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Computer, graphic, and traditional systems: A theoretical study of music notation

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UNIVERSITY OF CALIFORNIA, SAN DIEGO

Computer, Graphic, and Traditional Systems:

A Theoretical Study of Music Notation

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Music

by

Richard Wood Massi

Committee in charge:

Professor John Silber, Chair
Professor Gerald J. Balzano
Professor Frantisek Deak
Professor Allan Kaprow
Professor Jann Pasler

1993

The dissertation of Richard Wood Massi is approved, and it is acceptable in quality and form for publication on microfilm:

Chair

University of California, San Diego

1993

Dedicated to

my lover and domestic partner,

Larry Brinkin

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ACKNOWLEDGEMENTS

This dissertation would not have been possible without the time, money, patience, advice, *savoir faire*, encouragement, love, trust, and inspiration I received from many people. I especially would like to thank the following:

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Awards, Honors, and Credentials

Regents Fellowship, University of California, San Diego. 1988 & 1989

Dissertation Research Grants, Office of Graduate Studies and Research, UCSD. 1987 & 1988

Graduate Research Fellowship, UCSD. 1987 & 1988

Music Department Fee Scholarship, UCSD. 1987 & 1988

Course Development Grant, Mills College. 1985

Instructor Credential, Community Colleges, State of California. 1984

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<u>Mills College, Oakland, California</u>

- Assistant for Planning and Research, Provost's Office. 1992 to Present

  Manage the college's institutional research operations.

- Administrative Assistant. Planning and Administration, President's Office. 1991-92

- Lecturer. Music Department. 1985-86 & 1991

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- Performance Ensemble Coordinator. Music Department. 1991

- Director of Musicianship Training. Music Department. 1985-86

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- Teaching Assistant (Baroque Music). Music Department. 1983-84

<u>University of California, San Diego</u>

- Research Assistant. Center for Music Experiment (CME) and Computer Audio Research Laboratory (CARL). 1988-89

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- Instructor. Muir Writing Program. 1986

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- Instructor. San Francisco Community College Centers Division. 1985

  Taught Music Appreciation.

- Teacher. Self-employed; Paris, France. 1978-79

  Taught English as a second language. Traveled in England, the Netherlands, Belgium, Germany, Denmark, Italy, Austria, Yugoslavia, Turkey, and Greece.

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Service

Chairperson, Mills Diversity Committee. 1992-Present

Co-founder, Mills Lesbian, Gay, and Bisexual Faculty, Staff, and Friends Association. 1991-Present

Member of the Board, New Music Theater; San Francisco. 1989-Present

Student Representative, Graduate Curriculum Committee, Music Department; UCSD. 1986-87

Member of Provost's Music Library Committee; Mills College. 1985

Member of the Board, Mateel Community Radio (KMUD); Redway, California. 1981

Co-founder and secretary of Eel River Arts Center; Redway, California. 1976-81

Writings, Publications, and Research

Review of *Music and Discourse: Toward a Semiology of Music*, by Jean-Jacques Nattiez. *Notes* 48:4 (June 1992).

"Lectures on Anarchy: John Cage." *Contact* (London) 33 (Autumn, 1989).

"An Interview with Morton Feldman." *Cum Notis Variorum* 132 (April, 1989).

Compiler of "Bibliography." In *Darius Milhaud*, by Paul Collaer; translated by Jane Galante. San Francisco Press, 1988. Also researched the revision of "Catalog of Works," by Madeleine Milhaud, in the same book.

"John Cage at Wesleyan." Two parts, *Cum Notis Variorum* 126 & 127 (October & November, 1988).

Research on notation, semiotics, and John Cage, in Middletown, Connecticut. Interviewed Cage, Earle Brown, Christian Wolff, Leonard Meyer, Vivian Perlis, Richard Kostelanetz, Daniel Charles, William Druckman, Alison Knowles, and others. 1988

"The Words to the Music." *Poetry Flash* 176 (November 1987).

Unpublished papers and research on works by Milton Babbitt, Henry Cowell, and Robert Ashley, as well as on orchestration, bibliography, the sociology of music, and deconstruction. 1986-90

"Music/Picture." M.A. thesis article. Mills College. 15 pp. text; 75 pp. scores. 1984

Independent research in analog electronic music synthesis, *musique concrete*, and sound recording techniques, at the Center for Contemporary Music (CCM) of Mills College. Research in contemporary music notation. 1983-84

"Back-Beat, Born-Again Bob Dylan." Two parts, *Star Root* (October 16 and November 1, 1980); Redway, California.

Cover design and various music graphics published in *Star Root*. 1979-81

"Chamber Music Concert: Gifted Notes." *Star Root* (September 3, 1977).

Performances, Exhibitions, and Lectures

1991: Lecture series introducing the world premiere of Wayne Peterson's Pulitzer Prize winning *The Face of the Night, the Heart of the Dark*. "Inside Music" programs, San Francisco Symphony, Davies Hall.

1988: Solo performer in world premiere of *Sommitude*, by Alain Despres, for voice and the UPIC computer system. Center for Music Experiment, University of California, San Diego.

1988: Saxophonist and dancer in *Sound Shapes 1988: A Music Theater Extravaganza by Mauricio Kagel*. University of California, San Diego.

1988-89: Video of my teaching of Music History class used to train other T.A.'s. Teaching Development Program, UCSD.

1987: Soloist (narrator/actor) for *Do It*, by Robert Erickson. UCSD Performance Ensemble.

1987: Dancer in *Night of the Hippodrome*, by Kiva Performance Group. UCSD.

1984: Thesis Concert, including my performance in *Still Happening* (saxophone); *Water Pictures and Words* (artist); *Beethoven Slid* (projector, electronic music equipment, and taped piano). Mills College, Oakland, California.

1982-84: Performed with the Contemporary Music Ensemble (Larry Polansky, director), and the Gamelan (Lou Harrison, director) of Mills College.

1983: Major acting role in *Mister Billions Tango*, by Larry Simon. Mills College.

1980-85: Graphic music scores exhibited in Eureka, Harris, Oakland, and at Leah Levy Gallery in San Francisco.

1974-88: Prepared and hosted radio programs about twentieth-century music on KPFA, Berkeley, and on KMUD and KERG, Redway, California. My compositions played occasionally on these stations.

1970-Present: Performed frequently on saxophone, including an appearance with Herbie Hancock and the California Jazz Ensembles. Sang tenor with choruses at UC San Diego, Mills College, S.F. Conservatory, UC Berkeley, and elsewhere.

Musical Compositions and Arrangements

1988: *Someday*, computer variations on the melody to "We Shall Overcome." Six minutes.

1984: Choral and instrumental parts prepared for *The Bride Stripped Bare by Her Bachelors, Even*, an opera by Charles Shere. For International Performance Network; Berkeley, California.

1984: *Water Pictures and Words*, for string quartet and artist. Ten minutes. Engraved, self-publication.

1984: *Still Happening*, for flute, saxophone, trumpet, piano, cello, tape, painter, and two percussionists playing ten instruments designed by the composer. Twenty-five minutes.

1983: *One Richard Two*, for flute. One minute.

1983: *Trio: Obstinate Clutter*, for cello, piano, and tabla. Twelve minutes.

1983: *Beethoven Slid*, for photographic slides and tape. Twenty-seven minutes.

1974-Present: More than forty music paintings, drawings, and graphics. (A complete list is available upon request.)

1970-Present: Several dozen other musical compositions. (A complete list is available upon request.)

ABSTRACT OF THE DISSERTATION

Computer, Graphic, and Traditional Systems:

A Theoretical Study of Music Notation

by

Richard Wood Massi

Doctor of Philosophy in Music
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Professor John Silber, Chair

This study examines problems related to the representation of music. It constructs the sender/-message/perceiver/result model, a prototype broad enough to incorporate a large variety of music and other notation systems, including those having to do with computers. The work defines music notation itself, describes various models for studying the subject -- including the binary types prescriptive/descriptive, and symbolic/iconic -- and assesses music notation as a contemporary practice. It encompasses a review of the actions and intentions of composers, performers, and audiences, and a consideration of the message and how it is affected by media (e.g., writing, electronics), reference systems (e.g., representation, connotation, code, grammar), and meanings. Finally, through an examination of the possibilities of the self acting as a notation system within models posited

by feminist and queer theory, I attempt to demonstrate the power of notation to affect other systems and worlds, including the worlds of music, art, and politics.

The consideration of these topics draws on theories from linguistics, semiotics, structuralism, post-structuralism, cybernetics, and music, as well as the philosophies of John Cage, Jean-Jacques Nattiez, Nelson Goodman, and others. The work examines various languages and applications used to program computers for musical purposes, though this examination does not incorporate programs dedicated exclusively to printing music. Nor does the study focus on non-Western notations, suggestions for reforms of notation, or encyclopedic lists of notation devices.

The expository writing is augmented by excerpts from material I gathered in numerous interviews. There are separate sections containing interviews of Leonard Meyer, Allan Kaprow, John Cage, Earle Brown, Roger Reynolds, and Heidi von Gunden. There is also a large, partially-annotated bibliography.

My hope is that an inclusive, interdisciplinary exploration of music notation will be useful in broadening the theoretical and creative boundaries of the field, as well as bridging gaps among musicians using various music technologies, and artists and theorists from diverse fields and perspectives.

CHAPTER ONE

Objectives, Scope, and Methods

Symbolic processes in music are complicated systems involving elaborate interactions of the intentions of the composer, the interpretations of performers and listeners, and the contingencies of methodology, cognition, language and culture. Music notation systems play a crucial role in this process. As technological and theoretical inventions have increasingly enhanced the observability of music and sound, the importance of notation has grown as well.

All notation systems attempt to communicate meaning. In so doing, they both facilitate and constrain the flow of information. No matter how diverse notation systems are -- and we shall see that they come in a great variety of forms -- they all work as generative systems, ideal structures, and processes from which specific details are derived. They all have in common the ability to create micro-worlds and to contribute to the creation of larger worlds. This is a basic characteristic of language, and other ways of referring, such as denotation, connotation, naming, expression and depiction, and of systems of reference, such as natural and artificial languages, sign systems and models. Worlds are coherent and recognizable aggregates of structures and processes. What the different forms of notation do not have in common are the kinds of worlds they can make. These are determined by various aspects and circumstances of the notation, such as the medium used, the physical and deterministic relationships between the signifiers and the signifieds, the intentions of the users, the structures of the grammars, and the ideological, historical, and cultural contexts in which they are used. This dissertation, like notation systems themselves, or like any other system of reference, attempts the building of a world. In so doing, it collects thoughts, ideas and beliefs; it filters out other concepts, and it focuses attention by naming and specifying.

Studying Music Notation

Music is changing quickly. It is being transformed by new electronic and computational technologies; changes in the relationships among composers, performers and audiences; contemporary social, economic and political dynamics; modifications of the theoretical foundations of music and the aesthetic interests of musicians; and interdisciplinary endeavors. New notations appear constantly, generated by diverse desires, whether they be to draw in performers or to shield the work from untutored performances, to express nonlinearity in one way or another, to disseminate a unique, personal language, or simply to use new methods of reproduction. We need ways of describing music notation that will take these transformations into consideration.

There is an unfulfilled need to bridge the gaps between musicians working with different notation systems, and among theoreticians and practitioners in music and other fields. For instance, even though computers have been used for forty years to make music there has yet to develop a stable framework or language for the evaluation of computer music programming. Likewise, the appreciation of the varied and complex array of contemporary performance techniques is limited by inadequacies in our ability to represent them.

In every period of history, the question is asked: How does music work? What is its essential nature, what can it express, and what effect does it have? The answers depend on the philosophies current at the time. The late 20th century is no exception. Philosophical forces continue to gather and change, seemingly at an ever quicker pace -- though this perception may be an illusion brought on by our tendency to see history from the limited perspective of our own time.

Just as musicians have seen a growth in the means and purposes of representing music, practitioners in other fields of the humanities have seen advances in their theories of language, writing, and communication. With the evolution of linguistics, structuralism, semiotics, deconstruction, and cultural studies, the meaning of music and its tools comes around for redefinition. Theories, by their very nature, attempt to create or change cognitive and cultural environments, but they don't always succeed in doing so. Workers in the field affected by a theory may be uninterested in, or hostile to, new theories. But those who are oblivious to the theoretical foundations of their work, adhere by default to an older theory.

Richard Leppert and Susan McClary describe today's theoretical atmosphere:

> The past fifteen years have witnessed a major transformation in the ways in which the arts and humanities are studied. Influenced by such socially and politically grounded enterprises as feminism, semiotics and deconstruction, both the artifacts considered worthy of analysis and the questions asked of canonized works of art have changed radically. . . . To the extent that the arts produced during this same time period have been shaped by similar questions and influences, making sense of today's art world demands a full range of new critical methods.
>
> The only one of the arts that has remained marginally untouched by such redefinitions of method and subject matter in its academic discipline is music. For the most part, the

> discourse of musical scholarship clings stubbornly to a reliance on positivism in historical research, and formalism in theory and criticism, with primary attention still focused almost exclusively on the canon.[1]

The reliance on positivism, formalism, and the canon has manifested itself during the last several decades, for example, in the publication of numerous music analyses which rely heavily on various note-counting techniques such as Schenkerianism or serialism but which ignore the psychological, political, and philosophical contexts of the works they analyze. This need not continue to be the case -- and there are signs that the study of music is beginning to change.

Theories relevant to music notation have developed in linguistics, cybernetics, cognitive psychology, and computer science. Linguistics in particular has led to an intense interest in language, which has come to be seen as a fundamental source of knowledge about the world. Post-structuralism and post-modernism, growing out of linguistics and critical theory, have tended to emphasize a pluralistic context for communication. Even so, most theories tend to ignore at least some aspects of the larger picture. Many philosophical theories -- for instance, the art language theories of Nelson Goodman --

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[1] Richard Leppert and Susan McClary, eds., *Music and society: The politics of composition, performance and reception* (New York: Cambridge University Press, 1987), *xi-xii*.

deal too much with the mechanics of representation to consider the social ramifications of it. Computer languages are often too technical, and depend too heavily on quantitative, scientific analysis. Theories of natural languages are dominated by concerns about speech. Linguistics and semiotics may be too structuralistic, scientific, logocentric, totalizing or formalistic.

If we are to understand music notation today, clearly an interdisciplinary approach is called for. The dangers of transporting concepts and methods from one discipline to another are many, but so are the rewards, in terms of new insights and fresh perspectives.

Given the state of music notation, many of the old questions and standards of judgment seem to be useless, or naive. In a computer piece structured predominantly by timbral fluctuations, how important is the traditional grouping of instruments into choirs? In a graphic piece relying mostly on chance operations, the precise coordination of rhythms among the players is irrelevant. The theoretical implications of recurring attempts to reform notation, of the graphic music notation movement of the 1960s and 1970s, of computer music programs, and of music videos have not been adequately explored. Nor have the vigorous technological advances of electro-acoustic music. Other phenomena reveal the stagnation of music theory. We need a flexible conception of notation, one that describes the field as a process of change and creation. The current theories based on static models are insufficient. We need to move away from our almost total reliance on quantitative methods, and incorporate qualitative methods as well. Catalogues of notation devices, and diagrams of musical forms abound in the literature of music theory, but much of the being and experience of music remains unexamined.

Scope of the Study

This dissertation is a preliminary study outlining a number of theoretical perspectives on music notation. It delineates general principles of notation systems, and areas of compositional and theoretical concern where new work or new perspectives may be approached. Toward this end, it will be necessary to describe numerous models for notation and communication in general, to critique some, and to use portions of others to create new models and theories. One example is my conception of "program notation," derived from my understanding of program music.[2] More importantly, it is the inclusive, dynamic,

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[2] See Chapter Seven.

and broad model of notation I describe which will prove to be the more fruitful aspect of the work.

Crucial to this model is the idea that the communication systems we use influence our thoughts; they do not simply express meaning, they produce it. This idea has been a recurring theme in the twentieth century, appearing in the theories of Saussure, Husserl, Wittgenstein, and in McLuhan, "The medium is the message"[3]; Descombes, "The signifier precedes the signified"[4]; Lyotard, "Man is the work of his work"[5]; and many others. Music notation can serve as a paradigm of such influence, though it is not often looked at that way.

Being forms of communication, notations are based on value judgments. Such judgments have varied historically, and have been closely related to ideology. As a composer, I have tried not only to make the graphic quality of notation explicit in my work, but also to directly express ideology. I hope here to draw implications from how music notation interacts with political practice; that is, how it reinforces or weakens power relations between social

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[3] Marshall McLuhan, *Understanding media: The extensions of man* (New York: McGraw-Hill, 1964), 7-21.

[4] Vincent Descombes, *Modern French philosophy*, trans. L. Scott-Fox and J. M. Harding (New York: Cambridge University Press, 1979), 95.

[5] Jean-Francois Lyotard in Descombes, *Modern French philosophy*, 180.

groups in the musical world. Though it is quite difficult, if not impossible, to answer these questions precisely, I hope my attempt to do so will facilitate a better understanding of what notation includes, what it ignores, and why.

The study of various models of communication, representation, and notation, as well as the analysis of music notation, have led me to devise my own version: the sender/message/perceiver/result model.[6] After a general consideration of notation systems, a discussion of communication as structure and as process, and an examination of several types of notation and models of communication, I use the sender/message/perceiver/result model to examine concepts such as intention, medium, reference, meaning, performance, reception, and world-making. The aim of such a study is to broaden the theoretical and creative boundaries of the field, not only to encompass all currently used devices, systems and practices, but also to "augment the community of ideas for building [new] theories."[7]

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[6] Though I claim this version of the model as my own -- particularly as it emphasizes the *results* of communication processes -- it owes a great deal to other models used in linguistics, semiotics, philosophy, and music theory. See Chapters Six and Seven.

[7] Marvin L. Minsky, "Computer science and the representation of knowledge," in *The computer age: A twenty-year view*, ed. Michael Dertouzos and Joel Moses (Cambridge, Mass.: MIT Press, 1979), 413.

The focus of the work is on computer and graphic music notation systems. To the extent that I use ethnomusicological concepts, they are derived from the study of Western music. Though there are many interesting examples of notations used in other cultures and at other times in our own culture, I regretfully must confine my consideration to systems currently used in the West because otherwise the definitions of music notation, or even of music itself, become so much more complex. I have attempted to emphasize the most recent and important models of communication and notation, as well as the most recent notation strategies. Furthermore, I hope to emphasize questions more than answers. The theory of music notation is, after all, words about signs about sounds which themselves are notoriously about or not about any number of things. The particular form of questioning -- involving, as it does, interdisciplinary methodologies and a pluralistic perspective -- I associate with feminist theory among other things.[8]

Under the rubric, "The more you know, the more you know you don't know," I have minimized the consideration here of some otherwise important aspects of music notation. These include the specifics of the numerous

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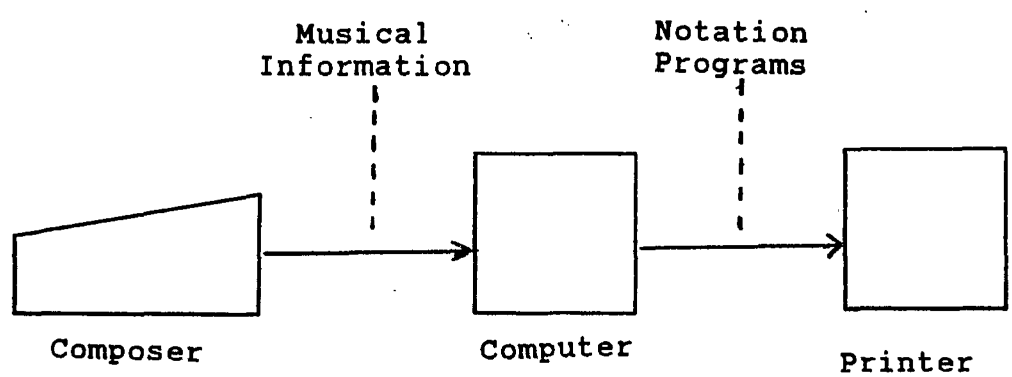
[8] See Hilde Hein, "Role of feminist aesthetics in feminist theory," *Journal of aesthetics and art criticism* 48:4 (Fall 1990): 281-292.

efforts at reforms of notation, though I do include some discussion of standardizing notational practice; nor do I embark on encyclopedic lists of notation devices, as these are amply provided for in the work of several other researchers.[9] Although I discuss words in music scores, I avoid discussion of words used as texts for vocal music. Likewise, although I describe various aspects of languages used to program computers for musical purposes, I exclude those programs dedicated exclusively to printing music. Such programs address the problem of music representation between a computer and some device which it drives, such as a printer or terminal. I am more interested here with questions of how musical information is represented between the composer and the computer.

Example 1-1: Notation and computer systems.



There are other aspects of contemporary music technology which may prove fruitful for theoretical work,

[9] See listings in the Bibliography for Erhard Karkoshka, Kurt Stone, Gardner Read, and Howard Risatti.

but which go beyond the scope of this dissertation. These include fractal geometry, object-oriented programming, congruent sound/animation algorithms, artificial intelligence, and some aspects of interactive composition and real-time performance.

Methodologies

The working title for this dissertation has changed quite a number of times. A composite title which reflects the various changes might read something like the following: *Music Notation as a Code and a Sign System: A Semiotic/Cultural/Theoretical/Post-Modern Study and Analysis of the Processes, Structures, and Results of Computer, Graphic, and Traditional Music Notations*. Such a title was clearly unwieldy, but it does reveal the breadth of interest addressed. In this regard, I am encouraged by the words of Eve Sedgwick concerning her own work:

> Any critical book makes endless choices of focus and methodology, and it is very difficult for these choices to be interpreted in any other light than that of the categorical imperative: the fact that they are made in a certain way here seems a priori to assert that they would be best made in the same way everywhere. I would ask that, however sweeping the claims made by this book may seem to be, it not be read as making that particular claim. Quite the opposite: a real measure of the success of such

> an analysis would lie in its ability, in the hands of an inquirer with different needs, talents, or positions, to qualify the distinctive kinds of resistance offered to it, from different spaces on the social map, even though such a project might require revisions or rupturings of the analysis as first proffered.[10]

Furthermore, to paraphrase Sedgwick, the only imperative that this dissertation means to treat as categorical is the very broad one of pursuing an interdisciplinary inquiry into music notation.

Like any other theoretical work, this one is defined by the objects of its study and the methods used in approaching them. As we shall see, however, the objects -- music notation systems -- are unstable, and the methods used here are numerous. Like others who have pursued critical theory, I have found that the unity of the field of inquiry is an illusion.[11] Faced with this situation, I have sought a pluralistic understanding of the field.

Linguistics, semiotics, music theory, and philosophy account for most of the concepts and methods I use. These, of course, are broad areas of study which have been mutually influenced by other fields, such as structuralism, cybernetics, sociology, etc. Linguists make a distinction between etic and emic approaches to an object

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[10] Eve Kosofsky Sedgwick, *Epistemology of the closet* (Berkeley: University of California Press, 1990), 13-14.

[11] See, for instance, Terry Eagleton, *Literary theory: An introduction* (Minneapolis: University of Minnesota Press, 1983), 194-217.

of study. The etic approach deals primarily with the raw data of the field, and the methodological tools a researcher uses to organize them. The comparisons, categorizations, lists, and diagrams provided here exemplify this approach. The emic approach attempts to uncover the significance of various aspects of a field, to reflect the viewpoints of the users of the concepts addressed. Toward this end, I have provided a series of interviews of native informants, as it were. I have alternated the etic and the emic by interpolating transcriptions of the interviews between the more expository chapters. Generally speaking, each interview takes up some question regarding music notation, which is later reflected, at least partially, in the following chapter.

Philosophers, semioticians, and other theorists frequently partition polymorphous fields into two or three sub-fields. Charles Peirce elaborates his general semiotics with trichotomies (firstness, secondness, thirdness; symbol, icon, index; etc.), and Jean-Jacques Nattiez grounds his semiology of music on the tripartition: Composer / Score (or the physical work itself) / Perceiver (performer, analyst, listener). Partitions of two parts are usually referred to as dichotomies or binarisms (natural/artificial, in/out, prescriptive/descriptive). Sedgwick explains the usefulness of binarisms:

> My casting of all these definitional modes in the form of binarisms, I should make explicit, has to do not with a mystical faith in the number two, but, rather, with the felt need to schematize in some consistent way, the treatment of social vectors so exceedingly various. The kind of falsification necessarily performed on each by this reduction cannot, unfortunately, itself be consistent. But the scope of the kind of hypothesis I want to pose does seem to require a drastic reductiveness, at least in its initial formulation.[12]

My methods include reductions into trichotomies and binarisms. For instance, I take the categories of traditional music notation, graphic music notation, and computer music notation as a useful division of the field in general.

Finally, some of the concepts addressed by this dissertation may be philosophical bombshells (e.g., intention, meaning, ideology, queer theory), but I invoke them in the belief that they are useful, if not always precise. At the very least, they generate questions, and frequently these are questions which need to be asked.

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[12] Sedgwick, *Epistemology*, 11.

INTERVIEW ONE

Leonard Meyer

Leonard Meyer is a musicologist and aesthetic philosopher. He taught for many years at the University of Chicago. He established the importance of the formalistic theory that music sets up expectations, the confirmation or frustration of which affects the perceiver of the music. His work has encompassed ideas drawn from information theory, psychology, history, and critical theory. He has maintained an interest in John Cage's music since they worked together at Wesleyan University in the 1960s. The ideas he articulates here about music's secondary parameters, and about the relationship between Cage's work and the work of visual artists, seem particularly germane to the question of how music notation is changing. I interviewed Dr. Meyer on February 20, 1988, in Middletown, Connecticut.

Wood Massi: I'm interested in talking about graphic music notation and visual works, for instance, the prints John Cage did at Crown Point Press.

Leonard Meyer: The prints, I don't know well enough. The first thing one has to recognize is that every notation exists within a tradition for notating it. In other words, let me take the example of . . . a Shakespeare play, okay? You read the text, and my feeling is that the text is only the beginning. There are traditions for reading English, and for reading the punctuation, and so on and so forth. Partly, any notation is a matter of degree, not of kind.

WM: A matter of degree?

LM: In other words, how specific is the notation? What has happened, in a sense, is that we have assumed that the most important thing to notate is pitch. That's basically what gets notated very carefully in the seventeenth, eighteenth, and nineteenth centuries. Now, if you look at notation, going through the nineteenth century, you see that what I call secondary parameters of music get notated more and more precisely. That is, instead of having *forte* and *piano,* you have triple *forte* and quadruple *piano,* let's say in Mahler. Instead of having a . . . fairly long *crescendo* mark, you end up by the beginning of the twentieth century, having a *crescendo* mark over one note. . . . Look at the tempo marks, for example from, let's say, 1700 to 1900. . . . All those are secondary grammar. What happened was that during the nineteenth century secondary parameters became more important in articulating the structure of music. And then by the time you get to Cage, they become the most important thing. And you leave out the markings of pitch.

WM: Do you think the idea of secondary parameters might also be extended to represent a larger reality, where you get away from the sound object itself, and into the social object that a score represents, or the aesthetic object somehow?

LM: . . . Performers become more important as choosers. . . . One of the great problems of twentieth century music is making choices. My view of the whole history of twentieth century music can be summed up by saying that it consists of various ways of creating constraints for the composition of music.

WM: That's what Stravinsky talks about in *Poetics of Music*.

LM: Yes. Neo-classicism *a la* Stravinsky is a constraint. Texts are constraints. I would guess the peer cent of texted music is much larger in our century than in let's say, the eighteenth century. . . . One of the things that composers do is leave choosing up to the performers. The reason for this is that making choices without constraints takes a tremendous amount of time. [Comparing the work of Bartok and Bach], look at the shelves in the library. Bartok may take [a little shelf space], and Bach will take [a lot]. Now that's not necessarily because Bach was more talented than Bartok. It means that, because the style was in a state of disrepair, so to speak, Bartok had to make many more compositional choices consciously, and making compositional choices takes time. Mozart could write the overture to *Don Giovanni* over eighteen, twelve hours, not only because he was a genius, although I'm sure he was. But because [for him composing was] just like my speaking English. I don't have to think about what words I'm going to use, or how to pronounce them, or how to construct sentences, but if I were speaking German to you, forget it. I would be thinking all the time, and I would speak much more slowly. . . .

WM: Well, I'm interested in the more visual things.

LM: Well, the visual. One of the interesting things is that you have this big connection in the twentieth century, which began in the nineteenth, between visual artists and composers. And this has to do partly with the fact that the composers are interested in sound, *qua* sound -- Cage reiterates this all the time -- which makes them allies with the painters, who were interested in colors *qua* colors. In order to do that, you have to strip away all syntax. . . . Let's say, if you are watching a color television, and it's a cops and robbers thing, you don't even notice the color. You're noticing all those people running around. And if the picture goes haywire, then you see the colors vividly. So, if you want to make people see the colors, if you want to make them attend to the secondary attributes of things and make those things primary, then what you have to do is take away what might be called the action of syntax, whether it's perspective in painting, or gesture, or whatever, between people. And one of the things that's happened, is that that's been much less possible in language. . . . Joyce does it. [But] language without syntax is very difficult to grasp.

[As for John Cage's style, it is] defined by the choices he makes. You may say that John's music hasn't any style when it's purely aleatoric, because he didn't choose the pitches, but ultimately he has a style because he chooses certain things as the precompositional constraints for picking the pitches. . . . The style of the man becomes what things does he use as the basis for choosing his constraints.

WM: [What did you mean in] your remark that one can't analyze aleatoric music, because analyzing the piece of music is something different than analyzing what goes before? [Does that have anything to do with] Nattiez' idea that everything that impinges upon the music entity can be part of the analysis: the culture, the history, the personality, the biography?

LM: If you want to define it as everything that impinges on it, then that's certainly true; but then the answer is that this music is no different from any other music. I mean, the same things were impinging on Mozart as are impinging on Cage. He had patrons, he had a hall, he had audiences, he cared about the audiences. Everything is impinging all the time.

WM: But there are different kinds of patronage, and different truths of culture, different theories of aesthetics. It's like they're different forms.

LM: That's true. . . . There's a peculiar avant-gardism. I think Cage's going to these universities is partly a way of support, and . . . I think that there's a kind of ideology that Cage has, that makes him do the kinds of things he does. Certainly, his association with painters is very important. . . . In the broader sense -- in the sense you want to use analysis (of everything that impinges on composition) -- then you're really talking about the analysis of his creative process, and certainly then, painting impinges on it.

CHAPTER TWO

Overview of Contemporary Notation

Definitions of notation come in as many varieties as the notations themselves. Ferruccio Busoni called it "an ingenious expedient for catching an inspiration."[1] Cornelius Cardew defined it as a social phenomenon: "Notation is a way of making people move."[2] Most people think of notation as a way of visually conveying something about music. According to this definition, music notation displays measured quantities and relative qualities by using combinations of points, lines, symbols, icons, words, numbers, shadings, and coordinate systems. This is certainly a useful conception of music notation, especially of traditional notation systems (sometimes called "common practice notation"); but it does not go far enough to include many contemporary practices. Gardner Read calls notation "the detailed guide by which the

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[1] Ferruccio Busoni in Gardner Read, "Self-indulgent notational aberrations," *World of music* 14:4 (1972): 37.

[2] Cornelius Cardew, *Treatise handbook* (New York: Peters, 1971), *x*.

creator instructs the performer."[3] This is another limited definition of notation, which leads to the devaluing of contemporary notational practices. Read ultimately concludes that a great deal of new music notation is "self-indulgent" and "aberrational".

If we want to get to an adequate and essential definition of music notation, we need first to ask a few questions. What are the purposes of notation? How is it used? What is its influence? What are the assumptions made by the notation? How well does it fulfill the needs it addresses? I take up most of these questions below, but I will begin by offering this working definition: Music notation is an enduring presentation, representation, or repeatable display of a musical work.

A musical work is a complex aggregate of activities, which includes sound, notation, and the various contexts of any given situation. It is important to distinguish between musical sound on the one hand, and music notation on the other. Each has its own set of musical facts (physical, psychological, social, historical, semiotic, philosophical, etc.) which sometimes coincide and at other times do not. Some theorists complain that music notation has seduced us into thinking of music in terms of notes and groups of notes; that is, as a thing rather than a

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[3] Read, "Notational aberrations," 36.

combination of complex and dynamic structures and processes. But certain aspects of a musical work do possess solid being. Primary among these is the score, which serves as a scheme for the work which otherwise finds its identity in the less stable forces of performance, perception, acoustics, and situation. Notation is a steady but often inefficient and incomplete representation of the total work. It is an abstract language with great potential. The possibilities of the language are infinite, but so are the objects it seeks to describe.

Uses and Purposes

Notation is a tool, an extension of the body; but it is an abstract tool, one which uses symbols to deal with an abstract and complex reality. Perhaps one reason notation is a complex phenomenon is that it serves such diverse purposes. Notation provides structural information about a piece (describes it), as well as instructions for performers (prescribes their activities). It facilitates invention and calculation, manifests the composer's tone of voice, and transmits her intent. Notation enables collaboration and the coordination of parts, making it possible to recreate the work. It serves as a mnemonic device for performers. The notation of a work, however, may exist merely as a way of securing a copyright, or of providing personal satisfaction to the composer.

One of the most important functions of notation is to preserve the work. Sound waves in the air dissipate much more rapidly, of course, than do paper and ink, or magnetic tape. Additionally, notation can serve as a sort of anchor, stabilizing specific aspects of the musical work for analysis. Finally, it is a device for controlling resources, its complexity and efficacy being determined by the degree of control desired and the number of resources to be controlled.

Many of the advantageous ways we use music notation carry with them concomitant disadvantages. One general rule of thumb is, the more efficient a notation is, the less flexible it is, and vice-versa. For instance, while music notation enables us to describe the music, it tends to replace the full meaning of the musical work with the graphic description. By making the vague clear, it confines our conception to the notatable.

While notation may free up the intellect of the composer, facilitating calculations and a broader perspective, it also may confine the music in ways that limit its expression. Notation may give the composer greater expressive and communicative powers, but at the same time, it may reduce those powers for the performer. Also, while notation may facilitate the preservation of music, it provides the means to accumulate cumbersome amounts of music information. This is another binary relationship manifesting the advantages and disadvantages of notation.

Good notation techniques require the balancing of needs and functions which often contradict each other. Traditionally, the best notation is simple, elegant, and economical, containing no extraneous information, yet adequately specific and elaborate to communicate what is necessary. Notation characters or marks are of a suitable size and number, and appropriate mixtures of them are used when necessary (for instance, words may be used to enhance the meaning of iconic signs). Ideally, the appearance of notation marks is distinct, attractive, and easy to reproduce. The meaning is clear, maintaining a proper scope and balance between generality and specificity. The symbols are used consistently.

Though these practical considerations may seem self-evident, it is by no means the case that they are consistently followed, even by highly-accomplished and acclaimed composers. Research I did on the version of the score for his Piano Concerto (1985) which Milton Babbitt used for its premiere performance found numerous "faults" in the notation: there are inconsistencies in beaming, rhythmic spacing, and disposition of instruments on the score pages; there is no complete list of instruments given on the first page; time signatures are too small; in many places, too many staves are used; the slashes between systems on the score are too small; some of the triplets are notated with a number, an equal sign, and a note value, which is redundant; there are unhearable *pianissimo*-against-*fortissimo* dynamics; there is no differentiation between the notation for strings *divisi* and double-stop notations; there are unplayable piano chords; no part is provided for the soloist; and the conductor's score is too small. Most of these problems can be interpreted as carelessness on the part of the composer.

Other problems with music notation derive from the innate limitations of the system itself. Traditional music notation especially has difficulty representing the covariant, dynamic and unique aspects of a musical work. Loudness and color are particularly difficult to capture over a short duration. The notation usually fails to tell us, for instance, about variations of timbre within each note, or when and how long to make small pauses, or how large, fast, and loud one's vibrato should be. Such factors are traditionally given to the performer to decide. The range of possible variations depends on the appropriate rubato technique or other performance practice. But with the changes currently taking place in how music is created and performed, the limitations of older systems become increasingly obvious.

Notation in Stress

Notation is inefficient and incomplete even under the best of circumstances. Gregory Bateson pointed out that "the map is not the territory, and the name is not the thing named."[4] Traditional music notation is showing the strain as contemporary music practices rapidly change and expand. New aesthetic developments, technological discoveries, and social relationships are constantly impinging on the field.

Aesthetically, the mingling of the arts in single works has a rich tradition from Wagner's *Gesamtkunstwerk* (total art work) to the performance art of today; from the works of Mallarme to those of Cage, or of contemporary pattern poets; from visual collages to present-day installation works. The inter-art impulse produces more works and theories today than ever before.

Other aesthetic changes have also affected the development of notation systems. Since Schoenberg's

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[4] Gregory Bateson, *Mind and nature: A necessary unity* (New York: Bantam, 1980), 30.

invention of dodecaphony, compositional practice has embraced the idea of completely changing the system of composition, temperament, notation, performance, or reception with each new style, even with each new work. Much greater latitude has been granted musicians in terms of system building. They are free to create new or more personalized strategies of composing, performing, or experiencing music, and in doing so, to create new tools of notation. We live in an age where anything can be art. Neither the performance nor the notation of sound is necessary to its designation as music. New combinations of rhythms, unique temperaments and scales, and extended techniques for playing musical instruments, all strengthen the demands of aesthetics on notation.

One of the defining trends of modern music has been the evolution of secondary parameters into distinct and independent structuring devices. Pitch and time have lost their hegemony over music, while structures and processes such as timbre, dynamics, notation, and conceptualization have become more important. Composers today have at their disposal a greater control of sound color than they ever have. Additionally, the visual aspects of a music's notation have greater formative power for the work as a whole. Some musical works today are conceived from the very beginning in visual terms.

Enabling technologies have evolved along with the aesthetic changes. Machines like tape recorders, computers, and photocopiers have had a profound effect on how music is made. A particular studio technique may produce a new and unusual type of sound. Performers using acoustical instruments may then devise extended techniques to imitate the sound. After that, composers may find it necessary to create new notation devices to represent either the sound or what the instrumentalist is doing. Finally, the listener, exposed to the new sounds and techniques, broadens her experience of music.

Electronic technology exerts a powerful influence over music today, an influence that, with computers, is becoming ever more diverse and pervasive. Computers are used for music composition, real-time performance, improvisation, simulation, transcription, and formal as well as acoustical analysis. The interactive aspect of computer composition has become ever more important. Programs provide quick and agile translation of composers' ideas while freeing them from many of the tedious tasks of traditional composition. Computer technology, however, by virtue of its ability to modify the most minute aspects of sound, adds the compositional burden of specifying the micro-structure of sounds; and to do that, composers frequently have to learn computer languages, mathematical models, and compositional grammars.

Technology multiplies the number of variables accessible to control. For instance, Big Briar's touch-sensitive keyboard senses

> key number, key-on velocity, release velocity, polyphonic pressure, and two further dimensions of control derived from two-dimensional finger position on the chosen key. . . . This yields six dimensions of control per note; and, if we can assume that a player can control three such note streams with full independence at once, and also operate two foot pedal controls, we get six times three plus two, equals twenty dimensions of simultaneous control. That's a lot to think about.[5]

Traditional notation is particularly inadequate for representing the full range of techniques currently available to composers and performers. Computer musicians routinely use representations of events that may be shorter than 1/15,000th of a second (e.g., the wave form of a single cycle of a high tone) or longer than a one-hour piece (e.g., score for a large-scale compositional structure). New forms of notation, such as sonographs, have evolved to represent new compositional techniques, such as spectrum analysis. New computer technologies will continue to push our conception of music and notation even further. Voice Navigator software controls various MIDI functions by creating voice triggers. Musicians can keep their hands on their musical instruments and simply tell

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[5] Jeff Pressing, "Cybernetic issues in interactive performance systems," *Computer music journal* 14:1 (Spring 1990): 19.

the electronic recording studio what to do. Other new control devices include those activated by movements of the eye. The interface between musicians and technology seems to be moving toward total sensory environments, where any gesture may trigger activities which, in turn, provide feedback to the senses of the user. This is known as "virtual reality," and is already used quite effectively by architects.

Photocopying technology is not as dramatic; nonetheless, it has had a profound impact on the practice of music by making music scores more widely available. It has become easier and less expensive to use music notation in a larger variety of ways. Composers can create works using highly unusual notations, and still be able to distribute them. Performers can afford to practice from a greater variety of notation types. Theorists and musicologists can more easily scrutinize specific works.

Together with aesthetics and technology, social structures and changes affect music notation. These developments feed on each other. Due to the declining number of trained music engravers over the past few decades, the cost of printing music had been increasing, despite other technological advances. This lent urgency to the search for a representation of music appropriate for computers, a search taken up by the DARMS project.

Changes in the social positions of composers and performers have had important implications for notation. As composers have left more of the decisions to performers, as performers have expanded their improvisational techniques, and as both roles have coalesced in computer music processing, an ambiguity has developed around the question of each person's role. Rather than relinquish control to performers, some composers have sought to prescribe every aspect of their compositions.

> In such music, only rigid sign realization is admissible; this does not permit 'interpretation.' At the same time, however, music of this nature is generally so complex that truly accurate sign realization is rarely ever achieved in performance. Thus, the score and the performer have actually exchanged roles; whereas the score used to be the map designed to guide the performer toward the composer's artistic vision, it now is often completely explicit. On the other hand, performances are now often mere stabs in the direction of the composer's envisioned perfection of execution. The imprecision and variability of human performance are actually quite detrimental to the requirement of totally organized and predetermined works. Realizing this, composers have begun to relegate such works to electronic performance media, which [reputedly] assure absolute accuracy.[6]

If the social definition of the roles musicians play affects notation, so does the social definition of the

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[6] Kurt Stone, "Problems and methods of notation," *Perspectives of new music* 1:2 (Spring 1963): 3.

instruments they use. Gary Grossman, in discussing the influence between society and the clarinet, contends that:

> The clarinet parts of *Til Eulenspiegel* could not have been conceived for a clarinet of the early nineteenth century. Conversely, *Til*, as a composition, is inconceivable without clarinet. . . . Compositions for woodwinds were really compositions for this model, and the technical judgement of the performance was predicated on the ability of the performer to play in conformance with the model. In that sense, the performer performed music using the instrument and, at the same time, performed the social definition of the instrument.
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> Beginning in the late 1950s [musicians] began to compose and perform using any sound that a given instrument could be reliably demonstrated to produce. This represented an attempt to explore, not merely to master, the instruments. And these explorations have not only produced new social models of each instrument, but a new meaning of 'musical instrument.' . . . The extent to which the bassoon produces the loudest and most varied key clicks, once seen as a necessary evil by builders, performers, composers, and listeners, can now be welcomed as a virtue by all.[7]

The economics of the society in general, and the music world in particular, also affect notation. The mass distribution of music in capitalist societies, driven by the pursuit of profit, leads to a devaluation of the original or unique, and a utilization of styles appreciated by the largest number of people, including styles of notation. A scarcity of resources leads to restricted rehearsal time, which in turn leads to a

[7] Gary Grossman, "Instruments, cybernetics, and computer music" in *Proceedings of the 1987 International Computer Music Conference,* comp. James Beauchamp (San Francisco: Computer Music Association, 1987), 213.

premium being placed on the efficiency of a notation system's communication abilities. Despite the importance of clear and consistent notation, however, the score -- like that of Babbitt's Piano Concerto mentioned above -- may be burdened by mistakes, omissions, and miscalculations because of the lack of money to pay copyists. A scarcity of resources also leads to smaller ensembles and fewer parts being produced.

The aesthetic, technological and social changes enumerated here add up to a crisis for music notation. The complexities of both the theoretical foundations and the desired sound and social results have passed the point at which they are expressible by traditional notation. Numerous reforms have been proposed throughout history, but few have taken hold. The idea of *replacing* traditional music notation is extravagant because so much time and energy have gone into training musicians who are frequently required by circumstances to use traditional notation. When they need to, they devise new signs for new ideas, but more often than not, these have no universal meaning. This leads to a search for new systems and, perhaps, to a concomitant rejection of the old systems. Without a "universal" theory of music, such as that provided by tonal theory during the common practice period, there can be no universal system of notation. Perhaps the classifications and models described in the next few chapters will take us another step along the way to a theory which is at lease more inclusive.

INTERVIEW TWO

Allan Kaprow

Allan Kaprow made "happenings" famous in America. He coined the term in an article in 1959, and has created numerous happenings since then. His work emphasizes action and everyday life. A student of John Cage in the 1950s, he also worked with the Fluxus group in the 1960s and 1970s. He has taught, exhibited, performed, and published widely. During the last couple of decades he has been a professor at the University of California, San Diego, where he teaches performance art. In this interview, which took place on June 22, 1989, in La Jolla, California, he discusses several types of notation as well as problems associated with trying to capture performance ideas in notation. He also discusses the question of what the artist's presence, the artist's self, means in a larger frame of reference.

Wood Massi: What kind of notation do you use? Is it related to a semiotic or linguistic analysis?

Allan Kaprow: I've used a number of different approaches to the question. . . . Initially, when I got into performative concerns, and the need for some kind of script, recipe, score, or plan arose, the question was, how do you do it? . . . My first instruction in that area came from John Cage. I'm talking now about the mid-1950s, around 1956 I guess, at a point when I was leaving painting for environmental, what we would nowadays call installation concerns . . . where it was not simply the constructed elements. It was also a number of options for visitors to get involved with as participants, by pushing buttons, moving things around, and so on. How do you go about, I wondered, providing that information for the visitor/participant? . . . Cage had already been facing what the new composing-performing-listening situation required by finding alternative kinds of scoring methods, or notating methods, which in the most extreme case were nothing more than the provided environment -- blemishes on paper or sounds you hear in the air, or who makes a noise before you, etc. These kinds of cues were minimal, and not even necessarily provided by the composer or artist. Other more elaborate methods were worked out by composers like Stockhausen and Pousseur, all of them trying to evolve a new way of making a plan, a new way of notating moves in the ensuing music-making situation. I really was benefitting by looking at all of those at that time;

there's no question about my learning from the musicians more than anybody else.

It's interesting that I discarded, as a possibility, the system of script writing used by theater people. It was much too elaborately verbal, at least toward the middle of the century in the West, much too specialized and precise.

WM: By that, you mean indications about how to speak, and so forth?

AK: How to speak, stage directions, all kinds of things. Mediated, of course, by the directive, the drawing coach, the speech coach, and endless kinds of specializations that seemed to be overworked. . . . What I did was reduce the stage directions to rudimentary verbal clusters, that is, to the sorts of things you could say with marginal notes in previous literature, things like "X jumps until breathless," or "Y unravels a ball of string over three miles." And then what these little verbal clusters would be treated to, is a kind of randomized or sometimes a literal spatialization on a page which would correspond to an imaginary field of action. Since I was using the real environment, rather than galleries by then, or staging areas, it was "across the street," or "around that tree," or "upstairs," or "tomorrow." So, tomorrow would be, let's say, three pages later, with perhaps blank pages in between, where you would use the lexical processes of normal reading, and then introduce within those kinds of habits the notions of spatialization or temporalization.

WM: So you used something similar to Cage's idea that graphic space equals time?

AK: Equals time, but also space equals literal space, which he usually didn't bother with. That is, as far as I know, the typical playing structure of either chamber groups or orchestra groups was not generally questioned by Cage; I don't think he moved people around. I remember in the class I took with him [at the New School for Social Research, in New York], I would set up the classroom as one space with its subspaces. I had the hallway as another space, and remote rooms as other spaces, or stairwells, bathrooms, hallways. Doors open, doors closed to the sound, would or would not transmit well. And these had to be indicated in some kind of scoring method so that the players would know where to go and when to do whatever. . . . People didn't know how to read it very well, or to take it as a real recipe, and cook with it.

That was the earliest form. But in addition to that, I used clusters, as I had seen Stockhausen and other musicians do, quasi-musical staff lines, that is, where you'd have a little postage-stamp-sized area, but it would have staff lines. Now, I didn't have staff lines in the literal sense, I had staff lines corresponding to superimpositions of sounds, actions, or extensions in time, within the small little cluster, and that was stuck somewhere on the page, or an open two page form, or sometimes a scroll, which I like to use. The unravelling of the scroll is a kind of time frame, too, under various constraints of fast or slow, sometimes using a clock, sometimes not. So I borrowed in that period whatever I could, mostly from the more experimental musicians, and hadn't really worked out an adequate representation of instructions.

But then, that exhausted itself, in my view. I could have carried it further, but I saw it leading into the possibility of concertizing, which is exactly the opposite of what I wanted to do. The more people became familiar with the particularities of this system, as you've seen in music, the more it would become normative, the more easily assimilated by the performer, musician, theatrist, who has grown up with a pluralistic equipment system. I didn't want to go in that conventionalizing direction.

WM: Your approach seems similar to Cage's in some ways. You try to loosen up the directiveness that is imposed on the performer or the listener. But then there is a difference. As you pointed out, Cage tends to stay in the concert hall. . . . Of course, there are his pieces, like *Variation IV* which was performed at an art gallery, and *49 Waltzes for the Five Boroughs* which calls for taking sound samples in various locations. But, for the most part I think you're right. Your work seems, however, to have been much more concerned with getting out into the world in a literal and geographical sense.

AK: Geographical, but even social, and finally philosophical. . . . Most experimentalists up until recently have gone through some pains to reassure the public that, indeed, they love the past -- as I do -- and that therefore, their relation to tradition is a continuous one. I think what has happened in my case over the last thirty-odd years, is a determination to take a more philosophical view of living itself, rather than a view of my being continuous with the arts, even if I love them, have been trained in them, and see my point of departure as having been generated by the more experimental aspects of the arts. The jump-off point somewhere back in the 1950s allowed me, then, to go into the rest of life, rather than into my continuity with the arts more determinedly. . . .

The question that you're raising about notational systems, in relation to, say, linguistic studies, is an interesting one, because there is still the idea of a plan. Call it score, recipe, script, program -- borrowing the word more from "computer program" than from "theater program." They're all words which are more or less inadequate to serve this idea of what it is I might want to see going on, what it is we might do. . . .

I don't like the words "strategy" or "tactic" because there's something military about them which disturbs me; and I don't want that association. But nevertheless even the military during a war has some sort of plan. . . .

I discarded the musical format as leading too definitely to concertizing, theatricalizing, if I let it go farther, perfected it, and ironed out the kinks. I wanted to know what would be better, what would be a loose framework of instructions or guidelines for something that could take place in the everyday environment, and would not set itself too far apart from that everyday world. For a while, I used something looking like a telegramic form: words which are not primarily literary or even, for that matter, spoken; words having to do with actions, like those that I described before. "Dig a hole so you can bury yourself." One of Yoko Ono's plans comes to mind: "Draw a map to lose yourself by." Little rudimentary things that I used the telegram as an analogy for, because I thought, well, telegrams are expensive to send; you have to pay for every letter. So what is the cheapest, most concise form for getting an instruction across? [I sometimes used things like] dropping out the definite articles, the modifiers, and so forth; so that I got essentialist, almost cryptic, little clusters of things that, put together, began to resemble poetry, sadly enough. I'm saying this somewhat ironically. Not that I object to poetry, but rather that I didn't want my stuff being then taken for modern poetry, which in fact, it was.

WM: You were sort of between musical scores and poetry, a rock and a hard place.

AK: Exactly. [I wanted] to be less fettered by the reminders of art. If I was going to have fetters, because life is full of fetters, it would be those of everyday life, and all the problematics of getting up in the morning and taking a shower too late, and all of that sort of thing, which seemed far more interesting as problems. So, what still would be the adequate way to do this kind of planning?

WM: Without being constrained by your notation.

AK: By the analogies automatically drawn by others. That kept creeping up in not so much the work, as that part of the work which had to do with notation and planning.

So then I started combining pictures with words, using as the model the escape instructions in the backs of airline chairs, you know where they have the graphic designs of how you get out of your seat, how you buckle your seat, how to use the oxygen mask, in very, sort of Egyptianized diagrams of pictures with simple words. . . . They are graphically and visually and verbally equivalent to what actually, in the most rudimentary form, would be taking place in the activity that would go on from this plan. So I made booklets of this sort. I spent about eight or nine years trying to work this form out. Well, guess what? It didn't work. . . . The piece actually would turn out, whenever it was done, to be so messy and rough, and sometimes emotionally charged, and sometimes impractically done, that the two were absolutely at poles apart. . . . The booklets were handsome people thought. They were collected; they were exhibited in glass cases as art works.

From that, I changed over, again being guided by the airplane instruction format, by the videos that they now show instead of the little cards, which is a more living example, less abstract. They have some nice looking young man showing you how to buckle your seat belt, how to evacuate in case of a forced landing, and so on. So I began to make video tapes, and/or films, which would have the same sort of generalized, rather neutral quality as those posed images have in the booklets, but which would have real action. And guess what? They failed, too. They did not serve as adequate scoring devices, to use the musical analogy. You couldn't simply give these tapes, films, booklets, to a group of people that wanted to do an Allan Kaprow piece and have them do it. What they did was imitate the pictures. . . .

What always worked was me being present and saying, "Hey, let's do the following thing. . . . I've provided a kind of metaphor for personality types in some cases, and each one is going to decide whether we are stoopers basically, or climbers. We're going to take a piece of scotch tape, as far as our arm can stretch, we're going to go to various parts of this campus, and stretch the tape between two points. If we're stoopers, then we're going to stoop under it. . . . Then we're going to go find another place, and put the tape a little lower and stoop under that, until it's no longer possible to get under the tape, or to stoop. Now if we're climbers, it will be the exact opposite. We keep raising the tape in different places until it's no longer possible to get over the tape. And that will give us some idea, maybe, about ourselves."

Well, that might take anywhere from two hours to two weeks, and a variety of sites, or places chosen. Some people might like bathrooms, others trees, buildings, and so on. And you can see why what I just told you is the best sort of play plan that I've ever used. I might write it out on a piece of paper with some rudimentary indications, but basically it was me talking to one or more other persons about what we might do for a particular time. That worked. That's the only thing that ever worked.

WM: Ultimately, it just comes back to you and how you can personally communicate. [So perhaps for preservation purposes] just writing it out in script will do the job.

AK: Well, that really applies to the aftermath. That is, if somebody such as a magazine or a book, compiling performance pieces of a particular decade says, "We'd like to include some of your work of this decade, could you please send us a half dozen pieces?" Well, if they're recent things, like "Stoopers and Climbers," I would probably tell a kind of disarmingly simple little narrative, like a storyteller: "We did this and that. There were three friends who decided that all they wanted to do was step on each other's shadows. They spent the whole day stepping on each other's shadows. When the sun went behind the clouds, they had to find other ways of making shadows, so they went inside and put electric lights around them. And they did this funny little dance with bulbs at the ends of loose cords trying to make shadows. But because they kept moving around, the shadows kept moving, and it was very hard to step on each other's shadows. So they started stepping on each other." Now that kind of thing is simply the traditional form of a storyteller.

WM: So it's using narrative as a scoring technique, in a way.

AK: That's using narrative right there -- not the new-fangled kind of narrative which is very complex, but rather, very straightforward gossip form: "We did this and then he did that." And perhaps the sort of folksy tone that I might adopt is the way I normally talk, rather than a more literary form. But it is as close to a conversational, normative style as possible. That seems to get across more easily than anything else for post factum accounts.

The idea -- the hope that I once had for transmissible plans to those that I didn't know who might want to do something -- I find so far has not worked at all. I have to be present and generate my playmates out of friends, out of a chance meeting, out of whatever means is available, or brought up at the time. And without me, nothing's going to go on. . . . Indeed, the Western dream of massive communication might be unnecessary.

You know, it occurs to me that we're all profoundly influenced by notions of massification, by exaggerated and misleading ideas of democracy, by totalization, by a belief that we're no good unless greater and greater numbers of people appreciate us, that we're not loved, and that we need that, and we would die for it. Perhaps this is a moment when out of my own failures to do this -- and failure is probably at the very heart of what it is that I am doing -- maybe I am going to be able to reevaluate some of those biases that we grow up with. After all, I've cut myself off from critics. I keep running from the rest of the art world, which wants to always love me and take me into its bosom, or from the music world, or the theater world, the dance world, the poetry world. Maybe there's a sense to it, the sense being that as an alternative, the private subjective life has its own dimensions, its own needs, and it need not constantly measure itself against those larger expectations of the democratic statistical world.

WM: In a sense, you're saying that your aesthetic moves you beyond, or away from, scoring and notation themselves. You yourself, your physical presence is the notation, is the score.

AK: In a kind of way, a living score by example.

WM: And it's the best representation of what you want to communicate. But then, there is very readily the tendency for any artist to do what you've been struggling with all these years, which is to make some artifact, some physical thing, which can communicate in your absence. I sometimes think of it as different levels. There's the very primary level of your life being an expression, or a presentation of itself. Then there is another level up, where you might try to make a representation in some sort of notation, which could come close, perhaps, to expressing something that you want to express, but like any notation system, carries its own baggage, and constrains and distorts whatever is trying to be expressed through it. I don't know what the level above that is, I guess it's pure abstraction or something?

AK: Well, either that, or it's direct experience. And I don't think that, outside of paradox which is an interesting condition, we're even talking about contradiction. We're talking about difficulties in meeting the different needs of personal experience and social communication, or social obligations, even. They may be served by different means.

It seems at the moment that the best way to go about doing my quasi-art is a direct, very small-dimensional, social kind of involvement among a handful of people and myself. The best way to communicate this kind of practice to others, is the storytelling form. That's not a contradiction, because it's like what I did on my vacation. . . . There's no conflict between the vacation and the story afterwards. . . .

I am feeling a lot more comfortable with the present solution, now that I've begun to give up the underlying anxiety I used to have about not being able to provide, as in the usual model, a plan for unlimited others to do my work. . . .

WM: I like your idea of using narrative as a notational technique, or a means of communicating between people. What interests me is that a narrative can communicate both to a performer, and to a listener or a receiver, an audience. The narrative is exemplificative for a performer. You say, "We did this and we did that," and the implication is that if you want to perform this, you can copy or imitate, or make your own version of what we did. Alternatively, if you had a passive audience or receiver, that person can just read the story, and experience the happening vicariously, the way any passive receiver does. It's a particularly economic form of notating or communicating.

AK: It could even include the low-level information of snapshots as distinct from professional photographs. It could have various reliquary remains. For example, the sock that I took off when I had a blister walking through that stream. Pieces of the true cross that you find in thousands of churches. So you can have a quasi-iconic inclusion, if you want, in that rudimentary story-telling, or gossip form. Just like the fisherman's display of the fish that were caught, the traditional photo on the dock. These can be included if they're appropriate.

I see no reason why amplification of that otherwise verbal form is not possible, but I would say at the base of it, words are the easiest thing by which we communicate, combined, if possible, directly with gestures. That's the rudimentary form. It can be amplified or dressed up a little bit by additional things.

WM: Your presence in person brings about a whole set of communications, which the words alone, in the form of text, could not communicate. Your vacation, and your sun tan are, in Charles Peirce's sense, a nonverbal index, the cause/effect sign of your vacation. That would initiate the conversation, or the narrative, you would communicate to someone by having a tan that you had been somewhere, or that something had happened to you. Of course, as you mentioned, all the gestures, the body languages, are available in person.

Your idea of including socks or pieces of a cross is another way of conducting a similar kind of nonverbal communication. But the difference is that that kind of stuff, these artifacts, can last in time. It seems that time is the operative, the primary difference between a personal interaction and trying to communicate with all these other means that we're talking about. Given your ideas about communicating, would you say that personally you are relinquishing the desire to communicate over time?

AK: Yes. In other words, it seems to me, that if the cost is giving up some things, it's the least costly to give up. . . . So what it seems to suggest is that the real-time, interactive aspect is the most compelling to me, and interesting; and that the historical or eternal aspects have been partly made desirable by texts, by photos, by objects. They're wonderful, but maybe they're not essential.

CHAPTER THREE

Types of Notation

Music notation communicates meaning through the senses. Any musical work is a multi-sensual experience, and notation partakes of that multiplicity. Musicians look at musical scores, touch instruments with their hands, hear and imagine sounds. The notation of a musical work is the physical embodiment of the work and a jumping-off place for the rest of the experience. Notation usually implies vision, looking at a piece of paper with marks on it. But examples ranging from medieval chironony and other forms of ensemble conducting to the use of light signals to cue players in recording studios reveal that paper is not necessary. Neither is vision. There are Braille notations for the blind. By now, someone has probably even attempted to notate music with odors.

Although sound is necessarily the end toward which musical means such as notation are implemented, sometimes sounds, themselves, serve as the means. For instance, click tracks, periodic clicking sounds fed through earphones to players, also are used in recording studios.

Sounds, whether signals (notations) or the final product, are necessarily temporal, and thus tend to present meanings sequentially. Visual notations, on the other hand, possess a much stronger ability to present meanings simultaneously. A consideration of the capabilities and limitations of various senses pervades any attempt at describing a taxonomy of notations. But it is only one set of distinctions we must make.

We who study semiotics can never resist categorizing signs. I will focus here on four notation types and three notation systems (two binarisms and a trichotomy), though the number of subtypes and subsystems is enormous. The two binarisms are between prescriptive and descriptive types, and symbolic and iconic types of notation. The three systems are traditional notation, graphic notation, and computer notation.

The prescriptive/descriptive binarism describes relationships between users and notations -- i.e., what notations mean to us, what we use them for -- the former *prescribing* actions for performers or composers, and the latter *describing* sounds to be produced. The symbolic/-iconic binarism concerns the notations' relationships to what they signify, and how that affects both their shapes and the kinds of things they can represent. For *symbolic* types the relationship between the signifier and what it signifies is arbitrarily established by convention. For *iconic* types there is some perceivable analogy between the forms of the signifiers and what they signify.

Types blend in various ways to form the three basic systems. The traditional music notation system includes signs used during what is often called the common practice period, from about 1600 to 1900, a time when music notation in the West was relatively stable. The computer music notation system consists of signs and signals employed in using computers to work with music. And finally, the graphic notation system comprises signs which emphasize a visual interpretation of music, and which I associate with indeterminacy and a sort of programmatic or conceptual import to meaning.

These are not the only types or systems of notation we could study, and they are not the only ones discussed in this work. I choose them because each represents a distinct world of aggregate uses and conceptions. In my experience of music, each of these systems forms a coherent structure -- though the boundaries between them merge and break in a maddening variety of ways.

Among the affinities across the two binarisms perhaps the strongest are temporal and spatial. Both symbolic and prescriptive notations tend to appear more frequently in some relationship to time. They are particularly useful in delineating temporal boundaries; but they are not restricted to representations of time, having the capacity to represent all of the basic parameters of music. The same is true of iconic and descriptive notations which, however, are primarily spatial in nature. Temporal codes represent by using strings or arrays of signs; spatial codes use images and configurations of signs.

The remainder of this chapter attempts a deeper definition of the four primary types, giving examples and comparing them to other possible taxonomies.

Prescriptive and Descriptive Types

In 1958, Charles Seeger proposed a classification system which occasionally has been used in the analysis of music notation. Notations are either prescriptive blueprints of how a "piece of music shall be made to sound," or they are descriptive reports of how a "performance . . . actually did sound."[1] Seeger saw these categories as manifestations of the subjective and objective representations of music. The subjective, prescriptive notation is essential to the realization of the sound, the execution of the work. Its primary reference is to the performance *process*. The objective descriptive notation, however, refers primarily to the

[1] Charles Seeger, "Prescriptive and descriptive music writing," *Musical quarterly* 44:2 (April 1958): 184.

compositional *structure*. It is a transcription of the sound, and its purpose is conceptual. Prescriptive notation precedes the sound, and takes the composer's or sender's point of view. Descriptive notation follows it, taking the point of view of the perceiver, or analyst.

Prescriptive Notation	Descriptive Notation
process	structure
blueprint	report
subjective	objective
realization	transcription
performance	conception
action	contemplation

Like the affinities among all the sign categories, the connections between these types of notation are by no means exclusive. In fact, the same notation may be taken as either prescriptive or descriptive, depending on the perspective of the user. For instance, in a typical published score of a classical piano work in traditional notation the noteheads might be taken as descriptive of pitch -- they refer to the pitches the musical work uses. The arabic numerals indicating keyboard fingering are prescriptive, because they tell the performer what to do. A middle C played with the second finger sounds the same as it does played with the first. The rhythmic notation of the piano score is both prescriptive and descriptive.

It tells the performer how long to hold notes in relation to other notes, and it provides a rough description of the flow of time.

Components of computer and graphic scores can also be classified as prescriptive or descriptive. For instance, an electronic score may be designed to facilitate a realization of the piece, prescribing the various technical matters required to produce the sounds (e.g, switch setting, speaker placements, etc.). Alternatively, it may simply describe sound structures which are more precisely represented on a tape or in a computer program. Composers frequently use such notation to coordinate the actions of live performers with sounds on prerecorded tape. (We might conceive of this as descriptive notation being used prescriptively.) Of course, the tape recording itself is a good example of descriptive notation.

Graphic music notation as description may imitate spatially some aspect of the musical object, or simply indicate a contemplation or a conceptualization of a sound image. As prescription, it may indicate actions to be performed without actually providing a picture of what sounds the actions may produce. Such indeterminate prescriptive notation is sometimes called action notation. It may initiate the production of a sound, a theatrical event, or an interaction between players.

To summarize, the prescriptive/descriptive binarism focuses on the uses of notation, defining it in terms of time, process, sequence, and execution on the one hand and space, structure, simultaneity, and contemplation on the other. You might say it is oriented toward people, whereas the next binarism we will consider is oriented toward things.

Symbolic and Iconic Types

The second binary opposition of types, between symbolic and iconic notations, uses some of the same terms of comparison as the prescriptive/descriptive binarism, but applies them to the associations between the notation and the thing notated -- sound, action, idea, classification -- rather than focusing on the users of the notation.

The symbolic is temporal; the iconic, spatial. They are time and space notations. Temporal codes come in strings and arrays; spatial codes, in images and configurations.

Substituting the terms "verbal" for what I have called "symbolic", and "visual" for "iconic", the following statement by Nikhil Bhattacharya highlights the principal differences between these two types of notations:

> Verbal [i.e., symbolic] abstraction consists of forming a class of individual objects or events, and then using the class name as a sign for representing any particular. . . . Such abstraction or classification can be done on any ground -- structural or functional -- whatever. Visual representations, however, having spatial structure, have to commit themselves to some structural features. . . . The paradigmatic visual representation is a map that represents a set of spatial relationships. That is what we shall mean by iconic representation. The aim in mapping or iconic representation is to use one set of spatial relations to represent another. When an icon attempts to represent a class of objects that do not have identical maps, it becomes symbolic. . . . Representations of non-spatial entities and relations are not iconic, but symbolic.[2]

The following set of binarisms illustrates some of the differences between the two types of notation:

Symbolic Notation	Iconic Notation
time	space
strings	images
arrays of signs	configurations of signs
asynchronous	synchronous (simultaneous)
by convention	by example
durational	figural
computer conversation	computer model-world
prefix	postfix
verb-->object	object-->verb
diachronic	synchronic

[2] Nikhil Bhattacharya, "A picture and a thousand words," *Semiotica* 52:3/4 (1984): 231-233.

Like the descriptive, the iconic is structural. There is a concrete structure which the notation describes. Iconic notations possess an analogical mapping between the sign and the object, between the signifier and the signified. At a very basic level all notations are iconic because the existence of the notation itself implies the existence of something to which it refers, and the minimum structure an entity can manifest is existence. (The simplest notation is a single mark on a blank ground. Zen priests and composers such as Pauline Oliveros use unadorned circles and dots as notations.)

Symbolic notations are more arbitrary. The relationship between the signifier and the signified of a symbol is most often a matter of convention. An icon is an exemplification by the signifier of the signified; there is a "natural" relationship between the two. Symbolic notation is well suited for sequential communication. Iconic, on the other hand, is useful for communicating simultaneities.

Roman numerals clearly use both the iconic and symbolic types. Numbers I, II and III are the graphic iconic traces of tallying, yet we arbitrarily read the symbolic IV to be greater than III.

Example 3-1: Symbolic and iconic notations.

a) b)

Example 3-1 shows a trill notated symbolically and iconically. For me, the "physical" similarity between the iconic signifier (b) and what it signifies makes it easy to think of this notation as descriptive, as well. That, in turn, makes it easier for me to think of the symbolic (a) as prescriptive. The four types seem to have an affinity to these pairings.

Look at Examples 3-2 and 3-3, two published versions of John Cage's *4′33″*.

Example 3-2: Symbolic version of Cage's *4'33"*.

I

TACET

II

TACET

III

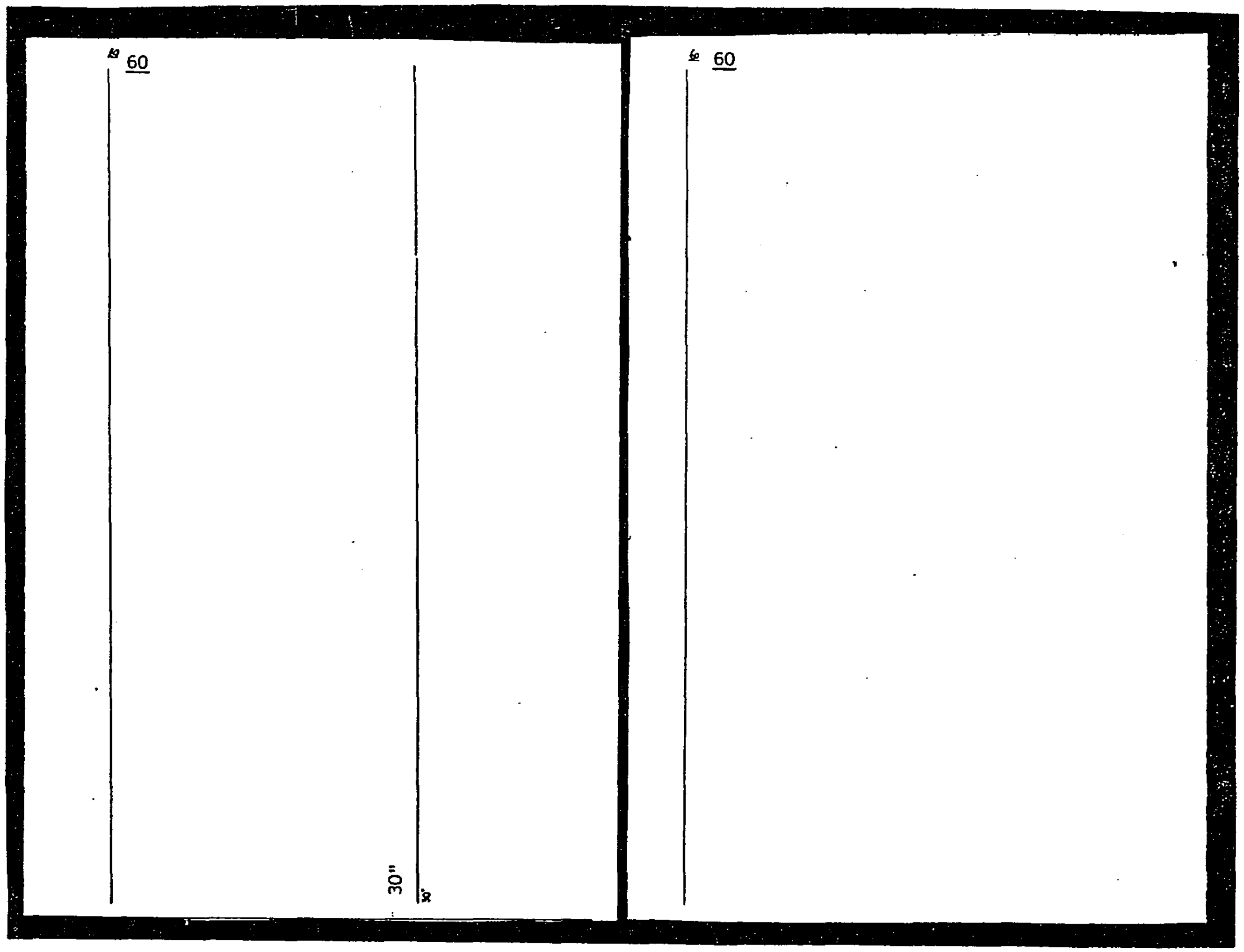
TACET

NOTE: The title of this work is the total length in minutes and seconds of its performance. At Woodstock, N.Y., August 29, 1952, the title was 4' 33" and the three parts were 33", 2' 40", and 1' 20". It was performed by David Tudor, pianist, who indicated the beginnings of parts by closing, the endings by opening, the key-board lid. However, the work may be performed by an instrument-alist or combination of instrumentalists and last any length of time.

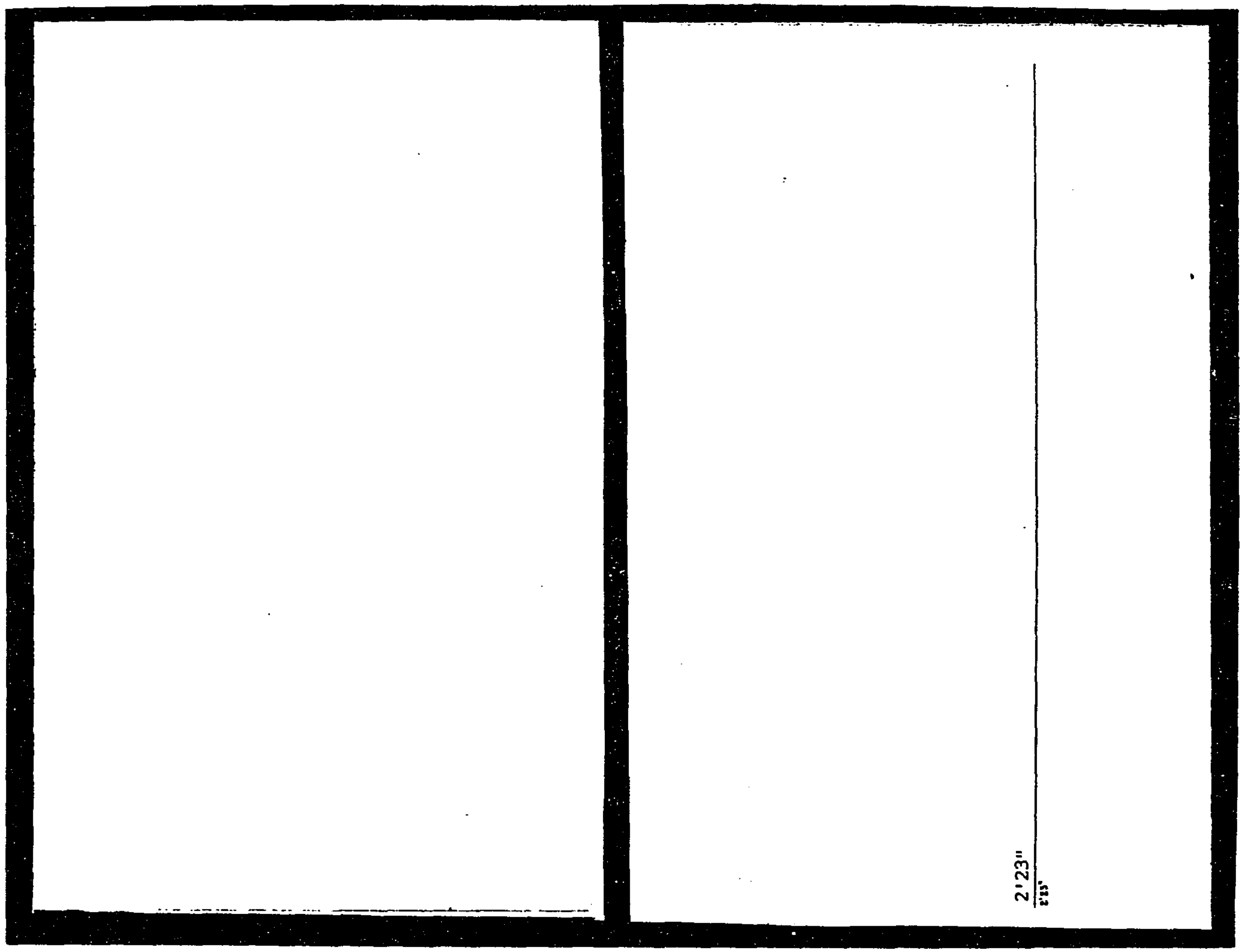
FOR IRWIN KREMEN JOHN CAGE

Source: Cage, *4'33"* (Henmar), 1.

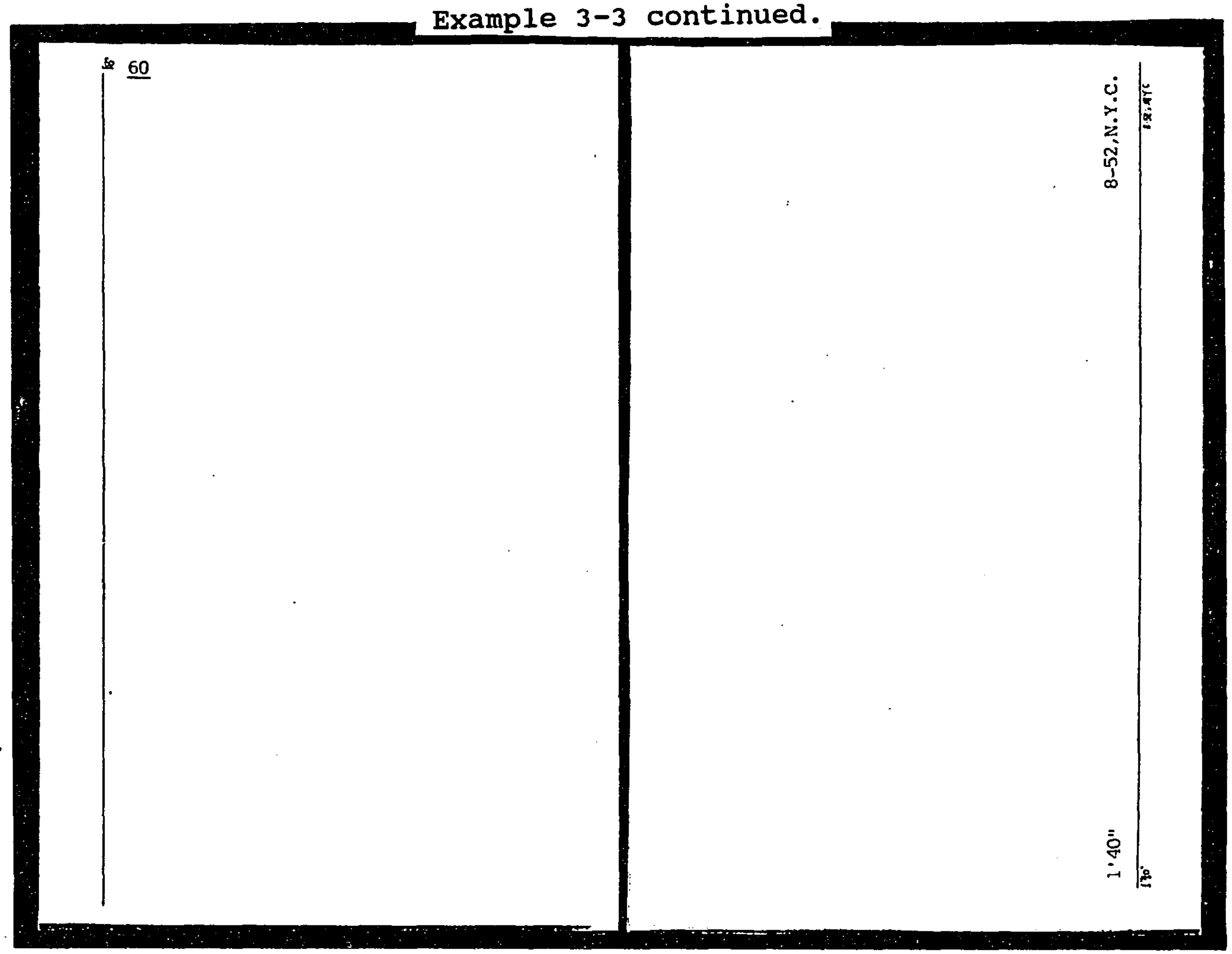
Example 3-3: Iconic version of Cage's *4'33"*.



Example 3-3 continued.



Example 3-3 continued.



Source: Cage, *4'33"* (*Source*), 49-55.

Example 3-2 represents silence by using the word "Tacet", and words are almost always symbolic rather than iconic. Roman numerals indicate the three movements, however; so in this limited sense the score is iconic. The version in Example 3-3 was published as six separate pages in *Source* magazine. It is the autograph version by John Cage. (I have reduced the size; and for the sake of legibility I have typed in the numbers Cage wrote indicating the beginnings of the three sections with "60" and the time lengths with minutes and seconds. Here, time equals space, and silence is represented by a blank field. There is even space for "nothing" between the three movements. This score is much more iconic than the other.

The binary oppositions I have described suggest other models which, in turn, reflect back on the concepts already defined. One such paradigm is the left-brain/-right-brain binarism. According to Robert Ornstein, the primary functions of the left hemisphere of the human brain involve operations of analysis, logic, language and linearity -- all associated with symbolic and prescriptive functions. The right hemisphere exceeds when synthesis, emotions, creativity, and images are involved, perhaps making this part of the brain more important to iconic functions.[3]

Two sets of notation models, the first graphic and the second used with computers, illustrate the interaction between the perspective of the user and the notation device used. The graphic set, suggested by Jeanne Bamberger, makes a distinction between durational and figural types of notation, which are the same, respectively, as what I have been calling symbolic and iconic, or time and space notations. She uses this binarism to describe the basic types of notation produced by children whom Bamberger asked to devise a way of graphically transcribing a simple rhythm she played.

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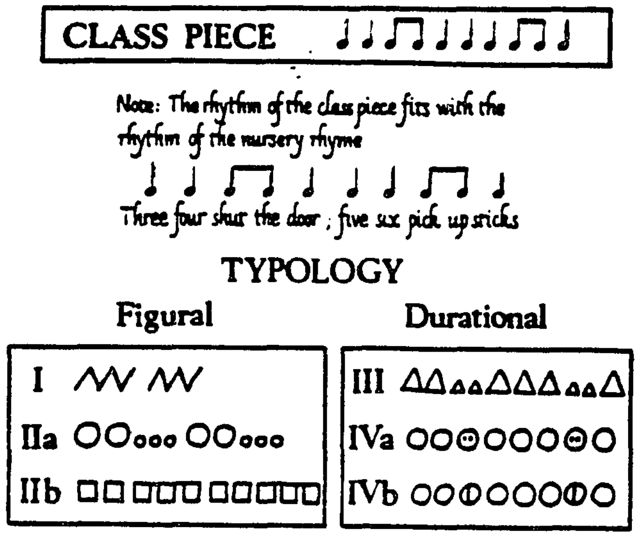
[3] See Robert Evans Ornstein, *The psychology of consciousness*, 2nd. ed. (New York: Harcourt Brace Jovanovich, 1977).

Example 3-4: Figural and durational notations.



Source: Bamberger, "Description of simple rhythms," 174.

Although the figural types apparently do a better job of visually capturing the example's metric grouping into two parts, they do so by depicting aspects of the immediate area, i.e., local relationships, whereas the durational examples seem to reach out across time. The figural is more continuous and hieroglyphic. The durational, like traditional music notation, sets up discrete units, or notes, and represents the relative qualities of each.

As developments in electronic music expand the flexibility and complexity of musical works, the grouping information available in figural notation becomes more important. Using a similar binarism, Peter Desain defines

> two major metaphors for the nature of human-computer interaction. A conversation metaphor

> . . . in which the user and system have a conversation about an assumed but not explicitly represented world, [and a] model-world metaphor [in which] the world of interest is explicitly represented, and there is no intermediary between user and world. Appropriate use of the model-world metaphor can create the sensation in the user of acting upon the objects of the task domain themselves.[4]

In model-world notations, the user first picks an object, and then decides what to do to it; the object precedes the verb. In conversational notation, the user states what action to take, and then says what to do it to; the verb precedes the object. The most well known contemporary examples of these two types of computer notation are IBM for the conversational metaphor, and Macintosh for the model-world metaphor. With the help of a keyboard of letters and numbers, IBM users enter alphanumeric strings such as "*DIR*" for "list the directory," and "*DIR A:*" for "list the directory of the disk on the A drive." The Macintosh model-world system users employ pointing devices such as a computer mouse to choose icons, which are then acted upon by choices made from menus. IBMs use prefix commands, whereas Macintoshes use postfix commands. Usage under the model-world system is much more deitic, a grammatical term meaning that the user specifies identities, actions, or positions in time

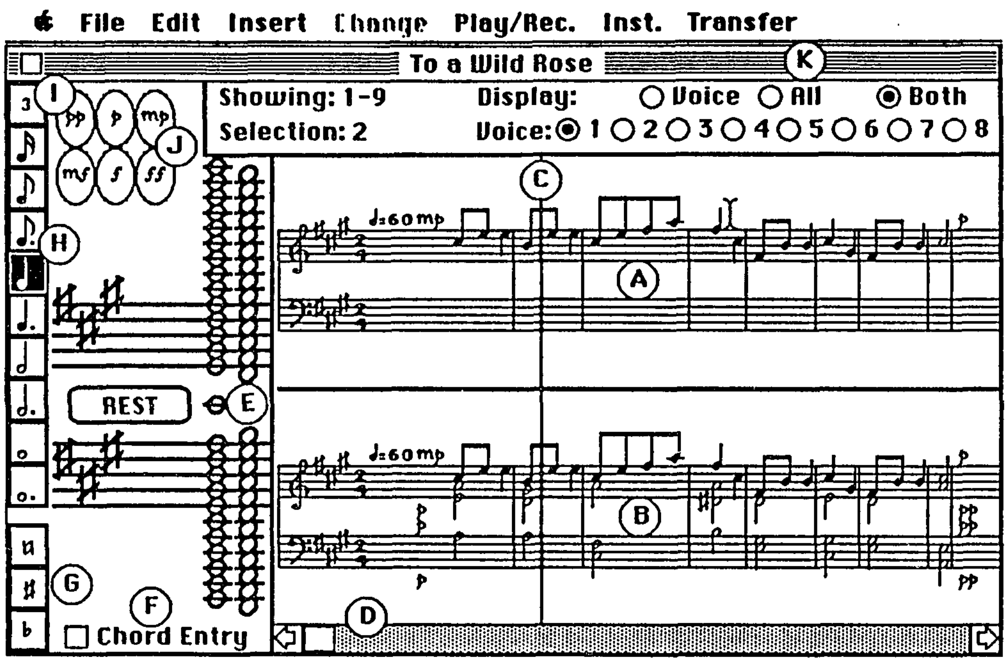
[4] Peter Desain, "Graphical programming in computer music: A proposal," in *Proceedings of the International Computer Music Conference, 1986*, ed. Paul Berg (San Francisco: Computer Music Association, 1986), 163.

or space from her own perspective (examples include the English words *this, here, now*, and *that, there, then*). The two systems are also conceptually related to the right-brain (model-world) and left-brain (conversation) paradigm mentioned above.

All three parts of Example 3-5 demonstrate the versatility of the model-world, iconic approach. Example 3-5a incorporates traditional music notation. Example 3-5b shows graphic notation used to represent the processes involved in defining a particular electronic timbre. Example 3-5c shows the verbal and grid notations employed in changing the appearance of the icons used in other parts of the system such as the instrument icon *H* used in Example 3-5b.

Example 3-5: Mixed notation systems.

Example 3-5a:



A Selected Voice

B All Voices

C Insertion Point

D Scroll Bar

E Note Pitch and Rest Buttons

F Chord Entry Checkbox

G Accidental Boxes

H Note Duration Boxes

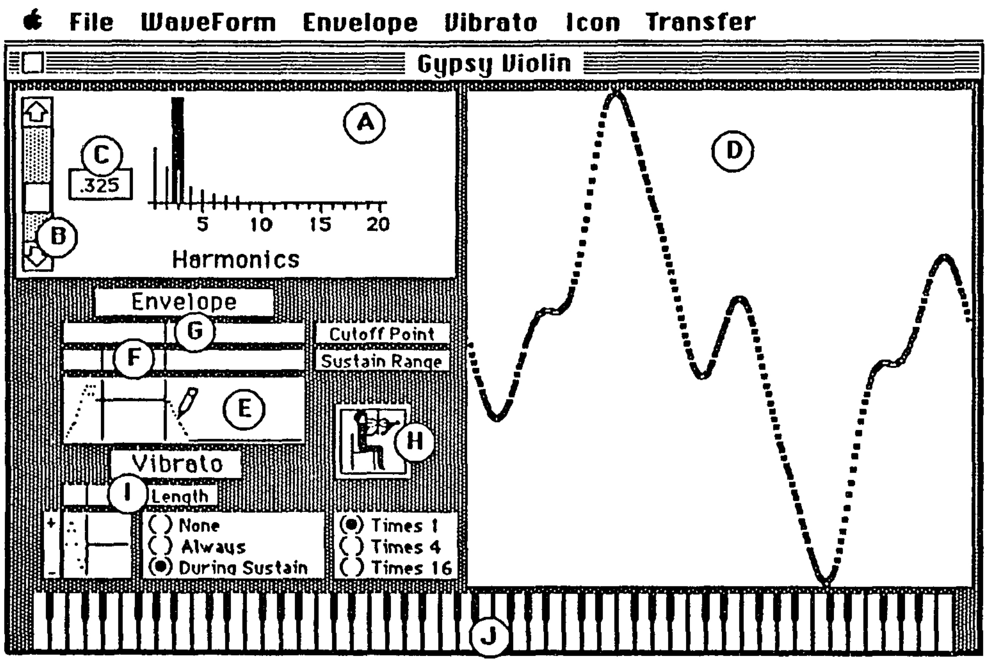
I Triplet Box

J Volume Buttons

K Voice and Display Buttons

Source: McConnaughey, *ConcertWare+*, 8.

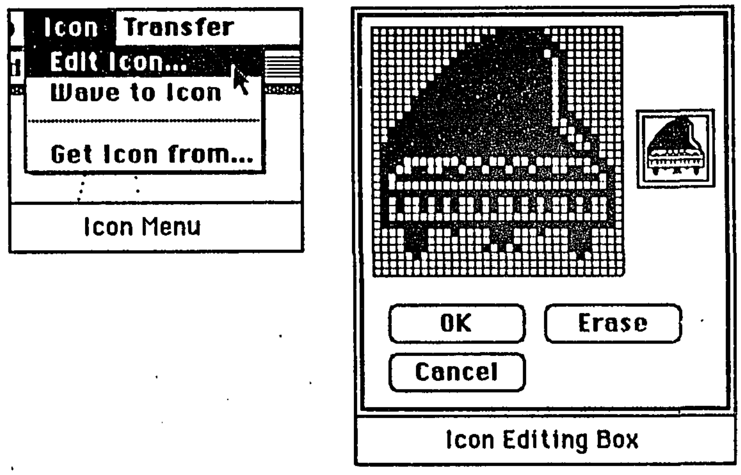
Example 3-5b:



A	Harmonics Box
B	Harmonic Slide Control
C	Harmonic Amplitude Indicator
D	Waveform Display Box
E	Envelope Display Box
F	Sustain Pointers
G	Cutoff Pointer
H	Instrument Icon
I	Vibrato Display Box and Controls
J	On Screen Piano Keyboard

Source: McConnaughey, *ConcertWare+*, 30.

Example 3-5c:



Source: McConnaughey, *ConcertWare+*, 41.

The mixing of model-world and conversational systems in music software is practically unavoidable, as is the mixing of other types and systems of notation, such as symbolic and iconic, prescriptive and descriptive, or traditional and computer. Such mixtures seem to increase the flexibility and effectiveness of notation systems, as each type is usable in proportion to how much it is needed.

Music is the combination of sounds and conceptions. Notation's ability to present and preserve information about music makes it a wonderful tool for understanding and controlling the operations of our senses and minds. But its inability to achieve a complete image of the total musical phenomenon limits its usefulness. Taxonomies of types and systems advance the functionality of notation.

Taxonomies set up conceptual structures, categories, explaining music and making it real. And conceptual structures are, according to many contemporary thinkers, the substance of perceived reality.

In an attempt to establish an appropriate ground for thought about traditional, computer, and graphic notations systems, the next chapter will examine structures per se connecting them to ideas about communication, abstraction, and context. Then there follows a comparison of ideal forms of the three systems.

INTERVIEW THREE

John Cage

John Cage was a composer, artist, writer, and philosopher. His music and thoughts, especially those created during the 1950s, generated a tremendous amount of experimentation in all the arts. Influenced by composers like E. Varese and H. Cowell, artists like M. Duchamp and R. Rauschenberg, writers like H. D. Thoreau and J. Joyce, as well as by his domestic partner of forty years, the choreographer Merce Cunningham, Cage's compositions focused on a pluralistic mixture of chance techniques, nature, percussion instruments, Zen aesthetics, and graphic and verbal notations. In this interview, which we conducted in a restaurant in Middletown, Connecticut, on February 26, 1988, the importance to Cage of accepting things as they are emerges clearly. He always seemed to allow numerous structures, operating at many different levels of existence, to interpenetrate in the most non-obstructing manner possible.

John Cage: If I'm making a notation, I'm not listening. Even if the notation is going to be used to produce sound. I make them in such a way that I will probably hear something that I haven't heard before, but not anything that I'm hearing in my head.

* * *

Wood Massi: [According to Roland Barthes' model] a signifier and a signified create a signification, as with music. Notation signifies a sound; and when the sound is created, that's a signification, that's the manifestation of the sign. Then he says, you can take that whole structure, and make that a sign for something else. It's another way of saying that there are levels of abstraction. I was talking to Earle Brown about that earlier. We were talking about your work and his work, and how maybe what you did -- the signs that you used in your notation, what you did to the language of writing music -- made a signification that broadened the language.

JC: You open another door.

WM: Yes. So then, we were trying to understand what Cornelius Cardew and Christian Wolff were saying about how music signifies the whole social structure. The music world becomes the sign that's related to the larger social structure. [How is] the relationship between society and music the same as the relationship between music notation and graphics?

JC: . . . Marshall McLuhan said that in our invention of electronics, we have extended the central nervous system so that the whole human race has become a mind.

* * *

WM: Charles Lemert, the social scientist, and Noel Carroll, the literary critic, were talking about meaning. Lemert said that talk is not when people say what is meant. Talk is what's happening now when [people] create and recreate life. He sort of related that to Ludwig Wittgenstein and "meaning is use."

JC: I think of it as what it is: the vibration of sounds.

WM: Does it create anything besides just vibrating sounds? What about when it's received by the audience?

JC: Well, then it changes from individual to individual.

* * *

WM: [Carroll said that] by framing a noise, meaning is given to it. It becomes . . . a *symbol* of noise.

JC: . . . I'm trying to get rid of that idea of framing. . . . What we're involved in, in life, it seems to me now, is reflection, transparency, and superimposition. All you have to do is look anywhere around the room, or into your glasses, and then you see that you're seeing the whole thing at once, and seeing it reflected back in surprising and interesting ways. If you start getting that complex situation that we're actually living in -- which involves both seeing and hearing, predominantly -- and you try to get that thicker by making it symbolic, or some other thing, philosophical, or other than what it actually is, then you have such a complex thing that I think you hesitate to have an idea, or even an experience. I remember a lady once, I said to her, "What did you think about what you just saw?" She said, "Oh, I'll have to think about it."

* * *

WM: [Given] the idea of reading a person as a notation, and the Barthes paradigm [of signs creating significations at higher levels of abstraction], then you as a person -- especially if you take the structure to be history -- you're a notation, you're a graphic. Considering all that, what is your relationship to the homosexual community, historically speaking? How do you see that?

JC: Well, I suppose that it's clear that that's my way of living. So that if someone were concentrated in that direction, or using his faculties in those terms, then he would see my work in that context -- or could.

WM: So once again, it becomes like what you were saying about your sound works, it achieves meaning in the receiver.

CHAPTER FOUR

Notation Structures and Systems

Art is an exploration of communication. It involves representation which is an activity, a doing of something that has some sort of outcome between people. Communication generates coherent environments of structures and processes. It creates worlds. These communication aggregates combine with other structures and processes, functioning at higher levels of abstraction, to constitute larger worlds. This is a basic characteristic of ways of referring -- such as denotation, connotation, naming, expression, and depiction -- and of systems of reference -- such as natural and artificial languages, sign systems, and models. At each level there is always a context containing variables not taken into account from the perspective of the previous level.

In earlier chapters I defined music notation as a preservable duplicate or representation, a concrete display, of changing relationships among the structures and processes of musical phenomena. Connections exist between music makers and what they must do to make their music (prescriptive notation), and between music perceivers -- whether makers, or analysts -- and how they might conceive a musical fact (descriptive notation). Differences between the marks or signals and what they signify generate other relationships (symbolic/iconic notation). In what follows, I survey the worlds surrounding computer, graphic, and verbal music notations by first looking at structures and communication. In later chapters I will compare models suggested by linguistics, semiotics, and cybernetics, and examine the prototypical sender/perceiver process, taking up questions concerning the intentions of the users, the media used, the structures of the grammars, and the ideological, historical, and cultural contexts in which these phenomena exist. For the moment, however, I would like to follow a few of the implications for notation of ideas posited by structures and structuralism.

Structure and System

The structuralist movement developed partially from what was essentially an idealist philosophy in the work of Ferdinand de Saussure, and grew to encompass empiricism, relativism, and functionalism. Structuralists seek to define clear boundaries around objects of study, bracketing out elements not falling within the defined limits. This, together with methodological tools like the posing of binary oppositions, nourished the twentieth century's fascination with both enormous and minute forms of language. In music theory, score analysis, particularly Schenkerianism, exemplifies structuralism. In performance, a strict interpretation of a score is, at its core, a structuralist interpretation. Structuralism assists the effort to grasp multidimensional events by narrowing the focus to self-contained aspects of the object of study.

I once undertook, with Roger Reynolds, analyses of the structures of John Cage's notation in several major works. We designed a matrix of notation parameters (see Examples 4-1, 4-2, and 4-3) which classifies the various graphic marks and words used by Cage. This analysis instrument is designed to generate intense observation. It calls for demonstrating, rating, and commenting on each notation device. It consists of a horizontal axis containing illustrations or verbal descriptions of the marks to be analyzed; a series of five descriptive categories, each of which contains a continuum, usually a binarism; and a space for comments concerning the notations, the descriptive ratings, or other germane matters.

Example 4-1: Notation analysis matrix -- Horizontal axis.

DESCRIPTIONS

ILLUSTRATION:	**GRAPHIC COMPLEXITY:**	**FRAME OF REFERENCE:**
(Samples)	Elemental-Compound	Disjoint-Continuous

SIGNIFICATION:	**INTENDED DETERMINACY:**
Symbolic-Iconic	Free-Approximate-Exact

INFERRED DETERMINACY:	**COMMENTS:**
Ambiguous-Redundant	(Observations)

Three of the descriptive classes represent conceptions I drew from the work of Nelson Goodman, specifically from his book, *Languages of Art*.[1] These are graphic complexity, frame of reference, and inferred determinacy. The distinctions made along the continuum for symbolic and iconic signification are based on semiotic theories by Charles Peirce. John Cage's own ideas on determinacy serve as a basis for ratings made along the free, approximate, and exact continuum.

[1] Nelson Goodman, *Languages of art: An approach to a theory of symbols*, 2nd. ed. (Indianapolis: Hackett, 1976).

Example 4-2: Notation analysis matrix -- Vertical axis.

CATEGORIES

I. TIME

Note Heads/Stems (or Events)

Unit Subdivisions

Silences/Rests

Pauses/Holds/Extensions

Tempo/Durational Frame

Meter/Grid/Cue Line

Fluctuation of Tempo or Time Frame

Durational Limits

Repetition

Chords/Clusters

Phrasing/Grouping

Temporal Proportions

Coordination of Parts

Temporal Latitude

II. PITCH

Staff/System

Clef/Register/Octave

Accidentals/Microtones

Glissandi/Arpeggios

Vibrato/Trills/Tremolos

Pitch Limits

Pitch Latitude

III. DYNAMICS

Range of Representations (e.g., *ppppp* to *fffff*)

Fluctuation

Dynamic Limits

Dynamic Latitude

Articulation (i.e., Amplitude Envelope)

IV. TIMBRE

Instrument or Sound-Source Designations

Fluctuation (e.g., Expression)

Idiomatic Notation (e.g., Prepared Piano, Electronic Sources)

(**TIMBRE** continued)

Timbral Latitude

V. The Score

Score-Parts Relationship

Placement of Verbal Instructions

Graphic Density (e.g., Calligraphy)

Special Directions or Presentation (e.g., Dedication, Performance History)

Physical Characteristics (e.g., Size, Material)

Source of Edition (e.g., Autograph, Print)

VI. COMMENTS

Themes

Conflicts/Inconsistencies

Tone of Voice

Composition Identity (i.e., Performance Invariance)

Background/Sources/Precedents

The vertical axis on the matrix (Example 4-2) is taken up by a categorization of the various parameters of music. These were arrived at by looking at Cage's works. Some parameters which might apply here would not apply to traditional notation, and vice versa, but most would.

Example 4-3: Sample Notation Analysis Matrix (first page).

ANALYSIS MATRIX: JOHN CAGE NOTATION

R. Wood Massi UCSD Spring 1989

TITLE: MUSIC OF CHANGES

DATE: 1951

DESCRIPTIONS

CATEGORIES

I. TIME
- A. Noteheads/Stems (or Event)
- B. Unit Subdivisions
- C. Silence/Rests
- D. Pauses/Holds/Extensions
- E. Tempo/Durational Frame
- F. Meter/Grid/Cue Line
- G. Fluctuation of Tempo/Frame
- H. Durational Limits
- I. Repetition
- J. Chords/Clusters
- K. Phrasing/Grouping
- L. Temporal Proportions
- M. Coordination of Parts
- N. Temporal Latitude

II. PITCH
- A. Staff/System
- B. Clef/Register/Octave
- C. Accidentals/Microtones
- D. Glissandi/Arpeggios
- E. Vibrato/Trills/Tremelos
- F. Pitch Limits
- G. Pitch Latitude

Illustration

I. TIME

A. ♩, ♩ See Fig. 1.
THE NOTATION OF DURATIONS IS IN SPACE. 2 1/2 CM = ♩. A SOUND BEGINS AT THE POINT IN TIME CORRESPONDING TO THE POINT IN SPACE OF THE STEM OF THE NOTE (NOT THE NOTE HEAD). IN THE CASE OF A SINGLE WHOLE NOTE THIS STEM POINT IS IMAGINED BEFORE THE NOTE (AS). IN THE CASE OF ADJACENT-IN PITCH WHOLE NOTES, BETWEEN THEM (AS). IN THE CASE OF A GLISSANDO, IN THE CENTER OF THE DURATION INDICATED.

B. See Fig. 2. FRACTIONS ARE OF A ♩ OR OF 2 1/2 CM.

C. See Fig 1.

D. 1) (o) ; 2) See Fig. 1 & 2.
A CROSS (+) ABOVE AN OR AT THE END OF A PEDAL NOTATION INDICATES THE POINT OF STOPPING SOUND AND DOES NOT HAVE ANY DURATION VALUE.
PEDALS ARE INDICATED = SUSTAINING, AFTER THE ATTACK, SUSTAINING OVERTONES, SOSTENUTO.

E. 69 - ♩ - then, 176 See Fig. 3 & 4, & 6.

F. See Fig. 3,4,5,&6. See I,A.

G. See Fig. 2 & 3, & 6.
THE RHYTHMIC STRUCTURE, 3 - 5 - 6 3/4 - 3 - 5 1/8, IS EXPRESSED IN CHANGING TEMPI (INDICATED BY LARGE NUMBERS) (BEATS PER MINUTE). A NUMBER REPEATED AT THE SUCCEEDING STRUCTURAL POINT INDICATES A MAINTAINED TEMPO. ACCELERANDOS AND RITARDS ARE TO BE ASSOCIATED WITH THE RHYTHMIC STRUCTURE, RATHER THAN WITH THE SOUNDS THAT HAPPEN IN IT.
(A DIAMOND) = A KEY DEPRESSED BUT NOT SOUNDED.

J. TONE CLUSTERS ARE NOTATED AS IN THE WORK OF HENRY COWELL. See Fig. 1 & 3. See I,A.

L. See G. 1) ; 2) I, II, etc. See Fig 5.

N. IT WILL BE FOUND IN MANY PLACES THAT THE NOTATION IS IRRATIONAL, IN SUCH INSTANCES THE PERFORMER IS TO EMPLOY HIS OWN DISCRETION.

II. PITCH

A. & B. See Fig 15.

C. ♯ ♭ x. See Fig. 9.
ACCIDENTALS APPLY ONLY TO THE TONES THEY DIRECTLY PRECEDE.

D. See Fig. 7-10.

E. 1) tr 2) See Fig. 11 & 12

	a) Graphic Complexity: Elemental-Compound	b) Frame of Reference: Disjoint-Continuous	c) Signification: Symbolic-Iconic	d) Intended Determinacy: Free-Approximate-Exact	e) Inferred Determinacy: Ambiguous-Redundant
I. A.	4	4	3	5	4
I. B.	4	4	2	4	4
I. C.	4	4	3	5	4
I. D. 1)	5	4	2	5	4
I. D. 2)	2	4	5	5	2
I. E.	4	4	3	4	5
I. F.	4	2	2	4	4
I. G.	4	5	1	4	2
I. J.	3	4	3	5	4
I. L. 1)	1	1	4	5	3
I. L. 2)	2	1	4	5	4
I. N.	4	4	1	1	2
II. A.	5	1	3	5	4
II. B.	1	1	1	5	3
II. C.	1	1	1	5	3
II. D.	5	?	2	3	2
II. E. 1)	4	3	3	4	3
II. E. 2)	2	?	2	4	3

Comments

I. TIME

A. Because of the space=time system, noteheads here tend much more toward continuousness than traditional noteheads. The system is both symbolic (♩) and iconic (space=time).

B. See A. Subdivisions are more symbolic than notes because there is less space for iconicity.
C. See A.

D. There are really no extensions, as the durations are so exact. But holds, in the sense of maintaining a duration, are notated in two different ways. The pedal marks are somewhat ambiguous because of their similarities.
E. The numbers represent beats per minute, and the arrowed lines measure the units in centimeters. "Irrationalities" modify the exactitude--see I,N.

J. Ratings here reflect the chords as time signs more than pitch signs.

L. The duration structure is marked by tempo changes. Several sections of various tempi are contained in larger sections marked off by double bar lines. These parts are in turn grouped into the four movements which constitute the entire work and which are labeled with roman numerals.

II. PITCH

A. Since the second staff illustrated is for non-pitched sounds, ratings are for the first only.

D. How can the ossia f-p be an alternate to the hairpin f-p?

E. 1). This sign combines a prototypically symbolic and disjoint element (tr.) with an iconic and continuous one (wavy line).

We used the data gathered during our work with the matrices to compare the degrees of conformity and deviation from traditional practice evidenced by the works analyzed. Detailed, precise dissections like the matrix give a scientific, positivistic value to structuralism and its sibling semiotics. But ultimately the judgements have to be subjective. This is one of the conclusions I drew from working with the matrix. The difficulties experienced in attempting to come to clear and convincing classifications while working out the details of the analyses seemed to incorporate something like the Heisenberg principle of uncertainty; that is to say, the more closely I looked at the operations of the individual notations, the more difficult it was to come to a precise understanding of their meanings.[2]

Structuralism emphasizes the binary relationship between the diachronic (linear or temporal) and the synchronic (simultaneous) orientations depicted in most music scores on the horizontal and vertical axes, and expressed theoretically in melody and harmony. A synchronic analysis looks at a structure during one moment in time. Structuralist grammarians are primarily interested in the synchronic view. They bracket out the

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[2] For a more detailed discussion of the overall analysis, see R. Wood Massi, "John Cage's notational behavior" (Ph.D. qualifying examination, University of California at San Diego, 1989), 1-31.

portions of the work that do not interest them. This is certainly useful, but confining as well. To create conceptions that are manageable, or to grasp complicated relationships, analysts study synchronic, formal configurations circumscribed by time. Defining a structure thus helps them to focus on a single, or a few, aspects of something which in its totality might be too complex to understand. To do otherwise with regard to music notation would be to attempt a transcendent score analysis, taking into consideration the plethora of elements affecting and affected by the text of the music. Structural analysis is immanent analysis, focusing on the object itself, attempting to quantify its dimensions.

Structures are self-contained and self-regulating. But despite this primary structuralist emphasis on synchronic relationships, they are also self-transforming, and that requires the consideration of time. "A structure is a system of transformations."[3] In Piaget's definition the distinctions among structure, process, and system tend to dissolve. Similarly, Thomas DeLio emphasizes the operational nature of art structures which he characterizes as "complex process[es] evolving over a period of time, integrating an elaborate and diverse range

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[3] Jean Piaget in Thomas DeLio, "Structural pluralism: Some observations on the nature of open structures in the music and visual arts in the twentieth century," *Musical quarterly* 67:4 (October 1981): 527.

of activities that reaches out far beyond the framework of the art object itself. A structure is a continuum of activities."[4]

What DeLio calls structure I call system or world, thereby reserving the word *structure* in a position of binary opposition to *process*. The basic binarism is useful in attempting to deconstruct symbolic and social arrangements related to notation. Systems or worlds in motion embody structures, yet like processes they change over time. A diachronic analysis is appropriate for understanding the history of systems.

The structure:process formation is nothing new. It has taken numerous theoretical forms during the twentieth century, not the least of which was the structuralist: functionalist debate carried on by social and philosophical thinkers. Another important binarism associated with structuralism, the syntagmatic:paradigmatic dichotomy, helps to bring variations among notation systems into focus. The use of the syllable "syn" in both "synchronic" and "syntagmatic" is confusing because the meaning of the latter is more like the diachronic than the synchronic. It expresses linear relationships, syntax chains. But at the same time, paradigmatic relationships are synchronic; they are associative, consisting of things

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[4] Ibid., 528.

that are essentially the same, things that can be substituted for each other, and not depending on time. Some one has said that the relationship between a red car and a blue car exemplifies a paradigmatic association, whereas that between a driver and a car is syntagmatic. Rose Subotnik sums up the difference as follows:

> Roughly speaking, "paradigmatic" (or "metaphorical") elements in structuralist terms are almost elements that could be substituted as equivalents for one element in a configuration (say, harmonies that could replace IV in a IV-V-I cadence); "syntagmatic" (or "metonymical") elements are elements that have a continuous or complementary relationship with a configuration (say, IV, V, and I in the above cadence).[5]

The grammatical terms parataxis and hypotaxis constitute another useful pair of categories. Parataxis is the placing together of individual units without conjunction. Hypotaxis is creation through syntactic subordination. They parallel the paradigmatic and syntagmatic, and join with the other binarisms mentioned here (albeit in subtle differentiation from them) to delineate larger formations, one which I represent by the structure:process dissimilarity, and another the system unity.

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[5] Rose Rosengard Subotnik, "Why is Adorno's music criticism the way it is? Some reflections on twentieth-century criticism of nineteenth-century music," *Musical newsletter* 7:4 (Fall 1977): 8.

By changing perspectives, by taking a pluralistic view of notation structures and processes, two principal groupings of binarisms seem to emerge:

<u>Structure</u>	<u>Process</u>
vertical	horizontal
synchronic	diachronic
paradigmatic	syntagmatic
parataxis	hypotaxis
design	function
descriptive	prescriptive
iconic	symbolic
figural	durational
harmony	melody
metaphor	metonym

These groupings imply affinities among various aspects of communication and notation. They seem to indicate, for example, that the synchronic representation of structures, like that of spatial configurations, is most easily accomplished with iconic notation and paradigmatic relationships. But the representation of procedures which necessarily take place over time might more efficaciously use symbolic notation and syntagmatic relationships.

Structuralism, in general, tends to emphasize the being of the sign over its interpretation, the concrete form over the multivocal meaning. Another way of saying this is that the structural perspective favors nouns while the functional favors verbs. Structuralism in music analysis searches for deep, universal patterns. One criticism of structuralist approaches such as Schenkerian analysis, is that they hold no appeal for newer musical forms. It could be said, for example, that they do not deal adequately with postmodern music where the meaning is often derived from the tension between surface processes of the work on one hand and larger aesthetic and social worlds on the other, rather than simply from the underlying organization of the piece.

Analytical strategies which focus on the individual, independent from the environment, distort our understanding of their mutual influence. Susan McClary says that

> inasmuch as every piece of music assembles and problematizes very different elements of the shared semiotic code, the interpretive process is by definition both ad hoc (it derives its strategies from the specific demands and features of the individual composition) and dialectical (it strives to account for particularities in terms of the norms they affirm or oppose).[6]

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[6] Susan McClary, "The blasphemy of talking politics during Bach year," in *Music and society: The politics of composition, performance and reception*, ed. R. Leppert and S. McClary (New York: Cambridge University Press, 1987), 20-21.

Structuralists reduce the object of study, whether it is notation, history, or something else, to an immanent, self-contained manifestation. This sort of art-for-art's-sake, or pure art, approach denies the functions of art which encompass the compositional and perceptive behaviors involved.[7]

Structure in computer programming is a matter of creating and naming distinct blocks of definitions, relationships, and procedures, such as external blocks, subroutines, instrument definitions, data structures, arrays, etc. Naming makes such systems distinct, thus enabling other programs to invoke them. As for computer notation Peter Desain says,

> It is simpler to depict structural information (e.g., a patch, an electronic schematic), than to describe such information in words. It is simpler to describe functions of objects (what is the function of this filter, this transistor) in words, than to define good graphic representations of them. . . . These two types of information, natural language [verbal prescription] and direct manipulation [structural depiction] . . . are complementary.[8]

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[7] For more on these issues, see Walter Benjamin, "The work of art in the age of its technical reproducibility," ed. Hannah Arendt, trans. Harry Zohn, in *Art and its significance: An anthology of aesthetic theory*, ed. Stephen David Ross, 2nd. ed. (Albany: State University of New York, 1987), 526-547; and Jean-Jacques Nattiez, *Music and discourse: Toward a semiology of music*, trans. Carolyn Abbate (Princeton: Princeton University Press, 1990), *ix*.

[8] Peter Desain, "Graphical programming in computer music: A proposal," in *Proceedings of the International Computer Music Conference, 1986*, ed. Paul Berg (San Francisco: Computer Music Association, 1986), 165.

The types "natural language" and "direct manipulation" point, respectively, to the process and structure categories above. Perhaps a somewhat similar distinction can be drawn between rule-based and knowledge-based programming, or reflected in other computer binarisms like the data base and the main program, step time and real time, note statement and tendency mask, or calculated composing and interactive improvising. The first terms in these pairs are associated more with rules of grammar and structures such as musical data-entry systems which delineate each note of a work, rather than with process controls which are more dynamic. Processes involve time, evolution, change. Structures imply contexts which in turn imply levels of abstraction.

Context and Levels of Abstraction

The meaning of something comes with the experience of using it within a given context, the setting, framework, or background against which the foreground figure stands out. There is an interdependence between a figure and its context. The context of something is its "other", and significance is based on difference. Failure to understand context results in ambiguity on the part of the sender and misconception by the perceiver.

Context exists at many different levels. Its nature requires that any process is part of a structure from a more comprehensive vantage point. For example, we use computer programming languages today which contain older programming processes as objects, subroutines, structures. Structuralists have shown that it is theoretically possible, and frequently enlightening, to separate a sign from its context; that is, to distinguish it from its ground as well as from other signs. One way of bringing an individual out from a background is by naming it (a note, an instrument definition); another way is by emphasizing a particular entity more than what surrounds it. The theorist may find, however, that the context includes noise or unintended information. Such random fluctuations in the background can obscure the outline of a weak figure. In such cases it may be possible to bring out the figure by averaging multiple instances of the entire field, thereby allowing the noise to cancel itself out (i.e., the empirical method). A probabilistic analysis of this sort could delineate the boundaries of a given style or system of notation.

Context in music defines how we hear as well as how we represent sounds. For instance, dissonance is largely a matter of context. The principles governing enharmonic equivalents illustrate how context also determines notation. If the key of a piece is F minor, the pitch between C and D will be notated as D^b rather than $C^\#$. But at a higher level of abstraction, the meaning of a work or its form of notation derives partly from the cultural and historical contexts.

A number of relatively recent developments in diverse areas of study consider context (whether or not the term itself is actually used) to be crucial to the understanding of various systems. One such approach to music and cognition, stimulated by "the advent of the computer as both a perceptual and productional aid to performance,"[9] is known as the "ecological" perspective on cognitive science.

> One of the hallmarks of this approach is the rejection of organism-environment dualisms. These include both the classic mind-body dualism and the subject-object dualism. . . . One should consider [organisms and environments] subsystems of a larger system. Properties of organisms should be described relative to environments and properties of environments should be described relative to organisms. . . . Only accounts of environments and organisms that 'point both ways' can have the proper emphasis on the mutuality of the perceiver and perceived, of the knower and the known.[10]

A concern with understanding perception as a matter of context and as a process based both on the reception of an object and on its formal existence is central, also, to Jean-Jacques Nattiez' semiotic tripartition (see Chapter

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[9] Gerald J. Balzano, "Command performances, performance commands," *Contemporary music review* 4 (1989): 438.

[10] Ibid., 444.

Six), as well as several other contemporary avenues of thought. Worth mentioning here is the newly evolving field of discourse analysis which attempts to study language, particularly conversation, within its normal context as people really use it, taking into consideration tone of voice, style, social function, etc. This approach connects written or oral uses of language to their social backgrounds by studying forms longer than the sentence, forms that exist beyond the more constrained domain of traditional linguistics. Discourse analysis is conscious of context and seeks to understand language as the arbitrator of social relations.

Hermeneutics -- the study of textual and other forms of interpretation -- incorporates within its domain an appreciation of context as well. Terry Eagleton describes the hermeneutical method as one which "seeks to fit each element of a text into a complete whole, in a process commonly known as the 'hermeneutical circle': individual features are intelligible in terms of the entire context and the entire context becomes intelligible through the individual features."[11]

Clearly, a full consideration of context requires broadening the field of enquiry or experience to encompass as many aspects of the phenomenon under investigation as

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[11] Terry Eagleton, *Literary theory: An introduction*, (Minneapolis: University of Minnesota Press, 1983), 74.

possible. The salient question then becomes, How large does one make the circle? Composers like John Cage try to expand the realm of music to the extent that it includes all of life. But if life is the context, and if we seek to understand, analyze, or represent the higher structure encompassing life, then we face the cognitive limitation natural to our species. It is a question of how inclusive, and therefore abstract, the experience is to be, how *many* forms and how *much* content to include. Leonard Meyer has said that "notation is a matter of degree not kind." (See Interview One above.)

Certainly our cognitive abilities and our skills in using more and more abstract representations can be trained and increased, but the individuality of each one of us ultimately limits the extent to which we can communicate the full content of our experiences. According to Nikhil Bhattacharya, each of us is

> an independent cognitive agent, with her own experiences, which will never be quite the same as anyone else's. Her use of 'Jones' or 'chair', to the extent they represent her encounter with Jones or chairs, will never quite represent what anyone else's use of these terms will. . . . To represent something is a constructive act. We have to do something, to produce a sign for the thing signified. . . . We must begin by drawing a distinction between presentation and representation. If Jones walks into the room and I say to others, 'This is Jones', I am presenting him. If Jones is not around, and I say 'Jones is a stout, balding, middle-aged insurance salesman with a hail-fellow-well-met manner', I am offering a representation. So am I if I draw a charcoal

> sketch of Jones. . . . My direct perception of Jones . . . would presumably consist of an infinity of elements and relationships. In representation, I cannot reproduce that totality and re-present Jones.
>
> Instead, I must perform an abstraction. I must analyze my perception of Jones into a selected number of elements, ignoring the rest, and recombine them into a construct that I choose to represent Jones with.[12]

An appreciation of the role of individual consciousness in the process of abstraction is important to understanding how representational and referential forms work. The physical marks of music notation, material artifacts, signifiers, and syntax are examples of forms and formal relationships; they initiate reference. Interpretations of notation by individual performers and perceivers, aesthetic meanings, signifieds, semantics, and hermeneutics emphasize content and the completion of the referential process. To this way of thinking forms are concrete and content is relatively abstract. Also, content seems to deny formal relationships their neutrality. But like structure and process form and content become the form of something else as the level of abstraction increases.

The idea of abstraction pervades a great many theories about how we think and communicate. This is central to what Gregory Bateson calls a "hierarchy of

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[12] Nikhil Bhattacharya, "A picture and a thousand words," *Semiotica* 52:3/4 (1984): 217, 220, 221.

logical types."[13] Names, classes, and dynamic systems are higher logical types than things named, members, or static systems. For example, "acceleration is of higher logical type than velocity."[14] Semiotic models of abstraction include Saussure's *parole/langue* and Peirce's token/type. Barthes' paradigm of "staggered systems": the signifier and signified unite to form a signification which, in turn, becomes the signifier at a higher level, is similar to Peirce's idea of the infinite "interpretant": the sign and object acquire meaning in an interpretant and, taken together, they point to a series of interpretants in a never-ending chain of meanings, each at a higher level of abstraction than the previous one.[15]

Descending levels of abstraction in traditional music notation include score (scheme) and part, staff (system) and measure, note (character) and note head (mark). Some computer music applications notate only the information embodied in waveforms or in a sequence of notes; others may notate functions of a higher level, such as the group or space from which timbres or notes may be chosen by a given function (e.g., rules, grammars, stochastic methods,

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[13] Gregory Bateson, *Mind and nature: A necessary unity*, (New York: Bantam, 1980), 122.

[14] Ibid., 247.

[15] For a more detailed discussion of semiotic models, see Chapter Six below.

Markov chains, etc.). Genre, style, theory and history define systems of higher abstraction in all kinds of music notation.

Abstraction necessarily suppresses detail and isolates patterns from their immediate contexts, and it is the same in notating music. Notation tends to degrade the immediate context while enhancing the abstract associative nature of the musical stimulus. Are the suppression of detail and the interpretation of music connected? Perhaps they are. To talk about interpretation we may need a statistical measure of meaning, a way of bringing the "figure" of meaning out from the "noise" of its context -- in other words, a sort of averaging. Notation is a useful tool in this interpretive process.

Ultimately, however, meaning in its most primary existence is sense data. The lowest level of abstraction is the perceptual experience of the thing. Naming the experience generates the first abstraction and begins to enable the communication of meaning. Even naming the absence of something has meaning -- in fact, a great deal of meaning. It is a metasign. Examples include zero in mathematics, paper money in economics, the vanishing point in visual arts, and rests in traditional music notation.[16] In an ironic bending of the function of signs, metasigns

[16] For more on this, see Brian Rotman, *Signifying nothing: The semiotics of zero* (London: Macmillan, 1987).

like these import a context for the absent entity. They nevertheless require a conceptualization at a different level of abstraction.

In our experience of music and music notation there exists a large number of options for how they might be taken, how we might perceive them, what names and meanings we might give them. As users of notation and music we are constrained by our cognitive limits and by the nature of the signs themselves. But ultimately analysis and criticism will differ according to which level of abstraction is taken as the ground, which context and model given or chosen.

Comparison of Systems

Among the models I have chosen to use to study notation are the traditional, graphic, and computer music notation systems. A system is a group of facts, principles, and procedures forming a complex whole. It implies lesser and greater "worlds," as for example the solar system presupposes both planets and the universe. Systems are much like what I have been referring to as structures, but the term system implies less rigidity, a greater tendency to include process, and a weaker integration and interdependence of its components. A system is a looser version of a structure, and a world is a looser version of a system. Each of them exists at every level of abstraction and in diverse contexts.

The division of notation into computer, graphic, and traditional systems is useful for comparing different approaches to reference in music, even though it is not the only way the field could be partitioned, and despite the fact that each system contains elements of the others. These are influential and coherent systems. They encompass socio-cultural arrangements of user groups, notation types, history, and aesthetic principles. The common elements among the signs they use reflect the fact that the most powerful systems of notation use words, numbers, symbols, and drawings together, rather than relying on only one type of signification. Though their boundaries overlap and the separation of them into discrete systems is somewhat arbitrary, an examination of the purposes, tendencies, and constituent meanings of the three systems brings them into focus as autonomous constructions. Here I endeavor to segregate them into their purest and most distinct forms to illustrate ways of examining notation systems.

Typically, a traditionally notated score is produced by a composer initially using pen, ink and paper to draw predominantly symbolic (as opposed to iconic) signs which provide a live performer or analyst with fairly well-defined prescriptions for producing actual sounds. Computer notations on the other hand are characteristically created by a composer, researcher, or programmer using symbolic, alphanumeric strings to encode a magnetic medium with signals directing the flow of information to various processing devices and ultimately to sound-producing machines. (As we shall see in the next chapter, however, computer notations frequently use graphic images along with alphanumeric strings. The "characteristic" computer notation I am referring to here is described in terms that enable me to contrast it with graphic and traditional notations.) The determinacy of computer music notations can be extremely precise, though random elements can also be programmed. A general comparison of the three systems in their ideal manifestations reveals that traditional notation falls between two extremes: on the one hand, computer notation which lends itself best to syntactical concerns and the microscopic perspective, and on the other, graphic notation which works better for semantic problems and the overall view.

All visible notation is graphic, but graphic music notation per se is usually quite iconic. Produced by a composer or a researcher such as an ethnomusicologist, graphic scores describe sound images which may or may not actually be produced. The sound objects of such signs are often indeterminate. Graphic notation, like computer notation, is much more easily adapted to the needs of individual users or unique situations than is traditional notation.

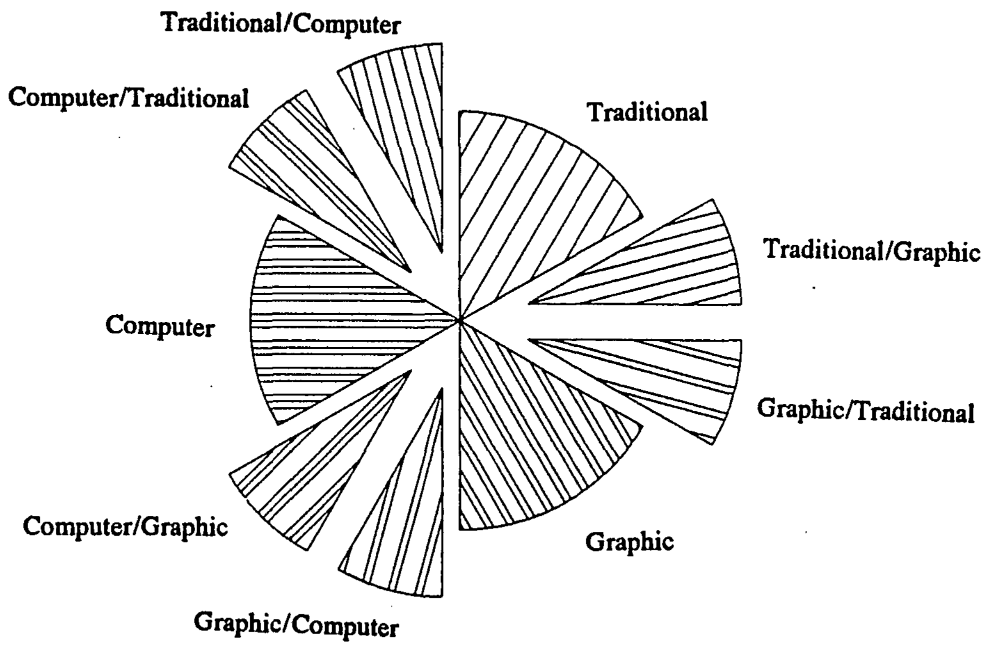
In terms of contemporary usage, traditional notation serves as a ground against which the other two systems have been drawn. It tends to emphasize the preservation of the music, music history, and the maintenance of traditional forms of social control in the performance situation. Both graphic and computer notation systems have grown rapidly since the 1950s, the former especially before, and the latter after, 1970. Much of the growth in graphic notation can be traced to contemporary aesthetic developments and new forms of interaction among the producers and consumers of music. Generally speaking, technological changes gave birth to computer notations, under which I also include notations peculiar to electronic music.

Both graphic and computer notations have come to rely on the segregation of verbal messages from visual images and have generated a huge expansion of the use of words in music representations. For graphic works the words are called performance instructions, for computer works they are called documentation. At a lower level of abstraction, the alphanumeric representation of computer music consists of binary digits, known as machine language; at a higher level the verbal representation of all three systems is called music theory.

Different systems require different amounts of knowledge about the various parameters of music. The user must understand what constitutes a true object of the sign used. Different systems have different names for similar phenomena: frequency/pitch, amplitude/loudness/weight, duration/rhythm, waveform/timbre/color, etc. They also manifest different degrees of precision, ambiguity, and binding with the objects to which they refer. Also, the normative intentions and degrees of understanding possessed by the composers, or senders, of these notations -- as well as by the performers, machines, and perceivers -- differ among the systems.

Example 4-4, a circle of notation systems, depicts music notation as a field divided into the three systems traditional, graphic, and computer music notations. The detached sections of the graph represent the ways the three basic systems overlap.

Example 4-4: Circle of Notation Systems.



The following are illustrations of the nine different subsystems. Decisions involving the question of whether a given example of mixed characteristics is placed in a particular subsystem or in the other version of the same mixed subsystem -- say the traditional/graphic subsystem rather than the graphic/traditional -- were made by asking what the primary motivation of the notation is. Where more than one example is given in a subsystem, I have ordered each according to the proximity of its primary motivation to one or another of the three elemental types.

- Traditional: *Nocturne*, by Frederic Chopin (Example 5-25). Trill (Example 3-1a).
- Traditional/Graphic: Trill (Example 3-1b). Guitar tablature (Example 5-11). *Le Bain de Mer*, by Erik Satie (Example 5-10).
- Graphic/Traditional: *Water Pictures and Words*, by R. Wood Massi (Examples 5-14, a & b). *Wonderful Piano*, by Jacques Spacagna (Example 5-7).
- Graphic: "December 1952," by Earle Brown (Example 5-13).
- Graphic/Computer: *Mutatis Mutandis*, by Herbert Brun (Example 5-25). *ConcertWare+* applications -- instrument icons (Example 3-5c).
- Computer/Graphic: Amplitude envelope (Example 5-20). UPIC waveform library (Example 5-19).
- Computer: *Someday*, by R. Wood Massi (Examples 5-4, a-d). Signal flow chart (Example 5-16).
- Computer/Traditional: *ConcertWare+* applications -- staves, notes, rests, etc. (Example 3-5a).
- Traditional/Computer: DARMS user code (Example 5-2).

Having attempted a delineation of the relationships among types of notation and the communication structures and systems which use them, it would be helpful to provide concrete examples of what notation types and systems look like. The following chapter presents samples of traditional, graphic and computer notations. They are not immediately labeled as one of the three categories, however, because for the most part each individual sample is a mixed form manifesting varying degrees of iconicity or prescriptiveness, or traditionality or graphic significance. After all, music notations almost always take shape as mixed, rather than pure, forms. In chapters following the next, this analysis of notation promises to become even less pure as it moves beyond the physical, objective nature of the notation signs themselves to a consideration of their functions in processes involving actors and the communication of musical meanings.

INTERVIEW FOUR

Earle Brown

During the 1950s, Earle Brown was a member along with John Cage and others of the "New York school" of experimental composers. His work initiated new and radical developments in graphic notation and open form. His "December 1952" is the first composition to be written in wholly graphic notation (see Example 5-13). He was influenced by visual artists like J. Pollack and A. Calder, composers like Cage and A. Webern, and by jazz. Professor Brown has taught, lectured, and conducted around the world, and his compositions are widely performed. This interview took place on February 22, 1988, in Middletown, Connecticut. In it he discusses his musical evolution and the history of several recent developments in notation.

Wood Massi: How did you come to invent time proportional notation?

Earle Brown: It all started when I first began really reflecting on the work of [the visual artist Alexander] Calder. . . . I wanted to create a musical composition which was -- in performance, in real-time -- spontaneously flexible and variable, as in a Calder mobile. . . . My first experiments really were when I was teaching Schillinger techniques in Denver, 1950 to 1952. . . . I utilized serial principles, as implied by Schillinger, in twelve-tone compositions, but I had the feeling that I was losing the spontaneity of my musical conception before I could get it down on paper. In other words, I would have a musical conception for a piece and begin it, and get eight or twelve or fifteen, sixteen bars into it. Then I would lose the spontaneity because of the intricate serial manipulations. [I] had this feeling that I was losing my original conception of the totality of the piece. . . . So my first action was to sketch a string quartet. [It was] almost like "automatic writing" as the Surrealists spoke of it. I would hear the first violin . . . and I would draw <u>that</u> in almost real time . . . rapidly sketching out . . . the textures, densities, and trajectories of the piece, and then going back and "rationalizing" it, making it readable metrically. . . . I wanted to get the whole conception down as fast as possible, and then go back and punctuate it, as in metric notation. The graphic was primary for me. . . . I made a twelve-tone row that I liked and then did all the twelve-tone expansions of it, but first was the graphic. . . . I wanted [to use] my immediate instinct, like a jazz performer does. . . . I would improvise graphically with line drawings as if I were *playing* the string quartet. . . . The sketches for that [early work] look exactly like one of the sections for my string quartet of 1965; but in 1950, it never occurred to me that any string quartet would play directly from the graphics. . . . If you read from a graphic directly, it's a kind of guided improvisation. . . . Two years ago [when we were rehearsing a graphic score, the players] kept saying to me, "It's so much easier to play this now than it was [twenty years ago]."

After 1950 and the string quartet sketch, and graphic notation, I slowly went on, over a period of three years, to try to discover a notation which was rational, readable, but the rhythmic aspect of which was flexible, not restricted to counting "1 2 3, 1 2 3, *et cetera*."

WM: Not restricted in meter?

EB: Yes. I started in the *Folio* pieces. The first, "October 1952" . . . is in standard notation of eighth notes and half notes and sixteenths, and so forth, but there were no rests between the notes. I did that intentionally in order to throw the musician into a temporal, proportional world, so that they could not count. . . . That was the beginning of proportional notation.

[Cage used precise measurements in his *Music of Changes*] -- in centimeters, I believe -- but I didn't do that. . . . I didn't have any system of metric measurement. . . . I called it "time notation" because the sonic material and the silent areas are expressed merely by space, not measurement. . . . I called it time notation to differentiate it from metric notation. . . . The events depicted spatially are performed in time, relative to time, rather than to meter.

I was looking for a way to notate a score that would allow it to be transformable, mobile, and open. Finally, after [*Folio*] I came up with a notation that functioned for me. There was enough control for me to control the textures and densities of the musical composition as I made it, but it was . . . creatively ambiguous. . . . With *Twenty-five Pages* for one to twenty-five pianos . . . I began to realize that without flags and stems and rests, I could invert [or] turn it upside-down, or read it from any direction . . . like a petal on a Calder mobile.

WM: Creating music that can be seen from more than one point of view . . . turning the score upside-down or sideways . . . that's one of your techniques. [What about] having performers start at any point, or at any frame in a composition?

EB: That is true of "November 1952 (Synergy)," "December 1952," and other pieces in *Folio 1952-53*. And in the "open form" pieces like *Available Forms I* and *II* from 1961 and 1962 . . . I consider there are two kinds of mobility: "physical mobility," which is true of turning the page in either inversion and performing the pages in any order you choose, as in *Twenty-five Pages*, which was done in 1953, and "conceptual mobility," which means that you can start from any place, and go to any other place in the score.

WM: In your pieces, like the *Available Forms* pieces, you have flexibility for the performer, but if you're a listener sitting out there, and you don't have a score -- maybe you don't read music -- is there some kind of conceptual mobility?

EB: Early on, I thought of projecting the score on a screen, above the orchestra, with an arrow-pointer. [But] it's too expensive and detracts from <u>listening</u>. . . . A long time ago someone from MIT said that they were trying to set up a do-it-yourself, audience-participatory system, and my *Available Forms* pieces were perfect for what they had in mind. . . . There are twenty-nine total events in

Available Forms I [and the idea was to pre-record them]. You could conduct each event rapidly, or very slowly, or you could interrupt it, superimpose other events, *et cetera*.

WM: [That's like my string quartet, *Water Pictures and Words*.] I photocopied the score onto transparencies and projected them. Then I drew it while they were playing it, so the audience could see that now the string quartet is playing the graphic of a spiral, and this is the end of the spiral, and here are the waves. . . . I thought of it as a way of giving responsibility to the audience, just like graphic notation gives it to the performer. . . .

EB: In the mall, in White Plains, there's one of those recording studios. You can go in, and you can use the background of some film that's popular, or a rock tune. You sing, or play, and you come out with your own record. . . . I think that's real democratization. . . .

[There is a] tremendous difference between myself and John [Cage], and there always was. . . . I hoped romantically that I could raise the subjectivity level of a conductor or a performer to the point where he could perform above his habits. [Cage] worked always with time structures. Time structures were to me a kind of tyranny. . . . I always worked with composing the content and putting it into a flexible performance situation, whereas John would create a structure, and then fill it by chance. . . . John did not want his subjectivity; that's why he went to pure chance. I wanted super-subjectivity. . . . John was really wanting to liberate sound more than to liberate people.

WM: What about the political music of Christian Wolff and Cornelius Cardew?

EB: I consider that Christian's trying to write music "for the people" in that political way, and Cardew's and Christian's, and [Frederic] Rzewski's attitude is kind of demeaning to the people. I never had a political motive about that. I had jazz. The relationship of musicians in jazz is so much warmer, and so much more generous and giving, than in traditional classical music. I brought that from jazz. It was very much a part of my motivation to make the open form pieces and the graphic pieces, because I believe in performers. . . . Europeans always read political motives into my *Folio* things, thinking that I was doing them because I was against the authoritarian nature of the composer and the conductor. . . . My motives were entirely aesthetic, and musical -- and poetic, in a certain sense. I can see what they mean, but that was not my motivation, and neither was it Morty's

[Morton Feldman's] motivation, but [Heinz-Klaus] Metzger read into both of our works that that's what we were trying to do. . . .

WM: You've used tools of notation and you have techniques that have changed the structure of the musical world. . . . Roland Barthes talks about the sign and the signified, creating a signification. . . . Maybe the sign was your techniques of composing with new means, and the signified was creating a liberated jazz kind of ambiance in music, and the signification was the musical world of the '50s, '60s, and on into today. You can look at that whole complex, that whole structure; it makes it a sign for something at a broader level . . . so what you're doing in changing this structure of the music world is changing the larger society. . . .

EB: It is sociological, but not political. . . . I spent a lot of my life teaching classical musicians how to *quasi* improvise, and how to feel more liberated about reading the notation that I've made. . . . Think about if John [Cage] were not around [to explain his works]. Apart from what's on the paper that John makes, there has to be a great deal of verbal understanding. I've heard his pieces in Europe just <u>murdered</u>, played so erroneously. . . . The less control information you write down, the more you have to say verbally.

WM: Outside the score?

EB: Yes . . . John tries very hard to make explicit performance and program notes in the scores. [But] I've seen people be very confused, when confronted with *Winter Music*, and also with Christian's music. [Their] music has such intricate, complex instructions. . . . Some musicians might not be the most imaginative people. They sit in that orchestra for centuries, playing the same music over and over again. . . . In 1961 and '62 I presented them with this open-form, proportionally notated piece, and out of ninety-eight people in *Available Forms II*, about seventy-five of them are staring at you like you're out of your mind. But I've always had the experience that once we do the explanation, we do nine hours of rehearsal, and we do a performance, they say, "My God, that sounds very good. I didn't know what we were doing at the beginning." And so in New Music, it is a process of philosophical and performance education, in a certain sense.

CHAPTER FIVE

Diverse Notation Systems

Computer and Verbal Notations

Symbolic functions in computer music are frequently conveyed with alphanumeric notation. At the most basic level, there is the stream of binary digits one and zero, which notates the codes that carry messages to computers from users, and to other machines from computers. Example 5-1 shows some binary equivalence to decimal numbers. Using ones and zeros in groups no larger than eight (one byte), binary numbers can represent up to 256 possible characters, integers, or marks. These signs form the ASCII (American Standard Code for Information Interchange) and other codes for programming at higher levels than the machine language which uses binary numbers. Programming languages, in turn, are used to create or manage files, memory data, algorithms, subroutines, scores, score editors, wavetables, etc.

Example 5-1: Some binary-to-decimal equivalents.

1 =1	10000 =16
10 =2	100000 =32
11 =3	1000000 =64
100=4	10000000 =128
101=5	100000000 =256
110=6	1000000000 =512
111=7	10000000000 =1024
1000=8	100000000000 =2048
1001=9	1000000000000 =4096
1010=10	10000000000000 =8192
1011=11	100000000000000 =16384
1100=12	1000000000000000 =32768
1101=13	10000000000000000 =65536
1110=14	100000000000000000 =131072
1111=15	1000000000000000000 =262144

Source: Dodge and Jerse, *Computer music*, 5.

In ASCII code, the binary equivalent of the decimal numbers twelve, ten and twenty-nine spell "CAT." In DARMS (Digital Alternate Representation of Musical Scores), the code *!g rq re 9e_<,vf 9#q._* notates the musical event represented by traditional music notation in Example 5-2.

Example 5-2: DARMS user code.

Source: Brinkman, "DARMS music coding," 28.

While using an alphanumeric notation like DARMS, most computer music programs will create long alphanumeric lists of notes, each with its own assigned values in a set of parameter fields. See, for example, the DARMS note list in Example 5-3 (also see Example 5-4c).

Example 5-3: DARMS scanner code.

```
c Meter signature: 4 / 4  beats:    4; beatnote:  1 / 4
m0    0.0000                1.0000 1 / 1  1 / 4

{1       2         3          4       5      6      7     8   9    10}
i1    0.0000    0.2500    1.0000     -1   1 / 4    0     0   0    -1
i1    0.2500    0.3750    1.2500     -1   1 / 8    0     0   0    -1
i1    0.3750    0.5000    1.3750   5053   1 / 8    0    35   0    80
i1    0.5000    0.8750    1.5000   5063   3 / 8    0     3   0    80
i1    0.8750    1.0000    1.8750   5031   1 / 8    0     3   0    80
b1    1.0000              2.0000      0
i2    0.0000    0.5000    1.0000   4042   1 / 2    1     0   0    80
i2    0.5000    0.6250    1.5000   4042   1 / 8    2     0   0    80
i2    0.6250    0.7500    1.6250   4032   1 / 8    0     3   0    80
i2    0.7500    1.0000    1.7500   4053   1 / 4    1     0   0    80
b2    1.0000              2.0000      0
i3    0.0000    1.0000    1.0000     -1   1 / 1    0     0   0    -1
b3    1.0000              2.0000      0
i3    1.0000    2.0000    2.0000     -1   1 / 1    0     0   0    -1
b3    2.0000              3.0000      0
i4    0.0000    0.2500    1.0000     -1   1 / 4    0     0   0    -1
i4    0.2500    0.7500    1.2500   2000   1 / 2    0     3   0    80
i4    0.7500    1.0000    1.7500   2095   1 / 4    0     3   0    80
b4    1.0000              2.0000      0
i1    1.0000    1.1250    2.0000   5042   1 / 8    0     3   0    80
i1    1.1250    1.2500    2.1250   5021   1 / 8    0     0   1    80
i1    1.2500    1.3750    2.2500   5000   1 / 8    0     0   2    80
i1    1.3750    1.5000    2.3750   4074   1 / 8    0     0   1    80
i1    1.5000    1.6250    2.5000   4032   1 / 8    0     0   2    80
i1    1.6250    1.7500    2.6250     -1   1 / 8    0     0   0    -1
i1    1.7500    2.0000    2.7500     -1   1 / 4    0     0   0    -1
b1    2.0000              3.0000      0
i2    1.0000    1.1250    2.0000   4053   1 / 8    2     0   0    80
i2    1.1250    1.2500    2.1250   4032   1 / 8    0     3   0    80
i2    1.2500    1.5000    2.2500   4011   1 / 4    0     0   1    80
i2    1.5000    1.6250    2.5000   3106   1 / 8    0     0   2    80
i2    1.6250    1.7500    2.6250     -1   1 / 8    0     0   0    -1
i2    1.7500    2.0000    2.7500     -1   1 / 4    0     0   0    -1
b2    2.0000              3.0000      0
i4    1.0000    1.2500    2.0000   3063   1 / 4    0     3   0    80
i4    1.2500    1.5000    2.2500   4021   1 / 4    0     3   0    80
i4    1.5000    1.6250    2.5000   4116   1 / 8    0     3   0    80
i4    1.6250    1.7500    2.6250     -1   1 / 8    0     0   0    -1
i4    1.7500    2.0000    2.7500     -1   1 / 4    0     0   0    -1
b4    2.0000              3.0000      0
i1    2.0000    2.3750    3.0000   4000   3 / 8    0     3   0    80
i1    2.3750    2.5000    3.3750   3106   1 / 8    0     3   0    80
i1    2.5000    3.0000    3.5000   4010   1 / 2    0     0   0    80
b1    3.0000              4.0000      0
i1    3.0000    3.1250    4.0000   4000   1 / 8    0     0   5  6080
i1    3.1250    3.2500    4.1250   4021   1 / 8    0     0   0    -1
i1    3.2500    3.3750    4.2500   4032   1 / 8    0     0   6  7090
i1    3.3750    3.5000    4.3750     -1   1 / 8    0     0   0    -1
i1    3.5000    4.0000    4.5000     -1   1 / 2    0     0   0    -1
b1    4.0000              5.0000      0
i2    2.0000    2.1250    3.0000     -1   1 / 8    0     0   0    -1
i2    2.1250    2.2500    3.1250   3095   1 / 8    0     3   0    80
i2    2.2500    2.7500    3.2500   3116   1 / 2    1     0   0    80
i2    2.7500    2.8750    3.7500   3116   1 / 8    2     0   0    80
i2    2.8750    3.0000    3.8750   3106   1 / 8    1     0   0    80
b2    3.0000              4.0000      0
i2    3.0000    3.1250    4.0000   3106   1 / 8    2     0   0  6080
i2    3.1250    3.3750    4.1250   3116   1 / 4    0     0   0  7090
i2    3.3750    3.5000    4.3750     -1   1 / 8    0     0   0    -1
i2    3.5000    4.0000    4.5000     -1   1 / 2    0     0   0    -1
b2    4.0000              5.0000      0
i3    2.0000    2.5000    3.0000     -1   1 / 2    0     0   0    -1
i3    2.5000    2.6250    3.5000     -1   1 / 8    0     0   0    -1
i3    2.6250    2.7500    3.6250   3085   1 / 8    0     3   0    80
i3    2.7500    2.8750    3.7500   3106   1 / 8    0     0   0    80
i3    2.8750    3.0000    3.8750   3095   1 / 8    1     0   7  6080
b3    3.0000              4.0000      0
i3    3.0000    3.2500    4.0000   3095   1 / 4    2     0   0    -1
i3    3.2500    3.3750    4.2500   3000   1 / 8    0     0   8  7090
i3    3.3750    3.5000    4.3750     -1   1 / 8    0     0   0    -1
i3    3.5000    4.0000    4.5000     -1   1 / 2    0     0   0    -1
b3    4.0000              5.0000      0
i4    2.0000    3.0000    3.0000     -1   1 / 1    0     0   0    -1
b4    3.0000              4.0000      0
i4    3.0000    3.5000    4.0000     -1   1 / 2    0     0   0    -1
i4    3.5000    3.7500    4.5000     -1   1 / 4    0     0   0    -1
i4    3.7500    3.8750    4.7500     -1   1 / 8    0     0   0    -1
i4    3.8750    4.0000    4.8750   3085   1 / 8    0     0   0    80
b4    4.0000              5.0000      0
```

```
Annotation:
Parameter fields for notes:

1. instrument number

2. start time        (in whole-note units)

3. end time  (in whole-note units)

4. measure number (measure.partmeasure)

5. pitch (-1 = rest)

   ex.  5 05 3  (F in octave 5)
        |  | |_ name class   (0-6 = c-b)
        |  |___ pitch class  (0-11)
        |______ octave number

6. Duration type (1/4 = ♩)

7. tie field
   0 = no tie
   1 = beginning of tie (any odd digit)
   2 = end of tie
  21 = note tied to previous and next note

8. articulation (single digits concatenated)
   0 = no articulation
   1 = ' (staccato)
   2 = " (wedge accent)
   3 = _ tenuto mark
   4 = > (accent)
   5 = < (up-bow)
   6 = ; (fermata)

9. slur field (as in ties)

10. dynamics
    -1 = undefined
     0 = pppppp
    10 = ppppp
    20 = pppp
    30 = ppp
    40 = pp
    50 = p
    60 = mp
    70 = mf
    80 = f
    90 = ff
   100 = fff
   110 = ffff

   The special dynamics codes used are:

   1000 = sfz, ffp, fffmp, fz, etc.
   2000 = decresc over a single note
   3000 = cresc over a single note
   4000 = beginning of decresc
   5000 = end of decresc over several notes
   6000 = beginning of cresc
   7000 = end of cresc over several notes
   8000 = >< over a single note
   9000 = <> over a single note
```

Source: Brinkman, "DARMS music coding," 25.

Example 5-4 consists of excerpts from the score of a computer piece I wrote using *cmusic* software. The program in part 5-4a calls several subroutines, including the one in 5-4b. It draws information from other files, such as the one in 5-4d. In a sense, the relationship between Example 5-4a on the one hand, and b, c, and d on the other, is similar to the relationship between a conductor's score and instrumental parts in traditional notation.

Example 5-4: Excerpts from *Someday*, by R. Wood Massi.

* * *

Example 5-4a: A program to read instrument, duration, and pitch data, and to create procedures to generate a note list.

```
#include <stdio.h>

/* A macro to put the pitch tunings off by a small
percentage. */
#define JAMES_BALDWIN(p,min,max)
(p*((random_number(min,max))/100.))

float random_number();   /* for subtracting from pitch */

main (argc, argv) int argc ; char *argv[] ; {

   int   n ;                /* note index */
   float random_number(),/* for subtracting from pitch */
        min, max,         /* random boundaries */
         pitch,dur,         /* for scanning and printing */

         t;                 /* note starting time */
   char  ins[3];          /* string to name instruments */

  printf ("\#include \"sd32.h\"\n");

                            /* Print notelist contents:  */
   for (t = 0., n = 0; n < 43; n++) {
```

```
     scanf("%f %f %s",&pitch,&dur,ins);   /* Scan a data
file. */

     pitch -= JAMES_BALDWIN(pitch,0.5,5.5);   /* Offset the
pitches. */

     if (t >= 1.)   t=0.;   /* Reset starting time. */

     printf ("%s(%.2f,%.2f,%.2f);\n", ins, t, dur, pitch);
/* Note macros. */

     t += dur;   /* Keep track of summed durations for t
reset. */
  }

  printf("endmerge;\nter p2+4;\n");   /* Sort and end
notelist. */
}
```

* * *

Example 5-4b: A program to define the instruments and the note statements.

```
#include <carl/cmusic.h>

set list;

ins 0 PeterTchaikovsky;
osc b1 p5 p6 f1 d;
out b1;
end;

ins 0 GertrudeStein;
osc b1 p5 p6 f2 d;
out b1;
end;

SINE(f1);
GEN5(f2) 1,1,0 2,1/3,90Deg 3,1/2,0 4,1/6,90Deg 5,1,0;
NORM(f2);

ins 0 WaltWhitman ;
shape b4 f6 d ;
end;

GEN4(f6) 0,.1 3 .66,.9 0 .88,.8 -2 1,.7;

ins 0 HarveyMilk;
```

```
     etc.

#define X (60MM) {Tempo macro.}
#define A (1.) {Amplitude.}

{Notelist macros:}

#define PT(t,dur,pitch) note t*X PeterTchaikovsky dur*X A
(pitch)Hz

#define GS(t,dur,pitch) note t*X GertrudeStein dur*X A
(pitch)Hz

#define HM(t,dur,pitch) note t*X HarveyMilk dur*X A
(pitch)Hz \
        1/(sqrt(2))*p6 0*MF (10-Doffset)*MF p4sec
merge;

note 0 WaltWhitman 32;
```

* * *

Example 5-4c: Note lists.

```
note 0 PeterTchaikovsky .5 0dB 392.00Hz;
note p2+p4 GertrudeStein .5 -5dB 392.00Hz;
note p2+p4 PeterTchaikovsky .5 0dB 440Hz;
note p2+p4 GertrudeStein .5 -5dB 440Hz;
                    etc.
```

```
PT(0.00,0.50,386.15);
GS(0.50,0.50,388.44);
PT(1.00,0.50,435.83);
GS(1.50,0.50,437.03);
     etc.
```

* * *

Example 5-4d: A data file.

```
392.00   .5   PT   392.00   .5   GS   440.00   .5   PT
 440.00   .5   GS   392.00   .75   PT   329.63   .25   PT
 392.00  1.    PT   392.00   .5   PT   392.00   .5   GS
     etc.
```

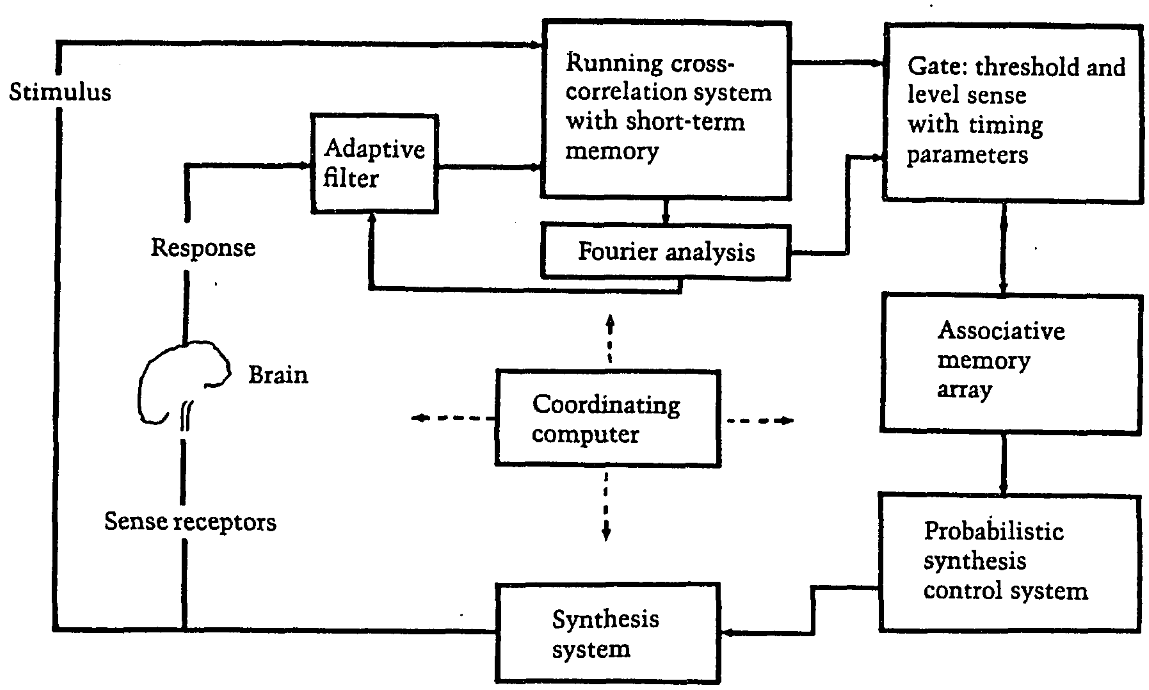
Computer programs may take information from a terminal using graphic or alphanumeric devices, or from other devices, such as electronic piano keyboards or digitizing tablets. More recent computer music systems, which have sought to move away from the note concept, and which have concentrated more on stochastic processes like tendency masks, seem to depend less, for their user interface, on alphanumeric notation, and more on graphic systems. Of course, words and alphanumeric strings are useful as notations even at the large-scale levels of a musical work. Example 5-5 is a score which briefly describes the sound files and designates the names, order, and genesis of the short sections constituting the second half of *Someday*.

Example 5-5: Score for *Someday*, Part II.

w.s5 = 4 sec. sine wave at R=500; sounds like triangle with overtones.
t.sf = sampling rate (R) @ 1K, makes two long tones (8 sec).
v.sf = z.sf (R @ 1K) on 4 channels (8 sec); source very slow.
chn = short distortions and reverb of source file, played twice.
ret = retro of u.sf, a straight version of source.
comb = retro on reverb.
n.sf = retro and straight versions played simultaneously on 2 channels.
r.sf = one channel uses repeated notes, other the straight piece (8 sec).
we.sd = recompilation of the source to manifest triple meter.
w.sf = very fast (8 sec) on 4 channels.
y.sfr = retro of y.sf.
y.sf = source very very fast (4 sec) on 4 channels.
y.sfr = retro of y.sf.

Verbal notation is more important today than it ever has been. Example 5-6 demonstrates the use of words in a diagram representing the system used to perform a piece based on brain waves. It is hard to imagine discussions of this piece being confined to the use of traditional music notation.

Example 5-6: *On Being Invisible*, by David Rosenboom.



Source: Roads, ed., "Symposium on computer music," 48.

Words are used to represent all sorts of things about music. Documentation is crucial to any endeavor using computers. Even icons require verbal explanations. Likewise, one needs documentation, or instructions, or an introduction to understand much of the music which is being composed today, especially music using graphic notation, but also electronic music scores. Documentation comes in all forms, from owners' manuals to the proposals, reports, and photos used to represent some conceptual or temporary art works. Instructions can come in the form of words or prescriptive notations using symbols as traditional music notation does.

Instructions define the boundaries of permissible realizations. In so doing, some entirely verbal scores bridge the gap between poetry and theatrical scripts, as in *Raining*, by Allan Kaprow:

> Black highway painted black
> Rain washes away
>
> Paper men made in bare orchard branches
> Rain washes away
>
> Sheets of writing spread over a field
> Rain washes away
>
> Little grey boats painted along a gutter
> Rain washes away
>
> etc.

Notes on *Raining*:

> "Black highway painted black": A lonely stretch of highway should be selected, and a time when it is only sporadically traveled, such as 3 a.m. Black watercolor in large buckets is splashed and brushed onto as long a piece of road as possible. When it next rains, the painters may choose to sit at the edge of the black strip. . . .
>
> "Little grey boats painted along a gutter": children (or adults) should paint images of a

> boat in a gutter; when it rains, they may watch them dissolve and disappear down the sewer.[1]

Other instructional text pieces are more musical in intent, for example *Singing on the Run* (1972) by Charlemagne Palestine, who suggests that the performer:

> Begin singing on one tone. . . . Slowly begin to walk and sing -- gradually picking up speed to a fast walk, eventually breaking into a run, singing all the while. Keep running until you are out of breath. Stop wherever you are and catch your breath. Then begin again as many times as you can. Each time, singing the same sustained note. The more endured, the better.[2]

The growth of the use of words for notating music came not only from an interest in the theatrical and poetic, but also from a desire to reveal something about oneself, to analyze oneself, or to refer in the score to some level of interpretation outside the purely performative. Words are frequently more useful for these purposes than other types of symbols because of their ability to carry strong connotative meanings along with their denotative meaning.

Included within the purview of a broad perspective on music notation are words used in discourse, particularly words used in theory and analysis. Books and articles about music can be analyzed using models developed for

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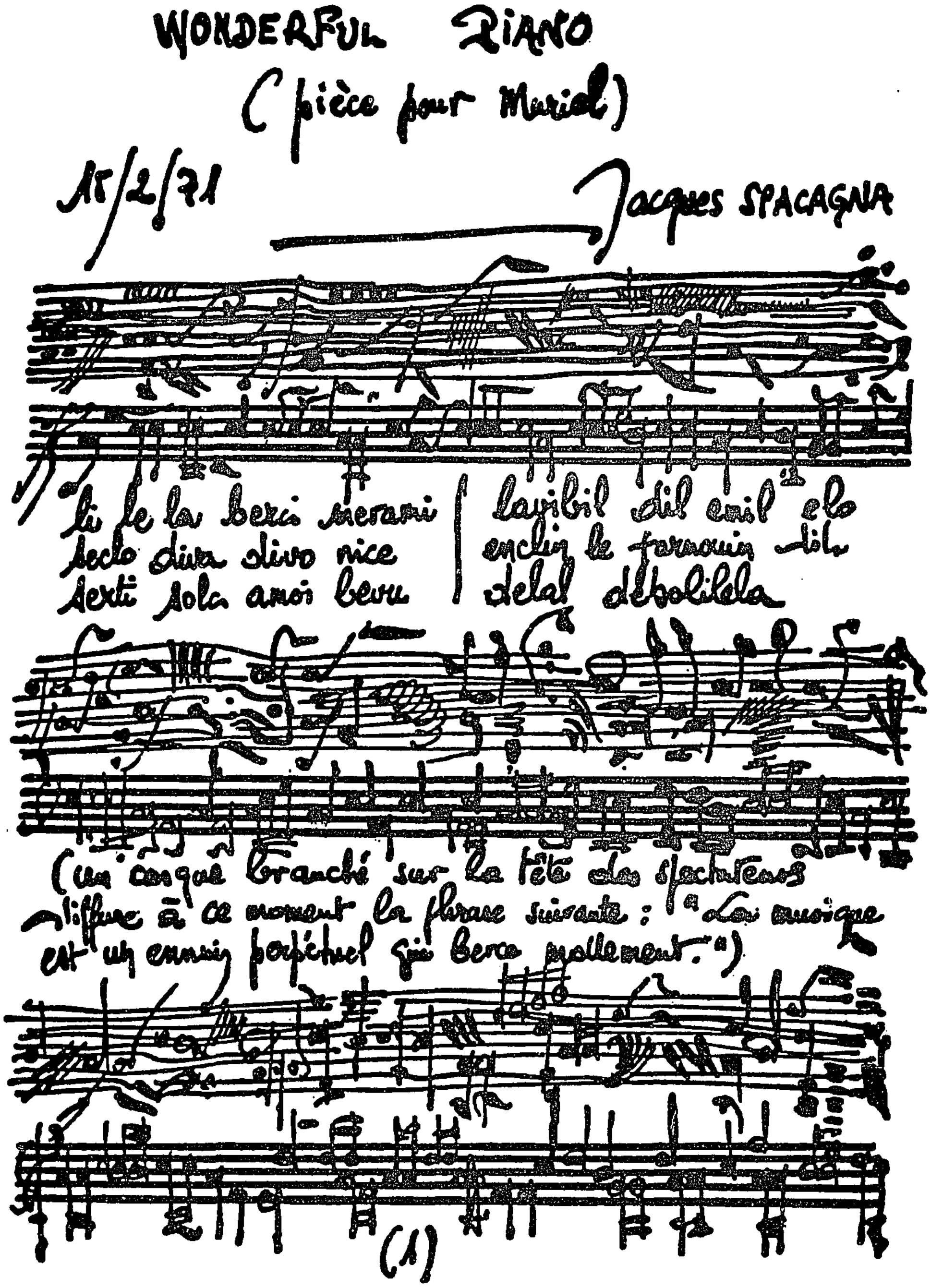
[1] Allan Kaprow, *Some recent happenings* (New York: Great Bear, 1966), 12-13.

[2] Charlemagne Palestine in Roger Johnson, comp., *Scores: An anthology of new music* (New York: Schirmer, 1981), 68.

literary texts. Even more than non-verbal musical notation, books and articles create worlds, tell stories, and elaborate the myths behind our music culture.

Sometimes, words are used for their iconic and exemplificative significance in addition to their symbolic and conventional meanings. Example 5-7 is an excerpt from a work by the *lettriste* artist, Jacques Spacagna. The expressiveness of the shapes of the words combines with that of the other graphic shapes to create the work. One can easily see that it would not do for the works to be typeset.

Example 5-7: *Wonderful Piano*, by Jacques Spacagna.



Source: Curtay and Gillard, eds., *Musique lettriste*, 107.

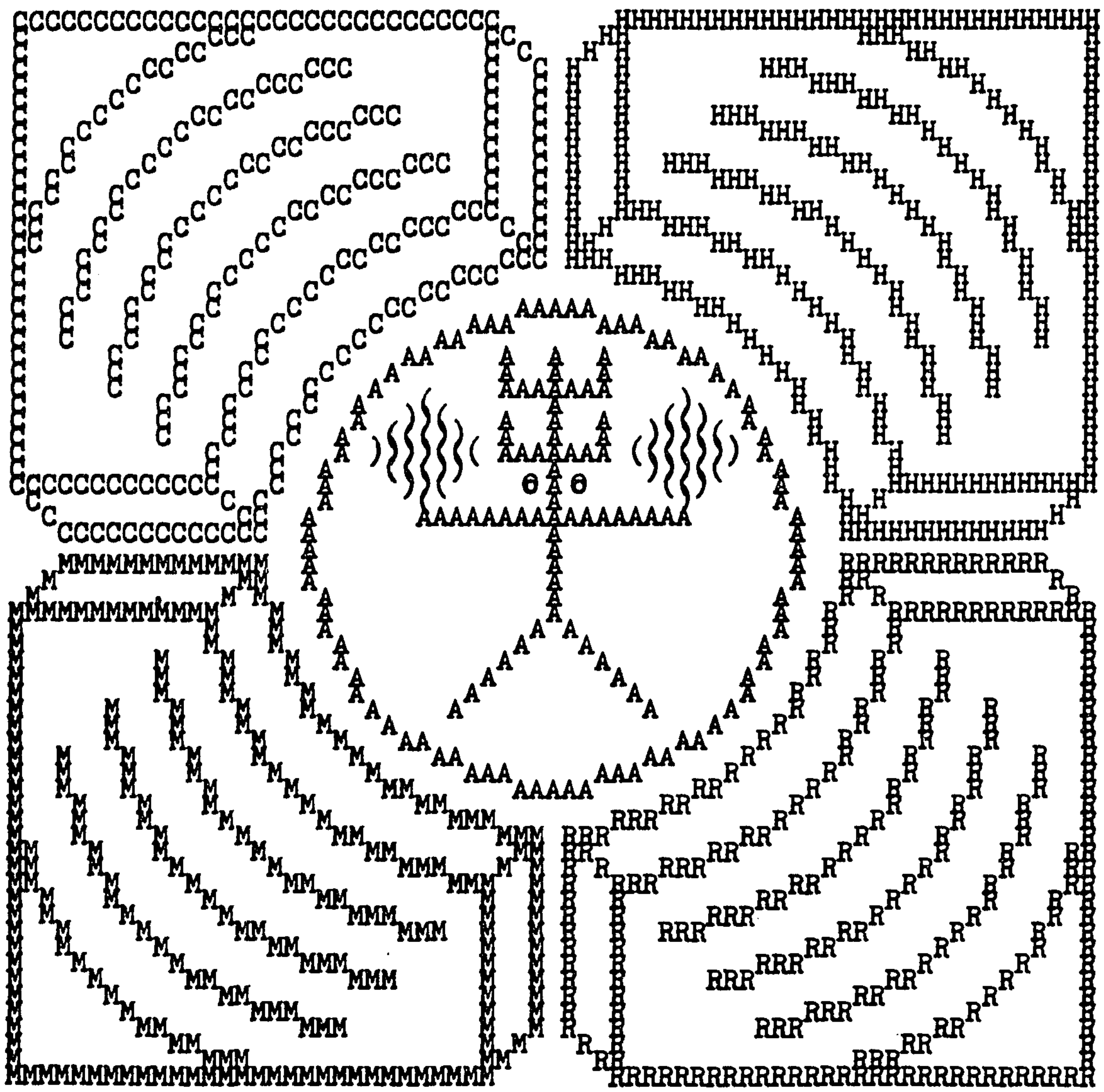
Concrete or pattern poetry also uses the connection between the visual and the alphanumeric to create art works which refer on several levels. In Examples 5-8 and 5-9, alphanumeric strings serve iconically as a quantitative visual medium, and symbolically as spellings for words. Both types of notation have their own meanings; but in these two examples, there is a referential connection made between the two types.

Example 5-8: Poem by Claus Bremer.

```
is the text the text left out
 is the tex  he text left out
  is the te    e text left out
   is the t      text left out
    is the       text left out
     is the       ext left out
      is th        xt left out
       is t         t left out
        is            left out
         is           left out
          i            eft out
                        ft out
          t              t out
          th               out
          the              out
          the               ut
          the t              t
          the te
          the tex             t
          the text           xt
          the text          ext
          the text l        text
          the text le        text
          the text lef     e text
          the text left   he text
          the text left  the text
          the text left o the text
          the text left ou s the text
          the text left out is the text
```

Source: Bremer in Williams, ed., *An anthology of concrete poetry*, no p. num.

Example 5-9: *Word Charm*, by Karl Kempton.



Source: Kempton, "Visual poems," 22.

Alphanumeric notation has always been an important tool for music theory. This short excerpt from a harmony text exemplifies some of the usage: "The D^b of bar 2 (right-hand part) moves up to E^b in bar 3, rather than down to C. In other words, $\hat{4}$ -- the 7th of the root position -- moves up. . . . With parallel 10ths (less often 3rds) above the bass, $\hat{4}$ ascends. . . . This usage of $V^{4/3}$ corresponds to the usage of VII^6 shown in example 7-11a."[3] Here, letters refer to pitches and numbers refer to measures, scale degrees, intervals, chord members, chordal configurations, and example locations. Alphanumeric units and strings are clearly capable of being organized, measured, and weighed in any number of ways.

Alphanumeric and verbal notations are truly versatile referential tools and can be found in all notation systems, though they function more powerfully in computer music notation systems and, to a lesser degree, in traditional notation systems. They tend to be symbolic rather than iconic and more prescriptive than descriptive.

Graphic Notation

I connect graphic inscriptions with iconic and descriptive types; but like alphanumeric and verbal signs they participate in nearly all notation systems. The term "graphic notation" is associated with the rush of changes in music notation which occurred in the 1950s, 1960s and

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[3] Edward Aldwell and Carl Schachter, *Harmony and voice leading*, 2nd vol. (New York: Harcourt Brace Jovanovich, 1979), 99.

1970s. Today, it appears that some composers and theorists think of that period as a backwater movement, one which has spent its energy, and has little to say to us at this time. Many of the stimuli that affected notation in that earlier period, however, still exist, and the questions raised by the movement resonate in today's music world.

One's understanding of graphic music notation is partly a matter of focus. In trying to describe types of musical graphics, one book calls directive graphics "a type of notation (developed primarily for use in aleatoric works) containing symbols for pitch, dynamics, and tempo, that permit the performer a certain amount of freedom in his reaction to, and interpretation of, the score."[4] The trouble with this definition is that it could apply to practically any type of music notation.

The defining characteristic of graphic notation is that it focuses attention on the visual aspect of a work -- either the visual shape of the notation itself, or the visual shape of some variable which is affecting the notation. Known as "eye music," *Augenmusik*, or *carmen figurati*, or "word painting," graphic notation is evident in works from Cordier's heart piece, to the lithographs of

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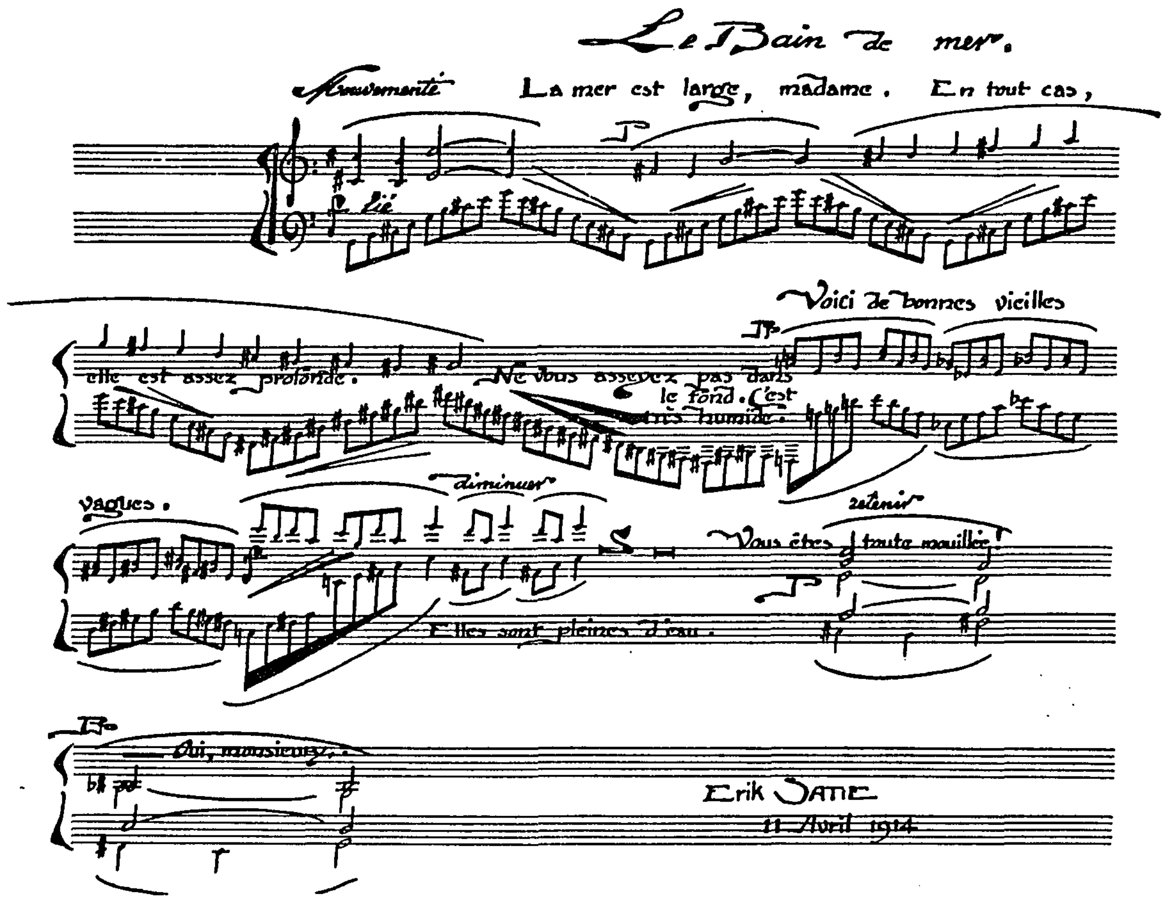
[4] Robert Fink and Robert Ricci, *The language of twentieth century music: A dictionary of terms* (New York; Schirmer, 1975), 22.

John Cage, and including the Renaissance practice of using black notes to express grief, or pitch register (and therefore graphic position in the score) to signify "up/down," and "heaven/hell."

Graphic notation uses the eye to import some external meaning into the work, some programmatic intent. The graphic richness of the Satie piece in Example 5-10 is not only a function of his expressive use of calligraphy, but also his incorporation within the outlines made by the notation, of a spatial, visual analog of the subject of the song. It is as if Satie adds a conceptual meaning to the performative meaning already manifest by the notation. The graphic aspects of the notation have captured meanings that the alphabet-like functions of traditional notation alone usually cannot.

Example 5-10: *Le Bain de Mer*, by Erik Satie.



OCEAN BATHING. *Agitatedly*. "The ocean is wide, Madame. Anyway, it's quite deep. Don't sit down at the bottom. It's very damp. Here are some good old waves. *Diminuendo*. They are full of water. *Holding back*. You are all wet!" "Yes, sir."

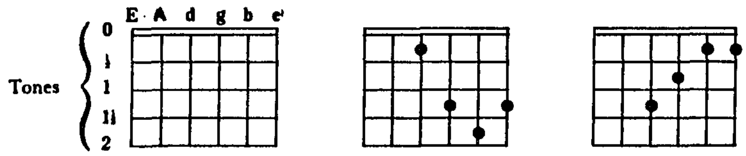
Source: Satie, *Twenty short pieces*, 22-23.

Graphic notations can be grids, diagrams, pictures, hieroglyphs, calligraphies, or macroforms. Those which focus on directing a performer are frequently indeterminate, or open-ended. Their purpose often is to preserve the option of supporting variable realizations. They are often designed to inspire improvisation; indeed many graphic notation pieces emphasize improvisation.

Any notation system allows for variety in its interpretations, the degree of variance being circumscribed by the appropriate performance practice. Graphic notation systems have developed partially from composers' desires to expand the range of the diversity permitted. Otherwise, they are often much like traditional notation. In fact, traditional notation is quite "graphic" in its own way.

Though graphic notation systems tend to function descriptively more than prescriptively, there are certainly numerous cases of the latter. Example 5-11 shows the guitar tablature commonly used for many published pop and jazz pieces. It is highly prescriptive, instructing the performer where on the fret board to place her fingers.

Example 5-11: Guitar tablature.



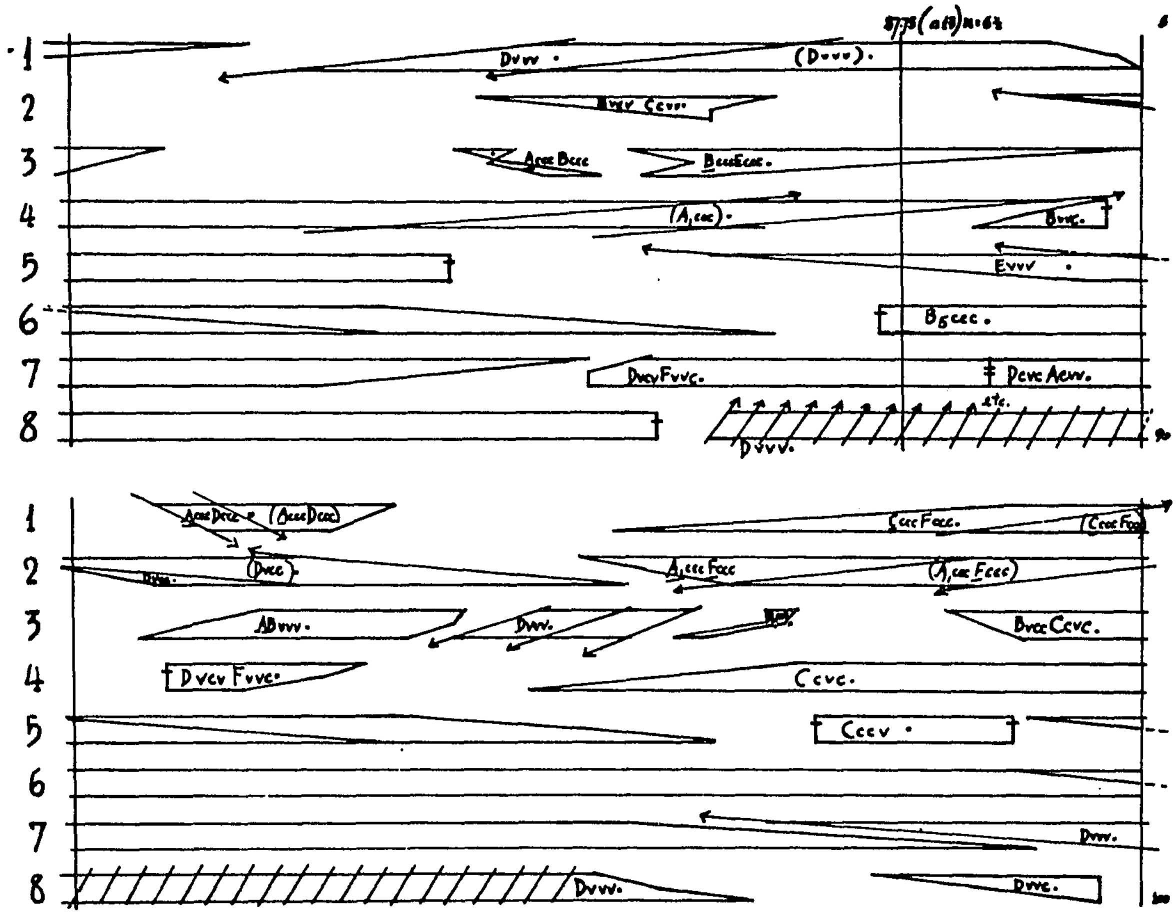
E^b chord F chord

Source: Cole, *Sounds and signs*, 39.

Frame notation is a simple form of prescriptive, but somewhat indeterminant, graphic notation. Frames are subsections of larger musical works. They set off events, usually within rectangles, which become subject to choices by performers. The material within the frame may be predetermined or not, and the choice left to the performer may merely be when or whether to play the frame. Sometimes, however, frames are used simply to set off sections which are significantly different in some way from the surrounding material. (Earle Brown's *Available Forms* and Karlheinz Stockhausen's *Klavierstuck XI* are good examples of frame notation.)

Graphic notations, whether prescriptive or descriptive, usually act as iconic analogs and refer by implication, suggesting general shapes and values in the indicated domain. They have been closely associated with the development of indeterminant, multimedia, and electronic works. One of the most significant ideas associated with these genres and graphic notation is time proportionality, sometimes known as proportionate or piano-roll notation. During the early 1950s composers such as Earle Brown and John Cage began for the first time to work with magnetic recording tape. They observed the direct relationship of the medium to the passage of time in the works they created. In taped pieces time equals space; one second of sound may require fifteen inches of tape, for instance. Cage and Brown collaborated on a piece called *Williams Mix*, drawing scores like the excerpt in Example 5-12 which indicates tape length, splicing shapes, and sound contents.

Example 5-12: *Williams Mix*, by John Cage.



Source: Kostelanetz, *John Cage*, 110.

At the same time they were working with tape they began to create other works using the iconic time-equals-space model. In *Music of Changes* (1951), Cage let two and one-half centimeters equal a quarter note, but otherwise he proceeded with the use of traditional note heads and stems; only the placement was different and the measures were all the same size. Brown tried using thick black lines on traditional staves, the lengths of the lines indicating the durations. Other composers tried other combinations of traditional and proportionate notations. But as Kurt Stone has pointed out, none of these worked as well as traditional notation for the coordination of parts among players. "Human beings simply do not seem to possess a space perception equal in acuity to their pulse perception; if they are not given something they can count, they will not be able to play 'in time'."[5] This is a good example of how perception affects the utility of different kinds of notation. Other problems existed with these hybrid systems, including the questions of where to place the bar lines, or how to provide for sensible page turns.

With his composition *Folio*, Brown broke away from the traditional system to create more indeterminant, iconic, and conceptual kinds of notation. Example 5-13 is the first purely graphic score, "December 1952" from *Folio*.

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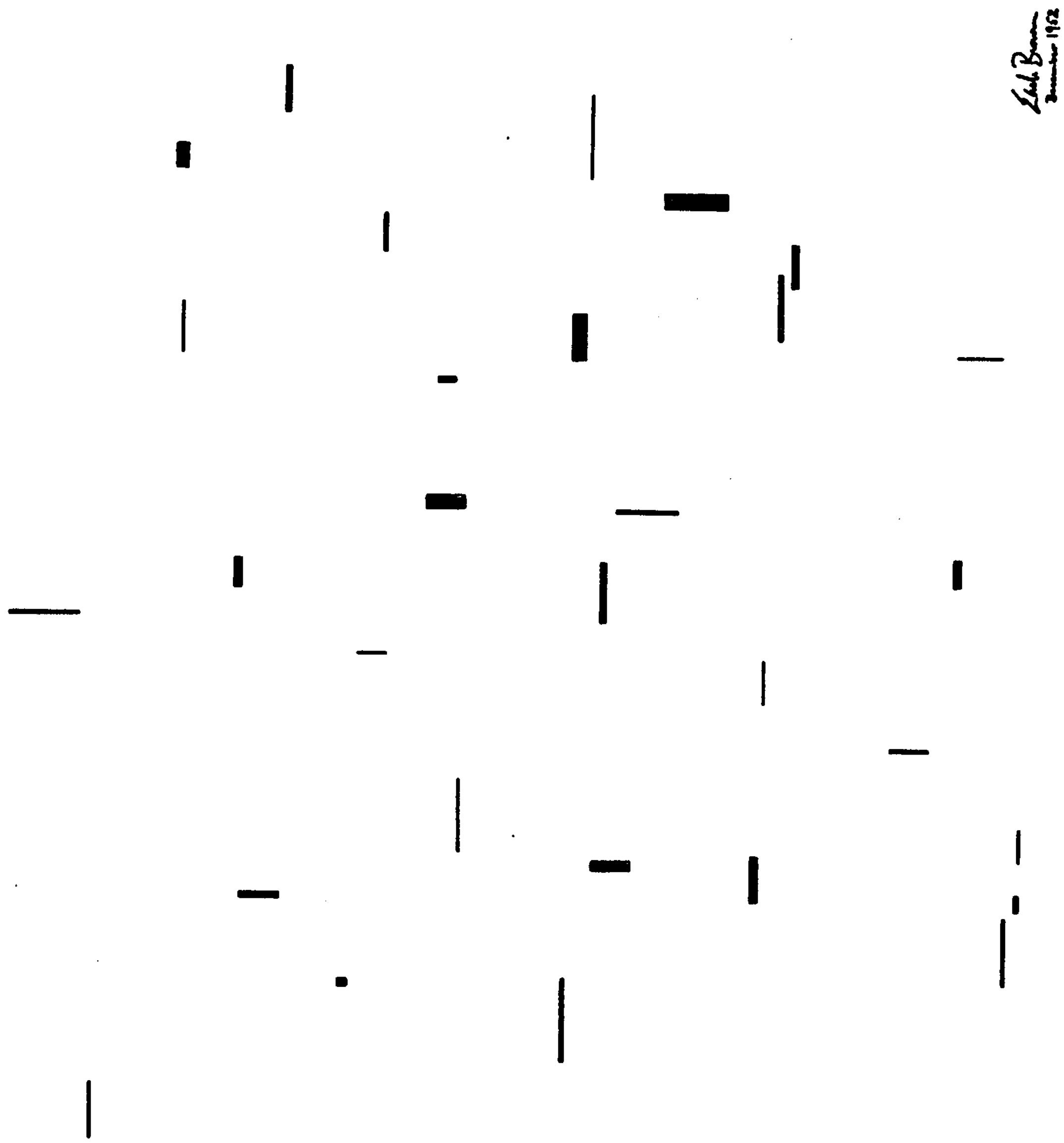
[5] Kurt Stone, "Problems and methods of notation," *Perspectives of new music* 1:2 (Spring 1963): 22.

Example 5-13: "December 1952," by Earle Brown.



Source: Brown, *Folio*, no page number.

In the "Prefatory Note" to "December 1952" Brown says that

> the composition may be performed in any direction from any point in the defined space for any length of time and may be performed from any of the four rotational positions in any sequence. In a performance utilizing only three dimensions as active (vertical, horizontal, and time), the thickness of the event indicates the relative intensity and/or (where applicable instrumentally) clusters. . . . It is primarily intended that performances be made directly from this graphic "implication" (one for each performer) and that no further preliminary defining of the events, other than an agreement as to total performance time, take place. Further defining of the events is not prohibited however, provided that the imposed determinate-system is implicit in the score and in these notes.[6]

Morton Feldman, a member with Cage, Brown, and Christian Wolff of the New York Experimental School, used time proportionality in his pieces from the same period. He seems to have preferred to use grids like those on graph paper -- that is, a series of adjacent squares in uniform horizontal and vertical rows -- thus reinforcing the name "graphic notation." Each square is given the same amount of time, and each horizontal row is assigned to an instrument or to a particular range of pitches within an instrument. Feldman indicated the number of pitches to be played during the course of a square, but did not specify which pitches or how long each should

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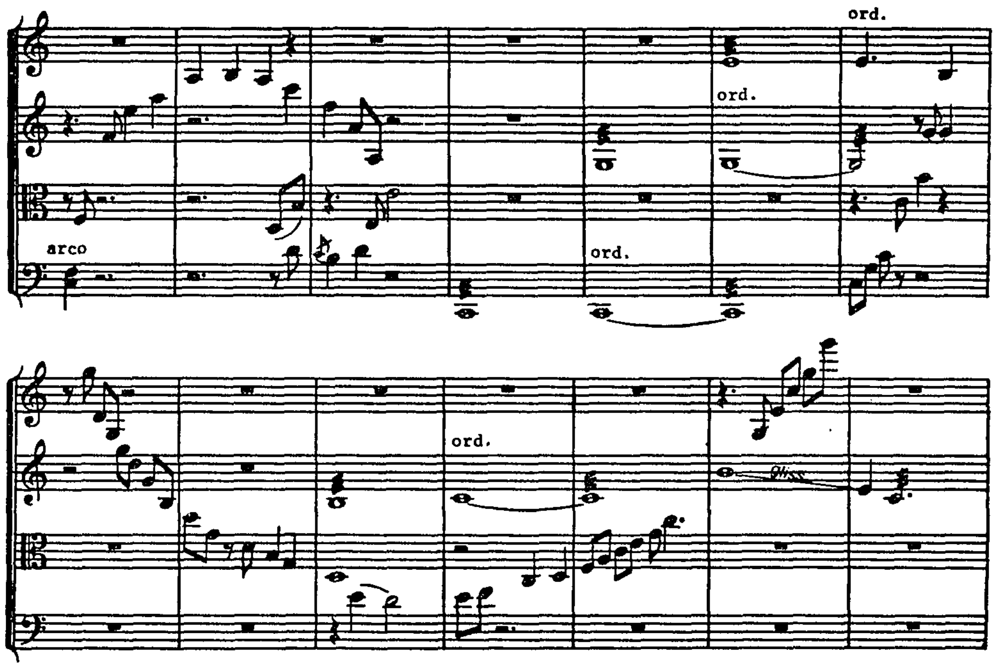
[6] Earle Brown, *Folio* (New York: Associated Music, 1961), no page number.

last, though they had to be played within the time allotted. This provided a stochastic, aleatoric dimension to these works. (For examples, see his *King of Denmark*, and the *Durations* and *Intersections* series.)

In a process called millimetration, Heitor Villa-Lobos also used graph paper to translate drawings, maps, pictures, etc. into traditional notations (see his *New York Skyline*). Here, as with most graphically based music, horizontal dimensions represented pitches and vertical dimensions durations. I used a similar, but not identical, technique composing my string quartet *Water Pictures and Words* (see excerpts in Examples 5-14a, 5-14b, and 5-14c).

Example 5-14: Excerpts from *Water Pictures and Words*, by R. Wood Massi.

Example 5-14a:



Example 5-14b:

Example 5-14c:

Example 5-14a depicts an ocean wave breaking; it is based on the Fibonacci sequence. Example 5-14b represents a fish in water, and 5-14c the letters B-A-C-H (German for "brook"). The pictures in the first two cases appear across two separate systems and emerge gradually as the instrumentalists play the music. The letters in c) are another case of alphanumeric notation used quantitatively as a medium for a different signifying system.

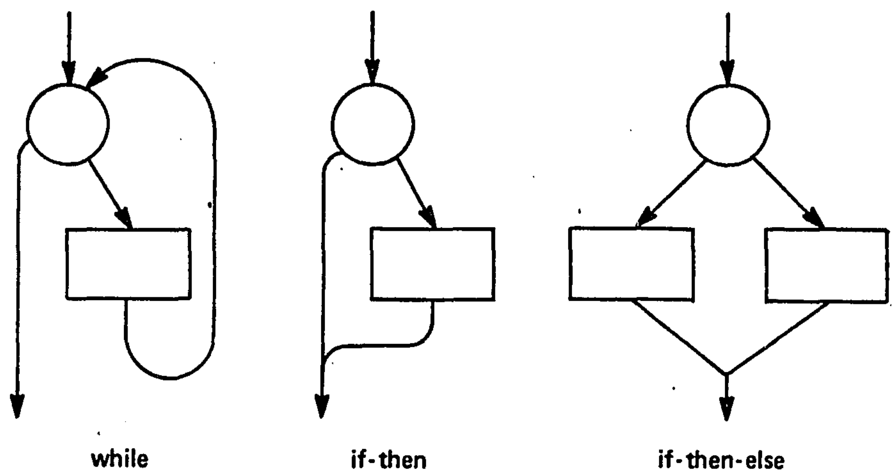
The instructions for *Water Pictures and Words* call for the score to be copied onto transparencies, projected onto a large screen, and drawn in a connect-the-dots manner during the performance. It is my intention to draw the audience into an experience of the notation by showing them what the players see. This work manifestly attempts to express meaning on several different levels, which gives it the quality of conceptual notation in addition to its graphic characteristics. I will discuss conceptual notation more thoroughly after a consideration of some of the graphic devices used in notating computer music.

Combined Computer and Graphic Notations

The use of graphics pervades the electronic and computer music world, from the smallest, most local level to the broadest. Musicians and engineers use diagrams, flow charts, histograms, songraphs, spectrograms, and graphic scores intended to assist the conception, realization, or reception of a work.

The necessity of representing the flow and changes taking place during logical and electronic processes is basic to computer work. As we have seen, programmers most frequently write their programs in alphanumeric notation. But along the way to formulating the code, they will often resort to graphic representations of operators and other programming constructions. Example 5-15 shows representations of basic "while," "if-then," and "if-then-else" procedures. The circles represent conditions and the squares activities.

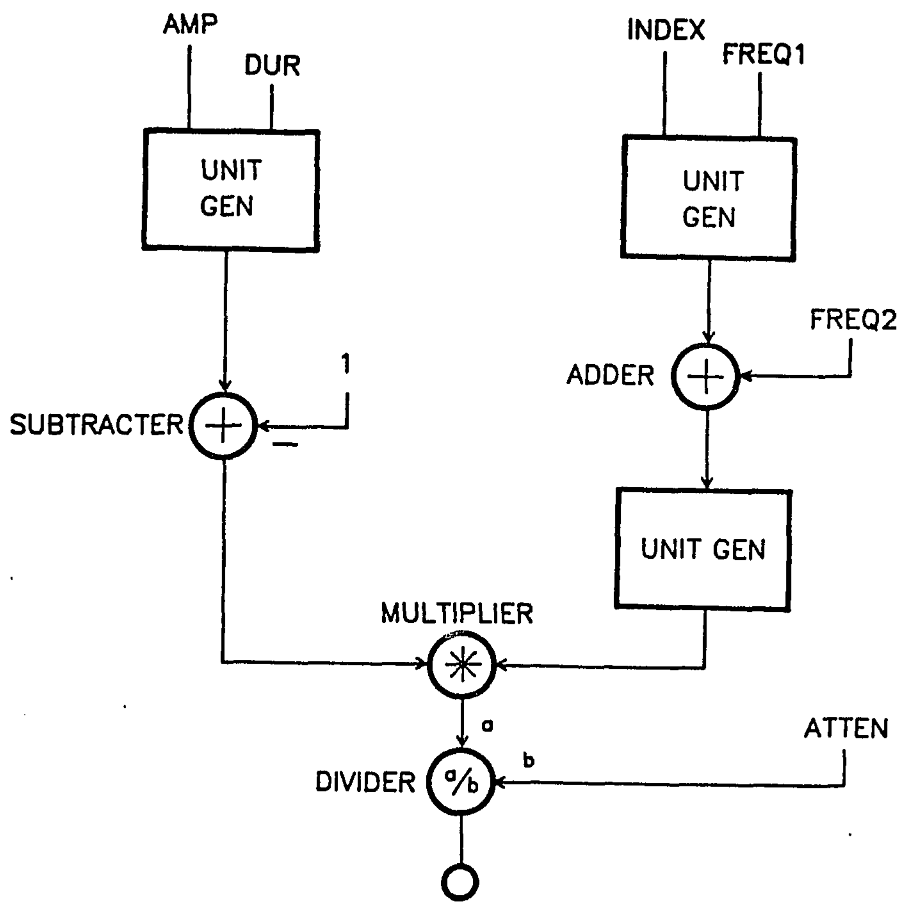
Example 5-15: Programming constructions.



Source: Abbott, "Machine tongues, Part II," 6.

Similar representations describe the flow of conditions, states, activities, controls, options and signals, though the meaning of circles and squares may differ in various systems. Example 5-16 shows a signal flow chart which defines a computer instrument designed to produce a specific timbre and called as a subroutine by the larger musical program/score. This chart communicates to the human user; alphanumeric strings and binary signals communicate the same information to the machines which implement it.

Example 5-16: Signal flow chart.

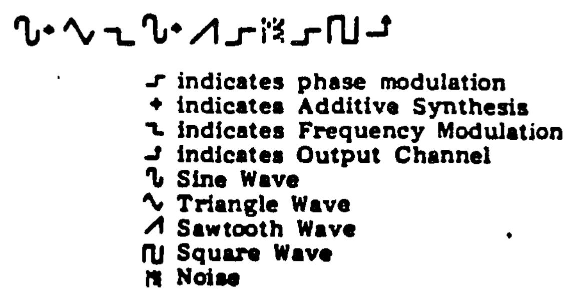


Source: Dodge and Jerse, *Computer music*, 64.

Flow charts are diagrams. Musicians and engineers also use them to represent data structures, most commonly "trees"; connections among machines and processes in a particular arrangement, such as MIDI set-ups; and parallel processes capable of doing several things at once, such as Petri nets.

The portrayal of timbre requires a good deal more variety and elaboration in electronic and computer music than is available in traditional notation because the breadth of control is so much greater. In Example 5-16 we saw a flow chart definition of a computer instrument. In Example 5-17, Don Lieberman uses a string of graphic characters to represent a specific timbre. It symbolizes both processes and waveforms.

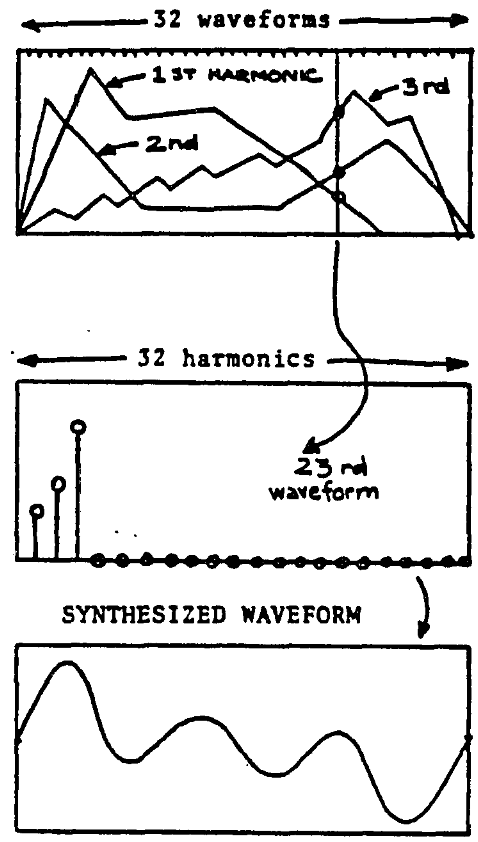
Example 5-17: Timbre symbolization.



Source: Lieberman, "The ADS 200," 577.

The relative strengths of the various harmonics which constitute any sound determine the shape of the resultant waveform, and thereby the timbre. Harmonics and waveforms are subject to manipulation by computer techniques; so they need to be notated. Example 5-18 shows several graphic ways of signifying these types of information.

Example 5-18: Harmonics and waveforms.



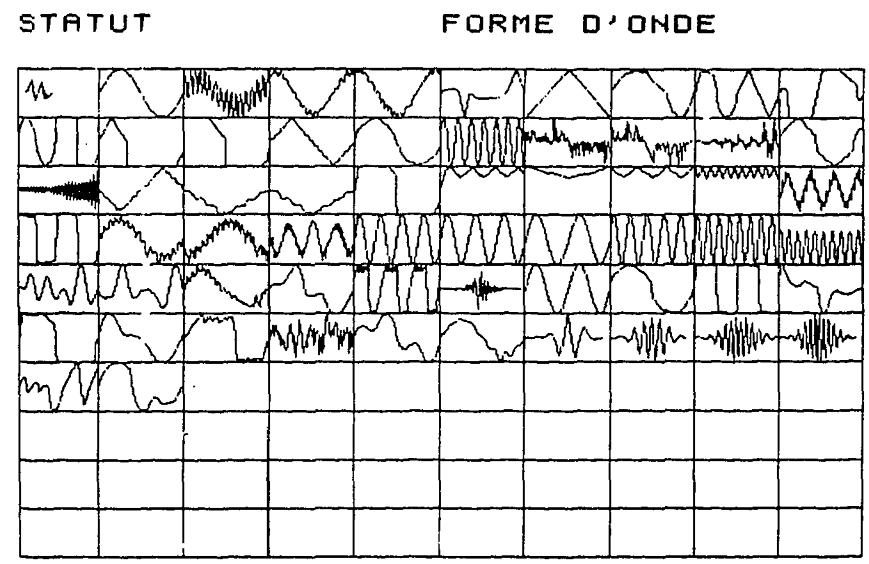
Source: Levine and Mauchly, "The Fairlight," 568.

Example 5-19 shows a waveform library available to users of the UPIC, though the system allows the composer to design her own forms. UPIC is

> a complex system of computers and peripherals designed to facilitate direct access to sound and musical material by the user. The focal point of the system [are] an electromagnetic stylus and a two-dimensional graphics tablet on which you draw, as if onto music paper, with millimeter lines instead of staves. . . . Underneath the calibrated field is a conductive pad containing a tight network of electric fibers. . . . What you have drawn is simultaneously displayed on two cathode-ray tubes, one for graphic (analog) representation, and one for alphanumeric representation. [The

designs are] immediately calculated and
transformed into sound by the computer.[7]

Example 5-19: A UPIC waveform library.



Source: Lohner, "The UPIC system," 47.

Depending on the immediate concerns of the user, the representation of timbre with computers may focus on the time domain or the frequency domain. One frequently encounters other kinds of notation for these data, particularly mathematical formulae and wavetables (sequential arrangements of alphanumeric values, or samples, taken at periodic points within a waveform). They are often coupled with notations of amplitude envelopes such as the one in Example 5-20.

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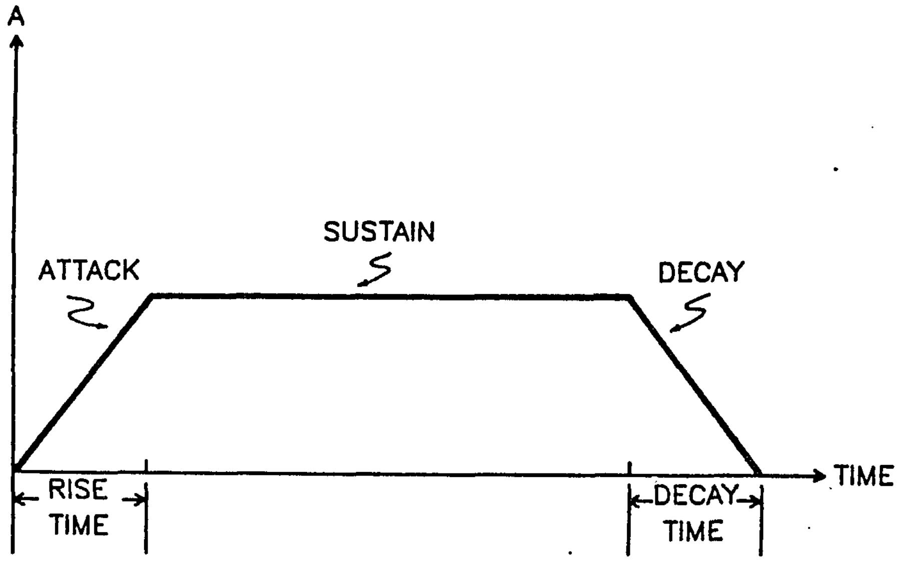
[7] Henning Lohner, "The UPIC system: A user's report," *Computer music journal* 10:4 (Winter 1986): 42-44.

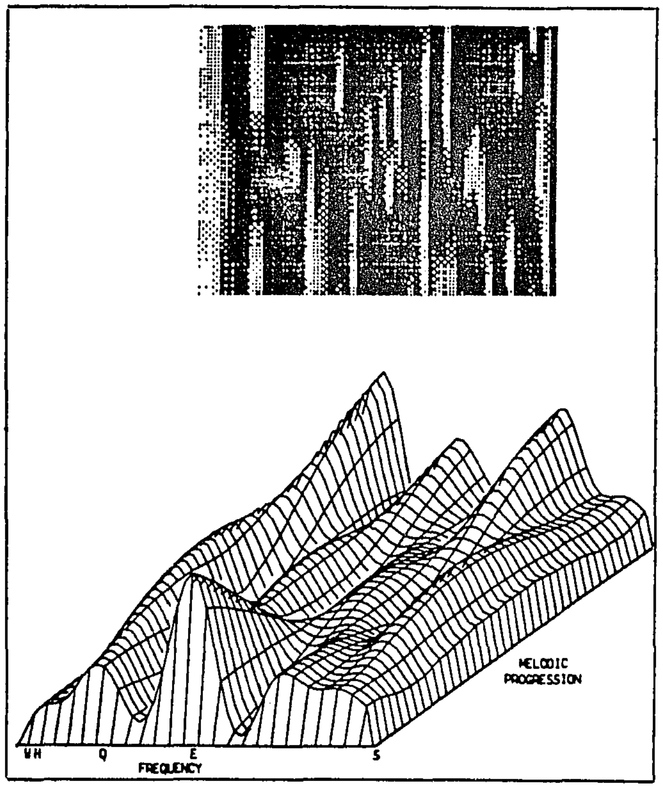
Example 5-20: Amplitude envelope.



Source: Dodge and Jerse, *Computer music*, 71.

Various forms of spectrum analysis (the evaluation of component amplitudes and frequencies) on wave forms, melodic fragments, and complete works have yielded quite a few different forms of graphic notation known variously as histograms, sonograms, spectrographs, spectrograms, power spectra, soundscores, pitch periodograms, and so forth. These forms usually involve the mapping of some combination of frequency, amplitude, and time onto a three-dimensional model. Example 5-21 consists of a spectrogram at the top and a topographic power spectrum at the bottom representing an excerpt from the Aria *Ach, ziehe die Seele mit Seilen der Liebe* in J. S. Bach's Cantata No. 96.

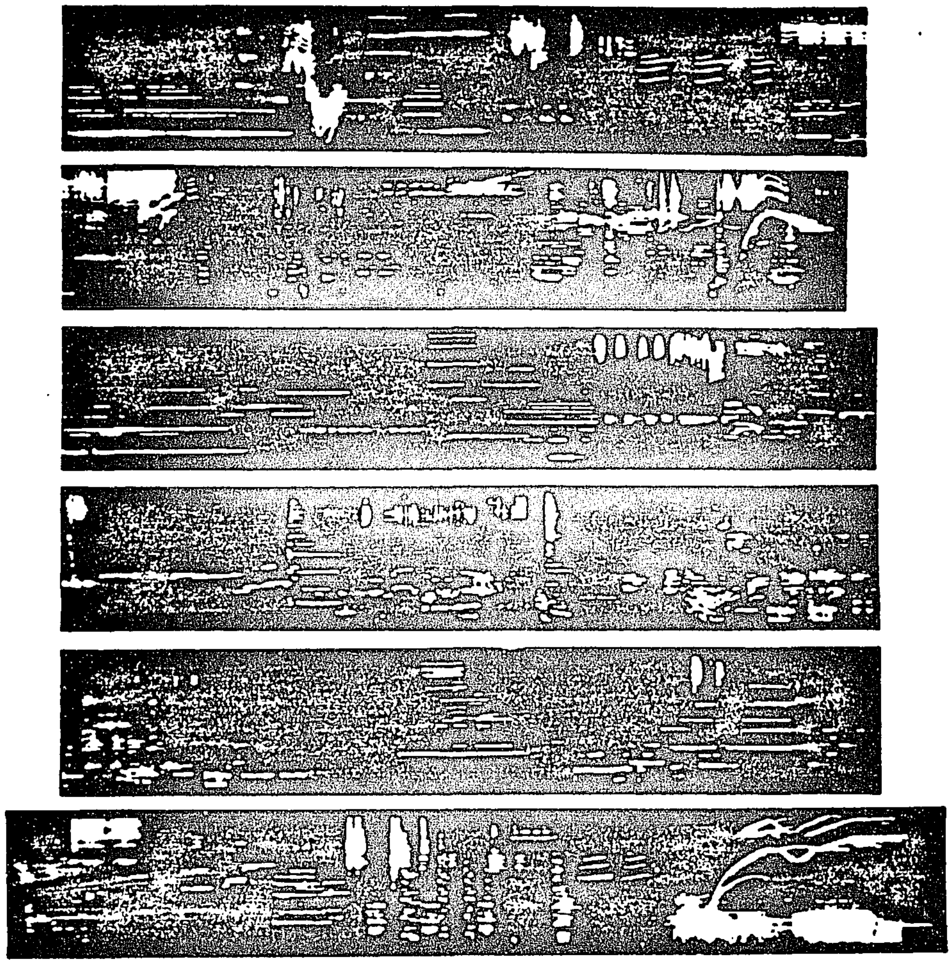
Example 5-21: Spectrogram and power spectrum.



Source: Pickover, "Representation of melody patterns," 75.

Example 5-22 is a two-dimensional soundscore of *Poeme Electronique*, a tape piece by Edgard Varese. It maps time horizontally, and pitch and harmonic content vertically. The relative strengths of the partials in the sounds are mapped as relative brightness. Such scores are useful for depicting work not amenable to notation by traditional means, and for the analysis of specific performances, as the notation is purely descriptive, drawn from the actual sounds themselves.

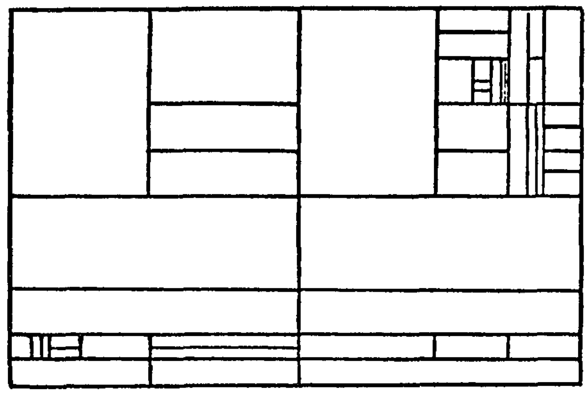
Example 5-22: Sonographic soundscore.

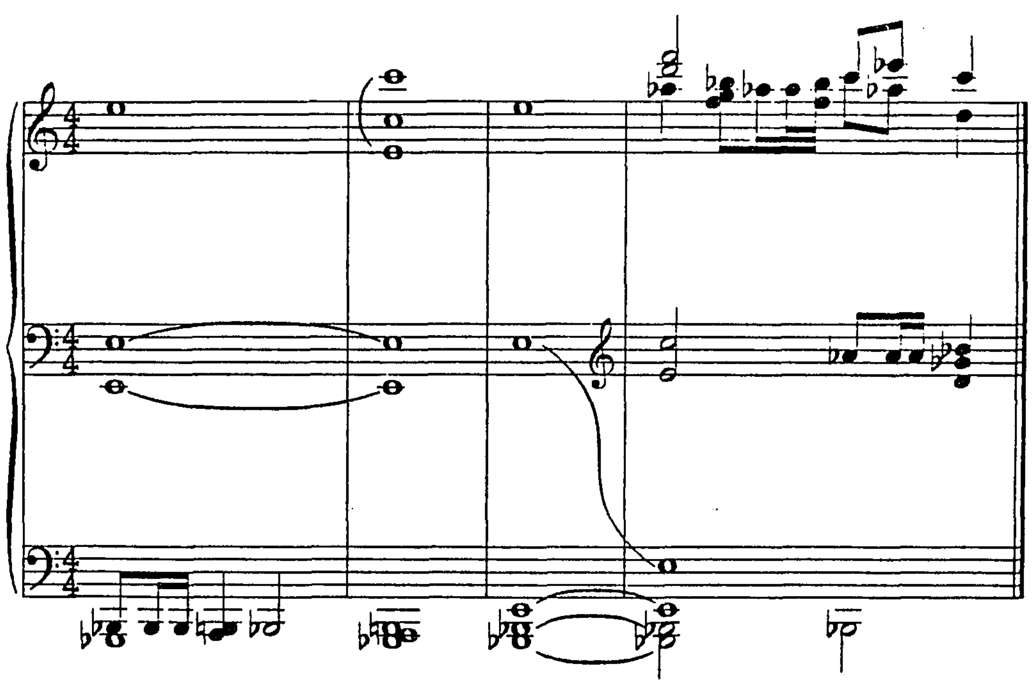


Source: Potter and Teaney, "Sonic transliteration," 142.

For some computer music applications, mapping takes place not from the sound to the graphic, but the other way around. The uppermost graphic in Example 5-23 shows a stochastic space grammar which was used as the source to generate the traditional notation at the bottom.

Example 5-23: Space grammar and translation.

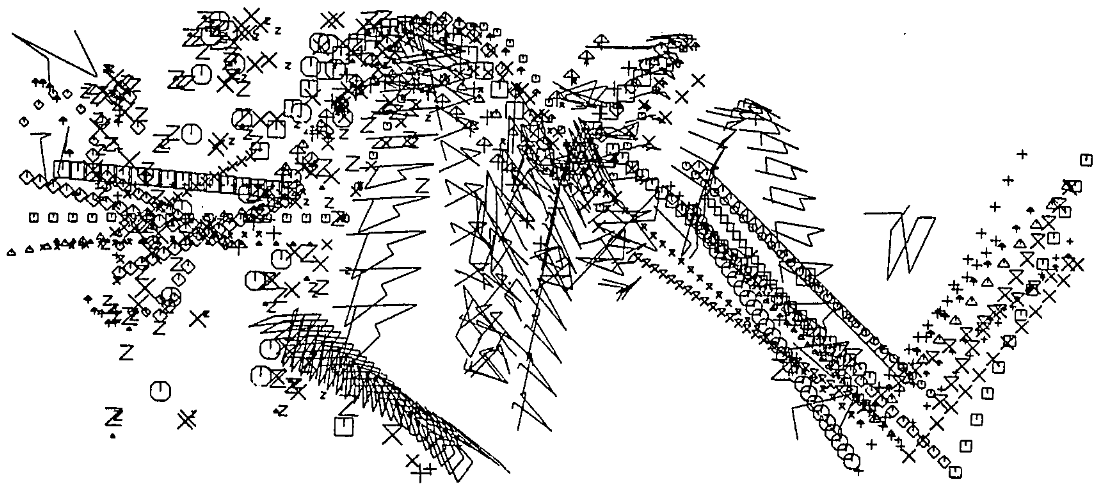




Source: Jones, "Compositional applications," 56.

Another option is illustrated in Example 5-24. This computer-generated "composition for interpreters" is intended to provoke sound images in the mind of the reader of the notation, and in that sense it exhibits an essential element of conceptual notation.

Example 5-24: *Mutatis mutandis 33*, by Herbert Brun.



Source: Roads, "Symposium on computer music," 42.

Conceptual Notation

The constitution of a traditional music work encompasses sounds and the hearing of them, a visual representation (i.e., notation) of the sounds or of the actions necessary to produce them, and reactions to both the hearing and the representation. The reactions, taking place in the minds of those who come into contact with the music, involve perception and, in a larger sense, experience. William Dougherty's explanation of Ferdinand de

Saussure's conception of signs touches on some important distinctions.

> Signs are relational identities that consist of two separate (but inseparable) parts -- the signified and the signifier. . . . For Saussure, the signified constitutes the conceptual aspect of the sign-function while the signifier embodies the more physical aspect. [Nonetheless], the "sound-image" [i.e., signifier] is not the actual material sound, but "the psychological imprint of the sound, the impression it makes on our senses."[8] (This distinction attempts to account for non-physical processes of communications as in, say, mentally "talking" to ourselves. In music, an analogous situation arises when we mentally "listen" to a composition.) Conversely, "concept" [i.e., signified] refers to the mental image evoked by the signifier. Thus Saussure's sign-function is a Janus-like form which mediates between the world of thought, on the one hand, and the world of sound-images, on the other.[9]

The idea of sound images is important to what is occurring when composers, analysts, and ethnomusicologists use listening scores to describe electronic and computer works or unnotated works from other cultures.[10] The

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[8] Ferdinand de Saussure in William Dougherty, "An examination of semiotics in musical analysis: The Neapolitan complex in Beethoven's op. 131" (Ph.D. diss., Ohio State University, 1985), 21.

[9] Ibid., 20-21.

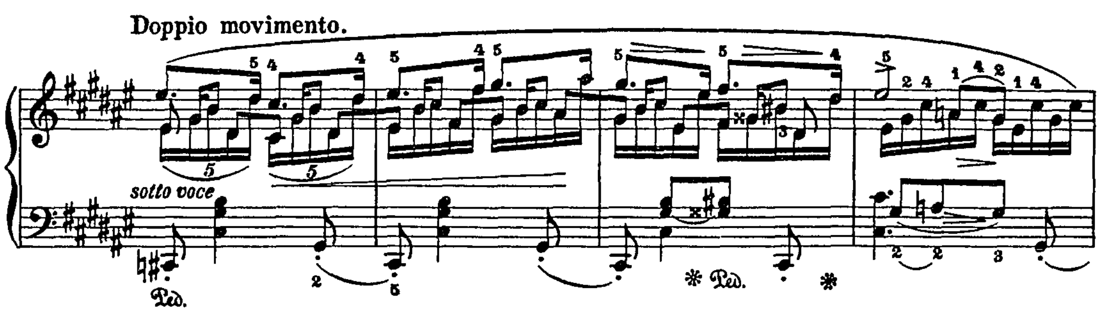
[10] Another term for this kind of score is *Horpartitur*. Rainer Wehinger's listening score for G. Ligeti's *Artikulation* is discussed in Goffredo Haus, "EMPS: A system for graphic transcription of electronic music scores," *Computer music journal* 7:3 (Fall 1983): 31-32; and Jean-Jacques Nattiez, *Music and discourse: Toward a semiology of music*, trans. Carolyn Abbate (Princeton: Princeton University Press, 1990), 81-82.

notations engender sound images which in turn may or may not indicate some further meaning.

Just as some composers feel that music is primarily about sounds and hearing, others feel it is about representation and thought.[11] No matter which perspective one takes, however, musical sounds are clearly more than simply auditory sensations. Similarly, music notations are more than visual perceptions. The mind, by interpreting notations, brings external factors to bear on the experiencing of them. Conceptual notations focus on the primacy of human interpretation.

All notations are to some extent conceptual. A complete understanding of the notation by Chopin in Example 5-25 requires a great deal of interpretation.

Example 5-25: *Nocturne*, op. 15, no. 2, by F. Chopin.



Source: Chopin, *Nocturnes*, 25.

[11] For a discussion of these two perspectives as exemplified by the theories of Pierre Schaeffer and Pierre Boulez, see Nattiez, *Music and discourse*, 97-100.

Slurs are frequently used in traditionally notated music to indicate phrasings or simply a feeling that the part of the music contained within the limits of the slur should be considered in one way or another as a unit.[12] When slurs cross bar-lines to encompass a relatively large number of measures, or when they seem to contradict melodic or harmonic structures, the appropriate consideration is usually more conceptual than performative (though these perspectives certainly do not exclude each other).

It is often the case that notation requires amplification in the minds of interpreters. Rock and jazz improvisers may use extremely abbreviated notations to stimulate mental and performative responses. Thus, a few small marks on a page -- notation that may not even provide any indication of dynamic levels -- could result in a guitar chord so loud that members of the audience can practically feel the sound waves bouncing off their faces.

The elaboration of some scores is purely mental -- no actual sounds are encountered or expected, only sound-images. This type of notation is found in works designed for silent imagining such as *Musik zum Lesen* (Music to

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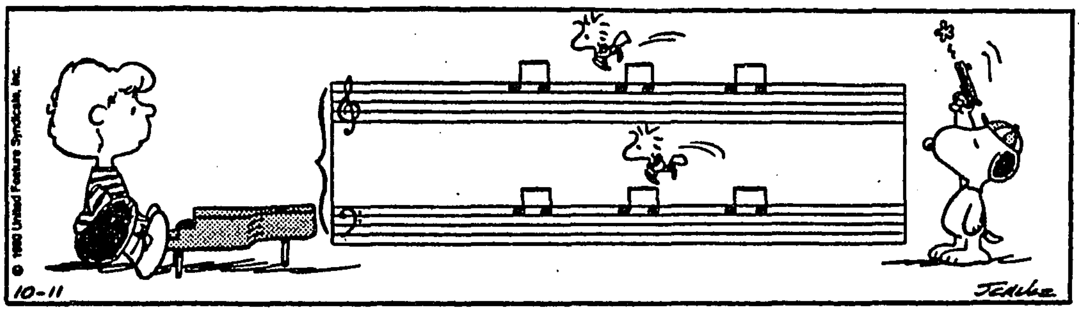
[12] For more on slurs, with several notated examples, see Hugo Cole, *Sounds and signs: Aspects of musical notation* (London: Oxford University Press, 1974), 84-86.

Read) by Deiter Schnebel; in comic strips,[13] like the one in Example 5-26 (also see Example 7-2); in photographs, prints, drawings, and paintings by visual artists like Saul Steinberg and composers like John Cage; and in theoretical and pedagogical works.

Example 5-26: "Peanuts," by Charles Schulz.



Source: San Francisco Chronicle (October 11, 1990), D-8.

Theory notations include those by composers like Arnold Schoenberg, who devised symbols to indicate primary and secondary melodic lines, and by theorists like Eugene Narmour who devised a set of symbols for analyses based on the implication/realization model.[14]

[13] For a score based on comic strip figures and intended for use in the production of real sounds, see Cathy Berberian, *Stripsody* (New York: C. F. Peters, 1966).

[14] See Eugene Narmour, "Toward an analytic symbology: The melodic, harmonic and durational functions of implication and realization," in *Musical grammars and computer analysis*, ed. Mario Baroni and Laura Callegari (Florence: Olshki, 1984), 83-114.

What all of these notations have in common is not only a focus on interpretation as well as some aspect of the notation outside the signs themselves, but also a sense of straining at the confines of what music notation ordinarily is conceived to be.

> When composers invent music that a semiographic system can no longer represent, a period of crisis ensues, in which composers cannot free themselves totally from the old system, yet they seek to represent their intentions by means of new notational signs, which -- because new -- are often without universal meaning. This situation will give rise to different attitudes toward the score: from searching for optimally precise notation, or tentatively inventing new universal symbols, to rejecting the score, or making an ironic mockery of it.[15]

In efforts to expand the old system, interpreters, whether they be the composers or other people perceiving the notation, serve as the instruments onto which the notation is mapped. An interpreter might even "map" that which is not commonly thought of as notation. Thus, in the manner of Marcel Duchamp and his ready-made art, messages can be drawn from ordinary objects re-contextualized to carry some musical meaning. It is a distinct ambition of much contemporary art to organize new modes of perception and sensibility in this way. Conceptual notation is music's contribution to the cause.

The ideas behind conceptual notation lead to larger formations concerning how notation works among those who

[15] Nattiez, *Music and discourse*, 79.

use it in processes of communication. A good deal of theory in disciplines outside music involves the study of communication and the invention of models to describe it. In the next two chapters I describe some of those models and try to extrapolate a broad set of ideas from a similar paradigm, the sender/message/perceiver/result model.

INTERVIEW FIVE

Roger Reynolds

A composer and teacher, Roger Reynolds co-founded the ONCE group of experimental composers in the 1960s in Ann Arbor, Michigan. He has organized festivals in the U.S., in Europe, and especially in Japan. He teaches at the University of California, San Diego, where he founded the Center for Music Experiment and where he has added numerous computer music pieces to his catalog of works which incorporate a wide range of techniques and media. His music has been particularly influenced by his interest in science, mathematics, and human consciousness. We had this conversation on June 20, 1989, in La Jolla, California. In it Professor Reynolds examines the successes and failures of experiments in notation during the 1950s and 1960s, the constraints and possibilities computers impart to notation, and the difference between the notation and the message.

Wood Massi: In your book *A Searcher's Path* you write about the tools of contemporary artists, including architects. You discuss how steel and reinforced concrete extend the range of the architect's aesthetic. What is the contemporary equivalent, in music notation, of steel and concrete?

Roger Reynolds: In the period from about 1950 to 1970, notation was used in a lot of ways: as an act of defiance, as an act of punishment, as an act of personal assertion. I look at much of the extreme forms of notation that happened in that post-war period as having been directed at the musical establishment, either the individuals who represented the establishment at that time, or the tradition in general. And I look at them as having been, at the beginning, primarily a kind of corrective device. Later there was perhaps more of a creative urge under the utilization of unusual graphic or notational conventions. . . . The corrective thing was to say, "The standard stimuli that you have learned to use as a traditionally trained musician are part of the reason for which you are limited in your ability to express new music, or to deal with newer musical materials. One of the ways that we're going to show you this is by putting in front of you a stimulus which is not to be understood as a matter-of-fact translation of well-known purposes.

In other words, the notation says that we expect of you a broader, or more fluid, or adventuresome, a less constrained use of your capabilities as a musician." This is addressed to a performer or a conductor. My feeling is that much of that was a negation rather than an affirmation of the genuinely new.

However, I think that later, as notational innovation was explored more, and certain attractive results were achieved, it became more and more an honorable, perhaps even an affirmative subject in and of itself. After a while, it, like any permissive, evocative system, ran up against the barrier of how much more you can elicit from someone who is presumably capable, when you give them less and less in the way of a guide, of a goal, of a challenge. Of course, some of the most elaborate graphical representations of music in those years, were extremely complex and detailed from the standpoint of their graphic surface. But that isn't to say that what they actually demanded of the player or of the conductor was equally complex. . . .

If we look at the situation now . . . we see that there has been a very marked, almost astonishing, diminution in the amount of interest and belief that these conventions still are necessary to achieve these composers' goals. You could say that that was because the goal -- if my off-the-top-of-my-head notion of corrective or defiant purpose were true -- the corrective either has been achieved, or as much as seems necessary or likely to occur, has been achieved. Therefore there's no reason to continue to antagonize or drain the overall situation by continuing to be "unreasonable," if indeed these ever were unreasonable. That's one possibility.

The other possibility is that it just didn't turn out to be the case that the areas of musical organization and expression that were opened by means of these new conventions are as fruitful as might have been expected. . . . The traditional idea that everybody should be relating to one constant, external frame of reference -- a conductor, a tempo, anything like that -- was rightly considered debilitating. [The belief was] that releasing musicians from that would somehow create a more elegant texture to the music, linearly; or that performers would be inclined, spontaneously, to choose a more lively range of paths through musical materials than the composer sitting in his studio was likely to dream up on his own; or that the range of useful timbral variation was going to be somehow opened in a profitable way, by allowing symbols to suggest their own sound attributes. It seems now as though those kinds of goals don't turn out to have been served so successfully by these tactics, or that the goals in themselves were simply not as fruitful as might have been thought originally.

I feel that the critical element that remains an issue is that which [Iannis] Xenakis has claimed credit for, that is to say the idea that every element of music is a continuum, and that it should be no longer possible to speak of pitch only as a tempered and stepped phenomenon, or of consistent timbre as basic to the identity of a voice. It seems to me that if we look at the residue of these decades of experimentation, I would guess that the biggest factor that remains a force . . . is the idea that we don't need to remain within one frame of reference from moment to moment. . . .

WM: The experimentation in notation . . . opened the way to an acceptance of continua or the understanding of the continuous nature of various musical parameters.

RR: Same thing with glissandi, same thing with gradual variations of vibrato or sul ponticello to sul tasto. Things of this sort, which I think would have been considered rather fussy in earlier scores, may have a slightly larger role than they used to . . . although perhaps notated in a more straightforward, traditional fashion. A flexibility of the ear and mind was generated in that period. . . .

WM: That reminds me of Leonard Meyer's interest in secondary parameters. One way of looking at what happened is that the concern for secondary parameters is sent back onto the primary parameters, and opens our ears to the continuous nature of them, because the secondary parameters -- like dynamic levels, or tempo -- are almost of necessity continuous.

RR: . . . He's probably right. But a great deal of the flexibility with regard to pitch and pitch systems, tunings and so on, that was very widespread in the '60s, has not been followed up on. It could be argued that the flexible use of musical specification within the pitch domain is ornamental, that is, largely expressive and texture-creating, rather than primary. . . . I think that notation has been less a producer of material in and of itself, than a kind of liberator of the use of material.

WM: What about notation and computers?

RR: . . . It's certainly the case that the computer has required a lot of detailed and explicit description of what it was that you wanted. Now, that, too, is probably going to turn out to have been an initial era. . . . I don't believe that the tedium and also the explicitness that has been required by synthesis on computers from the beginning, is going to remain that way. . . . There's probably going to be a great rise in the number of graphic aids, mouses, whatever, that will little by little allow you to do things by ear, to tune things, to shift spectra, to perform all kinds of operations in a continuous fashion.

WM: Perhaps there's a parallel between the rise of early electronic music and rise of these very free graphic forms [during the 1950s]. In the '80s computers began to take over, and there developed a concomitant specificity in the notational practice, even in music which has no computer connections at all. Perhaps now the pendulum is going to swing back.

RR: I think it's very unlikely that there will be a new wave of demand, or defiance, or pushing at the edge. . . . I don't see us getting back to a looser relationship between the composer and the performer.

WM: Maybe the looseness will come at a different part of the communication process, the listener and the composer, rather than the composer and the performer, or through some connection between computer graphics and sound. For instance, by showing the audience the score we can make a clear connection between the visual of the music and the aural of the music, [creating] a more direct relationship between the composer and the listener where the technology becomes the performer.

RR: . . . The problem is that when you get a bimodal experience, there is very often a kind of interfering, a destructive influence where one modality will override the content of another. You almost are obliged to go for a trivial message in one channel in order not to degrade the quality and complexity of the message in the other, although I think it is not inconceivable that one could develop a kind of neutral but not irrelevant visual world, for particular kinds of music. . . .

Programs containing the information necessary to create a musical passage, that those kinds of scores were so detailed, is really a function of the generality of computer music synthesis. . . . In music that is not computer music, the relationships between performers, or the stability of instruments as physical systems, are taken for granted; whereas in computer music, everything can change. . . .

The importance of functions is, of course, very great. You don't see the functions on the score of *cmusic* specifications. You see a lot of macros and other kinds of representations in further stages of elaboration. [In computer music] less springs to the eye than it does in the case of traditional music notation.

WM: It's more symbolic than iconic.

RR: Yes . . . we have learned over time to make a fairly economical representation of all that the musician needs to know on one two-dimensional sheet of paper. And the only bifurcation you have is the too little examined distinction between an individual part and a score. But in computer music, it's never the case that any one comprehensive set of representations gives you the whole picture. You're going to have to have an initial score, a definition of instruments and functions, any macros that are involved, any sub-routines or processing like note lists. . . .

WM: All of that is similar to the relationship between the parts and the score in traditional music notation.

RR: It's valuable to have a coordinated partial picture of the whole. If you looked at some of Cage's scores, in the *Sonatas and Interludes*, there was [in the instructions for preparing the piano] a definition of the instrument included within the score. . . .

The specification of data necessary to create a passage of computer music doesn't allow you nearly as much access to matters of musical convention [as in traditional music, where] all kinds of things do not need to be specified -- for example, where open strings are involved. . . . There are all kinds of things that are fundamental to those instruments, that any musicians knows as a part of his training, but which of course would not be known by the computer. In a parallel situation, they would have to be specified. So, you might say that metaphorically, the macros, in the case of the composer of traditional instrumental music, are a part of his orientation to the field of music. . . . It's simply built into the plan.

WM: So you could look at the cello as a macro, or a set of macros. . . .

To what degree are the parts of traditional or computer music notated similarly to the whole, or to other parts?

RR: . . . Instead of elevating notational concerns . . . I would propose to you that computer music notation might be seen as a crude tablature, an aspect of a very powerful system which is not at a mature point in its own self-definition, being put at the service of an extremely sophisticated and complex field of endeavor. You have this problem that the fluctuation of sound is incredibly subtle. And the machine is incredibly literal.

WM: Certainly there is the complex nature of the sound, and the powerful nature of the computer. But you can also think of overlaying that with a complexity of reference, and meaning . . . by using some sort of poetic level of reference in computer notation -- for instance, naming our macros after artists, or states of mind, or something like that -- so that when one reads the score, one is not just reading letters and numbers, but is experiencing the input of things that bring up feelings. . . . It's a way of expanding the referential nature of the notation, of making it refer on more than one level.

RR: But are you saying, that somehow instead of calling a whole note a whole note, if we called it a total note or a complete note or a fulfilled note, that it would be different?

WM: Yes, I think it would be. To the reader of the score it would become an entity in itself.

RR: It would be murkier. . . . I think notation is quite important enough without you having to attribute to it status that it doesn't need, or that it can't really address.

WM: By expanding the referentiality of a particular notation, there is a cost paid in communication ability. It's not as useful, perhaps, towards creating a sound object as it would be if we didn't think of the notation as independent in some ways. But this can be thought of as just another manifestation of what has happened a lot in this century: artists moving to the surface of what they're dealing with, getting into writing for writing's sake, using letters and syllables the way John Cage or James Joyce do.

RR: . . . Movement to the surface of things, you feel that that is a goal rather than a transitional behavior? . . . I have trouble seeing it as sufficiently rewarding to actually become the basis of an era. I see those kinds of extremely fluid situations as being explorative or intermediary circumstances, situations in which artists need somehow, for a time, to be more immersed, or to be less directed. . . . Again, I see it as a kind of corrective, rather than a place that someone arrives at as the subject, the authority, the norm that one then wishes to really live within. . . .

WM: What is the difference between the message of the music notation and the message of the sound? Or the message of the event as a whole?

RR: . . . I think that it's not the case that music *is* notation; and I don't believe that notation *specifies* music. I think that notation *elicits* music in collaboration with a whole range of understood information: . . . the transforms and filters of tradition, of habit, of training, of air temperature and moisture; the weight of the body, but also the body of the instrument, the particular instrument, the class of instrument; the place in the acoustical setting, in which the instrument is performed -- all these things. There's a virtually endless list of things, which are not specified in the score, although they may in some sense be indicated. . . .

The swelling G-string on the violin carries with it, certain kinds of other auditory images quite apart from the question of what note it goes on to. There's something about that sound in itself that resonates, literally as well as figuratively, with other phenomena; and I think that there's no way that notation is ever going to be complete.

[What about this as a] definition of performance: the enlivening of the abstraction of the specifications of the notational system. . . . If a child plays a Schubert Impromptu, or Rudolph Serkin plays it, then why is it one may tenderly touch us and the other profoundly move us; or one might irritate us, and the other reward us? . . . If you were being objective about it, you would say that the actual variations between the sound events in those two performances might be of an extremely small order, that is to say their correlation would be extremely high. And yet, somehow, the small degree of variation between the two carries a very large percentage of the actual message. You might say that the harmonic, melodic, rhythmic, [or notational aspects are] all, in some sense, only the carriers, and not the messages at all. The message is somehow in the manipulation of that carrier structure. [These] are mysteries with which it seems to me, perhaps unfortunately, music notation deals with almost not at all.

CHAPTER SIX

Notation Processes and Models

Sensing, perceiving, using, inscribing, referring, intending, receiving, and changing are all integral to the process of notating music. Decisions, choices, definitions, and assignments precede action; and information and feedback usually follow it. Processes are the where, how, and who (or what) of such operations.

Both the context and the objects of processes are structures. So far, we have considered several types and structures of notation, along with several representative systems or worlds in which they operate. All of these formations, schemes, or patterns employ processes. The current chapter deals with, among other procedures, the creation, interpretation, and reception of music.

Processes tell "about what we do, not about the fixed being of things."[1] Action and time characterize processes. "Notation is a symbolization of process over

[1] Terry Eagleton, *Literary theory: An introduction* (Minneapolis: University of Minnesota Press, 1983), 9.

time."[2] Notation processes operate mechanisms, structures, systems, and worlds to produce texts. They are thus diachronic symbolizations and tend to be expressed prescriptively -- though that is not always the case. Representing a changing system with iconic, figural notations is possible when "snapshots" from different moments in time are presented in a sequence; for example, frames in a movie, or notes in a traditional score or a computer note list. When combined with alphanumeric notation this becomes a powerful way of communicating.

Taking a cue from literary theory, try replacing the concept of notation as a work, or static structure, with that of notation as a text, the pluralistic process of experiencing the music. Though structures provide contexts for processes, processes rupture stasis and create new foundations for new structures. In this conception, the text invokes other texts. The number of interpretations is infinite because signification is continuous, not static. Since use and meaning are never fixed in time, there is no "final" structure when applied to the communication of musical meanings.

Despite the fluid nature of interpretation, complex precision is appropriate to many kinds of representations

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[2] John Anthony Celona, "Structural aspects of contemporary music notation; and, command-string notation: A new music notational system" (Ph.D. diss., University of California, San Diego, 1977), 3.

of music. The structuring nature of constraints -- style, code, convention, etc. -- harnesses meaning in both computer programming and composing. Programming, of course, involves a good deal of analyzing communication processes. Meaning has to be well-defined, and notation can help define it. The complexity of processes of electronic music, for instance real-time performance or the parallel processes used in artificial intelligence applications, call for tight, complex languages, at least at the primary levels of abstraction.

The multi-dimensional, simultaneous control available with computers encourages attention to the instrument itself and models of sounds we already know, and opens up timbre as a compositional resource in a way unknown until recently. As a result, timbre has become more prominent among the diverse array of processes confronting musicians. It is in grappling with a great diversity of issues that users conceive, collect, fashion, and define notations and models of music. This extended process is fundamental to all the other processes associated with music and its notation.

Communication Process Models

"A good model is also a good tool, and can be used equally well to generate new structures as to analyze existing ones."[3] To facilitate a consideration of music notation, I would like to propose a prototype called the sender/message/perceiver/result process. I have used this model to try to understand some of the other models I have encountered. It is useful in illuminating the essential processes of music and notation, such as acting, and perceiving (which is a kind of acting), and changing -- as well as the process of simply existing, being.

Since the foundation of the sender/message/-perceiver/result model rests on models devised by several disciplines concerned with communications, perhaps a description of some of these is a good way to define the outlines of the sender/message/perceiver/result process. They hold in common their function as models: they all collect facts, filter impulse and intent, and focus attention. They differ in the parameters each model emphasizes and in the ways it maps changes in the structures it represents.

[3] Gerald J. Balzano, "Command performances, performance commands," *Contemporary music review* 4 (1989): 440.

The linguistic model offered by Roman Jakobson comes close to the sender/message/perceiver/result model. He outlined six parts of the communication act:

Context

Addresser Message Addressee

Contact

Code

> The addresser sends a message to the addressee. To the operative the message requires a context referred to [and] seizable by the addressee . . . ; a code fully, or at least partially, common to the addresser and the addressee (or in other words to the encoder and decoder of the message); and finally, a contact, a physical channel and psychological connection between the addresser and the addressee, enabling both of them to enter and stay in communication.[4]

Jakobson's model emphasizes the fact that a great many factors impinge upon the message. In the sender/-message/perceiver/result model, I equate the sender with the addresser, the perceiver with the addressee, and the message with the aggregate constituted by the medium (contact), the reference code, and the meaning as experienced by both the sender and perceiver. All these elements function within a context, as does the final element (which I add to the Jakobson model), the *result*,

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[4] Roman Jakobson, *Essais de linguistique generale* (Paris: Minuit, 1963), 213-214; cited in Jean-Jacques Nattiez, *Music and discourse: Toward a semiology of music*, trans. Carolyn Abbate (Princeton: Princeton University Press, 1990), 18.

embodying the changes the process generates. Defining the basic elements of any act of communication or symbolization, whether musical or otherwise, will go a long way toward defining the total reality of the communication itself.

Communication is complex and dynamic. Seen from the various perspectives included within the sender/message/-perceiver/result model, it is expressive and psychological (sender), structured, representative and referential (message), volitional and dynamic (perceiver), and social (result). The context effects the communication and the communication effects the context.

The message itself may be a statement, a question, or a command; like English, it may be indicative, interrogatory, or imperative. Taking music notation as an example, computer music note lists and most descriptive traditional music notations are statements; open forms, indeterminate notations, and computer functions such as "FOR" and "IF" are questions; and prescriptive notations are commands. But communications, and language in particular, can also function in other ways and on other levels. For example, communication may be metalinguistic when it refers to the code currently in use. Music is metalinguistic when it varies and develops motives and themes previously stated. Similarly, communication is poetic when it is taken for the intrinsic value of the message itself. There is also phatic usage, as when communication serves simply to establish contact between the sender and the perceiver. Perhaps the musical equivalent here would be the sounding of the pitch A 440 to tune up an orchestra. Clearly, it is no easy task to detach one aspect of any communication process from others, but the attempt is worthwhile.

Language Models

Language stands between the sender and the perceiver, forming their physical and conceptual connection. Many theorists divide the study of language into phonology, syntax, and semantics, for which John Sloboda offers the following definitions:

> Phonology concerns the way in which a potentially infinite variety of sounds are "parceled up" into a finite number of discrete sound categories which constitute the basic communicative units. Syntax concerns the way in which these units are combined into sequences. A major concern of those studying syntax has been the discovery of rules which reliably produce legal sequences, and eliminate illegal ones. Semantics concerns the way in which meaning is carried by the sequences so constructed. Particular fixed combinations of phonological units can have fixed meanings, but it is a characteristic of both language and music that meaning is also carried by the

> ordering and combination of elements in longer sequences.[5]

According to this view, language creates maps, analogies, and isomorphisms by setting up relationships among phonological, syntactical, and semantic units which it then uses to form classes.

Representation might be seen from a more expansive perspective as a process involving actions leading to some outcome among people. The process involves analysis, selection, and recombination, and an understanding of the pragmatic, or contextual, aspects of language. Arno Penzias contrasts semantic, syntactical, and pragmatic analysis with the following example: If we change the semantically clear sentence "Have the boys refused the tea and coffee?" to "Have the boys refuse the tea and coffee," we find that the meaning of the first word now depends on that of the fourth. This is syntax. If we say, however, "The boys refused the tea and coffee because they were too cold," then "extracting the meaning represented by these words calls for a pragmatic understanding of what people drink -- an understanding of culture."[6]

Questions of syntax, semantics, and pragmatics help to classify languages. Communication using language

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[5] John A. Sloboda, *The musical mind: The cognitive psychology of music* (Oxford: Clarendon, 1985), 11.

[6] Arno Penzias, *Ideas and information: Managing in a high-tech world* (New York: Norton, 1989), 71.

depends on the symbiotic relationship among structures (representational constructions), processes (analyses, selections, and recombination), and their contexts. Furthermore, all languages attempt to standardize, codify, and regulate the connections among their constituent parts. The connections among the components of artificial languages, as opposed to natural languages, are much more explicit. Natural languages are the ones we use every day to communicate with other humans. Artificial languages are what machines, and diverse kinds of theorists use.

Natural languages -- such as English, and within music's limited domain, traditional notation -- are cultural, inferred from usage. They are informal, context-oriented, and in several senses of the word pragmatic. It is relatively easy to acquire competence in them, so they are known widely. Their regulating grammars are variable. They are flexible and multiplex, communicating with gestures as well as tonal and referential inflections, and possessing unlimited vocabularies. (The latter characteristic, though certainly applicable to broad languages like English, seems to relate to graphic more than to traditional music notation.)

Artificial languages -- like Morse code, strict Schenkerian musical analysis, or computer languages -- are sometimes called formal languages. They are rule-based and syntax-oriented. Unlike natural languages, they are unambiguous, logically rigorous, and closed systems. Learning them requires a special effort outside everyday interactions. Their vocabularies are limited and their uses usually quite specific.

Music is both a natural and an artificial language. The bibliography of this dissertation lists a large number of treatises comparing language and music. One, which focuses on natural language, is Leonard Bernstein's *The Unanswered Question*. He compares the following musical and linguistic units:[7]

Music	Language
note	phoneme
motive	morpheme
phrase	word
section	clause
movement	sentence
rhythm	verb
melody	noun
harmony	adjective

[7] Leonard Bernstein, *The unanswered question: Six talks at Harvard* (Cambridge, Mass.: Harvard University Press, 1976); see especially Chapters 1-3.

Though Bernstein admits problems with the analogies he makes, he creates them to focus attention on the structures of both systems.[8]

How, exactly, is music similar to spoken language? They are both auditory phenomena possessing duration, pitch, loudness, and timbre. They are both founded in culture; all human groups, and only human groups, use them (not to discount the work that has been done by zoo-semiologists and composers like Olivier Messiaen). Both language and music are arbitrary, repetitive, structured, and capable of creating unlimited sequences of events. They both use notation.

There are, however, very real differences between language and music, the most primary of which seems to be that they have different fields of reference. Ask yourself, what is the vocabulary of music? John Sloboda points out that music has no reference to the "real" world.[9] Music, in other words, is more metaphorical than language. Furthermore, the language model of music, especially in its structuralist manifestations, may

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[8] Keiler's work in the semiotics of music reveals other problems with the language-music model presented by Bernstein. See Allan Keiler, "Bernstein's *The Unanswered Question* and the problem of musical competence," *Musical quarterly* 64:2 (April 1978): 195-222.

[9] See Sloboda, *Musical mind*, 11.

conceal important musical aspects such as the surface level changes taking place.

Language and music are one thing; the notation of them is another. Any notation seems essentially to be artificial. It is a substitute for the thing conceived as real. The context and field of reference of writing and traditional music notation specify explicitly what they represent. On the other hand, if one privileges writing -- as the grammatology of Jacques Derrida and works by French lettrists do -- one isolates writing as a closed system. Within this structure, it takes on more of the qualities of natural language.

The same is true of music notation. Once the primary relationships between the signs and what they stand for has been set up, the flexibility and subtlety, and the ambiguity of reference, available in graphic representation are again accessible. The system becomes capable of representing dynamic processes as they change from one state to another, of providing built-in utilities for resolving ambiguous references when necessary.

Though as closed systems writing and music notation have similar attributes, the differences between them are rooted in the differences between language and music. Music is more abstract. To symbolize something it has to pull itself up by its boot straps; it must, therefore, refer to itself more. Writing is primarily about language and music notation about music -- but language is about the world before it is about itself, whereas music is about itself before it is about the world.[10]

Representational processes in music are frequently examined by theorists from numerous fields.[11] In addition to those cited above, works by Roger Scruton, and Peter Kivy address the similarities between music and language directly. Paul Klee, Wassily Kandinsky, Jenefer Robinson, and others compare musical and visual representation processes. Writers such as Nelson Goodman, V. A. Howard, and Benjamin Boretz have taken broad theoretical perspectives using music and the philosophy of representation as mutual points of focus in their works. These latter writers take particular interest in defining exactly what constitutes notation as opposed to representation, description, exemplification, expression, and symbolization.

Finally, the process of music notation itself -- the flow of information among composers, sound producers, performers, analysts, listeners, hearers, perceivers, etc. -- is the object of models designed by Gerald Warfield and Doris Stockmann, among others. In addition to offering

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[10] For more on this, see Richard Kuhns, "Music as a representational art," *British journal of aesthetics* 18:2 (1978): 124.

[11] See citations for the following authors in the Bibliography.

several graphic schemes of notation, Stockmann suggests that a theory of notation might entail the following factors: achieving an understanding of the fundamental nature of music; separating the universal aspects of music from the historically and culturally determined aspects; placing music notation "within the framework of writing systems in general;" solving the problem of the "limits of the human eye;" and elaborating "an overall description of the construction of the notational code [through a] theory of signs."[12] Stockmann's list, like the aggregate of the models alluded to here, is quite inclusive, suggesting a variety of ways to study notation including aesthetic, cognitive, semiotic, and computational approaches.

Semiotic Models

Semiotics, or semiology (the latter term is more frequently used by the French, but otherwise is interchangeable with the former), has produced some of the twentieth century's most influential models of language, writing, and music. Semiotic theorists have concentrated

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[12] Doris Stockmann, "Two communication models and a theory of notation," in "Current problems in notation," ed. Igmar Bengtsson, 747-750, part of *International Musicological Society: Report of the twelfth congress, Berkeley, 1977*, ed. Daniel Heartz and Bonnie Wade (Kassel: Barenreiter, 1981), 746.

on semiosis -- the state, relationship, act, connection, or process between a signifier and a signified -- and on the infinite mechanism of interpretation this generates. The relationship between the signifier and the signified ultimately is arbitrary; anything can be a signifier and anything a signified. Their connection is almost always simply a matter of convention.

Perhaps semiosis can be taken to include both signification and communication. The latter invokes the question of intention more prominently. A foot print in the sand is a sign that someone has passed by; but unless that someone intends for it to say something, it is not communication. Compared to communication, signification is more central to perception and, therefore, more sensual, visual, and tactile, a process for which objects are more important, but also one in which qualitative and interpretive considerations are primary. It seems more related, therefore, to descriptive and iconic signs. Communication, in the sense I am using the term here (i.e., as separate from signification) is more procedural, quantitative, implying a sender connecting with a perceiver. It is more immediately dependent on prescription and symbolization by convention.[13]

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[13] For a related discussion of "mechanisms of indication," see "Semiotics as a Theory of 'L'Acte Semique': Luis Prieto," in Sandor Hervey, *Semiotic perspectives* (Boston: Allen & Unwin, 1982), 59-92. It should be noted, however,

No matter how one specifies the process, the *sine qua non* of semiosis, signification, and communication is the sign. Charles Peirce, in his classic definition of a sign, said it "is something which stands to somebody for something in some respect or capacity."[14] Charles Morris expanded this to say that signs set up in interpreters "the disposition to react in a certain way . . . to a certain kind of object [i.e., absent], under certain conditions."[15] The sender/message/perceiver/result model parses the same elements like this: the message (i.e., the medium and code, within the constraints of meaning and context) sets up in perceivers certain reactions to entities which are not present. This definition, as far as it goes, encompasses what I have called "signification" above. To include "communication" one could say that the message, as a manifestation of a sender's intention, sets up in perceivers certain reactions and in the context certain changes of circumstances or probabilities (i.e., results). The common element in all these definitions

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that Hervey uses the term "communication" differently than I do. Also see the discussion of Jean Molino's idea that communication is only one of the potential consequences of symbolic processes, in Jean-Jacques Nattiez, *Music and discourse: Toward a semiology of music*, trans. Carolyn Abbate (Princeton: Princeton University Press, 1990), 15-28.

[14] Charles Peirce in Nattiez, *Music and discourse*, 6.

[15] Charles Morris, *Signification and significance*, (Cambridge, Mass.: MIT Press, 1964), 3.

seems to be that signs are stimuli. But signs come in all types, and the taxonomies offered by the theorists are manifold.

Ferdinand de Saussure was the first to specifically partition the sign into the signifier and the signified. Instead of thinking of these latter terms as the name and the thing named, however, he considered them the sound-image and the concept, thus firmly grounding his linguistics in the psychological realm. Given such a foundation, the importance of subjectivity and interpretation and the possibility of sign functions such as those encountered in conceptual music notation are not difficult to accept. A less psychological partitioning of the sign might see it as consisting of a sign-vehicle and its meaning, or as an expression and its content.[16]

In addition to Saussure's psychological view of the sign and the support it ultimately has lent to pursuits such as hermeneutics and reception theory, his work is the source of a great many other conceptions central to a complete understanding of languages and notation systems. Nattiez cites several:

> One of Saussure's most difficult ideas, because it is the most abstract, [is] that the sign is characterized by its value. It does not exist within a system of signs except by opposition to

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[16] Jean-Jacques Nattiez mentions the work of Louis Hjelmslev in this regard. See Nattiez, *Music and discourse*, 5.

> and difference from the other signs in the same system. [He said that] 'Language is a system of interdependent terms in which the value of each term results solely from the simultaneous presence of the others.' Saussure applies this idea of value both to the signified 'face' and the signifier 'face' of the sign. . . . In the Saussurian edifice, the notion of value demands that of interdependent relations. This is why Saussure is led to separate the synchronic from the diachronic (i.e., there is a system of language that is explicable independently of language's history), *langue* from *parole* (this system is embodied not on the level of individuals but in a linguistic collectivity), external from internal elements of language (the system exists only as relationships between internal elements).[17]

Saussure's differentiation between *langue* and *parole*, that is between language and speech, sees the former as the abstract communication structure and the latter as the individual instances used in concrete, everyday situations. Saussure used chess to illustrate the difference. The rules of the game are similar to a language, and the moves of the pieces in an actual game are like speech. Language transcends and determines speech, but it cannot exist without speech. The same distinction can be made with regard to the relationship between music notation and performance, or between a particular music notation system and how it is used in a given composition.

Charles Peirce who, other than Saussure, is the most important progenitor of semiotics, made a similar

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[17] Nattiez, *Music and discourse*, 5.

distinction by differentiating between what he called a type (the sign itself) and a token (how the sign is used in a particular instance). Peirce defined many more kinds of referential relationships than Saussure did. Within Peirce's vast taxonomies of referential entities, the distinction he makes among icon, index, and symbol is crucial. Sandor Hervey sums up the differences this way:

> (1) If the sign denotes its object by virtue of a real similarity that holds between physical properties . . . of the sign and physical properties of its object, [as, for example, when a trill in music is indicated by a wavy line], Peirce designates that sign as an icon;
> (2) If the sign denotes its object by virtue of a real cause-and-effect link . . . that holds between sign and object, [such as lightning signifying impending thunder or fever indicating disease], Peirce designates that sign as an index;
> (3) If the sign denotes its object by virtue of a general association of ideas that is in the nature of a habit or convention [as, for example, when a trill in music is indicated by the letters "tr."], Peirce designates that sign as a symbol.[18]

The differences between the icon and the symbol described here are the ones I use in Chapter Three to distinguish the iconic and symbolic types of notation from each other. I have not felt it useful to this discussion of music notation, however, to distinguish an indexical type (though perhaps a tape recording, to the extent that it is music notation, could be considered indexical).

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[18] Hervey, *Semiotic Perspectives*, 30-31.

Peirce saw the sign as a mediating phenomenon among an object, a representamen (roughly what Saussure called the signifier and others have called the sign vehicle), and an interpretant. Mihai Nadin has described the relationship from the object to the representamen as representation, from the representamen to the interpretant as expression, and from the interpretant to the object as knowledge.[19] I question the directionality of some of these relationships -- for instance, does expression flow from the representamen to the interpretant only, or does the interpretant have some part to play in its construction -- but the general scheme gives a good picture of how the triadic association works.

Signs are not independent. They are always related to other signs. Signs embody interpretations, but when an interpretation is formed, it becomes part not only of its own sign but of other signs as well. The interpretant is capable of merging with other interpretants, objects, and representamens to become a different sign, to establish a new set of relationships at another level or in a different context, thus forming an infinite chain of meanings or results.

Pierce's conception of the infinite interpretant is quite similar to Roland Barthes' idea of staggered systems

[19] Mihai Nadin, "Interface design: A semiotic paradigm," *Semiotica* 69:3/4 (1988): 270.

of signification. They both are subtle and difficult formations; but they enable the study of any system of signs to be expanded to include the largest possible domain. They constitute a sort of unifying theory of reference.

Barthes explained that a signifier and a signified, when fused into a sign, can be taken at another level of abstraction as the signifier of a new signified; and these in turn taken as the signifier of yet another signified; and so forth. Such a staggered system is central to Barthes' discussion of connotation and metalanguage.

> Any system of significations comprises a plane of expression (E) and a plane of content (C) and . . . the signification coincides with the relationship (R) of the two planes: E R C. Let us now suppose that such a system E R C becomes in its turn a mere element of a second system, which thus is more extensive than the first: we then deal with two systems of significations which are imbricated but are out of joint with each other, or staggered. [There are, however, two different ways of inserting the first system into the second.]
>
> In the first case, the first system (E R C) becomes the plane of expression, or signifier, of the second system:
>
> | | | | |
> |---|---|---|---|
> | 2 | E | R | C |
> | 1 | ERC | | |
>
> or else: (ERC) R C. . . . The first system is then the plane of denotation and the second system (wider than the first) the plane of connotation. . . .
>
> In the second (opposite) case of derivation, the first system (E R C) becomes, not the plane of expression, as in connotation,

> but the plane of content, or signified, of the second system:
>
> 2 E R C
> 1 ERC
>
> or else: E R (ERC). This is the case with all metalanguages: A metalanguage is a system whose plane of content is itself constituted by a signifying system.

The spinning out of an analysis of music notation incorporating the staggered systems model together with the infinite interpretant idea might run something like this: A system of dots fused into a tightly packed row signifies a line; lines and larger dots signify musical notes; notes and the sounds they elicit signify a musical event; musical events and the rules they manifest signify a musical style; musical styles and all that goes into maintaining them signify a musical culture; a system of different kinds of cultures signifies a society; a system of societies signifies humanity; humans and other animals signify consciousness; consciousness and other modalities of being signify existence; existence and non-existence signify the cosmos. Of course, the number of possible routes between the minute and the ultimate is infinite and may finally depend on the meaning given to them by the person or thing taking the trip, the perceiver. But that does not make the process senseless. The connections *do* exist; and it is by tracing them that one achieves a larger idea of what music notation is and can be.

During the past two decades, semiotic theorists have begun to turn their attention to music as a sign system, though as yet music notation per se has not been the focus of much semiotic study. The leading scholar in this field has been Jean-Jacques Nattiez.[20] Perhaps the most important paradigm Nattiez uses is the semiological tripartition which the author derives from the work of the French linguist Jean Molino. Basic to this model is the premise that music -- or any other social or cultural configuration -- must be understood not only as a self-contained object, "a whole composed of 'structures' [but also] the procedures that have engendered it (acts of composition), and the procedures to which it gives rise: acts of interpretation and perception."[21] These three aspects of the tripartition are called the immanent (or neutral, or trace), the poietic, and the esthesic levels of music. Nattiez schematizes the relationship among the three levels as follows:

poietic --> immanent <-- esthesic

These components correspond roughly to what I have called the sender, message, and perceiver. The left pointing

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[20] Some of what follows is taken from my review of Nattiez' *Music and discourse: Toward a semiology of music*, in *Notes* 48:4 (June 1992): 1286-88.

[21] Nattiez, *Music and discourse*, *ix*.

arrow is crucial to Nattiez' interpretation for it is his contention that meaning is created by the perceiver as much as by the sender.

One effect of using a semiological model such as the tripartition to analyze music and discourse is to broaden the perspective of the analysis, motivating it to include a qualitative consideration of the entire lived experience of the producers and consumers of a work or theory. Thus Nattiez brings his semiological and epistemological investigations to bear upon the analysis of music. "An analysis in effect states itself in the form of a discourse -- spoken or written -- and it is consequently the product of an action; it leaves a trace and gives rise to readings, interpretations, and criticisms. . . . Discourse about music is a metalanguage".[22] Nattiez uses the semiological tripartition model, as well as the idea of the infinite interpretant, to provide a coherent and critical framework for the study of musical metalanguages, the analysis of analyses.

The gap between the world of semiotics and that of computers is wide, even though they both have generated a large number of communication models. They seem to hold in common an affinity to language. Semiotics' approach to

[22] Nattiez, *Music and discourse*, 133.

language, however, is more humanistic whereas the approach by computer science is, of course, more mechanical.

Computer Models

Information, data, codes, programs, compilers, filters, interfaces, feedback, input/output -- these are all conceptions associated with computers and other electronic machines. The primacy of machines and their use is really nothing new to music. Musicians probably always have used musical instruments, and for centuries they have used complex models of musical structures and processes as well. Music notation is one such model; but it has traditionally been limited to a relatively small portion of the total musical phenomenon, or the musical fact, as Nattiez calls it. With the ascension of computers and the myriad designs and operations they manifest, come new ways of looking at music and its notation.

Like music, computer science has drawn heavily on paradigms established by other disciplines such as linguistics, but particularly mathematics. Much of the power of mathematics originates in its independence from context. Though I have repeatedly cited limitations inherent in traditional music notation -- limitations associated with a similar independence from context -- it is precisely this aspect which makes notation so handy. Some people even think of it as a universal musical language because it need not necessarily be tied to any particular verbal language -- this, of course, ignores its ties to western tradition as a whole.

Information theory, another field which has been a source of models for both computer designers and music theorists, has also gained theoretical strength by framing its issues in terms of closed, self-sustaining systems disengaged from contexts. It is no accident that information theory enjoyed a prominence in numerous fields at the same time as structuralism. Information theorists isolate patterns to assess their "informedness;" but they raise the level of perspective to include contexts as larger patterns. "Information is the technical term for a measure of the degree of randomness exhibited by a pattern of events. A totally random succession of events would produce a state of maximum informedness."[23] Phenomena characterized by low information are redundant. Giorgio Tedde's phenomenology of musical communication takes account of information theory by pointing out that the first part of a typical piece of music has

> low information values conjugated with high redundancy values: it serves the global

[23] Edgar Coons and David Kraehenbuehl, "Information as a measure of structure in music," *Journal of music theory* 2:2 (November 1958): 129.

> structure as a code instruction function. [Then come] increasing maxima of information, and corresponding dropping values of redundancy: after the grammar and dictionary instruction phase, there is the development of its specifically learned language. . . . Breaking previous symmetries leads to higher ambiguity degrees which extend the original code.[24]

Here Tedde is speaking of specific music compositions, but the same logic can be applied to computer languages as they developed from extremely redundant binary machine codes to high-level languages (more on this later). This information theory model is even useful as a way of looking diachronically at the historical and social development of music notation, taking traditional notation as the early stage and graphic and high-level computer notations as a later stage when the code and grammar are expanded to encompass new degrees of ambiguity as well as precision.[25]

From differing perspectives traditional music notation exists either as a structure independent of its interpretation, or as an element of a larger system encompassing the behavior of the humans who use it, or as a part of an even larger construction. The comparison by

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[24] Giorgio Tedde, "Phenomenology of musical communication," in *Proceedings of the International Computer Music Conference, 1986*, ed. Paul Berg (San Francisco: Computer Music Association, 1986), A-11.

[25] For an interesting discussion of a similar topic, see Barton McLean, "Symbolic extension and its corruption of music," *Perspectives of new music* 20:1-2 (1982-1983): 332-356.

Lounette Dyer of traditional and computer music systems illustrates some of the similarities between human and machine music models.

> A computer music synthesis system is homomorphic to the real world orchestra. . . . Scores are data, and the conductor and musician are processes. The instrument is a synthesis medium, either hardware or software. The conductor communicates global information to the musicians (and perhaps takes real-time input), and the musicians read their part, observe the conductor, and generate input for their instrument. The musician process is similar to a device driver. . . . The model maps to the following computer configuration: score (data file) --> conductor/musician (microprocessor) --> instrument (synthesis medium).[26]

Though there are abstract similarities between human and computer music systems, there are real differences between people and machines. The chart below compares some of those differences:[27]

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[26] Lounette M. Dyer, "Toward a device independent representation of music," in *Proceedings of the International Computer Music Conference, 1984*, ed. William Buxton (San Francisco: Computer Music Association, 1985), 252.

[27] C. Marlin Brown, *Human-computer interface design guidelines* (Norwood, N.J.: Ablex, 1988), 6.

Humans Generally Better:	Machines Generally Better:
• Sense low-level stimuli.	• Sense stimuli outside human's range.
• Sense stimuli in noisy background.	• Count or measure physical quantities.
• Recognize constant patterns in varying situations.	• Store quantities of coded information accurately.
• Sense unusual and unexpected events.	• Monitor pre-specified events, especially infrequent ones.
• Remember principles and strategy.	• Make rapid and consistent responses to input signals.
• Retrieve pertinent details without a priori connection.	• Recall quantities of detailed information accurately.
• Draw upon experience and adapt decision to situation.	• Process quantitative data in pre-specified ways.
• Select alternatives if original approach fails.	• Reason deductively: infer from a general principle.
• Reason inductively: generalize from observations.	• Perform repetitive pre-programmed actions reliably.
• Act in unanticipated emergencies and novel situations.	• Exert great, highly controlled physical force.
• Apply principles to solve varied problems.	• Perform several tasks simultaneously.
• Make subjective evaluations [and] develop new solutions.	• Maintain operations under heavy information load.
• Concentrate on important tasks when overload occurs.	

- Adapt physical response to changes in situation.
- Maintain performance over extended periods of time.

In general, it seems that humans excel at learning, and are more dynamic, adaptive, subtle, and creative, while machines are faster and stronger, as well as more reliable, consistent, and predictable.

Humans and machines reinforce each other when they work together. The study of the control of machines by humans and by other machines, and of the flow of information among them, is called cybernetics. It provides several interesting models germane to notation. One of the ways cybernetics describes the associations among machines, instruments, tools, and agents involved in communications with each other is to divide them into groups of control devices and effector devices. Manipulators -- similar to senders in the sender\-message\perceiver\result model -- apply forces to some object or circumstance by first applying analogous forces to a control mechanism. The impact is translated and transmitted by the effector device to the object, thus distancing the sender from the receiver, but at the same time giving the sender access to the power of the effector device, enabling humans to be as fast, strong, and consistent as machines.

Jeff Pressing analyzes the cybernetic relationship between a performer and a musical instrument, and lists some of the notation devices used in the course of the interaction:

> Playing an instrument causes the transfer of spatial and temporal information from the central nervous system to the system that physically produces the sound. Any such information transfer operates from within complex traditions of culture, musical design, and performance technique, and is shaped by human cognitive and motor capacities, as well as personal experience. . . .
>
> The human operator shapes some external ongoing process or its effects (naturally occurring or designed) that is being concurrently amplified or transduced to function as . . . either a sound source or a control source. Shaping can be simply turning on and off, filtering, or various types of parametric control.
>
> [As for] the sensory reinforcement of controllers . . . first there is the direct tactile feedback of the body part in contact with the controller; second, there is usually visual reinforcement that promotes accuracy of performance by not having the player put all his or her eggs in one sensory basket. In other words, the performer sees as well as feels and hears the control. . . .
>
> The performance data [produced by human and machine agents] are of two types: representation and transformation. Representation data describe or represent the musical output of an agent. Transformation data are data produced by one agent, designed to affect the output of other agents. These are the data that make the system interactive. Sound is either produced directly by manipulation of the musical instrument or with the aid of an intermediary representational form, using some kind of control device. This intermediary representation is most commonly MIDI code, but traditional music notation, graphic notations . . . , Music-V style event lists, spectral display schemes, as well as other designs, are also used. The reverse procedure also happens,

> . . . representations are produced by directly converting sound from the instrument, most commonly via pitch-to-MIDI or amplitude- or spectrum-to-control voltage converters.[28]

Pressing's work shows a deep understanding of the similarities between computer procedures and traditional musical procedures. His categories of performance data -- representation and transformation -- embody respectively aspects of descriptive and prescriptive notation types. Also, the place Pressing gives notation in his analysis demonstrates its effectiveness as a mediator of interfacing, filtering, signaling, and feedback operations.

The mutual reinforcement of human and machine interaction takes place within a variety of structures and processes which manipulate symbols and information and which frequently carry extensive notational requirements. I have already discussed some of the structures, or systems, involved in computer music, along with the importance of looking at them from the perspective of context (see Chapter Four above). Relationships between structures and processes pervade the world of computers and music. As in mathematics, the structures and processes involved are expressed in systems of symbols.

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[28] Jeff Pressing, "Cybernetic issues in interactive performance systems," *Computer music journal* 14:1 (Spring 1990): 12-21.

Besides simply observing the existence of process/-structure models, how can we characterize them? In attempting to describe notation models, particularly those used in computer music, some questions might be useful: Do they represent the structure of the performance, or of the interrelationship among the performing agents? Considering that notation systems have relatively strong or weak capabilities, can they represent more than a few kinds of musical phenomena? Similarly, how general are they; that is, are they independent of particular instruments or situations? Can they be used with other kinds of knowledge representation; for example, other computer routines or formations? Can they evolve, learn, and accumulate new capabilities; for instance, do they send or receive feedback? Are they flexible, or instead do they inordinately impose themselves on the end product? In seeking answers to these questions, it might help to keep in mind the advice that a computer music model "may be inferred from the program and data structure . . . and from the behaviour of users."[29]

The systems used to create electronic and computer music pieces are called "set-ups." They are usually more specific as to input and output terminals and exact

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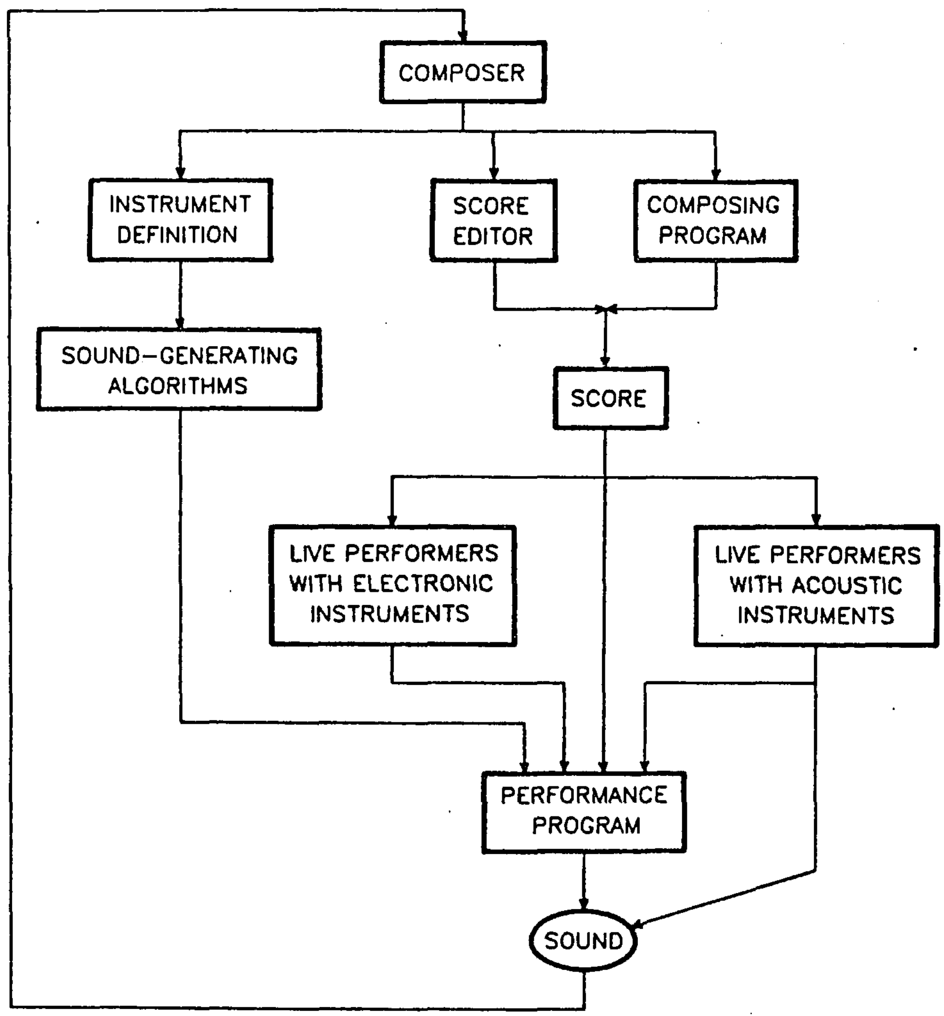
[29] Barry Truax, "A communicational approach to computer sound programs," *Journal of music theory* 20:2 (Fall 1976): 230.

machinery involved, but Example 6-1, a broad representation of how composers use computers, captures the quality of a set-up:

Example 6-1: How composers use computers.



Source: C. Dodge and T. Jerse, *Computer music*, 11.

The model above depicts a large number of interface possibilities, which in turn indicates that an abundance of information can be communicated among the components of the set-up and that a great deal of notation is necessary. There are compositional ideas to bed expressed, sounds to be synthesized and processed, scores to be created and edited, instructions to be given and learned, and commands and reactions to be rendered as quickly as possible, sometimes even immediately. Along with the interface complications, there are specific considerations to be made concerning hardware and software capabilities as well as input and output techniques. Input might need to be typed on an alphanumeric keyboard, or played on a piano keyboard, or indicated graphically by pointing or drawing gesturally with a joystick or foot pedal or with sounds, or simply scanned in with an optical reader. I have described in earlier chapters the equally diverse output possibilities, ranging from unnotated sound, to traditional music notation, to time/frequency graphs, to sonographic spectral analyses. In addition, if the setup is to avoid an overwhelming rigidity, there must be ample attention paid to the necessity of providing feedback to all parts of the system.

Earlier in this chapter I said that language stands between the sender and the perceiver, forming their physical and conceptual connection. Similarly, programming languages stand between the input and the output of computer systems. Programs are tools for mapping input onto output.

Using a computer, like using any other tool, requires a series of actions. With computers, however, the actions are performed by other machines as well as by human agents, and the series of actions is large, specific, and ultimately divisible into minute steps. "Systematic notations for the specification of such sequences of computational steps are referred to as programming languages."[30] A program is the notation of a set of steps designed to accomplish a specific task. The text of the program is the code. The work "code" is also used to refer to the machine code, which is the lowest level of computer language after the initial inscription of the binary zeros and ones. At this level the binary figures are simply transposed into friendlier alphabetic symbols and addresses written in normal decimal form. This process is somewhat analogous to the transpositional notation used in traditional music notation for orchestral instruments such as the horn in F which is notated in scores at one pitch but which actually sounds at an interval a fifth below.

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[30] Anthony Ralston and Chester L. Meek, eds., *Encyclopedia of computer science* (New York: Mason/Charter, 1976), 1159.

Anthony Ralston and Chester Meek give a feeling for how computer languages nest their structures and processes to form higher level systems:

> The next higher level [above the machine code] is the "symbolic assembly language" in which the names of the variables are written in symbols so that the location can be referred to symbolically rather than numerically. . . . The next level of complexity involves a macro-assembler in which the user may define new "instructions" and use them in his program, with their definitions being given elsewhere in the program. . . .
>
> The previous levels bring us to what is frequently called "higher-level language," . . . interchangeable with the term "programming language." The term "source program" means a program written in a higher-level language. It is generally translated to an "object program," which is in a form directly understandable by the computer. The translation is usually done by a program called a "compiler."[31]

Translators such as compilers are the driving force behind the growing power of programming languages. They enable the implementation of notations that are familiar to users and appropriate to the specific problems being solved, thus making them more flexible. In fact, Peter Zinovieff imagines a future possibility of simply issuing a command "PMMABC" to indicate "please make me a beautiful composition," and then having it.[32] In programming, however, there is frequently a trade-off between

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[31] Ralston and Meek, *Encyclopedia of computer science*, 1169-70.

[32] P. Zinovieff, "Technical advances and the modern composer: The special case of computer intuitive music scores," *Composer* (London) 66 (Spring 1979): 25.

flexibility and accuracy. Also, consideration must be given to a programming language's efficiency.

The usefulness of a programming language, or of a program written in it, will not only depend on the capacities of the language but also on the crucial question of how the problem is defined in the first place. Similarly, within the sender/message/perceiver/result paradigm, communication depends not only on the medium of the message, but also on the question of the sender's intent.

Programming and composing algorithms involve breaking down a problem in well-defined steps. The programmers have to say what they want to do; but they must also say what they want to do it to. The representations of the actions are the code, and the representations of the objects are the data. When particular aggregates of code and data are separated out and named, they might be called a subroutine. These definitions, of course, are quite elementary, and the state of programming today is considerably more complex than they indicate. They are, however, taken up here to provide a hint of the sort of basic models computer science can provide for the study of notation systems.

Lounette Dyer presents an analysis of traditional music notation which reflects a computational perspective, but which seems to blur the distinction between action and data:

> Music notation is a symbolic representation. It is an abstraction of the physical parameters frequency, time, and amplitude. The notation is primarily the same for all instruments with the exception of a few special instrument-dependent symbols. There are two basic types of data, note symbols, which are frequency time events, and an interpreter or state space, which consist of a set of state variables and operators on the input symbols. The interpreter may be global, or there may be a number of them, each applying to one or more instruments. For traditional music notation, the state variables include key signature, meter, and dynamics.[33]

Dyer's separation between event and interpretation reflects a division central to numerous computer music models. On one hand there is the even-oriented, often symbolic (as opposed to iconic), asynchronous note concept so prominent in many early computer composition systems. On the other hand there is the function-oriented, often iconic or graphic, synchronous sound stream idea characteristic of synthesis systems. Good examples of sets of languages which rely more on the former conception are Music IV, Music IV-B, Music V, etc., which Gareth Loy and others call Music N. Examples of the sound-stream type include procedural languages like Pile and graphic languages like the UPIC system.

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[33] Dyer, "Toward a device independent representation of music," 252.

The binarism formed by the two computer music models is useful in distinguishing one language from another and in determining the notation requirements of each. In actuality, however, most systems partake of both types, just as most notation systems exhibit both symbolic and iconic, as well as prescriptive and descriptive characteristics. I discussed this aspect of notation types in Chapter Three.

INTERVIEW SIX

Heidi Von Gunden

Heidi Von Gunden is a musicologist with a particular interest in contemporary composers. She received her doctorate from the University of California, San Diego, with a dissertation on the emblematic nature of Olivier Messiaen's compositions. She has written books on Pauline Oliveros and also on Ben Johnson with whom she is a colleague on the faculty at the University of Illinois. I met Dr. Von Gunden at a conference at Wesleyan University celebrating John Cage's seventy-fifth birthday; she was presenting a paper on Cage's aesthetics. This interview took place on February 12, 1988, in Middletown, Connecticut. It reveals Dr. Von Gunden's interest in the way perceivers react to musical messages, and her belief that messages require no interpretation if one remains in the present moment and place.

Wood Massi: You've written a lot about Pauline Oliveros and John Cage. What would you say is the nature of symbolization in their works?

Heidi Von Gunden: With Pauline and John, I think you transcend symbols. The music or the sound isn't a symbol of something else, it's itself. . . . There's a certain respect for all things in themselves. . . . You have to experience [Oliveros' work]. It doesn't symbolize, it causes. . . . These are recipes that cause something to happen. They set vibrations going. One reads the word, it begins a vibration in the brain, and it follows through to the sonic vibration.

[The trouble with] Pauline's scores is that people read in so much. They don't take the words for just what they mean. Reading her score, to me, is like a meditation. You look at every word just for itself. . . . Some people don't follow the score exactly; they don't do exactly what she says. . . . People have to learn to apply a respect of the word, especially when she is not there. When she is there, then there's this other layer of listening to her, respecting her, realizing her power. . . . There's a certain dynamism. You experience her mind, Pauline's. That's very dynamic, strong. It just knocks the socks off people. . . . Then the proper things happen; and she's not saying anything any different than what she writes down in her scores.

WM: But when she's there, she *is* saying something different, she's adding to it. . . . She's adding all these other signs and symbols. Her body becomes a notation in itself, her personality becomes a notation added on top of the written notation.

HV: She's saying, how does mind-body-breath react to these words, to this score? It's a tuning, and then the people tune to it. It's very simple. . . . What she's doing is just being herself, which is what she's asking people to be in her music. . . .

WM: I can't help but think that some of the notations Oliveros uses are symbolic. The simple circle with the dot in the middle, it symbolizes all the rest of what she says. . . . It seems to me that one of the ideas about her music is that the performers and the audience are the same. She doesn't have people stand in a circle and hum to an audience which doesn't participate, but just watches. That to me, is similar to what Allison Knowles does. She makes a graphic score, and she projects it onto a screen during the performance of it. . . . In projecting it, she's giving responsibility to the audience. She's saying, okay, this is what the performers are asked to do. You can read it, too.

HV: It's also a way of focusing. I'm thinking of Pauline's circle; . . . that's a meditative form. It reflects the structure of the mind; so it helps with this focus.

WM: The circle and the dot, you mean?

HV: These holistic shapes. I don't know what kind of shapes Allison Knowles uses, I'd be interested.

WM: She takes photographs of things like a fish fin, or fishermen in boats, or shoe laces, and puts them in a series, and asks people to perform the pictures. . . .

I know you've also studied Oliver Messiaen's work. What's the difference between Messiaen, Cage and Oliveros?

HV: With Messiaen, you've got to have a dictionary. You really need to know the emblems he is using. In the *Quartet for the End of Time*, most people understand the emblems: the apocalypse, the angel for the end of time, the dance of the seven trumpeters.

WM: Are those timbral emblems, and chords?

HV: No, right now I'm just thinking of the inscriptions that he puts on his pages. His pieces exist at several levels. He addresses the spiritual level, which is a collective . . . symbolic understanding of western christianity. If you know . . . the imagery, Messiaen speaks immediately. It works. If you're not sensitive to the imagery, to the emblem, then there's a real instant dislike to his music.

WM: Why, because the audience is confused, and doesn't know what it's all about?

HV: No, I think it's hitting some spiritual levels they don't want to address, they don't want to look at in themselves, maybe something they buried. I've seen people get up and leave a Messiaen concert within the first two or three measures. They physically cannot tolerate what they're taking in. I've really seen people risk life and limb to get out.

WM: That's like Cage's concerts. There are always a few of those people.

HV: And it's not the music; it's themselves. They can't sit there. The same [thing happens during] some of Pauline's concerts.

WM: Isn't there a different reason why somebody would leave a Cage concert than an Oliveros concert?

HV: Yes. It goes down to the structure of the mind, what it means to be human. It's a vibratory phenomenon. With Pauline you actually have to vibrate, to become sound and make sound. Sometimes it's very physical. . . . With Cage, he gives you the time to observe your likes and dislikes. You don't know what those sounds are going to be; you don't know what anything's going to be, usually.

WM: With Cage, you're usually not making the sounds as you are with Oliveros.

HV: Yes, you're there witnessing it, watching the people making the sounds, so it's a little more complicated.

WM: I'd like to take up this question of the composer -- or anyone -- being present and serving as a sort of notation in themselves. I'm a notation. I think we all are. . . . I started to think about this because of Roland Barthes and his famous study of fashion, [describing] how we give messages by what we wear. . . . You read me by verbal cues, and the way I look.

HV: And the history of what you say.

WM: The history of what I say, and what's written on the page here. It's the same thing as you're reading me by my clothes. Those are all semiotic structures, which interpenetrate. . . . The thing I admire in Cage's work is that he sets up a rich variety of semiotic structures, and allows them to interpenetrate -- Oliveros too. I admire their willingness to be non-traditional in their choice of semiotic structures. Also, there's an acceptance by them of the ordinary, as a semiotic structure. They seem to be saying, these things are here; they have a meaning on some level. . . . That's something we're experiencing right now; it's here now. Cage tells us that that can have meaning, if we experience it. . . . It's the ideas of life, movement, vibration . . . and that we all share the same energy. You affect the energy by what you do; and that energy affects you. You're not just you.
But it doesn't seem to be very easy to accept this semiotic interpenetration. . . . What happens in the mind, it seems to me also, is that you have a problem of obstruction.

HV: The obstruction is you not being aware. And the obstruction is not being present to the right now, is letting the mind go to other places rather than right here, letting it worry about when you get back to San Diego, getting this interview transcribed, and all these sorts of things.

WM: But, you know, that *is* part of the right now for me. Being in the future is part of the present in a way.

HV: No it isn't.

WM: It is one of those systems or structures that is operating right now in my mind, you know?

HV: But it isn't in reality yet.

WM: The way I rationalize that is related to what Cage calls "doing what's necessary." For instance, you can't just cross the street without looking. If there's a car coming, you have to project two seconds into the future, and say, I'm going to stop now and let the car pass, and then I'll pass. You're not in the absolute present. I just expand that a little bit, and I say, what I'm doing is research, and part of that is gathering tapes and having them transcribed. So just moving toward that future, I'm going to be aware of whether the tape is running, and things like that.

HV: But that's the present moment. . . .

WM: I guess so, but it is a form of being focused. Lastly, I'd like to ask if you think the meaning of music can be broken up into codifiable units, as some linguists attempt to do with language?

HV: Music is not a universal language, because it doesn't have a dictionary. You can't look up and see what such and such means. But, Messiaen establishes a dictionary. He has certain sounds he uses over again, certain themes in his music, his love theme, certain colors, all this sort of thing. Messiaen is so symbolic because his works have an interpretation; they have meanings. In case you don't understand the dictionary, he writes long prefaces to his scores. He does the interpretation for you. Cage does not have a dictionary. Pauline doesn't have a dictionary.

WM: Perhaps for them, theorists are creating the dictionaries?

HV: They're imposing their own dictionaries.

CHAPTER SEVEN

Sender/Message/Perceiver/Result

In order for there to be music there has to be sound, or at least a conception of sound. Furthermore, there has to be some behavior, even if it is only understanding or assuming an idea about sound.[1] Behavior is elemental to music notation and the sender/message/perceiver/result model. The sender, whether it be a human, a machine, or an aggregate form (possibly including social forces or technical and aesthetic phenomena), manifests intention by way of a message. The message comprises a medium and a reference code which constrain and are constrained by meaning and the context of the process. The message, which uses abstraction in representing absent entities, sets up reactions to those entities in perceivers of the message. The message not only changes the perceiver but continues along with the perceiver to effect changes in the context; that is, to create interpretational,

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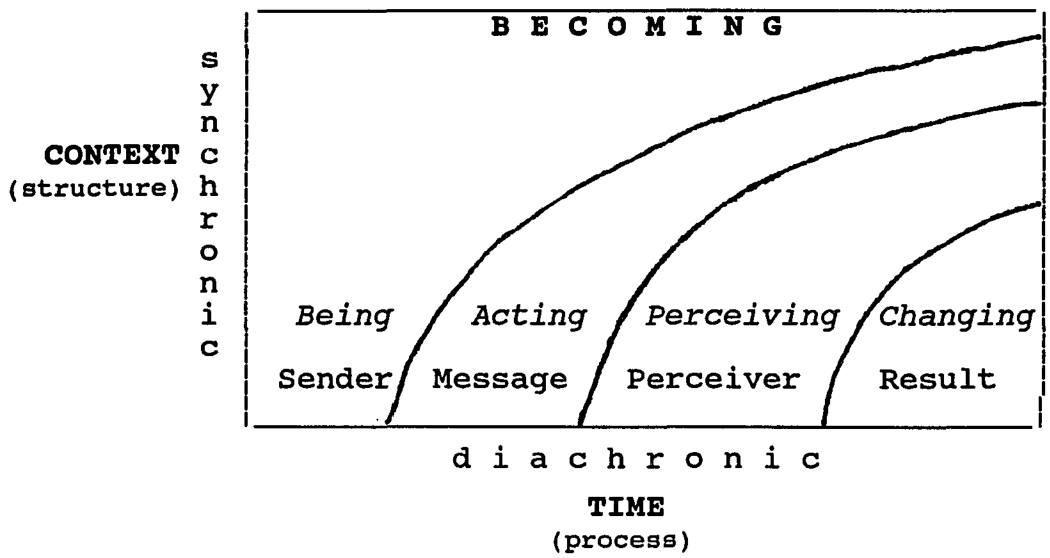
[1] See Jean-Jacques Nattiez, *Music and discourse: Toward a semiology of music*, trans. Carolyn Abbate (Princeton: Princeton University Press, 1990), 41-45 & 60-70.

psychological, and social results. Initiated by the sender and modified by the perceiver, the message becomes the result.

Another way of saying this is that the sender broadcasts the message which, like a radio or sound wave, is conveyed by the medium and the code and comes to resonate in the form of the result. Over the course of the procedure, the medium and code change. The "wave" changes too, most noticeably in amplitude, but it continues to manifest its essential shape. One of the primary results of the sender/message/perceiver/result process is feedback. The sender becomes the perceiver as the results of the message resonate back to it. Similarly the perceiver becomes at least something of a sender as it modifies and interprets the message, thus incorporating its own intention into the message and the feedback resonance.

The central procedural behavior of any semiosis or communicative act is becoming. In Example 7-1, I break this behavior into four primary elements which I map onto the sender/message/perceiver/result model and other conceptions used in earlier chapters. The four elemental behaviors are being, acting, perceiving and changing.

Example 7-1: Being, Acting, Perceiving, Changing.



This model shows the changes taking place as communication proceeds through time (horizontal axis) and as the contextual structure is taken at higher levels of abstraction (vertical axis). The message becomes the result, and the sender the perceiver. Actions by the sender precede those of the perceiver, but at higher levels all four components of the process partake of all four of the elemental behaviors.

Certainly the large majority of what is thought of as music notation operates at a low level of abstraction. The composer makes some sort of graphic mark, which a performer interprets in sound, which in turn initiates some reaction in a listener. But from a broader perspective the situation is considerably more complex. The distance between the sender and results can be large.

As they manifest material, intellectual, and social results, messages travel not only through a succession of media and codes but also psychological and philosophical interpretations. A psychological relationship exists between the sender and the perceiver; and it is within the predominantly human domain of psychology that these two parts of the sender/message/perceiver/result model are most useful. At the same time, the concrete, immanent nature of the message and the abstract, transcendental character of the result lend a more philosophical accent to examinations of the relationship between these parts. A causal link holds the four components together, one part becoming another through transformation. The causal link runs in both directions, however, as feedback resonates back across the process.

The broad, inclusive nature of the sender/message/-perceiver/result model increases its usefulness as a methodological tool. It enables the parsing of fields taken up by other models of notation, communication, semiosis, or signification such as the composer/-performer/listener model, a widely-used paradigm in the world of music theory.[2] One might try to make the case, for instance, that the composer/performer/listener model

[2] See, for example, Roger Sessions, *The musical experience of composer, performer, listener* (Princeton: Princeton University Press, 1950); and John Cage, *Silence* (Middletown, Conn.: Wesleyan University Press, 1961).

is more centered on the relationship between the sender and the message than the perceiver and result. That is to say, it emphasizes the left side of the sender/message/-perceiver/result process more than the right. The model presented by classical information theorists also emphasizes the left side, whereas the implication/-realization model described by theorists such as Leonard Meyer and Eugene Narmour seems to lend greater importance to the right side, or at least the perceiver portion. Jean-Jacques Nattiez's use of the tripartition prototype of musical semiosis gives a more even emphasis, but in its current state of development it still fails to take equivalent notice of the broad results of semiosis. (Nattiez, however, is continually expanding and refining his theories.) The sender/message/perceiver/result model might also be useful as a tool in achieving greater understanding of how theories based on structuralist or post-structuralist principles compare to each other.

In constructing the sender/message/perceiver/result model I examined numerous other models. One is behavioristic, based on the idea of stimulation and response, and illustrated in the sender/message/receiver association. I find the term "receiver" misleading. Someone or something may passively *receive* a message, but to *perceive* is to be more active. The term "perceiver", therefore, allows for a greater consideration of the constructive role of intent on the part of the receiver/-perceiver. Intent, competence, and determinacy all play crucial roles in the sender/message/perceiver/result process. The model facilitates the effort to understand how they interact.

Sender

The sender is that which uses action to transform intention into invention. Kari Kurkela points out that

> a goal-directed act can be categorized as including (i) an agent's intention ("I will do *q*"), (ii) the agent's belief concerning what one has to do in order to achieve the intended goal ("if I do *p*, then *q*"), (iii) the agent's causal influence upon the environment (*p*), and (iv) a change in the environment as a result of the agent's action (*q*).[3]

Though Kurkela's article is about musical performance, its categories -- intention, belief, causal influence, change -- apply to composition as well.

The sender is an agent, but especially in today's world of computers and complex social forces it is sometimes not so easy to attribute conscious intent to a sender. Thus it becomes necessary to distinguish signification, or unintended meaning, on the one hand from

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[3] Kari Kurkela, "Score, vision, action," *Contemporary music review* 4 (1989): 417.

communication (semiosis), or intended meaning on the other. These terms are notoriously ill-defined and the use theorists make of them varies greatly, but the essential difference as I define it here is that signification is centered in the perceiver whereas communication focuses more on the conscious sender and must therefore take intent into account.

Just as there can be significance without intention, there can be a disparity between what a sender intends and the eventual result. In both computer programming and music notation, debugging is an important skill. It improves the chances of congruence between the intent and the result.

Intention affects the way notations are formed and the way they are perceived. This is particularly important with graphic music notation. Gardner Read points out that

> never before in the history of music has the visual aspect of a musical idea been of such paramount concern to those who originate it. . . . A vast amount of new music today gives the unmistakable impression of having been conceived primarily in visual terms, with auditory significance apparently secondary to the composer's intent and purpose.[4]

Visual conception in itself has certainly become more important, but it might also be that the musical

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[4] Gardner Read, "Self-indulgent notational aberrations," *World of music* 14:4 (1972): 40.

motivation of graphic notations comes from the desire to preserve the possibility of differing options with regard to performance and interpretation, in which case the composer's intent is demonstrated and maintained by the notation. This is what happens with conceptual notation, but it is anathema to the most common intent motivating traditional and computer music notations which is to precisely define a sound or action.

Intention involves desire, striving, conation, and so invokes psychology. The sender intends to send a message and, therefore, desires to influence the reception of the message. Furthermore the composer holds particular attitudes about music, notation, and communication. These involve thoughts, beliefs, and feelings. Attitudes manifest themselves in techniques affecting the way something is composed and therefore *what* is composed.

Having arrived at the psychology of the sender, it is a short step to a consideration of the role of the unconscious in composition. The phenomenologist Edmund Husserl saw consciousness as being intended; therefore, he tried to bracket out the unintended as meaningless. But we know from Sigmund Freud and others that the unconscious affects how we act and the choices we make about the symbols, languages, and notation forms we use. Perhaps some music notations reveal something about the unconscious forces at work within the composer. Are graphic notations a rebellion against authority? Are computer notations a defense mechanism against close scrutiny by others? Is the use of traditional notation motivated by a fear of change?

In addition to deliberative intent the sender is characterized by productive, immediate action. The work of John Cage brings into focus several questions with regard to the roles of intention, action and the unconscious in music composition. Cage frequently pointed out that intention makes music out of sound, and that silence is really just unintended sound to living beings who are always experiencing at least the slight sound of blood flowing through their ears. He defined an experimental action as one in which the outcome is not foreseen. He strove to make his compositions free of intention, a desire which led him to the extensive use of chance operations. Such methodological purposelessness causes the sender to concentrate on the action itself, and on the present. Cage's graphic notations from the early 1950s -- and those of the other New York experimentalists Earle Brown, Morton Feldman, and Christian Wolff -- coincide with the development of action painting in the visual arts. His aesthetic of action led Cage to maintain that composition, performance, and listening have nothing to do with each other. Yet such an approach, centering as it does only on surface aspects of musical phenomena, leaves larger questions of the role of the unconscious unanswered. It strikes me as similar in some ways to the tendency of structuralists and phenomenologists to bracket out that which does not present itself immediately to the senses.

Christian Wolff asserts that Cage's "idea of sounds as sound -- as though they were part of nature itself -- . . . really doesn't mean anything because we *perceive* those sounds. We are human and therefore our perception humanizes them. Even the very fact that we identify them as natural is really a human identification with human meaning."[5] John Tilbury states the case more sharply:

> Cage's intention seems to be to reflect mechanically, "unconsciously" (that is with no purposeful compositional intervention) the present stage of the historical development of the musical material, and thus cover up the decisive factor in the historical development of the musical material, namely social development and conscious participation. In this he mirrors the "objectivity" of those bourgeois scientists who mechanically assemble and process tons of data: their "objectivity" is a veil to conceal the class standpoint from which their researches are carried out.[6]

Patterns of intention, action, and use distinguish various types and systems of music notation from each other. In Chapter Three I described how prescriptive

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[5] Interview with the author, February 28, 1988, Wesleyan University, Middletown, Connecticut.

[6] John Tilbury in Cornelius Cardew, *"Stockhausen serves imperialism" and other articles* (London: Latimer New Directions, 1974), 112.

notations represent actions to be taken and descriptive notations represent sounds to be produced, leaving the question of action to the producer. Musicians within the traditional, graphic, and computer music worlds all use notation. The differences in how they deliberate or interpret on the one hand, and how they act or execute on the other, define the three systems. The following are representative accounts of the thoughts and actions of these three theoretical types of senders:

1) Traditional -- imagines a musical sound (i.e., one produced by traditional means); translates it as strictly as possible into traditional music notation; writes a manuscript, perhaps with parts; produces a finished score from the manuscript by engraving or hand-written autography. (Because I am describing a theoretically unadulterated type here, I am specifically excluding the currently common tactic of using a computer to produce traditionally notated scores.)

2) Graphic -- imagines any sound or non-traditional relationship among musicians, or visualizes an image with which sound or a musical relationship can be associated; translates it freely into graphic music notation; draws or paints a score; reproduces the original with photocopiers or print-making techniques.

3) Computer -- imagines any scheme for producing sounds with computers from the most random to the most

determinate; translates into code; types program; prints score.

The three types of musical senders are constrained in different ways. The traditional and graphic composers, for instance, might have trouble arranging for performances of their work, especially if it involves more than one instrument. This is not as much of a problem for computer composers, though they may find it difficult to gain access to the electronic equipment they need to produce their compositions. Different constraints engender different strategies which not only act as filters, selecting some aspects of the objects they describe and rejecting others, but which also may spur innovation.

Leonard Meyer describes the relationship between constraint and innovation (novelty) as one mitigated by rules (conventions) and style.

> At least three kinds of novelty need to be distinguished. (1) Some novel patterns arise out of, or represent, changes in the fundamental *rules* governing the organization of musical processes and structures. . . . 2) Novel patterns may also result from the invention of a new *strategy* that accords with prevalent stylistic rules. [These are more easily grasped by society than changes of fundamental rules] . . . 3) Most novel patterns -- original themes, rhythms, harmonic progressions, and so forth -- involve the innovative *instantiation* or realization of an existing strategy or schema. . . . Rules are transpersonal but *intra*cultural constraints -- for instance, the pitch/time entities established in some styles, as well as grammatical and syntactic regularities.

> Strategies are general means (constraints) for actualizing some of the possibilities that are potential in the rules of the style. The rules of a style are relatively few, while the number of possible strategies may, depending upon the nature of the rules, be very large indeed.[7]

Meyer's model defines three levels of abstraction with regard to actions. Senders must choose what actions to take, what means to use, and what results to accept. With regard to music notation the margin of choice is constrained by the nature of the senders and perceivers involved in the sender/message/perceiver/result process. When both the sender (as an instrument of a human composer) and the perceiver are machines, as they frequently are in the world of computer music, the choice of notation and the possibility of innovation is the narrowest. A little more choice is afforded the composer/programmer when another human, rather than a machine, is reading the program because the perceiver can accommodate more information -- ambiguity, creative meaning, and connotation -- in addition to simple denotation. The traditional composer, working from a clearly determined intention and with an attentive and competent performer/perceiver, has even more latitude. Finally, the composer of graphic music notation enjoys a wide range of choices when the sender's intentions are

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[7] Leonard B. Meyer, "Innovation, choice, and the history of music," *Critical inquiry* 9:3 (March 1983): 519.

indeterminate and the perceiver is competent, and the widest range when the perceiver is "incompetent" -- when what is being represented or the way of representing it are not standardized, are not yet constrained by convention, and are not previously learned by the perceiver. Of course, in the latter case the perceiver will have to become competent, at least in relation to the given message, if she is to understand it.

Along the path from intention to invention the sender is faced with the many contingencies inherent in attitude (both conscious and unconscious), action, competence, constraint, and style. Intention drives the sender to create a message, and the message -- by way of its medium, code, and meaning -- becomes a driving force in itself. Just as necessity is the mother of invention, invention is the mother of necessity.

Message

Within the context of the sender/message/perceiver/-result model, the message is what physically and psychologically brings the sender and perceiver in contact with each other. It serves an inter<u>media</u>ry function between them, mapping the intentions of the sender and mirroring the attentions of the perceiver.

Medium

The message encompasses a mode of inscription, a way of referring, and an interpretation. The mode of inscription is the medium, embodied in the material being of the signifier as opposed to the mental being of the signified. Variations in the physical medium create information-carrying codes perceivers translate, perform, and render meaningful.

Writing, electronic signals, and graphics, are material or physical modes of inscription used to portray the variables of sound, time, or social relationships. The first subject of music which comes to mind is sound in time. But music also expresses social relations among musicians and listeners, a part of the art which is more difficult to imagine in terms of material media -- though not impossible given some ideas related to marxist theory, or examples of Christian Wolff's or Robert Ashley's compositions built around how performers interact with one another.

Though musical works involving electronics are frequently represented in alphanumeric or graphic scores -- either detailing the technical data necessary to reproduce them or simply showing symbolic variations to facilitate following them silently in the mind -- the most important and far-reaching medium in these works has been magnetic tape. The use of tape has imported into the world of music notation an appreciation of the importance of time proportionality, the one-to-one relationship between the time occupied by the sounds and the space occupied by the representations.

The use of electronic signals as a musical medium continues to evolve rapidly. Computers have replaced tape recorders and patch boards as the primary tool for shaping signals, making it easier to do things like splicing sounds together, patching or plugging the flow of signals through various modifiers, or generating different kinds of visual representations of a work, including traditional and alphanumeric notations and a multitude of graphic forms.

Computers have also created among musicians an understanding of the difference between analogical and digital representations. When the strength or speed of a signal is directly embodied as a spatial relationship in the representational medium, which is the case with tape recordings from the pre-computer era, the medium is said to be analogic or analogical. When the medium represents a signal by breaking it up into tiny, discrete, controllable bits, as computers do, then it is digital. It is possible to establish a correlation between tape recordings, pictures, analogical representations, and iconic notations on the one hand and computers, words, digital representations, and symbolic notations on the other.[8]

Separating the iconic from the symbolic and the analogical from the discrete is difficult, however, especially when the mode of inscription is graphic representation. As tallying marks demonstrate, graphics tend toward the iconic. The larger the quantity of the signified the larger the number of, and therefore the space occupied by, tally marks used to represent it. This means that the relationship between the signifier and the signified, taken as a whole, is analogical and implies an iconic reference. But the tally marks themselves are usually seen as discrete entities implying a digital reference. As long as the marks are considered to be discontinuous and equal to one another -- that is, to either exist individually as complete within themselves or to not exist at all -- they are digital. If, however, they are dense in themselves -- that is, they can be divided and can represent proportional quantities such as a half mark or a millionth of a mark -- then they are analogical.

A clear tendency exists for units within symbol systems to accumulate. As this happens there is a need to

[8] For a good discussion of the iconic, the symbolic, and computers, see Nikhil Bhattacharya, "A picture and a thousand words," *Semiotica* 52:3/4 (1984): 213-246.

abbreviate and to develop "conventions of syntax, and grammar, designed to de-iconize"[9] the analogical, graphic traces. Roman numerals evolved from simple tallying marks embodied in the symbols I, II, and III to coded systems exemplified by IV and other numbers.

Questions of what constitutes analogs, digits, marks, characters, and notations are addressed with persuasive thoroughness by Nelson Goodman.[10] He maintains that symbolic systems are dynamic, changing phenomena. When they tend toward the digital, they are particularly useful for expressing definiteness and repeatability. When analogical, they are more sensitive and flexible. Therefore, one finds in evolving symbol systems a pattern where analogs are used to explore new ways of representing and digits are used to fix the representations.

Given the experimental nature of graphic notation, it is not surprising that the aesthetics of composers like Cage, Brown, and Wolff led them to use it. During the 1950s, a particularly exploratory period in their careers, they seem to have found traditional notation, with its "digital" emphasis on discrete units and rhythmic limits, to be too confining. Rhythmic values smaller than a

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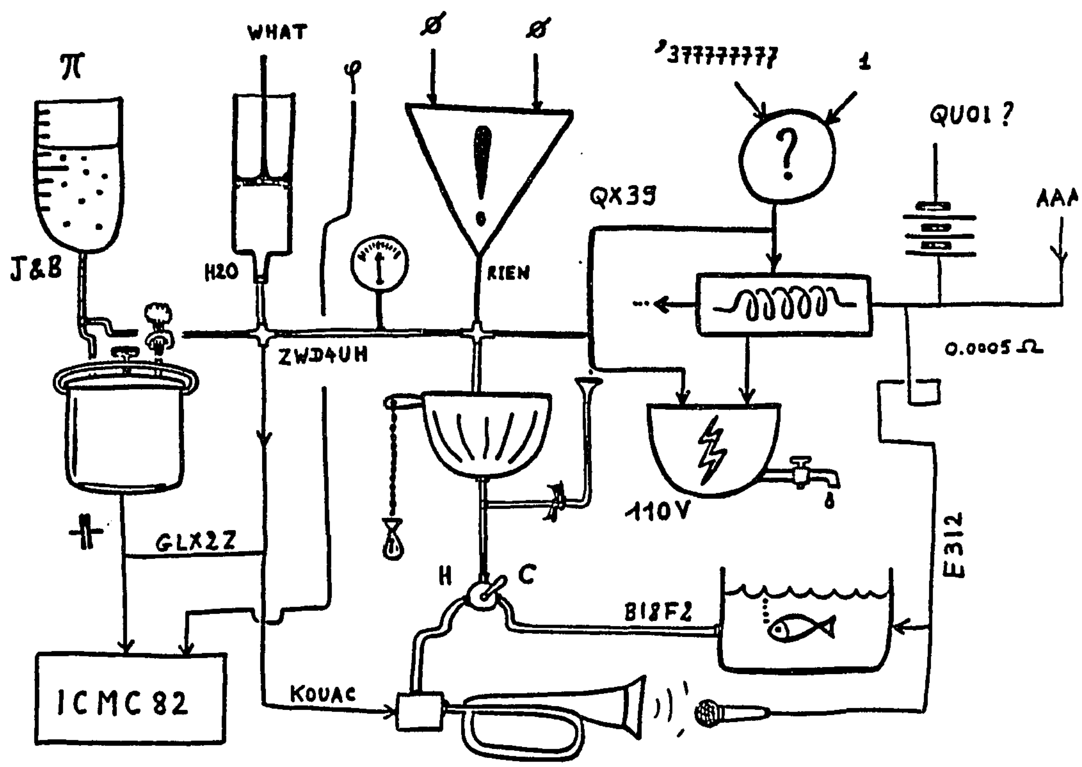
[9] Brian Rotman, *Signifying nothing: The semiotics of zero*, (London: Macmillan, 1987), 9.

[10] Nelson Goodman, *Languages of art: An approach to a theory of symbols*, 2nd. ed. (Indianapolis: Hackett, 1976); see particularly "The theory of notation," 127-173.

sixty-fourth note and complex or indeterminate rhythmic subdivisions, for instance, are difficult or impossible to notate with traditional means, but can be expressed easily with graphic notation. Cage and others turned to more analogical and iconic signs when referring to duration. It is nevertheless true that simultaneously Morton Feldman, a member of the same group of composers, produced graph notations (not to be confused with graphic notations) which can easily be taken as examples of the digital representation of duration.

The same is true with computers where composers and other artists have sought to develop more analogical, higher-level notations even though the entire system is ultimately based on digital technology. In the evolution of this particular system, the fact that analogs followed digits shows that there can be an oscillation between the two ways of referring. When it comes to notation, the mixing of media is as natural as the mixing of types and systems discussed earlier.

Example 7-2: Parody of a music synthesis flow chart.



Source: Rodet et al., "The CHANT Project," 400.

The computer instrument definition and signal flow chart shown in Example 7-2 demonstrates humorously the type of media mixing one frequently finds in music notations. It contains both graphic and written media. I use it here because it also exemplifies the binarism of hieroglyphic and alphabetic types which are to writing what iconic and symbolic are, roughly, to notation. Hieroglyphic writing emphasizes the visual while alphabetic writing emphasizes the aural. Hieroglyphs along with ideograms form a class known as morphemographic writing -- meaningful linguistic units manifesting some visual similarity to their referents. This is contrasted with phonographic writing which is not in itself meaningful but which designates a sound and thus can be used to string sounds together into meaningful units. But even differences in phonographic writing may not always translate into differences in sounds. Take for instance the following set of writings which, given the vicissitudes of dialect and accent, all sound the same:

- *C'est si bon!* (French song lyric)
- Say, "See bow." (Imperative statement by a teacher of English as a second language)
- Say! Sea bone! (Exclamation and sentence fragment by a beachcomber)
- Say, C 'bone? (Interrogative of a musician confused about whether or not trombones are transposing instruments)

Writing as a musical medium of expression -- in the forms of score notation, software documentation, theoretical reasoning, or generalized musical discourse -- is essential to understanding music. But writing as a medium for literature, narrative, poetry, and metaphor is also a rich source of insights about music notation. Writing and music notation are both systems of symbols, and what can be observed about one system can be compared to the other.[11]

It is partly by way of a theoretical interplay among diverse discourses that the concept of media expands to include new forms not writable, not scriptable in the usual ways. Like music notations and sounds, the self emerges as a form of notation, along with groups and cultures as signifiers of meanings which often are difficult to grasp. These are aspects of the result part of the sender/message/perceiver/result paradigm.

One final feature of medium concerns reproducibility and authenticity. Nelson Goodman makes a distinction concerning graphics in the arts when he talks about autographic and allographic techniques. An art is autographic "if the distinction between original and forgery of it is significant."[12] Thus, painting is clearly autographic. If a graphic is reproducible without doing damage to its essential quality, then it is

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[11] For an interesting comparison of how various symbol systems such as music notation, literature, and painting illustrate the principles of true notation systems according to the criteria set forth by Nelson Goodman, see Martin Krampen, "Prehistory of graphic notation systems," in *Semiotics unfolding: Proceedings of the second congress of the International Association for Semiotic Studies [1979]*, ed. Tasso Borbe (New York: Mouton, 1983), 3:1465.

[12] Goodman, *Languages*, 113.

allographic. Goodman classifies music as an allographic art.

> One notable difference between painting and music is that the composer's work is done when he has written the score, even though the performances are the end products, while the painter has to finish the picture. No matter how many studies or revisions are made in either case, painting is in this sense a one-stage, and music a two-stage, art.[13]

I believe that this distinction is, today, too constraining. Music-writing as graphism is attaining an independence it never had. Scores are being created for which the instrumentation is the reader's mind. The prints that John Cage made during the last twenty years are good examples of such scores. They are prints, but they are a natural outgrowth of his interest in graphic notation; for instance, his incorporation of Thoreau's doodles in his music scores, and the fact that almost all his scores are published as photocopies of the original manuscripts. Despite, or perhaps because of, the photography, we become aware of the unique nature of Cage's notation.

Earle Brown also incorporates allographic and autographic reproduction in his piece *Hodograph I* (1959) the score of which contains areas of mass-reproduced, traditional notation to be played simultaneously with other areas which "are left blank in the printed copies.

[13] Ibid., 114.

The graphics are subsequently drawn in by hand, so that no two areas contain the same graphics, and no two copies of the piece are the same."[14] It is perhaps ironic that the use of an autographic medium like drawing is seen here as innovative, whereas printmaking and photography are seen as innovatively allographic among visual artists where painting and drawing are the traditional processes.

Whether allographic or autographic, methods of reproducing notations evolve because of questions of practicality, ease of reproduction, portability, and musical technology. As a result, the lines between the original and the copy in music begin to blur. According to Walter Benjamin,

> mechanical reproduction emancipates the 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.[15]

Numerous theorists give a great deal of consideration to the problem of the difference between the original and

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[14] Kurt Stone in John Vinton, ed., *Dictionary of contemporary music* (New York: Dutton, 1974), 524.

[15] Walter Benjamin, "The work of art in the age of its technical reproducibility," in *Art and its significance: An anthology of aesthetic theory*, ed. Stephen David Ross, 2nd. ed. (Albany: State University of New York, 1987), 530.

the copy.[16] What role does the work's presence in time and space play? What about the copy which has no original, the simulacrum, that which is the double of itself?[17] What are the differences between *difference* and *differance*, and what is the relationship between writing and sound?[18] What about the re-presentation of imitation, as when Cage draws a bird whistle into the score for *Water Music*,[19] or the "liquidation of the identity principle."[20] And finally what about absence: "Since *nothing* falls under the concept 'not identical with itself', I define nought as follows: 0 is the number which belongs to the concept 'not identical with itself'."[21]

The mode of inscription, or medium, of a message -- from its most basic manifestations in physical reality,

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[16] See, for example, Terry Eagleton, *Literary theory: An introduction* (Minneapolis: University of Minnesota Press, 1983), 122.

[17] For more on this, see Mark Poster, *Mode of information: Poststructuralism and social context* (Chicago: University of Chicago Press, 1990), 9.

[18] See Jacques Derrida, *Writing and difference*, trans. Alan Bass (London: Routledge and Kegan Paul, 1978).

[19] See Peter Kivy, *Sound and semblance: Reflections on musical representation* (Princeton: Princeton University Press, 1984), 16-17.

[20] Vincent Descombes, *Modern French philosophy*, trans. L. Scott-Fox and J. M. Harding (New York: Cambridge University Press, 1979), 183.

[21] Gottlob Frege in Brian Rotman, *Signifying nothing: The semiotics of zero* (London: Macmillan, 1987), 7.

to its more problematic social, economic, and philosophical features -- covers only the part of the message that is outside the perceiver. For a deeper understanding of the sender/message/perceiver/result process, one must take account of the ways references are made, the coding systems and the meanings they set up in perceivers.

Reference

Ways of referring, representing, and symbolizing abound. The diversity of referential and interpretive strategies includes names, labels, signals, and samples, as well as denotation, articulation, enunciation, indication, identification, description, depiction, delineation, characterization, association, abstraction, generalization, connotation, implication, suggestion, imitation, presentation, expression, illustration, demonstration, exhibition, and both literal and metaphorical exemplification. These are all ways signifiers are related to signifieds.

During the nineteenth century, the relationship between music and reference formed the core of a vigorous debate concerning program music. Can music refer to something exterior to itself, or is it to be thought of only in absolute terms? Program music of the sort exploited by Beethoven (Pastoral Symphony) and Berlioz (*Symphonie fantastique*) stimulated the debate. Though today the question seems largely moot, there are still echoes of it in the works of music theorists trying to understand the differences between purely synthesized electronic music, which can be thought of as absolute music, and *musique concrete*, in some ways programmatic. I would suggest a similar question, one that relates to notation.

Certainly the idea that music notation can refer to something outside the sound it denotes, that "it may also be viewed as an art object embedded with aesthetic potential,"[22] is not new. Referential configurations of notation were used during the fifteenth century. Baud Cordier, for example, composed a love song in the shape of a heart.[23] Also, rounds appeared in circular layouts. Richard Rastall calls these devices "mannered notations."[24] I identify such configurations -- along with

[22] John Anthony Celona, "Structural aspects of contemporary music notation; and, command-string notation: A new music notational system" (Ph.D. diss., University of California, San Diego, 1977), 5.

[23] "Belle bonne" in the Chantilly MS; cited in Willi Apel, *Notation of polyphonic music 900 - 1600* (Cambridge, Mass.: Medieval Academy of America, 1942), 427.

[24] Richard Rastall, *The notation of Western music* (London: Dent, 1983), 80. He discusses them along with various note coloration schemes and other strategies used to imply

the types of notation which do not involve shaping the staves but arranging only the notes instead, such as my *Water Pictures and Words* (see Examples 5-14, a & b) -- as pattern notation. They are part of the graphic-traditional notation system. The designation "pattern notation" derives from pattern poetry (see Examples 5-8 and 5-9). This type of poem is sometimes referred to as "concrete," and it is also known by the Latin name *carmen figuratum*.[25]

Pattern and mannered notations are additionally related to eye music which uses a visual aspect of the notation to refer to something outside the music, and to word painting which uses visual patterns of notes to express or depict words in an accompanying text. Words can also serve as notation devices to make outside references, as for example when I spell out Bach's name with note heads (see Example 5-14c), or when score instructions elicit associations not immediately necessary to the reproduction of a work. All of these notations refer to something outside the music, and so as a group I call them program notations. But just as program music

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special learning by the composer and "to keep music a highly-trained skill to which the uninitiated should not be admitted" (p. 89).

[25] See Dick Higgins, *Pattern poetry: Guide to an unknown literature* (Albany: State University of New York Press, 1987).

can stand alone without benefit of an external association, program notation will indicate sounds whether or not the fuller meaning is recognized.

Program notations are nearly the same as conceptual notations. They both can consist of traditional, graphic, or alphanumeric characters. But even though program notations always make external connections, they also always denote sounds rather than only theories or ideas as conceptual notations might. In general program notations are a matter of reference, whereas conceptual notations are a question of intention and reception; that is to say, the essence of the former exists in the message and that of the latter in the sender and the perceiver.

Because reference takes shape in the infinite web of interpretations constituting the experiences of senders and perceivers there is always some ambiguity inherent in the process, especially in processes like natural languages. But the degree of precision embodied in a given notation can be judged from within the confines of a closed system set up by the rules invoked by the notation, as is frequently the case with computers. The ranges of notation specificity can be mapped across binary continua such as determinacy/indeterminacy, uniformity/pluralism, regularity/anarchy, and order/spontaneity. "If all . . . references were unique, no ambiguity would arise but the labour of specification would be so great that communication would be hopelessly restricted . . . . The power to extend thought has to be purchased at the risk of ambiguity."[26]

From neumatic, figured bass, and cadenza notations to mood and tempo indications, traditional music has always included plenty of ambiguity. The balance between the vague and the well-defined has been worked out over the centuries to produce an effective and enduring system of notation; but one which has nevertheless been greatly expanded in recent years by graphic and computer notations. As we have seen, the former tends toward the indeterminate and the latter toward the precise. In Nelson Goodman's terms, it is usually easier to construct compliance classes with computer music notations than with graphic ones. Computer practices usually make it clear that a particular notation is denoting something and whether or not a particular phenomenon is included in the class of things being denoted. Graphic music notation, since it frequently resorts to ways of referring such as exemplification, does not provide the user with as much certainly about what may or may not be indicated by a particular instance of notation. The clarity of reference in computer notation makes it possible to construct chains

[26] John Parry in Hugo Cole, *Sounds and signs: Aspects of musical notation* (London: Oxford University Press, 1974), 14.

of meaning incorporating larger fields of reference, but fields which ultimately must still be analyzable into their component parts. As I have noted before, however, the ambiguity of graphic notations makes them more useful as indicators at higher levels of abstraction and as devices for the immediate facilitation of creative impulses.

Though total determinism has been a goal in music at least since the 1940s, and even though electronics has greatly enhanced the degree to which performances of works can be prescribed, the ideal of complete control is ultimately an illusion. Notation, human, machine, and social variables make it impossible. Even if a piece of music could be fully described by the notation, and the actions of the performer or interpreter completely prescribed, with all the contingencies of style and other constraints accounted for, there would still be elements of randomness incorporated into any specific experience of the piece. All this, of course, does not mean that it is unrewarding to strive toward as much determinacy in notation as the users of the notation desire.

Code

The degree of determinacy is largely dependent on the rules being followed and the code embodying the rules. A code is a system of rules common to the participants in the sender/message/perceiver/result process, enabling the transmission and interpretation of messages. The systems of rules come in a large variety of forms, from mathematics to graphic layout to economic exchange. Arriving with a system of rules is an associated syntax; and necessary to their use is a given database. If these are altered, the entire meaning of the notation is changed, as when Norman Cazden uses traditional notation to encode Lincoln's Gettysburg Address.[27]

Computers understand rules because they are precisely defined. Even if the rules call for random choices in some cases, the application of the chance operations is clearly determined.[28] Humans, on the other hand, understand by practice, use, and sensory analogy. Agreement as to what rules are to be shared in a code are made by tradition, learning, and probability. Nevertheless, as computers get better at using features of

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[27] Norman Cazden, "How to compose non-music," *Journal of music theory* 5:2 (1961): 287-297.

[28] It might be interesting in this regard to compare the indeterminacy processes used by John Cage and the randomness generators commonly used in computer programs.

artificial intelligence, such as neural nets and parallel processing, they will be able to interpret codes more as humans do.

The comprehension of rules may require a variety of auxiliary codes. Intonation, stress, timing, gesture, and facial expression, for example, are used to disambiguate speech. Such auxiliary codes come to play in the interpretation of traditional music notation in the form of performance practice, style, musicology, and so forth. An understanding of visual, aesthetic, and philosophical codes enhances the utility of graphic music notation, just as an understanding of mathematics augments the usefulness of computer notations.

Rules imply standardization, grammar, and syntax, all of which serve to enhance the communicativeness of notation as well as to circumscribe its diversity. Music teachers and theorists have standardized traditional music notation.[29] A thorough analysis and taxonomy of intention-based notations used in new music took place in the early 1970s and resulted in the International Conference on New Musical Notation held in Ghent, Belgium in 1974 and the establishment of the *Index of New Musical Notation* housed in the Library of the Performing Arts at

[29] Perhaps the most thorough and easy to use book on traditional notation practice is Gardner Read, *Music notation: A manual of modern practice*, 2nd. ed. (New York: Crescendo, 1969; Taplinger, 1979).

Lincoln Center in New York.[30] Though this work does not encompass computer music notation, it does include many graphic constructs and extensions of traditional forms.

Because precision is so important to its operation, the standardization of computer music notation has been particularly crucial to facilitating the development of the field. As with traditional notation, but in a process taking years rather than centuries, the practitioners of the art have had the most to say about the evolution of the notation. These practitioners have also formed a committee to try to enhance standardization and the ease of exchanging and reproducing works and other data. The Music Information Processing Standards committee of the American National Standards Institute (ANSI) has been working since the mid-1980s to develop and disseminate the Standard Music Description Language (SMDL) which incorporates earlier rules included in the Musical Instrument Digital Interface (MIDI) language. The goal is to develop computer standards not only appropriate for performance but for music notation engraving as well. Previous efforts in this area have enjoyed some success, most notably the Digital Alternate Representation of

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[30] See Herman Sabbe, Kurt Stone, and Gerald Warfield, eds., *International Conference on New Musical Notation report* (Amsterdam: Swets & Zeitlinger, 1975); and Kurt Stone, *Music notation in the twentieth century: A practical guidebook* (New York: Norton, 1980).

Musical Scores (DARMS) from the 1970s, but SMDL promises to have wider distribution, especially among publishers of scores.

The least standardized of the three music notation systems is the graphic; and this is the source of a great deal of consternation among theorists and particularly among performers. They complain that without notation conventions the performer is forced to study more than when music is notated traditionally. But even though it necessitates greater work on the part of the performer, the absence of norms is to a large extent what such works are about.

Diversifying the code, in a similar fashion, enhances the power of verbal language. Dennis Baron, discussing college English pedagogy, illuminates the problem of too much standardization:

> Even as we celebrate cultural difference in American history, society, and literature, we fear and reject diversity in the American language, where "correctness" and standardization remain the academic goals. It's fine to explode the canon and rewrite the syllabus in the name of cultural pluralism or to restructure the classroom to accommodate the different learning styles of students. It's even acceptable now in most disciplines to "rewrite" standard English to make it more fair in matters of race, gender, and ethnicity. But it still borders on the unethical to allow students to practice linguistic diversity unchecked. Let's face it: Most English instructors believe that

> failing to enforce language standards could cost them their jobs.[31]

The music world sustains a similar rigidity about music notation. It developed from the strict practices of the nineteenth century which have been significantly softened by developments during the last fifty years. A residue of authoritarianism, however, persists. It is auxiliary to the reaction against the redefinition of all the fields of music, including performance, musicology, theory, and practice.

Two other aspects of reference and coding are crucial to the understanding of notations: grammar and syntax. Grammars are backgrounds upon which references are drawn. They form the contexts within which notations happen. During the past half century, the study of grammars has become an abiding concern of music theorists. Much of this interest finds its inspiration in the theories about generative grammar, transformational rules, surface and deep structures, and similar phenomena described by linguists like Noam Chomsky and music theorists such as Heinrich Schenker. Fred Lerdahl and Ray Jackendoff have focused and redefined earlier efforts, and Curtis Roads and others have applied similar principles to computer music. Though these efforts certainly are useful within

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[31] Dennis Baron, "Why do academics continue to insist on 'proper' English?" *Chronicle of Higher Education* (July 1, 1992): B2.

their specific domains (i.e., the immanent aspects of the works studied and their underlying structural forms), they exclude consideration of the larger meaning or results of the works. They focus on syntax to the exclusion of semantics and pragmatics. They thus avoid having to deal with that notoriously difficult philosophical construction, truth. To do that one has to move beyond the confines of media, ways of referring, and codes to the unfolding of the sender/message/perceiver/result process in the perceiver and in society.

Perceiver

Even though the perceiver might be a machine or a social structure, it reinvigorates the sender/message/-perceiver/result process. It introduces into the process a new aggregation of attention, cognition, intention, and competence, which provides a way of interpreting the formal relationships in the notation, of giving them meaning.

Meaning

Meaning is relational. It has been called the ghost in the machine, the immaterial essence of the structure. But like perception, meaning is active and constructive and derives from engagement and commitment, from paying attention. Meaning ensues from the interaction of the perceiver and the message, a process inherently constrained by the context and the code. It depends on code because the way something is used is what gives it meaning, and codes regulate usage. But meaning is mercurial. It changes as it moves along the succession of interactions in sender/message/perceiver/result operations and down the infinite chain of sign interpretants involved in the process. Meaning meaning so much, and yet being impossible to fully understand, is like an onion: each layer is smaller but thicker than the previous one. The skin of the onion is the lived experience of the perceiver.

Meaning comes in all shapes and sizes. Many theorists have attempted to disentangle the various types.[32] Roughly, meanings can be described as either

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[32] See, for example, Charles Ogden and Ivor Richards, *Meaning of meaning: A study of the influence of language upon thought and of the science of symbolism*, 4th. ed. (New York: Harcourt Brace, 1936). They define sixteen types of meaning.

internal to the perceived object or external to it. I have grouped the terms from several models of meaning into a binarism of types.

<u>Internal Meaning</u>	<u>External Meaning</u>
immanent	transcendental
inherent	exterior
structural	contextual
embodied	designative
congeneric	extrageneric
absolute	referential
explicit	implicit
intrinsic	extrinsic
substantial	metaphorical
pheno-textual	geno-textual
literal	allegorical
denotative	connotative
expressive	associative

Another binary depiction of how meaning operates draws a distinction between meaning and information. When meaning is high, as it is in denotation for example, information is low. Connotative meaning, characterized by Nattiez as a "dust cloud of personal and affective associations,"[33] involves a high degree of information and low degrees of redundancy and clarity of meaning.

Meaning seems to exist along a continuum of perceiving, knowing, and understanding, all of which are notoriously thorny conceptions discussed at great length by pursuers of phenomenology, hermeneutics, and cognitive science, which are just three of the many possible philosophical orientations toward these processes. The role of notation seems to fall toward the end of this epistemological continuum as it does toward the end of a similar social-psychological progression. Humanity has evolved through

> three developmental processes. They are anatomical-physiological, individual consciousness and social organization. The developments in each of these sectors have led the human species to an increasing independence [from its immediate context. They involve the following:]
> 1) . . . The integration of redundant aspects of the environment . . . coded in memory for later re-utilization. . . . Coding and storing are the preconditions for direct exchange of symbols and hence for notation systems.
> 2) . . . Individual experiences of the ever changing environment as a structure of typical objects and characteristics, as a "world", in which temporal sequences of situations are experienced as "history" of typical events.
> 3) . . . Increasing independence of mere reactions to an immediate situation . . . accompanied by . . . the capacity to recognize oneself in the behavior of others. . . .

[33] Nattiez, *Music and discourse*, 24.

> Notation systems are immediately bound up with . . . the capacity to experience sequences of events as "history".[34]

Data without at least minimal meaning are not perceived. At the early stage of sensitivity and stimulation, cognitive processes such as discovering, remembering, recognizing, learning, imagining, and wishing provide the necessary meaning. But when representations -- as opposed to presentations -- come more into play and complex systems of notation evolve, simpler forms of cognition combine with more complex phenomena such as attitude, training, and the unconscious, as well as biases such as race, class, gender, sexuality, and history to generate interpretations.

Interpretation, in this sense, is what Nietzsche was referring to when he said that "there are no facts, only interpretations."[35] We tend to think of facts as solid, logical, absolute phenomena. But in fact (pun intended), they are based on judgements. Though logical

> rules of inference are separate from the "facts" and "propositions" -- specific knowledge about the real world -- on which the logical system operates, and the hope is to separate "knowledge" from "reason" in the same way, [logical inference] has serious, and I think fatal, problems [because] if there is even one

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[34] T. Luckman in Krampen, "Prehistory of graphic notation," 1467.

[35] Friedrich Nietzsche in Susan Sontag, *Against interpretation and other essays* (New York: Farrar, Straus & Giroux, 1966), 5.

> single inconsistency, then one can deduce anything, however absurd.[36]

Today logical meaning is frequently taken simply as one among several modalities of meaning.[37]

One corollary of the contemporary mistrust of facts, logic, and codes is the ascendence of the image as opposed to the word or string of alphanumeric characters. I believe this consequence is reflected in music and art worlds by the growth of interest in graphic notations and sound images, though certainly a large increase in logical codes and alphanumeric strings has accompanied the development of music as a branch of computer science.

Denial

Interpretation is closely bound with judgement. One aspect of music notation which is strongly affected by judgement concerns what the notater fails or refuses to

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[36] Marvin L. Minsky, "Computer science and the representation of knowledge," in *The computer age: A twenty-year view*, ed. Michael Dertouzos and Joel Moses (Cambridge, Mass.: MIT Press, 1979), 404.

[37] The questioning of rationality (i.e., *logos*) as a governing principle of the universe has been at the center of a great deal of discussion surrounding post-structuralist, deconstructionist, and post-modern theory. For more information, consult works by the following authors cited in the Bibliography: Edmund Husserl, Martin Heidegger, Jacques Derrida, Michel Foucault, and Vincent Descomb.

notate. This involves absence. Notating absence is different from refraining from notating something which is absent, or notating something which prevents the presence of something else. A quarter-note rest in traditional music notation, an area of blank space in graphic notation, or a programmed duration of silence in a computer music score all indicate the absence of something which had been there before, or which will follow, or which is there in some other capacity. This is why Nattiez says, "Sound is an irreducible given of music. Even in the marginal cases in which it is absent, it is nonetheless present by allusion."[38]

Codes and conventions tell the sender what is to be included in what is said as well as what it means when something is not said. For instance, articulation indications, as rendered by contemporary composers of vocal or string music, usually assume that vibrato will be used; to avoid its use, they must specifically notate its absence. In this way codes and conventions identify what is important to the users of the notation system; but they also identify what the users avoid.

A similar use of codes and conventions is evident in the notation of political life by the agents of its discourse. The usage is especially apparent to people who

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[38] Nattiez, *Music and discourse*, 67.

belong to marginalized groups whose realities are denied by the dominant culture. For example, the "ten-day episode over whether to end this country's ban of homosexuals in the military was a disgrace, a colossal waste of time," according to one perspective on the issue. "Americans voted for Clinton . . . because they wanted [a president who is] engaged in the problems of everyday people."[39] This perspective denies that lesbians and gays, who comprise ten percent of the population, are everyday people.

An even more startling example of denying discourse appeared in a report issued by the National Academy of Sciences:

> If the current pattern of the epidemic (AIDS) holds, U.S. society at large will have been able to wait out the primary impact. . . . AIDS will "disappear," not because, like smallpox, it has been eliminated, but because those who continue to be affected by it are socially invisible, beyond the sight and attention of the majority population.[40]

The refusal to recognize that something is important, meaningful, or even real, is what I call ontological denial. In music notation at higher levels of abstraction -- as discourse, theory, diachronic analysis, and social

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[39] From *Chicago Sun-Times*, quoted in "What others are saying," *San Francisco Examiner* (February 6, 1993): A-15.

[40] From "Social impact of AIDS in the United States," cited in Rob Morse, "Read the news today, oy veh," *San Francisco Examiner* (February 7, 1993): A-3.

and political phenomena -- ontological denial is evident in statements such as the following, which I have found repeated numerous times during my research:

- Appropriate music notation is culturally neutral. It should not attempt to address political issues or anything else exterior to the music.
- Music using unusual notation devices is flawed and will never be performed very much.
- Graphic music notation is a movement affiliated only with a few disaffected musicians from the 1960s. Its time, at this point, has come and gone.
- The most suitable music analysis and theory deals only with immanent, internal aspects of musical works.

The structuralist focus on syntax with its concomitant avoidance of semantics and pragmatics, as well as the insistence of some experimental composers like John Cage that the physical phenomena of sound itself or of a graphic mark are more important than their possible meanings at higher levels of abstraction, are two other examples of ontological denial. But it is precisely at more abstract levels, where notation systems coalesce with other cultural constructs to form social and philosophical worlds, that ontological denial plays a crucial role in controlling the environment and where silence, indeed, comes to equal death.

Questions about what cultural aggregations actually constitute worlds are more easily dealt with as results than as perceptions, though certainly both parts of the sender/message/perceiver/result process are involved. The meaning, and in a practical sense the being, of something abides in the totality of its consequences for the consciousness of the perceiver and the larger system in which it operates, the context. These are both results, but the former is centered on the perceiver.

Perceptual Construction

Perception is constructive and active, reaching out to its stimulation to create itself. The motivation of perceivers -- performers or listeners -- comes with their identification with the sender/message/perceiver/result process, more particularly with the meanings they ascribe to composers' intentions. The cognitive components of perception include attention, volition, attitude, and the subconscious. They all play a role in the unfolding of the perceiver's workings. Meaning evolves as the perceiver acts, but it is molded by the environment where the action takes place.

> Perception of the social world implies an act of construction. [It] takes place in practice. . . . The categories of perception of

> the social world are, as regards their most essential features, the product of the internalization, the incorporation of the objective structures of social space. Consequently, they incline agents to accept the social world as it is, to take it for granted, rather than to rebel against it.[41]

Music notation, like all writing, is a social procedure, and as such it internalizes the social structure of the music world. But seeing music notation in this light is often difficult.

The idea of perception as a creative process is embodied in the term *apperception* which is conscious perceiving or comprehension. It implies an identification of the perceiver with the goals of the sender or, at least, with the force of the sender/message/perceiver/-result process as a whole. Linda Fiore's discussion of her reactions to a work composed in indeterminate, ideographic notation illustrates the way performer identification changes the perception of a work and the perceiver's role in the process. She asked herself:

> How flexible can I be? . . . How closely must the instructions be followed? The answers lie in performers' willingness to adapt to new practice habits, learn improvisational techniques, and adjust to the idea of exploring their own musical personalities and applying it to the entire process. Unintentional ambiguities occur in all notated music, but those in *Return and Recall* purposely served as problems for the performers to challenge. It is when musicians (performers) start asking themselves

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[41] Pierre Bourdieu, "The social space and the genesis of groups," *Social science information* 24:2 (1985): 201.

> (as I did) "What are *my* intentions? What do *I* want to explore?" that they are on their way to creating a new piece of music out of this performance system.[42]

The creative process initiated by examining oneself, questioning intentions and desires, and striving to change one's practices and habits of thought lead to more inclusive perspectives about music notation, music theory, and society in general.

Comprehension and Competence

The perceiver's comprehension and competence will never be adequate without the her volition. There must be a desire on the part of the perceiver to comprehend something, but there must also be a facilitating context. The context is where the difference between miscomprehension and ambiguity lies. The former results from the perceiver's failure to understand the context; the latter from the sender's failure to understand it or her intent to initiate a vague reference. Sometimes the perceiver

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[42] Linda Fiore, "Notes on Stuart Smith's *Return and recall*: A view from within," *Perspectives of new music* 22:1-2 (Fall-Winter 1983, & Spring-Summer 1984): 291. Brian Ferneyhough, confining himself for the most part to traditional notation, poses a similar problem in some of his works which are so difficult as to be "impossible" to be performed, but which are nonetheless presented in performance.

must "read between the lines" to understand something, must exploit the complete potential of the signifier.

Comprehension is no simple matter. It comes in various degrees. It specifies and excludes, and provides the opportunity for illusion to arise. But context and competence define its boundaries. Consider how different readings might be signified by hoof prints in the soil:

- An animal was present.
- A horse was present.
- A horse ridden by a heavy person was present.
- The king's well-fed soldiers were riding about.
- The king's well-fed soldiers were trying to prevent Robin Hood from helping the poor.
- The poor are oppressed.

It is by being saturated in appropriate conventions and codes, and by filtering stimulations through learned grammars that the perceiver comes to understand.

Saturation in a language is what builds the perceiver's competence which is crucial to the usefulness of any notation system. The acquisition of competence marks a major difference between traditional music notation, with its relatively flexible meanings, and computer notations.

> The trick that [traditional music notation] accomplishes is to allow the information not carried in the score to be recovered through the application of the . . . score to a set of interpretive rules. Musicians are trained to apply the rules in order to reconstitute the music from the . . . score. Some of the rules

> are manifest, but the majority of them can be verbalized only with great difficulty. The extent of this unwritten body of lore is made painfully evident by attempts to formalize it, [for computer notation systems].[43]

Though computers can aggravate the ordeal of competence, once basic procedures are programmed they can also ease the burden. Today's music softwares frequently enable musicians to accomplish tasks that traditional systems would force them to defer.

Most of what I have said about perceivers to this point has been general or applicable to musical performers, and that is consistent with the approach taken by traditional music theory. With the addition of machines to the population of music notation perceivers, questions of standardization, translation, reproducibility, and technology acquire greater importance. Representation systems used in creating music databases, for instance, must be defined and tested. Answers must be found to musicological questions about what information ought to be included, such as errors in copying or other ambiguities in historical source notations, as well as practical questions of who will have

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[43] Gareth D. Loy, "Composing with computers: A survey of some compositional formalisms and music programming languages" (Center for Music Experiment, University of California, San Diego, 1988, draft), 32. Published in *Current directions in computer music research*, ed. Max Mathews and John Pierce (Cambridge, Mass.: MIT Press, 1989), 291-396.

access to a musical database, where it will be stored, who will get credit for its compilation, and how it will be distributed.[44]

But there is another aspect of perception which is currently receiving a good deal of attention by theorists: the reception of music by listeners. When translated to the domain of music notation, reception theory focuses on the reader of the score who, in a sense, is a performer but who may not necessarily be interested in producing sounds per se. Reception theory brings up questions of who or what is at the center of the process of music communication. From there a vast field of investigation, one germane to but beyond the scope of this study, opens onto considerations of the relationships among the subjects and objects of representational systems, the minds and bodies of the users, and the phenomenological and hermeneutical aspects of the aesthetic enterprise.[45] The final thrust of this dissertation is toward a

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[44] Some of the ideas addressed here are drawn from Walter Hewlett, "Fullscore musical databases: Applications and issues," paper presented at the annual meeting of the Northern California Chapter of the American Musicological Society (Stanford, March 1990).

[45] For more on the topic of reception aesthetics, see Richard Leppert and Susan McClary, eds., *Music and society: The politics of composition, performance and reception* (New York: Cambridge University Press, 1987); Alan Swingewood, *Sociological poetics and aesthetic theory* (London: Macmillan, 1986); and Hans Robert Jauss, *Toward an aesthetic of reception*, trans. Timothy Bahti (Minneapolis: University of Minnesota Press, 1982).

pragmatic consideration of the results of using music notation and of how they contribute to the creation of worlds which in turn affect how we live our lives personally and socially.

Result

The sender/message/perceiver/result model embodies a tripartite relationship among structures, processes, and agents. Senders and perceivers are active agents, but at another level of structural abstraction, at a different point in procedural time, they themselves are created by the circularity of the aggregate phenomenon variously called communication, semiosis, or symbolization. In a version of meaning similar to Peirce's "infinite interpretant," Karl Jaspers said that "interpretation encircles and circumscribes, penetrates and illuminates. It becomes itself at once a part of the symbol. By interpreting, it participates in symbol-status. The symbol is not passed over by being understood, but is deepened and enhanced by being meditated upon."[46]

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[46] Karl Jaspers in Gordon Epperson, *The musical symbol: A study of the philosophic theory of music* (Ames: Iowa State University Press, 1967), 231.

Structures, processes, and agents eventually come together in a united flow of events. Sign vehicles effectuate the long journey to the results. The syntax of signs embodies the structural rules and requires competence of senders and receivers. Semantics invokes the creative capacities of agents as interpreters of meaning. But it is pragmatics which finally addresses the questions of how signs are used and the consequences of their use.

Worldmaking

All forms of notation currently used to represent music or sound create micro-worlds and contribute to the creation of larger worlds. This is a basic characteristic of ways of referring -- such as denotation, connotation, naming, expression, and depiction -- and of systems of reference -- such as natural and artificial languages, sign systems, and models. Worlds are coherent and recognizable collections of structures, processes, and agents. The particular kind of worlds each form of notation is capable of making or influencing is determined by aspects of the notation and its circumstances such as the media used, the physical and deterministic relationships between the signifiers and the signified, the intentions of the users, the structures of the grammars, and the historical, ideological, and social contexts in which they are used.

Notations create worlds because in any operation of a sign, with all the concomitant requirements of circumstance, there is enough of the as yet unknown to generate something that has not yet existed, a world or a part of a world. "When a formerly unknown trace [symbol] comes into the realm of lived experience, this new trace will modify the space of forms, as well as the space of meaning. The symbolic defines a potential horizon of new symbolic organizations."[47]

The worldmaking power of notation is evident in the histories of many different kinds of notation. Approximately 300,000 years ago, *Homo erectus* primates produced the first ordered and successively engraved marks. Two hundred ninety thousand years after that (i.e., 10,000 years ago), the first pictures appeared in caves in France and Spain. This was an important point in the development of notation; it is evidence that people were giving symbolic meaning to graphic marks. These cave drawings eventually led to pictographic writing and the alphabet. They were prototypes for the written language which enables most of what we know today.

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[47] Nattiez, *Music and discourse*, 34.

A notation system, apparently based on the connection between ten and the number of fingers on the human hand, led to the decimal and time number systems we currently use. When the Babylonians used their hands to count, they proceeded by touching a thumb to each of the three segments of the four fingers on the same hand. This method yields the number twelve for one cycle of counting. Keeping track of each cycle of twelve by folding over one digit in the other hand every time a cycle was completed, they arrived at twelve times five, or sixty. This number came to influence their time-keeping system, and ours. Similarly, the Romans found that a thousand paces is a convenient unit of measurement. It adds up to approximately the distance we call a mile; and the word mile is derived from the Latin word for "thousand".[48]

Bodily gestures seem to be abstracted into symbols, and acquire world-defining functions, musically as well as numerically. Ancient musicians sometimes used hand gestures to delineate approximate pitch contours. This is known as chironomy, and was most likely the basis for the neumatic notation which developed in the Middle Ages. Chironomy may have led to ecphonetic notation, prosodic recitation marks representing short, melodic formulae used in reading religious texts during the Middle Ages. Once

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[48] Arno Penzias, *Ideas and information: Managing in a high-tech world* (New York: Norton, 1989), 178.

conventions were established for the notation of pitch, the system began to influence what pitches were chosen for musical works. The precise notation of time came later, and it is credited with enabling the development of polyphony as well as inhibiting the evolution of complex improvised rhythms.

In contemporary society, with its technological and economic complexities, worldmaking is frequently a quicker and more conscious pursuit, especially where computers are concerned.

> Every point of contact between the computer and the user will be integrated in the extended model of user interface, from product design to service (support, documentation, tutorials, seminars, packaging, etc.). By extension, a manufacturer of computers interacts with the market through numerous constitutive interfaces, or . . . through the language of the product and of everything participating in its marketing.[49]

With the advent of virtual reality, computers have achieved a new level of interfacing directly with users, of creating worlds almost at will. The beauty of, and the trouble with, such self-contained worlds are that what you see is what you get (WYSIWYG), but also, what you see is *all* you get.[50]

Computer notation systems have played an important part in the work I have done in producing this disserta-

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[49] Mihai Nadin, "Interface design: A semiotic paradigm," *Semiotica* 69:3/4 (1988): 274.

[50] Ibid., 282.

tion. I use an IBM clone with the standard disc operating system (DOS). This has necessitated limiting the names of my on-line files to eight characters, a dot, and three more characters. The limitation has affected the way I organized the thousands of notes used to produce this study, even the hand-written ones which never were transcribed to a computer disc, and has inspired a filing system I otherwise would not have devised.[51]

Representation is worldmaking. To represent something it is necessary to analyze it, to select certain aspects of its totality, and to construct an instrument, a sign or group of signs, to stand in its place. Nelson Goodman points out that "we are confined to ways of describing whatever is described. Our universe, so to speak, consists of these ways."[52] He goes on to describe several processes used to make worlds. These include the following:

- Composition and decomposition -- "Composing wholes and kinds out of parts and members and subclasses, combining features into complexes, and making connections; [as well as] dividing wholes into parts and partitioning kinds into

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[51] A discussion in Chapter Three contrasts the model-world metaphor used in the iconic notations found in Macintosh computers with the conversation metaphor used in the symbolic notations of IBM systems.

[52] Nelson Goodman, *Ways of worldmaking* (Indianapolis: Hackett, 1978), 3.

subspecies, analyzing complexes into component features, drawing distinctions."[53]

Given that one of my intentions as a sender in a sender/message/perceiver/result process is to help create in the music theory community an acknowledged place for queer theory (i.e., the lesbian/gay/bisexual/transgender corollary to feminist theory), then my dedication of this dissertation to my lover emerges as an attempt at worldmaking. Similarly, in the notation for my computer piece *Someday* (see Example 5-4) based on the civil rights song *We Shall Overcome*, the naming of subroutines after historically famous lesbians and gay men illustrates the use of music notation in a worldmaking strategy of composition and decomposition. It necessitates an analysis or deconstruction of the sign systems used in computer music notation (e.g., programs, subroutines, variables) and in gay liberation advocacy (e.g., labels, politics, history) and a recombination of them into a composition which refers, by means of what I have called program notation, not only to its internal workings but to the outside world as well. Of course, any music composition, or any artistic creation, is a form of worldmaking. Knowing that, the question becomes What worlds are made?

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[53] Ibid., 7.

• Weighting -- In comparing worlds one may find that "some relevant kinds of the one world, rather than being absent from the other, are present as irrelevant kinds; some differences among worlds are not so much in entities comprised as in emphasis or accent, and these differences are no less consequential."[54] This, perhaps, is the worldmaking process under which ontological denial would fall.

• Ordering -- "Nothing is at rest or is in motion apart from a frame of reference."[55] Context and levels of abstraction involve ordering. The gestural notation, described above, which the Babylonians used for counting and the way in which it led to the development of the system of dividing hours and minutes into units of sixty are examples of the worldmaking power of ordering.

• Deletion and supplementation -- "The making of one world out of another usually involves some extensive weeding out and filling -- actual excision of some old and supply of some new material. Our capacity for overlooking is virtually unlimited, and what we do take in usually consists of significant fragments and clues that need massive supplementation."[56]

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[54] Ibid., 11.

[55] Ibid., 13.

[56] Ibid., 14.

- Deformation -- "Some changes are reshapings or deformations that may according to point of view be considered either corrections or distortions."[57]

Similar and dissimilar processes of worldmaking or model building might be cited, such as transformation, estrangement, defamiliarization, classification, specification, generalization, particularization, universalization, and making compatible or unique. But "while a tighter systematization [of such processes] could surely be developed, none can be ultimate; for . . . there is no more a unique world of worlds than there is a unique world."[58]

The most important instrument of worldmaking is language because it not only mediates how we communicate with one another but also how we represent reality to ourselves. The belief that language not only expresses meaning, but also produces it has been an important and recurring theme in twentieth century thought from Ferdinand de Saussure to Ludwig Wittgenstein. According to James G. Miller, "ontology recapitulates philology," meaning that the study of being is really the study of

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[57] Ibid., 16.

[58] Ibid., 17.

words.[59] Martin Heidegger referred to the "way-making movement" of language.[60]

The work of the linguist Deborah Tannen, a specialist in discourse analysis -- the study of language as it is used in everyday conversation -- shows that

> people make use of certain linguistic devices, like intonation or pauses, to carry on a conversation. Such devices are quite apart from the actual words people use, but are just as important in conveying meaning. Moreover . . . the choices people make regarding the conversational devices they use -- long or short pauses, say -- seem to be linked to certain factors such as age, race, sex, and ethnic or regional background. . . . "Conversational style isn't something extra added on like icing on the cake; it is the very stuff of which the cake is made."[61]

Two points about Tannen's work are germane to music notation. First, one's personal style, whether it be in composing, improvising, or notating music, is crucial to what one communicates. Second, that style is related to one's social, economic, and political position. Within a larger frame of reference, style itself becomes a signifying system, a way of notating.

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[59] James G. Miller in Willard Van Orman Quine, *Word and object* (Cambridge, Mass.: MIT Press, 1960), *vii*.

[60] See Ronald Bruzina, "Heidegger on the metaphor and philosophy," in Michael Murray, ed., *Heidegger and modern philosophy* (New Haven: Yale University Press, 1978), 197.

[61] Ellen Coughlin, "Linguist, listening between the words, marks different styles of everyday talk," *Chronicle of Higher Education* (October 3, 1990), A8. The internal quotation is Tannen's.

Context governs the result of the sender/message/-perceiver/result process more than any other aspect. Worldmaking is important because it has the power to change the context. The historical framework changes with what is remembered, the ideological with what is valued, and the social and political with who has the power to speak, to buy, or to otherwise affect groups of people.

History and Culture

The history even of individual words involves a dynamic process of contextual change. Not many musicians today make the conscious connection between the terms *arm* and *harmony*. Yet when the latter expression was initially derived in the late fourteenth century from the Greek term for arm or joint, the implied reference to human limbs must have been evident to those who created the metaphor. Languages are ripe with forgotten metaphors which came to be understood by convention, but which originally were little associative worlds made by transforming the meaning of a signifier to have it indicate a new signified.

A similar process occurs in computer programming. "The programming technique of yesterday is the language feature of tomorrow -- that is, as the problems which more or less ad hoc programming techniques solve become better understood, their solutions enter our programming languages."[62]

As a notation or sign evolves from an improvised solution for immediate problems using standardized codes and grammars on the one hand, to become an extension of the standards and an expansion of the code on the other, it moves from a system low in information and high in redundancy to one high in information, low in redundancy, and rich in ambiguity and connotation. Along the way it becomes a record of the history of the world and the social space in which it functions. Christian Wolff puts it this way: "Music (art) imitates (represents) not nature, even in its mode of operation, but (inevitably, since we do not exist apart from nature nor nature apart from us) human life in both its material (biological, natural, etc.) aspect and its history, its movement at once personal, social and political, through time."[63]

The interpretation of the notation takes place in the individual perceiver whose memories are governed by education, tradition, theory, method, and practice -- a perceiver who is culture-bound. Just as the cultural and historical context of words and computer programs change

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[62] Curtis Abbott, "Machine tongues: Part II," *Computer music journal* 2:2 (September 1978): 5B.

[63] Christian Wolff, "Open to whom and to what," *Interface* 16:3 (1987): 134.

across time, the context for perceptions also changes. Jeanne Bamberger found that once children had been taught duration-based music notations they tended to forget the figure-based devices they may have developed spontaneously.[64] The "right" one became the one they were taught.

In the music world we are constantly taught by professors, theorists, composers, and society that some ways of thinking about music are preferable to others. The academic music establishment takes a constrained ideological view. According to Richard Leppert:

> For the most part, the discourse of musical scholarship clings stubbornly to a reliance on positivism in historical research, and formalism in theory and criticism, with primary attention still focused almost exclusively on the canon. . . . So long as music is understood essentially as autonomous, abstract pitch relationships, then the technologies that produce and reproduce the sounds and the institutions that decide what to perform, publish, broadcast, and so forth, remain invisible -- or inaudible. They are regarded simply as the means by which the composer's subjectivity comes into contact with that of the listener, and that mystical union of composer and listener seemingly will admit of no actual mediation.[65]

Susan McClary raises a similar point concerning questions of gender, a topic which rarely enters into discussions of music:

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[64] See Chapter Three above for a discussion of Bamberger's study.

[65] Leppert and McClary, eds., *Music and society*, *xii* & *xvi*.

> The absence of a feminist critique in music is not necessarily owing . . . to an anti-woman bias. Until there exists some way of dealing with music in general as a social discourse, gender will remain a non-issue. In this, it is treated no differently than any other matter one might wish to examine critically or ideologically.[66]

Ideology

Rose Rosengard Subotnik makes a point about ideology in her discussion of two significant philosophical orientations in academic music circles: Continentalist and Anglo-American. The Continentalist perspective, as characterized by writers like Theodor Adorno, concerns itself with question about ideological and cultural contexts, and seeks to find the larger conceptual premises underlying musical artifacts, taking note along the way of conflicting ideologies. The Anglo-American point of view most often confines itself to consideration of the immanent, structural properties of the musical artifact itself. It maintains a scientific outlook and ignores contrary ideologies. It practices ontological denial

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[66] Susan McClary, "The blasphemy of talking politics during Bach year," in Leppert and McClary, *Music and society*, 53. The need for a broader, more inclusive perspective toward critical analysis is also one of the central themes in Joseph Kerman, *Contemplating music* (Cambridge, Mass.: Harvard University Press, 1985).

rather than ideological confrontation. Subotnik asks, "What good is freedom of thought if it amounts to nothing more than a freedom to refuse to understand?"[67]

The attempts of Continentalists to understand the underlying contexts of art have led to the view that musical notations, analyses, and theories (i.e., musical discourses) are texts, narratives, and mythical inventions. This facilitates the application to music of techniques developed by literary and cultural analysts. For instance, questions concerning metaphor, characterization, plot, authorial point of view, and subtext provide support for attempts to move beyond the immanent structures of works or theories toward an understanding of why the works and theories exist and what the result of their existence is for the larger world.

To Subotnik's Anglo-American scholars the usefulness of ontological denial in musical discourse is that it provides a means for controlling the social space in which they live. In his description of social space Pierre Bourdieu draws parallels between economic capital and symbolic capital, the latter signified by prestige, distinction, and certification, such as, for example, a doctoral degree. Both economic and symbolic capital are

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[67] Rose Rosengard Subotnik, "Role of ideology in the study of Western music," *Journal of musicology* 2:1 (Winter 1983): 9.

accrued by means of struggles, but their acquisition is "unequally probable" because of the histories of society, particular social worlds, and the individuals themselves, and because "objects of the social world can be perceived and uttered in different ways because, like objects in the natural world, they always include a degree of indeterminacy."[68]

Agents struggle for symbolic capital because the same labor receives "different remuneration, depending on the title of the person who does it."[69] The way this happens is that agents use symbolic capital to make or influence, to name, to make explicit, to classify -- processes "performed incessantly at every moment of ordinary existence."[70] They define a "social topology," a social space.

Ways of defining and dividing social space which are consequential to music and notation include the maintenance of autonomous academic disciplines by theorists and other practitioners and of academic departments by educators. According to Donald Lazere,

> The excesses of departmentalization and specialization in academic studies are indirect by-products of the assembly-line division of labor devised by industrial capitalism to

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[68] Bourdieu, "Social space," 201.

[69] Ibid., 207.

[70] Ibid., 202.

> maximize profits while dehumanizing workers. Such compartmentalization serves the ideological function of keeping a Marxist or any other integrative perspective off the academic agenda, in the same way that the fragmented discourse of American politics and the mass media work to preclude any coherent critique of the system they perpetuate.[71]

The circumscription of the social space by the acquisition of symbolic capital is particularly strong in the academic computer music world where the formidable obstacles posed by the technology and "the exclusivity of the field . . . virtually guarantee that those with access to technology would enjoy a high professional profile. Just as electronic music spawned a society of 'techno-haves' in the 1960s, computer music has generated an even more remote community."[72] This community has gathered resources together

> to increase personal power which could not be had by compositional activity alone. And because the problem of studio-access has been consistently postponed, it has often given rise to absurd, feudal arrangements. [At] large computer music production centers, you have to be "known" in the instrumental-academic world in order to produce a piece, otherwise you are not given the means to produce that for which you wish to be "known". In fact, musically

[71] Donald Lazere, "Academic Marxists are being falsely accused of guilt by association with totalitarian communist regimes," *Chronicle of higher education* 36:39 (June 13, 1990): B1.

[72] Bruce W. Pennycook, "Language and resources: A new paradox," in *Language of electroacoustic music*, ed. Simon Emmerson (New York: Hardwood Academic, 1986), 125.

> speaking, what the large centers mainly supply is prestige, rather than means of production.[73]

The evolution of computer music notation illustrates the paradoxical role often played by technology. Numerous arcane systems of notating computer music have emerged over the past forty years, some accumulating great symbolic capital for their creators and thus helping to maintain power relations inherent to the social space in which they were created. Nonetheless, one group of notations, the Music N family, seems to have achieved a dominant position, becoming the standard taught to virtually all computer music students. Such standardization democratizes the notation of computer music and at the same time necessitates the redeployment of capitalizing tactics on the part of the power holders in order to sustain their positions.

A similar phenomenon exists with regard to the increasing commercial availability of the hardware technologies associated with computer music. Such cultural artifacts offer a certain degree of "power to the people," but ultimately they do not seem to effectuate real changes in the basic social paradigm in which we live. They do not change the fact that computer music

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[73] Nicola Bernardini, "Computer music: The state of the nation," *Proceedings of the International Computer Music Conference, 1986*, ed. Paul Berg (San Francisco: Computer Music Association, 1986), A14.

artists still seem to me to be white, male, heterosexual, and not from working-class backgrounds. They are the ones who, as Margaret Spillane say about some artists, get "to make art . . . to imagine that they might become an artist and . . . to have their story told through art."[74]

Straight, white men, of course, are not the only artists or scholars. They are simply the best placed to "live by culture [and] to do so because of the labor of those who do not."[75] But even given such a state of affairs, can individuals not consciously take responsibility for the worlds they help to create?

Self as Notation

One of the maxims I use when I become frustrated by oppressive power relations is, If you don't like this notation, go out and become your own. It is based on a similar statement used by a San Francisco news person, Wes "Scoop" Nisker, who used to end his broadcasts by saying, "If you don't like the news, go out and make some of your own," and it reflects my interest in the idea of the self as notation.

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[74] Margaret Spillane, "The culture of narcissism," *Nation* 251:20 (December 10, 1990): 737.

[75] Eagleton, *Literary theory*, 215.

In Chapter Two I defined notation as a steady but relatively inefficient and incomplete representation of a total work, an abstract language with great potential. The syntax of the language is infinite, but so is the object it seeks to describe. This definition holds up fairly well when used to describe the self as a notation in the larger context of society or of existence itself.

The self is a paradoxical phenomenon. It is both active and unifying. It divides reality into the knower and the known and like structuralism it brackets off the parts it does not or can not take into consideration. At the same time, it provides a relatively persistent perspective on reality making it all part of one unique being.

As notation, the self effectuates the transmission of information between social and political senders such as educational institutions or the musical establishment to perceivers like students or the public. But the self can carry information from students and the public to educational institutions or the musical establishment too. At the highest levels of abstraction, the sender/message/-perceiver/result process forms a circle in which feedback is equal to feed-forward and in which the four components spread out to overlap the same territory more and more. The sender more frequently becomes the message itself and the perceiver the result, or the sender. Performers, usually thought of as perceivers of music notation, become part of the musical medium when their performances transmit the message to listeners.

The career of Nancy Fau, the organist at the largest baseball stadium in Chicago, exemplifies how a person can be taken, almost literally, as notation. She is unable to read music notation and plays completely by ear. Nevertheless, during the last two decades she alone has brought live music to more listeners than the entire Chicago Symphony Orchestra with the vast training of its members and their considerable abilities to read music. Like a news anchorperson she has become the medium through which society sends a message to itself, and in her case it is almost entirely a musical message.

Two aspects of the phenomenon Nancy Fau represents strike me as significant. First, she achieves what she does partly by the power of technology. Sitting alone in a booth, the small gestures of her hands are transformed, amplified, and broadcast as great blasts of sound to tens of thousands of people. Second, her status as notation is linked to improvisation and the absence of a detailed and explicit musical script. Ultimately, we all improvise; and the power of our improvisations is enhanced by the technologies we use.

Taken as power relations, art becomes important to the extent that its result is a changing of consciousness.[76] When changes in consciousness provide the conceptual framework, what Susan Sontag said about interpretation also applies to other aspects of artistic semiosis:

> Interpretation is not (as most people assume) an absolute value, a gesture of mind, situated in some timeless realm of capabilities. Interpretation must itself be evaluated, within a historical view of human consciousness. In some cultural contexts, interpretation is a liberating act. It is a means of revising, of trans-valuing, of escaping the dead past. In other cultural contexts, it is reactionary, impertinent, cowardly, stifling.[77]

The notater who wishes to influence the making of worlds by using the self as notation may even be required to give up what is the most graphically significant aspect of his written notations. That is what happened to Cornelius Cardew.

> Notation is a way of making people move. If you lack other ways, like aggression or persuasion. The notation should do it. This is the most rewarding aspect of work on a notation. Trouble is: Just as you find your sounds are too alien, intended "for a different culture", you make the same discovery about your beautiful notation:

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[76] See Michael Kirby, "The aesthetics of the avant-garde," in *Esthetics contemporary*, ed. Richard Kostelanetz (Buffalo, N.Y.: Prometheus, 1978), 36-70.

[77] Sontag, *Against interpretation*, 7.

> no one is willing to understand it. No one moves.[78]

Cardew solved his dilemma by giving up his experiments with graphic notation and concentrating on improvisation and the political nature of his musical efforts.

It is not, however, always a simple matter to know what the context is for one's attempts at interpretation or artistic communication. Research by Michel Foucault and others has shown that agents of the sender/message/-perceiver/result process, such as the self or the perceiver, embody aspects of an underlying, unconscious, all-pervasive system of power and knowledge. Pierre Bourdieu puts it this way:

> Inasmuch as the properties selected to construct [social] space are active properties, one can also describe it [social space] as a field of forces, i.e., as a set of objective power relations which impose themselves on all who enter the field, and which are irreducible to the intentions of the individual agents, or even to the direct interactions among the agents.[79]

Foucault and Bourdieu perhaps represent the next movement in what Nelson Goodman called the

> mainstream of modern philosophy that . . . exchanged the structure of the world for the structure of the mind, continued [by exchanging] the structure of the mind for the structure of concepts, and that now proceeds to exchange the structure of concepts for the structure of the several symbol systems of the sciences, philo-

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[78] Cornelius Cardew, *Treatise handbook* (New York: Peters, 1971), *x*.

[79] Bourdieu, "Social space," 196.

> sophy, the arts, perception, and everyday discourse.[80]

Foucault has said that "liberty is a practice."[81] I believe the same is true of a meaningful life, one lived as a notation, accepting the social and political attributes of discourse along with the necessity to act. But it is not the outcome of action that provides the meaning, it is the practice itself.

Derrick Bell, an African-American law professor who gave up his tenured position at Harvard because the school failed to hire any African-American women to teach law, said that because of the entrenched advantages whites receive from racialism, the movement for racial equality has had to face the abandonment of teleology, the failure of intention, and the impossibility of communication.[82] He compared this experience to the human experience of death. But, he said, it is possible to endure such experiences and still go on working for racial justice because such work itself gives our lives meaning. Meaning is derived from engagement and commitment, which lead to service, which in turn leads to humility.

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[80] Goodman, *Worldmaking*, *x*.

[81] Paul Rabinow, ed., *Foucault reader* (New York: Pantheon Books, 1984), 245.

[82] Taken from remarks made during a speech at the ACLU Bill of Rights Day Celebration, San Francisco, December 9, 1990.

Queer Theory

My hope, as I come to the end of the long period during which I have written this dissertation, is to bring my self out as notation. My object is to help to make a world that includes an honored place for lesbians and gay men. I see my writing as a notation device in service to this project.

Sometimes, I giggle to myself about the Italian name for a bassoon, *faggot*. Other times, I shudder when I remember the etymology of the slang term "faggot". It is a Latin word meaning a bundle of sticks. During the Middle Ages, it came to be applied to gay men who were bundled up with a rope and thrown on the pyres of witches, being murdered along with them in the fire. Thus, I make associations about the bassoon and some of what it means as a complete cultural artifact manifesting diverse historical, aesthetic, and political results. When I make such associations, I make queer theory.

It is not easy to do this in a society which censors so much that has to do with lesbians and gay men; but I see it as necessary. Notation finally becomes for me a metaphor for my life. I find it to be the site of a mighty struggle and perplexing paradoxes. But I draw meaning from the reading.

BIBLIOGRAPHY

Introduction

This bibliography addresses questions related to several fields of inquiry: music, linguistics, semiotics, visual arts, philosophy, and computer science. Taking the year 1975 as a point of departure, I tried to cite the most important and recent works directly related to the notation of computer or graphic music, and to notation in general, as well as a selection of some important, or pedagogically useful works from related fields. I chose 1975 for three reasons:

1) That was the year Jean-Jacques Nattiez, the founder of the semiotic study of music, published the definitive work *Fondements d'une semiologie de la musique* (recently translated, updated, and published as *Music and Discourse* -- see below), which itself cites many applicable works.

2) In 1976 Gerald Warfield published his comprehensive, annotated bibliography *Writings on contemporary music notation*. (Works which have directly affected my own thinking, or for which I have had something to say in annotation, appear both here and in the Warfield.)

3) Soon after 1975 both the *Computer music journal* and the *Proceedings* of the annual meetings of the International Computer Music Association began publication. Here I have tried to update Warfield's work and to expand Nattiez' into computer science.

The criterion in making the computer music citations was the relevance of the work to the interdisciplinary study of computer science on the one hand and notation, the representation of sound, linguistics, and philosophy on the other. As for citations of scores, only those which are used as sources for Examples in the text are listed here.

Some citations, especially those with an obvious relavance to the topics of the disseration, are not annotated. In those that are annotated, I have tried to explain how what otherwise might be puzzling entries are related. Some of the annotation are taken from other sources which I have cited at the ends of the annotations.

Many of the works germane to the topics of this dissertation, particularly in semiotics, were originally published in languages other than English. I have, however, limited this bibliography to publications in English and French. I concentrated on translations; but there may be significant works not yet available, especially in Russian or Czechoslovakian. A twnety-eight page German bibliography of the semiotics of music can be found in Reinhard Schneider's *Semiotik der musik: Darstellung und kritik* (Munich: Wilhelm Fink, 1980).

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Boretz, Benjamin; and Cone, Edward T.; eds. *Perspectives on notation and performance*. New York: Norton, 1976.

An excellent, though now somewhat dated, overview of the major questions of the field. The articles are drawn from the journal *Perspectives of new music*. Some are cross-referenced in this bibliography. The following theorists, composers, and performers are represented: Kurt Stone, Charles Wuorinen, Gunther Schuller, Lukas Foss, Leonard Stein, John MacIvor Perkins, David Behrman, Brock McElheran, Roman Haubenstock-Ramati, Donald Martino, John C. Heiss, Brian Fennelly, Emmanuel Ghent, Paul Zukofsky, M. V. Mathews, L. Rosler, and Aloys Kontarsky.

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Describes a flexible process for generating analytical graphs from scores by using DARMS code and several other programs to produce PostScript descriptions of various aspects of the music represented.

Brooks, William. "Choice and change in Cage's recent music." In *John Cage reader: In celebration of his seventieth birthday*, edited by Peter Gena, Jonathan Brent, and Don Gillespie, 17-37. New York: Peters, 1982.

Brown, C. Marlin. *Human-computer interface design guidelines*. Norwood, N.J.: Ablex, 1988.

Brown, Earle. *Folio*. New York: Associated Music, 1961.

Composed in 1952 and 1953, this is possibly the first of the graphic music scores by the group of experimental composers from New York which included Brown, John Cage, Morton Feldman, and Christian Wolff.

Brown, Earle. "Notation and performance of new music." *Musical quarterly* 72:2 (1986): 180-202.

An edited version of lectures given by Brown at Darmstadt in 1964; the content is still quite relevant to current notation theory.

Brown, Norman O. *Closing time*. New York: Random House, 1973.

Provides a unique perspective on language and on John Cage; also addresses ambiguity.

Brun, Herbert. "Computer-plotted graphics." *Computer music journal* 5:2 (Summer 1981): 29-35.

A set of images, or conceptual graphic music notations, produced by a computer program.

Brun, Herbert. "Composer's input outputs music." In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 133-147. Cranbury, N.J.: Associated University Presses, 1989.

Discusses social and political aspects of computer music composition.

Buxton, William A. "A composer's introduction to computer music." *Interface* 6:2 (1977): 57-71.

An introductory article dealing with issues important to the history and philosophy of computer music. Includes a good reference list.

Buxton, William A.; Sniderman, Richard; Reeves, William; Patel, Sanand; and Baecker, Ronald. "The evolution of the SSSP score editing tools." *Computer music journal* 3:4 (December 1979): 14-24.

Buxton, William A.; Patel, Sanand; Reeves, William; and Baecker, Ronald. "On the specification of scope in interactive score editors." In *Proceedings of the 1980 International Computer Music Conference*, compiled by Hubert S. Howe, Jr., 86-95. San Francisco: Computer Music Association, 1980. Reprint in *Computer music journal* 5 (Fall 1981): 50-56.

Deals with questions of context, syntax, semantics, descriptive notation, and naming.

Byrd, Donald. "An integrated computer music software system." *Computer music journal* 1:2 (April 1977): 55-60.

Discusses a system which uses fourteen music programs including Music V, Xenakis' STOCHOS, Byrd's music printing utility SMUT, and the MUSTRAN language. Contains code examples in Fortran.

Byrd, Donald. "Human engineering in a portable music notation system." In *Proceedings of the 1980 International Computer Music Conference,* compiled by Hubert S. Howe, Jr., 306-323. San Francisco: Computer Music Association, 1980.

Defines "levels of description" as they apply to computer systems and languages.

Byrd, Donald. "User interfaces in music-notation systems." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 145-151. San Francisco: Computer Music Association, 1986.

Defines important problems and goals related to the graphic representation of music, both with and without the use of computers.

Cage, John. *4'33"*. New York: Henmar, 1960. 2nd. version. *Source* 1:2 (July 1967): 46-57.

Cage "silent" piece, composed in 1952, notated symbolically with text in the Henmar version and iconically with blank paper and lines in the *Source* version.

Cage, John. *Silence*. Middletown, Conn.: Wesleyan University Press, 1961.

Cage, John. *A year from Monday*. Middletown, Conn.: Wesleyan University Press, 1967.

Cage, John. *Notations*. West Glover, Vt.: Something Else, 1969.

Cage, John. *M*. Middletown, Conn.: Wesleyan University Press, 1973.

Cage, John. *For the birds: John Cage in conversation with Daniel Charles*. Boston: Boyars, 1976.

Cage, John. *Empty words*. Middletown, Conn.: Wesleyan University Press, 1979.

Cage, John. *Themes and variations*. Barrytown, N.Y.: Station Hill, 1982.

Cage, John. *I - VI*. Cambridge, Mass.: Harvard University Press, 1990.

Consists of hundreds of mesostics used by Cage in his six Norton Lectures at Harvard. Contains material on notation, intention, indeterminacy, and structure, among other topics.

Cardew, Cornelius. "Notation: Interpretation, etc." *Tempo* 58 (Summer 1961): 21-33.

Cardew, Cornelius. *Treatise handbook*. New York: Peters, 1971.

Notes (documentation) for *Treatise*. Includes a complete version (i.e., interpretation) of *Treatise* for piano, and an excerpt for orchestra.

Cardew, Cornelius. *"Stockhausen serves imperialism" and other articles*. London: Latimer New Directions, 1974.

See particularly Cardew's repudiation of his own earlier work.

Cardew, Cornelius. "Wiggly lines and wobbly music." In *Breaking the sound barrier: A critical anthology of the new music*, edited by Gregory Battcock, 235-253. New York: Dutton, 1981.

Cardew, Cornelius, ed. *Scratch music*. Cambridge, Mass.: MIT Press, 1972.

Verbal and graphic scores, introductions, catalog of the Scratch Orchestra.

Cardine, Eugene. *Gregorian semiology*. Translated by Robert M. Fowels. Sable-a-sur-Sarthe, France: Abbaye Saint-Pierre de Solesmes, 1982.

Carroll, Lewis. *The annotated Alice: "Alice's adventures in Wonderland" and "Through the looking glass."* New York: Potter, 1960.

Annotated by Martin Gardner, this edition contains the well-known pattern poem illustrating the mouse's tale, along with a note about C. Peirce's fascination with such poetry.

Carroll, Noel. "Hume's standard of taste." *Journal of aesthetics and art criticism* 43:2 (Winter 1984): 181-194.

In discussing Hume's aesthetics, Carroll takes up issues of representation, context, the subject/object dichotomy, standards, and rules.

Carroll, Noel. "Conspiracy theories of representation." *Philosophy of the social sciences* 17:3 (1987): 395-412.

Addresses the characterization, by "politicized post-structuralists," of representation as ideological, and argues that such a characterization has its roots in modernism. Challenges arguments based on the effects of illusion, transparency, and naturalization.

Cazden, Norman. "Staff notation as a non-musical communications guide." *Journal of music theory* 5:1 (1961): 113-128.

Cazden contrasts traditional music notation with "scientific" or objective methods of representing sound. His delineation of the conceptual and executive functions in notation corresponds roughly with Seeger's categorizing of descriptive and prescriptive types. Cazden demonstrates a system of using traditional notation as a code for non-musical messages such as Lincoln's *Gettysburg address*. He presents examples of the code here and translations of these examples in the next issue of the same journal.

Cazden, Norman. "How to compose non-music." *Journal of music theory* 5:2 (1961): 287-297.

Celona, John Anthony. "Structural aspects of contemporary music notation; and, command-string notation: A new music notational system." Ph.D. diss., University of California, San Diego, 1977.

Chadabe, Joel. "Some reflections on the nature of the landscape within which computer music systems are designed." *Computer music journal* 1:3 (June 1977): 5-11.

Deals in general terms with functions and processes of computer music systems.

Chadabe, Joel. "Interactive composing: an overview." *Computer music journal* 8:1 (Spring 1984): 22-27.

Contains a clear block diagram of an interactive system from human performer to sound output.

Chamberlin, Hal. *Musical applications of microprocessors.* 2nd ed. Hasbrouck Heights, N.J.: Hayden, 1985.

A primary reference in the field of computer music.

Chambers, J. K. "Generative theories of two lively arts." *Canadian journal of linguistics* 29:2 (1984): 157-175.

Charles, Daniel. "L'ecriture et le silence: Notes sur Pampelune." *Musique en jeu*, no. 11 (June 1973): 99-108.

Beginning with a discussion of the music festival at Pamplona in 1972, Charles moves on to discuss silence, the music of John Cage, leftist politics, and semiotics. He mentions the work of Julia Kristeva and Roland Barthes along the way.

Chiarucci, Henri. "Essai d'analyse structurale d'oeuvres musicales: *Carre* de Stockhausen, et *Fluorescence* de Penderecki." *Musique en jeu*, no. 12 (October 1973): 10-43.

A structuralist and phenomenological approach to analysis. Citing linguistic inspiration, Chiarucci broaches such topics as phonology, linguistic opposition, and deconstruction; and he relates them to the works mentioned.

Chomsky, Noam. *Aspects of the theory of syntax*. Cambridge, Mass.: MIT Press, 1965.

Chomsky, Noam. *Language and mind*. New York: Harcourt, Brace & World, 1968.

Chomsky, Noam. *Syntactic structures*. The Hague: Mouton, 1968.

Chopin, Frederic. *Nocturnes*. New York: Peters, n.d.

Contains a copy of opus 15, number 2, the second movement of which provides an example of unusually complex rhythmic indications in a traditionally notated piece.

Chroma Foundation. *Chromatic notation: The results and conclusions of the international enquiry*. Victoria, B.C.: Editions Chroma, 1983.

Reviewed in *Music teacher* 64 (August 1985): 20; and in *Canadian university music review* 5 (1984): 316-319.

Clark, Ann. "Is music a language?" *Journal of aesthetics and art criticism* 41:2 (Winter 1982): 195-204.

Clarke, Eric F. "Issues in language and music." *Contemporary music review* 4 (1989): 9-22.

Clements, Peter J. "Computers and musical notation." *Studies in music from the University of Western Ontario* 5 (1980): 145-172.

Clements, Peter J. "Musical data structures in a multi-use environment." In *Proceedings of the 1980 International Computer Music Conference*, compiled by Hubert S. Howe, Jr., 231-245. San Francisco: Computer Music Association, 1980.

Contrasts DARMS with Music V languages (i.e., graphic with aural) and describes the effects that the digital environment and the user's intentions have on the usefulness of these languages. Proposes an intermediate language.

Clements, Peter J. "A system for the complete enharmonic encoding of musical pitches and intervals." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 459-461. San Francisco: Computer Music Association, 1986.

Clifton, Thomas. *Music as heard: A study in applied phenomenology*. New Haven: Yale University Press, 1983.

Reviewed by Judy Lochhead in *Journal of musicology* 4:3 (Summer 1985): 355-364.

Clynes, Manfred. "Secrets of life in music: Musicality realized by computer." In *Proceedings of the International Computer Music Conference, 1984*, edited by William Buxton, 225-232. San Francisco: Computer Music Association, 1985.

Describes musical microstructures and the impossibility of capturing them in notation. Says writing down scores "kills" music.

Cogan, Robert. *New images of musical sound*. Cambridge, Mass.: Harvard University Press, 1984.

This is a major study in phonology using fast Fourier transform spectrum analysis (i.e., audio spectroscopy) and photography to represent music.

Cogan, Robert. "Imaging sonic structures." In *Proceedings of the International Computer Music*

Conference, 1986, edited by Paul Berg, 407-412. San Francisco: Computer Music Association, 1986.

Coker, Wilson. *Music and meaning: A theoretical introduction to musical aesthetics.* New York: Free Press, 1972.

An early and frequently cited work explicitly incorporating the semiotics of music. Discusses types of signs, affects, and meanings (e.g., congeneric and extrageneric meaning), as well as notions of gesture, value, and aesthetics. There is very little, however, on music notation per se. Contains a long bibliography.

Cole, Hugo. *Sounds and signs: Aspects of musical notation.* London: Oxford University Press, 1974.

In the first part of this helpful and accessible book, Cole discusses communication theory and notation as a system of signs. Then he focuses on the parameters of music (pitch, rhythm, etc.) and how each is notated, giving special attention to basic principles, limitations, and recent developments. The book closes with a theoretical look at notation and a glance toward the future. There are many useful examples, pictures, and quotations throughout, as well as a reading list.

Cole, Hugo. "Communication: Some failures and their causes." Composer (London) 64 (Summer 1978): 12-17.

Cone, Edward T. "Beyond analysis." In *Perspectives on contemporary music theory*, edited by Benjamin Boretz and Cone, 72-90. New York: Norton, 1972.

Cone, Edward T. *The composer's voice*. Berkeley: University of California Press, 1982.

See particularly "Epilogue: Utterance and gesture," and Cone's discussions, throughout the book, on performers' and listeners' identifications, and on poetry. Reviewed in *Canadian university music review*, no. 4 (1983): 333-334.

Conger, Jim. *C programming for MIDI*. Redwood City, Calif.: M & T, 1988.

Although there are some code errors, in general this is a good introduction to the subject for those with a functional grasp of C. Outlines MIDI, a patch librarian, and a simple sequencer for the MPU-410 interface. These programs are available on disk with full source codes, in the MS-DOS format.

Computer Audio Research Laboratory. *CARL startup kit.* La Jolla: Center for Music Experiment, University of California, 1985.

Software manual for cmusic and csound, and articles by F. R. Moore, D. G. Loy, and others.

Cook, Nicholas. *A guide to musical analysis.* New York: Braziller, 1987.

Cook compares semiotic analysis with set-theoretical analysis as well as "psychological approaches" such as Meyer's and Reti's. Includes several traditional analyses.

Cook, Nicholas. *Music, imagination and culture.* New York: Oxford University Press, 1990.

Deals with the disparity between how people imagine music and how they experience it.

Cooke, Deryck. *The language of music.* London: Oxford University Press, 1959.

Cooke takes up a modern version of the Baroque theory of the affections, maintaining that structure determines reference in music. According to Cooke, there is a direct relationship between such musical phenomena as quickness of pace, and listener experiences like agitation or excitement. Though association is important to the experience of the listener in this regard, structure is at least as important.

Coons, Edgar; and Kraehenbuehl, David. "Information as a measure of structure in music." *Journal of music theory* 2:2 (November 1958): 127-161.

A classic in information theory in music.

Cooper, Robin. "Propositions pour un modele transformationnel de description musicale." *Musique en jeu*, no. 10 (March 1973): 70-88.

Cope, David. *New directions in music.* Dubuque, Ia.: Brown, 1971.

Cope, David. *New music notation.* Dubuque, Ia.: Kendall/Hunt, 1976.

Contains a long and useful introduction and a dictionary of symbols currently used. The bibliography is annotated.

Cope, David. "An expert system for computer-assisted composition." *Computer music journal* 11:4 (1987): 30-46.

Combines a linguistic approach and computer science.

Cowen, Denis. "Morphology and value in music." Ph.D. diss., University of Chicago, 1960.

Creston, P. *Rational metric notation.* Hicksville, N.Y.: Exposition, 1979.

Reviewed in *Triangle* 75:4 (1981): 26.

Cupers, Jean-Louis. "Etudes comparatives: Les approaches musico-litteraires. Essai de reflexion methodologique." *Publications de l'institute de litterature UCL* 4 (1979): 63-103.

Curtay, Jean-Paul; and Gillard, Jean-Pierre; eds. *La musique lettriste (lettriste, hypergraphique, infinitesimale, aphoniste et supertemporelle).* Double issue of *La revue musicale* 282/283. Paris: Richard-Mass, 1971.

Eight articles containing interesting examples of the work, as well as a history, and discussions of the future and of specific lettrist artists.

Dahlhaus, Carl. *Esthetics of music.* Translated by William Austin. New York: Cambridge University Press, 1982.

Dahlhaus, Carl. *The idea of absolute music.* Translated by Roger Lustig. Chicago: University of Chicago Press, 1989.

Danielou, Alain. *Semantique musicale: Essai de psychophysiologie auditive.* Paris: Herman, 1967.

An interdisciplinary work which takes up questions about musical psychoacoustics, cybernetics, and number systems. Proposes a model of the process of hearing and reacting to music. Contains an extensive analysis of the numerical relationships inherent in musical pitches and intervals; and, in a large appendix, provides many beautiful graphic representations of these relationships. There is a brief but insightful discussion of the limits and consequences of notating music.

Danielou, Alain. "Symbolism in the musical theories of the Orient." *World of music* 20:3 (1978): 24-37.

Dannenberg, Roger B. "A structure for representing, displaying, and editing music." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 153-160. San Francisco: Computer Music Association, 1986.

Contains a useful and concise "glossary" of relevant terms such as score, hierarchy, event, granularity, etc., as well as some illustrative diagrams.

Danto, Arthur C. "The artworld." *Journal of philososphy* 61:19 (October 1964): 571-584.

Danto, Arthur C. *The transfiguration of the commonplace*. Cambridge, Mass.: Harvard University Press, 1981.

These philosophical speculations on art take up the question of how ordinary things become art. There are discussions on content and causation, interpretation and identification, representation, metaphor, expression, and style.

Davis, Deta. *Computer applications in music: A bibliography*. Madison, Wis.: A-R Editions, 1988.

An excellent bibliography containing 4,585 entries classified into 27 categories, extensively cross-referenced by the author.

Decker, Shawn; and Kendall, Gary. "A modular approach to sound synthesis software." In *Proceedings of the International Computer Music Conference, 1984*, edited by William Buxton, 243-250. San Francisco: Computer Music Association, 1985.

Decker, Shawn; Kendall, Gary; Schmidt, Brian; Ludwig, M. Derek; and Freed, Daniel. "A modular environment for sound synthesis and composition." *Computer music journal* 10:4 (Winter 1986): 28-41.

Describes an easy and flexible computer music interface influenced by CARL and implemented in UNIX. It includes an event-list preprocessor and an editor called "eled".

Deely, John. *Introducing semiotics: Its history and doctrine*. Bloomington: Indiana University Press, 1982.

Deely, John, ed. *Semiotics 1985: Proceedings of the tenth annual meeting of the Semiotic Society of America*. Lanham, Md.: University Press of America, 1986.

DeGeorge, Richard T., ed. *Semiotic themes*. Lawrence: University of Kansas Publications, 1981.

See articles listed here under G. D. Atkins, W. K. Percival, T. Sebeok, and A. Skidmore.

Deliege, Celestin. "Theorie et pratique de l'analyse musicale." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 151-171. Pasaro: Centro di Iniziativa Culturale, 1975.

DeLio, Thomas. "Structural pluralism: Some observations on the nature of open structures in the music and visual arts in the twentieth century." *Musical quarterly* 67:4 (October 1981): 527-44.

DeLio, Thomas. "Sound, gesture and symbol: The relation between notation and structure in American experimental music." *Interface* 10:3-4 (December 1981): 199-219.

DeLio, Thomas. *Circumscribing the universe*. Lanham, Md.: University Press of America, 1984.

Contains articles on Ashley, Cage and others.

Derrida, Jacques. *Of Grammatology*. Translated by Gayatri C. Spivak. Baltimore: Johns Hopkins University Press, 1974.

A translation of the 1967 work *De la grammatologie*, this is only one of numerous works by Derrida which are at least peripherally germane to music notation. The translator's introduction is useful in situating the author's work within the philosophic traditions of German idealism, phenomenology, hermeneutics, and deconstruction. Derrida contrasts phenomenology and structuralism, and discusses his theory of time and presence, and the relationship between writing and culture.

Derrida, Jacques. *Writing and difference*. Translated by Alan Bass. London: Routledge and Kegan Paul, 1978.

A translation of *L'Ecriture et la difference* (Paris: Seuil, 1967), this work posits Derrida's seminal conceptions of difference and differring, as well as speech and writing.

Dertouzos, Michael L.; and Moses, Joel; eds. *The computer age: A twenty-year view*. Cambridge, Mass.: MIT Press, 1979.

Considers the personal, social, and technological consequences of the computer revolution; makes predictions. Contains M. Minsky's "Computer science and the representation of knowledge."

Desain, Peter. "Graphical programming in computer music: A proposal." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 161-166. San Francisco: Computer Music Association, 1986.

Compares conversational methods of user interface with a "model world" (i.e., iconic) method. Discusses reference, representation, models, and abstraction.

Desain, Peter; and Honing, Henkjan. "LOCO: Composition microworlds in LOGO." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 109-118. San Francisco: Computer Music Association, 1986.

Discusses an object-oriented composition system, comparing it to other computer music programs (e.g., Music V, PLA, Pile). Contains sections on choices/randomness and on grammars.

Descombes, Vincent. *Modern French philosophy*. Translated by L. Scott-Fox and J. M. Harding. New York: Cambridge University Press, 1979.

Contains--among others--sections on nothingness, identity and difference, phenomenology, structuralism, communication, and semiotics. Discusses the work of about a dozen thinkers, including Sartre, Merleau-Ponty, Foucault, Althusser, Derrida, Deleuze, and Lyotard.

Dierbach, Charles. "Some initial ideas on the control of digital sound synthesis through AI techniques." In *Proceedings of the Rochester 1983 International Computer Music Conference,* 235-251. [San Francisco: Computer Music Association], n.d.

Contains a definition of "instrument" as an abstract concept, and a model of the computer music process which describes a user interface, subjective interpreters, and expert systems.

Dodge, Charles; and Jerse, Thomas A. *Computer music: Synthesis, composition, and performance.* New York: Schirmer, 1985.

Doubravova, Jarmila. "Musical forms as models of communication." In *Semiotics unfolding: Proceedings of the second congress of the International Association for Semiotic Studies [1979]*, edited by Tasso Borbe, v. 3, 1613-18. New York: Mouton, 1983.

Doubravova, Jarmila. "Musical semiotics in Czechoslavakia and an interpersonal hypothesis of music." *International review of the aesthetics and sociology of music* 15:1 (1984): 31-38.

Doubravova discusses the Prague Linguistic Circle and other important precursors to current theory. He mentions many people, and his account is quite clear. A brief bibliography is supplied.

Dougherty, William Patrick. "An examination of semiotics in musical analysis: The Neapolitan complex in Beethoven's Op. 131." Ph.D. diss., Ohio State University, 1985.

"This dissertation explores and explains semiotic constructs in order to develop a serviceable semiotic perspective. Following an overview of the two linguistic schools of thought--descriptive linguistics and transformational generative grammar--that have directly shaped approaches to a semiotics of music, three distinct strategies for a semiotics of music are examined and evaluated. Each strategy--the taxonomic-empiricist approach, the generative approach, and the implication-realization approach--is discussed with regard to its underlying theoretic assumptions,, its semiotic, linguistic and musical commitments, and the validity of its methodological results." These strategies are then brought to service in the analysis of the Beethoven piece. (*Dissertation abstracts international* 46:9 (1986): 2479A.)

Dreyfus, Hubert L. *What computers can't do: A critique of artificial reason*. Rev. ed. New York: Harper & Row, 1979.

Dreyfus, Hubert L.; Dreyfus, Stuart E.; and Athanasion, Tom. *Mind over machine: The power of human intuition and expertise in the era of the computer*. New York: Free Press, 1986.

Dreyfus, Hubert L.; and Rabinow, Paul. *Michel Foucault: Beyond structuralism and hermeneutics*. 2nd. ed. Chicago: University of Chicago Press, 1983.

Dreyfus, Hubert L.; and Hall, Harrison; eds. *Husserl, intentionality and cognitive science*. Cambridge, Mass.: MIT Press, 1982.

Duckworth, William E. "Expanding notational parameters in the music of John Cage." Ed.D. diss., University of Illinois at Urbana-Champaign, 1972.

Ducrot, Oswald; and Todorov, Tzvetan. *Encyclopedic dictionary of the sciences of language*. Translated by Catherine Porter. Baltimore: Johns Hopkins University Press, 1978.

This book is divided into sections on schools, fields, methodological concepts, and descriptive concepts. Within each section the terms are arranged alphabetically. There are indexes of terms and authors. Most terms are accompanied by useful bibliographies.

Duffin, Diana Ruth. "The interpretation of accent signs in Roger Sessions' third piano sonata." DMA diss., Ohio State University, 1979.

"The unusual detail and occasional peculiarities of the accent notation in Sessions's third sonata can be explained by the fact that the notation has its origin in orchestral writing....The data led to the conclusion that some signs are essential and playable, others are not literally playable but suggest a certain effect, and some must be regarded as superfluous." (*RILM* 13:2 (1979): 234.)

Duisberg, Robert. "On the role of affect in artificial intelligence and music." *Perspectives of new music* 23:1 (Fall-Winter 1984): 6-35.

Discusses AI, expression and denotation, affective meaning, syntax, semantics, grammars, metaphor, heuristics, human interfaces, and the work of Winograd, Lehnert, Minsky, and Lenat.

Dunsby, Jonathan. "Editorial: A hitch hiker's guide to semiotic music analysis." *Music analysis* 1:3 (1982): 235-242.

A brief, but informative, look at what Dunsby calls "famished" and "replete" semiotics (i.e., restricted, and excessive). In discussing the relevance of the field to music, he touches on Barthes' idea of deconstruction, and on the analytical work of Nattiez and others. The article contains several interesting music examples, charts and diagrams.

Dunsby, Jonathan. "Music and semiotics: The Nattiez phase." *Musical quarterly* 69:1 (Winter 1983): 27-43.

Dunsby, Jonathan; and Stopford, J. "The case for a Schenkerian semiotic." *Music theory spectrum* 3 (1981): 49-53.

Dunsby, Jonathan; and Whittall, Arnold. *Music analysis in theory and practice*. London: Faber Music, 1988.

See particularly Part IV: "From means to meaning: Analysis and the theory of signs," pp. 209-232.

Dydo, Stephen. "Surface relations between music and language as compositional aids." *Interface* 12:4 (1983): 541-556.

Dydo introduces a comparison of language and music with a discussion of Harweg's notions of phenomenological, transcendent, immanent and sign-theoretic discourse (see Harweg below), and goes on to describe the LIMID program which extracts patterns from any encoded score and performs compositional functions on them, such as the derivation of other parameters from pitches.

Dydo, Stephen. "Data structures in *The note processor*." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 311-

316. San Francisco: Computer Music Association, 1987.

Discusses DARMS, MIDI code, and graphic input with regard to a music printing program.

Dyer, Lounette M. "Toward a device independent representation of music." In *Proceedings of the International Computer Music Conference, 1984*, edited by William Buxton, 251-256. San Francisco: Computer Music Association, 1985.

Dyer, Lounette M. "MUSE: An integrated software environment for computer music applications." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 167-172. San Francisco: Computer Music Association, 1986.

Eagleton, Terry. *Literary theory: An introduction.* Minneapolis: University of Minnesota Press, 1983.

Eco, Umberto. *A theory of semiotics.* Bloomington: Indiana University Press, 1976.

A particularly important work in semiotics. Eco briefly discusses music codes, notation, and meaning. Includes a long bibliography and two indexes.

Elgin, Catherine Z. *With reference to reference.* Indianapolis: Hackett, 1983.

A thorough explanation of Nelson Goodman's ideas.

Emerson, Lowell. "Goodman and the semiotic theory of art." Ph.D. diss., Marquette University, 1985.

"This dissertation is a systematic explication and critique of Nelson Goodman's philosophy of art. [Emerson draws] historical and conceptual links between 'exemplification' and 'iconic signification'--in particular, as employed within the aesthetic theories of Charles Morris and Susanne Langer." (*Dissertation abstracts international* 46:6 (December 1985): 1649A.) He also discusses the ideas developed by Umberto Eco, and applies them to the conception of exemplification.

Emmerson, Simon, ed. *Language of electroacoustic music.* New York: Hardwood Academic, 1986.

Examines aesthetic and social questions raised by the medium. Most of the contributors are composers and musicologists. See particularly the entry for B. Pennycook below. Contains an opening essay by Pierre Boulez.

Epperson, Gordon. *The musical symbol: A study of the philosophic theory of music*. Ames: Iowa State University Press, 1967.

"This book develops the concept of music as a nonverbal symbolism." (p. xiv) It deals to a large extent with philosophy, containing chapters on Schopenhauer, Nietzche, Bergson, Hanslick, and Gurney. There is much historical information as well, including a discussion of Epperson's interest in the symbol per se. He touches on numerous issues which later would became important to the semiotics of music. The bibliography seems particularly good for aesthetic philosophy.

Erickson, Raymond F. "The DARMS project: A status report." *Computers and the humanities* 9:6 (1975): 291-298.

Outlines the basics of DARMS (Digital Alternate Representation of Musical Scores), an encoding or data language for translating scores into a machine-readable form. Discusses future plans.

Erickson, Raymond F. "Musicomp 76 and the state of DARMS." *College music symposium* 17:1 (Spring 1977): 90-101.

Another outline of the basics of DARMS. Also describes Musicomp 76, a workshop held in New York for learning and improving DARMS.

Evans, Brian. "Integration of music and graphics through algorithmic congruence." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 17-24. San Francisco: Computer Music Association, 1987.

Describes the generation of a music/animation piece by use of the same algorithm, which itself is based on fractal geometry.

Fabbri, Franco. "What kind of music?" *Popular music: A yearbook* 2 (1982): 131-143.

Feld, Steven. "Communication, music, and speech about music." *Yearbook for traditional music* 16 (1984): 1-18.

Asks whether music is communication or semiosis, and discusses the dialectics of the music process before and after the interpretations of the listener. Includes an interesting chart and a useful bibliography.

Fink, Robert; and Ricci, Robert. *The language of twentieth century music: A dictionary of terms.* New York; Schirmer, 1975.

Finkelstein, Sidney. *How music expresses ideas.* New York: International, 1952.

Fiore, Linda. "Notes on Stuart Smith's *Return and Recall*: A view from within." *Perspectives of new music* 22:1-2 (Fall-Winter 1983, & Spring-Summer 1984): 290-302.

A good discussion of notation, instructions, and performance of an ideographical score. Discusses the relationship between the composer and performer.

Florens, Jean-Loup; Razafindrakoto, Aime; Luciani, Annie; and Cadoz, Claude. "Optimized real time simulation of objects for musical synthesis and animated image synthesis." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 65-70. San Francisco: Computer Music Association, 1986.

Focht, Ivan. "Semiotics and aesthetics: Some preliminary questions of methodology." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 245-248. Pesaro: Centro di Iniaziativa Culturale, 1975.

Fodor, Jerry. "Methodological solipsism considered as a research strategy in cognitive psychology." In *Husserl, intentionality and cognitive science*, edited by H. Dreyfus and H. Hall, 277-303. Cambridge, Mass.: MIT Press, 1982.

Foell, Kristie. "Toward a semiotic understanding of music: The definition of the musical object." In *Semiotics, 1985: Proceedings of the tenth annual meeting of the Semiotic Society of America*, edited by

John Deely. Lanham, Md.: University Press of America, 1986.

Foucault, Michel. *The order of things: An Archaeology of the human sciences*. New York: Random House, 1970.

Foucault, Michel. *Language, counter memory, practice: Selected essays and interviews*. Edited by Donald F. Bouchard. Ithaca: Cornell University Press, 1977.

Of particular importance here is the essay "Nietzsche, genealogy, history," which describes the connections between Foucault's philosophy and its sources.

Francois, Jean-Charles. "The dissimulated voice." *Perspectives of new music* 19:1-2 (Fall-Winter 1980, & Spring-Summer 1981): 115-128.

Francois, Jean-Charles; Chăbot, Xavier; and Silber, John. "MIDI synthesizers in performance: Realtime dynamic timbre production." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 238-240. San Francisco: Computer Music Association, 1987.

Contains a brief analysis of the situation of human performers of computer music, and suggests methods to make their gestures do more than simply trigger machines.

Free, John. "Toward an extensible data structure for the representation of music on computers." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 317-324. San Francisco: Computer Music Association, 1987.

Describes a method of adding representation of notational information to the SSSP model while maintaining an economy of code/data space. Defines events and scores.

Freed, Adrian. "MacMix: Mixing music with a mouse." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 127-129. San Francisco: Computer Music Association, 1986.

Describes an iconic system of user interface.

Fry, Christopher. "Flavors Band: Beyond computer improvisation and/or a meta-composition language." In *Pro-*

ceedings of the Rochester 1983 International Computer Music Conference, 30-54. [San Francisco: Computer Music Association], n.d.

Includes a discussion of determinism (i.e., "precision of specificity") and computer music.

Fryden, Lars; Sundberg, Johan; and Askenfelt, Anders. "From music score to sound: A rule system for musical performance of melodies." In *Proceedings of the Venice 1982 International Computer Music Conference,* compiled by Thomas Blum and John Strawn, 426-436. San Francisco: Computer Music Association, 1983.

Fryden, Lars; and Sundberg, Johan. "Structural information in music performance." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 237-244. Florence: Olshki, 1984.

Fujieda, Mamoru. "Sign and signification in graphic notation: Semiotical approach." Ph.D. qualifying examination, Department of Music, University of California, San Diego, 1987.

Gaburo, Kenneth. "Murmur." In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 37-42. Cranbury, N.J.: Associated University Presses, 1989.

A poetic expression of the contemporary composer's relationship to music machines.

Gaburo, Virginia. *Notation: A lecture to be performed by solo speaker to attentive audience.* La Jolla, Ca.: Lingua, 1977.

More like a book than a lecture (except for the absence of a table of contents, and index), this work is full of stimulating graphics and substantive quotations. Gaburo defines music and investigates the relationships between notation, language, and sound from a distinctly contemporary perspective. She also emphasizes education and avant-garde and experimental notation.

Gadamer, Hans-Georg. *Philosophical hermeneutics.* Translated and edited by David E. Linge. Berkeley: University of California Press, 1977

Contains a forty-six page introduction and essays on the hermeneutical problem, language, semantics, aesthetics, phenomenology, and Heidegger, among others.

Gariepy, Louise; and Decarie, Jean. "A system of notation for electro-acoustic music: A proposition." *Interface* 13:1 (March 1984): 1-74.

The authors propose a prescriptive notation system based on "technical gestures" such as the flow of the audio signal. Contains a long appendix with many charts and examples.

Garland, Peter. *Americas: Essays on American music and culture 1973-80*. Santa Fe: Soundings, 1982.

See the chapter "On notation," a brief polemic favoring a plurality of music notations.

Gasparov, Boris. "Some descriptive problems of musical semantics." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 183-196. Pesaro: Centro di Iniziativa Culturale, 1975.

Ghircoiasiu, Romeo. "General problems." In "Current problems in notation," edited by Igmar Bengtsson, 756-760. Part of *International Musicological Society: Report of the twelfth congress, Berkeley, 1977*, edited by Daniel Heartz and Bonnie Wade. Kassel: Barenreiter, 1981.

Gibson, James J. *The senses considered as perceptual systems*. Boston: Houghton Mifflin, 1966.

A particularly good statement of the ecological realist perspective on cognition. See especially the discussions concerning invariability, the image, the graphical act, pictorial representation, alphabetic writing, and illusion, as well as perception and information in general.

Goldberg, Theo. "The prefiguration of a musical composition: Model of a computer graphics program." In *Proceedings of the International Computer Music Conference, 1985*, edited by Barry Truax, 233-236. San Francisco: Computer Music Association, 1985.

Describes a computer graphics program which permits the visualization or prefiguration of the macroform of a musical composition by using size, color, and location on the *x*, *y*, and *z* axes to represent the various parameters of the piece.

Golomb, Harai. "Function-reversal of similar subsystems in different auditory-temporal systems of communication: The roles of pitch and timbre in music and language." In *Semiotics unfolding: Proceedings of the second congress of the International Association for Semiotic Studies [1979]*, edited by Tasso Borbe, v. 3, 1643-46. New York: Mouton, 1983.

Goodman, Nelson. *Languages of art: An approach to a theory of symbols*. 2nd. ed. Indianapolis: Hackett, 1976.

The most well-developed and frequently cited theory of notation currently available.

Goodman, Nelson. *Ways of worldmaking*. Indianapolis: Hackett, 1978.

Goodman, Nelson. "Replies." *Journal of aesthetics and art criticism* 39:3 (Spring 1981): 273-280.

Goodman responds to a group of articles, reacting to his *Languages of art* and *Ways of worldmaking*, which appear in the same issue of this journal: J. Kulenkampff's "Music considered as a way of worldmaking" (see below), J. Ackerman's "Worldmaking and practical criticism," R. Martin's "On some aesthetic relations," A. Nagel's "'Or as a blanket': Some comments and questions on exemplification," J. Margolis' "What is when? When is what? Two questions for Nelson Goodman," A. Silvers' "The secret of style," and P. Hernadi's "More questions concerning quotation."

Gourlay, John S. "A language for music printing." *Communications of the ACM* 29:5 (May 1986): 388-401.

Discusses DARMS and other music-description languages. Takes up questions of abstraction, syntax, semantics, and macros.

Green, M. "PROD: A grammar based computer composition program." In *Proceedings of the 1980 International Computer Music Conference*, compiled by Hubert S. Howe, Jr., 101-110. San Francisco: Computer Music Association, 1980.

Contains good definitions of grammar ("a formal notation for describing the structure of elements and processes"), and production rules used in the synthesis of musical scores.

Greimas, Algirdas Julien; and Cortes, Joseph. *Semiotics and language: An analytical dictionary*. Translated by Larry Crist. Bloomington: Indiana University Press, 1982.

An interesting book, but it suffers a bit in the translation. The definitions are not as clear as those in the Ducrot above.

Grene, Marjorie. "Heidegger." In *The encyclopedia of philosophy*, edited by Paul Edwards, 459-465. New York: Macmillan, 1967.

Griffiths, Paul. *Cage*. New York: Oxford University Press, 1981.

Griffiths, Paul. *Modern music: The avant garde since 1945*. New York: Braziller, 1981.

An excellent history through the 1970s. The chapters "New York, 1951-3," "Chance and choice," "Indeterminacy-->Changing the system," and "American serialism-->Computer music" are particularly useful surveys for this dissertation. There are helpful lists of scores and phonorecordings following each chapter.

Grossman, Gary. "Instruments, cybernetics, and computer music." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 212-219. San Francisco: Computer Music Association, 1987.

Guck, Marion Alice. "The functional relations of chords: A theory of musical intuitions." *In theory only* 4:6 (1978): 29-42.

A critique of A. Keiler's critique of L. Bernstein's *The unanswered question*.

Guck, Marion Alice. "Metaphors in musical discourse: The contribution of imagery to analysis." Ph.D. diss., University of Michigan, 1981.

Guck, Marion Alice. "Analytic fictions." Paper presented at the annual meeting of the Society of Music Theory, Oakland, California, November 1990.

Guck sees musical studies as stories capable of creating "worlds" to which both the work and the reader belong.

Guedy, Anna; and Salazar, Philippe-Joseph. "Le 'sinthome' do la voix." *Avant scene opera operette musique* 63 (1984): 136-139.

This article discusses Lecanian semiotic theories and the concept of "woman" in opera and modern media; it uses Wagner's *Tannhauser* as an example.

Guiraud, Pierre. *Semiology*. Paris: Presses universitaires de France, 1971. Translated by George Gross. London: Routledge & Kegan Paul, 1975.

"Somewhat compressed account of general principles, but offers a valuable survey of the field." (Terence Hawkes, *Structuralism and semiotics*, 180.)

Hamel, Keith A. "Issues in the design of music notation systems." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 325-332. San Francisco: Computer Music Association, 1987.

Hammond, Ray. *The musician and the micro*. Dorset, England: Blandford, 1983.

An introductory guide to the software and equipment available in 1983.

Hanzelin, Fred Lee. "The software for computer-assisted graphical representation of single instrument melodic lines and harmonic spectra using DARMS encoding and acoustical data." DMA diss., University of Illinois at Urbana-Champaign, 1978.

Harris, Zellig. *Structural linguistics*. Chicago: University of Chicago Press, 1951.

Harweg, Roland. "Language and music: An immanent and sign theoretic approach." *Foundations of language* 4:3 (August 1968): 270-281.

Takes up questions of phenomenology, transcendentalism, abstraction, paradigm and syntagm, and *parole* and *langue*.

Harwood, Dane L. "Contributions from psychology to musical universals." *World of music* 21:1 (1979): 48-64.

"As a cultural and also a perceptual phenomenon, music embodies some universal symbolic relationships....Such symbolic relationships, based as they are on active musical perception and cognition, draw upon information processing, expectancy, iconicity, and world view. The processes underlying musical behavior, therefore, are not much different from those underlying other symbolic behavior such as language. Process, not structure, is what communities share in music making." (*RILM* 13:1 (1979): 120.)

Hatten, Robert S. "Explaining style growth and change: A richer semiotic model." In *Semiotics, 1980: Proceedings of the fifth annual meeting of the Semiotic Society of America*, edited by Michael Hersfeld and Margot Lenhart. New York: Plenum, 1982.

Hatten, Robert S. "Toward a semiotic model of style in music: Epistemological and methodological bases." Ph.D. diss., University of Indiana, 1982.

Hatten, Robert S. "Semiotic perspectives on issues in music cognition." *In theory only* 11:3 (1989): 1-11.

Hatzis, Christos. "Chronochroma." *Interface* 8:3 (October 1979): 73-90.

Proposes a compositional language based on color in music and suggests a notation for it. Continued in *Interface* 9:2 (1980).

Hatzis, Christos. "Towards an endogenous automated music." *Interface* 9:2 (1980): 83-114.

Continuation of the above article emphasizing algorithmic composition and its philosophical implications, and demonstrating its implementation in Music V.

Haus, Goffredo. "EMPS: A system for graphic transcription of electronic music scores." *Computer music journal* 7:3 (Fall 1983): 31-36.

Hawkes, Terence. *Structuralism and semiotics.* Berkeley: University of California Press, 1977.

A good introductory book to these two fields. Hawkes draws clear connections among the disparate ideas of linguistics, anthropology, literature, and criticism. He provides a particularly good annotated bibliography, divided into subjects, and with a study plan provided to suggest what the reader may wish to read next, according to her level of knowledge of the fields.

Haynes, Stanley. "Design considerations for a multi-processor digital sound system." *Interface* 10:3-4 (December 1981): 221-244.

Hays, Dan. "The rock and roll concert: A semiotic analysis." In *Semiotics, 1980: Proceedings of the fifth annual meeting of the Semiotic Society of America*, edited by Michael Hersfeld and Margot Lenhart. New York: Plenum, 1982.

Heartz, Daniel; and Wade, Bonnie; eds. *International Musicological Society: Report of the twelfth congress, Berkeley, 1977.* Kassel: Barenreiter, 1981.

Contains a section on notation--see Ghircoiasiu, Stockman, and Warfield.

Heidegger, Martin. *Basic writings: From "Being and time" (1927) to "The task of thinking" (1964).* Edited by David Farrell Krell. New York: Harper & Row, 1977.

See particularly "The origin of the work of art," and "The question concerning technology."

Heidegger, Martin. *Being and time.* Translated by John Macquarrie and Edward Robinson. New York: Harper & Row, 1962.

Heifetz, Robin Julian. "Computer music warmware: The human perspective." In *On the wires of our nerves: The art of electroacoustic music*, edited by Heifetz, 85-89. Cranbury, N.J.: Associated University Presses, 1989.

The article recommends a more humanistic, less technological, approach to computer music. The book contains eighteen recent articles on technology, aesthetics, composition, computer music, and a few specific applications, by a number of musicians including J. Appleton, H. Brun, O. Luening, K. Gaburo, B. Schrader, and D. Morrill.

Hein, Hilde. "Role of feminist aesthetics in feminist theory." *Journal of aesthetics and art criticism* 48:4 (Fall 1990): 281-292.

Helman, Alicja. "On the fundamental interactions of sound subcodes in films." *Polish art studies* 2 (1980): 201-213.

Henrotte, Gayle. "Music and linguistics: The semiotic connection." In *Semiotics, 1985: Proceedings of the tenth annual meeting of the Semiotic Society of America*, edited by John Deely. Lanham, Md.: University Press of America, 1986.

Hervey, Sandor. *Semiotic Perspectives*. Boston: Allen & Unwin, 1982.

A major work, with descriptions of numerous semioticians of historical importance.

Herzfeld, Michael; and Lenhart, Margot D.; comps. *Semiotics 1980: Proceedings from the fifth annual meeting of the Semiotic Society of America*. New York: Plenum, 1982.

See entries here for R. Hatten, E. Tarasti, P. Lin, and D. Hays.

Hessert, Norman Dale. "The use of information theory in musical theory." Ph.D. diss., Indiana University, 1971.

Hewlett, Walter B. "Fullscore musical databases: Applications and issues." Paper presented at the annual meeting of the Northern California Chapter of the American Musicological Society, Stanford, March 1990.

Addresses technical, musicological, and practical questions of music representation. Defines the difference between a source database with an open format and multiple uses, and an application-specific, software-dependent database. Mentions DARMS and ANSI.

Hewlett, Walter B.; and Selfridge-Field, Eleanor; eds. *Computing in musicology: A directory of research.* Menlo Park, Calif.: Center for Computer Research in the Humanities, 1990.

Most recent in a series of six such directories (previously called *Directory of computer assisted research in musicology*). An excellent source of information on the representation of music, standardization (e.g., ANSI, MIDI, etc.), music printing, and computer research.

Heyser, Richard C. "Alternatives." *Audio* 62 (1978): 50-52.

Hicks, David. "Reflections on computer music (1981)." *Perspectives of new music* 19:1-2 (1980-1981): 444-448.

A brief poem decrying the negative effects of technology on music.

Higgins, Dick. *A dialectic of centuries: Notes towards a theory of the new arts.* 2nd. ed. New York: Printed Editions, 1978.

Contains sections on intention, intermedia, innovation, Stein, conceptualism, and other topics.

Higgins, Dick. *Horizons: The poetics and theory of the intermedia.* Carbondale: Southern Illinois University Press, 1984.

See his discussions of visual poetry and process.

Higgins, Dick. *Pattern poetry: Guide to an unknown literature.* Albany: State University of New York Press, 1987.

An extensive and well-illustrated history and theory. See particularly "Analogues of pattern poetry" (e.g., mesostics, music).

Hiller, Lejaren A. "Composing with computers: A progress report." *Computer music journal* 5:4 (Winter 1981): 7-21.

Contains a block diagram of a versatile computer music system which neatly describes the process. Also lists numerous compositions and articles by Hiller.

Hiller, Lejaren A.; and Bean, Calvert. "Information theory analyses of four sonata expositions." *Journal of music theory* 10:1 (1966): 96-138.

Hiller, Lejaren A.; and Isaacson, Leonard M. *Experimental music: Composition with an electronic computer.* New York: McGraw-Hill, 1959.

Hiller, Lejaren A.; and Levy, Burt. "General system theory as applied to music analysis - Part 1." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 295-316. Florence: Olshki, 1984.

Describes in general terms the conceptions to be used by Hiller and Levy in a later analysis of the last movement of Beethoven's Sonata no. 29 in B flat, opus 106.

Hoegl, Juergen K. "Information transfer in transmedial and multimedial art." In *Semiotics unfolding: Proceedings of the second congress of the International Association for Semiotic Studies [1979]*, edited by Tasso Borbe, v. 3, 1667-77. New York: Mouton, 1983.

Hofstetter, Fred T. *Making music on micros: A musical approach to computer programming.* New York: Random House, 1985.

Hofstetter, Fred T. *Computer literacy for musicians.* Englewood Cliffs, N.J.: Prentice-Hall, 1988.

An excellent book for background in the field, especially the chapers on MIDI and PC applications. There are several useful glossaries here as well.

Holtzman, S. R. "A generative grammar definition language for music." *Interface* 9:1 (June 1980): 1-47.

Describes rules available for creating a set of programs which can be used to define a language and then to generate sounds (music) in that language. Takes up question of semantics and syntax, paradigmatic and syntagmatic relationships, deep and surface structures, types of grammars, terminals, rewrite rules, transformation, and mapping. Contains good examples of computer scores and the code for several generative grammar programs.

Holtzman, S. R. "Using generative grammars for music composition." *Computer music journal* 5:1 (1981): 51-64.

Much like the article listed above, but with a stronger emphasis on modeling Schoenberg's grammar, as well as practical applications of generative grammars.

Hosokawa, Shuhei. "Distance, gestus, quotation: *Aufstieg und Fall der Stadt Mahagonny of Brecht and Weill.*" *International review of the aesthetics and sociology of music* 16:2 (1985): 181-199.

A somewhat convoluted but interesting study in the semiotics of opera. Discusses the distance, for spectators of art, between the ordinary and the strange, the social complexity of the gestus, and the use of quotation in *Mahagonny*. Concentrating on the score and text of the opera, the author seeks to define a "semiosis in/by distance."

Hosokawa, Shuhei. "How Saussurian is music?" In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 155-164. Florence: Olshki, 1984.

Howard, V. A. "On representational music." *Nous* 6:1 (1972): 41-54.

In this frequently cited article, Howard takes up questions posed by Goodman in *Languages of art*. Includes discussions of the visual as representation of the musical, onomatopoeia (with implication for the study of *musique concrete*), pictorial labelling (applicable to the study of computer icons), scoring, notationality, systems and schemes, musical denoting, and expression. Contains several interesting interpretations of traditional notation.

Howe, Jr., Hubert S. "Composing by computer." *Computers and the humanities* 9:6 (1975): 281-90.

Howe discusses style and expressionism as they relate to computer music. Then he goes on to describe his work with multidimensional arrays. This includes a good discussion of the effects on the composition process of using a computer.

Howe, Jr., Hubert S. "Microcomputers and electronic music." In *Breaking the sound barrier: A critical anthology of new music*, edited by Gregory Battcock, 174-190. New York: Elsevier-Dutton, 1981.

A general discussion of the technical side of microcomputers. Contains a section on the capabilities and limitations of micros. The bibliography is rather dated at this point.

Husserl, Edmund. *Ideas: General introduction to pure phenomenology*. Translated by W. R. Boyce Gibson. New York: Collier, 1972.

First published in German in 1950.

Husserl, Edmund. *Logical investigations*. Translated by J. Findlay. New York: Humanities, 1970.

First published in German in 1913.

Imberty, Michel. "Perspectives nouvelles de la semantique musicale experimentale." *Musique en jeu*, no. 17 (January 1975): 87-110.

Here Imberty investigates the similarities between musical expressivity and verbal signification. He describes in detail the methodology and the results of an experiment he conducted using extracts from Debussy's *Preludes*, seeking to illuminate how and why people experience music as they do. He concludes that it is a question of culture and individual psyche.

Imberty, Michel. "Semantique musicale: Approache structurale, approche experimentale." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 225-244. Pesaro: Centro di Iniaziativa Culturale, 1975.

Imberty, Michel. *Signification and meaning in music (on Debussy's "Preludes pour le piano")*. Monographies de Semiologie et d'Analyses Musicales, 3. Montreal: Groupe de Recherches en Semiologie Musical, Universite de Montreal, 1976.

Imberty, Michel. *Entendre la musique: Semantique psychologique de la musique*. Paris: Dunod, 1979.

Imberty, Michel. *Les ecritures du temps*. Semantique Psychologique de la Musique, 2. Paris: Dunod, 1981.

Imberty, Michel. "*La Cathedrale engloutie* de Claude Debussy: De la perception au sens." *Canadian university music review* 6 (1985): 90-160.

International MIDI Association. *MIDI musical instrument digital interface specification 1.0*. North Hollywood, Calif.: International MIDI Association, 1983.

Isou, Isadore. "Explication sur la creatique ou la novatique," "Les creations du lettrisme," and "Oeuvres du meme auteur." Published jointly. Paris: Mouvement pour la creation et la recherche en ecriture, 1978.

Works by the founder of the Lettrisme movement.

Jaffe, David. "Ensemble timing in computer music." In *Proceedings of the International Computer Music Conference, 1984*, edited by William Buxton, 185-191. San Francisco: Computer Music Association, 1985. Also, in *Computer music journal* 9:4 (Winter 1985): 38-48.

Discusses approaches to timing, including "time maps" which Jaffe demonstrates with code and graphics.

Jakobson, Roman. *Essais de linguistique generale*. Paris: Minuit, 1963.

Presents Jakobson's adresser/message/addressee model.

Jakobson, Roman. "Closing statement: Linguistics and poetics." In *Style and language*, edited by Thomas Sebeok, 350-377. Cambridge, Mass.: MIT Press. 1960.

Jakobson, Roman. *Essais de linguistique generale*. Paris: Minuit, 1963.

Presents Jakobson's addresser/message/addressee model.

Jakobson, Roman; and Halle, M. *Fundamentals of language.* The Hague: Mouton, 1956.

Jameson, Fredric. *The prison-house of language: A critical account of structuralism and Russian formalism.* Princeton: Princeton University Press, 1972.

"A key work which makes an incisive critical analysis of the presuppositions of formalism and structuralism and offers a discriminating commentary on each. Necessary reading for advanced students." (Terence Hawkes, *Structuralism and semiotics*, 169.)

Janzen, Thomas E. "Aesthetic appeal in computer music." In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 111-120. Cranbury, N.J.: Associated University Presses, 1989.

Jauss, Hans Robert. *Toward an aesthetic of reception.* Translated by Timothy Bahti. Minneapolis: University of Minnesota Press, 1982.

Contains several essays by this important proponent of reception theory and literature. Puts forth the idea of the "horizon of expectation," that is, the cultural and artistic expectations held by readers--or performers or listeners--at the historical moment when a work appears. Jauss draws connections between reception and curiosity, essence, events, history, aesthetics, formalist theory, hermeneutics, marxism, sociology, and structuralism.

Jaxitron, [n.f.n.]. *Cybernetic music.* Blue Ridge Summit, Penn.: Tab, 1985.

Most of this book consists of a description of APL (A Programming Language) which, unlike a coding language, is independent of computers per se. There is an interesting but brief discussion of cybernetics and representation.

Jazan, Jose. *Un nouveau graphisme de l'ecriture musicale et les voies reeles de l'instrumentation.* Paris: Editions Richard-Masse, 1980.

One of several publications issued by *La revue musicale*, through Richard-Masse, concerning the works of the French lettrists (see J. Curtay above). Lettrist notations are remarkable for their great semiotic variety and their interdisciplinary techniques.

Jiranek, Jarouslav. "The development and present situation of the semiotics of music in Czechoslovakia." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 27-40. Pesaro: Centro di Iniziativa Culturale, 1975.

After a brief historical introduction, Jiranek discusses the basic concerns of musical semantics: "1) the natural and anthropological stratum of meanings, 2) the semantic stratum of man's social practice, and 3) the semantic stratum of musical phylogenesis." (p. 28) Then he investigates questions of intonation, expression, the icon, and the symbol.

Johansson, Ola. "Let us speak the same language: An essay on music notation." *Composer* (London) 78 (Spring 1983): 12.

On Braille music notation.

Johnson, Roger, comp. *Scores: An anthology of new music*. New York: Schirmer, 1981.

Good selection of works from the 1960s to the 1980s in all media (except computers). A reliable cross-section, showing a variety of notational practice.

Johnson, T. "Music from the drawing room (Xenakis' UPIC system)." *Village voice* 26 (December 23, 1981): 80.

Jones, Kevin. "Compositional applications of stochastic processes." *Computer music journal* 5:2 (Summer 1981): 45-61.

Jones discusses Markov chains, finite state grammars, stochastic grammars, and various space grammars. He uses the latter to translate geometric space into traditional music notation.

Joyce, James. "Stepping back to get a closer look: Computing as a semiotic tool." *Association for literary and linguistic computing bulletin* 7:2 (1979): 130-136.

Jurgens, Raymond F. "Algorithmic music language." In *Proceedings of the 1980 International Computer Music*

Conference, compiled by Hubert S. Howe, Jr., 337-354. San Francisco: Computer Music Association, 1980.

An "advanced microcomputer language for the control of analog synthesizers." (p. 337) Contains a list of machine instructions.

Kaegi, Werner. "The MIDIM language and its VOSIM interpretation." *Interface* 15:2-4 (1986): 83-161.

Describes the technical mathematics of the language used in the computer music studios at the Institute for Sonology in Utrecht. This issue of *Interface* contains six other articles on the VOSIM/MIDIM system.

Kagel, Mauricio. "Translation-Rotation." *Die Reihe* 7 (1961): 32-60.

Kahn, Douglas. "Cage and phonography." Paper presented at symposium, John Cage at Wesleyan, Middletown, Conn., February, 1988.

Discusses electronic and digital means of sound production, intention, signification, pure music, expression, representation, reference, and reception.

Kandinsky, Wassily. *Point and line to plane.* Translated by Howard Dearstyne and Hilla Rebay. New York: Dover, 1979.

With this book, originally published in 1926 by the Bauhaus, Kandinsky takes up his theory of art from an elemental perspective. Having previously written about the spiritual nature of art, here he deals with the specifics of graphic manipulation. He frequently relates points, lines and planes to sounds and music which were important to his overall conception. This is an excellent source of ideas for graphic music notation containing many examples of graphics by the author.

Kaprow, Allan. *Assemblage, environments, and happenings.* New York: Something Else, 1966.

Kaprow, Allan. "Manifesto." In *Manifestos.* New York: Great Bear, 1966.

Kaprow, Allan. *Some recent happenings.* New York: Great Bear, 1966.

Defines "Happening" and contains good examples of verbal instructions manifesting aspects of poems, stage directions, and text scores.

Karkoschka, Erhard. *Notation in new music: A critical guide to interpretation and realisation.* Translated by Ruth Koenig. New York: Praeger, 1972.

First published in German in 1966. A ground-breaking work containing numerous examples of graphic music notations.

Kasden, Leonard; and Appleton, Jon H. "Tradition and change: The case of music." In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 17-27. Cranbury, N.J.: Associated University Presses, 1989.

Keane, David. "Computer music: Some problems and objectives in applied aesthetics." In *Proceedings of the 1980 International Computer Music Conference,* compiled by Hubert S. Howe, Jr., 512-524. San Francisco: Computer Music Association, 1980.

Keane, David. "Architecture and aesthetics: The construction and the objectives of *Elektronikus mozaik.*" In *ICEM Conference on Electro-Acoustic Music [1985]: Proceedings*, edited by Bo Rydberg, 11-33. Stockholm: Royal Swedish Academy of Music, 1988.

Compares both left-brain (analytical) functions to right-brain (relational) functions, and the brain in general to computers.

Keane, David. "The quest for 'musically interesting' structures in computer music." In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 97-110. Cranbury, N.J.: Associated University Presses, 1989.

Keane, David. "Some practical aesthetic problems of electronic music composition." In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 43-56. Cranbury, N.J.: Associated University Presses, 1989.

Keiler, Allan. "Bernstein's *The Unanswered Question* and the problem of musical competence." *Musical quarterly* 64:2 (April 1978): 195-222.

Keiler, Allan. "The empiricist illusion: Narmour's *Beyond Schenkerism*." *Perspectives in new music* 17:1 (1978), 161-195.

Keiler, Allan. "The syntax of prolongation." *In theory only* 3:5 (1977), 3-27.

Kempton, Karl. "Visual poems." *Lightworks* 14-15 (Winter 1981-1982): 22-24.

Kendall, Gary S. "Composing from a geometric model: 'Five-Leaf Rose'." In *Proceedings of the 1980 International Computer Music Conference*, compiled by Hubert S. Howe, Jr., 382-403. San Francisco: Computer Music Association, 1980. Reprint in *Computer music journal* 5:4 (1981): 66-73.

Demonstrates the use of a geometric figure and a computer to give unity to many different aspects of a composition. Some of the techniques are similar to those I used in *Water pictures and words*.

Kerman, Joseph. *Contemplating music*. Cambridge, Mass.: Harvard University Press, 1985.

Kirby, Michael. "The aesthetics of the avant-garde." In *Esthetics contemporary*, edited by Richard Kostelanetz, 36-70. Buffalo, N.Y.: Prometheus, 1978.

Defines art in terms of intention and significance. Discusses the relativity and contextuality of perception, and art as communication (sender, receiver, message). Contrasts science and art. Maintains that significant art results in the changing of consciousness.

Kivy, Peter. *Sound and semblance: Reflections on musical representation*. Princeton: Princeton University Press, 1984.

Replete with musical examples, this work investigates music, notation, expression, and narration as representational processes. Kivy avoids directly engaging the specific conceptualizations of semiotics; but much of his discussion is germane to the field, since he does address the work of numerous philosophers precedent to semiotics.

Klee, Paul. *On modern art*. Translated by Paul Findlay. London: Faber & Faber, 1948.

Contains a number of reproductions of Klee's sketches, several of which incorporate music notation forms. The sketches are accompanied by Klee's analysis of the artistic process.

Klee, Paul. *Pedagogical sketchbook*. Translated by Sibyl Moholy-Nagy. London: Faber & Faber, 1953.

First published in 1925 by the Bauhaus, this book sets forth Klee's ideas about the "optical-physical appearance" of reality and its relationship to the "inner substance." Klee was tremendously interested in music notation as visual symbols; and his theories about the dynamics of dot and line, dimension and balance, and graphic energy are directly germane to issues raised by graphic music notation.

Kneif, Tibor. "Once more 'meaning' in music." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 208-213. Pesaro: Centro di Iniziativa Culturale, 1975.

Knobloch, Frank A. "Criticism double bound: The uncanny, the Baconian ideal, and the semantics of indeterminacy." Ph.D. diss., University of Wisconsin, Madison, 1986.

Citing ideas derived from Jameson and Bateson, Knobloch outlines connections between recent literary criticism and the conception of the uncanny as paradox, and between the "schizophrenic" dilemma thus uncovered and the gap among social classes in their perceptions of social evolution.

Knuth, Donald E. *The art of computer programming*. 2nd ed, 3 vols. Reading, Mass.: Addison-Wesley, 1973.

The definitive work on the subject.

Koenig, Gottfried Michael. "Aesthetic integration of computer-composed scores." *Computer music journal* 7:4 (Winter 1983): 27-32.

Compares the modes of production and divisions of labor involved in instrumental and electronic music processes. Discusses the relationship between histograms and scores, and the composer and a score.

Kostelanetz, Richard, ed. *John Cage*. New York: Penguin, 1970.

Articles by and about Cage, including an excerpt from the score to his tape piece *Williams mix*.

Kostelanetz, Richard. "Contemporary American esthetics." In *Esthetics contemporary*, edited by Kostelanetz, 19-35. Buffalo, N.Y.: Prometheus, 1978.

Discusses major figures of importance to the essay's subject, including Croce, Dewey, Langer, Moholy-Nagy, Cage, Kaprow, Greenberg, and McLuhan. Touches on the interdisciplinary nature of contemporary art, technological determinism, the importance of perception and awareness, communication theory, and an idealist philosophy of art.

Kostelanetz, Richard, ed. *Esthetics contemporary*. Buffalo, N.Y.: Prometheus, 1978.

Important articles by Marcel Duchamp, Milton Babbitt, John Cage, Allan Kaprow, Sol LeWitt, Henry Flynt, Michael Kirby, Morse Peckham, and others.

Kostka, S. M. *A bibliography of computer applications in music*. Hackensack, N.J.: Boonin, 1974.

Kramer, Jonathan D. *The time of music: New meanings, new temporalities, new listening strategies*. New York: Schirmer, 1988.

A study of techniques used in the contemporary reception of the temporal aspects of music from all periods.

Kramer, Lawrence. "The shape of post-Classical music." *Critical inquiry* 6:1 (Fall 1979): 144-152.

This is a reply to Subotnik's "The cultural message of musical semiology," listed below.

Kramer, Lawrence. *Music as cultural practice, 1800-1900*. Berkeley: University of California Press, 1990.

Kramer, Lawrence. "Hermeneutic and musical analysis: Can they mix?" Paper presented at the annual meeting of the Society of Music Theory, Oakland, California, November 1990.

Krampen, Martin. "Prehistory of graphic notation systems." In *Semiotics unfolding: Proceedings of the second congress of the International Association for*

Semiotic Studies [1979], edited by Tasso Borbe, v. 3, 1463-70. New York: Mouton, 1983.

Kremer, Joseph-Francois. *Les formes symboliques de la musique*. Paris: Klincksieck, 1984.

Kremer begins with a consideration of several epistemological questions relevant to music and pleasure, the imagination, symbols, form and structure. He closes with an analysis of Handel's Concerto Grosso V. His historical approach centers around baroque and classical music. There are a bibliography and several useful indexes.

Kristeva, Julia. "The system and the speaking subject." In *The tell-tale sign: A survey of semiotics*, edited by T. Sebeok. Lisse: Peter de Ridder, 1975.

Kuhns, Richard. "Music as a representational art." *British journal of aesthetics* 18:2 (1978): 120-125.

A refutation of R. Scruton's primary premise (see entry below) that music is incapable of representation.

Kuipers, P. "CANON: A system for the description of musical patterns." *Interface* 15:2-4 (1986): 257-269.

A complex system using the VOSIM/MIDIM programs.

Kulenkampff, Jens. "Music considered as a way of worldmaking." *Journal of aesthetics and art criticism* 39:3 (1981): 254-258.

"Discusses Nelson Goodman's theories of musical symbolism as expounded in his books *Languages of art* and *Ways of worldmaking*. Music is symbolization as expression (metaphorical exemplification)." (*RILM* 15:3 (1981): 405.)

Kurkela, Kari. *Note and tone: A semantic analysis of conventional music notation*. Helsinki: Musicological Society of Finland, 1986.

Kurkela, Kari. "Score, vision, action." *Contemporary music review* 4 (1989): 417-435.

A useful semantic analysis of the process of musical performance from the perspectives of interpretation and execution. Discusses notational competence, intention, abstraction, models, cognition, production theory, and codes.

Lalo, Charles. "A structural classification of the fine arts." *Journal of aesthetics and art criticism* 11:4 (June 1953): 307-323.

A taxonomy of the arts based on structuralism and Gestalt theory. Reveals similarities between hearing and seeing.

Lamt, M. R. "Computer games for developing musical skills." In *Proceedings: 1981 International Computer Music Conference*, 398-413. [San Francisco: Computer Music Association], n.d.

Describes games which "combine techniques of graphical animation with sound effects...to present concepts relating to musical form, timbre, and orchestration." (p. 398) The procedures are similar to those employed by the UPIC system. Contains numerous pictures of the graphic used.

Langacker, Ronald W. *Language and its structure: Some fundamental linguistic concepts*. New York: Harcourt, Brace, & World, 1967.

Langer, Susanne. *Philosophy in a new key: A study in the symbolism of reason, rite, and art*. Cambridge, Mass.: Harvard University Press, 1942.

The symbolic transformation of experience is the new key to understanding the world and human mentality. This frequently-cited book includes discussions of the logic of signs and symbols, discursive forms and presentational forms, significance in music, and facts, values, and meaning.

Langer, Susanne. *Feeling and form: A theory of art developed from "Philosophy in a new key"*. New York: Scribner, 1953.

Langer's aesthetics theory; a sequel to *Philosophy*. She frequently uses music as an example in her writings; here she also discusses dance, literature, poetry, and drama. Topics include paradoxes, expression, signs, representation, virtual space, abstraction, hermeneutics, program music, gesture, the subjective and objective, discourse, events, art and life, narrative, conventions, virtual memory, virtual future, intuition, anticipation, and the perceiver.

Langer, Susanne. *Philosophical sketches: A study of the human mind in relation to feeling, explored through art, language, and symbol.* Baltimore: Johns Hopkins University Press, 1962.

A collection of essays on the philosophy of mind. Of particular interest are "On a new definition of 'symbol'," and "Speculations on the origins of speech and its communicative functions."

Langleben, Maria M. "A proper name in poetry and music." In *Semiotics unfolding: Proceedings of the second congress of the International Association for Semiotic Studies [1979]*, edited by Tasso Borbe, v. 3, 1695-1702. New York: Mouton, 1983.

Discusses conceptions germane to techniques used in Massi's *Water pictures and words.*

Laske, Otto E. "Musical semantics: A procedural point of view." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 214-224. Pesaro: Centro di Iniziativa Culturale, 1975.

Laske, Otto E. "On some developmental problems of auditory imagery." *International review of the aesthetics and sociology of music* 7:1 (1976): 77-82.

Laske, Otto E. "Toward a musicology for the twentieth century." *Perspectives of new music* 15:2 (1977): 220-225.

Review of J. Nattiez' *Fondements d'une semiologie de la musique.*

Laske, Otto E. "Toward a theory of interfaces for computer music systems." *Computer music journal* 1:4 (November 1977): 53-60.

Laske, Otto E. "Understanding the behavior of users of interactive computer music systems." *Interface* 7:2-3 (September 1978): 159-168.

"Discusses decision-making processes in interactive computer music systems, particular attention being given to understanding semantic decision-making on the basis of protocol data. Proposes two knowledge

representations relevant to dealing with semantic information in protocols. They are thought to be central to studies in cognitive psycho-acoustics (sonology), a science linking psycho-acoustics and music theory." (*RILM* 12:3 (1978): 398.)

Laske, Otto E. "Subscore manipulation as a tool for compositional and sonic design." In *Proceedings of the 1980 International Computer Music Conference*, compiled by Hubert S. Howe, Jr., 2-21. San Francisco: Computer Music Association, 1980.

Describes score synthesis as a procedure involving grammatical and stochastic structures and taking place before sound synthesis, not just the product of the compositional process of a single work. Contains score examples of compositional macros. Includes notes on the programming and construction of the piece *Terpsichore*; and discusses the work of G. M. Koenig and W. Buxton.

Laske, Otto E. "Composition theory in Koenig's *Project one* and *Project two*." *Computer music journal* 5:4 (Winter 1981): 54-65.

Discusses the compositional process. Compares data-based and knowledge-based programs. Contains computer score excerpts.

Laske, Otto E. "Toward a definition of computer music." In *Proceedings: 1981 International Computer Music Conference*, 31-56. [San Francisco: Computer Music Association], n.d.

Relates score synthesis to sound synthesis and knowledge synthesis. Contrasts grammatical scores with strategical scores.

Laske, Otto E. *Music and mind: An artificial intelligence perspective, 1971-1981.* San Francisco: Computer Music Association, 1981.

A collection of twenty-eight articles dealing with topics such as cognition and the arts, competence and performance, extending compositional creativity through computer programming, and musical semantics. (Unfortunately, because of the photocopy method of reproducing these articles, much of the material in this edition is unreadable.)

Laske, Otto E. "Keith: A rule-system for making music-analytical discoveries." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 165-200. Florence: Olshki, 1984.

Lemaitre, Maurice. *Bilan lettriste*. Paris: Richard-Masse, 1955.

Leman, Marc. "Dynamical-hierarchical networks as perceptual memory representations of music." *Interface* 14:3-4 (1985): 125-164.

Includes a discussion of listening as "a process of knowledge acquisition and the construction of an associative structure in mind. These structures are called DH-networks; they combine dynamical and hierarchical aspects of musical listening and incorporate syntactic, semantic and pragmatic aspects of music." (p. 125)

Lemert, Charles; and Gillan, Garth. *Michel Foucault: Social theory as transgression*. New York: Columbia University Press, 1982.

Contains an appendix of concepts used by Foucault including discourse, document, events, history, practices, and subject.

Leppert, Richard. *Music and image: Domesticity, ideology and socio-cultural formation in eighteenth-century England*. New York: Cambridge University Press, 1989.

An historical study in which Leppert examines visual and written representations of music--scores, manuals, letters, and fiction--to draw conclusions about the upper classes, family, and gender during the period.

Leppert, Richard; and McClary, Susan; eds. *Music and society: The politics of composition, performance and reception*. New York: Cambridge University Press, 1987.

This collection contains articles "influenced by such socially and politically grounded enterprises as feminism, semiotics and deconstruction." (p. xi) Of particular interest to semiotics and notation are the following: "The blasphemy of talking politics during Bach Year," by McClary (pp. 13-62); "On grounding Chopin," by Rose Rosengard Subotnik (pp. 105-132);

and "The sound of music in the era of its electronic reproducibility," by John Mowitt (pp. 173-197).

Lerdahl, Fred; and Jackendoff, Ray A. *A generative theory of tonal music*. Cambridge, Mass.: MIT Press, 1983.

A major work in the field of music and generative grammars, this book proposes a formalist analysis methodology based on groupings and structures, reductions and prolongations, musical universals, psycho-linguistic and cognitive science. It is reviewed in *Journal of music theory* 28:2 (1983): 271-294; and in *In theory only* 8:6 (April 1985): 27-52.

Levine, Steve; and Mauchly, J. William. "The Fairlight computer music instrument." In *Proceedings of the 1980 International Computer Music Conference,* compiled by Hubert S. Howe, Jr., 565-573. San Francisco: Computer Music Association, 1980.

Includes a discussion of the graphic manipulation of wave forms, or drawing wave forms with a light-pen.

Levi-Strauss, Claude. *Anthropologie structurale*. Paris: Plon, 1958. Translated by Claire Jacobson and Brooke Grundfest Schoepf. London: Lane, 1968.

Levi-Strauss, Claude. *L'homme nu*. Paris: Plon, 1971.

In this ethnological study, Levi-Strauss analyzes Ravel's *Bolero*, and discusses the similarities of myth and music in their structure and functions. (See Jean-Jacques Nattiez' "Rencontre avec Levi-Strauss.")

Levitt, David. "Machine tongues X: Constraint languages." *Computer music journal* 8:1 (Spring 1984): 9-21.

Levy, Morten. "On the problem of defining musical units." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 135-150. Pesaro: Centro di Iniziativa Culturale, 1975.

Lidov, David. "Structure and function in musical repetition." *Canadian association of university schools of music journal* 8:1 (1978): 1-32.

"Previously observed characteristics of repetition include pervasiveness, concreteness, segmental hierarchy, defining effect, its role in stylistic development and as an affective element. Semiotic concepts provide a sign-theoretic view. Classed according to domains of reference as formative, focal, or textural, repetition correlates specifically with structural factors. The scherzo from Schubert's posthumous sonata in B-flat, which utilizes all types, is given as an example." (*RILM* 12:2 (1978): 242.)

Lieberman, Don. "The ADS 200 advanced digital synthesizer." In *Proceedings of the 1980 International Computer Music Conference,* compiled by Hubert S. Howe, Jr., 577-581. San Francisco: Computer Music Association, 1980.

Includes a brief presentation of a graphic language to describe timbre.

Lin, Paul Y. "Semiotic perspectives on Chinese: A picturesque language." In *Semiotics 1980: Proceedings from the fifth annual meeting of the Semiotic Society of America*, compiled by M. Herzfeld and M. Lenhart, 281-296. New York: Plenum, 1982.

Lincoln, Harry B., ed. *The computer and music.* Ithaca: Cornell University Press, 1970.

An early collection of articles covering history, composition, analysis, ethnomusicology, and information retrieval.

Lippman, Edward A. *A humanistic philosophy of music.* New York: New York University Press, 1977.

An interdisciplinary explication of music as a philosophical and social entity, touching on questions of material, form, meaning, style, and context. The section on permanence deals with the relationship between notation and scores, on the one hand, and music in general, on the other. Though Lippman has incorporated a number of ideas crucial to twentieth-century thought (e.g., phenomenology), he fails to address the most recently delineated ramifications of these ideas, or to explicitly cite the sources of the ideas. His is therefore a thoroughly modern--as opposed to post-modern--interpretation.

Lippman, Edward A. "The dilemma of musical meaning." *International review of the aesthetics and sociology of music* 12:2 (1981): 181-189.

In this article, Lippman "discusses the emergence of meaning as a central concern of philosophy in the 20th c., as evidenced by three types of investigation: hermeneutics, symbolism, and semiology. Reviews the literature in each of these fields." (*RILM* 15:3 (1981): 406.)

Lischka, Christoph. "Connectionist models of musical thinking." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 190-196. San Francisco: Computer Music Association, 1987.

Lischka, Christoph; and Gusgen, Hans-Werner. "M v S/C: A constraint-based approach to musical knowledge representation." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 227-229. San Francisco: Computer Music Association, 1986.

M v S/C ("if there is a System with Constraints then there is a Musical application") attempts to describe a model of musical thinking interacting with other cognitive processes, with the specific goal of synthesizing Bach chorales.

Lister, Craig. *The musical microcomputer: A resource guide*. New York: Garland, 1988.

Contains over 300 annotated entries.

Lohner, Henning. "The UPIC system: A user's report." *Computer music journal* 10:4 (Winter 1986): 42-49.

Lombardi, Daniele. "Futurism and musical notes." *ArtForum* 19:5 (January 1981): 43-49.

Discusses the graphic scores of Pratella, Russolo, and others. Contains good reproductions of score excerpts.

Longacre, Robert E.; and Chenoweth, Vida. "Discourse as music." *Word: Journal of the international linguistic association* 37:1-2 (1986): 125-133.

Here "structural and analytical analogies between language and music are offered, using some of the world's oral music systems as examples." (*Linguistic and language behavior abstracts*, 21:1 (1987): 112; but see p. 118 for a fuller description.)

Longton, Michael. "SAM: Priorities in the design of a microprocessor-based music program." *Interface* 10:1 (March 1981): 83-95.

Describes a composition-synthesis program. Starts out with a typology of existing software designs for synthesis which includes brief discussions of Music V, participatory programs, and user-defined programs.

Loy, D. Gareth. "The composer seduced into programming." *Perspectives of new music* 19:1-2 (Fall-Winter 1980 & Spring-Summer 1981): 184-198.

Discusses some of the technological, personal, and aesthetic consequences of using computers to make music. Compares hackers and "computer-phobes". Lists criteria of usefulness, and makes projections for the future.

Loy, D. Gareth. "Musicians make a standard: The MIDI phenomenon." *Computer music journal* 9:4 (Winter 1985): 8-26.

Loy, D. Gareth. "Designing a computer music workstation from musical imperatives." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 375-380. San Francisco: Computer Music Association, 1986.

Evaluates the structure of the musical task and suggests ways of incorporating this into computer implementations. See particularly his discussion of control theory.

Loy, D. Gareth. "Composing with computers: A survey of some compositional formalisms and music programming languages." In *Current directions in computer music research*, edited by Max Mathews and John Pierce, 291-396. Cambridge, Mass.: MIT Press, 1989.

Loy, D. Gareth. "Preface to the special issue on parallel distributed processing and neural networks." *Computer music journal* 13:3 (Fall 1989): 24-27.

Lyotard, Jean-Francois. *The postmodern condition: A report on knowledge*. Translated by Geoff Bennington and Brian Massumi. Theory and history of literature, vol. 10. Minneapolis: University of Minnesota Press, 1984.

Contains some interesting discussions on performance, competence, language, power, determinacy, and communication.

Mahin, B. "Twentieth-century music notation." *Instrumentalist* 36 (February 1982): 34-35.

Mahin, B. "Digital composition." *Instrumentalist* 41 (December 1986): 15-18.

Mallarme, Stephane. *Mallarme: The poems*. Translated by Keith Bosley. New York: Penguin, 1977.

Contains the orignal text, and a translation, of the important graphic-musical poem *Un coup de des*, which itself includes a brief discussion by Mallarme of the poem's relationship to music.

Malouf, Frederick L. "A system for interactive music composition through computer graphics." In *Proceedings of the International Computer Music Conference, 1985*, edited by Barry Truax, 225-232. San Francisco: Computer Music Association, 1985.

Discusses notation in general, contrasting traditional and computer methods. Describes the details of a system which uses line segment graphs to represent music. Cites several "pre-computer-age pioneers" (e.g., Schillinger, Grainger, Stockhausen).

Manniates, Maria Rika. "Musical symbolism." *World of music* 20:3 (1978): 38-55.

Takes up basic theoretical questions related to various kinds of symbol systems associated with music, including notation.

Manning, Peter. "Computers and music composition." *Royal Musical Association proceedings* 107 (1980-1981): 119-131.

Manning, Peter. *Electronic and computer music*. New York: Oxford University Press, 1985.

The section on computer music contains a thorough accounting of work carried on by numerous individuals and organizations.

Marcus, Aaron. "Visual rhetoric in a pictographic-ideographic narrative." In *Semiotics unfolding: Proceedings of the second congress of the*

International Association for Semiotic Studies [1979], edited by Tasso Borbe, v. 3, 1501-1508. New York: Mouton, 1983.

Martin, Richard M. "On the proto-theory of musical structure." In *Perspectives on contemporary music theory*, edited by Benjamin Boretz and Edward T. Cone, 91-96. New York: Norton, 1972.

Martin, Serge. *Le langage musical: Semiotique des systemes*. Paris: Klincksieck, 1978.

Matejka, Ladislav; and Titunik, Irwin; eds. *Semiotics and art: Prague school contributions*. Cambridge, Mass.: MIT Press, 1976.

Mathews, Max V. *The technology of computer music*. Cambridge, Mass.: MIT Press, 1969.

See particularly "A note-generating subroutine and graphic score" (pp. 89-93).

Mathews, Max V.; and Pierce, John R.; eds. *Current directions in computer music research*. Cambridge, Mass.: MIT Press, 1989.

Mathews, Max V.; and Rosler, Lawrence. "Graphical language for the scores of computer-generated sounds." *Perspectives of new music* 6:2 (1968): 92-118. Reprint in *Perspectives on notation and performance*, edited by B. Boretz and E. Cone, 153-180. New York: Norton, 1976.

Mauk, Frederick Henry. "Aspiring to the condition of language: An examination of aesthetic considerations in the application of structural (semiological) principles to musical problems." Ph.D. diss., Harvard University, 1982.

Reviewed by A. A. Schwadron, in *Council for research in music education bulletin* 81 (Winter 1985): 84-87. Mauk discusses Saussure, Chomsky, Blacking, Boiles, Ruwet, Lerdahl/Jackendoff, and Levi-Strauss, and applies their ideas to musicology. (*Dissertation abstracts international* 43:6 (1982) 1741A.)

Maus, Fred E. "Self-depiction in writing about music." Paper presented at the annual meeting of the Society of Music Theory, Oakland, California, November 1990.

Maus sees the text as a surrogate for the author.

McClary, Susan. "The blasphemy of talking politics during Bach year." In *Music and society: The politics of composition, performance and reception*, edited by R. Leppert and S. McClary, 13-62. New York: Cambridge University Press, 1987.

Discusses reception theory and music as social discourse.

McClary, Susan. *Feminine endings: Music, gender, and sexuality*. Minneapolis: University of Minnesota Press, 1990.

A ground-breaking set of essays connecting feminist scholarship with music theory.

McConnaughey, Kevin; McConnaughey, Laura; Mitchell, Chad; and Wood, Chet. *ConcertWare+ and ConcertWare+MIDI: Music software for Macintosh*. Menlo Park, Calif.: Great Wave Software, 1985.

User documentation for a multipurpose computer music application. Contains numerous examples of iconic symbols employed by the program interface.

McCorduck, Pamela. *The universal machine: Confessions of a technological optimist*. New York: McGraw-Hill, 1985.

McCreless, Patrick. "Roland Barthes's *S/Z* from a musical point of view." *In theory only* 10:7 (August 1988): 1-30.

McLean, Barton. "Symbolic extension and its corruption of music." *Perspectives of new music* 20:1-2 (1982-1983): 332-356.

Through a discussion of the works of Marshall McLuhan, Trevor Wishart, and others, McLean addresses the problems abstraction, music notation, and computers cause Western music, and the chances of breaking away from these problems.

McLean, Priscilla. "Fire and ice: A query." In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 148-154. Cranbury, N.J.: Associated University Presses, 1989.

Argues that "imago-abstract" sounds, gestural musical objects with qualities related to both instrumental and concrete electronic sounds (e.g., ululation), carry both a potential for significant meaning and an ability to structure entire works. Sees this as a direct consequence of the development of electronic musical techniques.

McLuhan, Marshall. *Understanding media: The extensions of man.* New York: McGraw-Hill, 1964.

A landmark book in communications theory, this work considers the nature of the relationship between the medium and the message, media as translators, the spoken word compared to the written, and automation and cybernation as aspects of contemporary life.

McLuhan, Marshall; and Fiore, Quentin. *The Medium is the Massage: An inventory of effects.* New York: Bantam, 1967.

A compilation of text and numerous graphics which illustrate the social and psychological ramifications of electronic technology.

Melby, John. "*Computer* music or computer *music*?" In *On the wires of our nerves: The art of electroacoustic music*, edited by Robin Heifetz, 90-96. Cranbury, N.J.: Associated University Presses, 1989.

Metzger, Heinz-Klaus. "Music in the entertained society." *Interface* 12:1-2 (January 1983), 65-73.

Discusses *Concert*, the masterpiece of graphic notation by John Cage.

Meyer, Leonard B. *Emotion and meaning in music.* Chicago: University of Chicago Press, 1956.

An important and often-cited early text on listener psychology and the connections between absolutist and referentialist positions with regard to semantic content in music. See the relatively recent review by Randall Dipert in *In theory only* 6:8 (March 1983): 3-17.

Meyer, Leonard B. *Music, the arts, and ideas.* Chicago: University of Chicago Press, 1967.

This book is relevant to the semiotics of music notation only in that it describes in detail the intellectual climate of work in music during the 1960s, the gestation period for music semiotics, and many developments in graphic and computer music notation.

Meyer, Leonard B. *Explaining music: Essays and explorations.* Berkeley: University of California Press, 1973.

With this book, Meyer updated the work he did in *Emotion and meaning in music*, following a more rigorous methodology.

Meyer, Leonard B. "Exploiting limits: Creation, archetypes, and style change." *Daedalus* 109:2 (Spring 1980): 177-205.

Describes the process by which "secondary parameters" (e.g., dynamic, tempi, expression indicators) became structurally more prominent in music during the nineteenth and twentieth centuries.

Meyer, Leonard B. "Innovation, choice, and the history of music." *Critical inquiry* 9:3 (March 1983): 517-544.

Micznik, Vera. "Gesture as sign: A semiotic interpretation of Berg's op. 6, no. 1." *In theory only* 9:4 (1986): 19-35.

"The goal of this paper is to identify and decode the connotative signs...present in Berg's piece." (p. 22) Along the way Micznik discusses musical examples of signification, denotation, connotation, and codes--concepts central to the work of Barthes and Eco, whom she cites. The unclear denotative nature of early atonal music makes it more accessible through a connotative analysis of musical gestures. Mecznik provides ample musical examples, in full score and in reduction, of this piece from *Drei orchesterstucke*, from 1923.

Minsky, Marvin L. "Computer science and the representation of knowledge." In *The computer age: A twenty-year view*, edited by Michael Dertouzos and Joel Moses, 392-421. Cambridge, Mass.: MIT Press, 1979.

According to this article computers have changed to more dynamic, logically richer machines, thus changing our conceptions of knowledge and intelligence. Minsky discusses logic, paradoxes, self-referentiality, cybernetics, figure and ground, essence, context, meaning, language, formalism, process, and analogies between computers and human communities.

Minsky, Marvin L. "Music, mind, and meaning." *Computer music journal* 5:3 (1981): 28-44.

Minsky, Marvin L. *Music, mind, and brain: The neuropsychology of music.* New York: Plenum, 1982.

Like the article "Music, mind, and meaning," this book discusses syntactic theories of music and Beethoven's Symphony no. 5 in C minor as a "teaching machine."

Molino, Jean. "Fait musical et semiologie de la musique." *Musique en jeu*, no. 17 (January 1975): 37-62.

Molino describes a theory of tripartition similar to Natitiez'.

Mont-Reynaud, Bernard; and Goldstein, Mark. "On finding rhythmic patterns in musical lines." In *Proceedings of the International Computer Music Conference, 1985*, edited by Barry Truax, 391-397. San Francisco: Computer Music Association, 1985.

Discussion of the perception of monophonic patterns and their notation.

Moore, F. Richard. *Programming in C with a bit of UNIX*. Englelwood Cliffs, N.J.: Prentice-Hall, 1985.

Moore, F. Richard. "Applications for an integrated computer music workstation." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 381-386. San Francisco: Computer Music Association, 1986.

Contains a schematization of the main subtasks of musical processes, and a definition of music productions, or structures, such as representations of musical abstractions, algorithmic generation and modification of musical structures, and methods of displaying data.

Moore, F. Richard. "The dysfunctions of MIDI." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 256-263. San Francisco: Computer Music Association, 1987.

Argues that MIDI has become the "de facto standard for the digital representation of musical events." Discusses dysfunctions in performance capture, representation of control processes, and synthesizer control.

Morehen, John. "Computer-assisted musical analysis: A question of validity." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 337-339. San Francisco: Computer Music Association, 1986.

Takes up the question of which features of a composition are to be included in a computer representation for analysis.

Morin, Elizabeth. *Essai de stylistique comparee: Les variations de William Byrd et John Tomkins sur "John come kiss me now"*. Semiologie et analyse musicales. Montreal: Universite de Montreal, 1979.

"The author analyzes characteristics of identical, analogous, or transformed units, segmented according to the semiological principle of paradigmatic classification; the syntagmatic continuity of these units and their melodic movement; and their syntagmatic action within each variation." (*RILM* 13:1 (1979): 100.)

Morris, Charles. "Foundations of the theory of signs." In *International encyclopedia of unified science*, vol. 1, no. 2. Chicago: University of Chicago press, 1938.

Morris, Charles. *Signs, language and behavior*. New York: Prentice-Hall, 1946.

Morris, Charles. *Signification and significance*. Cambridge, Mass.: MIT Press, 1964.

Morris, Charles. *Writings on the general theory of signs*. The Hague: Mouton, 1971.

Morthenson, Jan W. "The concept of 'meaning' in electronic music." In *ICEM Conference on Electro-Acoustic Music [1985]: Proceedings*, edited by Bo Rydberg, 35-48. Stockholm: Royal Swedish Academy of Music, 1988.

Morthenson, Jan W. "Aesthetic dilemmas in electronic music." In *On the wires of our nerves: The art of* *electroacoustic music*, edited by Robin Heifetz, 57-68. Cranbury, N.J.: Associated University Presses, 1989.

Mowitt, John. "The sound of music in the era of its electronic reproducibility." In *Music and society: The politics of composition, performance and reception*, edited by R. Leppert and S. McClary, 173-197. New York: Cambridge University Press, 1987.

Muller, Giovanni. "High quality music notation: Interactive editing and input by piano keyboard." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 333-340. San Francisco: Computer Music Association, 1987.

Mulvaney, Becky Michelle. "Rhythms of resistance: On rhetoric and reggae music." Ph.D. diss., University of Iowa, 1985.

Using "an audience-centered, interpretive, ethnographic approach to the analysis of music," Mulvaney observes "the uses to which audiences put popular music forms. The study also employs a semiotic vocabulary, thereby allowing [her] to examine nonlinguistic signs in popular music." (*Dissertation abstracts international* 46:4 (1986): 2856A.)

Murray, Michael, ed. *Heidegger and modern philosophy*. New Haven: Yale University Press, 1978.

Myers, Robert. "There are right reasons and wrong reasons for studying rock." *Chronicle of higher education* 36:21 (February 14, 1990): B2.

Myhill, John. "Controlled indeterminacy: A first step towards a semi-stochastic music language." *Computer music journal* 3:1 (1979): 12-14.

Nadin, Mihai. "Interface design: A semiotic paradigm." *Semiotica* 69:3/4 (1988): 269-302.

Narmour, Eugene. *Beyond Schenkerism: The need for alternatives*. Chicago: University of Chicago Press, 1977.

Taking the perspective of implication-realization theory on Shenkerian analysis, Narmour finds this form of analysis lacking. He addresses many of the essential philosophical questions germane to such work. There are numerous musical examples. See the critique by A. Keiler listed above.

Narmour, Eugene. "Toward an analytic symbology: The melodic, harmonic and durational functions of implication and realization." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 83-114. Florence: Olshki, 1984.

Nattiez, Jean-Jacques. "Trois modeles linguistiques pour l'analyse musicale." *Musique en jeu*, no. 10 (March 1973): 3-11.

Nattiez, Jean-Jacques. "Bibliographie de semiologie musicale." *Musique en jeu*, no. 10 (March 1973): 12-20.

Nattiez, Jean-Jacques. "Rencontre avec Levi-Strauss: Plaisir et structure." *Musique en jeu*, no. 12 (October 1973): 3-10.

Nattiez briefly discusses Levi-Strauss' relevance to music and asks him a few questions about myths and intuition. Several long quotations from Levi-Strauss' work are given, including "Fugue musicale, fugue mythologique," from *L'homme nu*.

Nattiez, Jean-Jacques. "Semiologie et semiographie musicales." *Musique en jeu*, no. 13 (November 1973): 78-86.

Nattiez, Jean-Jacques. "Semiologie musicale: L'etat de la question." *Acta musicologica* 46:2 (1974): 153-171.

Nattiez, Jean-Jacques. "De la semiologie a la semantique musicales." *Musique en jeu*, no. 17 (January 1975): 3-10.

Nattiez, Jean-Jacques. "Les rencontres de semiologie musicale en 1973-1974." *Musique en jeu*, no. 17 (January 1975): 131-133.

Nattiez discusses the following conferences: a) The First International Congress of Musical Semiotics, in Belgrade; b) "New methods in the analysis of music," a session at the congress of the Society for Ethnomusicology, at Urbana; c) "Linguistic methods in musical analysis," at the congress of the American Musicological Society, in Chicago; d) The International Symposium on Musical Semiotics, in Rome; e) Music sessions at the first congress of the

International Association of Semiotics, in Milan; f) Semiotic communications from the conference of the International Society of Musicology, in Zagreb.

Nattiez, Jean-Jacques. *Fondements d'une semiologie de la musique*. Paris: Union Generale d'Editions, 1975.

Nattiez is probably the leading contributor to the field of semiotics of music, and this book is his most important. He begins by comparing musical semiology (i.e., semiotics of music) with other areas of semiotics and with other disciplines. He addresses the work of previous theorists in music as well. Then he undertakes an extended discussion of the relationship between music and language. He illustrates his theory about the levels of signification in music with numerous examples drawn from the works of Debussy, Brahms, and others. There is an extensive bibliography. The French seems particularly easy for an English speaker to understand. This book is reviewed by Otto Laske and by Jonathan Dunsby, in *Perspectives of new music* 15:2 (1977): 220-233, and is the object of much discussion and debate among various theorists and composers. Revisions and a partial translation are listed below under *Musicologie generale et semiologie* (Paris: Bourgois, 1987).

Nattiez, Jean-Jacques. "From taxonomic analysis to stylistic characterization: Debussy's *Syrinx*." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 83-110. Pesaro: Centro di Iniziativa Culturale, 1975.

Nattiez, Jean-Jacques. "The contribution of musical semiotics to the semiotic discussion in general." In *A profusion of signs*, edited by Thomas Sebeok, 121-142. North American Semiotics Collegium, University of South Florida, 1975. Bloomington: Indiana University Press, 1977.

Nattiez, Jean-Jacques. "De l'ontologie musicale a la pratique de la musique." *Musique en jeu*, no. 29 (1977): 34-45.

In reviewing five recent books, Nattiez discusses several topics relevant to the semiotics of music, including the individual experience of music, the essence of music, metamusical discourse, and the future of music. The books he discusses are: *L'homme musical*, by Jean-Etienne Marie; *Musique et* *education, essai d'analyse phenomenologique et des fondements de sa pedagogie*, by Guy Maneveau; *Le musical, essai sur les fondements anthropologiques de l'art*, by Raymond Court; *Introduzione alla semiotica della musica*, by Gino Stefani; and *Les musiques electro-acoustiques*, by Michel Chion and Guy Reibel.

Nattiez, Jean-Jacques. "Le Solo de cor anglais de Tristan: Une analyse et quelques problemes." *Degres: Revue de synthese a orientation semiologique* 18 (1979): 1-24.

Nattiez, Jean-Jacques. "Paroles d'informateurs et propos de musiciens: Quelques remarques sur la place du discours dans la connaissance de la musique." *Traditional music yearbook* 13 (1981): 48-59.

Nattiez, Jean-Jacques. "Varese's *Density 21.5*: A study in semiological analysis." Translated by Anna Barry. *Music analysis* 1:3 (1982): 243-340.

Contains a long, bar-by-bar analysis with many charts and diagrams, followed by a poietic analysis, and an esthetic analysis. There are a clear introduction, and a summary comparison of analyses at the end, as well as a fairly long list of references. See the response by J. W. Bernard above.

Nattiez, Jean-Jacques. "The concept of plot and seriation process in music analysis." Translated by Catherine Dale. *Music analysis* 4:1-2 (1985): 107-118.

Nattiez, Jean-Jacques. *Musicologie generale et semiologie*. Paris: Bourgois, 1987.

The first volume of a revision by Nattiez of his chief work *Fondements d'une semiologie de la musique*. A second volume is forthcoming; it will be titled *Analyse musicale et semiologie*. A translation of most of the first volume has been published--see *Music and discourse* below.

Nattiez, Jean-Jacques. *De la semiologie a la musique*. Montreal: Universite du Quebec a Montreal, 1988.

A collection of earlier works in the original versions and in revisions together with some new articles. Part of this was translated in 1989 into English in "Reflections on the development of semiology in music" (see below).

Nattiez, Jean-Jacques. "Reflections on the development of semiology in music." Translated by Katharine Ellis. *Music analysis* 8:1-2 (1989): 21-75.

Like a well-developed bibliographic essay, this article describes the main orientations of semiology and assesses its activities and effectiveness, while citing hundreds of writers and works. It is the clearest examination of the field presently available in a work of its size.

Nattiez, Jean-Jacques. *Music and discourse: Toward a semiology of music*. Translated by Carolyn Abbate. Princeton: Princeton University Press, 1990.

A translation, with some changes, of Nattiez' *Musicologie generale et semiologie*.

Nattiez, Jean-Jacques; and Hirbour-Paquette, Louise. "Analyse musicale et semiologie: Le prelude de *Peleas*." *Musique en jeu*, no. 10 (March 1973): 42-69.

Naud, Gilles. "Apercus d'une analyse semiologique de *Nomos Alpha*." *Musique en jeu*, no. 17 (1975): 63-72.

Neisser, Ulrich. *Cognition and reality*. San Francisco: Freeman, 1976.

A major work in cognitive psychology.

Nestrovski, Arthur. "Music theory, Saussure, *theoria*." *In theory only* 10:6 (May 1988): 7-14.

Norris, Christopher. *Derrida*. Cambridge. Mass.: Harvard University Press, 1987.

Norris, Christopher, ed. *Music and the politics of culture*. New York: St. Martin, 1989.

A collection of thirteen essays including several by British philosophers and literary theorists who apply ideas by Adorno, Heidegger, and Derrida to music. In general, these essays exemplify an approach to music which is more willing to engage social and political questions than is traditional musicology.

North, Roger. *Roger North's "The musical grammarian 1728"*. Edited by Mary Chan and Jamie Kassler. New York: Cambridge University Press, 1990.

This old treatise, newly edited, considers how music should be written and how it should sound, as well as questions of invention, communication, and history. There are two introductions.

Noske, Fritz. *The signifier and the signified.* The Hague: Nijhoff, 1977.

Noske's discussion of the "musico-dramatic sign" is, according to Dunsby, an example of a liberal conception of the sign, and may threaten the possibility of a practical methodology.

Nyman, Michael. *Experimental music: Cage and beyond.* New York: Schirmer, 1974.

Ogden, Charles K.; and Richards, Ivor A. *Meaning of meaning: A study of the influence of language upon thought and of the science of symbolism.* 4th ed. New York: Harcourt Brace, 1936.

Describes 16 kinds of meaning.

Oliva, Joseph. "Structure of music and structure of language: A semiotic study." Ph.D. diss., State University of New York, Buffalo, 1977.

"The question this study seeks to answer is: What is a semiotics of music, and how does it differ not only from what conventional musicologists do but also from what linguists do?...The approach taken in this study is that of 'functional empiricism' inspired by the work of Paul L Garvin, and applied here to a description of musical structure." (*Dissertation abstracts international* 38:7 (1977): 4138A.) Oliva also discusses the work of Saussure, Peirce, Sebeok, and the gestalt psychologists Buhler and Ehrenfels.

Oppenheim, David V. "The need for essential improvements in the machine-composer interface used for the composition of electroacoustic computer music." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 443-445. San Francisco: Computer Music Association, 1986.

Orlando, Francesco. "Propositions pour une semantique du leitmotiv dans *l'Anneau des Niebelungen.*" *Musique en jeu*, no. 17 (January 1975): 73-86.

Orlov, Henry. "Toward a semiotics of music." In *The sign in music and literature*, edited by Wendy Steiner, 131-137. Austin: University of Texas Press, 1981.

"Here Henry Orlov discards the notion of music as a secondary modeling system based on language. Instead, he argues that musical semiotics should proceed from only the primary reality of the text--music as sound. By this statement he means performed sound, for each single tone, unlike each word in speech, 'is contemplated and experienced by the listener as an inimitable multidimensional object, a piece of reality itself alive and rich with all sorts of meaning.' This very richness is what makes music a promising subject of semiotic study according to Orlov." (Steiner, p. 7)

Ornstein, Robert Evans. *The psychology of consciousness*. 2nd. ed. New York: Harcourt Brace Jovanovich, 1977.

Contains Ornstein's theory contrasting the intuitive functions of the right hemisphere of the brain with the rational functions of the left. There may be some connections to be made concerning iconic and symbolic types of notation.

Osgood, Charles E; Suci, George J.; and Tannenbaum, Percy H. *The measurement of meaning*. Urbana: University of Illinois Press, 1957.

The theory of semantic differentiation.

Osmond-Smith, David. "Formal iconism in music." *Versus* [*VS*] 15:5 (1973): 43-53.

Osmond-Smith, David. "Iconic relations within formal transformation." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 45-55. Pesaro: Centro di Iniziativa Culturale, 1975.

See particluarly his discussion of modes of codification.

Osmond-Smith, David. "The semantics of pluralism: A study of connotations of origin and use in music." *Versus* [*VS*] 13:1 (1976): 5-10.

Takes up hermeneutic questions concerning how listeners' responses are determined by history, and geoculture, as well as by factors such as ordinariness or strangeness.

Page, E. S.; and Wilson, L. B. *Information representation and manipulation in a computer*. 2nd ed. New York: Cambridge University Press, 1978.

Contains sections on symbols, codes, storage, arrays, lists, trees, searching, and sorting.

Palmer, F. R. *Semantics*. 2nd ed. New York: Cambridge University Press, 1981.

Paturzo, Bonaventura Antony. *Making music with microprocessors*. Blue Ridge Summit, Penn.: Tab, 1984.

Peirce, Charles Sanders. *Collected papers of Charles Sanders Peirce*. 8 vols. Edited by Charles Hartshorne, Paul Weiss and Arthur W. Burks. Cambridge, Mass.: Harvard University Press, 1931-1958.

Peirce, Charles Sanders. *Philosophical writings of Peirce*. Edited by Justus Buchler. New York: Dover, 1955.

Pennycook, Bruce W. "Music languages and preprocessors: A tutorial." In *Proceedings of the Rochester 1983 International Computer Music Conference,* 274-297. [San Francisco: Computer Music Association], n.d.

A thorough survey of the topic. Defines "music language," recounts a history of synthesis languages, and discusses work by Hiller, Koenig, Xenakis, Truax, Smith, Buxton, and others.

Pennycook, Bruce W. "Language and resources: A new paradox." In *Language of electroacoustic music*, edited by Simon Emmerson, 119-137. New York: Hardwood Academic, 1986.

Takes up questions in the sociology, politics, and pedagogy of computer music, particularly the question of access to new technologies.

Penzias, Arno. *Ideas and information: Managing in a high-tech world*. New York: Norton, 1989.

Contains sections on information processing, symbols (numbers, words, pictures), rules, technology, and intelligence.

Percival, W. Keith. "Ferdinand de Saussure and the history of semiotics." In *Semiotic themes*, edited by Richard T. DeGeorge, 1-32. Lawrence: University of Kansas Publications, 1981.

Perloff, Marjorie. "Music for words perhaps: Reading/hearing/seeing John Cage's 'Roaratorio'." *Genre* 20:3/4 (Fall-Winter 1987): 427-462.

Peterson, Tracy Lind. "Interactive digital composition." In *Proceedings of the 1978 International Computer Music Conference*, compiled by Curtis Roads, 167-174. Menlo Park, Calif.: Computer Music Journal, 1979.

Piaget, Jean. *Le structuralisme*. Paris: Presses universitaires de France, 1968. Translated by Chaninah Maschler. London: Routledge & Keggan Paul, 1971.

"One of the central texts, valuable for its 'definitions' (chapter I) and for its discussion of structuralism in the field of mathematics, logic, biology, psychology, linguistics, philosophy, and the social sciences. Fairly advanced." (Terence Hawkes, *Structuralism and semiotics*, 162.)

Pickover, Clifford A. "Representation of melody patterns using topographic spectral distribution functions." *Computer music journal* 10:3 (Fall 1986): 72-8.

Describes the analytical use of three-dimensional power spectra, computed from coded versions of melody notations. Contains some striking graphic examples.

Plenckers, Leo. "A pattern recognition system in the study of the *Cantigas de Sant Maria*." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 59-70. Florence: Olshki, 1984.

Polansky, Larry; and Rosenboom, David. "HMSL (Hierarchical Music Specification Language): A real-time environment for formal, perceptual, and compositional experimentation." In *Proceedings of the International Computer Music Conference, 1985*, edited by Barry Truax, 243-250. San Francisco: Computer Music Association, 1985.

Describes a "real-time, non-stylistically based music ...language for the creation and execution of hierarchical morphologies," a language which draws many of its ideas from perception and cognition theory.

Polansky, Larry; Rosenboom, David; and Burk, Phil. "HMSL: Overview (Version 3.1) and notes on intelligent instrument design." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 220-227. San Francisco: Computer Music Association, 1987.

Polednak, Ivan. "Musical semiotics: A report from Prague." *In theory only* 11:6 (September 1990): 1-14.

Contains brief sections on historical background, the sign, semantics, syntax, and pragmatics.

Pope, Stephen Travis. "Music notations and the representation of musical structure and knowledge." *Perspectives of new music* 24:2 (1986): 156-89.

Pope, Stephen Travis. "The development of an intelligent composer's assistant: Interactive graphics tools and knowledge representation for music (or: Thoughts about music input languages: Several generations of MILs and orchestra/score editors). In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 131-144. San Francisco: Computer Music Association, 1986.

Poster, Mark. *Mode of information: Poststructuralism and social context.* Chicago: University of Chicago Press, 1990.

Contains sections on Foucault and databases, Derrida and electronic writing, and Lyotard and computer science.

Potter, Charles E.; and Teaney, Dale. "Sonic transliteration applied to descriptive music notation." In *Proceedings of the 1980 International Computer Music Conference*, compiled by Hubert S. Howe, Jr., 138-144. San Francisco: Computer Music Association, 1980.

Describes the use of audio spectroscopy and sonographic photography to produce a "soundscore" for use in performance and analysis. Contains examples, including an excerpt from E. Varese's *Poeme electronique*.

Pousseur, Henri. "The question of order in new music." In *Perspectives on contemporary music theory*, edited by Benjamin Boretz and Edward T. Cone, 97-115. New York: Norton, 1972.

Pousseur, Henri. *Musique, semantique, societe.* Paris: Casterman, 1972.

Reviewed by P. Torrens, in *Musique en jeu*, no. 10 (March 1973).

Poyatos, Fernando. "Silence and stillness: Toward a new status of non-activity." *Kodikas/code 3:1 (1981): 3-26.*

Discusses the semiotics of silence, its coding and functions.

Pressing, Jeff. "Cybernetic issues in interactive performance systems." *Computer music journal* 14:1 (Spring 1990): 12-25.

Price, Kingsley, ed. *On criticizing music: Five philosophical perspectives.* Baltimore: Johns Hopkins University Press, 1981.

Contains the essay by Rose Subotnik on the semiotic universe (see below), along with essays by four other theorists all of whom call for a broadening of the understanding of music, beyond analysis, to include meaning and reference. Reviewed by Gary Iseminger in *Journal of aesthetics and art criticism* 41:2 (Winter 1982): 219-221.

Prusinkiewicz, Przemyslaw. "Time management in interactive score editing." In *Proceedings of the International Computer Music Conference, 1984*, edited by William Buxton, 275-280. San Francisco: Computer Music Association, 1985.

Contains a discussion of how the choice of a particular notation system affects visual feedback in interactive score editing.

Prusinkiewicz, Przemyslaw. "Graphics interfaces for MIDI-equipped synthesizers." In *Proceedings of the International Computer Music Conference, 1985*, edited by Barry Truax, 319-324. San Francisco: Computer Music Association, 1985.

Discusses the use of pictures of items such as faces, trees, or castles to represent multivariate data.

Prusinkiewicz, Przemyslaw. "Score generation with L-systems." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 455-457. San Francisco: Computer Music Association, 1986.

Describes an algorithmic system for generating strings of symbols which can then be interpreted as a sequence of notes.

Quine, Willard Van Orman. *From a logical piont of view.* Cambridge, Mass.: Harvard University Press, 1953.

During a discussion of representation in his book *Languages of art*, Nelson Goodman notes that "Quine had sharpened the distinction between syncategorematic and other expressions, and had shown that careful observance of this distinction could dispel many philosophical problems." (p. 22)

Quine, Willard Van Orman. *Word and object.* Cambridge, Mass.: MIT Press, 1960.

"Language is a social art." Our understanding of linguistic meaning must take place in terms of our disposition "to repond overtly to socially observable stimulations." (p. ix) From this point of view, Quine undertakes a deliberation of the indeterminacy of translation, the semantics of reference, syntax, the nature of truth and being, identity, abstraction, the concrete and the universal, ambiguity, opacity, intention, and nominalism and realism (i.e., Platonism).

Quine, Willard Van Orman. *The roots of reference.* La Salle, Ill.: Open Court, 1974.

Rabinow, Paul. ed. *Foucault reader.* New York: Pantheon Books, 1984.

Contains excerpts from several articles and books by Michel Foucault, including *Order of things*, *History of sexuality*, *Madness and civilization*, and *Discipline and punish.*

Radier, J. C.; Deforeit, Charles; and Provost, D. "A user friendly synthesizer by means of a touch input with LCD graphic display." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 99-100. San Francisco: Computer Music Association, 1986.

Rahn, John. "On some computational models of music theory." *Computer music journal* 4:2 (1980): 66-72.

Discusses various models of computer music theory, including those of Rothgeb, Smoliar, and Meehan.

Ralston, Anthony; and Meek, Chester L.; eds. *Encyclopedia of computer science*. New York: Mason/Charter, 1976. 2nd ed. Published as *Encyclopedia of computer science and engineering*, edited by Ralston and Edwin D. Reilly, Jr. New York: Van Nostrand Reinhold, 1983.

Contains useful articles on programming languages, programming linguistics, grammars, instructions, models, algorithms, various processes, codes, and music applications. There is a convenient classification of articles at the beginning of the book.

Rastall, Richard. *The notation of Western music*. London: Dent, 1983.

A thorough historical study. Reviewed in *Musical times* 126 (August 1985): 464; and in *Consort* 42 (1986): 51-52.

Read, Gardner. "Some problems of rhythmic notation." *Journal of music theory* 9:1 (1965): 153-162.

Read, Gardner. "Self-indulgent notational aberrations." *World of music* 14:4 (1972): 36-49.

Read, Gardner. *Music notation: A manual of modern practice*. 2nd. ed. New York: Crescendo, 1969; Taplinger, 1979.

The most useful and thorough of the many texts about how to use traditional notation. Precise, and well-organized.

Read, Gardner. *Modern rhythmic notation*. Bloomington: Indiana University Press, 1978.

Reviewed in *Music review* 43:1 (1982): 72-75.

Read, Gardner. *Source book of proposed music notation reforms*. Music reference collection, 11. New York: Greenwood, 1987.

Includes descriptions of hundreds of proposals from the past three centuries, with the author's commentaries. There are sixty pages of comparative tables in an appendix, as well as a bibliography and index.

Reynolds, Roger. *Mind models: New forms of musical experience*. New York: Praeger, 1975.

Contains a chapter on notation and a section on computers and music.

Reynolds, Roger. "Thoughts on sound movement and meaning." *Perspective of new music* 16:2 (Spring-Summer 1978): 181-190.

Reynolds, Roger. *A searcher's path: A composer's ways*. I.S.A.M. Monographs, 25. New York: Brooklyn College, City University of New York, 1987.

Describes the process of composition, taking up questions of materials, methods, tactics, and the similarity of the composer's work to that of the performer.

Ricoeur, Paul. *Time and narrative. Vols. 1 and 2 translated by Kathleen McLaughlin and David Pellauer; vol. 3 translated by Kathleen Blamey and David Pellauer*. Chicago: University of Chicago Press, 1984, 1985, 1988.

Risatti, Howard. *New music vocabulary: A guide to notational signs for comtemporary music*. Urbana: University of Illinois Press, 1975.

A large collection of symbols, but a little difficult to use, and with almost no theory.

Roads, Curtis. "Grammars as representations for music." *Computer music journal* 3:1 (1979): 48-55.

Roads starts by discussing iconic, symbolic, and score representations, and goes on to consider several grammar types and how they have been applied to music by such researchers as Ruwet, Nattiez, Laske, Smoliar, Moorer, Winograd, Lerdahl/Jackendoff, and others. This article was revised and enlarged in *Foundations of computer music*, edited by Curtis Roads and John Strawn, 403-442 (Cambridge, Mass.: MIT Press, 1985). The latter version takes up several problems of grammar representations including hierarchy, ambiguity, context, syntax/semantics, and constraints. The bibliography is excellent.

Roads, Curtis. "Composing Grammars." In *Proceedings of the 1977 International Computer Music Conference*, compiled by Curtis Roads, 54-135. San Francisco: Computer Music Association, 1980.

Apparently a seed article for much to follow, this long essay covers a great deal of ground. Includes discussions of various types of grammars, a few specific theorists such as Nattiez, and notation systems. Goes on to propose a meta-language for composing grammars, incorporating many programming examples. Contains a section on structural semantics which covers semiotic tripartition, cognitive musicology, and paradigmatic/syntagmatic semantics. Closes with a consideration of lexical mapping and sonology.

Roads, Curtis. "An overview of music representations." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 7-38. Florence: Olshki, 1984.

Considers precomputer formalisms such as predicate calculus, set theory, and modal logic, as well as semiotics, computer encoding (Music V, etc.), stochastic processes, systems theory, grammars, AI representations, and distributed intelligence (or "society theory").

Roads, Curtis, ed. *Composers and the computer.* Computer music and digital audio. Los Altos, Calif.: Kaufmann, 1985.

Contains interviews with Herbert Brun, John Chowning, James Dashow, and George Lewis, and articles by Charles Dodge, Tod Machover, Jean-Claude Risset, Iannis Xenakis, and Roads.

Roads, Curtis, ed. "Symposium on computer music composition." *Computer music journal* 10:1 (Spring 1986): 40-63.

Fourteen computer musicians answer questions put to them by Roads. Sheds a good deal of light on the processes, problems, and limitations of computer music. Contains some interesting graphic examples.

Roads, Curtis, ed. *The music machine: Selected readings from "Computer music journal"*. Cambridge, Mass.: MIT Press, 1989.

Roads, Curtis; Strawn, John, eds. *Foundations of computer music*. Cambridge, Mass.: MIT Press, 1985.

Contains thirty-six of the most important articles in the field, covering hardware, software, synthesis techniques, perception, and signal processing.

Roberts, Don L. *Musical manuscripts*. New York: Drawing Center, 1979. Exhibition catalog.

Contains a brief discussion and lists approximately 150 graphic music notation works shown in this exhibition.

Robinson, Jenefer. "Discussion: Representation in music and painting." *Philosophy* 56:217 (July 1981): 408-413.

Rodet, Xavier; Barriere, Jean-Baptiste; Cointe, Pierre; and Potard, Yves. "The CHANT Project: Modelization and production, an environment for composers including the FORMES language for describing and controlling sound and musical processes." In *Proceedings of the Venice 1982 International Computer Music Conference,* compiled by Thomas Blum and John Strawn, 398-408. San Francisco: Computer Music Association, 1983.

Contains a thorough discussion of models, as well as some humorous examples of music representation.

Rolnick, Neil B. "A performance literature for computer music: Some problems from personal experience." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, 29-34. San Francisco: Computer Music Association, 1986.

Examines problems associated with using computer systems as generic musical instruments capable of performing works originally conceived for other computer systems; that is, problems of portability and preservation which are also functions of notation. Describes the use of MIDI to address the problems.

Ross, Stephen David, ed. *Art and its significance: An anthology of aesthetic theory*. 2nd. ed. Albany: State University of New York, 1987.

Ross, Ted. *The art of music engraving and processing*. New York: Hansen, 1970.

The most detailed and complete manual and reference book on the subject. Describes the field before computers significantly changed the process.

Rotman, Brian. *Signifying nothing: The semiotics of zero.* London: Macmillan, 1987.

Rousseau, Jean-Jacques. *Project concerning new symbols for music.* Translated by Bernarr Rainbow. Kilkenny, Ireland: Boethius, 1982.

A translation of the book first published in French in 1742, putting forth Rousseau's codification of cipher notation which never became successful. The introduction by Rainbow is interesting and informative. The book is useful in conveying a sense of how notation was regarded in earlier times.

Runeson, Sverker. "On the possibility of 'smart' perceptual mechanisms." *Scandinavian journal of psychology* 18 (1977): 172-179.

Contrasts smart machines, which comprise few but specialized components designed for specific tasks, with rote machines, consisting of many components "each of which performs a rather simple task." Models perception on smart machines. Discusses the phenomenological question of the difference between perception and cognition.

Ruwet, Nicolas. *Langage, musique, poesie.* Paris: Editions du Seuil, 1972.

Sections of this book include the following: "Contradictions du langage seriel," "Fonction de la parole dans la musique vocale," "Note sur les duplications dans l'oeuvre de Claude Debussy," "Methodes d'analyse en musicologie," and "Quelque remarques sur le role de la repetition dans la syntaxe musicale."

Ruwet, Nicolas. *An introduction to generative grammar.* Translated by Norval S. H. Smith. Amsterdam: North-Holland, 1973.

Ruwet, Nicolas. "Theorie et methodes dans les etudes musicales: Quelques remarques retrospectives et preliminaires." *Musique en jeu*, no. 17 (January 1975): 11-36.

Ruwet, Nicolas. "Methods of analysis in musicology." *Music analysis* 6:1-2 (March-July 1987): 11-36. Translated by Mark Everist. A translation of "Methodes d'analyse en musicologie." *Review Belge de musicologie* 20 (1966): 65-90.

Rydberg, Bo, ed. *ICEM Conference on Electro-Acoustic Music [1985]: Proceedings*. Stockholm: Royal Swedish Academy of Music, 1988.

From a meeting of the International Confederation of Electro-Acoustic Music in Sweden, this collection contains five articles on various aspects of the field.

Sabbe, Herman; Stone, Kurt; and Warfield, Gerald; eds. *International Conference on New Musical Notation report*. Amsterdam: Swets & Zeitlinger, 1975.

An important summation of the work achieved at this conference in Ghent in 1974, with a codification of notational instruments culled from new music and an explanation of the system used to register new devices.

Salomaa, A. *Formal languages*. New York: Academic, 1973.

Samuels, Robert. "Derrida and Snarrenberg." *In theory only* 11:1-2 (1989): 45-58.

Discusses the article "The play of *differance*," by Robert Snarrenberg (see below).

Santoiemma, M. "Formal representation of basic blocks for sound synthesis." In *Proceedings of the Venice 1982 International Computer Music Conference,* compiled by Thomas Blum and John Strawn, 297-307 & 297a-306a. San Francisco: Computer Music Association, 1983.

Suggestions for standard graphic representations of computer functions such as input and output, table look-up, feedback, if-then-else, oscillator, envelope, etc.

Satie, Erik. *Twenty short pieces for piano: Sports et divertissements*. New York: Dover, 1982.

Saussure, Ferdinand de. *Course in general linguistics*. Edited by Charles Bally and Albert Sechehaye, translated by Wade Baskin. New York: Philosophical Library, 1959.

This is a compilation of notes, first published in French in 1916, from Saussure's class.

Scaletti, Carla. "Kyma: An object-oriented language for music composition." In *Proceedings of the 1987 International Computer Music Conference,* compiled by James Beauchamp, 49-56. San Francisco: Computer Music Association, 1987.

Scalvini, Maria Luisa. "Code/system: Some hypotheses for architecture." In *Semiotics unfolding: Proceedings of the second congress of the International Association for Semiotic Studies [1979]*, edited by Tasso Borbe, v. 3, 1361-67. New York: Mouton, 1983.

Scherpenisse, J. "Digital control in electronic music studios." *Interface 6:2 (September 1977): 73-79.*

Contrasts manual, voltage, and computer controls of the musical process. Includes some clear diagrams.

Schiffer, Brigitte. "Thoughts and reflections on musical communication." *Composer* (London) 64 (Summer 1978): 9-12.

Schillinger, Joseph. *The Schillinger system of musical composition*. New York: Fischer, 1941.

A massive two volume work. See particularly the discussion of notation (pp. 236-246), the use of organic forms in melody (pp. 329-352), and the theory of semantic composition.

Schmidt, Brian L. "A natural language system for music." *Computer music journal* 11:2 (Summer 1987): 25-34.

Schmidt, Hans-Christian. "Possibilities of translation of music in film." Paper presented at the Center for Music Experiment, University of California, San Diego, March 1989.

Schmitt, Natalie C. "John Cage, nature, and theater." In *John Cage reader: In celebration of his seventieth birthday*, edited by Peter Gena, Jonathan Brent, and Don Gillespie, 17-37. New York: Peters, 1982.

Schottstaedt, Bill. "Pla: A composer's idea of a language." *Computer music journal* 7:1 (Spring 1983): 11-20.

Discusses the limitations inherent in some musical data entry systems, and proposes Pla as a solution. Contains some analysis of common music notation in terms usually applied to computer languages.

Schueller, Herbert M. "Correspondences between music and the sister arts, according to 18th century aesthetic theory." *Journal of aesthetics and art criticism* 11:4 (June 1953): 334-359.

Schulze-Andresen, Walter. "The three-dimensional music stave." *Die Reihe* (English) 8 (1968): 25-34.

Schwede, Gary W. "A fuzzy hierarchical systems model for real-time visual interpretation in musical experiences." In *Proceedings of the 1977 International Computer Music Conference*, compiled by Curtis Roads, 136-168. San Francisco: Computer Music Association, 1980.

This long and complicated article investigates the synaesthetic relationship of light and music, proposing a hierarchical model for describing musical structures and properties in colors and for programming a videosynthesizer. There are numerous diagrams. The quantitative consideration of qualities such as intensity and warmth, in terms of both image and music, is informative.

Scruton, Roger. "Representations in music." *Philosophy* 51:197 (July 1976): 273-288.

Sebeok, Thomas Albert. "Prefigurements of art." In *Semiotic themes*, edited by Richard T. DeGeorge, 179-224. Lawrence: University of Kansas Publications, 1981.

Sebeok, Thomas Albert, ed. *Style and language*. Conference on Style, Indiana University, 1958. Cambridge, Mass.: MIT Press, 1960.

Sebeok, Thomas Albert, ed. *The tell-tale sign: A survey of semiotics*. Lisse: Peter de Ridder, 1975.

Contains essays by Kristeva, Todorov, Eco and others.

Sebeok, Thomas Albert, ed. *A profusion of signs*. North American Semiotics Collegium, University of South Florida, 1975. Bloomington: Indiana University Press, 1977.

Sebeok, Thomas Albert; and Umiker-Sebeok, Jean; eds. *The semiotic web 1986*. Berlin: Mouton de Gruyter, 1987.

Sedgwick, Eve Kosofsky. *Epistemology of the closet*. Berkeley: University of California Press, 1990.

Discusses the worldmaking power of the homo/hetero-sexual binarism as it effects other binarisms (dicho-tomies), including some germane to notation (e.g., artificial/natural, input/output, etc.). See particularly the defense of interdisciplinary theore-tical studies. Analyzes several literary works.

Seeger, Charles. "Prescriptive and descriptive music wri-ting." *Musical quarterly* 44:2 (April 1958): 184-195.

Discusses the differences between subjective and objective representations of music, the symbolic and linear nature of music notation, and the dangers in-herent in current visual renderings of music. He proposes as a solution the use of graphs along with the usual notation, and he illustrates his ideas by discussing the tonal and rhythmic functions in music.

Seeger, Charles. "Tractatus esthetico-semioticus." In *Current thought in musicology*. Austin: University of Texas Press, 1976.

Seeger, Charles. *Studies in musicology 1935-1975*. Berkeley: University of California Press, 1977.

Along with other essays about musicology, the sociology of music, musical process and function, synchronic and diachronic orientations, music as concept, percept, fact, and value, this book contains the often-cited article, "Prescriptive and descriptive music writing."

Selfridge-Field, Eleanor. "Reflections on technology and musicology." *Acta musicologica* (1990), in press.

Sessions, Roger. *The musical experience of composer, performer, listener*. Princeton: Princeton University Press, 1950.

A mid-century perspective on a common musical model.

Shepherd, John. *Whose music? A sociology of musical languages*. London: Latimer, 1977.

Silber, John. "Music of no memory." Class hand-out; Music 206, University of California, San Diego, 1986.

Silverman, Kaja. *The subject of semiotics.* New York: Oxford University Press, 1983.

Skidmore, Arthur. "Peirce and semiotics: An introduction to Peirce's theory of signs." In *Semiotic themes*, edited by Richard T. DeGeorge, 33-50. Lawrence: University of Kansas Publications, 1981.

Sloboda, John A. "The uses of space in music notation." *Visual language 15:1 (1981): 86-112.*

Discusses the vertical/horizontal pitch/time axis and its historical development.

Sloboda, John A. *The musical mind: The cognitive psychology of music.* Oxford: Clarendon, 1985.

Reviewed in *Music and letters* 67:3 (1986): 320-321; and in *British journal of music education* 3:2 (1986): 240-242.

Smith, Leland. "SCORE: A musician's approach to computer music." *Journal of the audio engineering society* 20:1 (1972): 7-14. Reprint in *Numus-west* 4 (1973): 21-29.

Smith, Sylvia; and Smith, Stuart. "Visual music." *Perspectives of new music* 20:1-2 (Fall-Winter 1981 & Spring-Summer 1982):75-93.

Smith, Sylvia; and Smith, Stuart. "Musical notation as visual art." *Percussive notes (research edition, Percussionist)* 18:2 (Winter 1982): 7-14.

Smoliar, Stephen W. "A computer aid for Schenkerian analysis." *Computer music journal* 4:2 (1980): 41-59.

Smoliar, Stephen W. "Music programs: An approach to music theory through computational linguistics." *Journal of music theory* 20:1 (1976): 105-131.

Includes discussions of syntax, semantics, sonology, and Music V.

Snarrenberg, Robert. "The play of *differance*: Brahms's Intermezzo, op. 118, no. 2." *In theory only* 10:3 (1987): 1-25.

Snarrenberg, Robert. "Myth and theory: Stories for ourselves." Paper presented at the annual meeting of the Society of Music Theory, Oakland, California, November 1990.

Analyzes music discourse as similar to myths, with implications for model building and for notations as forms of discourse.

Sontag, Susan. *Against interpretation and other essays.* New York: Farrar, Straus & Giroux, 1966.

"In place of a hermeneutics we need an erotics of art." (p. 14)

Sontag, Susan. "Writing itself: On Roland Barthes." *New Yorker* (April 26, 1982): 134-141.

Spillane, Margaret. "The culture of narcissism." *Nation* 251:20 (December 10, 1990): 737-740.

Takes to task contemporary avant-garde, experimental, and academic artists whose status "makes them members of the affluent class of Caucasians serviced by both the N.E.A. and corporate donors..." (p. 738) Some of Spillane's arguments may apply to composers working in recently developed notation systems.

Stampe, Dennis W. "Toward a causal theory of linguistic representation." In *Contemporary perspectives in the philosophy of language*, edited by Peter A. French, Theodore E. Uehling, Jr., and Howard K. Wettstein. Minneapolis: University of Minnesota Press, 1978.

"A dissenting view of representation as a nonintentional, 'natural' phenomenon..." (Peter Kivy, *Sound and semblance*, p. 225)

Staten, Henry. *Wittgenstein and Derrida.* Lincoln: University of Nebraska Press, 1984.

Stautner, John P. "Analysis and synthesis of music using a model of the auditory transform." In *Proceedings of the Venice 1982 International Computer Music Conference,* compiled by Thomas Blum and John Strawn, 466-478. San Francisco: Computer Music Association, 1983.

Contains examples of "pitch periodograms," that is, histograms which graphically represent successive stages of the predominant periodicities of an acoustic signal.

Stearns, R. H. "Rhythm, meter, and notation: Some thoughts on common techniques from the Renaissance to the present." *Soundboard* 10:1 (1983): 46-52.

Stechow, W. "Problems of structure in the visual arts and music." *Journal of Aesthetics* 11 (June 1953): 324-333.

There is a reply to this by Beal, in the same journal, 12 (June 1954): 522-525.

Steels, Luc. "Learning the craft of music composition." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, A27-A31. San Francisco: Computer Music Association, 1986.

Describes an experiment with a frame-based knowledge representation system.

Stefani, Gino. "Situation de la semiotique musicale." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 9-26. Pesaro: Centro di Iniziativa Culturale, 1975.

Here Stefani sets the stage for the First Congress, as well as for the field in general, attempting to elucidate the need for a specific focus as well as a broad range of interests. He reviews numerous approaches to the semiotics of music, including structuralism in musicology, communications theory, theory of signs, linguistics, analysis, and semantics. There is a bibliography, but it is inadequate and contains some mistakes.

Stefani, Gino. "Musical competence, analysis and grammar." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 219-228. Florence: Olshki, 1984.

Stefani, Gino, ed. *Proceedings of the first International Congress on Semiotics of Music*. Pesaro: Centro di Iniziativa Culturale, 1975.

A mixed bag of papers presented at the congress which met in Belgrade during October of 1973. Researchers from fourteen countries "discussed the new perspectives on music as signs and communication, particularly the new methods of musical analysis (stemming from linguistics, computer sciences, and other sciences), and the cognitive, semantic, sociological and anthropological aspects of music." (p. 5) All the papers published in this volume in English or French are listed in this bibliography under the following names: Stefani, Jiranek, Arom, Osmond-Smith, Nattiez, Sundberg, Baroni, Levy, Deliege, Gasparov, Vitanyi, Kneif, Laske, Imberty, Focht, and Supicic.

Steiner, Wendy, ed. *Image and code*. Michigan Studies in the Humanities, no. 2. Ann Arbor: Horace H. Rackham School of Graduate Studies, 1981.

Concerns semiotics and the arts, and contains a bibliography.

Steiner, Wendy, ed. *The sign in music and literature*. Dan Danciger Publications Series. Austin: University of Texas Press, 1981.

Contains the following articles on music: Henry Orlov, "Toward a semiotics of music;" Allan R. Keiler, "Two views of musical semiotics;" Alan M. Perlman and Daniel Greenblatt, "Miles Davis meets Noam Chomsky: some observations on jazz improvisation and language structure;" John Blacking, "The problem of 'ethnic' perceptions in the semiotics of music;" David Lidov, "Technique and signification in the twelve-tone method;" and Judith Becker and Alton Becker, "A musical icon: power and meaning in Javanese gamelan music." Reviewed by Raymond Monelle, in *Music analysis* 3:2 (1984): 208-214.

Stern, Nancy; and Stern, Robert A. *Computers in society*. Englewood Cliffs, N.J.: Prentice-Hall, 1983.

Begins with a thorough overview of computer science, and continues with sections on linguistics, cybernetics, and the arts.

Stockmann, Doris. "Two communication models and a theory of notation." In "Current problems in notation," edited by Igmar Bengtsson, 747-750. Part of *International Musicological Society: Report of the twelfth congress, Berkeley, 1977*, edited by Daniel Heartz and Bonnie Wade. Kassel: Barenreiter, 1981.

"Discusses descriptive and prescriptive notation and gives suggestions toward a theory of notation." (*RILM*, 15:3 (1981): 378.)

Stoianova, Iwanka. "L'enonce musical." *Musique en jeu*, no. 19 (June 1975): 21-57.

Stoianova takes a linguistic view of contemporary musical expression. This article deals with such concepts as language, text, signs, connotation, difference, stasis and kinesis, and structure. Several useful charts and diagrams are provided.

Stone, Kurt. "Problems and methods of notation." *Perspectives of new music* 1:2 (Spring 1963): 9-31.

Stone, Kurt. "Notation." In *Dictionary of contemporary music*, edited by John Vinton. New York: Dutton, 1977.

Stone, Kurt. *Music notation in the twentieth century: A practical guidebook*. New York: Norton, 1980.

An excellent guide, though more difficult to use than G. Read's similar work.

Stopford, John. "Structuralism, semiotics, and musicology." *British journal of aesthetics* 24:2 (Spring 1984): 129-137.

Strawn, John, ed. *Digital audio signal processing: An anthology*. Los Altos, Calif.: Kaufmann, 1985.

Strizich, Robert. "Notation in Elliott Carter's *Double Concerto*." *Ex tempore* 2:1 (1982): 46-81.

Strizich discusses the effectiveness of Carter's notation in defining the musical streams of the piece, as well as the tempo fluctuations. He critiques Carter's use of non-duple subdivisions, and concludes that, though Carter's "notation is exacting, meticulous and even painstaking,...it is precisely the great intricacy of the realization that paradoxically tends to obscure the clear projection of much of the work's musical thought." (p. 79)

Subotnik, Rose Rosengard. "Why is Adorno's music criticism the way it is? Some reflections on twentieth-century criticism of nineteenth-century music." *Musical newsletter* 7:4 (Fall 1977): 3-12.

Contains a discussion of paradigmatic, metaphorical, syntagmatic, and metonymical elements in music.

Subotnik, Rose Rosengard. "The cultural message of musical semiology: Some thoughts on music, language, and criticism since the Enlightenment." *Critical inquiry* 4 (Summer 1978): 741-768.

Subotnik, Rose Rosengard. "Tonality, autonomy, and competence in post-Classical music." *Critical inquiry* 6:1 (Fall 1979): 153-163.

A rejoiner to Kramer's "The shape of post-Classical music," which is a reply to Subotnik's "The cultural message of musical," both listed above.

Subotnik, Rose Rosengard. "Romantic music as post-Kantian critique: Classicism, romanticism, and the concept of the semiotic universe." In *On criticizing music: Five philosophical perspectives*, edited by Kingsley Price, 74-98. Baltimore: Johns Hopkins University Press, 1981.

Taking Kantian critical philosophy as her base, Subotnik demonstrates the uncertainty of cognition and communication, and the contingency of semiosis. She draws analogies between classical music and logic, citing sonata form as a particularly coherent semiotic structure. But she goes on to show the less temporal and more spatial nature of romantic music and its lack of semiotic wholeness. The final third of the article is an analysis, drawing from Leonard Meyer's work, of the meaning of Chopin's Prelude, op.28, no. 2.

Subotnik, Rose Rosengard. "Role of ideology in the study of Western music." *Journal of musicology* 2:1 (Winter 1983): 1-12.

Discusses the differences between the Continental and Anglo-American philosophies with regard to ideology and music, emphasizing the interest of the former in cultural contexts and the latter in empiricism and the exclusion of conflicting ideologies.

Sundberg, Johan; and Lindblom, Bjon. "A generative theory of Swedish nursery tunes." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino Stefani, 111-124. Pesaro: Centro di Iniziativa Culturale, 1975.

Supicic, Ivo. "Signification et intelligibilite de la musique." In *Proceedings of the first International Congress on Semiotics of Music*, edited by Gino

Stefani, 249-253. Pesaro: Centro di Iniaziativa Culturale, 1975.

Supicic, Ivo. *Music in society: A guide to the sociology of music*. Sociology of music, 4. Stuyvesant, N.Y.: Pendragon, 1987.

Contains a section on the socio-artistic aspects of music which discusses notation, innovation, and historical relativity.

Swingewood, Alan. *Sociological poetics and aesthetic theory*. London: Macmillan, 1986.

Contains sections of reception theory, and on aesthetics and politics.

Sychra, Antonin. "La chanson folklorique du point de vue semiologique." *Musique en jeu*, no. 10 (March 1973): 12-33.

Tagg, Philip. "Analysing popular music: Theory, method, and practice." *Popular music: A yearbook*, no. 2 (1982): 37-67.

Tagg, Philip. *Film music, mood music and popular music research--Interviews, conversations*. Goteborg: Universitat Goteborg, 1980.

Tarasti, Eero. *Myth and music: A semiotic approach to the aesthetics of myth in music, especially that of Wagner, Sibelius, and Stravinsky*. Helsinki: Soumen Musiikkitieteelinen Seura, 1978.

Reviewed by Raymond Monelle, in *Music analysis* 3:2 (1984): 208-214; and by J. Horton, in *Music review* 44:3-4 (1983): 310-313.

Tarasti, Eero. "Peirce and Greimas from the viewpoint of musical semiotics: An outline for a comparative semiotics." In *Semiotics, 1980: Proceedings of the fifth annual meeting of the Semiotic Society of America*, edited by Michael Hersfeld and Margot Lenhart. New York: Plenum, 1982.

Tarasti, Eero. "Towards a structural semantics of music: Reflections on the logic of musical discourse." In *Semiotics unfolding: Proceedings of the second congress of the International Association for Semiotic Studies [1979]*, edited by Tasso Borbe, v. 3, 1791-98. New York: Mouton, 1983.

Tarasti, Eero, comp. "Basic concepts of studies in musical signification." In *The semiotic web 1986*, edited by T. Sebeok and J. Umiker-Sebeok, 408-429. Berlin: Mouton de Gruyter, 1987.

Taylor, Mark C., ed. *Deconstruction in context*. Chicago: University of Chicago Press, 1986.

Tedde, Giorgio. "Phenomenology of musical communication." In *Proceedings of the International Computer Music Conference, 1986*, edited by Paul Berg, A7-A12. San Francisco: Computer Music Association, 1986.

Deals with statistical and formal analyses of the musical message and the structure of musical communication. Contains a graph contrasting information and redundancy.

Tenney, James. "META Meta + Hodos." *Journal of experimental aesthetics* 1:1 (1977): 1-10.

A theory of musical form and perception with close links to information theory and structuralism.

Tessarolo, M. "The musical experience: The semantic differential as a research instrument." *International review of the aesthetics and sociology of music* 12:2 (1981): 153-164.

Thompson, J. Patrick. *Data with semantics: Data models and data management*. New York: Van Nostrand Reinhold, 1989.

Thoresen, Lasse. "Auditive analysis of musical structures: A summary of analytical terms, graphical signs and definitions." In *ICEM Conference on Electro-Acoustic Music [1985]: Proceedings*, edited by Bo Rydberg, 65-90. Stockholm: Royal Swedish Academy of Music, 1988.

Proposes a notation system to represent aspects of field, positioning, demarcation, complexity, dominance, tempo, layer, mode, interrelationship, and similarity.

Tilbury, John. "The experimental years: A view from the left." *Contact* 22 (Summer 1981): 16-21.

Discusses Cage and ideology.

Tilbury, John. "Cornelius Cardew." *Contact* 26 (Spring 1983): 4-11.

Tjepkema, Sandra L. *A bibliography of computer music: A reference for composers.* Iowa City: University of Iowa Press, 1981.

Contains 1017 entries.

Todorov, Tzvetan. *The poetics of prose.* Ithica: Cornell University Press, 1971.

Todorov, Tzvetan. *Theories of the symbol.* Translated by Catherine Porter. Ithaca: Cornell University Press, 1982.

Toland, Lilah. "Score without parts (40 drawings by Thoreau): Twelve haiku, 1978." In *John Cage etchings 1978-1982*, compiled by Crown Point Gallery. Oakland, Calif.: Point, 1982.

A reproduction and discussion of the score by Cage.

Tomkins, Calvin. *The Bride and the bachelors: Five masters of the avant-garde.* New York: Penguin, 1968.

Essays on Marcel Duchamp, John Cage, Jean Tinguely, Robert Rauschenberg, and Merce Cunningham.

Toop, Richard. "Stockhausen's electronic works: Sketches and worksheets from 1952-1967." *Interface* 10 (December 1981): 149-197.

Tosolini, Marco Maria. "*Un'immagine do Arpocrate* by Salvatore Sciarrino." In *Musical grammars and computer analysis*, edited by Mario Baroni and Laura Callegari, 287-294. Florence: Olshki, 1984.

A defense of qualitative, as opposed to quantitative, analysis.

Truax, Barry. "A communicational approach to computer sound programs." *Journal of music theory* 20:2 (Fall 1976): 227-300.

Compares various computer music systems, including POD.

Truax, Barry. "The POD system of interactive composition programs." *Computer music journal* 1:3 (1977): 30-39.

Truax, Barry. "The inverse relation between generality and strength in computer music programs." *Interface* 9 (June 1980): 51-60.

Truax, Barry. "Models of interactive composition with the DMX-1000 digital signal processor." In *Proceedings of the International Computer Music Conference, 1984*, edited by William Buxton, 173-178. San Francisco: Computer Music Association, 1985.

Contains several useful flow charts representing the computer composition process.

Tufte, Edward R. *The visual display of quantitative information*. Cheshire, Conn.: Graphics, 1980.

Turnstall, Patricia. "Structuralism and musicology: An overview." *Current musicology* 27 (1979): 51-64.

Turnstall discusses the work of Serwer on Schenker, and Ruwet, Boiles, Arom, Nattiez, Chase, and others. (*RILM* 13:11 (1979): 18.)

Vidolin, A. "Some considerations in the formalization of compositional processes." Paper given at the third Colloquiuum on Musical Informatics, Padua University, Italy, 1979.

Villoteau, Guillaume-Andre. *Recherches sur l'analogie de la musique avec les arts qui ont pour objet l'imitation du langage: Pour servir d'introduction a l'etude des principes naturels de cet art*. 2 vols. Geneva: Slatkine Reprints, 1970.

Villoteau lived from 1759 to 1839. This reprint is reviewed by J. Nattiez in *Musique en jeu*, no. 6 (March 1972).

Vinton, John, ed. *Dictionary of contemporary music*. New York: Dutton, 1974.

See particularly "Notation" by K. Stone, "Electronic music: Notation" by B. Fennelly, and "Prose music" by F. Rzewski.

Vitanyi, Ivan. "Semiotics of standard musical language." In *Proceedings of the first International Congress on*

Semiotics of Music, edited by Gino Stefani, 197-207. Pesaro: Centro di Iniziativa Culturale, 1975.

Vitz, Paul C. "Experiments on affective reactions to 'music' stimuli." *Scientific aesthetics* 9: 1-2 (1974): 3-14.

Incorporates a discussion of perceptual coding and a critique of information theory.

Walsh, John P. "Design considerations for computer music systems." In *Proceedings of the 1977 International Computer Music Conference*, compiled by Curtis Roads, 187-191. San Francisco: Computer Music Association, 1980.

Citing the unlimited variety of compositional processes, with specific reference to Cage's *Notations*, Walsh proposes a hierarchical structure of interface modules, or high level languages to serve different signal generation requirements. The focus of the article is general and avoids discussion of specific implementations.

Warfield, Gerald. *Writings on contemporary music notation: An annotated bibliography*. Ann Arbor: Music Library Association, 1976.

A useful, clear, and thorough bibliography listing 452 items by author, cross-referenced by subject. The introduction provides a taxonomic analysis of the field, and a brief description of the Index of New Music Notation.

Warfield, Gerald. "A communication model." In "Current problems in notation," edited by Igmar Bengtsson, 747-750. Part of *International Musicological Society: Report of the twelfth congress, Berkeley, 1977*, edited by Daniel Heartz and Bonnie Wade. Kassel: Barenreiter, 1981.

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