction.

5. *Nootemporality.* This is the Umwelt of man. Personal identity and free will exist on this level. The consciousness of biotemporality is joined by the mind and by the sense of self. Only in the nootemporal Umwelt is an individual fully aware of the self-other dichotomy. Beginnings and endings are well defined in nootemporality, and they are remembered and anticipated. Every nootemporal being has a unique personal history. The encoding and remembering of information is a basic process in the nootemporal Umwelt. The science of nootemporality is therefore psychology. The musical expression of nootemporality is linearity.

6. *Sociotemporality.* Fraser postulates a sixth temporal level, the nature of which is difficult to define. It is the Umwelt of cultures and civilizations. Its science is sociology. This speculative level does not play an essential role in his theory, nor is there a formal musical metaphor for sociotemporality. I therefore omit this level from further consideration.

All levels below the sociotemporal exist in the physical world and in the mind and body of man. It should not be surprising, therefore, that all temporalities, not just the highest level, appear in music. Some cultures and some periods have produced pieces that favor lower levels. Yet all levels have made some appearance in the music of all eras and of all cultures. Western music has, for several centuries up through the nineteenth, adopted primarily the nootemporal mood. In other words, it has been predominantly linear. What is particularly exciting about modernist music (and other arts) is that it has rediscovered the lower temporal levels, without foresaking the nootemporal. A central theme of this book has been the interaction of temporalities, of linearity and nonlinearity, in twentieth-century music.

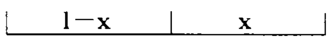
Just as I do not wish to make too much of the taxonomy of musical time offered in Chapter 2, so I do not want to exaggerate the correlation of my five species of time with Fraser's five levels of temporality. Yet Fraser has been careful to consider the arts,[67] including music, as expressive of temporal levels, and it would be narrow-minded to ignore the striking parallel between his hierarchical theory of time and my classification of music. Fraser's use of the idea of hierarchic level differs from mine, however. I am not calling my five species of time *levels*. Rather, they each can operate quasi-independently on different hierarchic levels of music. In moment time, for example, linearity may exist on the foreground while nonlinearity may determine the background. This is akin to saying that a moment-form composition may reflect nootemporality (or at least biotemporality) within its sections but prototemporality (or possibly eotemporality) in its totality. A vertical composition, for another example, may evoke in its totality the biotemporal Umwelt of dreams and the unconscious, while its surface suggests the primitive Umwelt of atemporality.

Fraser calls artworks that invoke the more primitive temporal levels *regressive*. His use of this term is not pejorative. Some twentieth-century art has rediscovered the innocence of the lower temporal levels. The childlike quality of some of the most temporally regressive music, that of vertical time, can be charming. The timelessness evoked by uncompromisingly vertical pieces approaches the mood of atemporality. Thus the timelessness of the music described in this chapter is not merely a denial of traditional values nor an experiment in eccentricity, nor an assault on the linear sensibilities of audiences. It is more than an attempt to express the schizophrenia of our age (thought it may be that). Its metaphorical expression of lower temporalities gives artistic voice to the archaic Umwelts from which we, as individuals, as members of human society, and even as physical entities, evolved.

All of Fraser's levels are contained in the highest temporal levels. Similarly, all varieties of musical time that civilization has known exist today. The eclecticism of musical styles in the last quarter of the twentieth century comes, in part, from the coexistence and interaction of very different temporal structures. We as listeners (and as composers and performers) know, and know how to utilize, many varieties of musical time. Thus the meanings of our music are vast and varied. And, in response, our listening strategies are (or at least should be) flexible and creative.

Appendix 1

Proof that the Fibonacci series approximates a series of golden means



Above is a unit line segment partitioned according to the golden mean. In other words,

$$\frac{1}{x} = \frac{x}{1 - x}$$

Or,

$$x^2 + x - 1 = 0$$

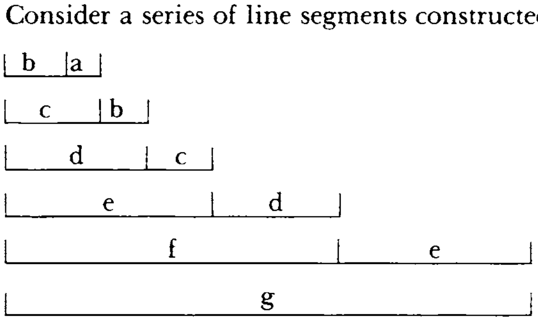
By the quadratic formula,

$$x = \frac{\sqrt{5} - 1}{2}$$

Thus the golden mean ratio, which we will designate R, is

$$R = \frac{1}{x} = \frac{x}{1 - x} = \frac{2}{\sqrt{5} - 1} = \frac{\sqrt{5} + 1}{2} = \frac{5 + \sqrt{5}}{2\sqrt{5}} \doteq 1.618$$

Consider a series of line segments constructed according to the golden mean.



etc.

Thus,

$$\frac{g}{f} = \frac{f}{e} = \frac{e}{d} = \frac{d}{c} = \frac{c}{b} = \frac{b}{a} = R$$

Let us choose a numerical value for a that will insure that the series a, b, c, d, e, f, g, . . . will be approximated by the Fibonacci series. Such a value is (as will be shown)

$$a = \frac{R}{\sqrt{5}}$$

Claim that in the series

$$\frac{R}{\sqrt{5}}, \frac{R^2}{\sqrt{5}}, \frac{R^3}{\sqrt{5}}, \ldots, \frac{R^n}{\sqrt{5}}, \ldots$$

the nearest whole number to the nth term $\frac{R^n}{\sqrt{5}}$ is the nth Fibonacci number F_n.

To prove this assertion we need Binet's formula,[1] which states that

$$F_n = \frac{\left(\frac{1+\sqrt{5}}{2}\right)^n - \left(\frac{1-\sqrt{5}}{2}\right)^n}{\sqrt{5}}$$

We shall show that

$$\left| F_n - \frac{R^n}{\sqrt{5}} \right| < \frac{1}{2}$$

and hence the F_n integers are closer to our chosen golden mean series than any other integers. By Binet's formula,

$$\left| F_n - \frac{R^n}{\sqrt{5}} \right| = \left| \frac{\left(\frac{1+\sqrt{5}}{2}\right)^n - \left(\frac{1-\sqrt{5}}{2}\right)^n}{\sqrt{5}} - \frac{\left(\frac{1+\sqrt{5}}{2}\right)^n}{\sqrt{5}} \right| = \left| \frac{\left(\frac{1-\sqrt{5}}{2}\right)^n}{\sqrt{5}} \right|$$

$\sqrt{5} \doteq 2.2361$, hence $\frac{1-\sqrt{5}}{2} \doteq -0.618$

Therefore,

$$\left| \left(\frac{1-\sqrt{5}}{2}\right)^n \right| < 1$$

Since $\sqrt{5} > 2$, then surely

$$\left| F_n - \frac{R^n}{\sqrt{5}} \right| < \frac{1}{2}$$

q.e.d.

To prove this another way, we will show that

$$F_{n+1}^2 = F_{n+2}F_n + (-1)^n$$

By induction: it is obviously true for $n = 1$, since $1^2 = 2 - 1$. Let us assume that the statement is true for some $n = k$, and prove that it is therefore true for $n = k + 1$.

$$F_{k+1}^2 + F_{k+1}F_{k+2} = F_{k+2}F_k + F_{k+1}F_{k+2} + (-1)^k$$

$$F_{k+1}(F_{k+1} + F_{k+2}) = F_{k+2}(F_k + F_{k+1}) + (-1)^k$$

By the definition of the Fibonacci series,

$$F_{k+1}F_{k+3} = F_{k+2}F_{k+2} + (-1)^k$$

Or,

$$F_{k+2}^2 = F_{k+1}F_{k+3} + (-1)^{k+1}$$

q.e.d.

Appendix 2

Proof that any two consecutive Fibonacci numbers are relatively prime.[2]

Proof by contradiction. Suppose that F_n and F_{n+1} do have some common divisor $d > 1$. Then F_{n+1} must be divisible by d. But $F_{n+1} - F_n = F_{n-1}$. Since F_{n-1} is therefore divisible by d, then $F_n - F_{n-1} = F_{n-2}$ is divisible by d. And so on until $F_3 - F_2 = F_1$ is divisible by d. But $F_1 = 1$, so F_1 cannot be divisible by $d > 1$. Therefore having assumed the contrary of the assertion has led to a contradiction. The assertion is proved.

Notes

CHAPTER 1

1. Susanne Langer, *Feeling and Form* (New York: Scribner's, 1953), p. 110.
2. Marvin Minsky, "Music, Mind, and Meaning," in Manfred Clynes, ed., *Music, Mind, and Brain: The Neuropsychology of Music* (New York: Plenum, 1982), pp. 4-5.
3. Jonathan D. Kramer, "Studies of Time and Music: A Bibliography," *Music Theory Spectrum,* 7 (1985), pp. 72-106.
4. Lewis Rowell, "The Temporal *Spectrum,*" *Music Theory Spectrum,* 7 (1985), p. 2.
5. See J. T. Fraser, *Of Time, Passion, and Knowledge: Reflections on the Strategy of Existence* (New York: Braziller, 1975), p. 45. See also Robert S. Brumbaugh, *Unreality and Time* (Albany: State University of New York Press, 1984), pp. 2-4 and 104-5.
6. Robert Brumbaugh, "Metaphysical Presuppositions and the Study of Time," in J. T. Fraser, Nathaniel Lawrence, and David Park, eds., *The Study of Time,* vol. 3 (New York: Springer-Verlag, 1978), pp. 1-3.
7. Fraser, *Of Time, Passion, and Knowledge,* p. 45.
8. Basil de Selincourt, "Music and Duration," *Music and Letters,* 1, no. 4 (1920), pp. 286-93.
9. Langer, pp. 104-19.
10. *Ibid.,* p. 109.
11. *Ibid.,* p. 111.
12. De Selincourt, p. 287.
13. Joseph Kerman, *Contemplating Music: Challenges to Musicology* (Cambridge: Harvard University Press, 1985), p. 73.
14. Rowell, p. 1.
15. *Ibid.,* p. 5.
16. Thomas Clifton, *Music as Heard: A Study in Applied Phenomenology* (New Haven: Yale University Press, 1983), p. 55. This book is a notable exception to my complaint, in Section 1.1, that music theorists do not attempt to reconcile analysis and aesthetics. But even in this fine book I find the musical analyses often simplistic. It is not by accident, though, that an excellent mind like Clifton's deals with time as an essential aspect of music, just as it is no coincidence that I quote from his book several times. Clifton and I were faculty colleagues at Yale University while we were both formulating ideas on time (1971-1975). Although we did exchange ideas and read each other's articles, our work was essentially independent of

each other's. It was only with the posthumous publication of his book in 1983 that I came to realize how close some of our ideas are. We reached some similar (and some different) conclusions working from very different perspectives. Another theorist who has worked toward bridging the gap between formalism and humanism is Christopher F. Hasty. See, for example, Hasty's "Rhythm in Post-Tonal Music: Preliminary Questions of Duration and Motion," *Journal of Music Theory,* 25 (1981), pp. 183-216. Hasty, like Clifton, employs broad-based methods in the study of musical time. It is interesting that Hasty was at Yale during the same period. Perhaps the most impressive attempt to reconcile theory and analysis with aesthetics and criticism that I know is a recent article by David Lewin, which concerns itself with musical time. See "Music Theory, Phenomenology, and Modes of Perception," *Music Perception,* 3 (1986), pp. 327-92.

17. Errol E. Harris, "Time and Eternity," *Review of Metaphysics,* 29 (1976), p. 465.
18. Harris also believes that time is a relationship. From his scientific perspective, however, he finds the relationship not between people and events but between the events and other events: "Time is not a process or a series of events, [but] a structure or form of relations between the events that constitute a process." *Loc. cit.* One way to study this relationship is through psychology. See John A. Michon, "The Compleat Time Experiencer," in John A. Michon and Janet L. Jackson, eds., *Time, Mind, and Behavior* (New York: Springer-Verlag, 1985), p. 20. Another way is through psychoanalysis. Jacob A. Arlow writes: "Time does not flow or stand still, it does not expand or contract, it neither brings nor takes away, nor does it heal or kill. Because time is reified and anthropomorphized, it can be drawn into the nexus of intrapsychic conflict, and it is at this juncture that the various functions of the ego can influence how time is experienced consciously." Arlow, "Psychoanalysis and Time," *Journal of the American Psychoanalytic Association,* 34 (1986), p. 514.
19. Clifton, p. 51.
20. In a private communication.
21. Masanao Toda, "The Boundaries of the Notion of Time," in *The Study of Time,* vol. 3, pp. 371-72.
22. Clifton, p. 114.
23. *Ibid.,* p. 81. The distinction between the time an artwork uses and the time it evokes is particularly evident in film. The durations of scenes, sequences, and cuts is defined by the continual succession of frames, while the time of plot, characters, or (especially with abstract films) images is evoked internally. See Alexander Sesonske, "Time and Tense in Cinema," *Journal of Aesthetics and Art Criticism,* 33 (1974), pp. 420-22. See also Section 6.7.
24. De Selincourt, p. 287.
25. For a penetrating discussion of the fallacy of assuming that the law of contradiction applies to musical time, see Lewin, pp. 357-73. For Lewin, the fallacy that only one kind of time, or only one particular timespan, exists at once derives from excessive reliance on the printed notation as standing for the music. "Our fallacious sense that only one musical time

is involved, in only one musical time-system, is prompted by the unique horizontal coordinate of . . . [a] notehead-point in the . . . representation of time in that notation." P. 360.

26. Stanley Cavell, *Must We Mean What We Say?* (Cambridge: Harvard University Press, 1976), pp. 192-93. See also Lewin, pp. 381-91.
27. This chart is freely adapted from Gabriele Lusser Rico, *Writing the Natural Way* (Los Angeles: Tarcher, 1983), p. 69; Robert E. Ornstein, *The Psychology of Consciousness* (New York: Penguin, 1972), p. 83; Peter Russell, *The Brain Book* (London: Routledge and Kegan Paul, 1979), p. 54; and Jeremy Campbell, *Grammatical Man* (New York: Penguin, 1984), pp. 241-48.
28. Psychologist Diana Deutsch questions the dichotic (presenting different musical information to the two ears) research that has led to the idea that melodies are processed whole by the right hemisphere. She does not deny the conclusions, since they are also supported by research into brain-damaged listeners and subjects with one hemisphere anaesthetized for experimental purposes. But she does feel that the ear preferences shown in dichotic studies may be due to several factors other than hemispheric processing, such as a natural tendency to hear high sounds on the right side and low tones on the left, despite their actual point of origin. See "Dichotic Listening to Melodic Patterns and Its Relationship to Hemispheric Specialization of Function," *Music Perception,* 3 (1985), pp. 129, 150-52.
29. John A. Sloboda, *The Musical Mind: The Cognitive Psychology of Music* (Oxford: Clarendon, 1985), p. 264.
30. There has been a small amount of research in this area. See G. Robinson and D. J. Solomon, "Rhythm Is Processed by the Speech Hemisphere," *Journal of Experimental Psychology,* 102 (1974), pp. 508-11. This article is discussed in Maria A. Wyke, "Musical Ability: A Neuropsychological Interpretation" in Macdonald Critchley and R. A. Henson, eds., *Music and the Brain: Studies in the Neurology of Music* (London: Heinemann, 1977), p. 166.
31. This research is reviewed in António R. Damásio and Hanna Damásio, "Musical Faculty and Cerebral Dominance," in Critchley and Henson, pp. 145-48. See also Robert J. Zatorre, "Musical Perception and Cerebral Function: A Critical Review," *Music Perception,* 2 (1984), pp. 196-221. Also, Sloboda discusses research that indicates that music professionals and amateurs make use of different brain hemispheres in the different ways they listen. He also reviews case studies of musicians with damage to one hemisphere. The most extraordinary such case is the Russian composer V. G. Shebalin (1902-1963), whose compositional abilities continued as normal, despite considerable verbal impairment from a massive stroke that affected his left hemisphere. See Sloboda, pp. 260-65.
32. Oscar S. M. Marin, "Neurological Aspects of Perception and Performance" in Diana Deutsch, ed., *The Psychology of Music* (Orlando, FL: Academic Press, 1982), p. 468.
33. To my knowledge, this idea has not been tested. Most of the research into how the hemispheres process music is marred by naïve notions of what music consists of and by simplistic concepts of musical ability. See Section 11.1 for a discussion of problems in the application of psychology to music.
34. Paul Watzlawick, *The Language of Change* (New York: Basic Books, 1978),

pp. 25-26. See also Thomas G. Bever and Robert J. Chiarello, "Cerebral Dominance in Musicians and Nonmusicians," *Science,* 185 (1974), pp. 537-39.

35. Karl H. Pribram, "Brain Mechanism in Music: Prolegomena for a Theory of the Meaning of Meaning," in Clynes, pp. 24-25.
36. Juan G. Roederer, "Physical and Neuropsychological Foundations of Music: The Basic Questions," in Clynes, pp. 44-46.
37. Ornstein, *The Psychology of Consciousness,* p. 94.
38. Russell, *The Brain Book,* pp. 55-57.
39. John Fowles, *The French Lieutenant's Woman* (New York: Signet, 1970), p. 165.
40. *Ibid.,* p. 252. Anyone interested in time in the fiction of John Fowles should read H. W. Fawkner, *The Timescapes of John Fowles* (Rutherford, NJ: Fairleigh Dickinson University Press, 1984). Interestingly, Fawkner begins with a consideration of the duality of the human brain.
41. I am indebted for this insight to Melba Cuddy.
42. Leonard Meyer differentiates three aspects of musical enjoyment—the "sensuous," the "associative-characterizing," and the "syntactical." See *Music, the Arts, and Ideas* (Chicago: University of Chicago Press, 1967), pp. 34-36.
43. These terms are also Meyer's. "Designative" meaning occurs when a stimulus is different in kind from the object or concept it connotes. For example, the word "tree" has nothing inherently similar to an actual tree. The kind of time evoked by, as opposed to presented by, music is designative. "Embodied" meaning occurs when the stimulus is directly similar to a referant, as when the piling up of storm clouds implies (*means*) that a storm is (probably) coming, or when a dominant seventh chord means that a tonic is (probably) coming. See *Music, the Arts, and Ideas,* pp. 6-7.
44. See Fraser, *Of Time, Passion, and Knowledge,* p. 46, on the sources of temporality in the conflict between permanence and change.
45. Edward T. Hall, *The Dance of Life: The Other Dimension of Time* (Garden City, NY: Anchor, 1984), p. 9. For a brief history of time, focusing on linear and nonlinear concepts, see G. J. Whitrow, "Reflections on the History of the Concept of Time," in J. T. Fraser, Francis C. Haber, and Gert H. Müller, eds., *The Study of Time,* vol. 1 (New York: Springer-Verlag, 1972), pp. 1-11.
46. Thomas J. Cottle, *Perceiving Time: A Psychological Investigation with Men and Women* (New York: Wiley, 1976), pp. 6-17, 85-86, 102-3.
47. Hall, pp. 25-26.
48. Edward T. Cone, *Musical Form and Musical Performance* (New York: Norton, 1968) pp. 14-22.
49. T. S. Eliot, "The Dry Salvages," from *Four Quartets* (London: Faber and Faber, 1944), lines 206-12.
50. Hall, p. 26.
51. Arnold Hauser, "The Conceptions of Time in Modern Art and Science," *Partisan Review,* 23 (1956), p. 330. This article includes an excellent brief summary of temporal concepts in the art of many eras.
52. Hauser, *The Social History of Art,* vol. 4, trans. Stanley Godman (New York: Vintage, 1958), p. 245.
53. Ornstein, *op. cit.,* p. 98.

54. Fraser, *Of Time, Passion, and Knowledge*, pp. 312–13. See section 12.8 for a brief discussion of Fraser's theory of temporal hierarchies.
55. Fraser gives a useful overview of the ideas of being and becoming throughout history. See *Of Time, Passion, and Knowledge*, pp. 11-46.

CHAPTER 2

1. I am adapting these definitions, with slight modification, from Joel Chadabe's paper "From Simplicity to Complexity" (presented at the symposium "Time in Music, Rhythm, and Percussion: East and West," University of Wisconsin at Milwaukee, 9 March 1979) and from subsequent informal discussions with him.
2. Robert E. Ornstein, *The Psychology of Consciousness* (New York: Penguin, 1972), pp. 104–5.
3. Lejaren A. Hiller and Calvert Bean, "Information Theory Analyses of Four Sonata Expositions," *Journal of Music Theory*, 10 (1966), pp. 96–137; Lejaren Hiller and Ramon Fuller, "Structure and Information in Webern's Symphonie, Opus 21," *Journal of Music Theory*, 11 (1967), pp. 60–115; Joseph E. Youngblood, "Style as Information," *Journal of Music Theory*, 2 (1958), pp. 24–35; Abraham Moles, *Information Theory and Esthetic Perception*, trans. Joel E. Cohen (Urbana: University of Illinois Press, 1966); Leonard B. Meyer, *Music, the Arts, and Ideas* (Chicago: University of Chicago Press, 1967), pp. 15–21; Leon Knopoff and William Hutchinson, "Information Theory for Musical Continua," *Journal of Music Theory*, 25 (1981), pp. 17–44; Knopoff and Hutchinson, "Entropy as a Measure of Style: The Influence of Sample Length," *Journal of Music Theory*, 27, pp. 75–97.
4. A. Wayne Slawson, "*Computer Applications in Music*, ed. Gerald Lefkoff" [review], *Journal of Music Theory*, 12 (1968), pp. 108–10.
5. A similar but more analytically useful approach is offered by David Lewin. He considers events of different sizes occurring in contexts of different lengths. His contexts include expectations derived from past events and anticipations of future events. See "Music Theory, Phenomenology, and Modes of Perceptions," *Music Perception*, 3 (1986), pp. 335–57.
6. As Justin London has pointed out (in a private communication), a major problem of information-theoretic analyses of music is the impossibility of isolating the appropriate Markov order. If event C depends on event B and B depends on A, then there may nonetheless be a functional relationship between A and C, despite an apparent first-order construction.
7. Zeroth-order perceptions are possible even within linear contexts, however. We can, for example, appreciate a particular triad for itself as well as for its participation in a tonal progression. See Lewin, pp. 345–47.
8. Clifford Geertz, "Person, Time, and Conduct in Bali," in *The Interpretation of Cultures* (New York: Basic Books, 1973), p. 393.
9. Christopher Small, *Music, Society, Education* (New York: Schirmer, 1977) pp. 45–47.
10. Gregory Bateson, "Bali: The Value System of a Steady State," in *Steps to an Ecology of the Mind* (San Francisco: Chandler, 1972), p. 86.

11. Colin McPhee, "Dance in Bali," in Jane Belo, ed., *Traditional Balinese Culture* (New York: Columbia University Press, 1970), p. 311.
12. Physicist David Park considers the implications of languages that do not allow for ideas of temporal passage, or a moving present, or goal direction. If such languages serve their speakers well—in other words, if they adequately account for the world—then we who communicate in linear languages can learn, from these people who speak nonlinearly, about different ways to conceive and talk about time. See "The Past and the Future," in J. T. Fraser, Nathaniel Lawrence, and David Park (ed.), *The Study of Time,* vol. 3 (New York: Springer-Verlag, 1978), pp. 353-54.
13. Dorothy Lee, "Lineal and Nonlineal Codifications of Reality," in Edmund Carpenter and Marshall McLuhan, eds., *Explorations in Communication: An Anthology* (Boston: Beacon, 1966), p. 141.
14. *Ibid.,* pp. 144-46.
15. Ornstein states that the nonlinear time sense of the Trobrianders "does not postulate duration, a future or a past, a cause or an effect, but a patterned 'timeless' whole." See *The Psychology of Consciousness,* p. 94.
16. Richard Saylor, "The South Asian Conception of Time and Its Influence on Contemporary Western Composition," presented at the national conference of the American Society of University Composers, New England Conservatory of Music, 29 February 1976.
17. Small, p. 55.
18. Benjamin Lee Whorf, *Collected Papers on Metalinguistics* (Washington, DC: Government Printing Office, 1952), p. 39. Also, Edward T. Hall, *The Dance of Life: The Other Dimension of Time* (New York: Doubleday/Anchor, 1984), pp. 36-43.
19. Judith Becker, "Hindu-Buddhist Time in Javanese Gamelan Music," in J. T. Fraser, Nathaniel Lawrence, and David Park, eds., *The Study of Time,* vol. 4 (New York: Springer-Verlag, 1981), pp. 161-72. This article contains an excellent discussion of Indonesian time concepts and how they are reflected in music.
20. Hall, pp. 81-90. His remarks are based largely on Barbara Tedlock, *Time and the Highland Maya* (Albuquerque: University of New Mexico Press, 1981).
21. The term is Edward T. Cone's. See *Musical Form and Musical Performance* (New York: Norton, 1968), pp. 23-27. I am using it in a somewhat looser manner, one that I feel accords more with the current common usage: I am not requiring that a structural downbeat coincide with a cadential downbeat. I am postponing until Chapter 4 discussion of downbeats as points of initiation vs. termination.
22. This idea differs from the more Schenkerian position of Carl Schachter, who points out that length is not a defining attribute either of the structural (in the Schenkerian sense) tonics or of the structural dominant. See "Rhythm and Linear Analysis: A Preliminary Study," *Music Forum,* 4 (1976), pp. 290-99.
23. As Roger Sessions points out. See *Harmonic Practice* (New York: Harcourt, Brace, and World, 1951), pp. 203-4.
24. Some consequences of this unique opening are felt immediately. The initial instability is intensified by several factors: the arrival of root-position tonic harmony on the weakest beat of m. 1, the statement of tonic harmony midway

through (rather than at the beginning of) m. 3, the first real change of harmony occurring on a weak beat in m. 7, the inordinately slow harmonic rhythm, and the imbalance of 6½ measures of tonic followed by 11½ measures of dominant. Because of this instability, a tremendous sense of resolution is felt when the tonic returns unequivocally in m. 19.

25. I am using the terms "consistency" and "progression" in a manner similar to Forte's "context" and "continuity." See "Context and Continuity in an Atonal Work," *Perspectives of New Music,* 1, no. 1 (1963), pp. 82-92. These terms are particularly useful in differentiating the nonlinear (pitch-class-set) from the linear (voice-leading) aspects of atonal compositions.
26. For a useful discussion of atonal cadential procedures in one particular composer's work, see Alden Ashforth, "Linear and Textural Aspects of Schoenberg's Cadences," *Perspectives of New Music,* 16, no. 2 (1978), pp. 195-224. According to Ashforth the primary factors that create cadences in Schoenberg's music are motivic dissolution, pitch and motive reiteration, change in the type of melodic motion (stepwise vs. disjunct, up vs. down, extreme vs. middle register), voice leading, change of textural density, and change of timbre. Ashforth promises to deal with harmonic and rhythmic factors in a future study.
27. I study in some depth the type of nontonal pitch linearity discussed in this example in Chapter 7. Both stepwise voice-leading linearity and pitch and set referentiality are discussed in analyses of pieces by Schoenberg and Webern.
28. Schoenberg's large-scale linear procedures are studied in Andrew Mead's excellent article "Large-Scale Strategy in Schoenberg's Twelve-Tone Music," *Perspectives of New Music,* 24, no. 1 (1985), pp. 120-57.
29. See the linear analysis of this work by Felix Salzer, *Structural Hearing,* vol. 1 (New York: Dover, 1962), pp. 248-50, and vol. 2, pp. 298-305.
30. The tonal and harmonic linearity of the two preludes has been elegantly analyzed by several theorists. See Wallace Berry, "Metric and Rhythmic Articulation in Music," *Music Theory Spectrum,* 7 (1985), pp. 16-30; Arthur Komar, *Theory of Suspensions* (Princeton: Princeton University Press, 1971), pp. 66-67, 87, 99, 119-22, 141-2; Salzer, *Structural Hearing,* vol. 2, pp. 39, 279; Allen Forte and Steven Gilbert, *Introduction to Schenkerian Analysis* (New York: Norton, 1982), pp. 188-94; Cone, *Musical Form,* pp. 63-65; Heinrich Schenker, *Five Graphic Music Analyses,* ed. Felix Salzer (New York: Dover, 1969).
31. Jane Perry-Camp, "Time and Temporal Proportion: The Golden Section Metaphor in Mozart, Music, and History," *Journal of Musicological Research,* 3 (1979), pp. 133-76.
32. Arlene Zallman's work is currently unpublished.
33. Perry-Camp (p. 151) has found several movements from the Mozart piano sonatas with golden-mean proportions.
34. In earlier versions of this chapter, I tried using first the term "statistical" and then the word "stochastic" to refer to cumulative listening. While both these terms come close to an accurate label of the phenomenon I wish to describe, they both carry misleading connotations from other fields. My use of the term "cumulative" is similar to that of Jann Pasler. She writes of the

"*cumulative* impact, rather than moment to moment logic," of much recent music. Writing of the return of "narrative" (a term roughly equivalent to my "linearity") to recent music, in particular Bernard Rands' *Canti lunatici,* she states:

> The goal . . . is to make a cumulative impact. From this perspective, then, narrative is the sense that one has of a certain kind of a whole when one has reached the end, not necessarily while one is listening to the each and every part in its middle. As narrative continues to challenge composers to redefine it in modern terms, we can look forward to increasing incorporation of such techniques as fragmentation, juxtaposition, and multiplicity.

Pasler's invited paper "Narrative and Narrativity in Music" was read to the International Society for the Study of Time, Dartington Hall, England, 9 July 1986.

35. See, for example, Martin Cooper, *French Music* (London: Oxford University Press, 1961), p. 90, or Donald Jay Grout, *A History of Western Music* (New York: Norton, 1973), p. 656.
36. Small, pp. 103-7. Also, Leonard B. Meyer, *Music, the Arts, and Ideas* (Chicago: University of Chicago Press, 1967), p. 73.
37. I am indebted on this point to my former student Daniel R. Kuritzkes and his excellent unpublished paper "East-West Duality in Mahler's *Das Lied von der Erde.*"
38. Robert P. Morgan, "Spatial Form in Ives," in H. Wiley Hitchcock and Vivian Perlis, eds., *An Ives Celebration* (Urbana: University of Illinois Press, 1977), pp. 148–53.
39. Neely Bruce, "Ives and Nineteenth-Century America," in Hitchcock and Perlis, pp. 36–41.
40. I am indebted on this point and several others to Judy Lochhead.
41. Another work with a fascinating multiple temporal continuum is the first movement of Mahler's Symphony No. 3 (1896). Both theorist Thomas Clifton and musicologist Leo Treitler have remarked on the temporal multiplicity in this work. Clifton argues for the passage from rehearsal [11] to [13] (in the Kritische Gesamtausgabe score, 1974) being an insertion from the work's future into its present. See *Music as Heard* (New Haven: Yale University Press, 1983), pp. 122–24. Treitler feels that the movement does not really begin until [26]; the three hundred preceding measures have the function of bringing the music "into hearing range, . . . or from backstage to centerstage." See "History, Criticism, and Beethoven's Ninth," *Nineteenth Century Music,* 3 (1980), p. 193.
42. Stravinsky's neotonality is a special case, since he deals less with motion than with stasis.
43. Karlheinz Stockhausen, "Von Webern zu Debussy (Bemerkungen zur statistischen Form)," in *Texte zur elektronischen und instrumentalen Musik,* vol. 1 (Cologne: DuMont, 1963), pp. 75-85.
44. Herbert Eimert, "Debussy's *Jeux,*" trans. Leo Black, *Die Reihe,* 5 (1959), pp. 3-20.
45. For a lucid discussion of the time sense in *Jeux,* see Jann Pasler, "Debussy's

Jeux: Playing with Time and Form," *Nineteenth Century Music,* 6, 1982, pp. 60-75.

46. I am indebted to John Colligan for pointing out the multiply-directed time in "We're Late."
47. Quoted in the opera program for *The Mask of Orpheus* (London: English National Opera, 1986). Concerning the fascinating details of the time structure in this opera, see Peter Zinovieff, *The Mask of Orpheus: A Lyric Tragedy Libretto* (London: Universal, 1986), pp. 46-67.
48. Quoted in the opera program for *The Mask of Orpheus.*
49. Birtwistle has long been interested in musical time, as titles like *Chronometer* (1971) and *The Triumph of Time* (1972) indicate. In a paper presented at the University of Southampton on 8 February 1986, Jonathan Cross showed how the composer accompanies a linear vocal line (actually a compound line progressing stepwise to C in two layers) with a potentially infinitely repeating instrumental component. This simultaneous combination of goal-directed linear time and nonlinear time occurs in "Moral 1" from the opera *Punch and Judy* (1967). Cross' paper is titled "Lines and Circles, Text and Music, *Punch and Judy.*"
50. In his composition seminars at the University of California at Davis in 1966-67.
51. Carl Schachter hints at a solution of this problem in his concepts of tonal and durational rhythm. Durational rhythm derives from the calculable lengths of notes, rests, and other musically meaningful timespans. Tonal rhythm, on the other hand, is flexible. It is created by patterns, regardless of their literal durations. Since duration has nothing to do with tonal rhythm, the concept is of limited usefulness in getting at the sense of proportion that arises from varying patterns. But the separation of pattern from duration is necessary if we wish to understand the interaction between subjectively and objectively measured proportions. See Schachter, "Rhythm and Linear Analysis," pp. 313-17.
52. I refer to the version recorded on Columbia MS-7315.
53. It is possible to structure a nonvertical piece by first establishing and then periodically expanding its potentially vertical sound-world in a dramatic fashion. An example is Roger Reynolds' *Ping* (1968)—at least as performed at Mills College in the late 1960s. Such music is dynamic and kinetic (linear) at the points where it redefines its world, and thus its time sense is not ultimately vertical.
54. Meyer, *Music, the Arts, and Ideas,* pp. 68-84 and 158-69.
55. One polemicist for the experimental in art argues that boredom is a necessary and positive component of the new sensibility. See Dick Higgins, "Boredom and Danger," in *foew&ombwhnw* (New York: Something Else Press, 1968).
56. I am indebted to Don Walker for calling my attention to the necessity of a positive response to what vertical music contains (as opposed to a negative response to such music's "deficiencies"). I am also grateful to him for several other perceptive comments on the ideas in this chapter.
57. Pasler differentiates the temporality of minimal music from that of other vertical music. Her three categories "anti-narrative" music, "nonnarrative"

music, and music "without narrativity" correspond roughly to my moment music, process music, and nonprocess vertical music. She writes of minimal music: "Repetition . . . does not require us to recollect. In minimal music, it does not mediate past, present, and future, but rather forces us to concentrate fully on an extended present. Time appears to stand still as the work turns in place. Indeed the object here is not time but eternity." See "Narrative and Narrativity."

58. Mainstream Records 5005.
59. See Barney Childs, "Time and Music: A Composer's View," *Perspectives of New Music*, 15, no. 2 (1977), pp. 194-219.
60. Another example: Webern's fascinating orchestration (1935) of the six-voice Ricercar from Bach's *Das Musikalische Opfer* (1747) is a nonlinear interpretation of a linear work. I am indebted on this point to Justin London.
61. Edward Lippman divides this continuum into three areas: "continuity or succession," "propulsion," and "logic of consecution." See "Progressive Temporality in Music," *Journal of Musicology*, 3 (1984), pp. 121-41.
62. Actually, the compositional process is quite complex, although the aural result is still nonlinear in the foreground. See Iannis Xenakis, *Formalized Music*, trans. Christopher A. Butchers (Bloomington: Indiana University Press, 1971), pp. 79-109.
63. Succession and progression are not solely musical concepts. A succession is a series of distinct events. In a progression (Harris uses the terms "continuity" and "process," but not "progression"), on the other hand, an event persists until its transformation. See Errol E. Harris, "Time and Eternity," *Review of Metaphysics*, 29 (1976), pp. 464-68.
64. For a complete description of this piece, see Lejaren A. Hiller and Leonard Isaacson, *Experimental Music* (New York: McGraw-Hill, 1959).

CHAPTER 3

1. For a discussion of the sociological impact of recording technology on the meanings of music, see Jacques Attali, *Noise: The Political Economy of Music*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1985), pp. 87-132, but especially pp. 102-103.
2. Because of the nature of the tape recorder, changing recording speed necessarily affects pitch and timbre. Only recently have digital recording capabilities made it viable to alter speed without changing pitch and timbre.
3. Christopher Small, *Music, Society, Education* (New York: Schirmer, 1977), p. 174.
4. Walter Everett, "Fantastic Remembrance in John Lennon's 'Strawberry Fields Forever' and 'Julia,'" *Musical Quarterly*, 72 (1986), p. 377.
5. I am indebted to Martin Sweidel for telling me about this intriguing recording.
6. Columbia M-34105.
7. I am indebted to Jerry Studenka for playing this recording for me.
8. Elektra Records 5E-513.

9. Such as Zak Kramer, who called my attention to this hidden message.
10. Walter Everett informs me that this example is quite typical of pop music. Backwards taping was possibly used in such Beatles' compositions as "I'm Only Sleeping," "Strawberry Fields Forever," and "Revolution Number 9," and also after particular songs on *Abbey Road, Sergeant Pepper's Lonely Hearts Club Band* (European mix only), and the "white album."
11. Peter H. Lewis, "Harmony of Art and Science Lifts a Music Industry Barrier," *New York Times,* 4 March 1987, p. 30.
12. Walter Benjamin, "The Work of Art in the Age of Mechanical Reproduction," trans. Harry Zohn, in *Illuminations* (New York: Schocken, 1969), p. 224.
13. As Justin London has pointed out to me, ambient sounds have annoyed (or occasionally delighted) listeners in outdoor, and even indoor, concerts for centuries. It is only with the advent of portable radios and stereos that the phenomenon has become pervasive, accepted, and even welcomed.
14. Recordings allow a listener to choose what parts of a work to hear and in what order. In the days of 78 rpm records, for example, someone who chose to play albums recorded in manual sequence on an automatic turntable regularly heard scrambled versions of classical music. In other art forms the perceiver's ability to alter or choose temporal order has varied considerably. Once literary arts became written rather than oral, readers acquired the ability to read and reread in any order. For video art and videotape-recorded drama and dance, the VCR now provides a viewer with a comparable ability to impose his or her own potentially discontinuous viewing patterns on the inherent continuity of artworks. A view of paintings and sculptures always was able to regulate the time structure of his or her experience with art. In these ways audience interaction with art has differed greatly from one medium to another. (I am indebted to Justin London for these observations.) As critics and analysts have focused on artworks rather than on responses to them, they have ignored the impact of this "random access." With the advent of technological production and reproduction of artworks, most art forms now offer random access to their audiences, whether the artists and critics approve or not.
15. R. Murray Shafer, *The Tuning of the World* (New York: Knopf, 1977), p. 114.
16. In a private conversation, San Francisco, 1967.
17. Robin Maconie, *The Works of Karlheinz Stockhausen* (London: Oxford University Press, 1976), pp. 30–40.
18. Jay Leyda, *Kino: A History of the Russian and Soviet Film* (New York: Collier, 1960), pp. 170–74.
19. Arnold Hauser, *The Social History of Art,* vol. 4, trans. Stanley Godman (New York: Vintage, 1958), pp. 239, 241.
20. Marie Winn, *The Plug-In Drug* (New York: Viking, 1977), pp. 3–11.
21. Tape head echo is created by sending a sound, as it is played back off a tape, directly into the tape machine's record head, so that it is duplicated on the same tape after a short interval (usually less than a second), that is determined by the speed at which the tape moves and the distance between the heads.
22. Tape loops are made by splicing a piece of recording tape end to end,

creating a circle. When the tape loop is played by a tape recorder, it repeats continually whatever is recorded on it.

23. Charles Wuorinen, notes to the recording of *Time's Encomium,* Nonesuch H-71225.
24. Pierre Boulez, " 'At the Ends of Fruitful Land . . . ,' " *Die Reihe,* 1 (1958), pp. 21, 23.
25. A sequencer is a device, often part of a synthesizer, that gives out a series of voltages one at a time, in a fixed order, repeated indefinitely. The most common way to use a sequencer is as a pitch controller, so that a sequence of notes (usually with identical duration) is played again and again.
26. The contrast between the digital computer (dealing with *discrete* numbers) and the analog synthesizer (using *continuously variable* voltages) is a telling metaphor for fundamentally different mental processes, corresponding to the two hemispheres of the brain. I am indebted to Robert S. Moore for this observation. Also, see Paul Watzlawick, *The Language of Change* (New York: Basic Books, 1978), pp. 15-16. With the increasing popularity of hybrid electronic music systems (including computers playable in real time with organ-like keyboards, storage in digital memory of performed control voltages, digitally sampled analog voltages, and digital control of analog circuits) the metaphor becomes blurred.
27. It is impossible to transfer all of the nuance of traditional performance into the electronic medium. Even the more sophosticated electronic keyboards, called "velocity-sensitive" because they react to touch as well as to duration, operate on the assumption that all the information in a keyboard player's interpretation can be conveyed in just three or four parameters: which key is struck, possibly with how much pressure it is held down, how fast it is struck, and how long it is depressed. Several other variables are ignored, however: speed of release, resonance created by other keys depressed, mass of the finger. Rather than produce pale imitations of sensitive performances, electronic music systems should be used to create a kind of music that is not concerned with the subtleties of physical gesture.
28. Attempts I have heard to program aesthetically pleasing irregularities into computer-generated rhythms have failed to capture the sensitivity of which a human performer is capable.
29. RCA ARL 1-1919.
30. "Beyond the Sun," Mercury SRI-80000. I am indebted to Charles Brown for bringing this recording to my attention.
31. The research supporting this surprising conclusion is reported in many sources. See, for example, Alf Gabrielsson, "Perception and Performance of Musical Rhythm," in Manfred Clynes, ed., *Music, Mind, and Brain: The Neuropsychology of Music* (New York: Plenum, 1982), pp. 163-68. Also, "Interplay between Analysis and Synthesis in Studies of Music Performance and Music Experience," *Music Perception,* 3 (1985), pp. 59-86. Gabrielsson shows that the variations from rhythmic regularity are not random but systematic.
32. Carl Seashore, *Psychology of Music* (New York: McGraw-Hill, 1938), pp. 247-48.
33. This effect is discussed in Eric F. Clarke, "Levels of Structure in the Or-

ganization of Musical Time," *Contemporary Music Review*, 72 (1986), pp. 211-38.
34. Ingmar Bengtsson and Alf Gabrielsson, "Analysis and Synthesis of Musical Rhythm," in *Studies of Musical Performance*, ed. Johan Sundberg, (Stockholm: Royal Swedish Academy of Music, 1983), p. 37.
35. *Ibid.*, pp. 38-42, 46.
36. The Synclavier II digital synthesizer, for example, allows for varying degrees of approximation. Similar programs are becoming available for microcomputers. H. Christopher Longuet-Higgins has also devised such a program, but for a quite different purpose. He is interested in studying how performers provide listeners with cues to meter. See his "Perception of Melodies," *Nature*, 263 (1976), pp. 646-53.
37. Bengtsson and Gabrielsson, "Analysis and Synthesis of Musical Rhythm," p. 58.
38. Elmer Schonberger and Louis Andriessen, "The Apollonian Clockwork," trans. Jeff Hamburg, *Tempo*, 141 (June, 1982), p. 5.
39. The Percussion Group has recorded the work on Opus One Records 80/81.
40. Although I cannot prove it, I suspect that what we interpret as the percussionists' struggle is in fact their slight deviations from metronomic precision, analogous to, but no doubt considerably smaller than, the imprecision we interpret as nuance in traditional performance.
41. Gone are the days of early computer music composition, when composers had to wait several days while a digital data tape was translated into an analog sound tape.

CHAPTER 4

1. It would be instructive and useful to compare many of the assumptions, details, and results of the diverse theories these authors have constructed. Also, since several pieces are analyzed in different sources, the practical applications of the theories should be contrasted. To make such a thorough comparative study, however, would require an entire book, not just a chapter. Although I agree and disagree with each author on a wide range of ideas, I am restricting my remarks in this chapter to a few areas that are particularly germane to this book.
2. See, for example, Alf Gabrielsson, "Perception and Performance of Musical Rhythm," in Manfred Clynes, ed., *Music, Mind, and Brain: The Neuropsychology of Music* (New York: Plenum, 1982), pp. 163-68.
3. Eric F. Clarke, "Structure and Expression in Rhythmic Performance," in Peter Howell, Ian Cross, and Robert West, eds., *Musical Structure and Cognition* (London: Academic Press, 1985), pp. 212-17.
4. Clarke performed his experiments twice. One time he used the identical atonal melody in all ten contexts, the other time a slightly altered (to accord with the changed metric implications) tonal tune. The results were the same with both melodies.
5. Another good example is the opening of the third movement of Beethoven's Fifth Symphony, discussed in Fred Lerdahl and Ray Jackendoff, *A Genera-*

tive Theory of Tonal Music (Cambridge, MA: MIT Press, 1983), p. 33. See also Joel Lester, *The Rhythms of Tonal Music* (Carbondale: Southern Illinois University Press, 1986), p. 158.

6. Edward T. Cone, *Musical Form and Musical Performance* (New York: Norton, 1968), pp. 26-31.
7. Peter Westergaard, *An Introduction to Tonal Theory* (New York: Norton, 1975), pp. 309-19.
8. William E. Benjamin, "A Theory of Musical Meter," *Music Perception,* 1 (1984), pp. 385-88.
9. Carl Schachter "Rhythm and Linear Analysis: Durational Reduction," *The Music Forum,* 5 (1980), p. 205.
10. Wallace Berry, *Structural Functions of Music* (Englewood Cliffs, NJ: Prentice-Hall, 1976), pp. 326-31.
11. Hugo Riemann, *System der musikalischen Rhythmik und Metrik* (Leipzig: Breitkopf und Härtel, 1903), pp. 196-213.
12. Arthur Komar, *Theory of Suspensions* (Princeton: Princeton University Press, 1971), pp. 49-54.
13. Lerdahl and Jackendoff, pp. 31-32 and 335.
14. See also Robert P. Morgan, "The Theory and Analysis of Tonal Rhythm," *Musical Quarterly,* 64 (1978), pp. 435-70.
15. Lerdahl and Jackendoff, p. 17.
16. David Epstein anticipates (although less than satisfactorily) Lerdahl and Jackendoff in his discussion of stress, metric accent, and rhythmic accent. See *Beyond Orpheus* (Cambridge, MA: MIT Press, 1979), pp. 61-62. While acknowledging this threefold distinction, he is unwilling to see meter as an important large-level force, despite the admitted structural importance of middleground nonalignment of meter and rhythm. See pp. 64, 71.
17. Lerdahl and Jackendoff, p. 17.
18. Grosvenor Cooper and Leonard B. Meyer, *The Rhythmic Structure of Music* (Chicago: University of Chicago, 1960), p. 8.
19. Epstein, p. 72.
20. Cooper and Meyer, pp. 96-99.
21. For example, Benjamin's otherwise excellent study is marred by a failure to differentiate between types of accents. Cooper and Meyer, p. 88, hint at the independence of metric and rhythmic accents, but they seem to be thinking only of metrically irregular contexts. They do not explore the idea very deeply.
22. Lerdahl and Jackendoff call it a "structural" accent (p. 17), but I prefer "rhythmic accent" because metric accents are also structural.
23. Cone, p. 79.
24. Schachter hints at this important distinction. See, for example, his analysis in "Rhythm and Linear Analysis: A Preliminary Study," *The Music Forum,* 4 (1976), p. 325, of a brief passage from Bach's Suite in E Minor for Lute (before 1717). Schachter describes a particular metric downbeat in this music as not a goal but as "clearly on the way" to a more stable pitch, which arrives with an accent that cannot be metric, since it occurs on the weak beat of the measure.
25. Cone derives his notion of accent from Roger Sessions' cadential accent, or

accent of weight. See *Harmonic Practice* (New York: Harcourt, Brace, and World, 1951), pp. 83–84.
26. Cooper and Meyer, p. 203.
27. Epstein believes that large-scale downbeats and upbeats are timespans that begin with accented timepoints. See pp. 64–65.
28. See Benjamin's discussion on p. 382. We understand agogic accents because attack points remain in short-term memory while we experience the subsequent duration of a note. See my discussion of the perceptual present, Section 11.12.
29. See also Schachter's remarks on the Chopin preludes, "Durational Reduction," p. 204.
30. Lerdahl and Jackendoff discuss this prelude on pp. 168–69 and 237–39.
31. Berry analyzes the opening of the third movement of Mendelssohn's Sonata No. 2 for Cello and Piano, opus 58 (1842), as a series of metrically end-accented phrases. See *Structural Functions*, pp. 332–34. The challenge of finding unequivocal examples of metrically end-accented phrases is telling.
32. Heinrich Schenker, *Der freie Satz* (Vienna: Universal, 1935), pp. 187–88.
33. Schachter, "Durational Reduction," p. 205.
34. Berry, "Rhythmic and Metric Articulation in Music," *Music Theory Spectrum*, 7 (1985), p. 10.
35. Joel Lester argues to the contrary: "Measures and measure subdivisions are of predictable length and accentual structure because of their incessant repetition. Phrases are, in most tonal music, of varying length. Recognizing that an event occurs on, say, the third measure of a phrase, or the upbeat to the fourth measure, does not specify where that event is in relation to preceding and following accented points. The phrase may be of a different number of measures than the previous phrase(s), it may begin with one or more upbeat measures, and it may feature an irregular accentual pattern." *The Rhythms of Tonal Music*, p. 168. Lester is mistaken to compare measures and phrases. A measure is a metric unit, while a phrase is a rhythmic unit. The proper comparison is between a measure and a hypermeasure. A hypermeasure cannot begin with "one or more upbeat measures." But hypermeasures do vary in length. Nonetheless, once one hypermeasure has been succeeded by another, we understand the accentual quality of each of its hyperbeats. Recognizing an event as happening on the third beat of a hypermeasure does indeed locate it with respect to the previous hyper-downbeat and, eventually (even if there is an irregularity) to the next hyper-downbeat as well. See note 4.89.
36. Berry, *Structural Functions*, pp. 325–29.
37. Victor Zuckerkandl, *Sound and Symbol: Music and the External World*, trans. Willard R. Trask (Princeton: Bollingen, 1956), pp. 167–97.
38. Berry, "Metric and Rhythmic Articulation," p. 10. See also *Structural Functions*, pp. 326–34.
39. Christopher F. Hasty, "Rhythm in Post-Tonal Music," *Journal of Music Theory*, 25 (1981), p. 188.
40. Lester, p. 163.
41. Lerdahl and Jackendoff, p. 18.
42. Maury Yeston, *The Stratification of Musical Rhythm* (New Haven: Yale University Press, 1976), pp. 65–68.

43. Cone analyzes the first eight measures of this movement as strong-weak-weak-strong/weak-strong-weak-strong. See pp. 42-43.
44. Schachter, "A Preliminary Study," pp. 309-10.
45. In a private discussion.
46. Lerdahl and Jackendoff, pp. 334-35.
47. Komar, pp. 62-67. See also note 5.9.
48. Epstein, p. 58.
49. Epstein, *loc. cit.* Cooper and Meyer offer different definitions of "beat" and "pulse." Unfortunately, their use of "pulse" is close to Epstein's understanding of "beat." They state: "A pulse is one of a series of regularly recurring, precisely equivalent stimuli. Like the ticks of a metronome or a watch, pulses mark off equal units in the temporal continuum. Though generally supported by objective stimuli (sounds), the sense of pulse may exist subjectively." Cooper and Meyer use the term "beat" to refer to pulses that are metric: "Meter is the measurement of the number of pulses between more or less regularly recurring accents. Therefore, in order for meter to exist, some of the pulses in a series must be accented—marked for consciousness—relative to others. When pulses are thus counted within a metric context, they are referred to as *beats.*" See pp. 3-4. For Cooper and Meyer, a beat is a kind of pulse. Because they do not deal with what Epstein calls "pulse," I have chosen to adopt Epstein's terminology.
50. Psychologists have begun to study the mechanisms by which listeners extract information about meter from pitch and rhythm patterns. For example, Mark J. Steedman has considered the occurrence of long notes and the repetition of melodic motives as cues to the meter of unaccompanied tunes. See "The Perception of Musical Rhythm and Meter," *Perception,* 6 (1977), pp. 555-69.
51. Lester, pp. 16-17. See also p. 51.
52. Berry, "Rhythm and Metric Articulation," p. 7. On p. 33 he baldly states, "Rhythm is: everything." See also p. 30.
53. Berry, *Structural Functions,* p. 301.
54. Benjamin Boretz, "In Quest of the Rhythmic Genius," *Perspectives of New Music,* 9, no. 2, and 10, no. 1 (1971), p. 154.
55. Cone, p. 25.
56. Lester, pp. 166-68.
57. Cooper and Meyer, p. 2, define the primary rhythmic level as "the lowest level on which a complete rhythmic group is realized." Lerdahl and Jackendoff call the primary-level beat the "tactus." See pp. 73-74.
58. See Epstein, p. 64; Benjamin, pp. 403-13; and Lerdahl and Jackendoff, pp. 21-25.
59. Berry argues, in "Metric and Rhythmic Articulation," p. 16, that meter is not fundamentally periodic, even at surface levels. Berry's concept is rather different from mine. He feels meter is "oriented toward, motivated by, and finally receding from" points of metric focus (p. 21). I believe, on the contrary, that such motions are essentially rhythmic. I agree with Lerdahl and Jackendoff's idea that rhythmic grouping makes metric beats into upbeats or afterbeats (see p. 28). Meter consists of timepoints and is defined by their relative accentual strength. Berry projects meter onto the deepest level because for him

it is continuous. I project it onto the deepest level because it depends on the alternation of nested strong and weak points. Benjamin, on the other hand, seems to accept deep-level structures similar to my hypermeasures, but he does not want to call the result meter, because the timespans produced may be unequal. See pp. 360-62. Benjamin refers to this "patterning of time that is neither metric nor based on grouping" as "partitioning by accent." I find the distinction between meter and partitioning by accent cumbersome. If we admit the difference between rhythmic and metric accents (which Benjamin does not), then I find no problem in calling the "partitioning by [metric] accent" meter.

60. Lerdahl and Jackendoff prefer the term "metric deletion" because, they feel, points in time cannot overlap. See p. 339. Epstein labels overlap "elision" (p. 64), as do Benjamin (pp. 393-94) and Komar (p. 62). I find the term "overlap" move communicative than "elision": the experience is more of two events (end and beginning) occurring at once than of something suppressed.
61. Lerdahl and Jackendoff formalize the process of metric overlap. See pp. 103-4.
62. Borrowed from Benjamin, p. 394, and also discussed in Lerdahl and Jackendoff, pp. 55-56.
63. Lerdahl and Jackendoff, pp. 33-34.
64. Komar formalizes the methods by which these operations produce irregular middlegrounds from regular backgrounds. See pp. 62-67.
65. Benjamin, pp. 408-9.
66. *Ibid.*, pp. 410-12.
67. *Ibid.*, p. 412.
68. See Lerdahl and Jackendoff, pp. 69-74, for discussion.
69. *Ibid.*, p. 97.
70. *Ibid.*, pp. 99, 101.
71. *Ibid.*, pp. 74-90.
72. *Ibid.*, p. 53.
73. Lester, pp. 18-37.
74. Berry, *Structural Functions*, pp. 339-45.
75. Benjamin, pp. 366-67.
76. James Tenney and Larry Polansky offer a numerical weighting of grouping rules in "Temporal Gestalt Perception in Music," *Journal of Music Theory*, 24 (1980), pp. 205-41. See also Lerdahl and Jackendoff's criticisms of Tenney and Polansky's article, p. 55.
77. Benjamin, pp. 379-83.
78. Mari Riess Jones, "Structural Organization of Events in Time," in John A. Michon and Janet L. Jackson, eds., *Time, Mind, and Behavior* (New York: Springer-Verlag, 1985), p. 206.
79. One exception is John A. Sloboda, who proposes a fundamental grammar for the perception of meter. In contrast to many psychologists, he—a conductor and composer as well as a psychologist—is aware of the complexities and ambiguities of real music. *The Musical Mind: The Cognitive Psychology of Music* (Oxford: Clarendon, 1985), pp. 47-52.
80. Lerdahl and Jackendoff, pp. 37-52.

81. *Ibid.*, pp. 37-39.
82. See Lerdahl and Jackendoff's discussion of grouping overlaps and elisions, pp. 55-62.
83. Lerdahl and Jackendoff, pp. 43-55, give more rigorous versions of these rules.
84. Cooper and Meyer, pp. 1-87.
85. Paul Fraisse, "Rhythm and Tempo," in Diana Deutsch, ed., *The Psychology of Music* (Orlando, FL: Academic Press, 1982), pp. 159-62.
86. Lerdahl and Jackendoff, pp. 30-34.
87. *Ibid.*, pp. 133-37.
88. See Lester, pp. 251-55, on polyphonic rhythm, and pp. 6-8 on composite attack patterns.
89. Lester, pp. 158-77. One reason Lester does not believe in the existence of deep-level meter is that he takes the phrase, rather than the hypermeasure, as the deep-level analogue of the measure. On p. 163 he disagrees with Schachter's statement that "the metric organization of a group of measures" does not differ "in principle from that of a single measure" (see note 4.33 for reference to Schachter). But Lester's arguments against Schachter apply to phrases, not "groups of measures." As we have seen, a metric accent can occur anywhere within a phrase, while a hypermeasure must begin with its strongest beat. Although Lester has much to say about hypermeasures and about phrases, his failure to distinguish them as metric and rhythmic phenomena respectively leads him to deny the existence of deep-level meter in much tonal music.
90. The term is Leonard B. Meyer's. He refers to "the tacit and usually unconscious assumption that the same forces and processes which order and articulate one hierarchic level are operative, are equally effective, and function in the same fashion in the structuring of all levels." *Music, the Arts, and Ideas* (Chicago: University of Chicago Press, 1967), p. 96. See also pp. 257-59 and 306-8.
91. Hasty, "Rhythm in Post-Tonal Music," pp. 192-94.
92. Martha M. Hyde, "A Theory of Twelve-Tone Meter," *Music Theory Spectrum*, 6 (1984), p. 51.
93. For discussions of surface meter in Stravinsky's *Symphonies*, see Pieter C. van den Toorn, *The Music of Igor Stravinsky* (New Haven: Yale University Press, 1983), pp. 231-32 and 341-42; and Hasty, "Succession and Continuity in Twentieth-Century Music," *Music Theory Spectrum*, 8 (1986), pp. 64-65.
94. See also Schachter, "Durational Reduction," pp. 230-31.
95. Lerdahl and Jackendoff, p. 21.
96. Lerdahl and Jackendoff do allow for hypermetric irregularities introduced by "irregular-length" groups or by overlap, but only at relatively local levels. See pp. 99-104.
97. *Ibid.*, p. 22.
98. *Ibid.*, p. 28. Also see Yeston, *The Stratification of Musical Rhythm*, pp. 65-67.
99. Lerdahl and Jackendoff consider this possibility in their Interpretation B of Example 4.11, p. 24.
100. See Cone, pp. 24-25, on large-scale initial upbeats.

101. Epstein offers yet a different metric analysis of this passage. See pp. 68-70. Since he analyzes metric accents only up to the two-bar level and rhythmic accents only through the four-bar level, he does not consider some of the passage's most fascinating temporal aspects. Benjamin also studies this excerpt; see pp. 406-8. Curiously, Benjamin identifies "metric groups" that are not required to start with metric accents. Therefore he is able to find four-bar metric units consistently, starting not in m. 1 or m. 3 but in m. 2. These units begin to coincide with the accentual pattern in m. 10. Benjamin takes mm. 16-19 as a surface transformation (extension) of the third beat of a four-beat hypermeasure. This process is akin to his composed-in *fermata*. See pp. 397-98 and also note 5.8. Lester, pp. 23-38, 69-71, and 160-62, also analyzes this passage.
102. Lerdahl and Jackendoff, p. 22.
103. *Ibid.*, p. 25.
104. *Ibid.*, p. 21. Lester feels that, since we cannot direct our attention equally to all metric levels at once, the largest levels, those requiring the greatest attentional effort, cannot truly be perceived. See p. 168. I believe, on the contrary, that we can, at least subconsciously, perceive a great many metric levels simultaneously, and that we may choose, possibly under the influence of the piece or its performance, to focus on large levels of metric activity. It is only when we expect equal timespans between beats of comparable metric accent that we are forced to turn our attention to the shallower, "foot-tapping" levels of metric activity in tonal music.
105. See, for example, Lerdahl and Jackendoff, pp. 241-48.
106. Berry discusses the existence of a single, strongest metric accent for entire movements. See *Structural Functions*, p. 350.
107. This idea is borrowed from Lester, p. 262. He is concerned with foreground levels, however: "At and below the primary metric level, other accentuations, often out of synchronization with the meter, promote continuity." But Lester also discusses large-scale noncongruence. See note 7.21.
108. Komar, pp. 151-61.
109. Berry analyzes the second phrase of this movement in a manner similar to mine. See *Structural Functions*, p. 331.
110. Initially we are led to hear mm. 45-50 as 2+2+2, because of the return to m. 45 in m. 47. When m. 49 repeats m. 48, however, it becomes impossible to hear m. 49 as more strongly accented than m. 48, and we must revise our understanding of the accentual weight of the downbeat of m. 47. The six-bar hypermeasure is ultimately understood as 3+3.
111. Cone's term is nicely defined by Lerdahl and Jackendoff as a convergence of metric accent, accented boundary of a rhythmic group, and harmonic arrival. See Lerdahl and Jackendoff, p. 33. Also see Cone, pp. 24-25.

CHAPTER 5

1. Joseph Kerman, *The Beethoven Quartets* (New York: Knopf, 1967), p. 355.
2. The beginnings of Schubert's large Symphony in C Major (1826) and Liszt's *Les Préludes* (1854) are straightforward examples of upbeat beginnings leading to clear structural downbeats. Opus 135 is more equivocal.

3. I am indebted for this observation to Fred Lerdahl.
4. I am indebted for this observation to Judy Lochhead.
5. Grosvenor W. Cooper and Leonard B. Meyer, *The Rhythmic Structure of Music* (Chicago: University of Chicago Press, 1960), pp. 32-36, 54-57, and 168-74.
6. *Ibid.*, pp. 85, 129-39, and 149-50.
7. Hugo Riemann, *System der musikalischen Rhythmik und Metrik* (Leipzig: Breitkopf und Härtel, 1903), pp. 259-70.
8. "One of the metric spans in an underlying structure is given a notationally specific longer duration[. T]he transformed and expanded span is typically filled with activity that is notated as if it were a metric continuation of preceding, untransformed spans. In other words, it often looks, during a composed-in *fermata,* as if the metrical count already established is meant to be continued." William E. Benjamin, "A Theory of Musical Meter," *Music Perception,* 1 (1984), pp. 397-98.
9. "The bifurcation operation effects a repetition of a timespan such that the attack-point of the repeated timespan is equivalent to that of the initial time-span with respect to metrical position. That is, under the bifurcation operation, two adjacent timepoints can be equally strong (or weak) beats." Arthur Komar, *Theory of Suspensions* (Princeton: Princeton University Press, 1971), p. 62.
10. There is an intriguing change of detail, as the sequence of m. 110 is altered in m. 112 so that the sequence ascends by step melodically while it descends by step harmonically.
11. This renewed emphasis on E-flat helps to clarify in retrospect the relatively stable G-major section in the development, mm. 93-96, which in turn refers to the tonal inflection toward G minor in mm. 18-19. Although E-flat is never tonicized, it is reiterated and doubled so much that it participates in the tonal plan of the movement. E-flat balances G major symmetrically around the tonic F.
12. Rudolph Reti, *The Thematic Process in Music* (London: Macmillan, 1951), pp. 206-18. For a more general discussion of motivic derivation, see Deryck Cooke, "The Unity of Beethoven's Late Quartets," *Music Review,* 24 (1963), pp. 30-49. An interesting analysis of Opus 135 from a rather different point of view—the consequences of the quartal implications of the unusual opening—can be found in Curt Cacioppo, "Color and Dissonance in Late Beethoven: The Quartet Opus 135," *Journal of Musicological Research,* 6 (1986), pp. 207-48.
13. This interpretation is clouded by the viola move to E, third of the dominant harmony, on the first rather than the second beat of m. 102.

CHAPTER 6

1. Phrases in tonal music are created by a confluence of several processes, only some of which are distinctly tonal. Nonetheless, it is impossible for a truly tonal composition not to be partitioned into phrases.
2. But see Section 6.4, which includes a discussion of the interior climax of one

particular piece. See also David Epstein, "On Musical Continuity," in J. T. Fraser, Nathaniel Lawrence, and David Park, eds., *The Study of Time,* vol. 4 (New York: Springer-Verlag, 1981), pp. 180-97.

3. For further discussion of tonal closure, see Leonard B. Meyer, *Explaining Music* (Berkeley: University of California Press, 1973), pp. 88-90.
4. The term originated with Schoenberg: "*Liquidation* consists in gradually eliminating characteristic features, until only uncharacteristic ones remain, which no longer demand a continuation." *Fundamentals of Musical Composition,* ed. Gerald Strang and Leonard Stein (New York: St. Martin's, 1967), p. 58. I am indebted to William Caplin for reminding me of the original formulation of the liquidation concept.
5. Relevant to this chapter's ideas on multiple time is Thomas Clifton's suggestion that there are two beginnings in the first movement of Beethoven's Ninth. See *Music as Heard: A Study in Applied Phenomenology* (New Haven: Yale University Press, 1983), pp. 83-88. Leo Treitler, on the other hand, believes that the symphony has *no* clear beginning. His "History, Criticism, and Beethoven's Ninth Symphony" explores the consequences of the gradual start of the first movement. The subsequent music seems "unable to pull away from its static point of origin." See *Nineteenth Century Music,* 3 (1980), pp. 193-96.
6. In much recent music, however, where ending gestures are less (if at all) conventionalized, the framing silence can be the first clue that the piece has ended. Anyone who attends new music concerts has surely noticed the often quite long (and awkward) gap between the cessation of sound and the onset of applause.
7. For a discussion of listener competence with respect to both tonal implications and tonal conventions, see Meyer, *Explaining Music,* pp. 207-8. Meyer also offers a valuable discussion of the potential independence of context and function. See pp. 208-13.
8. Some music, more neutral in character, does not imply its function in its shape. See Meyer, *Explaining Music,* p. 207.
9. This distinction parallels Lewis Rowell's discussion of music as process vs. product. See "The Creation of Audible Time," in J. T. Fraser, Nathaniel Lawrence, and David Park, eds., *The Study of Time,* vol. 4 (New York: Springer-Verlag, 1981), pp. 198-210. A similar classification is implicit in Ernst Toch's "Beginning and Ending," a chapter of his book *The Shaping Forces of Music* (New York: Dover, 1977). See pp. 217-38. For a discussion of the conventions of beginning in the music of Debussy, see James A. Hepokoski, "Formulaic Openings in Debussy," *Nineteenth Century Music,* 8 (1984), pp. 44-59.
10. The increasing durations of silences are heard as a slowing down of the tempo, not as syncopations. Tchaikovsky used this device again at the actual ending of *Francesca da Rimini* (1877).
11. Clifton discusses such an ending in the last of Schumann's *Fantasiestücke,* Opus 12. See *Music as Heard,* pp. 88-89.
12. Epstein, "On Musical Continuity," pp. 192-94.
13. V-I is inherently neither strong-weak nor weak-strong. See Wallace Berry,

Structural Functions of Music (Englewood Cliffs, NJ: Prentice-Hall, 1976), pp. 329-34.

14. Leonard G. Ratner calls this a "cadence out of countenance." See *Classical Music: Expression, Form, Style* (New York: Schirmer, 1980), pp. 39-40.
15. Clifton discusses this passage in *Music as Heard,* p. 268.
16. Janet M. Levy, "Gesture, Form, and Syntax in Haydn's Music," in Jens Peter Larsen, Howard Serwer, and James Webster, eds., *Haydn Studies* (New York: Norton, 1981), pp. 355-62.
17. Leonard B. Meyer, "Toward a Theory of Style," in Berel Lang, ed., *The Concept of Style* (Philadelphia: University of Pennsylvania Press, 1979), pp. 33-38. This passage is also discussed in Burton S. Rosner and Leonard B. Meyer, "Melodic Processes and the Perception of Music," in Diana Deutsch, ed., *The Psychology of Music* (Orlando, FL: Academic Press, 1982), pp. 318-19.
18. *Explaining Music,* pp. 212-13.
19. Judy Lochhead, "The Temporal in Beethoven's Opus 135: When Are Ends Beginnings?" *In Theory Only,* 4, no. 7, January 1979, pp. 6-7. Lochhead identifies gestural time with "absolute temporal function" and absolute time with "contextual temporal function"; to avoid confusion over the word *absolute,* I use "inherent temporal function" in place of her "absolute temporal function." See her p. 4. This perceptive article is a response to my earlier formulation of the ideas discussed in this chapter, "Multiple and Non-Linear Time of Beethoven's Opus 135," *Perspectives of New Music,* 11, no. 2 (1973), pp. 122-45. I am considerably indebted to Lochhead and to her article, although I do not agree with all her criticisms and formulations. As Lochhead implies, my article does contain a certain degree of conceptual fuzziness, which I trust is cleared up in the present chapter. Those who have read my article must understand that my use of the term "linear time" is different in this book, and that "multiple time" in the article corresponds to the book's "multiply-directed (linear) time." I have tried to avoid the article's terminology in the book, except for the retention of the term "gestural time."
20. An important question must be considered. Just how absolute is absolute time? Several types of musical time can be characterized as a one-dimensional succession: both of David Epstein's temporalities (chronometric and integral time); both of William Benjamin's times, that which is measured by accents and that which is measured by timespans. Furthermore, we must consider the relevance of absolute duration (as measured objectively by a clock) to duration as experienced in music. These matters are taken up in Chapter 11.
21. Lochhead, p. 4.
22. *Ibid.,* p. 16.
23. Minute changes have been made in Examples 6.6-6.9 in order to show more clearly the gestural connections. Compare with the original.
24. Lochhead, pp. 7-8.
25. Both at the University of California in Berkeley, 1968 and 1970.
26. Actually, a composition has at least three temporal continua. There is a sense in which the piece is in history. In this sense the work has an open future. It is undecided whether a particular performance will take place,

what it will be like, whether a repeat will be taken, whether the speakers will distort during a certain hearing of a recorded performance. The future of the internal time of a piece—for example, its final cadence (whether defined by temporal placement or only by gesture)—is, on the other hand, determined. The temporal continua referred to in Section 6.5, indeed in most of this book, are internal to the piece and, except for the case of indeterminate music, fixed.

27. The most complete exposition of McTaggart's ideas is found in *The Nature of Existence* (London: Cambridge University Press, 1927).
28. This brief overview of McTaggart's ideas is adapted from Richard M. Gale, *The Language of Time* (New York: Humanities Press, 1968), pp. 3-14.
29. Gale, p. 6.
30. However, as Meyer points out (*Explaining Music,* p. 212), the possible discrepancy between ending gesture and beginning function was recognized early. Theorist Johann Mattheson wrote in 1739 that "cadences . . . are quite common . . . and may be found in every piece. When, however, they are used at the beginning of a piece, they become something *special,* since they normally belong at the end." See Hans Lenneberg, "Johann Mattheson on Affect and Rhetoric in Music," *Journal of Music Theory,* 2 (1958), p. 70.
31. D. S. Mackay, "Succession and Duration," *University of California Publications in Philosophy,* 38 (1935), pp. 179-81. Interestingly, Mackay uses the terms "succession" for the B-Series and "duration" for the A-"Series": "Our experience of time includes both succession and duration, or rather it is an experience of *succession in duration.* For the succession, in terms of which we determine what is earlier than, simultaneous with, or later than any given event, has no temporal significance apart from the duration of things or processes, either remembered as past, perceived as present, or expected as future."
32. Gestural time is not independent of memory. It requires memory of other pieces. How else could we understand conventions? But the memory of music's absolute time operates within the boundaries of a particular performance and hence is quite different from the listener's memory of prior musical experiences.
33. J. B. Priestley, *Man and Time,* (Garden City, NY: Doubleday, 1964), p. 179.
34. Meyer, *Music, the Arts, and Ideas* (Chicago: University of Chicago Press, 1967), p. 150.
35. Everyone's personal blend of past, present, and future is determined to some extent by societal values. Sociologist Lawrence L. LeShan has shown that different social classes conceive time differently. In the United States, for example, lower classes are present-oriented, middle classes are future-oriented, and upper classes are past-oriented. These values are instilled in children by the way their parents reward and punish. Lower-class children, for example, often receive punishments and rewards in an unpredictable manner, so that they learn that the future is not to be trusted. Middle-class children are taught to plan for the future, as, for example, by being urged to do well in school in order to be accepted into a good college. The values of upper-class children are often shaped by exhortations to live up to the standards established by past generations. See LeShan, "Time Orientation

and Social Class," *Journal of Abnormal Sociology and Psychology,* 47 (1952), pp. 589-92.

36. John A. Michon, "The Compleat Time Experiencer," in John A. Michon and Janet L. Jackson, eds., *Time, Mind, and Behavior* (New York: Springer-Verlag, 1985), pp. 40-41.
37. These historical ideas are necessarily oversimplified. For fuller discussions of time and culture in the late eighteenth and early nineteenth centuries, see Georges Gurvitch, *The Spectrum of Social Time,* trans. Myrtle Korenbaum, (Dordrecht, Holland: Riedel, 1964); G. J. Whitrow, *The Natural Philosophy of Time,* 2nd ed. (Oxford: Clarendon Press, 1980); Sadik J. Al-Azm, *Kant's Theory of Time* (New York: Philosophical Library, 1967); Stephen Toulmin and June Goodfield, *The Discovery of Time* (New York: Harper and Row, 1965).
38. As Meyer once remarked (in a private discussion at Oberlin College in October 1970), it is possible to find music that, because of its lack of unequivocal referential meaning, seems to support virtually any hpothesis about the culture in which it was written.
39. The phrase is William Barrett's. See *Irrational Man* (Garden City, NY: Doubleday Anchor, 1962), p. 49.
40. *Ibid.,* pp. 53-54.
41. John Cohen, "Subjective Time," in J. T. Fraser, ed., *The Voices of Time,* 2nd ed. (Amherst: University of Massachusetts Press, 1981), p. 274.
42. Ralph Stephenson and Jean R. Debrix, *The Cinema as Art* (Baltimore: Penguin, 1969), p. 106.
43. *Ibid.,* p. 96.
44. *Ibid.,* p. 121.
45. Many modern abstract films do confront time directly. Using abstract shapes moving in time, they create or at least express a pure temporality much like that of music.
46. See Priestley, p. 122.
47. For a discussion of ways contemporary views of time relate to musical tempo and rhythm, see Robert Erickson, "Time-Relations," *Journal of Music Theory,* 7 (1963), pp. 174-92.
48. The performer may choose, by flipping over the score, to go in either direction around the circle. Thus the piece proclaims the equality of backwards and forwards.
49. Stockhausen, ". . . . . how time passes . . . . . ," trans. Cornelius Cardew, *Die Reihe,* 3, p. 36.
50. See Donald B. Anthony, "A General Concept of Musical Time with Special Reference to Certain Developments in the Music of Anton Webern" (Ph.D. diss., Stanford University, 1968), p. 161.
51. Strictly speaking, clock time is not a subset of absolute time, because clocks can stop. Consider a football game. The official clock continually stops, so that the clock-time duration of a game is considerably less than its absolute-time length (or than the length measured by a spectator's watch). Yet the series of segments of absolute time included within the game's clock time is indeed meaningful and continuous; it in fact *is* the game.

CHAPTER 7

1. Edward T. Cone was one of the first to explain the importance of stepwise connections in atonal music. "The ear will naturally connect each tone with those nearest it in pitch. The adjacent pitches may be diatonic or they may be chromatic; they may be actually adjacent or displaced by one or more octaves; they may be present by implication only." "Analysis Today," in Paul Henry Láng, ed., *Problems of Modern Music* (New York: Norton, 1960), pp. 39-40. See also Roy Travis, "Directed Motion in Schoenberg and Webern," *Perspectives of New Music,* 4, no. 2 (1966), pp. 85-89.
2. The trichord 015, incidentally, is prevalent throughout the movement. Some of its more prominent occurrences are circled in Example 7.1.
3. These two figures are melodic statements of 014 trichords. There are several other prominent 014s in the movement. A few examples (other than subsets of the indicated 0147s) are shown in Example 7.1.
4. Schoenberg may have had the sounds of tonal music lingering in his composer's ear when he wrote this movement, but third-derived sonorities are not a necessary aspect of his musical language in this work. The sixth piece for example, gradually builds two different structures in fourths: the G-C-F in m. 1 expands upward to include B-flat in m. 5 and downward in the same measure to include D and E (A is omitted because of its presence in the reiterated A-F-sharp-B chord). The other structure of fourths is built up from the C-sharp and F-sharp that span the left hand in m. 7. These notes are reiterated in m. 8, where B and E are added above. The last measure adds both A, which extends the second structure of fourths one fourth higher and also, at the very last note, the A-flat (an octave down for purposes of sonority and cadence) that extends it one fourth lower. These two fourth-structures provide an organizational framework for much of the final movement. Each of the twelve pitch classes belongs to one series of superimposed fourths or the other (A theoretically belongs to both, although it is actually omitted from the first structure), except that D-sharp, presented prominently in octaves in mm. 3-4, belongs to neither. The entire movement is pervaded by these fourths. Its harmonic language has little if anything to do with the first movement's superimposed thirds.
5. The isolation of the D-sharp in m. 1 is intensified by the absence from m. 2 of a C-sharp that would pull the D-sharp down a step in the way m. 2's A connects with the opening B.
6. It is interesting to compare this place with the other phrase (not metric) overlap, mm. 14-15. The first chord of m. 15 is simultaneously the cadence of the phrase in mm. 13-14 and the start of the final phrase, mm. 15-17. There is no ambiguity comparable to that in mm. 2-3 here. This clarity parallels the other linear moves toward greater clarity discussed in this analysis.
7. The more common problem among inexperienced twelve-tone composers, however, is excessive consistency. Student serial works are often little more than demonstrations of the ways a row can be manipulated.
8. George Rochberg, "Webern's Search for Harmonic Identity," *Journal of Music Theory,* 6 (1962), pp. 108-22. György Ligeti's analysis predates Rochberg's

by two years, but Ligeti does not label the row forms in the manner used here. "Über die Harmonik in Weberns erster Kantate," *Darmstädter Beiträge zur neven Musik,* 3 (1960), pp. 49-64.

9. An "interval class" is analogous to a pitch class. The interval class, or IC, of a given interval is the number of semitones in its smallest inversion. Thus, for example, a major second, minor seventh, major ninth, etc., are all reducible to IC2—the interval class with two semitones.
10. A vertical is a chord, or potential chord, formed by sounding simultaneously notes with the same order position in different forms of the same row. This term is borrowed from various analysts of Stravinsky's late twelve-tone music. Stravinsky's procedure is different from Webern's, however. Stravinsky's verticals are hexachordal, and the row forms from which they are formed are derived from the basic row by successive rotations of each hexachord. Stravinsky furthermore welcomed PC duplications in his verticals, while Webern carefully constructed his system to avoid duplicated PCs (except for the perfect fourths that appear four times in Example 7.3).
11. Ligeti studies the significance in this movement of inversion about an axis that is a semitone, rather than a single PC. See pp. 53-55.
12. The pitch D, for example, is a specific sound in a particular register. The pitch class (PC) D is an abstraction standing for all Ds in all registers.
13. Graham H. Phipps, "Tonality in Webern's Cantata I," *Music Analysis,* 3 (1984), pp. 130-33. Phipps' analysis is unique among those of Opus 29 that I know for his attempts to study music and text interrelationships and also to consider all three movements.
14. Robin Hartwell, "Duration and Mental Arithmetic: The First Movement of Webern's First Cantata," *Perspectives of New Music,* 23, no. 1 (1984), p. 352.
15. Jonathan Harvey, "Reflection after Composition," *Contemporary Music Review,* 1 (1984), pp. 83-84.
16. *Ibid.,* p. 86.
17. For discussions of the double canons in mm. 37-40 and 43-46, see Phipps, pp. 138-41 and Hartwell, pp. 353-57. The recapitulation canons depart from strictness to a greater extent than do those in the exposition. The gradual relaxation of canonic strictness is a linear procedure throughout the movement.
18. Phipps, p. 137.
19. Webern chooses to space this chord as in m. 7, rather than symmetrically around the G-A-flat axis used earlier in m. 47. The symmetrical spacing (obtained by dropping the B an octave and raising the A an octave) actually sounds more final—perhaps too final for the end of a first movement. The actual spacing chosen is a literal tritone transposition of the harp chord in m. 42.
20. See Phipps, p. 126, for a discussion of Webern's ideas on tonic and dominant functions in twelve-tone music and on the importance of the tritone. Also, on pp. 132 and 134, Phipps discusses particular tritone relationships in Opus 29's opening movement.
21. Large-scale simultaneous temporal structures that are out of phase is not a phenomenon restricted to twentieth-century music. Joel Lester offers an in-

teresting analysis of the opening ten measures of Beethoven's *Spring Sonata* (1801), for violin and piano, in which he identifies a melody structured as 2+2+2+2+2 measures; sustained harmonies that group the measures 2+1+2+2+3; a larger harmonic repetition that subdivides the unit 7+3; and a bass-line repetition that suggests 3+4+3. "Attempting to reduce the passage to a regular duple hypermeter would not clarify the rhythmic structure but destroy the flow of the music." *The Rhythms of Tonal Music* (Carbondale: Southern Illinois University Press, 1986), pp. 254-55.

CHAPTER 8

1. Karlheinz Stockhausen, "Momentform," in *Texte zur elektronischen und instrumentalen Musik,* vol. 1 (Cologne: DuMont, 1963), pp. 189-210.
2. Stockhausen, "Erfindung und Entdeckung," in *Texte,* vol. 1, pp. 222-58, but especially pp. 250-58.
3. An important antecedent of pure moment form is *Klavierstück XI* (1956), in which 19 fragments (not really moments) are to be played in random order. Moment time is also suggested by the careful proportioning of these fragments according to the Fibonacci series (discussed in Section 10.9). See Robin Maconie, *The Works of Karlheinz Stockhausen* (London: Oxford University Press, 1976), p. 101. These proportions are less than obvious, however, since there are six different tempos that may be applied to the fragments in any manner the performer chooses.
4. Another antecedent is György Ligeti's 1958 article "Metamorphoses of Musical Form," trans. Cornelius Cardew, *Die Reihe,* 7 (1965), in particular pp. 14-16.
5. *Texte,* vol. 1, p. 199, trans. in Seppo Heikinheimo's book *The Electronic Music of Karlheinz Stockhausen,* trans. Brad Absetz (Helsinki: Suomen Musikkitieteellinen Seura, 1972), pp. 120-21.
6. William Barrett, *Irrational Man* (Garden City, NY: Doubleday Anchor, 1962), pp. 50-51.
7. For a discussion of the demise of the dramatic curve in music, see Barney Childs, "Time and Music: A Composer's View," *Perspectives of New Music,* 15, no. 2 (1977), pp. 196-98.
8. Dieter Schnebel, "Karlheinz Stockhausen," trans. Leo Black, *Die Reihe,* 4 (1960), p. 121.
9. An excellent discussion of ending vs. stopping can be found in Thomas Clifton, *Music as Heard: A Study in Applied Phenomenology* (New Haven: Yale University Press, 1983), pp. 88-95.
10. *Texte,* vol. 1, p. 207, trans. Heikinheimo, pp. 121-22. Heikinheimo retains the original *Anfang, Beginn, Ende,* and *Schluss,* for which I have substituted respectively "beginning," "starting," "ending," and "stopping."
11. I am indebted for this observation to Victor Grauer.
12. Quoted in Karl H. Wörner, *Stockhausen: Life and Works,* trans. Bill Hopkins (Berkeley: University of California Press, 1973), pp. 110-11.
13. Maconie, pp. 143-44.

14. *Ibid.*, pp. 164-65.
15. Allen Edwards, *Flawed Words and Stubborn Sounds: A Conversation with Elliott Carter* (New York: Norton, 1971), pp. 90-91.
16. *Ibid.*, p. 99.
17. *Ibid.*, p. 92.
18. *Ibid.*, p. 93.
19. *Ibid.*, p. 95.
20. *Ibid.*, p. 97.
21. Quoted in Wörner, p. 46.
22. *Texte*, vol. 1, p. 250, trans. Heikinheimo, p. 122.
23. Heikinheimo, p. 208.
24. Karlheinz Stockhausen and Jerome Kohl, "Stockhausen on Opera," *Perspectives of New Music*, 23, no. 2 (1985), p. 25. The composer next states something which seems to me to contradict utterly the nature of moment form. He refers to a moment full of "influences of the past and the future" as "a real transition, then: somewhere between definite moments."
25. Jonathan Harvey, *The Music of Stockhausen* (Berkeley: University of California Press, 1975), p. 20.
26. For an interesting and rather different discussion of musical stasis, see Clifton, "Some Comparisons between Intuitive and Scientific Descriptions of Music," *Journal of Music Theory*, 19 (1975), pp. 96-105. Also relevant is his discussion of "static succession" and "moving duration." See *Music as Heard*, pp. 102-6.
27. In an important article, Arnold Whittall suggests that "the need to interpret attempts by composers to give the concept of tonality a viable contemporaneity" is the overriding challenge to theorists today. Whittall studies in some depth the way Berg's Violin Concerto (1935) approaches tonality. See "The Theorist's Sense of History: Concepts of Contemporaneity in Composition and Analysis," *Journal of the Royal Musical Association*, 112 (1986-87), pp. 1-20.
28. Robert Sherlaw Johnson, *Messiaen* (Berkeley: University of California Press, 1975), pp. 22-23.
29. *Ibid.*, p. 23.
30. *Ibid.*, p. 24.
31. *Ibid.*, p. 183.
32. Paul Griffiths, *Olivier Messiaen and the Music of Time* (London: Faber and Faber, 1985), pp. 15-17.
33. Maconie, pp. 103-4.
34. The duration calculations are based on Messiaen's metronome markings. *Chronochromie* is one of the first works in which he uses precise metronome indications. Perhaps his reliance on specific numerical tempo markings comes from an increased sensitivity to exact proportions in an extended moment structure.
35. An interesting discussion of temporality in certain non-Western music is found in Richard Saylor's "The South Asian Conception of Time and Its Influence on Contemporary Western Composition." See note 2.16.
36. Griffiths, p. 193.

37. *Ibid.*, p. 196.
38. Private communication from Victor Grauer, 29 March 1980.

CHAPTER 9

1. Numbers in brackets are rehearsal numbers. All references are to the 1947 version, published in 1952 by Boosey & Hawkes. The original version, copyright 1926 by Edition Russe de Musique, has long been known primarily through a piano reduction by Arthur Lourié. A full score of the 1920 version has appeared in undated publications by Kalmus and by Belwin-Mills. Comparing the 1920 and 1947 versions is fascinating, particularly in matters of orchestration and barring. Because it is widely known and performed, the 1947 version forms the basis of the analysis in this chapter.
2. See, for example, Leonard B. Meyer, *Music, the Arts, and Ideas*, pp. 266-316. Also, Edward T. Cone, "Analysis Today," in Paul Henry Láng, ed., *Problems of Modern Music* (New York: Norton, 1962), pp. 37-38. The problems of analyzing avant-garde music are discussed in Section 12.7.
3. My analytic procedures are reductive, not generative. There is an ongoing debate among Schenkerians (and anti-Schenkerians) over whether Schenker's methods primarily explain how a tonal work is built from a background archetype or how the background underlies a tonal piece. But my analysis of *Symphonies* is definitely reductive. It looks for the underlying harmonies and motions, not for the principles that generate the piece from its basic structure.
4. Joseph Straus, "The Problem of Prolongation in Posttonal Music," *Journal of Music Theory*, 31 (1987), pp. 1-21.
5. See Pierre Boulez, *Notes of an Apprenticeship*, trans. Herbert Weinstock (New York: Knopf, 1968), pp. 72-145, and Jean Barraqué, "Rythme et développement," *Polyphonie*, 3, no. 1-2 (1954), pp. 52-58.
6. [41]-[42] subsequently returns as an independent moment. Thus there ultimately *is* ambiguity about the status of [41]-[42]. Such upgrading of a submoment to a moment does happen elsewhere; [3] is the source of [58]-[64].
7. For a discussion of the usage of octatonic pitch configurations in *Symphonies*, see Pieter C. van den Toorn, *The Music of Igor Stravinsky* (New Haven: Yale University Press, 1983), pp. 337-44.
8. I am indebted for this alternative analysis, and on a number of other points, to David Feldman.
9. Van den Toorn agrees that [0]-[6] functions as a single block. He cites the tendency of [0]-[6] to adhere to a single octatonic collection. See *The Music of Igor Stravinsky*, pp. 337-39, 343.
10. For a cellular analysis of *Moment A* similar in spirit to this one but using a somewhat different set of basic cells, see Laszlo Somfai, "*Symphonies of Wind Instruments* (1920): Observations on Stravinsky's Organic Construction," *Studia Musicologica Academiae Scientiarium Hungaricae*, 14 (1972), pp. 363-64.
11. In the Belwin-Mills and Kalmus publications of the original version (see

note 9.1), there are two octave C-sharps: the third and seventh vertical dyads. Significantly, the original scoring includes an alto flute.

12. See Somfai, p. 370, for a different cellular analysis of *Moment B*.
13. See Somfai's analysis of *Moment C*, p. 367.
14. Columbia Records M-33201.
15. I have not included alternate analyses of the cellular structure of *Moment D*, because they do not add to our understanding. No matter how we slice up that moment, its cellular construction remains beneath the surface. But see Somfai's analysis of the flute-clarinet duet, pp. 371–73.
16. John Rahn, *Basic Atonal Theory* (New York: Longman, 1980), p. 77.
17. Somfai's analysis of *Moment E* appears on p. 372.
18. See Boulez, *Notes of an Apprenticeship*, pp. 132–35.
19. In the original version of the final chord is a 4/4 whole note with a *fermata*. See Robert Craft, "On the *Symphonies of Wind Instruments*," *Perspectives of New Music*, 22 (1983–84), p. 455.
20. *Supplément musical* of *La Revue musicale*, 1, no. 2 (December 1920), pp. 22–23.
21. By Robert Craft, *loc. cit.*, pp. 448–51. Craft argues that the opening fanfare was jotted down in March or April, 1918. He does agree, however, that the final chorale was the first section of *Symphonies* to be completed.
22. The composer returned to the idea of the final chorale as a separate piece in 1945, when he made an arrangement for four flutes, four oboes, English horn, three bassoons, contrabassoon, four horns, four trumpets, three trombones, and tuba. He conducted this version on a half-hour broadcast with the *Symphony of Psalms* (which also has a large wind section lacking clarinets). See Robert Craft, *loc. cit.*, pp. 452, 454–55, and also Craft's liner notes to Stravinsky's recorded performance of *Symphonies*, Columbia Records ML-4964.
23. *The Music of Igor Stravinsky*, pp. 342–43.
24. For a discussion of the 0135 tetrachord in *Symphonies* and its use in the linear domain, see Joseph Straus, "A Principle of Voice Leading in the Music of Stravinsky," *Music Theory Spectrum*, 4 (1982), pp. 106–12. Straus introduces the idea of "pattern completion," which amounts to a possibly large-scale linear progression moving towards the completion of a 0135 tetrachord.
25. See Somfai's analysis of *Moment F*, pp. 366–67 and 375.
26. The analytic notation of *Cell Sequences 18, 19*, and *21* indicates no incompleteness, since an isolated highest note of the tetrachord has been given a symbol—6—as a legitimate part 3 of a cell. I chose to include this "6" since it does happen a few times, but I do not mean to imply that the cell has an ending that is as cadential as those parts 3 of *family b* which return to the stable lowest tone of the tetrachord.
27. Somfai's analysis of *Moment G* appears on pp. 375–76.
28. Straus, "A Principle of Voice Leading in the Music of Stravinsky," pp. 110–12.
29. Edward T. Cone, "Stravinsky: The Progress of a Method," in *Perspectives on Schoenberg and Stravinsky*, ed. Benjamin Boretz and Edward T. Cone (New York: Norton, 1972), pp. 155–60.

30. *Ibid.*, p. 156.
31. For yet another view of *Symphonies*, see Thomas Tyra, "An Analysis of Stravinsky's *Symphonies of Wind Instruments*," *Journal of Band Research*, 8, no. 2 (Spring 1972), pp. 6-39. Tyra's methodology is somewhat similar to mine in his study of the foreground details, although he reaches some different conclusions. He also discusses performance problems and scoring. More sophisticated analytic insights about *Symphonies* can be found in Christopher F. Hasty, "On the Problem of Succession and Continuity in Twentieth-Century Music," *Music Theory Spectrum*, 8 (1986), pp. 62-73.
32. Durations are calculated from the first attack point of the (sub)moment to the first attack point of the subsequent (sub)moment. *Fermata* values are calculated from the average number of beats (not number of seconds) per *fermata* in several recordings of "good," authentic performances (e.g., Craft, Stravinsky).
33. The question of approximation is considered in greater detail in Sections 11.3 and 11.5.

CHAPTER 10

1. B. M. Williams, "Time and the Structure of Stravinsky's Symphony in C," *Musical Quarterly*, 59 (1973), pp. 357-58.
2. Edward T. Cone, "The Uses of Convention: Stravinsky and His Models," in Paul Henry Láng, ed., *Stravinsky: A New Appraisal of His Work* (New York: Norton, 1963), p. 29.
3. Williams, pp. 355-56.
4. The quotations are from Stravinsky's *The Poetics of Music,* trans. Arthur Knodel and Ingolf Dahl (New York: Vintage, 1947), pp. 23-46.
5. In an interesting article, Roger Shattuck considers the two types of time postulated by Stravinsky. Shattuck shows that musical time is really neither of the two. "Stravinsky's simple distinction between ontological and psychological times falls short, therefore, because the categories misleadingly imply some kind of universal time beating beneath all experience for all to touch, particularly music. They exclude the kind of time in which his own works rate as masterpieces: not clock time or that of mere sensation, but artificial time, a tight vessel of presentness constructed by the sounds and rhythms that make up a musical composition. The time Stravinsky tells is not any time we ever lived until he composed it." See "Making Time: A Study of Stravinsky, Proust, and Sartre," *Kenyon Review*, 25 (1963), pp. 255-62 (quotation from p. 257).
6. Absolute-time duration calculations are made by multiplying the total number of notated beats in a section by its indicated metronome marking.
7. See note 10.15 on the perceptibility of 2:1 proportions.
8. Although my proportional analysis is based on Stravinsky's 1947 revision, the original version (see note 8.1) has essentially the same proportions.
9. I am indebted for this observation to Jeremy Noble.
10. These relationships are explored in Rob Hallquist's unpublished paper "Parallelism in Stravinsky's *Petrouchka*."

11. In something akin to a moment-form analysis of the second of the Three Pieces, Marianne Kielian-Gilbert studies the equality vs. inequality of durational spans. She makes the interesting point that timespan similarity may function as a substitute for motivic likeness. She has also uncovered some interesting proportional balances in "The Soldier's March" from *L'Histoire du soldat* (1918). See "The Rhythms of Form: Correspondence and Analogy in Stravinsky's Designs," *Music Theory Spectrum,* 9 (1987), pp. 42-66.
12. Cone, "The Uses of Convention," pp. 21-33, but see in particular pp. 25-29.
13. The movement is cast entirely in 2/2 time.
14. Stravinsky's music is not, strictly speaking, tonal, yet it does have unmistakable pitch centers, notes that function as points of stability, whether or not they are goals of motion. Thus I follow Arthur Berger in calling such music "centric" rather than tonal and in speaking of its "centricity" rather than its tonality. See "Problems of Pitch Organization in Stravinsky," *Perspectives of New Music,* 2, no. 1 (1963), pp. 11-13.
15. Doubled durations can be perceived. According to psychologists John A. Michon and Janet L. Jackson, "An interval that is physically twice as long as a given standard interval will, by and large, also appear twice as long." See "Introduction: The Psychology of Time," in Michon and Jackson, ed., *Time, Mind, and Behavior* (New York: Springer-Verlag, 1985), p. 5.
16. James Tenney has built a theory around the idea that temporal adjacency (which he calls proximity) and similarity are "the two primary factors of cohesion and segregation" involved in musical perception. See Tenney and Larry Polansky, "Temporal Gestalt Perception in Music," *Journal of Music Theory,* 24 (1980), p. 207.
17. In studying performances given by the same musicians over a span of several years, psychologists Manfred Clynes and Janice Walker found that performers were remarkably consistent in the total amount of clock time used for a particular piece. If performers can be this sensitive to large-scale durations, surely composers can as well. See "Neurobiologic Functions of Rhythm, Time, and Pulse in Music," in Manfred Clynes, ed., *Music, Mind, and Brain: The Neuropsychology of Music* (New York: Plenum, 1982), p. 183.
18. Some of these properties include the following:

a. Every third Fibonacci number is divisible by 2; every fourth Fibonacci number is divisible by 3; etc. See Dmitri Thoro, ed., "Beginner's Corner," *Fibonacci Quarterly,* 1, no. 1 (1963), pp. 51, 64.

b. The sum of the first n Fibonacci numbers is one less than some other Fibonacci number. In particular,

$$\sum_{k=1}^{n} F_k = F_{n+2} - 1$$

See N. N. Vorob'ev, *Fibonacci Numbers* (New York: Blaisdell, 1961), p. 6.

c. The last digits of Fibonacci numbers repeat at a cycle of 60 numbers; the last pairs of digits repeat at a cycle of 300; the last three at a cycle of 1500; the last four at a cycle of 15,000; the last five at a cycle of 150,000; etc. See Dov Jarden, "On the Periodicity of the Last Digits of the Fibonacci Numbers," *Fibonacci Quarterly,* 1, no. 4 (1963), pp. 21-22.

d. The sum of any sequence of consecutive Fibonacci terms plus the second such term is a Fibonacci number:

$$(F_i + F_{i+1} + \ldots + F_{i+j}) + F_{i+1} = F_k \quad \text{for some integers } i, j, \text{ and } k$$

See Brother Alfred Brousseau, "Ye Olde Fibonacci Curiosity Shoppe," *Fibonacci Quarterly,* 10, no. 4 (1972), pp. 441-43.

19. John Benjafield and J. Adams-Webber, "The Golden-Section Hypothesis." *British Journal of Psychology,* 67 (1976), pp. 11-15.
20. Marjorie Bicknell and Verner E. Hoggatt, Jr., "Golden Triangles, Rectangles, and Cuboids," *Fibonacci Quarterly,* 7 (1969), p. 73.
21. A. F. Horadam, "Further Appearances of the Fibonacci Sequence," *Fibonacci Quarterly,* 1, no. 4 (1963), pp. 41-42, 46. See also George E. Duckworth, *Structural Patterns and Proportions in Vergil's Aeneid: A Study in Mathematical Composition* (Ann Arbor: University of Michigan Press, 1962).
22. Donald A. Preziosi, "Harmonic Design in Minoan Architecture," *Fibonacci Quarterly,* 6 (1968), pp. 317, 370-84.
23. Richard E. M. Moor, "Mosaic Units: Pattern Sizes in Ancient Mosaics," *Fibonacci Quarterly,* 8 (1970), pp. 281-310.
24. Horadam, *loc. cit.*
25. Sister Mary de Sales McNabb, "Phyllotaxis," *Fibonacci Quarterly,* 1, no. 4 (1963), pp. 57-60.
26. Philip B. Onderdonk, "Pineapples and Fibonacci Numbers," *Fibonacci Quarterly,* 8 (1970), pp. 507-8.
27. S. L. Basin, "The Fibonacci Sequence as it Appears in Nature," *Fibonacci Quarterly,* 1, no. 1 (1963), p. 53.
28. *Ibid.,* pp. 54-55.
29. J. Wlodarski, "The 'Golden Ratio' and the Fibonacci Numbers in the World of Atoms," *Fibonacci Quarterly,* 7 (1969), pp. 523-24.
30. B. A. Read, "Fibonacci Series in the Solar System," *Fibonacci Quarterly,* 8 (1970), pp. 428-38, 448.
31. Leslie E. Blumenson, "A Characterization of the Fibonacci Numbers Suggested by a Problem Arising in Cancer Research," *Fibonacci Quarterly,* 10 (1972), p. 262.
32. Rolf A. Deininger, "Fibonacci Numbers and Water Pollution Control," *Fibonacci Quarterly,* 10 (1972), pp. 299-300, 302.
33. Albert J. Faulconbridge, "Fibonacci Summation Economics, Part I," *Fibonacci Quarterly,* 2 (1964), pp. 320-22.
34. Faulconbridge, "Fibonacci Summation Economics, Part II," *Fibonacci Quarterly,* 3 (1965), pp. 309-14.
35. Lendvai has published his findings a number of times. The sources include: *Bartók stilusa* (Budapest, Zenemükiadó, 1955); "Introduction aux formes et

harmonies bartókiennes," in Bence Szabolsci, ed., *Bartók: sa vie et son oeuvre* (Budapest: Corvina, 1956, also published in German in 1957); "Duality and Synthesis in the Music of Béla Bartók," *New Hungarian Quarterly,* 3, no. 7 (1962), pp. 91-114, reprinted in György Kepeš, ed., *Module, Proportion, Symmetry, Rhythm* (New York: Braziller, 1966); *Béla Bartók: An Analysis of His Music* (London: Kahn and Averill, 1971); *Bartók költöi világa* (Budapest: Szepirodalmi Könyvkiadó, 1971); *The Workshop of Bartók and Kodály* (Budapest: Editio Musica, 1983).

36. Particularly useful is Roy Howat's "Bartók, Lendvai, and the Principles of Proportional Analysis," *Music Analysis,* 2 (1983), pp. 69-96. Lendvai responds to this article in "Remarks on Roy Howat's 'Principles of Proportional Analysis,'" *Music Analysis,* 3 (1984), pp. 255-64. See also the reviews by Todd Crow in *Notes,* 29 (1973), pp. 722-24, and by Brian Fennelly in the *Journal of Music Theory,* 17 (1973), pp. 330-34. Also important are the analyses by George Perle. See "The String Quartets of Béla Bartók," in *A Musical Offering: Essays in Honor of Martin Bernstein* (New York: Pendragon, 1977), pp. 193-210. Another analysis by Perle is reported in Elliott Antokoletz, *The Music of Béla Bartók: A Study of Tonality and Progression in Twentieth-Century Music* (Berkeley: University of California Press, 1983), which also contains some useful proportional analyses inspired by Lendvai. Additional analyses based on the ideas of Lendvai can be found in Tibor and Peter J. Bachmann, "An Analysis of Béla Bartók's Music through Fibonacci Numbers and the Golden Mean," *Musical Quarterly,* 65 (1979), pp. 72-82; Jerald C. Graue, "Novel Symmetries in Bartók's Piano Music," unpublished paper discussed briefly by Howat, p. 93; Edward A. Lowman, "Some Striking Proportions in the Music of Béla Bartók," *Fibonacci Quarterly,* 9 (1971), pp. 527-28, 537; Michael R. Rogers, "The Golden Section in Musical Time: Speculations on Temporal Proportion," (Ph.D. diss., University of Iowa, 1977); Larry J. Solomon, "Symmetry as a Determinant of Musical Composition," Ph.D. diss., University of West Virginia (1973); and András Szentkirályi, "Bartók's Second Sonata for Violin and Piano (1922)" (Ph.D. diss., Princeton University, 1976).
37. See, for example, *The Workshop of Bartók and Kodály,* pp. 247-68.
38. *Ibid.,* pp. 252-53.
39. Howat, "Bartók, Lendvai, and the Principles of Proportional Analysis," p. 81.
40. *Ibid.,* pp. 78-79.
41. Solomon, "Symmetry as a Determinant of Musical Composition," (see note 10.36), pp. 140-53.
42. Clive Pascoe, "Golden Proportion in Musical Design," (D.M.E. diss., University of Cincinnati, 1973).
43. Wallace Berry mentions several different ways of calculating proportional relations, all of which "yield information of different kinds, all of potential significance." See *Structural Functions of Music* (Englewood Cliffs, NJ: Prentice-Hall, 1976), pp. 363-64.
44. Lendvai defends his inaccuracies as imperceptible approximations. See "Remarks on Howat's 'Principles of Proportional Analysis,'" *Music Analysis,* 3

(1984), pp. 255-57. My article "The Fibonacci Series in Twentieth-Century Music," *Journal of Music Theory,* 17 (1973), pp. 119-21, takes Lendvai to task for his approximations, something I am less eager to do now that I have considered Stravinsky's approximations. (Portions of the current chapter are adapted from this article.) The critical question is, what degree of approximation is imperceptible? Or, at what point does an approximation become large enough to be called an inaccuracy? These matters are touched on in Chapter 11.

45. Howat, "Bartók, Lendvai, and the Principles of Proportional Analysis," p. 78.
46. Howat, *Debussy in Proportion: A Musical Analysis* (Cambridge, England: Cambridge University Press, 1983).
47. Howat, curiously, takes m. 77, not m. 75, as the final return of the tonic chord (as opposed to tonic key). The beginning of m. 77 exactly bisects the segment from the climactic golden mean after 58 measures and the end.
48. Howat, *Debussy in Proportion,* p. 25.
49. Kenneth Kirk, "The Golden Ratio in Chopin's Preludes, Opus 28," Ph.D. diss., University of Cincinnati, 1987. See also Michael R. Rogers' detailed analysis of golden-mean proportions in one of the Chopin preludes, "Rehearings: Chopin, Prelude in A Minor, Op. 28, No. 2," *Nineteenth Century Music,* 4 (1981), pp. 245-50. This article also uncovers golden-mean ratios in the first movement of Beethoven's Piano Sonata in C-Sharp Minor, opus 27 no. 2 (1802).
50. Kirk attempts to measure in absolute time, despite the absence of metronome markings. He counts beats but makes estimated allowances for *rubati* and *fermate.*
51. Jane Perry-Camp, "Time and Temporal Proportion: The Golden Section Metaphor in Mozart, Music, and History," *Journal of Musicological Research,* 8 (1979), pp. 133-76.
52. J. H. Douglas Webster, "Golden Mean Form in Music," *Music and Letters,* 31 (1950), pp. 238-48.
53. Newman W. Powell, "Fibonacci and the Golden Mean: Rabbits, Rumbas, and Rondeaux," *Journal of Music Theory,* 23 (1979), pp. 227-73.
54. Margaret Vardell Sandresky, "The Golden Section in Three Byzantine Motets of Dufay," *Journal of Music Theory,* 25 (1981), pp. 291-306.
55. Brian Trowell, "Proportions in the Music of Dunstable," *Proceedings of the Royal Musical Association,* 105 (1979), pp. 100-41.
56. The composer spoke at length about this idea in his composition seminars at the University of California, Davis, 1966-67.
57. See Kirk, pp. 27-36.
58. Since the Universal score has neither measure nor rehearsal numbers, a.b.c refers to page a, line b, measure c.
59. I am indebted on this point to James Hoffmann.
60. The final measure is omitted from this process. It is a coda to the coda.
61. M. 7.2.7 appears to be missing a note, as it contains only 12 attack points, for no apparent reason. A trill is considered an extended attack.
62. Robin Maconie, *The Works of Karlheinz Stockhausen* (London: Oxford University Press, 1976), pp. 207, 263.

63. Jonathan Harvey, *The Music of Stockhausen: An Introduction* (Berkeley: University of California Press, 1975), p. 96.
64. Stockhausen, *Texte,* vol. 2 (Cologne: M. DuMont Schauberg, 1964), pp. 73–100.
65. Maconie, p. 101.
66. Jann Pasler, "Narrative and Narrativity in Music," invited paper read to the International Society for the Study of Time, Dartington Hall, England, 9 July 1986.
67. Jerome Kohl identified the use of the Fibonacci series in these last two works in his lecture on Stockhausen at the annual national meeting of the Society for Music Theory, University of Southern California, November 1981.
68. A more detailed account of the use of Fibonacci note durations in *Il canto sospeso* is given in my article "The Fibonacci Series in Twentieth-Century Music," pp. 126–30.
69. For a discussion of the problems inherent in duration serialization by means of an arithmetic series, see György Ligeti, "Pierre Boulez: Decision and Automatism in *Structure Ia,*" trans. Leo Black, *Die Reihe,* 4 (1960), p. 39.
70. Edward A. Lowman gives an example of a more sophisticated usage of the Fibonacci series as suggested by the music of Eloy. See "An Example of Fibonacci Numbers Used to Generate Rhythmic Values in Modern Music," *Fibonacci Quarterly,* 9 (1971), pp. 423–26, 436.
71. Described briefly in Will Ogdon, "Conversation with Ernst Krenek," *Perspectives of New Music,* 10, no. 2 (1972), p. 106.
72. Hugo Norden, "Proportions and the Composer," *Fibonacci Quarterly,* 10 (1972), pp. 319–23.
73. Norden, "Proportions in Music," *Fibonacci Quarterly,* 2 (1964), p. 219.
74. There is an additional recent study of some interest by David H. Smyth. His unpublished paper "Large-Scale Rhythm and Formal Closure in Classical Instrumental Music" was delivered at the annual meeting of the Society for Music Theory, Indiana University, 7 November 1986. Smyth has found nested large-scale 1:1 and 2:1 proportions (many of 100% accuracy) in the second movement of Mozart's Symphony in E-Flat (1788), the third movement of Beethoven's Symphony No. 3 (1804), and the first movement of Beethoven's Piano Sonata in A, opus 101 (1817). Also of recent interest is Julian Rushton's discussion of golden-mean and 1:1 proportions in several works of Berlioz. See *The Musical Language of Berlioz* (Cambridge, England: Cambridge University Press, 1983), pp. 183–88.
75. Howat, *Debussy in Proportion,* p. 21.
76. William K. Wimsatt and Monroe C. Beardsley, "The Intentional Fallacy," the first chapter of *The Verbal Icon* (Lexington: University of Kentucky Press, 1954).
77. Howat wisely warns, "Proportions can too easily become the type of study where one finds whatever one wants by looking hard enough." See *Debussy in Proportion,* p. 10.
78. Kirk, "The Golden Ratio in Chopin's Preludes, Opus 28," p. 6, and Howat, *Debussy in Proportion,* p. 2.
79. Benjafield and Adams-Webber, pp. 13–14 (see note 10.19). The references are to: D. E. Berlyne, *Aesthetics and Psychobiology* (New York:

Appleton-Century-Croft, 1971); H. Frank, *Grundlagenprobleme der Informationästhetik und erste Anwendung auf die Mime pure* (Quickborn: Schnelle, 1959); Frank, *Kybernetische Analysen subjektiver Sachverhalte* (Quickborn: Schnelle, 1964). For further discussion of this idea, see Kirk, p. 20.

80. Benjafield and T. P. G. Green, "Golden-Section Relations in Interpersonal Judgement," *British Journal of Psychology,* 69 (1978), pp. 26-29.
81. Benjafield and Christine Davis, "The Golden Section and the Structure of Connotation," *Journal of Aesthetics and Art Criticism,* 36 (1978), pp. 423-27. The analysis offered in this article is considerably more involved than hinted at here.
82. Howat prefers the terms *primary* and *secondary.* See *Debussy in Proportion,* p. 22.
83. Doris Lora discusses Gestalt psychology's figure-ground concept relative to music. See "Musical Pattern Perception," *College Music Symposium,* 19, no. 1 (1979), pp. 170-71.
84. Two examples of well-known works in which I, for one, sense problems of proportion are Carl Nielsen's Symphony No. 5 (1922) and the third movement of Beethoven's String Quartet in E Minor, opus 59 no. 2 (1807). The very end of the Nielsen symphony always seems to me to come too soon: The music needs more time for its hard-won stability to settle in before the actual ending. The Beethoven quartet suffers because the scherzo is played thrice and the trio twice; although the resultant total duration makes sense within the totality of the quartet, the third movement in itself does not warrant all these repeats. In other words, the internal proportions of the third movement are too small for the external proportions of the quartet, and the makeshift solution of additional repeats solves the latter problem only at the expense of the former.
85. Howat admits that there are several (early) works of Debussy that "betray *no* sign of any proportional systems, even after exhaustive examination" (*Debussy in Proportion,* p. 10). I am uncomfortable saying that such music has no proportional systems. I would prefer to state that the proportions in such pieces are not systematic, or not regular, or not obvious.
86. David Epstein, "Tempo Relations: A Cross-Cultural Study," *Music Theory Spectrum,* 7 (1985), pp. 34-71. See also *Beyond Orpheus* (Cambridge: MIT Press, 1979), pp. 75-95.
87. Some commentators have criticized studying proportions apart from considerations of what music fills the timespans under consideration. It is surely wise to remember the musical contexts of proportional analyses, but it is nonetheless useful to study duration itself. Marianne Kielian-Gilbert (see note 10.11) demonstrates that Stravinsky often treats dissimilar procedures (progressions, variations, reiterations, and contrasts as well as proportions) in similar ways. She labels such similarities "analogies," a term she contrasts with "correspondences," the traditional identities of motivic and harmonic materials. Kielian-Gilbert argues convincingly that Stravinsky's forms are generated not only by *correspondence* of materials but also by *analogy* of compositional process. Thus a proportional consistency fosters one type of

formal unity, quite different from but as important as the unity of contextual consistency. I strongly recommend this provocative study.

CHAPTER 11

1. This paragraph is paraphrased from William S. Condon's discussion of human behavior. See "A Primary Phase in the Organization of Infant Responding Behavior," in H. R. Schaffer, ed., *Studies in Mother-Infant Interaction* (London: Academic Press, 1977), p. 155. Condon derives his ideas from philosopher Edmund Husserl.
2. John A. Sloboda, *The Musical Mind: The Cognitive Psychology of Music* (Oxford: Clarendon, 1985), pp. v–vi.
3. John A. Michon and Janet L. Jackson, "Introduction: The Psychology of Time," in Michon and Jackson, eds., *Time, Mind, and Behavior* (New York: Springer-Verlag, 1985), pp. 6, 8. For a similar view see Mari Riess Jones, "Time, Our Lost Dimension: Toward a New Theory of Perception, Attention, and Memory," *Psychological Review*, 83 (1976), p. 334.
4. J. T. Fraser, *Of Time, Passion, and Knowledge* (New York: Braziller, 1975), pp. 72–73. See also Leonard W. Doob, *The Patterning of Time* (New Haven: Yale University Press, 1971), p. 407.
5. Mari Riess Jones, "Some Thoughts on the Relevance of Bergson to Contemporary Psychology," in A. C. Paponicolaov and P. A. Gunter, eds., *The Legacy of Henri Bergson: Towards a Unification of the Sciences* (New York: Gordon and Breach, 1987).
6. Robert Erickson, "New Music and Psychology," in Diana Deutsch, ed., *The Psychology of Music* (Orlando, FL: Academic Press, 1982), p. 535.
7. See, for example, Stephen Handel, "Using Polyrhythms to Study Rhythm," *Music Perception*, 1 (1984), p. 480. Handel is a thoughtful psychologist who has made a number of important contributions, but his notion of accent is simplistic. Although writing in 1984, he relies on theoretical ideas of Zuckerkandl (1956) and Cooper and Meyer (1960) that have been superceded. Similary, Paul Fraisse, another sophisticated psychologist, naïvely seems to equate accent with an increase in loudness. See "Rhythm and Tempo" in Deutsch, *The Psychology of Music*, p. 160.
8. Andrea R. Halpern and Christopher J. Darwin, "Duration Discrimination in a Series of Rhythmic Events," *Perception and Psychophysics*, 31 (1982), p. 86.
9. Richard A. Block, "Memory and the Experience of Duration in Retrospect," *Memory and Cognition*, 2 (1974), p. 153.
10. This idea is implied, though not overtly stated, in Richard A. Block and Marjorie Reed, "Remembered Duration: Evidence for a Contextual-Change Hypothesis," *Journal of Experimental Psychology: Human Learning and Memory*, 4 (1978), p. 657.
11. Thomas H. Stoffer, "Representations of Phrase Structure in the Perception of Music," *Music Perception*, 3 (1985), p. 196.

12. One of the most musically literate psychologists is Sloboda. See his brief discussion of the necessity of an interdisciplinary perspective, pp. v–vi.
13. Stoffer, *loc. cit.*
14. Jonathan Dunsby, "Editorial," *Music Analysis,* 1 (1982), p. 5.
15. Stephen Walsh, "Musical Analysis: Hearing Is Believing?" *Music Perception,* 2 (1984), p. 242.
16. Sloboda, pp. 152–53.
17. Lorraine G. Allan, "The Perception of Time," *Perception and Psychophysics,* 26 (1979), pp. 340–54.
18. H. Wayne Hogan, "Time Perception and Stimulus Preference as a Function of Stimulus Complexity," *Journal of Personality and Social Psychology,* 31 (1975), pp. 32–35.
19. Robert P. Morgan, "Spatial Form in Ives," in H. Wiley Hitchcock and Vivian Perlis, eds., *An Ives Celebration* (Urbana: University of Illinois Press, 1977), p. 155.
20. Robert D. Meade, "Time Estimates as Affected by Motivational Level, Goal Distance, and Rate of Progress," *Journal of Experimental Psychology,* 58 (1959), pp. 275–79.
21. Actually, Block's experiments and explanations are more elaborate than this brief description allows. His study is worth reading. See Richard A. Block, Edward J. George, and Marjorie A. Reed, "A Watched Pot Sometimes Boils: A Study of Duration Experience," *Acta Psychologica,* 46 (1980), pp. 81–94.
22. See John A. Michon, "Processing of Temporal Information and the Cognitive Theory of Time Experience," in J. T. Fraser, Francis C. Haber, and Gert H. Müller, eds., *The Study of Time,* vol. 1 (New York: Springer-Verlag, 1972), p. 254; Robert Ornstein, *On the Experience of Time* (New York: Penguin, 1969), p. 107; Allan, "The Perception of Time," p. 344; and Block, "Contextual Coding in Memory: Studies of Remembered Duration," in Michon and Jackson, p. 175.
23. Françoise Macar, "Time Psychophysics and Related Models," in Michon and Jackson, p. 117.
24. A. B. Kristofferson, "A Quantal Step Function in Duration Discrimination," *Perception and Psychophysics,* 27 (1980), pp. 300–6.
25. "Proportional to" does not mean the same as "equal to." "Proportional" means that one value is multiplied by a constant to obtain the other value. If D_A is the absolute duration, D_S is the subjective duration, and k is the constant, then

$$D_S = kD_a^{0.9}$$

When we compare two subjective durations, however, the constant cancels out and all that remains is the ratio. What is the perceived ratio, for example, between a duration and another duration twice as long? Suppose the two absolute intervals are D_A and $2D_A$ and the two subjective intervals are D_{S1} and D_{S2}. Then

$$D_{S1} = kD_A^{0.9}$$

and

$$D_{S2} = k(2D_A)^{0.9}$$

Then the subjective duration ratio is

$$\frac{D_{S2}}{D_{S1}} = \frac{k(2D_A)^{0.9}}{kD_A^{0.9}} = 2^{0.9} = 1.866$$

We should not rush, however, to apply Eisler's 0.9 exponent to the objective durations in Chapter 10's Stravinsky analyses in order to convert them to subjective durations. We should remember that Eisler's exponent is averaged from many kinds of psychological studies and that it is subject to considerable contextual influence.

26. Hannes Eisler, "Experiments on Subjective Duration 1868–1975: A Collection of Power Function Exponents," *Psychological Bulletin,* 83 (1976), pp. 1154–57.
27. Reported by Jones in "Time, Our Lost Dimension," p. 334. Her remark that "people detect relations between event durations and preserve relative time despite changes in absolute durations" gives hope for the perceptibility of exact musical proportions, even if duration perception is necessarily subjective.
28. See, for example, Roland Fischer, "The Biological Fabric of Time," in Roland Fischer, ed., *Interdisciplinary Perspectives of Time* (New York: New York Academy of Sciences, 1967), pp. 440–88. Fischer also comments on time dilation in near-death experiences, such as the apparent reliving of an entire life during a few seconds while a victim falls toward expected death.
29. Frederick T. Melges, *Time and the Inner Future: A Temporal Approach to Psychiatric Disorders* (New York: Wiley, 1982), p. 82. Melges notes that such racing of mental processes is typical of the manic phase of a manic-depressive patient. The depressive phase is characterized by a slowing of mental processes and biological clocks.
30. Edward T. Hall, *The Dance of Life* (Garden City, NY: Doubleday Anchor, 1984), pp. 127–52.
31. *Ibid.,* pp. 149–50.
32. The idea of chunking was originally proposed in George A. Miller's influential article "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information," *Psychological Review,* 63 (1956): 81–97. Chunking is one type of patterning. For an overview of psychological patterning in the perception of music, with special emphasis on Gestalt theories, see Doris Lora, "Musical Pattern Perception," *College Music Symposium,* 19, no. 1 (1979), pp. 166–82. This article includes a useful bibliography.
33. This is a metaphor typical in recent psychological studies of memory. See Section 1.3 on the appropriateness of the computer as a contemporary metaphor for the mind.
34. Two interesting attempts to formalize and generalize the process of chunking melodies appeared in 1981. They both are somewhat similar to my hypothetical list of encoding instructions for Example 11.2, but far more rigorous and complete. They try to account for rhythm. See R. Collard, Peter G. Vos, and E. Leeuwenberg, "What Melody Tells about Metre in Music," *Zeitschrift für Psychologie,* 189 (1981), pp. 25–33; and Diana Deutsch and John Feroe, "The

Internal Representation of Pitch Sequences in Tonal Music," *Psychological Review*, 88 (1981), pp. 503-22.

35. I am indebted to Eric F. Clarke for this observation.
36. Ornstein, *On the Experience of Time*, p. 43.
37. This method of time estimation originated with Ornstein. See pp. 20 and 51.
38. *Ibid.*, p. 20.
39. *Ibid.*, p. 40.
40. *Ibid.*, pp. 64-67.
41. One of the big advances of Ornstein's theory, over previous ideas of time perception based on information processing, is that he understands the importance not only of how a stimulus is encoded when it is perceived but also of how it is chunked in memory. See pp. 104-5. It is equally important to consider, however, how the temporal information presents itself to consciousness as it is retrieved from memory. See Block, "Memory and the Experience of Duration in Retrospect," *Memory and Cognition*, 2 (1974), p. 159. Do we recall remembered duration or do we retrieve the stimulus as remembered and look to it for duration information?
42. Block, "Memory and the Experience of Duration," p. 159.
43. Block tried and failed to verify experimentally Ornstein's hypothesis concerning the influence of *individual stimulus complexity* on apparent duration of a series of stimuli. Block concludes that the storage-size model need not be rejected. Rather, there may be many kinds of, levels of, or conditions for complexity, only some of which influence subjective duration. His work does verify, though, that *complexity in the pattern of stimuli* influences remembered duration. See Block and Reed, "Remembered Duration," pp. 324-25.
44. Deutsch, "The Processing of Structured and Unstructured Tonal Sequences," *Perception and Psychophysics*, 28 (1980), pp. 382-89.
45. *Ibid.*, pp. 383-84, 387-88. See also Deutsch, "Organizational Processes in Music," in Manfred Clynes, ed., *Music, Mind, and Brain* (New York: Plenum, 1982), pp. 129-33. Jones claims that Deutsch failed to allow adequately for changes of melodic direction and for accents as possible encoding cues. See "A Tutorial on Some Issues and Methods in Serial Pattern Research," *Perception and Psychophysics*, 30 (1981), pp. 500-2. For our purposes, it suffices to know how easily different melodic types are remembered (and, presumably, chunked). The precise mechanisms of encoding that a listener may use are less critical to the idea that perceived time depends on encoded information.
46. She also confirms the hypothesis that complex melodies seem longer than simple ones of the same absolute duration. See Joy Yeager, "Absolute Time Estimates as a Function of Complexity and Interruption of Melodies," *Psychonomic Science*, 15 (1969), pp. 177-78.
47. Jones, "A Tutorial," p. 501.
48. See Jones, "A Tutorial," p. 502, on the relevance of contour to coding.
49. Geoffrey Underwood and R. A. Swain criticize Ornstein for failing to account for variations in attention that influence subjective time. See "Selectivity of Attention and the Perception of Duration," *Perception*, 2 (1973), p. 101.
50. Block and Reed, "Remembered Duration," p. 325.

51. Block, "Contextual Coding in Memory," pp. 176–77. Even purely musical context is no simple matter. As David Lewin argues, a particular event belongs to several interacting contexts of various types and lengths. See "Music Theory, Phenomenology, and Modes of Perception," *Music Perception,* 3 (1986), pp. 335–57.
52. Janet L. Jackson, "Is the Processing of Temporal Information Automatic or Controlled?" in Michon and Jackson, pp. 184–89.
53. Thomas Clifton, *Music as Heard: A Study in Applied Phenomenology* (New Haven: Yale University Press, 1983), p. 53.
54. See, for example, Geoffrey Underwood, "Attention and the Perception of Duration During Encoding and Retrieval," *Perception,* 4 (1975), p. 292.
55. Jones, "Structural Organization of Events in Time," in Michon and Jackson, pp. 202–3.
56. Michon, "Processing of Temporal Information," p. 254.
57. Ornstein, *On the Experience of Time,* p. 107.
58. Block and Reed, "Remembered Duration," p. 324. Michon, in "Processing of Temporal Information," also discusses positive vs. negative time-order errors (p. 254).
59. For an interesting discussion of what composers' sketches suggest about the mental process of composition, see Sloboda, pp. 108–9.
60. One notable exception is Leonard B. Meyer. See *Music, the Arts, and Ideas* (Chicago: University of Chicago Press, 1967), pp. 42–53.
61. Psychologists usually divide our perception and memory into three areas, which operate quite differently: echoic memory (also called sensory register), short-term memory, and long-term memory. The sensory register perceives events as they happen and sends them to short-term memory, where they are available for replay in the sensory register. Encoding takes place in short-term memory. Psychologists differ considerably over the length of short-term memory, although an average of opinion is eight seconds. Once stimuli are encoded, they are moved from short-term to long-term memory, where they are potentially permanent (except for the gradual decay of some portions of long-term memory over long periods: forgetting). When we remember, we return events encoded in long-term memory to consciousness and thus to short-term memory. There are many sources that discuss the three areas of memory and perception. See, for example, R. M. Shiffrin and R. C. Atkinson, "Storage and Retrieval Processes in Long-Term Memory," *Psychological Review,* 76 (1969), pp. 179–93. An interesting contrast between short- and long-term memory is that, with auditory stimuli, short-term memory can replay actual sounds while long-term recalls from memory only their encoded meaning. In other words, we can seem to hear a figure just experienced a second time mentally, whereas we can only remember, not re-experience, a figure heard long ago. See Fraser, *Of Time, Passion, and Knowledge,* p. 86.
62. Jones presents a similar idea in her paper "New Ways to Think about Perception and Memory for Melody," given at the national convention of the Music Educators' National Conference, Indianapolis, 20 April 1979.
63. Jones, "Some Thoughts on the Relevance of Bergson."
64. Musical time perception not only involves both active and passive modes

but also is necessarily hierarchic. A model that incorporates both active changes and hierarchic processes would be of formidable complexity. An impressive first step toward such a model appears in Marc Leman, "Dynamical-Hierarchical Networks as Perceptual Memory Representations of Music," *Interface,* 14 (1985), pp. 125-64.
65. Ornstein, *On the Experience of Time,* p. 25.
66. James J. Gibson, "Events Are Perceivable but Time Is Not," in J. T. Fraser and Nathaniel Lawrence, eds., *The Study of Time,* vol. 2 (New York: Springer-Verlag, 1975), p. 299. Similar ideas are given by Errol Harris in the passage quoted in Section 1.2. In his presidential address before the International Society for the Study of Time, at England's Dartington Hall on 4 July 1986, John Michon remarked, "Time is conceived, not perceived."
67. Ornstein, *On the Experience of Time,* pp. 34-36.
68. Michon, "Processing of Temporal Information," pp. 244-45.
69. Clarke, "Levels of Structure in the Organization of Musical Time," *Contemporary Music Review,* 2 (1986-87), p. 222.
70. The quality of beats (discussed in Section 4.4) is, in part, a product of short-term memory. The entire metric structure of a phrase (or phrase pair) can exist in short-term memory, so that we feel, for example, the quality of the downbeat of a sixth measure even without having consciously counted the number of preceding hyperbeats. As our understanding moves onto deeper levels, however, long-term memory necessarily comes into play. It is perhaps for this reason that many theorists are unwilling to admit that meter exists beyond a middleground level. But we can remember as well as sense beat qualities and degrees of metric accentuation. Deep-level meter acts differently in some ways from middleground and surface meter, but that is no reason to deny its existence.
71. W. Jay Dowling, "Rhythmic Groups and Subjective Chunks in Memory for Melodies," *Perception and Psychophysics,* 14 (1973), p. 39.
72. Eric F. Clarke, "Structure and Expression in Rhythmic Performance," in Peter Howell, Ian Cross, and Robert West, eds., *Musical Structure and Cognition* (Orlando, FL: Academic Press, 1985), p. 217.
73. Clarke, "Levels of Structure," p. 231.
74. There is disagreement between theorists concerning whether Brahms' five-bar hypermeasures are subdivided 3+2 or 2+3. Schenker favors 3+2. See his sketch in Donald M. McCorkle, ed., *Brahms' Variations on a Theme of Haydn* (New York: Norton, 1976), p. 165. Lerdahl and Jackendoff also hear 3+2, although they admit that the recapitulation, after an intervening passage in 2+2 hypermeter, is likely to sound 2+3 (see Example 11.8). The last measure of this 2+3 hypermeasure overlaps (in m. 23) with the 2+2 coda, so that the 2+3 possibility leads to complete hypermetric regularity in the recapitulation and coda of this theme. See *A Generative Theory of Tonal Music* (Cambridge: MIT Press, 1983), pp. 205-6. Wallace Berry also favors 3+2, although he considers the possibility of the hypermetric accent falling at the downbeat of m. 2 rather than of m. 1. See *Structural Functions of Music* (Englewood Cliffs, NJ: Prentice-Hall, 1976), pp. 351-53. William Benjamin gives cogent reasons supporting both 3+2 and 2+3 hypermeasures, but he

prefers 3 + 2. See "A Theory of Musical Meter," *Music Perception,* 1 (1984), pp. 386-88. Allen Forte, on the other hand, prefers 2 + 3. See "The Structural Origin of Exact *Tempi* in the Brahms-Haydn Variations," in McCorkle, p. 188. The opening phrase of the melody seems to suggest 3 + 2, by virtue of the stepwise descent in mm. 2-3, the filled-in outline of the tonic triad members D and B-flat, and the melodic turn around C in mm. 4-5. The bass line, on the other hand, suggests 2 + 3, since mm. 1-2 prolong tonic harmony, the passing notes in m. 3 lead into m. 4, and mm. 3-5 both start and end with dominant harmony. The only analyst I have found willing to hear 3 + 2 and 2 + 3 hypermeasures simultaneously in different contrapuntal voices is Joel Lester. See *The Rhythms of Tonal Music* (Carbondale: Southern Illinois University Press, 1986), pp. 181-83. Brahms' subsequent variations perpetuate and explore the ambiguity rather than resolve it.

75. By omitting mm. 13-20 from Example 11.11, it is possible to construct a more condensed version of the exposition. The music, which would still make a certain degree of sense, would have a total of 46 measures, virtually half the 93 measures of Example 11.10. But then one important theme, and therefore considerable information, would be lost. It would no longer be possible to claim that the truncated version lacked only a relatively small percentage of the original information content.
76. Benjamin, "A Theory of Musical Meter," p. 404.
77. Macar, "Time Psychophysics and Related Models," p. 122.
78. Louis M. Gomez and Lynn C. Robertson, "The Filled-Duration Illusion: The Function of Temporal and Nontemporal Set," *Perception and Psychophysics,* 25 (1979), pp. 432-33. I recommend the introduction to this article.
79. Ewart A. C. Thomas and Wanda B. Weaver, "Cognitive Processing and Time Perception," *Perception and Psychophysics,* 17 (1975), pp. 363-64. It should be noted that Thomas and Weaver were studying durations not in excess of 0.1 seconds. Françoise Macar believes, however, that their ideas apply equally well to long intervals. See "Time Psychophysics and Related Models," p. 123.
80. Benjamin, "A Theory of Musical Meter," p. 382. Lester also discusses the phenomenon of an accent of length being perceived at the initiating timepoint of the note. Because he does not recognize that the musical present is longer than an instant, Lester is forced to argue that either our expectation of greater length or our memory of previous hearings of the passage causes us to perceive the accent at the beginning of a note, before we literally experience its duration. But surely an unexpectedly long note in a previously unknown piece can seem accented, solely because of its length, and its accent can be experienced at its inception, precisely because of the finite length of our short-term memory. See Lester, pp. 3-4 and 42-43.
81. Lewin argues for many contexts of varying size perceived simultaneously. See note 11.51. Each context, or horizon, or present, contains its own mixture of perception, retentión (memory), and protention (anticipation). Lewin, who bases his arguments on the temporal ideas of Husserl, succeeds in formalizing the notion of musical context.
82. Clarke, "Levels of Structure." See also Christopher F. Hasty, "Phrase Forma-

tion in Posttonal Music," *Journal of Music Theory,* 28 (1984), pp. 167-90. Hasty offers a cogent discussion of the perceptual present as exemplified in musical phrases.
83. See also Thomas Fay's discussion of the perceptual moment. "Context Analysis of Musical Gestures," *Journal of Music Theory,* 18 (1974), pp. 128-29.
84. Michon, "The Making of the Present: A Tutorial Review," in Jean Requin, ed., *Attention and Performance,* vol. 7 (Hillsdale, NJ: Erlbaum, 1978), pp. 90-92.
85. This sentence is given in K. S. Lashley, "The Problem of Serial Order in Behavior," in Lloyd A. Jeffress, ed., *Cerebral Mechanisms in Behavior* (New York: Wiley, 1951), p. 120.
86. E. H. Gombrich, "Moment and Movement in Art," *Journal of the Warburg and Courtauld Institutes,* 27 (1964), p. 301.
87. Meyer, *Music, the Arts, and Ideas,* p. 31.
88. Lashley, p. 118, and Gombrich, p. 300.
89. Lashley, p. 123.
90. Clifton, *Music as Heard,* pp. 57-59.
91. For a discussion of nonlinearity and consciousness, see Ornstein, *The Psychology of Consciousness* (New York: Pelican, 1972), pp. 91-108.

CHAPTER 12

1. The parallel between the temporality of experimental art and that of the schizophrenic mind was first suggested to me by an article of Fredric Jameson, who makes a similar disclaimer. See "Postmodernism and Consumer Society," in Hal Foster, ed., *The Anti-Aesthetic: Essays on Postmodern Culture* (Port Townsend, WA: Bay Press, 1983), pp. 118-23.
2. *Ibid.,* p. 118.
3. Frederick T. Melges, *Time and the Inner Future: A Temporal Approach to Psychiatric Disorders* (New York: Wiley, 1982), p. xix.
4. Melges, "Time Distortion in Psychiatric Disorders," invited paper presented to the International Society for the Study of Time, Dartington Hall, England, 5 July 1986.
5. Mari Riess Jones, "Structural Organization of Events in Time" in John A. Michon and Janet L. Jackson, eds., *Time, Mind, and Behavior* (New York: Springer-Verlag, 1985), p. 199. See also Richard A. Block, "Contextual Coding in Memory," Michon and Jackson, pp. 179-83.
6. Philip Glass, quoted in Wim Mertens, *American Minimal Music,* trans. J. Hautekiet (New York: Broude, 1983), p. 79.
7. Melges, p. 22. See also Edmund Bergler and Géza Róheim, "Psychology of Time Perception," *Psychoanalytic Review,* 15 (1946), p. 190.
8. Sigmund Freud, "The Unconscious," in *Collected Papers,* vol. 4, Ernest Jones, ed., Joan Riviere, trans. (London: Hogarth, 1946), p. 119.
9. Melges, *Time and the Inner Future,* p. 23.
10. *Ibid.,* p. 24.
11. Peter Hartocollis, "On the Experience of Time and its Dynamic, with Special

Reference to the Affects," *Journal of the American Psychoanalytic Association,* 24 (1976), pp. 368-70.

12. Thomas Clifton, *Music as Heard: A Study in Applied Phenomenology* (New Haven: Yale University Press, 1983), p. 97.
13. In other performances, pianists have exaggerated the differences in interpretive styles. In at least one case, a single pianist publicly performed the entire 18-hour movement. David Hatt played *Vexations* at California State University in San Bernardino on 9-10 April 1976.
14. Melges discusses the inability to distinguish past, present, and future in schizophrenic patients. See *Time and the Inner Future,* pp. 60-63.
15. *Ibid.,* p. 138.
16. Roland Fischer, "The Biological Fabric of Time," in Fischer, ed., *Interdisciplinary Perspectives of Time* (New York: New York Academy of Sciences, 1967), p. 444. Fischer is quoting W. R. Hess.
17. For a brief discussion of drugs, timelessness, and nonlinearity, see Robert E. Ornstein, *The Psychology of Consciousness* (New York: Penguin, 1972), p. 104.
18. Fischer, p. 445. See also Marie-Louise von Franz's discussion of Jung's ideas on timelessness and oneness with the universe, in "Time and Synchronicity in Analytic Psychology," in J. T. Fraser, ed., *The Voices of Time,* 2nd ed. (Amherst: University of Massachusetts Press, 1981), p. 221.
19. John Cage has written of his "view of the arts which does not separate them from the rest of life, but rather confuses the difference between Art and Life." *A Year From Monday* (Middletown, CT: Wesleyan University Press, 1967), p. 32.
20. Mertens, p. 21.
21. See the detailed description of this piece in Will Johnson, "First Festival of Live-Electronic Music 1967," *Source: Music of the Avant Garde,* 3 (1968), pp. 53-54.
22. I was first introduced to this piece in 1969 by Jon Barlow. I do not know the work's official title, but I usually call it the "Names Piece."
23. I once performed this piece with a large group of faculty members at a prestigious conservatory of music. They were name droppers. Several waited until the texture was relatively sparse before clearly speaking such names as "Vladimir Horowitz," "Isaac Stern," and "Igor Stravinsky"!
24. Earle Brown, quoted in Mertens, p. 106.
25. For a useful discussion of why vertical time is necessarily nonhierarchic, see Leonard B. Meyer, *Music, the Arts, and Ideas* (Chicago: University of Chicago Press, 1967), pp. 164-69.
26. In his unpublished book *Montage, Realism, and the Act of Vision,* Victor Grauer argues that if vertical music is totally concrete, it cannot imply anything beyond the boundaries of its performance time. It cannot, therefore, suggest an eternity. When it stops, it has ended, even though it may have had no internal cadential process. Once the performance stops, Grauer seems to believe, the music ceases to exist. My response is that even the concrete, the nonsymbolic, the nonreferential, can imply. The very concreteness of the music suggests that it could have gone on longer, seemingly without

end. The eternity I speak of does not continue mystically—apart from physical reality—once the performance has stopped. I call such music eternal only because it *could* have gone on longer, possibly much longer, without substantially altering its structure or meaning. Part of the appeal of nonteleological music lies in its ability to transcend its concreteness, to imply timelessness even while it refuses to convey syntactic meanings. Nonteleological music is timeless, just as the unconscious mind is timeless (see Sections 12.1 and 12.8).

According to Freudian theory, everyone considers him or herself immortal in the unconscious. Jacob Arlow has remarked (in his invited paper "Time as Emotion," read to the International Society for the Study of Time, Dartington Hall, England, 5 July 1986) that a sense of timelessness can be a fantasy to thwart death. The eternity wished for in the unconscious makes contact with the infinity projected by timeless music. The timelessness of vertical music engages the unconscious mind because temporal verticality implies infinite existence. On the relationship between timelessness, the unconscious, and immortality, see Bergler and Róheim, "Psychology of Time Perception," p. 190.

27. Glass, quoted in Mertens, p. 88.
28. Composer La Monte Young has said, "We must let sounds be what they are." Quoted in Mertens, p. 22.
29. Mertens, p. 108.
30. Cage, quoted in Michael Nyman, *Experimental Music: Cage and Beyond* (New York: Schirmer, 1974), p. 1. This quotation is discussed in Christopher Butler, *After the Wake: An Essay on the Contemporary Avant Garde* (Oxford: Clarendon, 1980), pp. 146-47.
31. Mertens, p. 109.
32. Morse Peckham, *Man's Rage for Chaos* (Philadelphia: Chilton, 1965), pp. 59-69. Peckham's preliminary definition is: art is "an occasion for a human being to perform the art-perceiving role in the artistic situation" (p. 66). Later he restates this idea: "a work of art is any perceptual field which an individual uses as an occasion for performing the role of art perceiver" (p. 68). Peckham presents another idea that is relevant to music that seems to destroy previously accepted musical values. He believes that it is a purpose of art to provide chaotic experiences. Art does not offer, as traditional aesthetics claims, instances of order in a chaotic world. Art provides instead contexts of disorder in an overly ordered world. By perceiving and understanding the chaos of new art, we unify it for ourselves and thereby grow and change as individuals and as a culture. I am necessarily simplifying and paraphrasing Peckham's argument, which he develops step by step throughout his book.

    Although Peckham is referring to radical art of all eras, his ideas were particularly appealing to experimental artists in the 1960s. Similar ideas are offered from a psychoanalytic perspective in Jacob A. Arlow, "The Poet as Prophet: A Psychoanalytic Perspective," *Psychoanalytic Quarterly*, 55 (1986), pp. 53-68.
33. António R. Damásio and Hanna Damásio, "Musical Faculty and Cerebral Dominance," in Macdonald Critchley and R. A. Henson, eds., *Music and the*

Brain: Studies in the Neurology of Music (London: Heinemann, 1977), pp. 146–47.

34. Christian Wolff, quoted in John Cage, *Silence* (Cambridge: MIT Press, 1966), p. 54.
35. Mertens, p. 107.
36. Young's *Dream House* is literally an everlasting piece, without beginning or end. See Mertens, p. 89.
37. This observation comes from, I believe, Barney Childs, although I cannot locate the source.
38. Morton Feldman, quoted in Mertens, p. 106.
39. Most of my own compositions written between 1972 and 1984 attempt to superimpose linear processes on static backgrounds by restricting the total pitch-class content to five, six, or seven notes. In *Moving Music* (1976), for example, a background of vertical time is insured by several factors: the use of only five notes throughout the thirty-minute piece; a constant drone; the use of only one timbre (the work is for solo clarinet and an ensemble of 12 clarinets); a limited repertory of note durations; and the strict derivation of all materials from one melody. Within this unchanging context, however, directional processes are created in the realms of melodic permutation, density, register, and physical location of sound sources (the 12 clarinetists are lined up across the stage). I tried to create a piece that *simultaneously* moves through time and remains frozen in a timeless present.
40. Alexander Ringer, lecture delivered at the University of Cincinnati, 12 February 1979.
41. Ruth M. Stone, "The Shape of Time in African Music," in J. T. Fraser, Nathaniel Lawrence, and Francis C. Haber, eds., *The Study of Time*, vol. 5 (Amherst: University of Massachusetts Press, 1986), p. 120.
42. *Ibid.*, p. 121. See also Pozzi Escot, "Nonlinearity as a Conceptualization in Music," in Thomas DeLio, ed., *Contiguous Lines: Issues and Ideas in the Music of the '60s and '70s* (Lanham, MD: University Press of America, 1985), pp. 166–69.
43. Ruby Cohn, *Just Play: Beckett's Theater* (Princeton: Princeton University Press, 1980), p. 34.
44. *Ibid.*, p. 35.
45. *Ibid.*, p. 36.
46. *Ibid.*, p. 40. According to Moshe Lazar, the only purpose of the dialogue in *Godot* is to "kill time." His paper "Time and the Psychodramatic Stage" was delivered at the symposium "Chronos and Mnemosyne: Time in Literature and the Arts," University of Southern California, 3 April 1982.
47. Cohn, p. 42.
48. See also Christopher Butler's discussion of suspended time in Beckett in *After the Wake*, pp. 77–82.
49. Edward T. Cone, "Analysis Today," in Paul Henry Láng, ed., *Problems of Modern Music* (New York: Norton, 1960), pp. 34–37.
50. It is interesting to compare these remarks on the analysis of vertical music with Leonard Meyer's ideas on the analysis of highly serialized music. See *Music, the Arts, and Ideas*, pp. 292–93, 295–96, and 304–05.

51. Cone, p. 38.
52. For a discussion of nonredundancy and nonlinearity in serial music, see Meyer, pp. 266-93.
53. *Ibid.*, pp. 283-93.
54. Lewis Rowell, "Stasis in Music," *Semiotica*, 60 (1987), pp. 181-88.
55. Process music is ritualistic. Repetitive rituals can be understood as an attempt to preserve time, to keep it from moving on, to achieve immortality. This idea was suggested to me by Reimer Hinrichs' invited paper "Time and Psyche," presented to the International Society for the Study of Time, Dartington Hall, England, 10 July 1986. Hinrichs identifies repetitive rituals as one manifestation of anal-compulsive, obsessive personalities.
56. Nyman, p. 136. There are also instructions for nonmusicians who may join the musicians. *Les Moutons* is perhaps best known from the performances and recording by the Blackearth Percussion Group, Opus One Records 20. The Blackearth performances do not include nonmusicians, and the final improvisation is omitted.
57. Another work in which cycles of repetition are gradually lengthened is Steve Reich's *Four Organs* (1970). The understanding that each cycle is essentially the same as the preceding one, though possibly slightly extended, makes time seem to stretch in this work.
58. For a detailed analysis of another process composition, see Wesley York, "Form and Process: Philip Glass' *Two Pages*," in *Contiguous Lines*, pp. 81-106. York's analysis, like mine, focuses on linear aspects of the music, despite its overriding nonlinearity.
59. In his article "Stasis in Music," Rowell identifies several "models" of timelessness, each "a potentially rich source of imagery for the composer" of static music. Many of Rowell's models correspond to ideas presented in this chapter. He includes a literal "void" ("a model of limited usefulness"), "eternity," the unconscious (or "uncensored consciousness"), "regression to, or vestigial memory of, an earlier evolutionary state" (corresponding to J. T. Fraser's lower temporal Umwelts, as explained in Section 12.8), the "expanded moment" (corresponding to my extended present), the "collective" ("a merging of individual identity into a higher social order"), and "ritual" (see note 12.55 on ritual).
60. The most complete exposition is to be found in J. T. Fraser, *Time as Conflict* (Basel, Switz.: Birkhäuser, 1978). Summaries are available in Fraser, *Of Time, Passion, and Knowledge* (New York: Braziller, 1975), pp. 435-46; Fraser, "Temporal Levels and Reality Testing," *International Journal of Psychoanalysis*, 62 no. 3 (1981), pp. 3-23; John A. Michon, "J. T. Fraser's 'Levels of Temporality' as Cognitive Representations," in *The Study of Time*, vol. 5, pp. 51-66. See also Fraser, *The Genesis and Evolution of Time* (Amherst: University of Massachusetts, 1982) and *Time, the Familiar Stranger* (Amherst: University of Massachusetts Press, 1987).
61. Fraser uses the German term because the most accurate translations are cumbersome: "self-world," "phenomenal world," "perceptive universe," "species-specific universe." Fraser offers a biological definition of Umwelt: "the circumscribed portion of the environment that is meaningful and effec-

tive for a given species and that changes its significance in accordance with the mood operative at a given moment." *Time as Conflict,* p. 20.

62. Fraser, *Time as Conflict,* pp. 21-22.
63. *Ibid.,* p. 284.
64. *Ibid.,* p. 23.
65. *Ibid.,* pp. 286-87.
66. There are also atemporal and prototemporal aspects of dreams. See Fraser, "Temporal Levels," pp. 10-11.
67. Fraser's examples of artistic expression of the five temporal moods often do not correspond to my musical analogues. Although he and I may disagree about the interpretation of the temporal meaning of various works, the essential point is that art, particularly in this century, offers metaphors for all levels of temporality.

APPENDICES

1. N. N. Vorob'ev, *Fibonacci Numbers* (New York: Blaisdell, 1961), pp. 15-20.
2. *Ibid.,* p. 30.

Glossary

absolute time. objective time, the time that is shared by most people in a given society and by physical processes

A-series. temporal ordering of events from past through present to future

atemporality. Fraser's lowest temporal Umwelt, in which all events are simultaneous (corresponds roughly to vertical time in music)

beat. timepoint that is musically significant because of its importance in a metric hierarchy

biotemporality. Fraser's fourth temporal Umwelt, in which the present is recognized as distinct from the past and future and in which beginnings and endings are differentiated; consciousness exists, but there is no long-range prediction or hierarchically organized memory (corresponds roughly to nondirected linear time in music)

B-series. temporal ordering of events from earlier through simultaneous to later

centricity. emphasis on one pitch or set of pitches as stable in an otherwise nontonal composition

chronometric time. Epstein's term for "essentially mechanistic, evenly spaced, and in large part evenly articulated time set up within a musical measure (and larger units)"; essentially equivalent to meter

chunking. mental grouping of stimuli (events) in a manner conducive to understanding and remembering them

clock time. absolute time as measurable by a clock

dyad. two-note set

eotemporality. Fraser's third temporal Umwelt, in which cause and effect exist but cannot be distinguished; there is temporal succession, but temporal direction is not significant (corresponds roughly to multiply-directed time in music)

gestural time. species of multiply-directed musical time in which the conventional meanings of gestures (beginnings, endings, structural upbeats, etc.), rather than the literal successions of events, determine the logic of continuity

goal-directed (linear) time. temporal continuum in which events progress toward predictable goals

grouping. separation of events into specific units; in music, grouping is a rhythmic phenomenon

horizon. the limits of consciousness (on some hierarchic level), where the present blurs into the past or the future

hyperbeat. metrically strong timepoint; the first and strongest beat of a hypermeasure

hypermeasure. group of measures that functions on a deep hierarchic level much as does a measure on the surface

hypermeter. the hierarchy of measures

information. meaningful events in music

integral time. Epstein's term for "the unique organizations of time intrinsic to an individual piece"; essentially equivalent to rhythm

interval class (IC). set of all intervals equivalent under inversion and/or compression within a single octave; for example, the following intervals all belong to the same intervals class (IC4): minor sixth, major third, four semitones, major tenth

invariance. holding of certain pitch classes constant despite operations that may change other PCs; for example, if PC set 01369 is transposed +3, PCs 0369 remain invariant while PC1 is replaced by PC4

kinetic. having motion; opposite of static

linearity. principle of composition and of listening under which events are understood as outgrowths or consequences of earlier events

linear time. temporal continuum characterized by linearity

Markov chain. series in which each event is understood in relation to preceding events: in a first-order Markov chain, each event is considered in relation to the one preceding event; in a second-order Markov chain, each event is understood in relation to the two preceding events; in a zeroth-order Markov chain, each event is independent of preceding other events

metric accent. timepoint that initiates a (hyper)measure on some hierarchic level

mobile form. composition in which some or all of the sections may be performed in different orders on different occasions

moment. self-contained (quasi-)independent section, set off from other sections by discontinuities

moment form. a mosaic of moments

moment group. set of moments related in some manner

moment time. temporal continuum of a moment-form composition

multiple time. shorthand term for multiply-directed time

multiply-directed (linear) time. temporal continuum in which progression is seemingly in several directions at once

nondirected (linear) time. temporal continuum determined by progression toward unpredictable goals

nonlinearity. principle of composition and of listening in which events are understood as outgrowths of general principles that govern entire pieces

nonlinear time. temporal continuum characterized by nonlinearity

nootemporality. Fraser's fifth temporal Umwelt, in which beginnings, endings, memory, and anticipation are fully developed (corresponds roughly to directed linear time in music)

normal time. absolute time

ontological time. Stravinsky's term for absolute time

order position. position of a pitch class in a twelve-tone row

ordinary time. absolute time, especially as agreed on by social convention

pitch class (PC). set of all pitches equivalent under octave transposition; for example, all C-sharps, D-flats, and B-double-sharps belong to the same pitch class

profile. gesture

progression. succession of events in which one event is not only followed by but also leads to the next event

prototemporality. Fraser's second temporal Umwelt, in which events can be distinguished only probabilistically (corresponds roughly to moment time in music)

pulse. brief timespan that is rhythmically significant

psychological time. Stravinsky's term for subjective time, in which durations may be distorted from their absolute-time norm

real time. term (rarely used in this book) for absolute time

rhythmic accent. short timespan (short note or start of a longer note) that is the focal point of a rhythmic group

ring modulation. electronic modification of a sound (whether electronic or not) by combining it with another sound; result is often a "metallic distortion" of a recognizable sonority

specious present. extended present, a few seconds in duration, that corresponds to the limits of short-term memory

stress. emphasis, which performers traditionally call "accent," on a note by slight delay, sharp attack, increased loudness, etc.

structural downbeat. major arrival point in a composition, usually where a large-scale metric accent, an accented boundary of a rhythmic group, and a harmonic arrival coincide

structural upbeat. passage leading to a structural downbeat

submoment. quasi-independent segment of a moment

succession. series of events in which there is not necessarily a sense of progression

temporal multiplicity. the quality of multiply-directed time

time-order error. tendency to judge the first of two timespans as longer (or shorter) simply because it was experienced first

timepoint. an instant, analogous to a geometrical point in space

timespan. interval between two timepoints

Umwelt. in Fraser's theory of time, a level of temporality; the entire knowable universe for a particular species, or in a particular thought system

vertical time. temporal continuum of the unchanging, in which there are no separate events and in which everything seems part of an eternal present

virtual time. Langer's term for the special time sense created by music (and other temporal arts)

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This listing includes those books, articles, dissertations, lectures, and papers that have been useful, whether to a large or to a small extent, in writing this book. The dozens of sources consulted that proved to be irrelevant, even several that are fascinating and/or important works, are not listed. For a more objective, less idiosyncratic research bibliography on musical time, see Jonathan D. Kramer, "Studies of Time and Rhythm: A Bibliography," *Music Theory Spectrum*, 7 (1985): 72-106.

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