THE ANALYSIS AND COGNITION OF BASIC MELODIC STRUCTURES

THE IMPLICATION-REALIZATION MODEL

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For Leonard B. Meyer

Preface

Even strictly-measuring science could hardly have got on without that forecasting ardour which feels the agitations of discovery beforehand, and has a faith in its preconception that surmounts many failures of experiment.
[Eliot 1876, 447]

This book seeks to discover and explain melodic syntax on the lowest level. It does so from a special theoretical point of view: how experienced listeners perceive melodic implication and realization. By examining note-to-note relations in great specificity, I attempt to answer such questions as, What exactly does a given interval imply to a listener? What is the implicative difference between a leap and a step? What constitutes the realization of an implication? How can we distinguish prospective perceptual evaluations from retrospective ones? What conditions create discontiguous connections between melodic tones? How does a melodic tone become transformational? What are the melodic conditions governing various degrees of closure? How are hierarchical levels formed and how deformed? How do lower-level implications influence higher-level ones and vice versa?

One main theoretical problem in answering such questions is to keep implication separate from realization. That is, realization cannot serve as the basis for hypothesizing implicative constants. For we cannot rely on arguments whose later demonstrations turn out to have been embraced a priori.

To get at this problem, I take a somewhat radical stance concerning several current issues in music theory. First, the theoretical constants invoked herein are context free and thus apply to all styles of melody. This book therefore discounts style as a basis for constructing the theoretical foundations of implication (I invoke as constants, e.g., none of the assumed hierarchical rules of tonality, such as scale-step priority). Arguing against the prevailing view that listeners share musical style like speakers share natural language, I demonstrate in part 1 how our current view of style is an extremely problematic source from which to posit theoretical constants governing the cognition of melodic implication. I go on to show how analysis must incorporate style in two very specially defined ways: as a top-down structural complex and as a bottom-up parametric simplex. Though a two-pronged approach to learning is relatively common in psychology, in most music theory such invocation of style goes relatively unappreciated.

Second, the book places considerable emphasis on the listener's cognitive performance (as opposed to his competence). My preoccupation with the listener—and in this I am far from alone (e.g., Laske 1977; Lerdahl and Jackendoff 1983; Meyer 1956, 1973)—stems in part from avoiding style as a constant for building a theory of melodic perception. For, in the absence of style, where logically can we turn for theoretical enrichment but to the constants of cognitive psychology (Narmour 1977)? Hence, chapter 4 invokes certain Gestalt laws as bottom-up, subconscious hypotheses of implication that apply separately to the melodic properties of intervallic motion and registral direction. This is a new approach in the application of cognitive psychology to music.

The title of the book stresses my interdisciplinary desire for increasing the dialogue between cognitive psychologists and music theorists. The primacy of *analysis* over *cognition* reflects my lack of expertise in psychology, whereas the use of *structures* underscores my belief that the melodic patterns discussed herein are significantly veridical with our perceptual-cognitive experiences. At the same time, the subtitle makes clear that the theory I expound on is, in terms of perception and cognition, a model whose validity concerning internal mental representations and processing of information ultimately depends on empirical experimental evidence. The book thus ends with suggested topics for more than twenty psychological experiments.

Toward this end, I therefore give over much space toward distinguishing top-down processing, which depends grammatically on the perception of schemata, from bottom-up processing, which makes use of mandatorily operative, scaled input systems of melodic information. And I devote considerable energy toward hypothesizing how listeners make conscious and subconscious cognitive "decisions" in the real-time processing of melodic pitch relations.

Two fundamental tenets drive the theory. On the one hand, the expostulated model amalgamates certain measurable, definable, and noninterpretive Gestalt principles (similarity, proximity, common direction) into rationalistic bottom-up constants governing the implication and realization of *process*. On the other hand, the model posits a symmetrical concept of implied *reversal* within the input system.

Both concepts of process and reversal are said to govern implications generated by the stylistic elements of melody (i.e., to analyze the syntactic primitives). Ultimately, the model coordinates the constants of process and reversal with certain empirical, top-down psychological theories of episodic memory, schemata, and representativeness (which govern implications generated by the stylistic structures of melody, i.e., the syntactic complexes).

All musical analysis ultimately rests on perception and cognition; by the same token, perception and cognition are ultimately always analytical.[1] Musical laws never escape the fundamental laws of psychology. Although it is true that completely reducing music theory to perceptual-cognitive laws is impossible (there will always be topics in music theory separate from, and of no compelling interest to, psychology), psychology nevertheless firmly grounds music theory: the role of the listener is an essential, indeed indispensable, component in musical analysis.

A third departure in this book concerns analytical perspective. Current analysis, it is safe to say, appears enthralled with the generation of higher-level structures, many of which seem to me at best metaphysically rationalistic, at worst mystical. In contrast, this book concentrates almost exclusively on low-level, note-to-note relations. As such, the analyses here are more manifestly connective on the note-to-note level, more "horizontally" construed, than those found elsewhere.

My general view is that "distant" higher-level melodic structures are perceptually much less important to listeners than traditional analysts tend to think they are. Moreover, current melodic analysis, with its emphasis on reduction to ever-higher levels, has a very bad habit of ignoring all kinds of cognitively real melodic relations in favor of the supersummative agencies of tree-structured grammars. Accordingly, I attempt here to construct a melodic theory that manifestly accounts for every low-level, note-to-note connection. I do my best not to omit or gloss over syntactic, temporal relations. In general, I argue that melodic contours are themselves basically foreground structures of implication and realization.

There are other analytical details characterizing this book. I analyze parameters separately, for instance, but treat them under one parsimonious set of rules (rules concerning process and reversal; formalized for the parameter of melody, these are listed in app. 1). Parameters, of course, do not exist by themselves—pitch always has duration—but here I conceptualize them separately (each with its own syntactic parametric scale) in order to hypothesize rules governing their interaction. I base this "divide and conquer" strategy on the premise that, contrary to prevailing beliefs, what motivates music is not any preordained unfolding of nested tonal prolongations but rather scaled parametric noncongruence.

The concept of independent parameters allows for, indeed necessitates, con-

1. For good examples of the discussions concerning the importance of psychology to music theory, see Lerdahl and Jackendoff (1983) and Rosner (1988). For a counterargument why we may treat psychology as just one among many models that music theory may borrow, see Lewin (1986). The basic disagreement between Lerdahl and Jackendoff (including myself) and Lewin is essentially the traditional argument between empiricism and rationalism. The empiricists see psychology as a true science; the rationalists see it as a limited phenomenological field hobbled experimentally by all the traditional problems of introspection.

structing syntactic parametric scales as mandatorily operative, "bull-headed," computationally reflexive input systems (Fodor 1983) for both intervallic motion and registral direction. I use these scales to measure various degrees of nonclosural implication, various degrees of closural realization, and various degrees of surprise (felt on denial). Thus, another distinctive characteristic of the theory advocated here is the establishment of rules of measurement. I believe that these metric concepts tentatively inch melodic analysis down paths never traveled before. I hope that they will prove useful to psychologists in devising experiments concerning melodic perception and cognition.

Though the theory in this book attempts to account for every low-level connection between melodic pitches, I have been exceedingly mindful of the pragmatic, time-consuming realities of attaching analytical symbols to musical tones. Having painstakingly drawn arrows and tails to represent implication and realization for so many years (Narmour 1974, 1977, 1983, 1984), I settle here on an alternative, simple symbol system that is quick and easy to employ yet, if properly interpreted, loses little in the reduction. Moreover, it is amenable to the typewriter keyboard (and current programmed systems of music notation), which should enhance its usefulness in computational paradigms, in the writing of scholarly work, and in the preparation of psychological experiments. The economy of its application has enabled me to represent the various analytical results of the implication-realization model in more than 350 musical examples.

Musicologists and theorists do not generally appreciate how important analytical symbols are. How many stop and think, for instance, what it really means to label a given sonority *V* or a given form *A prime?* If "symbols pave the royal route from raw intelligences to finished cultures" (Gardner 1983, 300), it follows that only by paying very close attention to the manipulation of analytical symbols can we ever discover what part of any theory is syntax, what part semantics, what part interpretation, what part belief, what part bias, what part culture—and, most important, what part erroneous, misleading, and in need of revision or abandonment.

The scholarly field of music also does not appreciate how powerful analytical symbols are in leading us to general discoveries. During the course of writing this book, I experienced something akin to what Mendeleyev experienced. As will be remembered, Mendeleyev was instrumental in formulating the periodic table of physical elements. By looking very carefully at his symbols, he saw that properties of elements were a function of their atomic masses and that certain logical progressions governed the ordering of physical elements. From his symbols, he understood gaps in the periodic table that enabled him to predict the discovery of other elementary structures.

Many years ago, I began my study of melody by symbolizing process as P and reversal as R (neither idea, incidentally, was at all original: most *Zuge* in

Schenkerian analysis [Schenker 1956] are processes, and Meyer's [1973] provisional gap-fill structures possess, in my terms, reversal properties). I gradually observed that certain melodic structures reversed only in the intervallic sense and symbolized these as IR (intervallic reversal). But if such was possible, I asked myself, then why couldn't processes [P] also occur in an intervallic sense? From this bit of conceptualizing I discovered that such intervallic processes did exist, and I symbolized them as IP, in parallel to IR. In analyzing melodies from the literature, I also began to see that reversal frequently combined with process, which suggested the combinational symbol PR.

Rationalistically, I then asked myself, Are combinations like IPR, IPIR, and PIR possible, and, if so, what melodic shape would they assume? Once conceived, these too I found lurking in the musical repertory. Still, as Mendeleyev found, there were large experiential gaps in my theory—a number of common melodic patterns in the musical literature inadequately accounted for.

One day I experienced a revelation: reversal had not only an intervallic aspect but also a registral one. Why, then, couldn't we have structures of registral reversal to parallel those of intervallic reversal? This seemed to explain a number of patterns, which I symbolized as VR, in parallel to IR.

Now conceptualization moved very fast. For if combinations like PR, PIR, IPR, and IPIR were possible, so then were PVR and IPVR—not to mention VP (registral process), VPR, VPIR, and VPVR. I had no knowledge of many of these latter types of structures and thus had to hunt for them in the literature. Indeed, I would not even have thought about them had it not been for the manipulation of the analytical symbols: the theory predicted their existence and ultimate discovery. Still, many types of melodic patterns remained absent in tonal music, the chief repertory with which I worked. Only after writing out numerous synthetic pitch exemplars to aid in the search did I discover these types to be representative of twentieth-century expressionism.

Thus, from the humble beginnings of the simple symbols P and R came the most exhilarating period of my intellectual life—the discovery of many different kinds of melodic structures. And from the manipulation of these analytical symbols emerged important taxonomic clues as to what kinds of melodic structures existed in both tonal and atonal music.

But, incredibly, even this was not the end of my inspirational odyssey in learning the conceptual power of symbols. One year later, while teaching a graduate seminar, I again had a revelation. Why couldn't we string together these various basic structures, as revealed by their symbols, in dovetailed pairs and triples? Indeed, why couldn't we link them together in an infinite variety of ways? Exploring this forms a significant portion of the sequel to this volume (*The Analysis and Cognition of Melodic Complexity*).

We will travel, then, in these two volumes from a very small number of basic melodic archetypes (five) to sixteen archetypal derivatives to some two hundred structural combinations to an indefinite number of patterned chains. Our goal is to comprehend the entire world of melody by constructing tokens, internal representations that capture melodic structure accurately, reliably, and efficiently. Ultimately, we want to see how compositional thought and active music listening make use of such structural information. Analytically, I characterize the whole journey as an explication of the "genetic code" of melody (Narmour 1989a), with the aim of discovering a consistent taxonomy of structural types. The hypothetical theory is simplicity itself, but its separate-parametric methodology quickly leads to complexity, befitting the inherent richness of that most evanescent of subjects, melody.

Herewith, therefore, I present in two volumes an analytical-theoretical examination of all these kinds of perceptual melodic structures, which *Beyond Schenkerism* (Narmour 1977) promised. A third book, discussing higher-level melodic structures, aesthetic strategies in melodic composition, and idiostructural analysis, is yet to come, as is a fourth book on harmonic implication.

In all this research I owe a tremendous, unpayable debt to my colleague, friend, and mentor Leonard B. Meyer. I thus affectionately and respectfully dedicate this volume to him. Those who have read his work will recognize my use not only of his concept of implication, about which he wrote extensively in *Explaining Music* (1973), but also his invocation of Gestalt principles, which he first discussed in *Emotion and Meaning* (1956), as well as his ideas of grouping (specifically germane to chap. 13 in the sequel to this volume), which, with Grosvenor Cooper, he explored in *The Rhythmic Structure of Music* (1960).

I also wish to express my profound thanks to my colleague and close friend George Crumb for his invaluable generosity in helping and advising me in the preparation of the examples. It is also a pleasure to acknowledge the advice and criticisms of William Thomson, who read the manuscript twice and saved me from many an egregious error. Thanks is also due to the students of my graduate seminars, whose suggestions significantly improved both books. I should, moreover, like to acknowledge here the help of David DeLaura, Carol Krumhansl, and David Butler.

In addition, my home institution, the University of Pennsylvania, gave me the necessary leave time to do part of the research; for this I thank the powers that be. And I am grateful to Wolfson College, Oxford University, for providing me with a sublime environment in which to do some of the writing.

Finally, it is with the greatest love that I acknowledge my wife Kathryn's help in the typing, editing, and proofing of the manuscript and in assisting in the preparation of the examples. During the ten years it has taken to complete this long and complex project, it was only her unfailing encouragement that enabled me to keep working.

Contents

PART 1

CONCEPTUAL BACKGROUND

1

Introduction

Science developed only when men began to refrain from asking general questions, such as: What is matter made of? How was the universe created? What is the essence of life? Instead, they asked limited questions, such as: How does an object fall? How does water flow in a tube? Thus, in place of asking general questions and receiving limited answers, they asked limited questions and found general answers. It remains a great miracle that this process succeeded, and that the answerable questions became gradually more and more universal.
[Weisskopf 1972, 143]

This book does not ask the question, What is melody? Rather, it asks, What are the specific, note-to-note principles by which listeners perceive, structure, and comprehend the vast world of melody?

The first general claim herein is that the perceptual structures of melody rest on the realization or denial of two universal formal hypotheses:

A + A → A (or a + a → a);
A + B → C (or a + b → c).
(where → = implies)
In natural language, we say of these constants,

> When form (*A* + *A*), intervallic patterns (A + A), or pitch elements (a + a) of a given melody are similar (*A*, A, or a), the listener subconsciously or consciously infers some kind of repetition of pattern, element, or form.

And we say,

> When form, intervallic patterns, or pitch elements are different (*A* + *B*, A + B, a + b), the listener subconsciously or consciously perceives some implied change in form, pattern, or element (*C*, C, or c).

The second general claim is that such forms exhibit one of two universal functions, either closure or nonclosure (in some degree). Definitions of similarity, difference, and function aside, I argue analytically that to understand melodic structure in terms of transformations, hierarchical levels, schemata, and archetypal patternings; to interpret the meaning of form, repetition, and replication in melodic style; to comprehend compositional strategies of melodic development, variation, and ornamentation; to criticize melody in the light of either syntactic aesthetic structure or mode of performance—all depend in large part on these two general claims.

To musicologists and theorists accustomed to experiencing a vast world of unique artworks surrounded by a constantly fluctuating style, the dependence of so much on apparently so little doubtless seems brash. However, because science in the past century has demonstrated everywhere nature's obedience to powerful yet parsimoniously structured laws, a similar kind of natural economy must govern the human perception of artworks. Thus, a few simple laws—perceptual-cognitive ones powerful enough to account both for the multiplicity of singular experiences and for the variation in perceived style—probably regulate the art of melody. As Fraisse (1982, 170) points out, gravity does not explain architecture, but architecture is subject to its law; likewise, perceptual laws do not explain music, but music cannot escape their influence. I believe that the two general assertions listed above are, or at least point to, just such laws. To show their power in the analysis and perception of melody is therefore a chief aim of this book.

The crucial relation in our two hypotheses is obviously implication, from which one may deduce a reciprocal relation: realization, or, as I have dubbed the theory of melodic perception here (and elsewhere), the implication-realization model.[1] Since in melody degree of similarity (A + A) or differentiation (A + B) between patterns and elements varies, and since likewise degree of implication or realization fluctuates, I hypothesize one additional major concept in order to measure and evaluate all such relations, that of a syntactic *parametric scale*. As we shall see, a syntactic parametric scale is an automatic, "brute" input system that is domain specific, mandatorily operative, and computationally reflexive (Fodor 1983). It determines what is similar (A + A) or differentiated (A + B). And it determines closural and nonclosural functions and the extent to which a melodic pattern is closed or open.

These general hypotheses—A + A implying A, A + B implying C, the presence of closure or nonclosure, and parametric scale—allow for the identification of five, and only five, kinds of melodic archetypes:

1. process or iteration (A + A, nonclosural);
2. reversal (A + B, closural);
3. registral return;

1. Other models of music perception include Baroni et al. (1984), Deutsch and Feroe (1981), Lerdahl and Jackendoff (1983), Meyer (1973), Perlman and Greenblatt (1981), and Sundberg and Lindblom (1976), to name but a few. For a discussion of the problems of modeling and a summary of some of what has been done in music, see West, Howell, and Cross (1985). One general criticism of Lerdahl and Jackendoff's work, the most recent full-scale attempt at modeling, is that it badly neglects melody. Rosner's criticism (1984, 285) says, for instance, that "melody is almost a wraith in this theory." Hence, one reason for the current two-volume study.

4. dyad (i.e., two-element groupings, the unrealized implications of classes 1 and 2);
5. and monad (i.e., one-element groupings, closed or unclosed, where no generation of implication occurs).

The Implied and Realized Structures of the Theory

The syntactic parametric scale hypothesizes that any pair of melodic pitches transmits separate intervallic and registral messages to the listener. In terms of subconscious expectations, it says, ceteris paribus, that small melodic intervals generate registral and intervallic implications of similarity (A + A). And it says that large intervals generate intervallic and registral implications of differentiation (A + B).

For example, when a realization of both a similar registral direction and a similar intervallic motion takes place from a small generative interval, I say that either a nonclosural process (symbolized P) or an unclosed iterative, duplicative structure (symbolized D) occurs. When from a large generative interval a change in registral direction and intervallic differentiation toward a smaller interval takes place, I say that we have a closural reversal [R].

Observe here that process [P] does not refer to a stylistic, goal-directed norm—either in the traditional sense of a recognized musical progression or in the general sense of a pattern exemplifying "good" continuation (Meyer 1956, 1973). Rather, it points to something very narrow and specific, namely, unclosed realization of both similar intervallic motion and a similar registral direction (whether ascending or descending).[2]

Likewise, closural reversal [R] does not refer to something new terminating a perceived sequence of musical events or to a contrasting unexpected change of events (in the Aristotelian sense). Rather, it indicates something very simple and specific: both a motion from a large interval to a small one (A + B) and a reversal of registral direction (up/down, down/up, up/lateral, or down/lateral). Example 1.1a–b below shows instances of P, D, and R.

Realization and Partial Denial

The kinds of registral directions (up, down, lateral) and the properties of intervallic motion (similarity, differentiation) also create various possibilities for

2. Notions of pitch height are not metaphoric concepts. As psychologists point out, our prehistoric ancestors needed to know whether the sound they heard was the chirp of a game bird or the roar of a saber-toothed tiger. (Does that noise in the jungle indicate something you might eat or something that might eat you? Does that voice signify a female or a male, a potential mate or a potential rival?) Thus, it is safe to assume as a cognitive constant our perception of individual pitch registers and thus registral rise and fall.