UNIVERSITY OF CALIFORNIA, SAN DIEGO

A Framework for the Analysis of Performer Interactions in Western Improvised Contemporary Art Music

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Music

by

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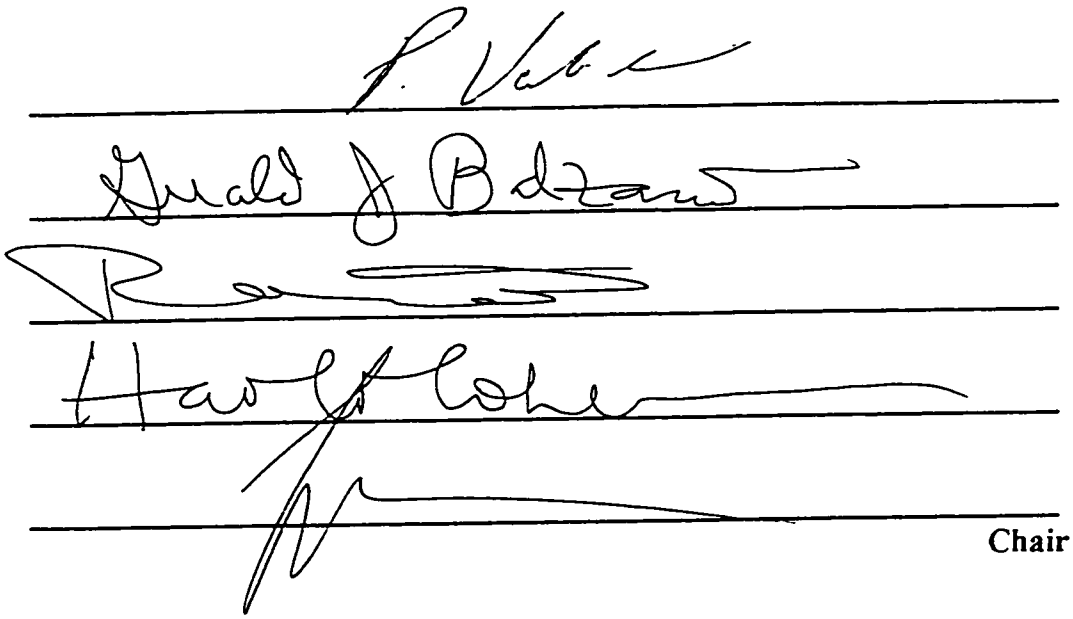

Chair

University of California, San Diego

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Dedication

This dissertation is dedicated to my two sons, Aidan and Isaac, born August 26th, 1997, and to their mother, Dori Pelz-Sherman. Being their dad is the most beautiful improvisation of all.

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ABSTRACT OF THE DISSERTATION

A Framework for the Analysis of Performer Interactions
in Western Improvised Contemporary Art Music

by

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This dissertation presents a framework for analyzing Western Improvised Contemporary Art Music (WICAM). The structure of WICAM (and of improvised music in general) has received relatively little attention by academic music theorists and therefore makes an excellent subject for new research. The core of the framework is the postulation of several elemental modalities of symbolic interaction between improvising performers. The usefulness of the framework is demonstrated through the analysis of several WICAM performances. Additionally, musical experiments called "micro-scores" are presented; these served to bring the structures of the framework into focus. This research draws upon knowledge from several diverse fields, including psychology, physiology, ethnomusicology, sociology, cognitive science, game theory, and communication theory. Foreseeable applications of this research include music composition, music analysis, music

pedagogy, and interactive music system design.

The framework rests upon the assumption that music created by multiple improvising performers has an analyzable structure which is fundamentally distinct from that of traditionally-composed music, as it is based on interactions between performers acting in real time rather than the decisions of a single composer acting outside of real time. Evidence for this structure includes the following observations:

- At most times during group improvisation, a performer is primarily either a "sender" or a "receiver" of musical information.
- Occasionally, performers seem to be sending and receiving equal amounts of information simultaneously to and from each other.
- Occasionally, one or more performers appear not to be sending or receiving information from any of the others.

These three conditions represent the three fundamental interaction *modes*: *soloing/accompanying*, *sharing*, and *not-sharing*, which make up the essential "building blocks" of the analysis framework. Appropriate communication of these states is essential to successful interaction and requires a high level of competence. These modes of musical interaction can be seen as syntagmatic units of musical signification which function within a paradigmatic sign system. When these paradigmatic relationships between performers are projected onto the temporal domain, they are transformed into narrative structures.

1. Introduction

Contemporary musicians, music theorists, and music historians have become increasingly interested in exploring the inner workings of improvised music. These individuals include classically trained performers wishing to expand their musical horizons, composers interested in new forms of expression, and computer musicians concerned with problems of formalizing interactions in the digital domain. Researchers in extra-musical fields have also shown an interest in the study of improvisation; cognitive scientists and psychologists, for example, have often used music as a "problem domain" for studying the creative mental processes underlying specialized skilled performance. My purpose is to lay out a framework for the analysis of "purely" improvised music, which takes form during performance as the direct result of the real-time interaction of multiple performers. In doing so, my work builds on a small but growing body of literature on music improvisation theory. With the exception of a handful of works (Briggs, Pressing, Dean, Jost, Such, Bailey, et al), there have been few serious attempts at describing and analyzing this area of musical activity, particularly as it exists in contemporary (non-traditional) musical practice. Some historical and technical details of improvisational practice over the past several centuries have been well documented by Ferand (1961) and Bailey (1980). Too often, however, what is billed as "analysis" of improvised music amounts to little more than an impressionistic description of its surface features; rarely have scholars probed into the deep structural organization of the music. In this work, I attempt to do just that.

Functional harmony, Schenkerian analysis, and set theory have proven to be extremely useful tools for analyzing Western classical music. The framework presented in this thesis is a contribution to music theory of a similar nature, geared for the ever-expanding universe of improvised, interactive music. This framework should help theorists and musicians understand and appreciate this art more deeply by providing a set of tools for creating, thinking, and communicating about performer interaction in WICAM.

1.1. Defining the subject

The subject of this study is the interaction among the performers of an increasingly diverse style of improvised music I call "western (group)-improvised contemporary art music," or WICAM for short. WICAM. WICAM is made by "Western" musicians who improvise in the context of what has come to be known as "art" or "concert" music. [1] No single term in current common usage accurately identifies this musical genre, hence for the sake of clarity and brevity, I have found it necessary to adopt a label with which to refer to the domain of musical practice that is my subject. Choosing a label for such a diverse and amorphous style is an onerous task, because it forces me to deal with many issues that are quite distracting from the main topic, the analysis framework itself. However, defining the genre one is attempting to analyze is a prerequisite for the creation of any analysis framework which claims to apply universally to said body of work. In order for an analysis framework to be of value, there must be some distinguishing features that set this music apart from other genres. Unfortunately, in trying to identify these features, I am forced to de-emphasize the uniqueness and creativity of the individual artists involved in contemporary improvisational practice. Fortunately, however, by isolating some defining characteristics of this music, we do make some headway into understanding it on a cultural and stylistic level, which is an essential starting point for analysis.

1.1.1. Antecedents and Acronyms

WICAM evolved as a synthesis of two major subcultural "streams" of musical practice, the first being "Free Jazz", and the second being late 20th century Euro-American "experimental" music. Important pioneers in the development of WICAM include the leaders in both developments. In Free Jazz, major innovators include

[1] Occasionally one even sees the term "classical" applied, however inappropriately, to this new music whose only connection to the music of the Classical era is the instruments used and the physical setting in which it is commonly performed.

Ornette Coleman, John Coltrane, Miles Davis, Don Cherry, Eric Dolphy, Charles Mingus, Cecil Taylor, Archie Shepp, Albert Ayler, the members and associates of the AACM (founded by Muhal Richard Abrams), Sun Ra, and many others. Early experimentalist pioneers include John Cage[2], Karlheinz Stockhausen (especially his later "Intuitive Music" pieces), Christian Wolff, Pauline Oliveros, and many others. While not all of the music these pioneers made entirely fits the stylistic criteria I propose below, these people were instrumental in introducing what Lewis (1997) calls "Afrological" elements of improvisation and interaction into the mainstream concert hall.[3] "First generation" WICAM artists whose work was recognized between the early 60's and late 70's would include the members of ensembles such as New Phonic Art, Circle, The Art Ensemble of Chicago, Musica Eletronnica Viva, AMM, KIVA, and Lysis (Australia). Outstanding individuals from this first wave of WICAM activity include Anthony Braxton, Derek Bailey, Cornelius Cardew, Alvin Curran, Richard Teitelbaum, and many others. "Second generation", or "emerging" WICAM performers making more recent contributions include members of the HUB, Robert Dick, Fred Frith, Jon Rose, Nicolas Collins, the "No World" improvisors Joseph Celli and Jin Hi Kim, Marilyn Crispell, Joelle Leandre, Gerry Hemmingway, Barry Guy, George E. Lewis... to name just a few. The music of these "second generation" performers is even more central to my research, as it represents a further maturation of the WICAM "style." While good written overviews (including discographies) of this genre can be found in Jost (1974), Litweiler (1984), Dean (1992), Bailey (1992) and Corbett (1994), recordings of this music can be extremely difficult to find. The enterprising reader is referred to Dean (1992), pp. 220-223 for a guide to obtaining recordings of some of the music under examination here.[4]

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[2] Cage's influence was instrumental in breaking from traditional materials and methods and allowing "intederminate" elements into contemporary art music, although as we shall see, Cage's philosophical approach to music was really quite different from that of most WICAM performers.

[3] Some consider the adoption of Afrological elements by mainstream composers exploitive, since Black musicians are seldom given due credit for being the torchbearers of the African interactive music tradition. However, I do think it's fair to point out that the Euro-American experimentalists brought a certain rigor and severity to the style, carried forward from the atonal innovations of the Second Viennese School and the timbral explorations of Ives, Cowell, and Varése. It is the *blending* of these two musical cultures that gives WICAM its unique sound.

Throughout this dissertation, I will refer to its subject as "western (group)-improvised contemporary art music," or WICAM for short. The overriding goal of all these qualifiers is to distinguish the kind of improvisation I have been interested in from that which operates according to any system of prior or external organization. Unlike, for example, 12-bar blues, WICAM has structure, but no rules. Let us examine each of these four qualifiers one by one:

This music is *Western*, because the areas where the musicians live and perform are geographically contained within the trans-cultural, industrialized regions of the Americas (both North and South) and Europe, "Westernized" post-war Japan, and certain Westernized post-colonial areas such as Australia and Hong Kong. Especially as more and more influences from non-Western cultures are appropriated by WICAM musicians, and as Western influences invade indigenous world cultures, this qualifier becomes more problematic. As with most "supercultural" phenomena today (cf. Slobin, 1993), the geographical boundaries of WICAM are fuzzy and are constantly expanding. For example, the old politically charged definition of "Western" as "non-communist" certainly does not apply since the collapse of the U.S.S.R. In many ways, one might say that central Russia is a more "Western" place now than some places in Europe or the United States: for example, the Basque regions of Spain, or the Native American reservations of the Southwestern U.S. where traditional ways are preserved.

Like the "Art" aspect, the "Western-ness" of WICAM is in some ways an anti-definition. In particular, I most emphatically do *not* meaning to invoke a value system sometimes associated with Western-ness which privileges conformity, positivism, rationalism, and materialism over intuition, freedom, and creativity. My use of the

[4] Among the recording labels that have been most active in this area, FMP (Free Music Production, Berlin) and Incus (Derek Bailey's label) are among the oldest. Others include Intakt (Switzerland), Leo (London), Nine Winds (L.A.), Einstein (Roulette-NYC), Tzadik (John Zorn's label), and the Knitting Factory label. In addition, the following catalogs offer excellent selection of recent WICAM recordings: O.O. Discs of Bridgeport, Connecticut, Music & Arts of Berkely, California (http://www.musicandarts.com/). Thanks to falling music production and distribution costs, independent recording labels are on the rise, and more are appearing all the time. A tremendous amount of information about European Free Improvisation can be found on the World Wide Web at the following URL: http://www.shef.ac.uk/misc/rec/ps/efi/ehome.html.

term is meant merely to distinguish this kind of improvisation from that which stems directly from an indigenous musical tradition; it does not attempt to define a new "indigenousness" unique to Western societies. In keeping with these postmodern times, "The West" has become a signifier of cultural non-specificity. Thus, when Indian tabla master Zakir Hussein plays with drummer Mickey Hart (of the Grateful Dead), the result is very likely to be "Western" music (meaning some kind of placeless, contemporary fusion of Indian classical and Western popular styles), whereas when Hussein plays with Indian sitar master Ravi Shankar, the result is much more likely to be more purely Indian. While all cultures seem to use some form of improvisation in their music, many of which have had important influences on WICAM musicians, we can distinguish WICAM from these practices in part by their participation in the "global cultural economy" (after Appadurai, 1990) commonly associated with the term "Western": a fluid matrix of financial, ideological, technical, ethnological, and media-based virtual "landscapes." Indeed, the "W" in WICAM might almost just as well stand for "World", in the sense the the West has become a virtual meeting space where the cultures of the world intermingle. George E. Lewis, quoted in Iyer (1996), sums up the "trans-cultural" nature of Western improvisation as follows:

> My own belief is that musical improvisation in the West is inherently and necessarily transcultural at base. Musics from all over the world are studied and influences flow freely between traditions, while traditional Western practices are often subtly decentered. This transcultural nature is, I feel, at the heart of the dilemma facing the creative person working through improvisation in the West, most particularly in the Americas.

WICAM is *(group)-Improvised and Interactive*, because all performers make decisions about what to do at any given moment based primarily on their own imagination and interpretation of signals from the others. Static, pre-established "referents" (i.e.: scores, chord "changes," memorized plans, stock "licks," and other artifacts of traditional Western composition) are kept to an absolute minimum. Furthermore, WICAM is <u>group</u> improvisation; solo improvisation is not under

consideration here. In fact, the "I" in WICAM can also stand for "interactive", since WICAM always involves a special kind of interaction of multiple agents. In WICAM performances, the overall balance of responsibility for generating musical ideas is shared equally among all participants. There is generally no persistent distinction between "lead" and "backing" musicians; instead, these roles are fluid and constantly shifting between the performers. This feature often manifests itself, especially in the context of jazz-based groups, in the subversion of the traditional roles played by certain instruments, notably the time-keeping roles of bass and percussion and the harmony-defining roles of keyboard instruments.

WICAM is *Contemporary* – by definition, "new." It is created and performed in the present-day era by living artists working outside any pre-established tradition. I will elaborate in section 1.2.2 on this concept of working "outside" of tradition, even though this music has roots or influences in late twentieth century musical practices such as Free Jazz, extended instrumental techniques, and graphical notation.

WICAM is *Art*, because it is generally performed in concert halls, theaters, or other specialized venues for the Arts, rather than as "background" for a religious or traditional ceremony, theatrical performance, film score, or other extramusical context that would prefigure the structure and/or meaning of the music. WICAM is to be appreciated strictly for itself, not as "ambience" (as in a restaurant) or "dance" music (as in a nightclub) or as accompaniment to any prefiguring "text" such as dance or film. For this reason, the use of pre-written "scripts" (e.g., libretti) or other fixed, linear texts are uncommon in WICAM, because the introduction of a fixed text predetermines a great deal about the nature of the music. WICAM's practitioners, furthermore, generally receive specialized training during which they absorb the techniques and concepts of jazz and European Classical musics (among others, possibly) before becoming involved in WICAM. This institutionalized aspect distinguishes WICAM from "folk" or "popular" music, which is generally passed on through oral tradition (nowadays assisted through recording technology).

Other adjectives that are often associated with this music and closely related to

its "Artistic" aspect are "creative" (as in the AACM's term "Creative Music", "free" (as in "Free Jazz" and "Free Improvisation"), "pure", and "out" (as in "outside" of tradition). While all of these terms have merit, to me they are all implied and subsumed by the term "Art." Indeed, the term "Art" has been used by some of WICAM's seminal practitioners in both America and Europe, such as the Art Ensemble of Chicago, and New Phonic Art. Therefore, I feel the use of term is worth the risk of being accused of elitism. It is also important to note that WICAM is but one of many Art musics of the West. In contemporary Western life, the term "Art" alone has no meaning other than something set apart to be appreciated for its beauty.

While I believe these four terms, "western, improvised/interactive, contemporary, and art", do describe a distinct musical genre, the boundaries of WICAM are by no means completely drawn as of yet, nor is it clear that WICAM ever will become "canonized" in the sense that jazz, for example, seem to have become. Then again, perhaps this canonization process has already begun; certainly, icons have started to appear whose work seems to have taken on an aura of "officialdom" in the eyes of some. Take, for example, Derek Bailey's description of the AMM in Bailey (1992):

> In some way, the AMM are the 'official' improvising group, something of an institution. In addition to their longevity, this is partly an acknowledgement of their overt seriousness, a stance not immediately apparent in many improvisors or groups and violently rejected by some. It's a seriousness reflected not only in their playing but in their concern for the philosophical and educational implications of improvised music, articulated in lectures, statements, and writings of various kinds. (p. 128)

By way of contrast, although new jazz compositions continue to be written, there are those who argue that jazz reached a point of closure to its evolution when the critical element of "swing" in the rhythm began to disappear from the music, and when some began to write "through-composed" jazz compositions; in other words, swing and improvisation have been viewed by some as essential, defining features of jazz music

(cf. Gridley 1994).

Since WICAM and jazz are both contemporary western musics incorporating improvisation and regarded as "art" music, it is tempting to draw a line between the two by saying "if it swings, it's jazz, not WICAM." In other words, the mere existence of a swinging pulse almost inevitably compromises the "contemporary-ness" of the music. There is no doubt that the use of a steady, lilting beat in the context of improvised music instantly creates a strong association for most acculturated listeners to traditional jazz music. However, we must be careful not to become too rigid in our definitions. All musicians bring elements of their culture to the "space of sonic exchange" (Lewis, personal communication), and in WICAM it is quite common for musicians to include all sorts of influences from everywhere on the planet (marches and swing tunes in Anthony Braxton, Korean folk music in Jin Hi Kim). Yet, there is an important difference between incorporating traditional music into WICAM performances vs. playing fully "inside" a traditional style. When a musician "falls back" on cliche licks she remembers from a TV show theme or a jazz standard or a Klezmer tune, she isn't as fully engaged in the creative improvisation/interaction process as she would be if she were not merely regurgitating materials held in "long term memory." I believe it is this very imperative to be fully engaged in the creative act that drives WICAM performers to purposefully distort, often beyond recognition, the cultural/ethnic/historical references in their music, just as Braxton (marches), Zorn (film noir, Klezmer, cartoon music), Steve Coleman (Cuban music), and Roscoe Mitchell (Euro-contemporary) do. The cultural references are certainly audible, but they aren't *defining* characteristics of the music; rather, they are elements in something new which has been created out of them. They are possible points of departure and arrival rather than the journey itself.

1.1.2. Heteroriginality vs. monoriginality

Making music involves making decisions about which sounds, when. All music-generating systems tend to fall into one of two categories: 1) those in which

decisions are made, either a priori or in real time, by a *single* individual, and 2) those in which decisions are made during performance as the product of the relationships of *multiple* agents. WICAM belongs decidedly to the latter category. I call the former category of performances "monoriginal" (singular in origin) and the latter category "heteroriginal." Heteroriginal music is governed by *relationships among performers*, whose decisions are made without reference to a pre-composed score or script of any kind. I chose the prefix "hetero" over "poly" because I wanted to emphasize the *separateness* of the contributing members of a WICAM ensemble (one of the definitions of "hetero" being "containing atoms of different kinds"). Each member of the WICAM ensemble has a unique contribution, the absence of which could radically change the music. In section 1.2 I will discuss how the heteroriginal nature of WICAM is an important signifier of "Afrological" presence; here, I merely wish to introduce and clarify the terminology.

In this work, I will occasionally substitute the term *interactive* for *improvised heteroriginal* music; "interactive music" and "improvised heteroriginal music" may be considered synonymous terms for the purposes of this thesis. While all musical performances posses varying degrees of interaction amongst the performers, the nature of performer interactions within the set of *improvised heteroriginal* pieces is of a sufficiently different nature as to justify the application of the term *interactive* to this set of pieces, as distinct from the interactions found in monoriginal musical practice.

There is a regrettable obfuscation in these terms surrounding the concept of "originality." In the context of the creative arts, there are two meanings of the word "originality", one referring to the source of the work and the other referring to the degree of uniqueness or creativity displayed in its composition and/or performance. In the former sense, the composer is considered the "originator" of monoriginal music, and as such, is considered the rightful "owner" of the music. In the Western world, in fact, the composer retains legal rights to all performances and even mechanical reproductions of his or her works. In the latter sense, musical compositions are judged on the basis of their "originality"; the less resemblance a work has to any other previous works, the more "original" it is said to be. The distinction I am drawing between the singular vs. the collective origination of music pertains only to the former

meaning of "original." Heteroriginal music has many creators, while monoriginal music has only one. The performers of heteroriginal music *are* its sole creators, while performers of monoriginal music are *interpreters* who realize or render the ideas of the creator audible to an audience.

1.1.3. Improvisation vs. Indeterminacy

To further pinpoint the musical activity that is the subject of the theory presented here, it is important to clarify the distinction between heteroriginal music and indeterminacy. Let us consider that the quintessential act of monoriginal composition is to assert that a given type of behavior (or a given range of behaviors), call it "X," shall occur at a given time. The degree of specificity as to what "X" is does not alter this definition; even John Cage's famous *4'33"*, perhaps the definitive modern indeterminate work, can be seen as a bona fide composition under this definition, with "X" being silence in this case, or at least an absence of intentional sound from the performer. Furthermore, most compositions which utilize indeterminacy are generally written so that a more or less *arbitrary* performer, trained in the techniques of rendering the notation, may perform the piece at a more or less *arbitrary* place and time. The choices of the performer are thus constrained to the (sole) composer's idea of what 'X' should consist of and when it should occur, even if 'X' is relatively open in its definition.

In the case of heteroriginal music, more than one performer gets to decide what "X" is; alternatively, one might say that there are many spontaneous compositions occurring simultaneously. Furthermore, rather than limiting the performer to a preconceived palette of ideas provided by the composer, heteroriginal music encourages the performer to contribute original, personal ideas. Once the number of composing intelligences exceeds one, each composer-performer's modus operandi must necessarily shift from from making unilateral decisions to establishing relationships and making collective decisions on the basis of those relationships. The conditionality of these relationships marks a fundamental difference between these two worlds of music; the dynamic nature of heteroriginal music makes it a relatively complex, risky, and exciting endeavor.

Arbitrariness of person and place, implied in modernist indeterminate compositional practice, is eliminated in interactive music. Each performance is uniquely shaped by the conditions present at the precise time of its conception: the personalities of the members of the ensemble, the makeup of the audience, the performance environment, etc., which makes interactive music much more strictly "chaotic" (sensitive to initial conditions) than monoriginal music. As we shall see in section 1.2.2, this quality of modern improvisation resonates strongly with the traditional African values of collective interplay and social/artistic integration.

John Cage, considered the "father" of 20th Century indeterminacy, described his aversion to the chaos of group interplay in an interview near the end of his life:

> I still feel very strongly that individual work is preferable to group work. I think that's one of the very interesting questions, though, as we continue, is what is our attitude toward doing something, whether it should be done by one person: with others, or not. And I think not. Whereas many people think it would be nice to work together. But I think in working together you make everything really impossible. (Corbett, p. 186)

Cage claimed to have based his preference for working alone on a statement by his literary hero, Henry David Thoreau: "If I go with anyone else than myself into the woods, I do not go into the woods." In the interview with Corbett, Cage describes a hypothetical walk in the woods in which each party thinks of themselves as "independent of going into the woods of the second person":

> And then you have a situation that neither one of you can possibly deal with because your inclination the moment you see something that attracts your interest is to point out to the other person that it's interesting. But that person is meanwhile seeing something else that is interesting. And you get a confusion. And then you run into the problem of sharing or not sharing, hmm? (Corbett , p. 187)

In Cage's metaphorical account of the creative process, the "woods," as I interpret it, represents the artist's subconscious mind, or nature, as the source of creative ideas or

raw material. Cage describes quite accurately one of the main problems faced by group improvisors: that of knowing when and how to assert one's influence on the musical direction of the group. Yet, it is evident that improvising musicians can and do overcome this problem quite successfully, especially by establishing familiarity with one another through rehearsal; in other words, good improvisors know when it is their turn to share the interesting things they have found, and when they should allow someone else that opportunity. Improvisors overcome the difficulties of group collaboration by learning to *structure* their interactions effectively. The fact that Cage, the champion of an aesthetic which celebrates chaos and noise, remained at the end of his career so adamantly opposed to the idea of "working together" is a strong indicator of the gulf between the practices of improvisation and indeterminacy.

Although indeterminacy and modern improvisation *practices* are totally different, the sonic *results* of these practices are often very similar. As Cage wrote in *Silence* regarding his 1959 work *Indeterminacy* (in which Cage reads a series of one-minute stories accompanied by David Tudor, each performing in separate rooms),

> My intention in putting the stories together in an unplanned way was to suggest that all things – stories, incidental sounds from the environment, and by extension, beings – *are* related, and that this complexity is more evident when it is not oversimplified by an idea of relationship in one person's mind.

Cage's method of exposing the interrelatedness of all things was to remove the "self": ego, style, tastes and preferences, from the process of generating compositions. Modern improvisation takes exactly the opposite approach; it *demands* the complete participation of each performer's ego, style, tastes and preferences, surfacing them as much as possible. Interestingly, both practices can arrive at similar musical "spaces." The common denominator between improvisation and indeterminacy is the idea that relationships between sounds do not stem from a single, pre-determined source, but rather emerge spontaneously during the performance. Both practices discourage efforts to pre-organize relationships between sounds, preferring instead to allow that organization to occur naturally as the performance unfolds.

1.2. Setting the Cultural Context: Western Improvisation at the end of the 20th Century

One of the central threads of this study is the tremendous impact of cultural factors on the perception and practice of contemporary improvised music. Any theory of music should first define the cultural context within which it can be said to operate. Theories of music, after all, depend on culturally-specific metaphors in order to function. Because musical sounds mean different things to different cultures, it has been stated that "the translation of specific musical imagery from one culture to another is impossible" (Walker 1990, p. 8). Walker states that "the most important force in musical behavior and choice of sounds for music is culturally derived belief about their efficacy" (p. 2, my emphasis). As Jost (1974) puts it,

> Just as it is not enough to take the development of a musical style as a vehicle from which to derive sociological theories, it is equally unprofitable to reduce analysis to musically tangible facts only. Free Jazz shows precisely how tight the links between social *and* musical factors are, and how the one cannot be completely grasped without the other. (p. 9)

While cultural factors are not the primary focus of this work, we must begin with an understanding of the social conditions from which the music in question has emerged.

1.2.1. Improvisation and Freedom in Western Culture

Within the context of western art music, improvisation has represented for several decades not just a subcultural but a *counter-cultural* activity, one which actively seeks to overthrow established practices. To see why this is so, we must first examine the norms and values of monoriginal practice, understand why and it what sense these have become dominant, and learn how and why monoriginal norms and values contrast with those of group improvisation.

The creation of musical performances as art "objects," as generally taught and

practiced in Western institutions of higher education, begins as a solitary process. The lone composer wrestles with a mysterious "inner muse" (associated with the subconscious mind or "imagination"), "mastering" wanton creative impulses and "capturing" them in standard music notation. These frozen moments of inspiration are then edited, shaped, and refined into a finished document, which is finally handed down to performers as instructions for the translation of the composer's new composition into music. Nowadays, this process may be expedited by formal compositional methods, or by computer software which can capture a composer's performance on a musical instrument and aid in converting it to standard music notation, but the flow of ideas from the mind of the composer through the performer to the listener remains essentially unchanged in the face of technological changes in the tools of the trade. In fact, some composers have opted to replace the performer altogether with recording, editing, and reproducing technologies (both analog and digital), though almost always with less-than-satisfying results.[5]

The monoriginal model of music-making elevates abstraction, mediation, and reproduction over the intuitive and spontaneous symbolic interaction of improvisation, and in doing so, severely limits its ability to communicate directly to an audience. Although many theorists insist that monoriginal music does have expressive import, there is a seemingly endless debate as to how this communication actually works, as evidenced by the abundance of contradictory theories of musical meaning and expression – Deryck Cooke, Suzanne Langer, Leonard Meyer, Peter Kivy, Gordon Epperson, Jerrold Levinson, Edward Lippman, Susan McClary, Carroll Pratt, Jenefer Robinson... – Davies (1994) summarizes the theories of all these authors and many more, comparing and contrasting them. Some theorists argue that for monoriginal music to carry meaning, it has to use a highly constrained language of simple tonal primitives and relationships (diatonic chord functions) and metrically simple rhythmic presentation, otherwise the task of parsing the music become too great for the listener. In other words, the "cognitive constraints" (cf. Lerdahl 1988) of the human perceptual

[5] The late composer Frank Zappa was a notable champion of this technology, though his most popular work to date remains that which was performed by humans rather than computers. There has likewise been a noticeable decline in the always-marginal interest in performances of pieces for "tape" in Western Art Music concerts.

apparatus prevent most listeners from understanding, or even truly hearing, much of the complex monoriginal music of the 20th century. Furthermore, monoriginal music is mediated so heavily by the conditions of performance that the composer's intentions easily become obfuscated and diffused through several layers of interpretation, the end result being a piece of music that can have radically different meanings for different listeners. Performers of monoriginal music are not perceived to "interact" with one another in the same way that people normally interact with each other, because their actions are so highly constrained by the dicta of the score or, in the case of a larger ensemble, by the conductor's interpretation of the score. Neither the performers nor the listeners are free to truly interrogate a monoriginal piece, to challenge, question, or influence its intended "message."

Improvised music, in contrast, tends to "wear its heart on its sleeve," so to speak. The interactions of the performers seem much more genuine, since they are directed by the performers themselves. Film directors such as Woody Allen frequently ask actors to "improvise" their dialog in a scene rather than following a script for this very reason. Furthermore, each of the performers has equal agency in determining the messages sent, and often the audience, through applause or other responses, may even play a role in determining the content and meaning of an improvised performance as it unfolds in real time. This freedom of improvisors to respond in real time to the conditions of a performance makes it much easier for them to communicate directly and immediately with other performers and with the audience using a wide range of musical signals.

The uni-directional flow of monoriginal music making is not only unique to an increasingly elite strata of Western culture, it is also confined to a brief, relatively recent period in the historical span of time that humans have been creating music. Nevertheless, it has remained the dominant model in terms of economic, academic, political and social status in the West for the past one and a half centuries. This position of dominance has been chiefly the result of the rise since the Renaissance of science as the yardstick by which all human endeavors are measured. There remains to

this day a distinct tendency, particularly within research-oriented communities, to consider monoriginal musical practice as more scientifically "advanced" than its alternatives. Because the necessarily constrained nature of the "language" used in most monoriginal music bears some resemblance to mathematical logic, and also because of the industrialization of the technology involved in the creation of musical instruments, a strong association between music and science has developed.

The belief in the superiority of quasi-scientific methods of musical creation has been consistently challenged by proponents of free improvisation. As Ornette Coleman has said,

> ...to this very day I realize more and more that all things that are designed with a strict logic only apply *against* something; it is not the only way it's done. In other words, if you take an instrument and you happen to feel it a way you can express yourself, it becomes its own law. (Litweiler, 1984, p. 32).

Nevertheless, despite overwhelming evidence of the existence of successful alternative models, monoriginal "flow of control" remains the underlying model for the vast majority of training and theoretical study in music throughout the Western world. As Moore (1991) writes,

> Music historians today agree that modern notions governing the performance of art music, and specifically those disallowing improvisation, are a relatively recent phenomenon. ... It is clear that only in the past hundred and fifty years attitudes towards improvisation in Western classical performance have changed drastically. The mandates of compositionally specified interpretation now supersede those of the instrumentalist. To many, improvisatory expression seems threatening, unfamiliar, or undeserving of interest. (pp. 62-63)

Political and socio-economic explanations for the staying power of the monoriginal musical model in the West have been formulated by several of today's more progressive scholars (cf. Small 1977, Walker 1990, McClary 1991, Moore 1991). It is no coincidence to many who study music as a socio-political phenomenon,

for example, that the ascendancy of the monoriginal model tracks fairly closely, and in some ways anticipates, the rise of post-industrial revolution societies with their concomitant emphasis on the reproduction and consumption of musical compositions (and later recordings) as "art objects." This relationship is argued for most forcefully in recent literature by the French economic theorist Jacques Attali, who argues in his brilliant and controversial book *Noise: the political economy of music* (1977) that changes in musical practice *predict* and even *precipitate* changes in a society, and that the decline of improvisation in western art music practice around 1850 was just such a prediction. Attali argues that the emphasis on representation and reproduction inherent in the monoriginal model in fact heralded the ascendancy of the capitalistic forces in shaping the economic conditions of modern western society.

Attali presents recent increases in amateur, collective participation in music making (e.g.: *Music Minus One*, karaoke, garage bands, drumming circles, community orchestras, and so on) as a "new noise" heralding a radical "seed change" in western society. An excellent example of this "new noise" can be seen in an annual community performance event called "Crepuscule," organized by AACM member and composer/performer Douglas Ewart, the first performance of which took place in Minneapolis, Minnesota in October of 1994. Ewart received a grant to turn a city park into a giant community improvisation. Small boats were provided which allowed participants to float around on a pond in the center of the park. Stages were set up all around the park with PA systems and open microphones. Beyond facilitating the improvisation by obtaining the necessary equipment (and city permits), and marking the beginning and ending of the event, Ewart did little to overtly direct the actions of the participants. People from all walks of life simply showed up with their instruments, and made music in whatever way they wished. The results were sometimes cacophonous, sometimes humorous, and occasionally beautiful, but the dynamics of group interaction on such a large scale were the main concern of the piece. Ewart's comments on the event were telling in regard to the cooperative attitude demanded by this type of activity:

> Some people come to these things and they may be, say, a professional vocalist, so they expect to be accompanied. Well, the thing is,

> nobody's just going to automatically start accompanying your ass. You have to make that happen by the way you sing; you can entice them into accompanying you, but it can't be forced. (personal communication)

Other composers working with similar techniques of large-scale audience participation and interaction include R. Murray Schafer and Pauline Oliveros.

My only contention with Attali's analysis of these developments is that he views them as a sudden and radical break with the past, whereas I see them as manifestations of humanity's continuing struggle for freedom and equality, a struggle which is probably as old as civilization itself. The evolution from monophonic chants to polyphonic motets in sacred music of the eleventh century A.D. gave rise to the concept of multiple "voices" in a piece of music, each receiving equal importance. The fugues of J.S. Bach later developed this concept to a high art. Resistance to and de-centralization of authority was an important theme in Beethoven's music as well, as evidenced in particular by his 9th symphony, set to a poem by Goethe originally entitled "Ode to Freedom." Control over what has been considered "acceptable" in music has passed gradually from the church to the state to the aristocracy to the individual composer. In the past three decades or so, we have seen this control move beyond the composer and into the ensemble, and ultimately to the audience and the community as a whole. This trend can be plainly seen in the drive toward greater freedom in Western music since Beethoven: the "emancipation" of dissonance; the breakdown of traditional metric structures; attempts in electronic music to "liberate" sounds from their environment and to thus expand the sonic palette; efforts by Cage and his followers to compose music using chance operations, thereby removing the composer as much as possible from the process. All of these things parallel the rise of democratic governments in the West.

Quoted in Byron (1995), ethnomusicologist John Blacking connects the rise in political stature of the peasant in Western society with the development of polyphony in Western music:

> The polyphony of early European music is in principle the same as the polyrhythm of much African music: in both cases, performance depends on a number of people holding separate parts within a framework of metric unity, but the principle is applied "vertically" to melodies in polyphony and "horizontally" to rhythmic figures in polyrhythm. The source of both musical techniques is the social activity of dancing. The change in European musical technique from the monody or plainchant to polyphony depended on mensuration, on the strict organization of rhythm so that the different singing parts would fit. And mensuration is the chief feature of dance music, which was a vital activity of the peasant classes. The medieval Church had allowed only plainchant, which was intended to express the unity of society within the framework of a Church dedicated to God; its style was completely divorced from the regular rhythms of secular dancing and the unsophisticated tonic-dominant relationships that occur in lively music like "Sumer is icumen in." It is not surprising that the early masters of polyphony came from the Netherlands and England, where the peasants had become free during the thirteenth and fourteenth centuries respectively. As the peasant's political importance grew, so their dance music became incorporated into the music written for the Church by professional composers. (pp. 47-48)

Seen in this light, the rise in popularity of heteroriginal music in late twentieth century America (Free Jazz, "pure" improvisation, fusions of popular music and "serious" art music, interactive computer music, collective improvisation, etc.) can also be read as a continuation of the strides for freedom attained in the late 18th century with the establishment of the Constitution of the United States of America and the Bill of Rights, the Emancipation Proclamation, and the Civil Rights movement of the 1960s. In the U.S. in particular, this trend received its greatest thrust from the influence of African sacred music, which has always been characterized by extensive group interaction and individual expression, and manifested in the polyrhythms and heterogeneous textures of their music (cf. Floyd, 1995).

Following this political trend, in the mid-1960s many composers (notably Cornelius Cardew, Frederic Rsewski and Christian Wolff) began to express their disdain for what they perceived to be "elitist" socio-political models underlying contemporary Western art music. They began to search for a way to embody Marx's

ideas of collective ownership in their work. In an interview, Wolff says:

> After 20 years, avant-garde music, although accepted to a certain extent, has not had overwhelming success and one comes to reconsider what it is all about. What are we doing? It is not a technical or formal problem, for different techniques have been developed and composers know how to put music together. It is more a problem of what music is doing in society or who listens to it. ... I am interested in engaging the performers more actively. It took me a long time to realize that implication. Performers do not think that they have to do the music more directly. Traditionally, performers are really like movie stars, a tradition that begins in the 19th Century. And performers in an orchestra or chamber group are so to speak high class reproducing machines. It is no accident that the whole electronic music business came along as a kind of extension of the performers. This was the way they were supposed to play. That may be alright, but it is something in which I am not interested. The other possibility, instead of using the machines, is to make a music where playing it is as much in the activity of making it as is the composing. The score is rather unimportant to the player, or the score is a kind of beginning, indicating directions and conditions under which music can be made.

Although the improvisation "movement" begun in the 1960s has never really achieved widespread support among the academic art music community, improvisation studies have flourished in some of the more progressive institutions such as Wesleyan University, where Anthony Braxton now serves on the faculty, and at the University of California San Diego under the guidance of professors John Silber, Pauline Oliveros, Bertram Turetsky, and more recently, George E. Lewis. Progressive university music departments such as these now offer courses in improvisation along with the traditional fare of functional harmony, counterpoint, and ear-training. These are rare exceptions, however; improvised music today is generally "ghetto-ized" into these special zones within academia. Composers- and performers-turned-improvisors are still viewed by the "Classical" music establishment as musical "radicals" or even as "traitors," whose chief purpose is to undermine the authority of the composer and conductor. The rise of the so-called "new complexity" movement in Europe over the last decade can be read as a direct reaction against the increased use of improvisation

in contemporary western art music from the mid-1960s through the mid 1970s. A primary subtext of new complexity music has been the placement of control - more firmly than ever - in the hands of the composer by means of increasingly specific notational techniques, with the implication that the quality of the music increases as the number of sources of musical decision-making decreases, resulting in a "tighter," more logically "advanced" form of expression. Many of the composers who made significant early contributions to the "radical" improvisation movement of the 1960's (Rsewski and Globokar, for example), have gone back to composing virtuosic, traditionally notated works. There are a wide variety of reasons one might pose for this retreat, not the least of which would be simple economics: artists generally need to be able to claim "ownership" of the results of their efforts in order to receive payment for them, and so they naturally feel uncomfortable with the idea that no single individual can claim ownership of the product of group improvisation. In general, funding structures for the arts tend to favor payment to individuals rather than groups. Because of its relative lack of economic viability, the improvisation "movement" has not fared well in the generally inhospitable climate of new music.

1.2.2. Cultural Roots of Contemporary Western Improvisational Practice

To be sure, contemporary improvisation in the West, and in America in particular, has complex and diverse cultural roots. In terms of the underlying *values* of the music, however, the most important contribution to Western improvisation is clearly the legacy of diasporic African culture and improvisation, especially as carried forth in the development of "Free Jazz," the leaders of which have been most instrumental in shaping contemporary group improvisation practices in the West, particularly in the United States. Improvisation is a vital and enduring force in African-American culture. As Leon (1988) writes: "Improvisational variation in cultural forms ranging from music and dance to textile design is pervasive throughout black Africa." Traditional African cultures express values that solicit and respect the creative participation of everyone in the "realization of community" through music

(Chernoff, p. 149). Most western improvisors are strongly influenced by these traditional African values. This influence is made evident both by direct statements by WICAM performers, and by the characteristics of the music itself.

Before delving into the details of this claim, I must explain what I mean by my use of the term "roots." There is an important difference between an artistic practice having "roots" in or "influences" from a tradition and being an extension of that tradition. The roots metaphor implies that there has been significant growth "above ground," beyond the roots, of something new which may bear little or no direct resemblance to the roots themselves, and of which the artistic practice is the flowering result. A music which extends a given tradition, on the other hand, still has a great deal in common with the existing literature of that tradition, and is likely to be folded back into the "mainstream" of that tradition with the passage of time. For example, be-bop – originally an extension of jazz – is today considered very much a part of the jazz tradition, whereas most of WICAM isn't really considered "jazz" today, and is never likely to be. Of course, the boundaries between musical genres are always highly amorphous, but there are certain basic elements of traditional jazz which one finds almost universally absent in WICAM: a steady, swinging beat propelled by drums and a walking bass; pre-determined harmonic structures, particularly those based on the chords ii-V-I and substitutions thereof; pre-composed, thematic "head" tunes played in unison by the entire ensemble at the beginning and end of each arrangement; formal "round-robin" solo assignment structure where each player gets a "turn" while the others sit out; etc. We also do not find in WICAM quite as much emphasis on "intertextuality" – or better, "intermusicality" (see Monson, pp. 127-128) – as one finds in jazz. Direct references to other works, quotations of well-known tunes, direct imitation of one player's "licks" by another, etc. – well-documented mainstays of the jazz tradition – while used by a few composer-performers (notably John Zorn), are relatively uncommon in WICAM.

Nonetheless, evidence of WICAM's strong ties to the jazz tradition is quite clear. The very notion of a music in which every player improvises, which is in fact a *vehicle* for extended improvisations, comes directly from jazz. Furthermore, the idea

of multiple performers "soloing" simultaneously, which was common in many early forms of jazz, notably Dixieland, became one of the defining features of Free Jazz. In addition, the invention of new forms where perhaps multiple groups might form complex organizational structures (such as the simultaneous, dual bass/drum solos on Ornette Coleman's "Free Jazz") were undoubtedly very influential. As Jost writes, "The solo is no longer the culminating point of an individual show of creativity, but is one of many possible structural units within the sonic and formal organization." (p. 168) Other manifestations of the jazz tradition on WICAM include an interest in "noisy" playing techniques such as "breaking up" or distorting the tone of the instruments in various ways (overblowing, biting the woodwind reeds, singing into the horn, piano clusters, etc.), and a "call and response" formal structure, all of which in turn stem back to essential aspects of traditional African "ring shout" music from which jazz sprang.

But beyond these formal manifestations, there lies the most important connection to jazz: the value of spontaneous creation. As Steve Lacy says so well (quoted in Bailey 1992):

> I'm attracted to improvisation because of something I value. That is a freshness, a certain quality, which can only be obtained by improvisations, something you cannot possibly get from writing. It is something to do with the 'edge'. Always being on the brink of the unknown and being prepared for the leap. And when you go on out there you have all your years of preparation and all your sensibilities and your prepared means but it is a leap into the unknown. If through that leap you find something then it has a value which I don't think can be found in any other way. I place a higher value on that than on what you can prepare. (p. 57-58)

While the fundamental values and structures of WICAM may derive from jazz, its *language* (musical materials and formal structures) owes a great deal to 20th century "experimental" music. This synthesis of African values with European techniques and structures was achieved simultaneously both by classically-trained European composers adopting the improvisational values of jazz, and by jazz musicians adopting the materials of modern European-based music. Three prime exemplars of

the latter are Cecil Taylor, Eric Dolphy, and Anthony Braxton, all of whom had extensive influence from 20th century "classical" composers whose innovations in composition, notation, orchestration, and conducting are all evident in their musical practice. These men in turn helped spread these musical practices through what became known as the "creative" music community of the 1960s. Radano (1993) reports that

> Cecil Taylor... acquired a formal knowledge of the concert tradition in the academy, having attended the New England Conservatory from 1952, where he studied early modern repertories, including those of his special favorites, Stravinsky and Bartók. (Taylor has said, "Bartók showed me what you can do with folk material.") (p. 110)
> ...

> Eric Dolphy was an admirer of the work of Schoenberg, Satie, Varèse, and Stockhausen as well as a collaborator with concert composers. (p.110)
> ...
> [Braxton] studied scores of Schoenberg, Varèse, Webern, Stockhausen, and Xenakis; these inquiries eventually led to an informal AACM study group that included trumpeter Leo Smith and, at times, Roscoe Mitchell and Joseph Jarman. (p. 114)

Modern concert music influences are very evident for example in the 1971 recording "Together Alone" (Delmark DD-428) by AACM members Anthony Braxton and Joseph Jarman. The flute lines on "Dawn Dance One" sound reminiscent of Varèse's "Density 21.5," and the piano playing (both in the highly "emancipated" choice of notes and the inclusion of inside the piano techniques) could have been lifted straight out of a Stockhausen "Klavierstucke." The use of recorded sounds (traffic, running water, etc.) in Braxton's "CK7 (GN) 436" is also very strongly related to works of the *musique concréte* school, to which Braxton was exposed during his time in France during the late 60s.

The music that formed the earliest and most enduring links between western art music and traditional jazz was the so-called Free Jazz movement, which began in the early 1960's. Once again, the pioneers of this movement were mainly African Americans. In support of the view of Free Jazz as a predominantly black music, Jost writes that

> ."..although it cannot be argued that white jazz musicians, far from merely swimming along with the tide of Free Jazz, have, in some cases, made decisive contributions to its development, it is plain that the early forms of Free Jazz and the innovations that marked its path came for the most part from black musicians. Furthermore, its most significant emotional components are not those of a diffuse 'world music', but clearly derive from a music that is Afro-American in the broadest sense. After seventy years of jazz, the observation that white musicians play music that is "black" in essence should surprise us as little as the statement that 18th-Century German composers wrote 'Italian' operas."

Founded in 1965, Chicago's Association for the Advancement of Creative Musicians, or AACM, represents one of the most important forces in the development of Free Jazz, and was highly supportive of the usage of music as a vehicle for improving the self-image of African Americans. Radano writes that "The AACM's notion of African-based creativity was intimately linked with a collective concept of aesthetic spiritualism....The point of complete transcendence was what Muhal Richard Abrams called the 'spiritual plane', where, through collaborative creation, intuition and intellect meet" (p. 101). As Radano points out,

> "Perhaps most remarkable about the AACM improvisations is the process by which these dynamic structures are produced. The improvisations *work*, and they work because of the performers' uncanny ability to discern interesting improvisational pathways during the moment-by-moment act of creation. The musicians are constantly faced with decisions of where to begin and end phrases and sections, when to play and when not to play. And they make these decisions to shape a composite texture, while also paying attention to signs of where the improvisation might lead. Such acute sensitivity developed from years of continuous ensemble playing and perhaps more generally from the collective orientation of African-American musical practice, which has been documented as far back as the spiritual." (p. 107)

As an example of such culturally-based foundations of improvisation, AACM member George E. Lewis has pointed out that African-American perceptions tend to discourage "the idea that one can simply impose an ordered series of events or tasks upon an arbitrary group of performers at an arbitrary time and place," preferring instead an attitude that links the creation of music with the interpersonal dynamics at the moment of its creation (personal communication). This observation is consistent with much 20th-Century African-American musical practice. Sun Ra, for example, when touring with his ensemble, would frequently write compositions for each new town in which his group appeared (Corbett, 1994). Duke Ellington was also known to compose pieces for certain occaisions (his appearances at the Newport jazz Festival,

for example), and was well-known for his ability to assemble the right combination of musicians to produce the precise sound he wanted from an improvising ensemble. WICAM artist John Zorn demonstrates the influence of this aspect of African culture on his music thusly:

> It's true I pick the bands and in that sense the Ellington tradition, the selection of the people, is very important. Everybody is vital. You take one person out and the chemistry is going to be different. You need people who are aggressive, you need people who are going to be docile, you need people with a sense of humor, you need people who are assholes, you need a wide variety to really get the pice going and picking musicians for the most part is not so much 'I need a violin and I need a cello and I need a keyboard and I need a guitar', it's more the people themselves that are important.

Another important characteristic of African music that has strongly influenced WICAM is the acceptance of influences from external sources. The jazz tradition has arguably been the most accepting of outside influences of any musical tradition in history. This acceptance of change and innovation has deep roots in African culture, as can be seen in the traditional African quiltmaking practice. "The acceptance of incidental changes as creative offerings (unlikely in the Anglo tradition) affirms an innovative process that originates beyond the conscious domain and is basic to improvisation." (Leon 1988). "Accidents are also embraced in African-American patchwork; piecing is seen as a process in which interesting things can happen that aren't entirely controlled by the quiltmaker. 'Mistakes' may be acceptable, or, not seen as mistakes at all, they may be welcomed as an integral part of the creative process." The acceptance, indeed the deliberate courting of events outside of the creator's control, such as the squeaks and strange distortions produced by saxophonists such as Albert Ayler and Roscoe Mitchell, may be behind the noted avoidance of formal measuring in African quiltmaking practice as well as the performance practices of WICAM. The affinity for diversity and heterogeneity in African artistic practice, also noted by Leon, resonates with the "heterogeneous sound ideal" noted by Floyd (1995) as being a common trait of all traditional African music. Almost all African music is characterized by multiple layers of widely divergent

sound sources.

Floyd theorizes that many of these traditional African values stem from a belief in the possibility of group "possession" by spirits, or the expression of supernatural forces through groups of people, which characterized African spirituality and which continues to play a central role in the spiritual practice of African Americans to this day. Certainly there is a wealth of evidence presented in Floyd's work to support such a connection. These core African values – emphasis on the specificity of time, place, and personnel; the courting of external influence; avoidance of strict rules of measurement; emphasis on heterogeneity; respect for all participants – all are underscored by belief in the possibility of and desire for collective action under the influence of "spiritual" forces, and all are also values evident in the jazz tradition, and have been carried over from jazz into the musical practice of many contemporary improvisors. Berliner (1994) cites several accounts of jazz performers for whom the experience of improvising together is very spiritual, and specifically very similar to their early participation in African American church services. Of such accounts, Berliner writes:

> Such accounts hearken back to those told earlier by soloists who, during the heat of their own part's conception, occasionally feel as if their creations come from outside themselves. The collective aspects of improvisation give a literal quality to these impressions, perhaps intensifying them by presenting an ongoing dichotomy between inside and outside sources of musical ideas, any of which can stimulate individual players.
>
> At some moments, the rapid interaction of improvisers blurs these distinctions altogether. The effect is to dissolve the boundaries that normally separate musical imaginations, sensitizing artists to the "telepathic" receptivity mentioned earlier, thereby creating a deeply satisfying sense of unity within the group. (p. 392)

These observations lead one to ask who or what these external spiritual forces might symbolize in African beliefs. Another scholar of African music, John Miller Chernoff, gives us an answer when he writes:

> In the African context, performance in music and dance responds ultimately to a single aesthetic concern, the realization of community. ... African music and dance are not performed as an unrestrained emotional expression; fundamentally, African music and dance are ways of posing structures and restrictions for ethical actualization, and the spiritual element present is one of wisdom. ... Symbolically, the drum is the "voice" of the ancestors, those who watch over the moral life of a community, and proper drumming and dance are founded on a sense of respect and gratitude to the ancestors for the continuity of the community which uses music and dance to restructure and re-focus its integrity as a source of strength in the lives of its members. The elders, to put it most simply, participate best because they know more dead people, and their drumming and dancing will communicate and contribute their greater awareness of the deepest moral forces which can serve to bind the living community. African music and dance are art forms which permit them to demonstrate and express this wisdom for all to see. (pp. 149-150, emphasis added)

Berliner also writes of this common thread between traditional African community values, the performance practices of African drumming, and African-American jazz:

> In Ghana, for example, traditional compositions for singers, dancers, and percussion orchestras commonly include multilayered cyclical parts performed by several drums that support the master drum part. ...Individual parts produce different schemes of counterpoint with each of their neighbors as their patterns alternately reinforce or cross over one another within the larger musical texture. ...In the New World, early African American composers strove to preserve a semblance of the rhythmic life of their musical heritage within the comparatively simple framework of European music composed in single meters ...When African Americans interpreted European pieces in light of their own values and performance practices and adopted their structures as vehicles for original composition, they commonly increased the music's rhythmic complexity by accenting the weaker upbeats or backbeats... (pp. 148-9)

While it may be a stretch to claim that all WICAM performers are consciously making efforts to demonstrate their connections to the "voices" of their ancestors, it

can be argued that such a spiritual element is present in all improvisational practice, whether explicitly strived for or not. It is an element made present by the successful practice of group improvisation itself, for to improvise well, performers must reach beyond the self into the collective consciousness of the community. They must find a way to integrate their voices into that of the group without destroying the balance of control in the group, just as a skilled African musician will tend to add a new rhythm, one that fills in the gaps, to an improvising drumming ensemble (Chernoff, p. 144). Musicians who succeed at this are, whether they realize it or not, exemplifying the very core principles of African spirituality.

1.2.3. Conflicts between European and African Musical Culture

The marriage of European and African culture that gave birth to WICAM has certainly not been without conflicts. Although it is clear that there has always been a very active cross-fertilization between the worlds of jazz and concert music, this exchange has been, until recently, extremely one-sided. While jazz musicians struggled, often in the face of brutal cultural insensitivity, to gain acceptance into the so-called "legitimate" musical community, the "hard core" concert music establishment, as represented by the institutions of musical education and professional symphony orchestras throughout the West, has to this day showed hardly any interest in adopting the core practices of jazz, most notably group improvisation. Even during the 1960's, when there occurred a brief flowering of interest in improvisation within the contemporary concert music "establishment", composers experimenting with incorporating improvisation into their work (notably Globokar, Henze, Kagel, Stockhausen, etc.) for the most part were careful to distance themselves from jazz. The failure of these composers to acknowledge the contributions of the jazz tradition to their work left many improvisors from the jazz community feeling "ripped off" (Lewis, personal communication).

There has also been great animosity within the Free Jazz community itself between anti-formalist jazz musicians and their formalist critics, whose efforts to

legitimize contemporary improvisation have been noted by Radano (1993) as having long been a target of skepticism and derision from jazz musicians. In particular, the use of the term "art music" is problematic with respect to the culture clash between the institutions of jazz and "classical" music. Particularly among jazz circles, as Radano points out, drawing a distinction between "art" and "popular" music – between "high" and "low" culture – has been seen as an attempt to disenfranchise certain groups, especially non-white, non-university-educated musicians. In addition to legitimacy, there has been contentiousness concerning who was first with this or that innovation. According to Lewis (personal communication), the "legitimate" European-based stream, through its greater access to media exposure, has generally empowered to decide (always in its own favor) concerning such matters.[6]

Yet, in spite of the resentment felt by groups that have been ostracized from the art music community in the past, Radano also points out that members of these same groups have, in fact, integrated many of the values of that community into their work:

> ...it would be hard to ignore the contradiction between the musicians' efforts to distance themselves from Western artistic notions while simultaneously pursuing exceedingly Western, progressivist artistic goals. There is no doubt that the AACM players embraced modernist views of style and greatness. They valued originality; they recognized virtuosity; they looked up to the same jazz "masters" honored by the critical community. Quite clearly, they, knowingly or not, acknowledged the critical standards and measures in which jazz, as an American form of "popular entertainment," had been situated over the years. (p. 104)

Indeed, it may be difficult to reconcile the resistance to the "art music" label from many improvising musicians with the fact that these same musicians frequently exhibit such strong alliances with various "art music" developments of the twentieth century: dodecophony, microtonality, open-form compositions, graphical and other alternative forms of "notation" (esp. Braxton & Oliveros), extended use of "noise"

[6] Some might find this point debatable, considering the generally greater visibility of the Jazz-based musicians in popular culture relative to "classical" musicians.

elements, etc. Clearly, it is not the musical materials themselves that are the source of contention between these groups. Rather, the conflicts have been about access to the privileges of "legitimacy", as defined by and within the "classical" music community, traditionally conferred exclusively upon members of prestigious academic institutions. Members of this "legit" establishment – predominantly white, upper middle-class males – have traditionally enjoyed full, government-funded economic support, and therefore were not under any pressure to obtain an audience for their music, thus permitting the modernist "Who-Cares-if-you-Listen?" stance championed by Milton Babbitt to flourish. Meanwhile, groups operating on the "fringe" of academia such as the Association for the Advancement of Creative Musicians (AACM), who until recently had been denied access to sheltered university positions, were forced to rely mostly on performing and recording for their livelihood.

One of the major issues underlying the notion of legitimacy has been the question of musical competency. Different musical traditions have vastly different ways of measuring this. In the WICAM community, technical competency is much more connected to the ability to improvise innovatively and expressively and to participate effectively in group improvisations, whereas in the "classical" music community, competency is measured by one's ability to sight read musical scores, to perform "great", complex, difficult works accurately, and to perform confidently and expressively as a soloist or under the guidance of a conductor. The specialized training required to achieve competency in classical music has historically been used as a kind of "screen" to filter out musicians whose talents were not well-suited to careers in the classical music field. In applying such criteria, however, the academic musical establishment implicitly upheld standards of traditional Western classical values to the exclusion of all foreign systems and cultures.

Thankfully, in more recent years, the criteria for legitimacy in academia have expanded considerably. More and more academic institutions have opened their doors to musicians who have established themselves through their work outside these institutions, while at the same time, the power of the music academy to confer legitimacy has been greatly diminished by socio-economic forces. There has been a fairly widespread penetration of improvisational elements into the so-called

"mainstream" composition scene, as evidenced by performances of the works of composers such as Terry Riley, John Zorn, and Anthony Braxton by major ensembles, as well as the appointment of people like Braxton to university faculty positions. Through the efforts of organizations such as the American Composers Forum, "Meet the Composer" grants, etc. as well as the rise of independent music production and distribution channels, improvised art music has found an increasing penetration into the non-academic community as well. Along with the narrowing of this schism, the hegemonic connotations of the term "art music" are beginning to fade, although one certainly still encounters improvising musicians both inside and outside academia who bristle at the suggestion that they are making "art music."

A complete study of the myriad intercultural tensions pervading contemporary improvisation would necessitate a thorough investigation of the relationship between the various subcultures of its practitioners to the Euro-American "superculture." One could conceivably argue that state of the art of new improvised music is really a collection of "micromusics" (cf. Slobin, 1993), each belonging to its own subculture. Certainly, it is true that many of the more famous pioneers of the WICAM style have developed "schools" or quasi-formal systems and practices of their own: Pauline Oliveros' "Deep Listening" and Ornette Coleman's "Harmelodics" are examples. This general line of thinking – the appreciation of the unique qualities of groups operating outside the mainstream – has increasing much popularity in the humanities in recent decades. Thankfully, nearly gone are the days when improvised music was regarded by academia from the same "primitivist" stance as it viewed other oral traditions. There seems to be a general recognition that a "clustering" of culture has occurred in Euro-America, and that each cluster bears a distinct relationship to the superculture.

Yet as important as such a study would be, it also seems useful to consider the possibility that a certain subset of today's improvisation-based "micromusics" share sufficiently important connections to the past and to one another to be called a genre. By offering the preceding disclaimers, as well as the explanations in the following paragraphs, I wish to emphasize that my efforts to define this genre, and my use of the politically-charged terms "Western" and "Art", are not acts of silent hegemony, but rather, to draw upon an important distinction made by Monson (1996, p. 120), merely

the articulation of an ideology which I believe unites many of these micromusics in some important ways.

1.2.4. Criticisms of Improvised Art Music

Practitioners of WICAM have long been regarded as being "fringe" elements of the musical establishment. As Richard Teitelbaum writes in the liner notes to the CD "Duet: Live at Merkin Hall" of his meeting Anthony Braxton at the notorious "Actual" Festival in France, 1969: "It's probably not surprising that we all met at a 'festival-in-exile', being pretty much all exiles ourselves – exiles from orthodoxies both musical and political that continue to this day." Braxton himself is quoted in the liner notes to his CD "Duets (with Marilyn Crispell): Vancouver 1989" as saying "It can be very intense trying to find enough money to live on. When you're playing the kind of music that I'm playing, certain avenues aren't open to you."

While the public's general disregard of WICAM is no doubt due more to social trends than true criticism, the typical reaction to WICAM by the average Western listener is one of confusion, displeasure and derision. Heteroriginal music is often accused of being both less imaginatively structured and less orderly than music produced monoriginally. Pierre Boulez, a powerfully outspoken critic of modern improvisation, has written

> Often, these improvisations are nothing more than pure, sometimes bizarre, samplings of sound that are not at all integrated into the directives of a composition. This results in constant arousal and appeasement, something I find intolerable. . . . The dialectic of form takes precedence over the possible; everybody appeases everybody else; it becomes a kind of public onanism. (quoted in Attali, p. 146)

Boulez' criticisms of improvisation, representative as they are of an entire "genre" of such complaints, seem to boil down to the following assertions:

1) Most pure improvisations lack large-scale formal organization; events seem to follow one after the other with no discernible continuity or "theme."

2) The aesthetics of improvisation are based on "arousal and appeasement" – in other words, improvisors are guided by simple sensual gratification rather than pushing or challenging themselves to produce startling or difficult sounds. This critique implies that improvisation requires no special talent, has no criteria for "greatness," and is therefore a morally degenerate form of music.

While it is not the purpose of this dissertation to "disprove" such statements, it seems appropriate to offer a few responses to these criticisms here. The criticisms are based on criteria of value and greatness in music belonging to the western Classical tradition, which, it is true, few contemporary improvisors adhere to, and to which many are in fact deeply opposed. Because of the deep differences between monoriginal and heteroriginal values, it is tempting to dismiss comparisons between heteroriginal and monoriginal music as being between "apples and oranges." On the other hand, one could defend WICAM by pointing out examples of improvised music with very high levels of thematic unity or rather sophisticated formal structure, both at the large-scale and middle-ground levels. Neither of these defensive strategies, however, really gets at the heart of the matter.

In this dissertation, I will lay out several structuring principles that can be shown to operate in WICAM; principles which can and do, when properly perceived, impart a strong sense of direction, integration and meaning to improvised music. I will show that these structuring principles are often based on symbolic exchanges of a much more complex nature than mere "mutual appeasement," and that the complexity of interactions in an ensemble can often reach astonishing levels. Yet, it must be recognized that there are certain problems inherent in producing improvised music for which performers do tend to resort to certain common (some might say banal) solutions. Recordings of improvised music are often presented as "excerpts" from a longer performance, with beginnings or endings which "fade" in and out. This reveals the fact that sometimes it may take a while for the music to really get "cooking," or that endings frequently sound unconvincing or arbitrary. There can be no denying that there is a trade-off between the qualities of immediacy and spontaneity in improvisation and properties of organic order, efficiency, formal "completeness" and

the thorough working out of ideas one finds in the masterworks of monoriginal music. While I contend that they do exist, I do not feel that it is these structural qualities which give improvised music its primary power; it is, rather, the very direct intensity of emotion, intimacy, spontaneity which gives WICAM its power to communicate instantly to an audience. To condemn a musical practice because it brings immediate pleasure to both performer and audience is a vestige of a stagnant and increasingly defunct modernist aesthetic.

1.3. The Function of Music Analysis Frameworks

A "framework," as I will use the term here, is a set of internally-consistent abstractions which help people organize their thoughts and observations about a particular subject. Frameworks are often used as a way of simplifying and guiding the analysis of complex phenomena. It is important to note, however, that while music analysis frameworks may help produce better analyses, no framework can ever hope to accommodate equally well *all* music of a given style, and it is inevitable that some pieces will fit under the framework better than others. With a solid analysis framework for improvisation, however, we can hope to become more articulate about its structure, and come to better understand how improvising musicians go about solving musical problems. The framework presented here should make a useful pedagogical tool, as well as an aid to composers interested in creating pieces of interactive music.

The reader should also note that it is not the author's intention to promote the framework as a yardstick for artistic quality. Music analysis does not yield, as its output, a measurement of the quality of the analyzed work. There is no observable relationship between the "analyzability" of a piece and its success or failure as a work of art (c.f. Pressing, 1987). Neither will this work attempt to evaluate or explain the specific choices (notes, timbres, rhythms, scales) of any individual player. My objective is rather to bring to light some of the structuring principles in musical interactions between players, as seen in the appropriate cultural context, in hopes of encouraging a deeper understanding and appreciation of the beauty and complexity of

interactive music. I do not fear, as some might, that bringing these principles to light will somehow destroy the "mystery" of the music; on the contrary, the more I discover about the complexities of performer interactions in improvised music, the deeper my appreciation grows for those who have mastered this most difficult art.

In closing, I feel it necessary to mention, in light of expected criticism from followers of French deconstructionism and other anti-hegemonic movements of postmodern critical thought, that the theoretical constructs presented here, though they may appear overly formal and suspiciously positivistic, are merely intended to enrich the available tools for improvisation analysis, not to establish a new "school" of thought or lay down dogmatic "laws" which limit, rather than extend, one's thinking. My aim is simply to present a number of "hooks" onto which we may hang our observations on improvised music, much as the "frames" used in artificial intelligence help researchers to build models of other complex processes of the human mind. I have tried to avoid the temptation of imposing the evaluative standards of Western musical scholarship onto this body of improvised work, even though I feel strongly that much of this music would, in fact, fare quite well under those standards. Finally, this work is by no means a systematic or comprehensive theory or framework for *all* improvisation. Rather it is a model, or a metaphor if you will, that enriches the conceptual material with which it makes meaningful contact, and leaves the rest alone.

2. Survey of Background Concepts and Literature: Perspectives on Improvisation and Interaction

I believe that humanity has been forced to the edge of a new frontier by the accelerating rate of change instigated by technology. This frontier is the exploration of consciousness: all forms of consciousness and especially human consciousness. A commonality might be found in the sensory and attention processes which enable humans to perceive, organize, interpret and interact with the intelligence that is music. It is no longer sufficient to dwell only on the music; the perceiver must be included. The analysis, understanding, and possible expansion of such sensory and attention processes, as distinguished from the content or results, with and without the aid of technology, will greatly influence the future of music.
- Pauline Oliveros, Software for People, p. 40

The study of performer interactions in contemporary improvised music requires perspectives from many disciplines: sociology, psychology, cognitive science, cultural studies, communication theory, and more. As improvisor Nancy Briggs has written, "current practices of improvisation must be understood as something unique. Traditional analytic methodologies can be applied with success only sparingly." (Briggs, p. xi) No single perspective or discipline can adequately describe the phenomenon. In addition to the extensive literature on music performance from the perspectives of psychoacoustics, psychophysics, psychology, sociology, cognitive science and applied mathematics, there are a few excellent studies on group musical improvisation itself, particularly pertaining to jazz music.

Interacting with our environment is central to our functioning as living beings, and critical to our survival as individuals and as a species. Interactions occur on all levels – physical, emotional, spiritual – and may range in complexity from the most basic and straightforward to the most subtle and sublime. Our central nervous system has evolved specifically to enable us to interact with our environment: for example, extreme heat interacting with our flesh produces a reaction of pain, which alerts us to the fact that tissue damage has occurred or may occur soon; a loud noise or flash of light may trigger an instinctive "fight or flight" response, etc.. As our

higher reasoning develops, humans quickly develop special attention to the complex interactions of language. Children learn very early (perhaps even while still in the womb, according to some research) to recognize and respond positively to the voice of their mother, for example. Children rapidly learn to recognize and replicate certain vocal sound patterns, which they learn to associate with the various objects, living creatures, and assorted phenomena that they encounter in their world. They also learn to produce sound-patterns which express their emotions and desires, and which can effect change in others: "I'm hungry," "I want that," etc. This process occurs with such little apparent conscious effort on the part of children that many researchers have come to believe that the human brain comes "pre-wired" for acquiring such linguistic skills. Therefore, it is logical to assume that events which seem somehow similar to speech should more readily capture our interest, and indeed, much of the most popular music in history bears many similarities to speech, if not actually including speech as a component. Parallels between music and speech (noted by Sundberg, Clarke, and many others) may provide a plausible explanation as to why certain kinds of music seem to be so much more popular than others. There is much evidence to support the theory that the rhythms and cadences of human speech – by far our most pervasive and most deeply-embedded improvised interactive activity – form the basis for many of our expectations about musical behavior.

Speech, however, is not the only area in which humans learn to improvise interactions with one another. Almost all aspects of everyday life involve some kind of interaction with others – driving, walking through a crowded area, negotiating prices, etc. Group musical improvisation must be seen as a special sub-domain of human social interaction. As Lewis writes, "Musical improvisation is one domain among the various possible domains of improvisation – an interaction within a multi-dimensional environment, where structure and meaning arise from the analysis, generation, manipulation, and transformation of sonic symbols" (personal communication, my emphasis). Because of this multi-dimensional aspect of musical interaction, there are many fields of academic inquiry that can and must inform this study. Traditional music theory alone is insufficient because it has historically been

focussed almost exclusively on monoriginal music, and therefore lacks analytical tools. Neither, however, can we simply graft theories from sociology or linguistics onto the musical domain without adaptation. Like the proverbial blind men approaching the elephant, we require information from multiple perspectives in order to achieve a true picture of the whole phenomenon. In this section, I will summarize what I have found to be the most revealing of the existing literature pertaining to interaction theory and analysis, concentrating on the ideas that I have found the most relevant to the analysis of heteroriginal music.

2.1. Linguistic Perspectives

When an event [the advent of structural linguistics] of this importance takes place in one of the sciences of man, it is not only permissible for, but required of, representatives of related disciplines immediately to examine its consequences and its possible application to phenomena of another order.

Claude Levi-Strauss, Structural Linguistics, p. 34.

Because musical reality manifests itself in various ways, we have to ask what the relation is between expression and content (signifier and signified) in each mode (tactical, visual, physical, phenomenal) and whether the different musical modes can be translated into each other, thus making possible the continuity of the musical process.

Eero Tarasti, A Theory of Musical Semiotics

Any inquiry into the nature of improvised music must begin by addressing the thorny problem of musical meaning. As symbolic interactionist Herbert Blumer has written, "People respond to things on the basis of the meanings those things hold for them." If we accept Blumer's statement as true (and it is difficult to imagine otherwise), it follows that improvised musical interactions, in which players are expected to continually respond to one another, must involve a meaningful exchange of some kind among the performers as well as (ideally) between performers and audience. Any attempt to circumvent the issue of how such meanings are transmitted and received will ultimately lead to essentially empty descriptions of sonic surface features.

Theories concerning how music generates meaning have been most forthcoming from the field of semiotics, the study of sign systems. Many theorists have pointed out the benefits of applying the analytical tools of semiotics to music. Semiotic approaches to music are highly formalistic in nature (owing to their roots in structural linguistics), and are characterized (according to Tarasti) by the study of the "smallest significant units" of a sign system. One of the chief contributions of structural semiotics to my analysis framework has been the realization that the various modes of musical interaction can be built up from small syntagmatic "units" of musical signification which function within a paradigmatic sign system. It is this general approach to analyzing relationships between expression and content, to transforming various modes of expression into each other, that makes semiotics such an important part of the foundation for my analysis framework.

As an illustration of the application of linguistic analytical tools to music, Perlman and Greenblatt (1981) propose a similarity between the "syntactic structures" of grammar (as outlined in Chomsky's *Syntactic Structures*, 1957) and the harmonic structure of tonal jazz improvisation. Their paper presents an analogy between the chord changes underlying an improvised jazz solo and the "deep structure" of English grammar. To support this analogy, they point out that grammatical structures and harmonic progressions share the common attribute of supporting multiple "surface realizations":

> Just as one linguistic deep structure can be realized by several different paraphrases (*John seems sick ~ John is seemingly sick ~ It seems [that] John is sick)*, so can certain chord sequences form the basis of dozens of songs.

The analogy does have a certain appeal, and can be taken even further than Perlman and Greenblatt do in their paper. One can imagine applying similar criteria of "completeness," for example, to both English sentences and chord progressions: a complete sentence must have both a subject and a verb, while a "complete" chord progression requires both tension and resolution. Transitive verbs require objects, while intransitive verbs do not. Thus, "*John likes*" is incomplete, while "*John*

sings." is complete. Similarly, the progression Bm7 - Dm7 - G7 is incomplete (unresolved), whereas Dm7 - G7 - C is complete (resolved). One might say that certain chord functions are more "transitive" than others, or that the "goal" chords in a given key function like the objects of transitive verbs.

Unfortunately, in spite of these structural similarities, there are major differences between the ways in which music and language convey meaning. The problem with making strict linguistic analogies to improvised music is revealed by the explanation given by Perlman and Greenblatt as to how meaning is generated in jazz improvisation. They claim that "the meaning of a phrase (of improvised jazz) is its history, that is, where it comes from." According to the authors, an improvisation is only meaningful for a listener if they have heard something previously which they can relate the piece to. However, as the authors themselves admit, this argument is contradicted by the success of avant-garde musical "geniuses," whom, as the authors themselves point out, "make startling new phrases which are not immediately comprehensible *and whose meaning is the present, since they have no history, or since their history is concealed*" (my emphasis). Most listeners have had many experiences with music (both heteroriginal and monoriginal) whose "history" was utterly unknown to them, and yet was nonetheless extremely meaningful. Clearly, therefore, musical meaning cannot rest solely on reference to past experience. Unfortunately, the authors don't expand on their statement of how musical meaning can be "the present"; for a more complete explanation of this, we need to consider how meaning is generated by social, symbolic interaction.

Because of these limitations, linguistics must be seen as an incomplete, but useful, framework for analyzing musical interaction. As Roads has written:

> The grammar form, though not a perfect model for music, has clarified many issues involved in the representation of music structure. As shown, the major limitation of grammar formalisms for music is their treatment of context. Grammar forms have been superseded by multiple-perspective knowledge representations in many artificial-intelligence applications.

It is important not to get too carried away with the connection between musical

meaning and linguistic meaning, lest in building a framework we build in language-bound constructs that may limit or misguide our thinking. Since, as Davies points out, "our paradigm of the meaningful is the linguistic utterance," and since by far our most familiar sign system is that of written and spoken language, several researchers (such as Perlman and Greenblatt) have chosen to frame their deciphering of the semiotic logic of musical improvisation in grammatical terms. However, I am inclined to agree with Davies when he states that "music is not usefully to be compared to language with respect to its meaning, and it is more misleading than illuminating to highlight such parallels as there are." (p. 1).

Davies lays out a number of types of meaning, which I summarize as follows:

A: Natural, Unintended Meaning: *Dark clouds mean rain.*

B: Intentional Use of Natural Significance: *Pulling a sad face; "those spots mean measles."*

C: Systematized, Intentional Use of Natural Elements: *Constructing a set of rules which exploit a natural potential for significance.* (e.g.: Seconds and sevenths are more dissonant than thirds and sixths, and are therefore frequently used to convey tension or anxiety.)

D: Intentional, Arbitrary Stipulation of Stand-alone Meaning: *Meaning is stipulated or given solely by conventions. A bell might be sounded to signify that supper is to be served.* (According to Davies, most monoriginal music falls into this category.)

E: Arbitrary Meaning Generated within a Symbol System: *A symbol or sign has meaning as an element of "character" in an arbitrary symbol scheme that provides rules for the generation of meaning by the appropriate uses of these elements.*

Davies argues that music "is not a code in the way Morse is [(type E)]; it does not provide a translation schema for natural languages. Musical 'signs' stand alone and do not depend for their significance upon their place within a wider symbol system." Davies offers, as an alternative, the idea that music "has meaning by depicting, as pictures do, rather than describing, as language does; or perhaps music is a symbol

system of a distinctive type, doing its own thing in its own way," (pp. 48-49, my emphases). Perhaps because that "thing" music does has no better name, people tend to use the word "language" to refer to music's signifying power, as Curtis Fuller does in describing his early encounters with Jazz:

> Jazz was a street music in a sense, the kind of expression coming out of the black community. When I discovered Jazz, it was like going to some part of the world where I hadn't actually studied the language, but finding out that I could understand certain things immediately, that it spoke to me somehow. I knew that I would have to travel a long and rocky road in my endeavor to play jazz, but I felt like I already understood the language. (Berliner, p. 21)

This passage is quite telling; it illustrates Davies' point that the "language" of music operates at a pre-syntactical level; its ability to signify is not strictly dependent on the pre-education of the listener, though some people may be more naturally sensitive to it than others, and certainly one's *cultural* education plays a major role in one's ability to "understand the language" of a given musical style.

Anthropologist John E. Kaemmer, in his book Music in Human Life (Kaemmer, 1993), provides an excellent framework for the study of meaning in music, based strongly on literary and linguistic theory. In particular, he proposes a split between *denotative* and *connotative* meaning. He writes,

> When meaning is purposefully formulated in music by the persons creating it, the result is **denotative meaning**. Because it is purposeful, this kind of meaning is usually overt, meaning that it is in the discursive consciousness of the participants. Music also conveys **connotative meaning**, which is inferred by the listener from experience with the music. ... The difference between denotative and connotative meaning is not always distinct, but awareness of the two types provides a framework for considering the numerous ways that music conveys meanings. (emphasis Kaemmer's)

In heteroriginal music, meaning is generated connotatively, through the

systematized, intentional use of "natural" elements inherent in sound relationships. Although music is not exclusively formal in the same arbitrary sense that language is., there is, in fact, a symbol system involved, which is furthermore not arbitrary at all, but based on very fundamental dialectical tensions such as consonance vs. dissonance, sending vs. receiving, following vs. leading, supporting vs. ignoring, sharing vs. not-sharing, etc., making heteroriginal music more likely to make use of Davies' meaning "C." In Chapter 4, I will show how symbolic meaning can be derived from the modalities of interaction themselves, as distinct from the content of the sonic surface, which explains how, unlike language, music that may be unfamiliar in its sonic materials may still communicate meaningfully.

2.1.1. Group Improvisation as Conversation

In spite of the aforementioned distinctions between language and music, *conversation* remains to date the most widely used metaphor for the interactive behavior of improvising musicians, no doubt in part because it is an instantly accessible analogy which almost anyone can grasp easily. Clearly, conversation strongly resembles several of the common surface features of improvisation, as well as sharing some of its deep structure. Both musical and conversational interactors engage in a "turn-taking" process, but will also frequently overlap, "track," or imitate one another. Often, they will extend or complete each other's phrases, or pick up where the other leaves off, or "punctuate" the others' statements. Monson (1996) devotes an entire chapter to this analogy, providing musical examples from Jazz which illustrate these similarities. In the following paragraphs, I present the notion of *conversation-as-performance* as being of special importance, and provide musical examples from the WICAM literature which illustrate this point.

If we apply the speech analogy to the binary classification of music proposed in chapter 1, monoriginal music would be like a monologue, whereas heteroriginal music is like a conversation. However, I feel it is important when making this analogy to distinguish between everyday private conversation and

public conversation, that is, conversations before an audience. In private conversations, people generally do not pay as much attention to the "performative" aspects of their activity as they do when an audience is present. The pressure on performers to keep the conversation interesting and palatable to their audience produces a "tighter" quality to the interaction, and an emphasis on thematic continuity and drive that might otherwise be lacking in more casual private conversation forms.

Panel discussions, or radio and television "talk" programs are popular examples of public conversations. Public conversations may be the closest possible subjects for conversational interaction analysis to actual improvised music performances.

Consider, for example, the following excerpt of a conversation between a radio talk show host (in italics) and a caller discussing the O.J. Simpson trial, recorded on Thursday, January 26th, 1995:

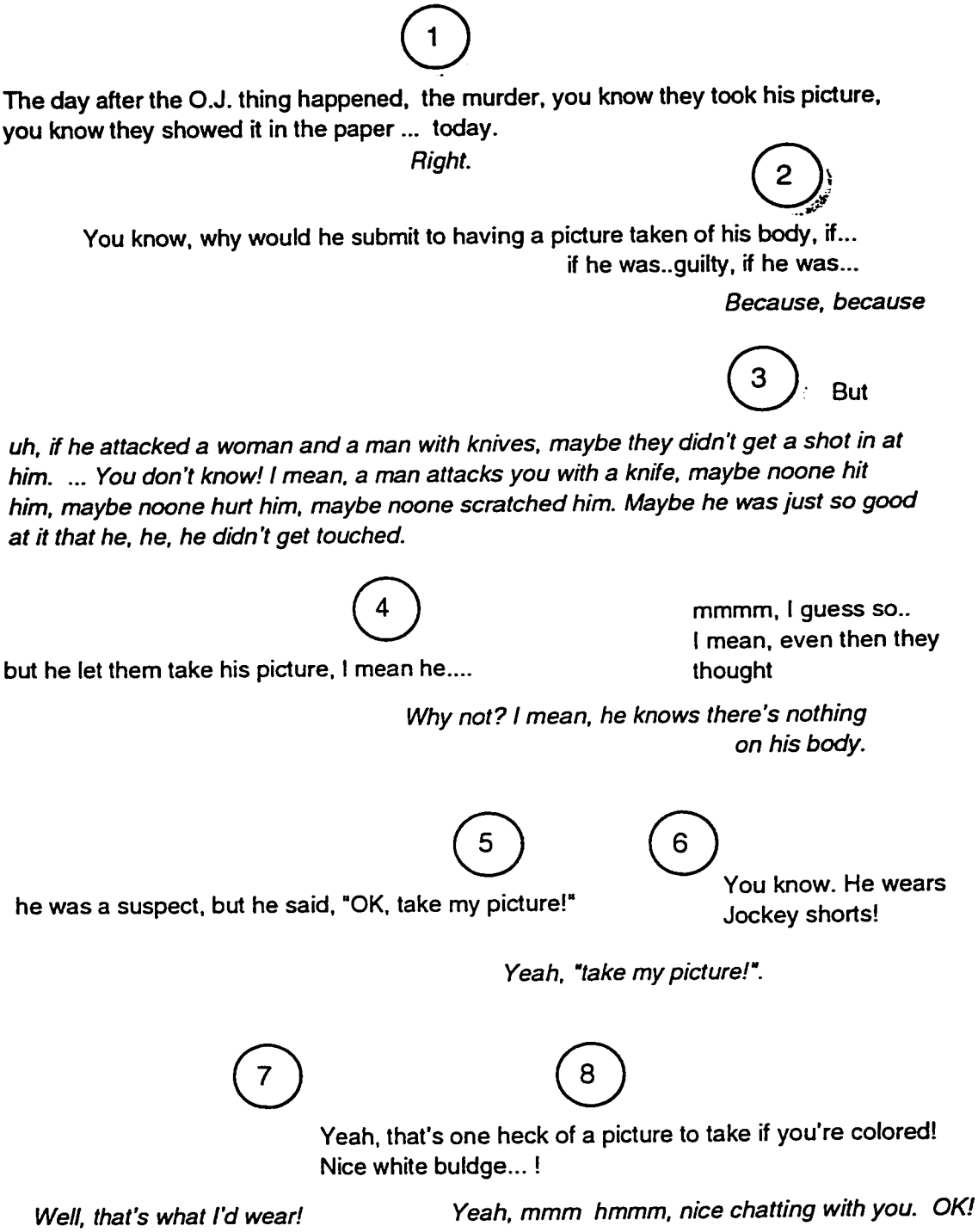


Figure 2.1: Talk show conversation analysis

I have labelled several important points of interaction in the conversation, where the

characteristic "turn-taking" exchanges take place. Below, each of these points in the conversation is analyzed.

1. Here, the host interjects the word "right" at a point in the caller's sentence just after the caller had paused just long enough to give the host the impression that the caller was finished, even though he did, in fact, have one more word to say. This demonstrates how even very slight pauses or stuttering can (mis)communicate closure. The word "right" serves to communicate the host's understanding and agreement to the caller. Perhaps the host felt the need to do so because the caller's frequent use of the phrase "you know," which functions as a way of "buying time" while one is formulating the next phrase. Because the conversation was taking place over the radio, prohibiting any visual cues, such phrases also serve as a kind of "audible nod."

2. The host jumps in, cutting off the caller in order to respond to his (possibly rhetorical) question. The caller's stammering tends to produce pressure for the host to pick up the thread of the conversation, to "keep the ball rolling." This also communicates to the caller (and the listening audience) a sense of urgency or strong emotion. This style of conversation is quite common in New York City and Boston, but in other areas of the country, it might be considered rude.

3. Now, it is the host's turn to let the caller know that he is winding up his statement by stammering (repeating the word "he"). While the host may simply be fishing for the next phrase, he is also communicating that he may be ready to complete his turn.

4. Again, the host interrupts the caller, responding immediately and passionately just after the caller completes his phrase, even though the caller appears to have more to say. The caller seems to be thrown off by this; his next comment seems more a continuation of his original thought than a response to the argument presented by the host.

5. Here, the host *imitates* the callers words as well as the intonation with which they are spoken. This is another form of "audible nod," particularly because it is proceeded by the word "yeah," indicating agreement. Musicians often use this technique to indicate support for a fellow improvisor, imitating a particularly agreeable or thematically important sound or gesture.

6. The caller acknowledges the verbal "nod" from the host with the words "you know," then proceeds to change the subject.

7. Again, the caller here simply continues with his train of thought, not seeming to respond to the humorous interjection of the host. This behavior may be taken as an indication of a lack of "competence"on the part of the caller, or a deliberate ignoring of the host.

8. As the tenor of the conversation becomes increasingly crass, the host begins overlapping the caller, eventually ending the conversation altogether.

The cymbal playing of percussionists Billy Higgins and Ed Blackwell behind Scott LeFaro and Charlie Haden's bass solos during the last "free" section of Ornette Coleman's seminal 1961 recording *Free Jazz* (c. 30:00 -31:00) makes an excellent subject for comparison to conversational performance, because it is strictly structured according to a "turn-taking" principle. A transcription of this segment of the music appears below. It does seem evident that a "dialog" of some kind must have been going on between the two drummers. However, even in this very unusually dialogic example, there are many aspects that are not common to conversation: the attention to development, for example, and the repeating "motif" of Blackwell's two stroke pattern. It is clearly a "cymbalic" exchange, but the meanings of the cymbals can only be roughly guessed, and they seem somewhat arbitrary and perhaps even humorous when expressed in linguistic form. However, a literary interpretation of this interaction, one which resonates well with popular contemporary theories of African-American cultural expression, would be to view

this exchange as an example of "Signifyin(g)," a seminal concept in African-American literary criticism coined by Gates in his 1988 work "The Signifying Monkey." Signifyin(g) (the absent g, Gates explains, is "a figure for the Signifyin(g) of black difference") involves the repetition and re-figuration of symbols. Gates writes:

> Improvisation, of course, so fundamental to the very idea of jazz, is "nothing more" than repetition and revision. In this sort of revision, again where meaning is fixed, it is the realignment of the signifier that is the signal trait of expressive genius. The more mundane the text ("April in Paris" by Charlie Parker, "My Favorite Things" by John Coltrane), the more dramatic is the Signifyin(g) revision. (p. 64)

The materials of this passage couldn't be more "mundane" – an almost comically simple motif consisting of two cymbal notes – but Higgins keeps mockingly revising and embellishing the lick, while Blackwell sticks doggedly to the original pattern laid down by Higgins. It is almost as though the two musicians were acting out a scene from one of the tales of Esu, where Blackwell (playing the part of the dim-witted Lion) is "signified upon" by Higgins (as the Signifying Monkey). Indeed, it is conceivable that there might have been a subtext of competition going on here on a number of levels. Higgins' increasingly complex statements can be read as "mocking" Blackwell's stubborn repetition of the two-note pattern started by Higgins; likewise, Blackwell's stubbornness could be read as a way of making fun of Higgins' somewhat banal two-stroke gesture.

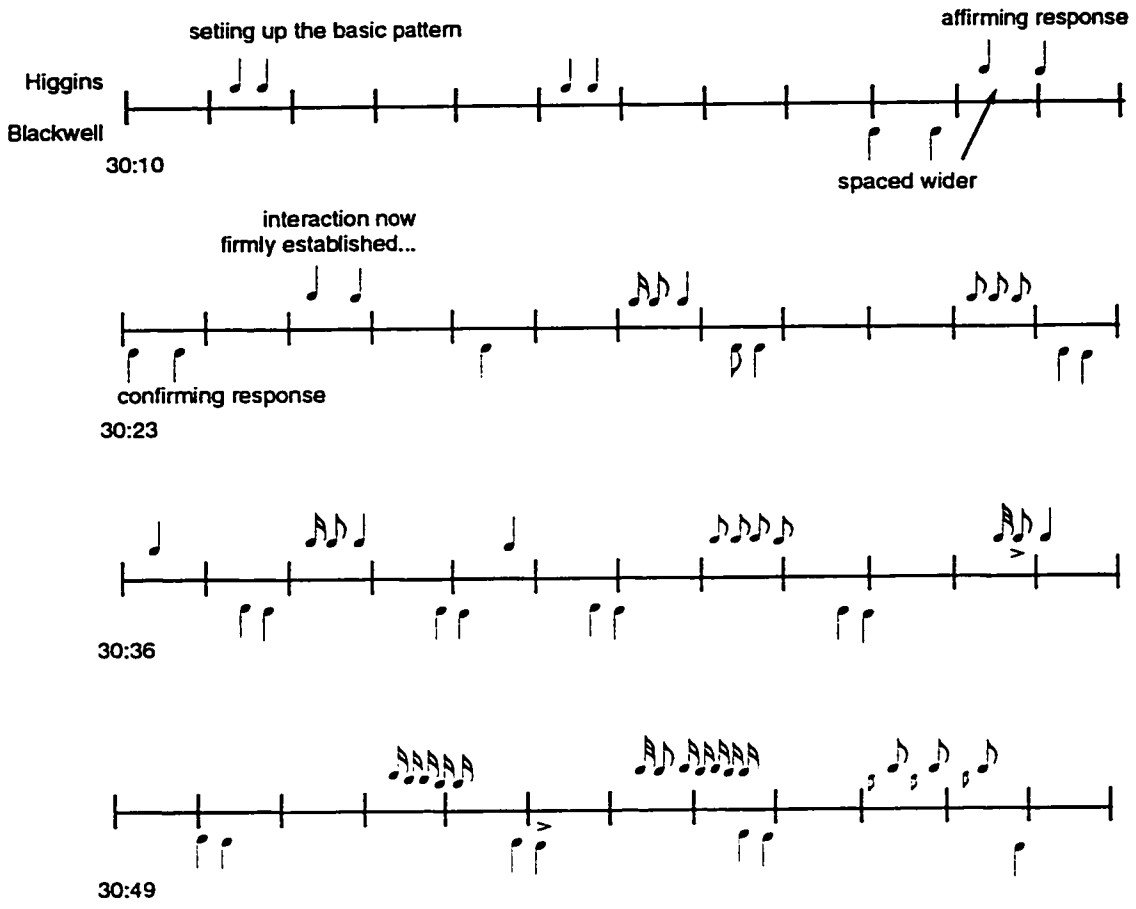


Figure 2.2: Higgins/Blackwell transcription (from Ornette Coleman, "Free Jazz")

If anything, the above examples show that there is much more to a conversation than simply deciding how and when to select the next speaker. At the *paradigmatic* level, conversation and musical interaction have a great deal in common. At the *syntactical* level, however, the unfolding of musical interaction is usually quite different from that of a typical conversation. Musical performances which bear literal surface resemblance to conversation are uncommon and usually seen as humorous (witness the audience's laughter during Mingus and Dolphy's famous "Live at Town Hall" recordings). Likewise, one hardly ever hears conversations that could really be described as "musical" on the surface; if it did, people's everyday conversation might sound something like operatic recitative!

The conversation analogy has proven to be particularly popular among designers of interactive computer music systems. Winkler (in press) states:

> Nothing is more interactive than a good conversation; two people sharing words and thoughts, both parties engaged. Ideas seem to fly. One thought spontaneously affects the next. Conversations assume much past experience and find excitement in shared experience. Conversations stay within a consistent context that creates a feeling of mutual understanding without being predictable.

The ImprovisationBuilder program designed by William Walker is based explicitly on a model of improvisation as conversation, which the author states was informed strongly by studies in conversational analysis (Walker, 1994). This system endeavors to emulate conversation by listening to musical input, generating related musical material with timing that "displays awareness of the other performers," and "employing timbral control as a coherent part of realizing musical materials." In his doctoral dissertation, Walker describes how his system employs the rules of conversation to guide computer-assisted musical interactions:

> Following the rules in the Sacks paper [on conversational analysis], the computer will defer if the current soloist explicitly selects the next soloist. Human musicians inform the computer of these decisions by simple keyboard commands, which are equivalent to the visual and verbal cues that humans use with each other. If no "speaker selects next" gesture is evident, the computer can attempt to self-select as the next soloist. Its likelihood of doing so can vary according to an "assertiveness" parameter. When self-selecting, the computer must monitor the other players to see if one of them is also attempting to begin a solo.

Rules of the kind that Walker employs in his ImprovisationBuilder program are clearly useful in modeling a basic system of turn-taking in musical interaction. The analogy works fairly well for certain traditional jazz forms where there is only one soloist at a given time. However, turn-taking is only one of several possible modes of interaction found in WICAM. Like their Free Jazz predecessors, (see section 2.2.2), WICAM players often improvise simultaneously, without taking on

clearly defined roles as soloists or accompanists. There is still a "give and take" of information, but it often occurs on several different musical "channels" or parameters at the same time (see section 4.1.1.c).

2.1.2. Group Improvisation as a Narrative Art Form

If conversation is our most readily available model for the *content* of heteroriginal music, then *narrative* may be considered an appropriate analogy for its *form*. Narratives have been used by humans for ages as a way of giving structure to the world. They are a sort of "pre-cognition – pre-epistemological or pre-scientific understanding of one's relationship with human beings, the surrounding culture, and the outside world." (Bang, in Andersen, Holmquist and Jensen, p. 210). Interactive time-based arts, in which the performers and audience are allowed to influence the composition, seems to require an even stronger narrative "glue" than monoriginal works, which (perhaps due to the more "fixed" nature of monoriginal works) is more capable of sustaining abstract, non-programmatic forms. Group-improvised musical performances thus tend to be conceived and/or perceived more like plays in which each performer takes on a certain "character," and the ensuing "dramatic action" consists of interactions between the characters (perhaps with the occasional soliloquy now and then).

In WICAM, owing to its roots in African myth and ritual, the overriding narrative form derives from African dance-possession rites and African-American spirituals, as illustrated by Floyd:

> The similarity of the jazz-improvisation event to the African dance-possession event [is] too striking and provocative to dismiss, but in the absence of a provable connection, it can only be viewed as the realization of an aspect of ritual and of cultural memory. Perhaps the elaboration of jazz improvisation from melodic paraphrase to running changes may be viewed as a long search for the essentials of spirit possession (although it would not be divine) and represents the closing of a circle: from ring shout to the beginnings of jazz (a derivation and

> a beginning), from the melodic embellishments of early jazz through the epic jazz tropings of the beboppers (including Coltrane), in which the essentials of the emotional fervor of the ring are appropriated. (p. 141)

This ritual element in WICAM may help to explain why so many WICAM performances seem to take on a similar "arch" form of slowly building to a climax and then (not quite as slowly) dying away again: such a form makes sense given the framing of such performances as possession rites.

Again, we can turn to semiotics to help gain an understanding of how these narrative elements are made manifest in music. According to Tarasti, narrative structures in Classical music are the result of the transformation of paradigmatic relationships into syntagmatic, temporal operations. (p. 32) Tarasti cites Rosen's observation that "'The move to the dominant in the first half of a sonata form is not merely confirmed by a full cadence on V at the end, but is marked by a decisive change of texture at a point between one-fourth to three-fourths of the length of the exposition' (Rosen, 1976, p. 229). A musical event presented in this way becomes a narrative element." In a great many pieces in the Classical era, the paradigmatic relationship between dominant and tonic which holds the dominant to be the penultimate chord of an authentic cadence is transformed into a dramatic "plot" whereby the arrival on V represents a "turning point" or "climax" in the narrative. Many other such connections between key areas and textural and rhythmic changes may be "read" in as having a narrative function. Narrative structures in WICAM operate in a similar fashion; paradigmatic relationships between performers are projected onto the temporal domain and transformed into narrative structures.

2.2. Game Theory and Multi-Agent Systems

Interactions among improvising performers have been likened by some artists and theorists to game-playing. Many improvisors, notably Anthony Braxton and John Cage (see Radano, p. 136), have professed a deep interest in highly-

structured games of encounter such as chess and Go. The analogy does have a certain salience, as illustrated by the following quote from Rinzler (1988):

> The jazz musician's goal is to fulfill the requirements of that musician's particular function at the time (for instance, to be a soloist or accompanist; to provide a chordal foundation, as a bassist or a pianist must; or to drive the music along or to lay back), and it can be achieved with varying degrees of creativeness and aesthetic sensibility within the norms of the style. Just as there is beauty in an "elegant" solution in mathematics and beauty in an "elegant" maneuver in chess, the jazz musician has the option of improvising an elegant solution to the particular musical problem presented. (p. 155)

Some composers, in fact, have used game-like strategies as the basis for compositions. Several early pieces of John Zorn, for example, are modeled after sports, such as

> ... Lacrosse, Hockey, Pool, Fencing, and I got bored with those and started using war games, kind of bookshelf games. The rule books were intense, so thick, you know, and if you write the rules out for [Zorn's game-based composition] Cobra they are impossible to decipher... (Bailey p.76)

In an interview with Derek Bailey, Zorn provides an explanation of one of his game pieces, entitled *Cobra*:

> I've created a series of about twenty different systems. Each one cued by the downbeat of a card. Any one of these basic systems can be called at any time by any one of the players at their whim. So what you get is a section lasting as long as the least patient person in the band who then says lets go somewhere else [sic]. (p. 77)

Likewise, composer/producer Brian Eno used role-play games as the basis for guided improvisations on the album *Outside*. As he writes in his diary *A Year With Swollen Appendices*,

> During the *Outside* sessions I was trying to find some new ways of

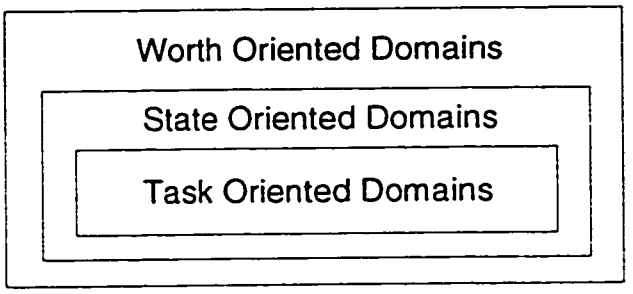
> making improvisations go somewhere they wouldn't otherwise. The usual problem with improvisational work is that it is either too homogenous (everyone settling in mutually familiar territory and droning on endlessly) or too chaotic (people making things that don't cohere in any interesting ways at all). ... It occurred to me that the great thing about games is that they in some sense free you from being yourself: you are 'allowed' forms of behavior that otherwise would be gratuitous, embarrassing or completely irrational. Accordingly, I came up with these role-playing games for musicians. (p. 382)

The branch of mathematics known as game theory was developed by von Neumann and Morgenstern to study various problems of conflict. It does this by abstracting common strategic features of theoretical models that are termed 'games' because they are patterned on actual games such as bridge and poker. Game theory has "opened up to mathematical attack a wide range of gamelike problems not only in economics but also in sociology, psychology, politics, and war." (Jones, 1980) Since game theory is concerned with "the mathematics of interactions, and particularly with the mathematical tools that can be used to analyze interactions" (Rosenscheim and Zlotikin, p. 17), it would seem to be potentially useful in the formal analysis of musical interactions (inasmuch as these are a subset of interactions in general). There is a similarity between game theoretical descriptions of human interactions and my own micro-score experiments in that both are analysis techniques which involve the creation of simplified versions of more typically complicated situations (see sec. 3.1).

Game theory can provide a good way of describing the surface mechanics of musical interactions. However, most traditional applications of game theory don't deal with issues of human perceptual functioning and higher reasoning involved in such interactions. Furthermore, most "multi-agent" systems assume that agents' individual and collective activities are directed toward a pre-defined, very specific goal. Techniques used in these systems focus on goal-directed reasoning in support of individual and group planning. Unplanned behavior occurs only when it is necessary to compensate for plan failure or when it happens to advance planned efforts to achieve established goals (Hayes-Roth and Brownston, 1994). However,

some research has been conducted toward the creation of "intelligent" agents: versatile and adaptive systems that perform diverse behaviors in their efforts to achieve multiple goals in dynamic, uncertain environments (Hayes-Roth, Pfleger, Morignot, and Lalanda., 1995). The formalisms developed in this research are particularly applicable to the formal description of the structure of group improvisation.

It is interesting to note ways in which musical interactions both do and do not lend themselves to game-theoretical analysis. Multiple Agent System (MAS) negotiation models present several formalisms that may be applicable to musical interaction. However, these formalisms are only applicable to the extent that the domains of musical interaction and negotiation theory intersect. Rosenschein and Zlotkin outline a three - tiered hierarchy of interaction domains: Task Oriented, State Oriented, and Worth Oriented. Task Oriented Domains (TODs) are a subset of State Oriented Domains (SODs), which are in turn a subset of Worth Oriented Domains (WODs). In TODs, an agent's activity can be defined in terms of a set of tasks it has to achieve. Negotiation is aimed at mutually beneficial task distribution. In SODs, each agent is concerned with moving the world from an initial state into one of a set of goal states. In WODs, agents assign a "worth" to each potential state, which captures its desirability for the agent. WODs are a generalization of State Oriented Domains (in SODs, the worth function is essentially binary – all non-goal states have zero worth). Rosenschein and Zlotkin provide precise, mathematical definitions of each of these domains, as well as defining the notion of an *encounter* in each domain type.



The Rosenschein-Zlotkin Game-Theoretical Domain Hierarchy

Figure 2.3

The key components of a Task Oriented Domain are *agents*, *tasks* and a *cost function*. Any agent is presumed to be capable of carrying out any task or combination of tasks. Thus, for example, we might assert that any performer in an improvisation is capable of effecting a change in tempo. Each set of tasks has an associated cost (determined by the cost function), which is independent of the agent or agents that carry it out. The cost of changing tempo would be assumed to be equal for each performer, for example. We could describe cost in a musical context as the degree to which a performer must contradict the previously established behavior of the group in order to accomplish the task. In the case of a tempo or key change, the more unrelated the new tempo or new key to the prevailing tempo or key, the greater the cost of making the change. Musical improvisation tasks often involve a two-step process: a performer must first develop a *plan*: e.g.: "I'm going to establish B as a tonal center"; she may then need to play louder or more vigorously than normal in order to get the group to pick up on her idea. This performer may have to temporarily go "against the grain" of the group in order to carry out her plan. The extra effort and risk involved in achieving tasks in a group improvisation are factors which contribute to the "cost function" of individual tasks.

State Oriented Domains add two new concepts to the Task Oriented Domain: *goal states* and *joint plans*. In SODs, the notion of task is replaced with the joint plan. The cost function must now take into account the agent's *role* in the joint

plan. Goals cannot be partially achieved. An example of a SOD-like situation in music might be the case where a group of musicians are attempting to end a piece or section together. This constraint may be placed on the group by a composer, or by some external referent (such as a film cue). The only acceptable "final world state," or goal, in this situation is that all of the players stop playing at the same time. This type of "collective task" is much more common in contemporary improvised music than the individual tasks of TODs. One very seldom hears in free jazz, for example, a single player or group of players attempting to singlehandedly change the tempo or "key" of the group; in fact, in most of the "classic" free jazz recordings, both tempo and key are rather difficult to pinpoint at any given time, especially during the "solo" sections. While some free jazz improvisors tend to play more "tonally" than others (Freddie Hubbard, for example), there is a definite avoidance of tonal centers and regular rhythms by the rest of the group.

Within the fields of Distributed Artificial Intelligence (DAI) and Multiple Agent Systems (MAS), of which game theory is a primary tool, "interaction" tends to be framed in terms of negotiation problems, which denotes "the process of several agents searching for an agreement" (p. 20). This description, on the surface, seems compatible with musical interaction, which is, after all, the product of multiple musical "agents" striving to make music together; but immediately we must define what is meant by "agreement" in the context of WICAM. There are many things improvising musicians often may attempt to agree upon during the course of an improvisation: tempo, key or mode, dynamics, and the overall style of playing are a few which come to mind. It's important to note that for musicians to "agree" on a tempo or key is not simply a matter of tempo following or key extraction. In such a "following" or "extraction" task, there exists a one-way "master-slave" relationship between the agents wherein the slave agent defers to the will of the master. Such situations in WICAM are relatively rare. When multiple agents have conflicting ideas about the optimal musical parameters for a given moment, a need may arise for a negotiation strategy to be employed by one or both agents. One performer may feel that the tempo of the piece is too slow, for example. This performer must

convince all of the other performers of this viewpoint by playing in such a manner as to communicate a) that player's desire to pick up the tempo, and b) an idea of what the new tempo ought to be. It may not be effective for this agent to simply start playing in the new tempo; she may need to start by playing more notes to the bar (a compromise that may gain her more control), and then perhaps by gradually picking up the tempo, she may be successful in bringing the rest of the group along with her. This process is definitely a kind of negotiation, which is indeed what game theory is all about.

On the other hand, musical improvisation usually involves a paradigm fundamentally different from those traditionally dealt with in the MAS field. The key differences between musical improvisation and the domains typically dealt with in game theory/MAS are a) novel plans, not constructed beforehand, are generated "on the fly" in response to the developing situation, and b) the agents may have multiple, complex goals which change during the course of the performance. One of the few research teams to deal with the domain of "directed improvisation" is that of Hayes-Roth and Brownston, who take theatrical improvisation as their model multi-agent system. Their work identifies many of the issues that distinguish directed improvisation from the Worth-Oriented Domains discussed above. In this extremely important excerpt, Hayes-Roth and Brownston point out the special nature of directed improvisation as a multi-agent system, in the process offering several key insights into the "heuristics" of improvisation. (I have altered a few words here, indicated by the use of brackets, to emphasize the excerpts relevance to musical interaction.):

> Directed improvisation emphasizes behavior that is situated, spontaneous, and opportunistic in the service of abstract and weakly constrained goals.
>
> ...
>
> Agents working in a joint production share a general goal to produce a successful joint performance that meets the constraints of the [composer's] directions. Although directions can vary in specificity, effective application of the paradigm typically involves relatively abstract directions that only weakly constrain the performance and

> give [the musicians] plenty of freedom to improvise. The working assumption is that producing the directed behaviors is easy; the art lies in the improvisation. The performing arts literature reflects this assumption in its prescription of two underlying cognitive heuristics for good improvisation: (a) *welcome possibilities* (Just let the [notes] flow. Do not fear mistakes. Turn off the censor. Look for relationships. Do not plan too far ahead.); and (b) *pursue promising possibilities* (Relate present actions to past actions. Keep the action on stage. Make the natural response. Listen and respond to your partner. Take it to the extreme. Accept, don't block, offers.) In contrast to the forward-looking, goal-directed reasoning and planning of agents in traditional paradigms, effective improvisers engage in backward-looking efforts to reincorporate incidental themes and behavioral qualities that they or their partners happen to have generated previously. Professor Patricia Ryan, who teachers improvisation at Stanford, describes the improviser at work as "a man walking backwards, trying to make sense of where he's been" (personal communication). In sum, the individual agent's behavior is firmly situated in the dynamic context, spontaneous in its short-term etiology, and opportunistic in its thematic relationships to other aspects of the performance. Ensemble behavior builds incrementally out of individual agents' actions and reactions. Achievement of the "goal" is not the specific product of a deliberate, provably correct process, but an emergent and uncertain epiphenomenon of the agents' real-time interactions. (p. 10)

Perhaps the most important overall "task" of improvising musicians is stated by Ornette Coleman in the liner notes to *Free Jazz*: to "play together, all at the same time, *without getting in each others way*" (my emphasis). This description places a strong value on the goal of non-interference, permitting the music to be described as a Worth Oriented Domain. The *worth function* of each agent will place a lower value on behaviors which violate this directive. This may help to explain why one rarely ever hears musicians "insist" on a faster tempo or a particular key during an improvisation. Ostinato passages, for example, are generally avoided in WICAM, because they tend to dominate the texture and constrain the musical "space." (The word 'ostinato' derives from the Italian for "stubborn"). Repeated patterns set up a periodicity that must be reacted to in some way (either ignored or followed), thus

changing the perception of the audience of anything the other performers might do. The process of group improvisation, as Hayes-Roth and Brownston observed, "demands intimate collaboration and shared control among agents engaged in closely intertwined and interdependent behaviors."

2.3. Cognitive Models of Musical Improvisation

The field of cognitive science has made some important contributions to the study of improvisation. In particular, computational methods, which allow for the simulation of musical interaction using digital computers controlling sound-producing hardware, have yielded many insights. The notion that creative musical behavior can be modeled and even simulated using computational methods has been around for quite some time, dating back far beyond the invention of the digital computer. (see Loy, 1988 for a fairly complete survey). While the music resulting from the application of such models has not achieved much critical acclaim, it has certainly been shown that computational methods can at least closely mimic certain functions of the human mind commonly associated with creativity, including the ability to respond to dynamically changing circumstances. Chess-playing computer programs are a famous example of this. Programs have been written which challenge even the world's greatest chess players. Such programs are only possible, of course, because of the reducibility of the task of winning a chess match to a set of separately solvable problems. The rules of chess and strategies for winning the game can be precisely defined in formal machine language, making it possible to design algorithms which can be quite effective, even against the world's best players. However, such programs offer a rather impoverished model of creative processes. After all, the strategies for winning a chess game are far more easily formalized than the "strategies" (if they can indeed be referred to as such) for creating engaging music. The success of chess-playing computer programs, as compared with that of art-producing programs, has to do with the fundamentally different kinds of creativity involved in winning a chess match as compared with creating art. Artistic performance demands a constant source of fresh, new ideas – something of which

formal methods have traditionally been assumed incapable of producing. The following sub-sections describe several of the most promising attempts to formally describe creative performance from the fields of experimental psychology, computer science, artificial intelligence, and the Arts.

2.3.1. Improvisation as Skilled Performance

Although in this thesis I focus primarily on group behavior, clearly we cannot fully understand the behavior of groups without understanding the cognitive mechanisms governing *individual* behavior. The branch of research most clearly dedicated to this understanding has been experimental psychology, which looks at improvisation as a "skilled behavior," akin to speech, athletics, or other kinds of specialized human functioning. By far the most complete modern treatment of improvisation as a skilled behavior is provided by Pressing (1984)[1]. Pressing acknowledges that one must look beyond musical performance research in order to obtain sufficient data on cognitive processes in improvisation. However, as he observes:

> There exists a large literature on improvisation in the arts, consisting mainly of: (a) descriptions by artists of their own improvisation processes; (b) analyses (e.g., by musicologists) of the recorded improvisations of artists; and (c) prescriptive teaching manuals written by artists. (p. 345)

Naturally, Pressing points out, literature from the time-based arts tends to be much more applicable to musical improvisation. However, he further observes:

> What is particularly striking is the similarity of general cognitive processes employed in many different areas of endeavor, when one penetrates beyond the specific language and traditions of each artistic discipline. (p. 346)

Pressing makes a number of insightful statements about cognitive processes

[1] I focus exclusively and extensively on Pressing's research here because it stands apart so dramatically from everything else in this field.

involved in improvisation:

> 1. There is a continuum of possibilities between the extreme hypothetical limits of 'pure' improvisation and 'pure' composition. These limits are never obtained in live performance because no improviser (even in 'free' improvisation) can avoid the use of previously learned material, and no re-creative performer can avoid small variations specific to each occasion.
>
> ...
>
> 2. Central to improvisation is the notion of the 'referent'. The referent is an underlying formal scheme or guiding image specific to a given piece, used by the improviser to facilitate the generation and editing of improvised behavior on an intermediate time scale.
>
> ...
>
> 3. On a faster time scale than in the typical in-time referent, intact behavior-encoded ideas, motives, or seeds are produced and manipulated by the performer. These seeds come from the referent, the performer's memory, or are freshly created.
>
> ...
>
> 4. All referent-guided improvisation systems, and even some free ones, stand in clear relation to a parallel repertory of compositions. That is, each such improvisation tradition has an associated group of devices used for development of ideas or seeds and those devices are in general very similar to those of the allied compositional practices.
>
> ...
>
> 5. The generation of seeds is an associative process. That is, each new seed generated will almost always be the result of combining previously learned gestures, movement patterns or concepts in a novel relationship or context.

Pressing claims this conservatism is due to limits on cognitive resources available for real-time composition, but admits that "all or nearly all improvisation traditions also proclaim the notion that completely new and unprecedented seed ideas sometimes spontaneously occur. The origin of such material is often ascribed to God, mysterious higher forces, or undefined transpersonal powers."

> ...
>
> 6. As a general rule, the larger the performing ensemble, the more restricted the scope for successful improvisation, and the more necessary a detailed referent to achieve overall coherence. ... An ensemble without agreed-upon common referent (e.g. free music ensemble) frequently results in a presentation of co-existing rather

than inter-relating streams. (p. 351)

Pressing goes on to point out that : "The body of psychological research most relevant to an understanding of improvisation is probably work on skilled performance. That is, improvisation may be viewed as a special kind of aesthetically constrained motor performance that maintains a commitment to high levels of real-time decision making." (p. 353, my emphasis) Pressing proceeds to break down improvisational processes along these lines. He refers to a chain of mechanisms leading from sensory input to motor output derived from the psychology literature on skilled performance, specifically Welford's *Skilled Performance*, 1976. This chain involves the following 3 steps :

1-perceptual coding of incoming sensory data
2-evaluation of possible responses and choice of response
3-execution and timing of chosen actions

There is some debate among researchers over whether stages 1 and 2 can run concurrently, but Pressing claims that "the automaticity of certain motor sequences shows that stage 3 can occur simultaneously with other processing. That is, the results of one decision can be performed while a new set of sensory data are being processed." The ability to process incoming sounds while playing is no doubt crucial to the attainment of competency in improvisation.

Next, Pressing attempts to answer the question "What goes on when improvisers practice?." This section includes a discussion of the so-called "peripheralist-centralist" debate. The crux of this debate is whether improvisation involves the invocation of "automatic" central motor programs ("licks"), or continuous sensory monitoring. Pressing relates this to the distinction between what he calls variously "object memory," "habit hierarchies," and "motor programmes" vs. "process memory" (compositional problem-solving) in improvisational practice. Although Pressing states no conclusions, he clearly believes (as do I) that both of these processes are involved, and that an overemphasis on one or the other can lead

to poor performance.

Pressing points out that feedback is crucial to the control of skilled improvisation. In particular, he emphasizes the necessity of the ability to recover from error in skilled improvisation. His paper includes a discussion of the role of feedback in successful error correction on various levels. (p. 354). Pressing claims that listening to recordings of one's own improvisations (a type of feedback) can improve one's ability to encode incoming information and recognize larger units. Such training "increases the appreciation of redundancy in the incoming sensory information." Pressing refers to a model proposed by Glencross in which the first two stages of Welford's chain, coding of input and response selection, "constitute an executive control system that is feedback-dependent." Pressing also discusses what he calls "feed-forward" cognitive methods, in which a player can "pre-hear internally a chosen motor action without relying on either memory or subsequent auditory feedback," as a critical component of musicianship.

Pressing notes that the two most critical variables in establishing the "complexity" of improvised behavior are *attention* and *memory*. He claims that older models of attention are inadequate because they don't allow for the "attentional flexibility characteristic of successful improvisation." Pressing prefers instead a "resource allocation" model, where attention is divided up into conscious and unconscious types. Pressing implies that unconscious attention handles automatic, spontaneous decisions, leaving the conscious attention more resources with which to operate. (p. 356) Pressing discusses some advantages of this "resource allocation" model of attention. He cites the example of a jazz drummer's ability to play a drum roll while improvising complex patterns with his feet and musicians' ability to rub their stomachs while patting their heads at apparently continuous gradations of tempi as counter-evidence of the old idea of attention as a 'single channel' processing capacity. He goes on to cite many examples from the psychology literature which bolster the idea that attention is not exclusively single-channel. To make a musical connection, he refers to Bailey (1992)'s accounts of the experience of improvisors whose "attention shifts fairly quickly between different

levels of meaning and structure." Over-emphasis on one factor is to be avoided during improvisation, just as airplane pilots are taught to avoid "tracking the needle." An opposite, yet related attention strategy is then presented which focuses exclusively on overall musical stability - "a global and diffuse attention strategy that attempts to leave all detail under the control of unconscious processing." Pressing claims "this strategy is normally considered to produce better music than the first."

Pressing explicitly mentions three points that his "resource allocation" model does not account for:

1) The finding of psychologists that "it is usually easier to divide the attention between sensory modalities than within one." (For example, it is known to be easier to read one document while listening to another than to read or listen to two documents simultaneously.) This contradicts Pressing's notion of splitting attention between conscious and unconscious processes.

2) This model of improvisational attention is centered around the near future and near past. This does not account for the use of long-term memory in the form of the referent as a guide over longer time scales.

3) The well-known difficulty even highly-skilled musicians have in performing two sets of timed motor actions (i.e. polyrhythms) makes it appear that relationships between subtasks contribute to the overall difficulty of a composite task.

Finally, in a discussion of the roles of short and long term memory during improvisation, Pressing notes that the development of music theory in long-term memory makes short-term memory more efficient; however, Pressing states that music theory training can also be constricting to the improviser because "the improviser yields the detailed control of fast events to previous (non-spontaneous) decisions, and introduces an element of composition." Fast time-scale decisions become less piece-specific and more training-specific. In other words, improvisers with a lot of musical training have a tendency to lapse into recall of well-practiced

licks, especially when the pace of the music increases.

2.3.2. Fuzzy and Neural Techniques

Since their inception in the late 1980's, there has been a fair amount of speculation about the potential of *neural* and/or *fuzzy* techniques to model creative cognition. At the heart of such speculation is the notion that if we could mimic brain physiology in software, we could then "train" such artificial brains just as we do real brains. With the ability to "learn," the theory goes, we could teach such systems to do virtually anything the human brain is capable of. A popular example was T. J. Sejnowski's "NETalk" program, which was trained to successfully synthesize speech from text without expert system rules. So-called "neural networks" and "fuzzy logic" systems have achieved at least one important property of all intelligent systems: they "adaptively estimate continuous functions from data without specifying mathematically how outputs depend on inputs" (Kosko, 1992). This "dynamic" property of these systems has led many, including Kosko, to speculate as to whether systems based on fuzzy logic might be capable of creativity. Kosko is quite explicit in his definition of creativity: "We call system behavior 'novel' if the system emits appropriate responses when faced with new or unexpected stimuli." Thus, Kosko proposes, we can mathematically model the creativity of a given system by the ratio of the volume of the "space" of appropriate responses it gives compared to the volume of the input stimuli "space" (p. 20). While this is an attractive proposal which may have some limited utility, it vastly oversimplifies the problems involved in artistic expression and has not proven to be generally useful. The theory and techniques of fuzzy logic are, however, quite promising as "modules" within a larger framework. One can certainly imagine many uses for a "fuzzy" phrase segmentation algorithm or tonal center extractor, for example. It seems intuitively true that many judgements made by improvisors about the nature of the input they receive is "fuzzy" in nature, rather than clearly belonging to a given category, an input stream may exhibit various degrees of "belonging" to each of several categories; for example, a melody may be mostly mixolydian but partially

dorian, if one analyzes a long enough time window. In a connectionist context, we might strengthen the activation levels of these "nodes" and weaken that of others[2]. Boden (1991) speculates that neural techniques offer close matches to the human creative process because of the many similarities between these techniques and those thought to be involved in human creativity: "training" (rather than programming), analogical pattern matching, a high tolerance for "noise" (the ability to recognize patterns in spite of small variations in the signal), and a certain kind of "contextual memory" (the current output depends on previous input).

The application of connectionist models to music in general has been extensively covered in Todd (1991). Some promising work in the area of sound synthesis using neural networks has been achieved by researchers at CNMAT (cf. Lee and Wessell, 1993). These techniques are still in their infancy, however, and there has been little to indicate that a radical breakthrough in modelling creative behavior with computational methods is forthcoming. Clearly, the "holy grail" of being able to "train" a computer to improvise effectively is still the stuff of science fiction. It is unclear as of yet whether connectionist methods will be any more successful than "traditional" computational methods at eliciting creative musical behavior from a computer, but West, Howell, and Cross have pointed out at least one fundamental problem with these methods:

> [Connectionist models] have not been very highly developed in the case of music. One reason may be that music is fundamentally a temporal phenomenon, and the representation of temporal interval or succession in connectionist models is difficult.

2.3.3. Hofstadter, Sequence Extrapolation and the Eliza Effect

Douglas Hofstadter's work has taken a distinctly different approach to modelling the creative process. Hofstadter, who has been working on artificial intelligence since the 1970's, has proposed the idea that *sequence extrapolation* lies at the core of human creative thought. The ability to detect patterns in sequences and

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2 Kosko (1992) writes that "mathematically, fuzzinesss means multivaluedness or multivalence." (p. 3, my emphasis)

expand on them is certainly very important to the improvising musician. Sequence extrapolation of a detected pattern is required to produce an "appropriate" response to a given stimulus. Hofstadter's work aims at unravelling the processes of pattern detection and extrapolation. Like the connectionists, he rejects the idea that the key to all intelligence is "just knowledge, knowledge, and ever more knowledge" (p. 35). "Intelligence has – and *has* to have – a powerful, general, and abstract knowledge-independent core." His belief that "such universal but famously elusive essences as simplicity, consistency, symmetry, balance, and elegance" seem to be the driving forces behind human pattern detection (Hofstadter refers to this principle as "esthetics-driven perception") is very reminiscent of, and no doubt influenced by, Gestalt theories of perception. Gestalt psychology has had great influence on many of today's foremost improvising composer/performers, such as James Tenny and David Rosenboom. Tenny's work *META-HODOS*, cited as the basis for a number of computer-music systems, is full of examples of "esthetics-driven" perception and behavior.[3]

In comments such as the following, Hofstadter eloquently summarizes his insightful perspective on human creativity:

> It is my belief that a nearly constant background activity of creative minds is a playful twisting-around of mental structures of all sorts – turning them inside-out or backwards, regrouping parts, erasing or inserting new levels of structure, moving things back and forth between levels, and so on. In short, taking full advantage of their mental representations, and simply being sensitive to the crazy, quirky, unanticipated side effects that crop up when this happens.

Having read this, however, one might get the mistaken impression that Hofstadter believes that computers can, in fact, successfully perform creatively simply by stringing together randomly re-arranged fragments of material. This is far from true. Chapter 4 of Hofstadter's book *Fluid Concepts and Creative Analogies* warns of the dangers of the slippery slope into the "Eliza effect" (a reference to the

[3] cf. Polansky, Rosenboom, and Burke 1987.

infamous "Eliza" program by Weizenbaum which simulates a nondirective Rogerian psychotherapist with frightening accuracy), which he defines as "the susceptibility of people to read far more understanding than is warranted into strings of symbols – especially words – strung together by computers" (p. 157). Hofstadter is not content with the fact that computer systems can and have been written which mimic certain types of human conversational behavior so closely that they have actually passed the Turing test – that is, they have fooled people into thinking they were a human typing text into a terminal. No doubt there are musical and artistic "Elizas" in existence as well. Telling the difference between an Eliza and something more fundamentally, "truly" creative is a daunting task, but it is essential if work in this area is to retain its integrity. As Hofstadter puts it,

> In truth, no program in the world understands even *one concept* at the same level of complexity as an ordinary person does. This does not mean that computers do not excel at certain tasks, such as spell-checking and chess-playing, where manipulation of genuine concepts is not required. However, understanding how people feel, how they interact, how they talk, what motivates them, and so on – these are the kinds of things that are completely out of the reach of today's technology and only at the fringes of today's theories and speculations in cognitive science.

The essence of Hofstadter's message is that any system that attempts to model creative cognition must take into account the effects of high-level **perceptual processing** of the human cognitive system. Human perception is strongly influenced by our beliefs, goals, and plans – aspects which Hofstadter and his colleagues believe have been overly neglected in "traditional" AI research.

2.3.4. Artificial Creative Systems

Artificial creative systems are computer systems that achieve convincing artistic performance without any human direction[4]. The creation of such systems requires the formalization of a set of creative values and processes in *algorithmic* terms (Knuth, 1968). Algorithms must be definite, complete, and deterministic, and many artists reject the possibility of formalizing their creative process to this extent. Stating one's creative processes in algorithmic terms is indeed difficult, and once one has done so, it is even more difficult to add mechanisms which allow the algorithm to explore other alternatives, to build in the kind of continuous development and variation that makes human creativity so captivating. Composers who create systems that interact with live improvisers have spent a great deal of time thinking about how to describe the way their machines should behave. Because of the highly formalized nature these systems, they are especially good tools for studying musical interaction.

Artists working in this area are frequently asked, "why bother to create a machine that acts like a human performer? Why not just use the real thing?" Artists choose the computer as their medium for many reasons – its unmatched plasticity, power, and control among them. Unfortunately, computers are notoriously lacking in expressive and responsive power. Computer-generated sounds can be exquisite, but without the ability to interact with human performers, they remain lovely but sterile experiments in sound manipulation. By adding the ability to respond expressively to input in real time, this shortcoming can be ameliorated. In addition, I believe there is something intrinsically attractive about a mechanism which embodies one's understanding of beauty. Through this act of "meta" creation, one produces a mechanism capable of exploring vast regions of musical "space" which could take lifetimes to fully explore using traditional techniques.

One example of such a system, and one that arguably transcends the Eliza

[4] Brian Eno in his diary (1996) uses the term "Generative Art" to describe the output of such systems.

effect, is Harold Cohen's *AARON.* AARON is a computer system that generates original drawings which successfully satisfy many of Boden (1991)'s basic criteria for creative behavior. It inhabits and explores "a conceptual space rich enough to yield indefinitely many surprises." It produces novel results generated by the program acting alone, without input from a human operator. Beyond mere novelty, however, AARON exhibits purposeful behavior rather than mere "random" processes; any randomness in its functioning is constrained by the general nature of the medium concerned and the unfolding of the work itself. The drawings AARON produces have been judged to be aesthetically pleasing to many people, yet it remains the source of much philosophical controversy as to whether any piece of software can be said to be "truly" creative in itself, or whether all creativity must still be attributed to its creator. Certainly, it must be said that AARON's drawings satisfy Boden's criteria that creative ideas must have "useful, illuminating, and challenging" qualities.

Perhaps the most important aspect of AARON's code is that it does not draw from a large database of "pre-fabricated" images or image-components. Instead, AARON operates upon first principles, building its works from the "ground up," as it were. AARON begins, for example, with the abstract "concept" of a human figure and then goes about realizing an instance of that concept in each new drawing. Cohen approaches all aspects of his work – form, color, shape – with this same rigorous avoidance of reducing the creative act to a mere selection process. To deal with color, for example, AARON would have to be imbued with some understanding of what it "means" to paint a green leaf or a blue sky. In this sense, AARON closely resembles certain programs for music improvisation, namely George Lewis' "Voyager" and my own "SIVA," which operate on a similar adherence to basic principles – systems whose creators have attempted to formally describe a "knowledge-independent core" of concepts at work in creative intelligence. Such systems do not depend on "machine learning" to produce creative behavior; instead, they are "taught" the necessary skills directly as part of their programming. The main challenge these programs attempt to solve is to formally describe those skills, and then set them in motion so that they interact constructively

to produce satisfying results.

In attempting to create a cybernetic system capable of carrying on a musical improvisation involving other performers, the programmer/composer faces several challenges. First, the artist must create an "artificial player" capable of producing music independent of any external input. This artificial player must be constructed with as many inputs as possible, however, so that the character of the music it generates may be opened up to external influence. The artist must then construct an "artificial listener" capable of parsing various musical parameters (loudness, tempo, register, articulation, phrase boundaries, etc.). Finally, the artist must decide how the listener should be connected to the player. Here lies the real challenge, for it is not enough simply to pass the inputs directly to the outputs. That would result in mere mimicry or triggering, not interaction. In order for the machine to seem like a true interactive partner, it must be endowed with its own "agenda," so that it can decide at times to ignore its input in favor of proceeding with its plans. Furthermore, the system should be able to decide when to abandon its plans in favor of a newly-emerging structure which may be different than what it had in mind. The system should have some means of "disrupting" the music from time to time in order to keep things from getting too predictable. Most importantly, the system must be built upon a *framework* for understanding the dynamics of interactive musical relationships. It is precisely the need for such a framework that led me to undertake this research.

According to the aforementioned principles of symbolic interactionism, people respond to things on the basis of the meanings those things hold for them. An important implication of this statement for artists is that they must consider the perceptual abilities of their audience in order to make their work meaningful to others. Harold Cohen states that his first guess, when setting out to create AARON "was that whatever else it needed, the machine, the program, would have to have something in common with the viewer." Cohen's biographer, Pamela McCorduck, adds: "That commonality couldn't be cultural, so it would have to be cognitive

instead." Another way of seeing this is that cognitive functions *are* cultural functions, and thus, artificial creative systems can succeed on the strength of their cognitive models, if these models are sufficiently attuned to cultural factors. Cultural factors are, in fact, *always* present in such systems, whether or not they are consciously put there by their creators. With artificially-creative interactive music systems, the main challenge is to tune the "listener" such that it responds in a similar manner to a human listener, and to tailor the character of the response to fall within the range of normal human expectations for that culture. Such expectations may vary widely from one culture to another. For example, I once attended an exhibit of an interactive sound installation piece by a Japanese artist. The piece featured electronically-generated crickets who, according to the program notes, responded to movement and sound. To discover this relationship, most of the (American) participants would move about quickly in the installation space, clap their hands, shout, etc.. Almost none of the participants noticed that when they did this, the crickets would stop, and would only start again after they stood quiet and still for several seconds. Thus it was the *absence* of input which was, in effect, the "cue" for this system. The artist informed me that Japanese audiences grasped this connection much more readily, perhaps because the use of silence and "negative space" in general is so fundamental to Japanese aesthetics. This example points out how cultural factors can influence one's cognitive model, and underscores the importance of taking cultural factors into account when designing interactive music systems.

2.4. Personality and Musical Behavior

Through long periods of association with one another both on and off the stage, musicians often develop an awareness of certain patterns of musical behavior in each other which can perhaps best be described in terms of "personality." Improvisors often remark that one of the most influential factors in interacting with other musicians is this personality, or behavioral profile, of the players involved. If musicians know one another well, the personalities of the individuals may function as a referent, almost in the sense that a recurring motif or a "theme" might function

in monoriginal music. As George Lewis writes, "In improvised music, the most salient reference is always the personality and practice of the individuals involved, their 'way'" (personal communication, 1995). Berliner relates an interview with pianist Roland Hanna, who, after thirty years of performing with bassist Richard Davis, is familiar enough with the way Davis thinks

> to have an idea of what he might play from one note to the next. If he plays a C at a certain strength, then I know he may be looking for an Ab or an Eb or whatever direction he may go in. And I know he may be making a certain kind of passage. I've heard him enough to know how he makes his lines. So I may not know exactly what note he's going to play, but I know in general the kind of statement he would make, or how he would use his words, you know, the order he would put his words in... We train ourselves over a period of years to be able to hear rhythms and anticipate combinations of sounds before they actually happen. (p. 365)

Generally, the style in which someone interacts with people in everyday life will be closely related to how they interact when they improvise. For example, a "leader" type may be more likely to lead, and a "follower" more likely to follow. Such things as assertiveness, gregariousness, and self-confidence can be important factors in defining a person more likely to be a leader in a musical interaction, while shy, soft-spoken, uncertain individuals are more likely to be followers. However, asserting a directly observable link between the personality traits of a musician and their behavior during improvisation is not always possible. Sometimes, an artist will seemingly use their performances as an outlet for a kind of expression reserved only for their music, or conversely, they may behave in "real life" in ways that seem to have no readily conceivable analogues in their music. On the other hand, improvisation can provide a forum for very deep aspects of personality which may be suppressed in everyday interaction.

The influence of personality on musical behavior is not limited to pure improvisation, of course. All musicians have unique temperaments which strongly determine the nature of their personal expression or style. In WICAM, however, the range of possible behaviors is so much less constrained by notation, tradition, and

performance practice that the personal expression of the performer are extremely foregrounded. Indeed, may be in part this very personal aspect of improvisation that makes modernist composers reject it. In its more extreme forms, 20th century modernism eschews relative personal "taste" in favor of a Platonistic search for "pure" beauty, while the improvisational aesthetic places the personality of the performer directly at center stage. Igor Stravinsky, for example expressed this attitude when writing of his piece *Octuor*, "[it] is not an 'emotive' work, but a musical composition based on objective elements which are sufficient in themselves." (Simms, 1986). Cage took this concept of the objectification of sound through the removal of personal elements to an even greater extreme. Cage's adoption of Zen philosophy led him to believe that music should be "unmotivated by human will and not produced as a metaphor for any other meaning." (ibid., p. 360). This eschewal of personal and narrativistic aspects of improvisation is, as Lewis (1997) points out, one of the key differences between modern "Eurological" structuralist musics and those stemming from improvisational (Afrological) traditions.

2.5. Physiological Approaches

Without question, movement of the body is an extremely important carrier of semantic content in musical interaction. Almost all musicians communicate important information through bodily movement, even though they themselves might not be aware of this. Evidence of this was found in my micro-score experiments (see Chapter 3), when people watching the videotapes with the sound turned off were able to identify the "leader" of an interaction by their body movements alone. Also, improvisors often speak of learning a vocabulary of *gestures* ("licks" or "riffs") which form the basic building-blocks of their music. Such gestures are often learned through repeated practice such that they become almost purely "physical" in nature, requiring almost no conscious thought to execute. David Sudnow has written extensively about this physical aspect of improvisation in his popular book *Ways of the Hand: the Organization of*

Improvised Conduct.

An important aspect of body movement is the way it can be used to influence other performers through a process known as "entrainment." The phenomenon of entrainment is the tendency of the movements of organisms and even inanimate objects to become synchronized with one another. On large time scales, humans living in close proximity tend to become synchronized with each others bodily rhythm of sleeping, eating, menstruation, etc.. As Daniel Goleman writes in his best selling book *Emotional Intelligence:*

> The degree of emotional rapport people feel in an encounter is mirrored by how tightly orchestrated their physical movements are as they talk – an index of closeness that is typically out of awareness. One person nods just as the other makes a point, or one leans forward as the other moves back. The orchestration can be as subtle as both people rocking in swivel chairs at the same rhythms. Just as Daniel Stern found in watching the synchrony between attuned mothers and their infants, the same reciprocity links the movements of people who feel emotional rapport.

This same "force of nature," operating at a physical, unconscious level on a short-term time scale, also has a powerful influence on interacting musicians. The physical "gravitational pull" toward synchronization, at both rhythmic and pitch levels, can become almost inexorable. Resisting this pull creates a very palpable tension which musicians can use to great advantage, provided they are aware of its effects. Composer George Russel has, in fact, written extensively about the metaphor of musical "gravity" in his 1959 treatise *The Lydian chromatic concept of tonal organization for improvisation.*

These physiological aspects of performer interaction operate at a very fundamental, subconscious level. Like laws of physics, they seem beyond our ability to control. Successful improvisors learn to use these forces to their advantage: to gain better information about other performers by interpreting their "body language," and to play with and against the gravitational "pull" of rhythmic and harmonic entrainment as a source of tension and release in performance.

2.6. Communication Theory

Communication, as defined in Shannon and Weaver (1963) as "all of the processes by which one mind may affect another," is clearly a major concern for the analysis of musical interaction. The basic premise of the mathematical theory of communication is that one can assign a level of statistical *probability* to a each of the various possible choices in a sign system. Specifically, the theory states that given *n* distinct choices for signs to send, the amount of information in the signal is inversely proportional to the sum of the logarithms of the probabilities of each choice. In other words, the more *evenly-distributed* the probability is among the various sign-choices, and the greater their *number*, the higher the level of *entropy*, or information in the signal (or "sign-stream"). A probability distribution which is highly constrained to a small subset of choices will yield less information than one which makes equal use of a large library of signs. Information in communication theory, writes Weaver, "relates not so much to what you *do* say, as to what you *could* say. That is, information is a measure of one's freedom of choice when one selects a message."

Communication theory provides a general, quasi-formal way to measure the amount of information in musical signals. As an example of how communication theory might inform an analysis of musical interaction, let us imagine a simple interaction between two performers. Performer A limits his choice of durations to 1/8th notes and 1/4 notes, and he plays 1/4 notes 70 percent of the time. Performer B chooses from a range of 10 durations ranging from 1/16th notes to dotted quarter notes, and chooses freely from this "palette" of durations such that each duration has an equal chance of being used. The output of such a system might be something like this:

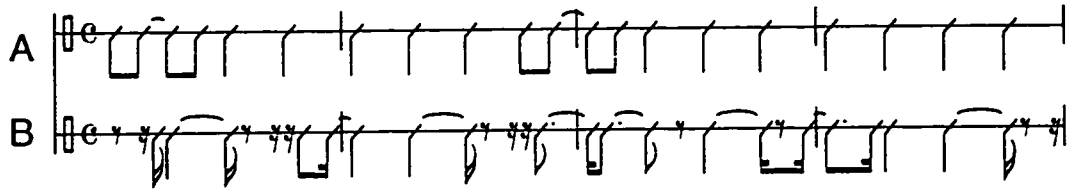

Figure 2.4: Probability-based rhythms

It seems obvious at first glance that B would be perceived as transmitting more information than A. However, it is not absolutely necessary that this should be the case. There are, of course, many other important factors involved in the perception of musical information which are not indicated here. Loudness, for example, can often be an overriding factor. If A were playing *fortissimo* while B played *pianissimo*, it would probably seem to most listeners that line A was the most important, or most "information-bearing" or "attention-grabbing" performer. Pitch register is another very influential factor. At least in most Western music, instruments which sound at about the register of the human voice tend to be used more for important melodic material than other instruments. This is partly due, no doubt, to the relative physical agility of these higher-pitched instruments (saxophone, trumpet, violin, guitar, etc.) as compared with the lower-pitched ones (bass, tuba, etc.). Perhaps because our ears are culturally and biologically attuned to higher pitches, a Western listener might very well select A over B for information content if A were played on a higher-pitched instrument.

One example of an improvised, interactive musical situation which demonstrates communication theory principles very clearly is the "drum jam" – an increasingly popular recreational activity among amateur musicians.[5] In such

[5] Clearly, these drum jams do not represent "textbook" examples of WICAM, since their "artistic" function is somewhat comprimised by the social function they fulfill. However, this is a relatively minor issue; in many respects, drum jams represent a very "pure" form of group improvisation, being less occluded by the stylistic affectations often acquired by professional musicians.

performances, the "leader/soloist" is almost always the person whose playing is the least repetitive (more repetition = less information). The leader's playing is almost always several decibels louder than the rest of the ensemble. The more repetitive the accompanimental parts are as compared with those of the leader, the more pronounced the degree of *agency* possessed by the leader. When the leader/soloist decreases her volume and starts to play repetitively, it is a signal for another soloist to take over. If nobody steps up to the plate, the leader may resume soloing. This kind of "passing the baton" interactive structure seems to govern the vast majority of the amateur drum jams I have witnessed. In a more sophisticated percussion improvisation among more skilled musicians, however, the difference between soloing and accompanying is much less pronounced; accompanimental parts can vary almost as much as the soloist's part. Nevertheless, the same underlying structure can usually be perceived, albeit with greater difficulty. In fact, this "blurring" of the line between soloist and accompanist is one of the hallmarks of WICAM performance practice, one which distinguishes it from traditional jazz.

Another area about which communication theory is relatively silent is the question of how listeners' judgements about information *content* affect their memory and perception of events. The theory implies that a listener mentally accumulates a running "histogram" of the different sign-choices a musician makes over the course of a performance. This histogram provides the listener with a measurement of the degree of *redundancy* in the signal. However, it is important to take into account the fact that each listener's perceptual filters are attuned somewhat differently. To construct this mental histogram requires the transformation of a continuous musical signal into discrete symbols which can be said to accumulate in perceptual "bins." Music psychologists call such categorical perceptual boundaries "just noticeable differences." However, the theory doesn't account for the fact that the sign-choices may have dramatically different meaning for each listener, and that the perceptual boundaries for each listener may differ widely. In other words, the definition of what comprises a "unit of information" may differ greatly depending on the cultural "training," experience, and personality of the observer. A listener unfamiliar with the language of free jazz, for example, might not perceive the

variations of tone and subtle pitch inflections in the playing of saxophonist Albert Ayler (on *Spiritual Unity*, for example) as containing high amounts of information; to such listeners, sections of this music might sound like slow, jittery versions of the same few notes, rather than a very fast, complex stream of many different pitches. Also, those who recognize the spiritual character of melodies such as "Amazing Grace" will be affected differently by them than those who do not make such a recognition. Information "resolution", it must be remembered, is as much a function of the experiences of the listener as of the physical characteristics of the musical signal. Simply put, as Blumer (1969), Hofstadter (1995) and Walker (1990) have noted, *belief influences perception.*

The amount of information in a musical signal is also highly dependent on the timbre of the instrument producing the signal. For example, with some musical instruments (particularly those of fixed pitch, such as idiophones and most keyboard instruments), pitch resolution can be empirically measured by simply counting the number of different vibrating objects with which the instrument can produce different tones. With continuous-pitched instruments, however, pitch resolution becomes more a matter of playing technique. String players, for example, have been shown to make significant microtonal adjustments in pitch in order to achieve intonation closer to just intervals. For example, an E in the key of C major will most likely be played several cents higher than in the key of C-sharp minor. Woodwind players are known to "color" notes differently by using alternate fingerings which alter the pitch of the tone subtly.

Because of such mitigating factors as those listed above, we must be cautious about drawing conclusions based solely on communication-theoretical analysis. Nevertheless, if we are careful to inform our empirical measurements with contextual cues and musical "common sense," the basic principle that *information is a measure of one's freedom of choice* can be applied successfully to many types of music. The ability to accurately assess the amount of information in a musical signal is a fundamental skill required of improvisors as well as those who attempt to analyze their work. For the sake of this framework, we will make the assumption that there are some essential qualities in musical signals that are not simply

constructed by perception and which can be used to make competent judgements about a performer's intentions.

2.7. Sociological Perspectives

Sociology holds many keys to the analysis of performer interactions in improvised music because human social structures and the social forces that guide human interactions in general are very much at play in improvised music. The application of the social sciences to music has resulted in the development of the field of ethnomusicology. Many of the most useful literary contributions to my research have come from the field of ethnomusicology, or have used techniques that are essentially borrowed from that field. Berliner (1994) is a prime example – a very extensive and thorough ethnomusicological study of Jazz music and the culture which produces it. Although, as pointed out in chapter 1, the language of WICAM has grown in a different direction from what is generally considered Jazz, the structuring principles of WICAM remain practically the same as those which govern Jazz improvisation, particularly when one includes the more "free" forms of Jazz expression. Berliner's study contains many insights into the structural principles of group musical interactions culled from his extensive interviews and transcriptions. His records of first-hand observations by musicians such as how a soloist is affected by what their accompanists play, and vice-versa, were extremely important to this study.

Of the free jazz style in particular, Berliner writes:

> Free jazz groups that express concern for democratizing jazz minimize or eliminate the distinctions between soloists and accompanists, at times involving band members in constant simultaneous solos throughout performances. Moreover, some groups reject altogether the use of pieces as formal structures for guiding improvisation, depending rather on collective sensitivity to work out, in performance, a consensus concerning the music's formal features of key, harmonic progression, and rhythmic organization. (p. 338, my emphasis)

The emphasis here on a "democratic" organization of music, informed by a

"collective sensitivity," resonates strongly with the political ideals of composers such as Wolff and Cardew in the 1960's. While it is not always the case that musical organization reflects social organization, the most "pure" WICAM performing ensembles tend to be highly egalitarian in their internal social structure. As Radano writes:

> The civil rights example taught the members [of the AACM] that collective action could promote personal goals, a concept that complemented their communal concerns and that, as will be seen, was expressed symbolically in the AACM's approaches to improvisation. CORE, SNCC, and even the SCLC were, in their view, saviors of the black community, assuming a spiritual/activist role once assigned exclusively to the church, a role and an action that made meaningful the musicians' creative lives.

Sociological perspectives have also informed my work in terms of the internal workings of the performances themselves. In his seminal *Frame Analysis* (1974), Erving Goffman shows many examples of how the contextual, sociological "framing" of events affects our perception of them. This phenomenon transcends boundaries of culture and even species. For example, animals may regard certain behaviors as play or as fighting, depending on the existence certain "marking" behaviors which set the "key" for the activity. Typical "marking" behaviors are used to create a distinction between musical performances and "everyday life" – the use of special clothing, dimming of lights, applause and bowing, for example (Kaemmer, 1993). It is also interesting to apply this kind of analysis to intra-performance events, for example, the problem of phrase segmentation in improvised music. Knowing when a phrase is ending, having a common understanding of "where one is" in the arc of a phrase, can be critical to the successful execution of expressive performance (see Pelz-Sherman, 1992). It is possible, through careful observation of both sonic and visual cues, to discover certain characteristic "marking" behaviors in performances which communicate phrase boundaries.

possible, through careful observation of both sonic and visual cues, to discover certain characteristic "marking" behaviors in performances which communicate phrase boundaries. This is particularly interesting at the very end of an improvised piece. Bringing a performance to a successful and convincing conclusion is often one of the most challenging problems an improvising group must solve. By providing the appropriate phrase-begin and phrase-end markers, a performer can "frame" her playing so that the boundaries are clear to the rest of the group. Even more important than phrase boundary marking, however, is the marking of *interaction modes*, which is covered in chapter 4.

3. The "micro-score" experiments

Until recently, the vast majority of academic research into musical performance has taken place in the field of psychoacoustics, whose practitioners generally make use of techniques borrowed from experimental psychology. Modern anthologies such as Deutsch (1992) as well as earlier volumes – e.g. Seashore (1938) – document the efforts of researchers to "dissect" musical performance using the analytical tools and techniques of the scientific method. Such studies have tended to focus on individual interpretations of traditionally-composed scores written in common practice notation. Studies such as Seashore, Sundberg, Todd, Clark and others have examined in detail the deviations of individual performers from the "raw" information in the score, and have developed models and rules which help us understand the structure of these deviations. Such research was very informative for my work in creating formalisms for lending expression to computer performances (Pelz-Sherman, 1992).

While analyses of individual performances abound, scientific studies which analyze *group* musical performance under traditional psychoacoustic "laboratory" conditions are much more rare. To some extent, we can attribute this to the fact that music psychologists seem to have been more interested in the workings of the individual mind rather than the functioning of the "collective mind" that is a musical ensemble. It is also possible that so little research into group musical behavior exists because the traditional techniques of experimental psychology do not apply well to group behavior. Whatever the reason, my attempts to locate formal experimental research into performer interactions in improvised music did not uncover much of interest.

The study of group improvisation has been much more abundant in the field of ethnomusicology, which seeks to systematically record and catalog cultural phenomena but does not generally try to "explain" those phenomena by scientific means. Two very recent works stand out as being particularly important here: Berliner's "Thinking in Jazz", and Monson's "Saying Something: Jazz Improvisation and Interaction", both of which were mentioned in chapter 2. The

method of research I chose for my study turned out to be much closer to the ethnomusicological practice used in these works, but it was useful, I believe, to have initially framed my research in terms of experimental psychology. This positivistic framing created an atmosphere of rigorous attention to minute detail both in the participants and in me, the observer, which was especially helpful during the interviews in getting people to articulate the thought processes guiding their performances. Two major and (still unfortunately rather novel) functions of the micro-scores framework are (a) to provide an environment for focusing the improvisors' reflections upon their processes of interaction, response and structure; and (b) to explore some of the ethnographic dimensions of improvised music-making within a relatively controlled environment.

3.1. Description of the research method

Initially, I set out to develop my analysis framework primarily by simple introspection, reflecting upon my personal experiences as an improvisor, as well as gathering ideas from informal interviews and discussions with colleagues, by studying the existing literature on the subject, and by listening intently to as many recordings and performances as possible. However, I quickly found myself wishing for some way to focus this research process. The information I was getting by these less formal methods was unstructured and very difficult to organize.

To address the challenges in obtaining more structured, focussed information about musical interaction, I developed a research tool I call the "micro-score". I consciously borrow the term from Seymour Papert's "microworlds", because of the micro-scores function like Papert's microworlds as tools to think with by creating simplified versions of complex situations.[1] A micro-score is a brief set of verbal directives to one or more real or imaginary musicians. The directives must be stated in complete grammatically correct sentences, avoiding ambiguity as much as possible. Each score sets forth a particular musical interaction "task" in a simple, direct and definite manner. The performance of these scores should last no more

[1] I must credit Henkjan Honing and Peter Desain for pointing me in this direction with their 1992 article, "A Microworld Approach to the Formalization of Musical Knowledge", in *Music, Mind and Machines*, i.d.b. Ltd., New York.

than a few minutes. The performances, as well as the responses of the performers, are recorded on videotape for subsequent analysis. The pieces are meant to be performed in a traditional concert-like setting (on a stage before a quiet, attentive audience), and it is assumed that the subjects, being sincere, skilled musicians and improvisors, will strive to make all of the performances as musical as possible. Interviews are held with the performers immediately after each performance; these, too, are recorded for subsequent analysis.

The aim of the micro-score is to create conditions which enable one to interrogate the process of group improvisation without entirely stripping these interactions of their musical context. They are a means of gathering live "specimens" of improvised performances, the "raw data" of which became essential to the formulation of my analysis framework. The micro-scores allowed me to create situations where I could observe actual improvised performances "in person" rather than trying to peer through the muddied waters of recorded performances and transcriptions. They also allowed me to focus on particular aspects of interaction which are otherwise more difficult to isolate in normal performances.

Pauline Oliveros' *Deep Listening* pieces are close analogues of my micro-scores, and were highly influential in their design. One such score, for example, essentially consists of the directive to alternate between imitating the sounds of others and making new sounds:

Listen
During any one breath
Make a sound
Breathe
Listen outwardly for a sound
Breathe
Make exactly the sound that someone else has made
Breathe
Listen inwardly
Breathe

Make a new sound from your imagination
Breathe
Continue this cycle until there are no more new sounds.

Figure 3.1: Score for Pauline Oliveros' "Deep Listening"

Performances of such scores can reveal a great deal about general principles of musical interaction. Many people, for example, will imitate an interesting new sound shortly after it is introduced, causing a rippling "theme and variations" effect. Some people will wait longer than others to respond, and this natural variance in delay creates an irregular and organically evolving canon, as each imitation contains some slight mutation which is carried into the next. Because of the restriction that a repeated sound must be followed by a new sound, however, such canonic episodes are inevitably followed by a burst of new activity. The most interesting of the new sounds generated during this period are generally the ones that are chosen by the most participants for imitation (a common evolutionary characteristic of heteroriginal music), and so the cycle continues. One can observe similar behavior patterns on many levels and in many forms of interactive music.

The micro-scores are also strongly influenced by game theory, which describes interactions in terms of tasks and their associated worth and costs, to the analysis of interaction (see sec. 2.2). Like the task-oriented domains explored by Rosenscheim and Zlotkin (1994), I have concentrated in establishing musical situations in which players are assigned individual as well as collective *tasks* to perform. The pieces are designed to "zero in" on certain musical behaviors by creating conditions which encourage these behaviors, yet the subjects are given enough freedom to allow for several alternative ways of realizing the behaviors, including the possibility that the desired behavior will not occur. For example, I make use of secret roles and secret goals in order to produce a "true" improvisation in which neither roles nor goals are pre-determined.

3.2. Description of the Experiments

The micro-score experiments were originally a set of five, from which selections were made during the experiment sessions in response to changing conditions of the moment. For each experiment, a list of questions was also developed which guided my interrogations after each performance. At UCSD, participants were volunteer students who were studying improvisation as part of their graduate work. In Minneapolis, I was referred to a list of improvisers by associates at the American Composers' Forum; from this list, I chose a group to work with based on their experience and stated interest in the experiment. The Minneapolis participants were paid a modest honorarium.

Before each session, a handout was distributed to each participant with the following information:[2]

> Dear Participant:
>
> As part of my PhD dissertation, *A Framework for the Analysis of Performer Interaction in Improvised Music*, I have developed a research tool for studying musical improvisation which I call the "micro-score". I consciously borrow the term from Seymour Papert's Microworlds (1980), because these micro-scores function much like Papert's microworlds as "tools to think with" by creating simplified versions of complex situations.
>
> A micro-score is a set of verbal directives to one or more real or imaginary musicians. While these scores are similar in form to Stockhausen's *Intuitive Music* and Oliveros' *Deep Listening* pieces, the directives are stated in complete, grammatically correct sentences which avoid ambiguity and poetic language as much as possible. Each score focuses on a particular musical interaction task in a simple, direct and definite manner.
>
> ...
> Below I have included several examples of micro-scores for your perusal. Please take some time to consider how you would participate in these experiments. Your comments will be greatly appreciated.

Figure 3.2: Micro-score handouts

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[2] Of course in retrospect I realize that giving performers this handout before the experiments could perhaps have tainted the results by causing the performers to incorporate my analytic viewpoint into their improvisative strategies. In future experiments I will probably reveal less beforehand about the nature of the procedures.

The following experiment descriptions, while extremely similar to those sent to the participants prior to the sessions, have been edited somewhat from their original versions in the interest of clarity. The explanation of the experiments always seems to undergo a certain degree of transformation in practice, as certain subtleties are explained which made the tasks easier to comprehend and carry out. I have decided to give each experiment a more descriptive name; in the original handouts, however, they were simply called "experiment 1, experiment 2, etc.". In addition, the handout contained the aforementioned questions which the participants were allowed to view before the experiments to help them understand what I was striving to learn from them.

"Change Together": All play continuously together in rhythmic and/or pitch unison. Vary pitch, tempo or rhythmic pattern collectively, remaining in unison as closely as possible. (Sound example: DAT #1, 1 hr. 37 min). A transcription of one of the performances of this experiment can be found in Appendix B.1.

Sample Questions:
-How are tempo and pattern established?
-How are changes effected in the group's behavior?

"Love Story": For three musicians: One player is publicly chosen as player "A". A second player is chosen, without A knowing who, as player "B" from between the remaining two. B and C begin together with B as the soloist. A should join with B in *sharing* mode (see section 4.2.1.a). B and C should try to communicate their roles to A through their playing. If the roles are communicated correctly, A should join with B, while C should remain in an accompanimental role.

A graphical representation of this score would be as follows (with secret roles shown in parentheses):

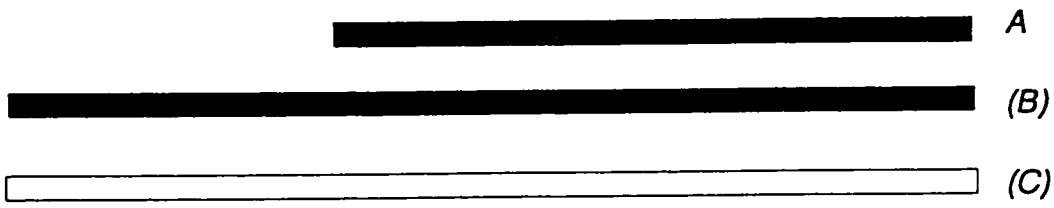

Figure 3.3: Graphical representation of micro-score "Love Story"

As an optional variation, the roles of B and C may be left to the group to determine during the performance, rather than being chosen ahead of time.

The name for this micro-score, "Love Story", comes from a narrative interpretation which arose during the Un-Sound Trio sessions, in which the scenario can be construed to be a "love triangle", with A and B as lovers, and C as a jealous parent or guardian.

Questions:

- Was player A able to determine the role assignments? If so, how? What constitutes a "seductive" musical gesture?
- What factors influenced player A's actual point of entry?

"Drop Out"

For three or more players using any instruments of consistent, readily distinguishable timbre. All players begin together. Players must drop out one by one until none are left playing. Players should avoid dropping out at precisely the same time. The experiment ends after 5 minutes, whether or not all musicians have stopped playing.

Questions:

What factors influenced each player's decision to stop playing?

"Ender's Game"

This experiment makes use of both secret roles and secret goals. For three or more

musicians: One player is secretly chosen as "A". All players start playing together. At some point during the experiment, A is to privately choose one of the following two goals:

1. stop playing, without causing any of the other players to immediately stop with her, or
2. stop playing, causing all of the other players to immediately stop with her.

3.2.1. The CRCA sessions

The first series of micro-score experiments were carried out at UCSD's Center for Research in Computing and the Arts (CRCA) on February 2nd and 3rd, 1995. The experiments were conducted in the main space of CRCA in the afternoon hours. There was a very small audience present, and occasionally members of the ensemble would sit out and act as a "surrogate" audience. All performances and discussions were recorded on both DAT and video tape. Public role assignments were made by simply announcing an ad-hoc choice to the group. Secret role assignments were made by distributing cards drawn at random by the players or by tossing a coin. In "Ender's Game", for example, only the player who drew the "A" card would know his or her status as "player A" before the group started playing. The performances described below are may be heard on a CD available from the author.

The subject group consisted of five musicians, all of whom were at that time graduate students in the UCSD music department: Kitty Pappas, cello; Renee Coulombe, piano; Scott Walton, double-bass; Patrick O'Keefe, clarinet; and Lisa Celli, flute. A few members of this group (Pappas, Coulombe, and Walton) had played together somewhat extensively, but the group as a whole had relatively little experience as an improvising unit. Two of the students (Walton and O'Keefe) had a substantial amount of professional performing experience with both concert and popular music, while the others had somewhat less professional experience. However, as graduate students involved in advanced classes in improvisation at one of the world's most progressive University music departments, these players represented the vanguard of WICAM, at least as represented in American institutions of higher education.

As this was the first time these experiments had been tried, this round was carried out in a rather informal way. It was usually necessary to explain the micro-scores in somewhat greater detail than was indicated in the original versions of the texts. For example, in the original version of "Love Story", C's role was unclear; this was remedied on the spot by explicitly articulating the role as "accompanimental". (At this point, the "love triangle" interpretation of this micro-score had not yet been introduced.) Originally, I had considered trying to limit the musicians to certain "parametric" forms of expression (i.e.: thinking in terms of pitch, rhythm, tempo, articulation, and dynamics as "variables") so as to make the resulting music easier to transcribe and analyze. This constraint proved too limiting[3], however, and so that idea was abandoned in favor of a completely free approach.

Another technique used in these sessions, which was not repeated in subsequent experiments, was the use of a computer-generated videotape which presented the performers with a series of extremely short "scores" to follow. These scores consisted of nothing more than a duration, specified in seconds, and two lines indicating when, during this time segment, each performer was supposed to play. The tape would show the performers the next score, and it would signal, using beeps, the beginning and end of the time period. This experiment was intended to capture all different types of interaction events (see chapter 4), so that they could be easily examined in isolation. However, it seemed clear after attempting this experiment that the results so obtained were "tainted" by the artificial nature of the task. Isolating individual interaction events from their musical context turned out to be too invasive a procedure. It was also extremely difficult for the performers to finish playing within the durations given. While this may have been partially due to a lack of experience on the part of the performers with this particular performance technique, it also indicated to me a certain reluctance by improvisors to constrain their expressive behavior to the confines of arbitrarily-imposed temporal

[3] The very fact that asking performers to limit their creative expressions to a single dimension seemed to so severely weaken their ability to interact effectively is, in itself, an indicator of a wholistic/Gestalt approach to listening and performing on the part of the participants.

boundaries, which is consistent with the cultural resonances with African values found amongst contemporary improvising cultures.

One of the more significant problems that arose, especially in "Ender's Game", was whether or not to restrict visual communication between the performers. Since the intent of the experiments was primarily to examine communication of performer perceptions and intentions through *sound*, it was sometimes necessary to prevent the visual channel from taking over, as when in "Ender's Game" the clarinetist gave an obvious visual "cut-off" to the ensemble using his instrument as a "baton", which was a dead giveaway to the other performers. It was decided that in this experiment, we would prevent the group from seeing one another by simply having them all face away from each other. In most of the experiments, however, the players were allowed to make visual contact with one another. It is interesting to note on videotape the various degrees and ways in which the performers used their bodies to communicate musically. In "Love Story", for example, players A and B would often use eye contact or other body language to help establish and confirm their relationships with one another. Whether this "body communication" was conscious or not, it is undeniably one of the most common features noted by observers of videotapes of these experiments.

The reader is encouraged to view the videotape or listen to the CD of these experiments while examining the following "field notes" from these sessions. Copies of both may be obtained by contacting the author.

Figure 3.4: Micro-score notes from CRCA sessions

After the "warm-up" exercises (parameters, videotapes), "Love Story" was explained to the group as follows:

MPS: We'll pick someone to be 'player A'. Everybody BUT player A will begin together, and player A will have to choose someone to 'come in' with; to "sync up with", musically-speaking. (I should note that the title "Love Story" had not yet been invented for this experiment. I referred to it as simply "Experiment 3". I also chose not to pre-define the "B" and "C" roles as "soloist" and "accompanist" at first. Later on, it became necessary to do so.)

I also mentioned some of the questions that would be asked afterward, such as "whom did you choose, and why?". The musicians had some questions about the procedure:

Pat: So, are the people who aren't A supposed to try to 'tempt' this other person?
MPS: Yes, exactly! So it's kind of a "competition", in a sense. These experiments all have kind of a game-like character, I suppose.

Love Story - CRCA - 1 (CD track 1):

Performance of "Love Story" began at 47:40 on the videotape with Pat as A. The texture quickly developed as follows:

Renee (piano): percussive striking of damped keys inside the piano.
Scott (piano): impressionistic arpeggios with lots of sustain pedal & open space
Kitty (cello): sustained "drone" with overtones
Lisa (flute): impressionistic solo melody, nicely meshed harmonically and rhythmically responsive to Scott's chords

At 0:28 on CD, Pat begins playing. He starts tentatively with a single note, then a trill, slowly developing into a sinuous melody which seems to have the most in common with Lisa's flute melody. However, Scott also begins to modulate his

arpeggios into more melodic statements closely resembling Lisa's. By around 0:30 it's difficult to tell who Pat is more in tune with. At about 1:00, however, Pat plays a repeated staccato note pattern, which Lisa picks up on immediately, further establishing their musical "bond". I cut the piece off at 48:44 (1:10).

MPS: You know, I was so busy monitoring levels and such that I wasn't aware of who you came in with.

Pat: Well let's see if the group knew!

Kitty: Well there was more than one! A few of us were doing very similar things.

Lisa: Yeah, cause it was my melody he started with, but then Renee picked up, so she was actually doing it with me.

Kitty: But he was using my technique!

Pat: My starting point was Lisa's E natural because she kept coming back so often to it. (Shows how repeating an idea can be a way of obtaining agency.) Just at the point when she went away from it, I decided to pick it up.

Renee: Right, and I was staying on E-flat and A-flat almost entirely, so it was really an interesting sonic dynamic.

Kitty: So you chose a pitch to come in on?

Pat: Yeah, I heard a pitch that I heard a lot, and she's sitting right next to me with her flute pointed right in my ear, too. ... Also, Lisa and I are new to improvising, and we tend to play more "tonally" than the rest, so it's possible that I was centering on that.

Love Story - CRCA - 2 (CD track 2):

Seeing that Pat may have had a point, I decided to break Pat and Lisa up. The next performance of "Love Story" begins at 51:38 with Lisa sitting out.

Renee, Scott, and Kitty all begin with extremely "noisy", pointillistic, non-pitched inside-the-piano playing. Pat begins around 52:00 (0:25 on CD), tentatively again, with a similarly pointillistic texture in his low register. At 52:11 (0:38), a high accented piano note (by Renee?) seems to trigger an imitative grace note gesture by Pat. The piece ended somewhat abruptly at 52:35 (1:03).

MPS: So was that kind of a collective, or an individual that you felt you were

coming in with?

Pat: Well, everybody seemed to be doing similar things, and I mainly came in with Kitty's more rhythmic things. But then everyone seemed to pick that up at times.

I consider this a "failed" attempt to carry out the task, since Pat was unable to identify anyone in particular with whom he had established an affinity relationship, probably because the group was too unified in its playing to give player A anything distinctive enough to latch onto. Listening to this cut in retrospect, I hear a definite affinity relationship with Renee, which apparently was not recognized by the group. In order to provide even greater clarity, I proposed a slight change to the experiment.

MPS: Let's have you come in one at a time, so you'll build up a texture, and instead of all doing the same thing, try to do contrasting things, so that she has to choose from the three of you. (Later on, I said, "I realized that if you all start at the same time, it's pretty likely you'll do something similar.")

Renee: So you want us to try to be contrasting?

MPS: Yes, and see if you can draw her in at a particular moment.

Love Story - CRCA - 3 (CD track 3):

This time, Pat sits out, and Lisa is chosen as "A". Scott begins on piano at 54:28 with a moderately fast, loud, wide-ranging, rhythmically active melodic bursts ending on a single sustained pitch. Kitty then comes in at 54:35 (0:07 on CD) with very high, accented, sustained cello notes, sometimes ending in upward glissandi, and alternating with noisy "scraping" rhythmic gestures. Renee plays slow, soft, impressionistic, drifting chords.

Lisa comes in at 54:47 (0:23 on CD), beginning tentatively with some soft low tones, seeming to be trying to match the sustained pitches at the ends of Scott's melodic bursts. Her long, quiet, drifting tones are picked up on by everyone in the group; the overall dynamic shifts down to her level. Kitty's playing becomes more oriented to her long tones; the scraping gestures disappear. Lisa's body language seems to indicate an affinity with Kitty - she seems to be staring directly at her for the last several seconds of the piece, which ends at 55:53 (1:24).

Lisa: I jumped in with Scott, but, um... I was rebuked! (Laughter) Well, I waffled

around for a while, but then I joined Kitty 'cause she was more friendly.

Renee: Well, I thought it was me, 'cause I was playing this very slow, periodic stuff (demonstrates).

Pat: Yeah, I thought you were coming in with Renee too.

Lisa: Oh, I couldn't hear [Renee] at all; I heard her go thump at the beginning, but that was it.

Pat: Wow - you were really in sync with Renee! (Was Lisa's inability to recognize her affinity with Renee, which was so obvious to the other performers, an indication of a "sub-conscious" processes at work? Or perhaps Lisa simply couldn't distinguish between the two pianos, which were in fact placed quite close together.)

Scott: So what did I do to "rebuke" you?

Lisa: Well, you'd be all over the place, and then you'd land on this note, and it would sound like, "yeah, I can come in", and I came in, and then you just kept going!

(Laughter)

Renee: That's why I thought you were with me, because you were holding your notes.

(The above discussion indicates that long, held notes were generally perceived as more "seductive" than faster, more aggressive playing, at least within the context of these experiments. Certainly one can imagine that if imitation is one criteria for musical "merging", then slower playing, which is easier to imitate, would also be easier to engage with.)

Love Story - CRCA - 4 (CD track 5):

Scott was elected as "A", and nobody sat out.

Piece begins at 00:36 on the video (counter was reset). Pat starts in with a sustained high C. Lisa begins with a tonal melody. Kitty and Renee come in with a "call and response" pattern of short cello glissandi and percussive piano grace note melodic fragments. Pat begins to modulate the amplitude of his long note until it becomes a tremolo. Lisa plays some scale-wise glissandi, adding to the overall density. Scott comes in at 1:06. The texture becomes very thick, and dies down fairly quickly.

Kitty: How did you get in? It was a little dense.
Scott: I wasn't sure until the very last moment who I was going to come in with. I almost jumped in on Renee 'cause she was doing these percussive things, and I thought, "No, that would be too easy to jump in with the piano." Then I came in with [Kitty's] thing and you were doing this, kind of like [plays a fast minor third tremolo]. But as soon as I started doing that, Renee started doing this [plays loud, accented, very low piano note]. So I kept on with that, sort of echoing her... then [Pat and Lisa] started doing these linear things (plays scale-wise glissandi), so I ended up trying to play with everybody!
Kitty: Yeah, the moment of getting in is sort of hard to say, because you pick it instantaneously, in the same manner in which you play, and changes within the play, that's the way you begin as well.

These observations point to the fact that in some WICAM performances, changes of musical alignment can happen so quickly and change so frequently as to make it truly impossible to assign "leader" or "follower" roles to the individual performers. In the framework presented in Chapter 4, I call this kind of leader-less situation "sharing" of musical agency, of which this last performance is a prime example.

Love Story - CRCA - 5 (CD track 6):

At this point, I could already see that five players was too many to allow the "Love Story" experiment to really work well. The complexity of the relationships between the performers was overwhelming, and it was too difficult to parse and track the interaction event structure. Furthermore, the "competition" between the players was causing too much confusion and making it too difficult for player "A" to decide who to join with. Therefore, for the next performance, I selected Renee (piano) as "A", and chose Pat (clarinet) and Kitty (cello) as "B" and "C" respectively. I also suggested that the B and C musicians stagger their entrances so that they could have a chance to hear what the other was going to do, thereby making it easier for C to do something different than B (or vice versa). The goal here was to maximize the contrast between the instruments and to scale the size of the group down to a minimum, in order to simplify the task of selecting a musical partner.

Pat began the next performance at 4:08 with in initiatory clarinet "scream", which evolved into spastic squealing noises in the extreme upper register. Kitty followed soon thereafter with a series of pizzicato double and triple-stopped chords

emphasizing perfect fifths and fourths. Renee began playing at 4:24 by pounding on the piano frame above the keys with the sustain pedal down, lending a percussive accompaniment to the piece. To my ears, Pat's role as the soloist was very clear. Both Kitty and Renee seemed to be functioning as accompanists for the duration of the performance. It was difficult for the performers to tell who Renee had joined with, as evidenced by their comments, but Renee had no trouble identifying Pat as the soloist:

Renee: I came in with Kitty, but then I decided I liked the really explosive way that Pat was playing, so I wanted to get to that kind of explosive stuff (bangs on the piano frame to demonstrate the connection between this gesture and Pat's clarinet playing). So I went kind of back and forth; when Kitty started doing low strings, I did a little bit of low strings, but I liked that just barely escaping air. I can get that if I hold the hammers down (demonstrates an inside the piano technique).

Pat: You were talking about being "seductive" in your playing, so I decided to go for sheer volume and excess to see if that would do it.

Renee: Well, when unexpected sounds start escaping from your instrument, it does, like, trigger [a thought of] "how can I compliment that on this instrument"?

Pat and Renee's comments reveal that they were, in fact, able to establish a link through musical communication. Renee's comments point out that non-standard playing techniques can be very effective in commanding attention.

Love Story - CRCA - 6 (CD track 7):

Another set of "Love Story" experiments were carried out, this time with the B and C roles explicitly assigned ahead of time, although A was kept in the dark about who had which role. A's task was to discover who B was through musical communication.

For the next performance, Lisa (flute) was chosen as A. Kitty (as B) began the next performance at 12:06 with long, lyrical cello tones. Scott (as C) came in at 12:10 (0:06 on CD) with aggressive bursts of extremely fast staccato notes in the upper register. At 12:27 (0:24 on CD), Lisa entered right in sync with Kitty's G natural. Kitty cued this entrance very effectively by playing four rhythmic, staccato low C's,

almost like a count-off. The roles remained clear throughout the short piece: Kitty and Lisa sharing the soloist role, with Scott playing a very distant and interruptive accompaniment.

Lisa: I was supposed to be with Kitty.

Kitty: That was too easy!

MPS: How did you know?

Scott: I was being ugly.

Renee: It wasn't ugly!

Kitty: It was accompanimental.

Renee: If I were a flutist, I would have thought I was supposed to come in with you, because [the gestures you were playing were very idiomatic for the flute].

Lisa: But it wasn't anything I could pull something out of.

Pat: I thought Kitty was playing the kinds of figures that Lisa tends to play.

Kitty: Hey, I do my job! I know what she wants to play!

These comments underscore the importance of sizing up and exploiting the personality of the other performers.

Love Story - CRCA - 7 (CD track 8):

Renee was chosen as the next A. Lisa was chosen as B, Kitty as C. Lisa began with a neo-classical sounding, rhythmically "square" melody in E major. Kitty joined soon thereafter with an accompaniment not quite in the same style, but fairly clearly accompanimental; lower in overall volume, sparse, and reactive to Lisa's melodic statements. Renee's entrance on a high trill demonstrated her understanding of Lisa's role.

Renee: I thought that I was supposed to come in with Lisa. ... I decided that the person with the most activity was the one most interested in distinguishing themselves.

Lisa: Then when she came in with the trill, I started playing trills too [which solidified the relationship].

Kitty's playing throughout the performance remained decidedly contrasting and

accompanimental, further strengthening the affinity relationship between Lisa and Renee.

Love Story - CRCA - 8 (CD track 9):

For the next several performances of "Love Story" (CD tracks 9 - 13), I worked on defining further the distinction between accompanimental behavior and soloistic behavior. It became clear after a few more rounds that for these performers, directed melodic playing was a "dead giveaway" (Lisa's words) of soloistic behavior. I encouraged the players to make the distinction a bit less obvious by keeping their activity levels closer to equal, or by encouraging the accompanists (the "non-B" performers) to try to act more like soloists, without actually crossing the line. For example, in CD track 9, Scott was chosen as A, Pat as B, Lisa as C. Again, Pat, through keeping his activity level high, was easily detected as the soloist by contrast with Lisa's demure trills in the low register. In track 11, Lisa and Kitty were able to connect through a common gestural and melodic language, with contrasting accompaniment provided by Pat and Renee.

Some of the more subtle methods of accomplishing musical "sympathy" or "seduction" during these performances included imitating rhythmic gestures, finding timbral similarities between diverse instruments, and observing facial expressions. Soloistic behavior was described as being more "directed" and "stubborn" - "sticking to one's guns" rather than reacting to things, whereas accompanimental behavior was described as "noodling", "laying back" or "backing off" from the musical "advances" made by the A players.

The next experiment performed was "Change Together". I asked the performers to use percussion instruments only. Instructions were given to get into a groove, and then change the groove and/or tempo roughly every 20 seconds.

MPS: Musically I expect it might be kind of boring, but what I'm interested in is hearing how, as a group, you negotiate those changes. The idea is that you're all playing the same rhythm pattern, so you might want to keep it fairly simple.

Change Together - CRCA - 1 (CD track 14):

In the first round, changes to the rhythmic pattern seemed to be initiated primarily

by Scott (clave) and Pat (conga). In subsequent rounds, however, agency became more evenly distributed. Changing the rhythmic pattern seemed much easier than changing tempo; once the group had settled into a certain tempo, they tended to stick with it. Pat observed that a rhythm of change tended to be set up at about four bars.

Lisa: It seems easier to follow if someone makes a small change to the existing pattern rather than changing the entire pattern.

Indeed, this principle of making small modifications to an existing musical "pattern" can be widely observed in most improvising groups. One rarely hears sudden, radical shifts of behavior. Transitions tend to occur more gradually by a process very similar to that which can be observed in microcosm in these performances.

In the next few rounds, I encouraged the group to focus on changing tempo rather than rhythmic pattern. A transcription of one of these performances is included in appendix B.1. The tempo changes exhibited the same tendency toward "modulation by modification"; new tempos usually had some relationship to the previous tempo. Often the "change leader" of the tempo shift would first obtain agency by playing some kind of polyrhythm against the existing pulse.

MPS: Remember, you don't have to play all the time, and you don't all have to be in the same tempo all the time - if it takes several seconds to settle in on the new tempo, that's fine.

Change Together - CRCA - 2 (CD Track 18):

In this performance (see transcription in appendix B.1.), an interesting phenomenon occurred. Lisa (on claves) clearly signalled in m. 12 (0:20 on the CD) that a change was going to take place by moving to a 3:4 polyrhythm, but it was actually Scott (on triangle) who moved the tempo up from 130 to 160 b.p.m. in a gradual accelerando from m. 13 to m. 17. This process was very clearly perceived by both Lisa and Scott, as evidenced by their descriptions of the event:

MPS: Who initiated that change? Did you all feel that there was clearly one person who caused that change that just occured?
Lisa: I think I set it up. I'm not sure. I mean I tried to, but once I realized what I was

doing, I realized I was in triplets, but then you (pointing to Scott) actually changed the tempo.

Scott: Which I was doing more on the offbeats...

Lisa: Yeah, which was kind of related to my triplets, but not quite, and then I just sort of picked you up.

Scott: ...and then once we got up there, everybody was on almost exactly the same rhythm.

Drop Out - CRCA - 1 (CD track 21):

"Drop Out" was performed only once by the group. Kitty set up a rhythmic percussive texture on the cello, which was imitated by Scott in the low register of the piano, but carried further into a busy, constant pattern of "random"-sounding notes. The wind players, Pat and Lisa, kept their parts rather subdued and percussive as well (using mouthpiece pops, key clicks, etc.), such that their entrances and exits remained rather unremarkable. Scott gradually began to introduce rests into his material, and allowed the "holes" in his texture to take over, leaving Kitty behind to end the piece alone. The group was able to carry out this task quite convincingly, although the wind players could be seen as having taken the "easy way" out by never really developing their parts to the point where their departures would be missed.

The next day (Feb. 3, 1995), Renee was not present, and Scott chose to play double bass instead of piano.

"Ender's Game" was performed several times with Scott on double bass.. There was some discussion as to how long the performances should last. Kitty expressed a desire to play longer, exclaiming, "five minutes is short!", but the rest of the group decided that it would be best to keep the performances shorter so more attempts could be made.

Ender's Game - CRCA - 1 (CD track 22):

In the first performance, Pat, chosen secretly as player A, was so completely masterful in his leadership of the group that almost everyone said they knew immediately that he was player A. His playing was extremely boisterous and

"athletic", firmly establishing himself as the leader. His ending cue was completely transparent to the group as well; even if he hadn't used his clarinet as a "baton" to cut the group off, his long, high note crescendoing to a stop would most likely have functioned just as effectively. This was a prime example of a virtuoso performer functioning as a strong musical leader in a group improvisation.

Seconds after the end of the piece, Scott said "I'll bet it was YOU!", pointing to Pat.

Laughter.

Kitty: That was too easy! Obviously! You win! 100% over there!

Lisa: I have to admit the cue [imitates Pat's final "cutoff" gesture with her instrument] was kind of [a giveaway]

Pat exclaimed that he didn't even know he had made the conductor-like "cut off" gesture!

Kitty: But he was cueing the whole time! I knew right when we started [that he was the leader]!

MPS: Really? You knew right away? How did you know?

Kitty: By the way he was playing. Because he crescendoed, he kept changing the licks...

Lisa: And how everyone was following him!

Ender's Game - CRCA - 2 (CD track 23):

In the second performance, a false identification of player A occurred. Most of the group (myself included) seemed to think Scott was "A", but it was, in fact, Kitty who had received the "A" card. Upon repeated listenings to this performance, it seems pretty clear that Kitty simply was not producing enough sound with her instrument to carry off that role convincingly.

Scott: So who did you think it was?

MPS: Sounded like it was you.

Scott: Wasn't me!

Kitty: Why'd you end it then? (laughter)

MPS: Yeah, it was a perfect ending!

Lisa: It just seemed right. But I had no idea [who A was]

MPS: So I guess the implied task of the rest of the group is to [keep going] if you're not A.

Kitty: Well, again, the [short] time length [was a problem] for me, because I was on my way to getting out without ending the rest of the group. I have the most difficult time developing something [in such a short period of time].

This comment led me to realize that the choice of tasks naturally had very different outcomes in terms of the identifiability of player A. In cases where player A chose the task of ending without causing the group to end,the group had a much more difficult time detecting who A was. This came as no great surprise, as it is much easier to single out a leader than single out a "follower" from a group of followers.

Ender's Game - CRCA - 3 (CD track 24):

In the next performance (beginning at 16:20 on the videotape), Scott, as player A, managed to lead the group to an ending point without anyone realizing it. Upon repeated listenings, his playing does seem to subtly lead the group in pitch register as well as overall rhythmic density without being overt about it. Perhaps because Scott's instrument, double bass, has a traditionally accompanimental role, this kind of "supportive" leadership was easier to carry off.

MPS: Sounded like Kitty had it again.

Kitty: No; whoever was supposed to drop out didn't do it, nor did they finish us.

Pat: It was Scott, wasn't it?

Scott: Yeah, it was me!

Kitty: But you didn't drop out!

Scott: But I finished! At the very end!

MPS: You might have been leading in ways I wasn't picking up on. Did anyone else know who it was?

Lisa: I had no idea.

Kitty: I was playing with these two [gestures to Pat and Lisa].

Pat: I just started and it seemed like Scott did something active that kind of lead, so I started going with that. We seemed to be going in the same direction at times.

Kitty: I guess too it's what you can hear. I was playing more with Lisa because I can hear her better.

Lisa: But I could hear Scott very well.

MPS: Yes, perhaps [Scott] got everyone there, but then it did seem that Kitty had the last word. Scott, were you choosing to end, or to drop out?
Scott: I was choosing to end; I was trying to take it somewhere that seemed like a logical ending point.

Indeed, Scott's movement toward the end of the piece to the upper register, with a gradual decrease in volume, does seem a fairly perceptible signal of "let's end now".

Ender's Game - CRCA - 4 (CD track 25):

In the next performance, Pat managed to drop out without causing the group to end. Lisa and Kitty recognized this.

Kitty: You left the bottom out of it. Then we couldn't end! We needed your cue!
MPS: Well good - so you accomplished what you were trying to do!
Pat: Well, I don't know, did I? It seemed like as soon as I stopped, [the piece pretty much ended].
Lisa: Well, but when you dropped out, I kept going, because it didn't sound like the piece was over.
MPS: Did you think about how you were going to do it? What strategy did you employ?
Pat: Well, I don't want to state the obvious, but the easiest way is to just not start - let somebody else get it rolling - then find somebody's texture that you can just hide in for a while, and then just get out of the way quietly when they stop.
MPS: So you're sort of shadowing someone?
Pat: Yeah, I was sort of shadowing Scott.

Ender's Game - CRCA - 5 (CD Track 26):

The next "Ender's Game" performance ended with Scott as the "drop out" player A. Several players knew.

MPS: It seemed to me there was a point [before the end] where you all were

thinking about ending.

Scott: That's what I was worried about, because by the time I dropped out, everyone must have thought I was going to end.

MPS: So did you try to do something to keep it from ending?

Scott: No, I just thought I was gonna hold my breath and hope they keep on going!

Lisa: We played these little inquisitive licks (sings) - and then [when you didn't answer, I thought] "well I guess I'll play a little more".

Pat: You must have been pretty successful, 'cause it was a while before I realized you weren't playing any more. When we were doing that stuff, I didn't notice, "wait, Scott's quit!"

MPS: Scott, did you consciously try to create a situation where you could hide?

Scott: Well, when I started off I realized I was kinda being the bass line, in a way; I mean I was setting up a little bit of a rhythm there, and I thought, well, I'll just follow this until it seems like an obvious time to change, and then I won't do anything. I was kinda hanging out waiting for things to go in a different direction, and then I'll just disappear...because with the role that I had, it would have been too obvious if I would've just stopped playing, with what we had going in the beginning.

Kitty: Somebody else had to take it somewhere first.

Ender's Game - CRCA - 6 (CD Track 27):

The next "Ender's Game" performance ended with Kitty as the "drop out" player A. Several players knew this as soon as the piece was over.

Pat: Kitty dropped!

MPS: Those of you who have been player A more than once, did you find it easier to get the group to continue on without you than to make them stop with you?

Kitty: It's easier to make everyone stop together, for me anyway. I've never had any problem with that!

Pat: I liked what Kitty did - she got everyone rolling, and then once we got rolling, she just kinda [dropped out].

MPS: Yes, it seemed like you had it planned from the very beginning, right? And you took control from the very first note! (Nods from Kitty)

Ender's Game - CRCA - 7 (CD Track 28):

For the next "Ender's Game" performance, we established a priori that player A would end the piece, since nobody had chosen that task for a while. This performance ended with a great deal of uncertainty as to who player A was.

MPS: What did you all think of that? Who was player A?

Lisa: I have no idea.

Kitty: Nobody [was]! We just all stopped.

Lisa: It just kinda petered out. I mean, the very last note Pat played was a good last note, and I thought, "OK, I can not come in after that last note."

MPS: But it wasn't convincing enough for you say it was definitively him that ended the piece?

Lisa: Yeah - I just kind of reacted to that last note.

MPS: Same for you, Kitty, pretty much, or ...?

Kitty: I didn't really feel anything - I was just playing along!

MPS: Well, what was the deal? You [Pat] were A, weren't you?

Pat: Yeah, I was A!

MPS: Yeah, I thought so. It seemed almost...pretty obvious to me, actually.

Lisa: Well I guess, 'cause you started with the spaced out [notes]... that made us timid.

MPS: It seemed like there was a point where you tried to end even a little earlier, but it wasn't quite happening, and you kind of had to ...

Pat: Yeah, I was just trying to be very conscious of not ending it the way I did the last time, with a long rip up and a loud, long note; I thought, "well I did that one, so I gotta do it differently". [Note the "internal dialog" and use of scripts and goals exhibited in this statement!] So I kinda started with what they did, and I tried to introduce some longer notes, and then this staccato thing happened, so I just tried to make mine slower and slower.

MPS: But it seemed like that wasn't quite enough to convince everybody that it was

really you [who was responsible for causing the piece to end].

Pat: No, it wasn't.

Kitty: I mean, we did it as a group - you didn't end us.

Pat: No.

MPS: Well, you were very sneaky about it, it seems, 'cause nobody was convinced it was you, but yet it worked!

Pat: That's why I played that one after the silence, [to tell them] "OK, it's me!"

MPS: I thought that was kind of a giveaway myself!

Kitty: That's what I thought! When I heard that note, I thought "Oh, well it must've been you."

MPS: It was kind of a dead giveaway, but you probably could have not played that note, and it still would have ended.

Pat: I found that a lot more difficult than the first time I did it, to make people end without being so obvious. "I'm the one, follow me... screech!"

Kitty: Well, but that's allright!

Pat: But it's been done!

For the next round of performances, I "improvised" a new micro-score in order to focus on the transfer of agency from one player to another. I'll call it "Relayer". The instructions for "Relayer" were as follows:

Cards were distributed so as to secretly select an "A" and a "B" player from the group. Player "A" was to gain agency, then pass it to player "B".

Relayer - CRCA - 1 (CD Track 29):

After the first performance of "Relayer", I correctly guessed that Kitty started out as the soloist, then passed it to Lisa.

Kitty: I thought you took it up, but you didn't keep it up, and then it seemed like it went over there (points to Pat) for a while.

Pat: Yeah, I got a little active, and then I went, "whoops!".

Lisa: I was just trying to do what you were doing.

Pat: But it seemed very obvious to me when Lisa became [the soloist].

MPS: Yeah, there was some serious imitation [and sequence extrapolation!] going on. What else were you doing to announce that you were [the soloist]?
Lisa: I was getting louder, imitating what Kitty was doing a little bit more aggressively each time, and then expanding, just to sort of let her know that I was in her wavelength.

Relayer - CRCA - 2 (CD Track 30):

After the next performance, Scott (when asked) correctly guessed "Lisa passed it to Pat".

Lisa: That was kinda neat, 'cause you were doing stuff that I could imitate, and then you took over.
Pat: Oh, really? I didn't know what I was doing.
Lisa: Well you were just doing little things in between what I was doing.
Pat: Yeah, I was trying every now and then to imitate what you did so you would know that I was "B".
Lisa: Oh, I knew almost right away that you were going to take over.

MPS: What is it that you guys feel differentiates accompaniment from soloing?
Pat: In here, dynamics... to me.
Kitty: A thousand things! Textural complexity easily stands out. Articulation.
MPS: So [when you solo], do you tend to play more legato? Making longer phrases?
Lisa: I use bigger leaps, playing wider intervals.

3.2.2. The Un-Sound Trio sessions

The second round of experiments took place on February 17, 1995 in Minneapolis, Minnesota at the home of Severin Behnin, accordionist for the "Un-Sound Trio", a group of seasoned improvisors who had just released their first recording. The group consists of Todd Harper on piano, Kevin Schmidt on

trombone, and Severin on accordion. Presentation of the micro-scores was more organized this time, requiring less explanation.

Micro-score session notes: Un-Sound Trio

After a brief, casual introduction and warm-up period, "Change Together" was described to the group roughly as follows:

"Everybody starts out on the same note. Stay on that note for a while, then move to a new note. Keep moving slowly from one pitch to another. Everybody stays in unison. Octave equivalents are allowed. I'll be looking to see how the group decides what note to move to next."

Kevin: "Do we indicate visually [when to move on to the next note]?"
MPS: That's up to you.

Change Together - UST - 1:

The performers occasionally ornamented the notes rather than just literally playing one note at a time. There seemed to be an implicit rule against initiating the next note. The order of note initiations proceeded as follows (T = trombone, P = piano, A = accordion):

T, P, A, T, A, A, P, P (accidental?), P, T, P, P, ... a fairly "random" distribution.

The players did not choose to cue changes visually. Occasionally, the performer who initiated the new pitch would play a "confirming" note after the other players had "found" the new note. Sometimes in the process of searching for a new pitch, a performer might brush a new note & accidentally trigger a change of pitch.

MPS: What kinds of decision-making processes do you find yourselves going through during this piece?
Kevin: Sometimes I feel like waiting for somebody else; sometimes I feel like playing a note. I just kind of go by feel; I like to choose every now and then, or lay back and let somebody else choose. Sometimes there's a conflict there, and sometimes I'll go with the other person. There was one point at which we all just

weren't agreeing; that's one thing you can do with trombone: just play real loud, and [the other players] have no choice [but to follow you]!
MPS: Does that role seem to fall to you a lot of the time?
K: Not so much in this ensemble. Todd (piano) is a lot of the time the one we follow; it seems to me more often he's the "anchor". Of course, he uses an electric piano, so he can just turn up his volume knob.
Todd: But that's after years of not playing with an amp!
K: Yeah, he's taking all those years of other people drowning him out in other bands out on us! (laughter)

T: No that's right, because you know personally I am fairly loud and fairly communicative. I try my best to lay back and hear what's going on. And then I hear the right moment where it's going to happen. You have to kind of harmonize. I think trios are really neat that way. With duo's, you always have to be working, where with a trio, one person can be laid back just a little bit, listening as much as you're playing. I love to hold down vamps and just listen to these guys go.

Change Together - UST - 2:

I proposed the performers do "Change Together" again, but this time with rhythm instead of pitch. The group chose to use their pitched instruments for the experiment, however.

K: Should we play in a 1/4-note rhythm?

MPS: Let's try leaving that open; you just have to set up a tempo - however you choose to do that is fine.

The result was a much more varied improvisation than the CRCA session with percussion instruments only. Tempo changes were very effectively carried out, however, generally at musically "logical" points in the phrase structure, often initiated by one player beginning an ostinato, in other cases by one player playing a ritard or diminuendo. As before, the trio displayed a remarkably even-handed distribution of agency. One tempo shift was initiated by Severin (the accordionist)

playing a very loud sustained chord which led the group into a long section of essentially pulse-less playing. The players seemed very pleased with their performance.

K.: Did we all want to end when we ended? (Others said "yes".)

MPS: I'm realizing how much better it is to use people who work together a lot.

Severin: Yes, we've done this kind of thing before.

Drop Out - UST - 1:

MPS: The next one I'd like to try is: everyone start playing together, and one by one, drop out until nobody is left. Keep it fairly short. (Todd jokes about Wagner & stubborn musicians - "6 hours later: I'm not dropping out!" - an example of Todd's jovial personality.)

They try the exercise, but seem to end together rather than staggering their exits.

MPS: Let's try that one more time, but see if you can make the intervals between the dropouts longer, so that for 10 or 15 seconds there are 2 of you playing, and then for the last 10 or 15 seconds only one.

Kevin: So if it looks like 2 of us are going to be ending at the same time, one of us should keep going.

Drop Out - UST - 2:

The trio tries "Drop Out" again, seeming somewhat tentative, searching for a "theme". After a minute or so, Kevin and Todd have arrived at a soloistic, pointillistic texture, forming a unified system, with Severin providing an accompaniment. This leaves Severin in a position to keep going after Todd and Kevin drop out, which they do basically together.

MPS: This seems a bit more challenging for you. Do you ever do this kind of "staggered ending" in your performances?

Severin: No, but it's a neat idea though.

Todd: Yeah, we've been working more with having 1 or 2 people playing at a time.

A discussion ensues of how many different "ensembles" can be formed by a group of N musicians using combinatorial arithmetic.

Ender's Game

MPS: The next one we're going to do involves picking a card. One of you will get the "A" card, which means you are "player A". That player will have one of two possible options: try and get everyone to end with you, or try to drop out without causing anyone else to end.

Todd: OK, so either try to be very influential, or not influential at all. Contributing to the stream, or withdrawing from the stream.

MPS: Right! And everyone else has to figure out who it is, so if you get the "A" card, don't give it away.

Cards are distributed. At Kevin's request, the instructions are repeated: "Either force the piece to end, or try to drop out without causing the piece to end. I'm giving you a choice [of tasks] so it's not too obvious what's going on."

Ender's Game - UST - 1:

Todd picks up a penny whistle; Kevin plays multiphonics on trombone, Severin plays long sustained clusters. Kevin soon starts playing a solo against this texture, which Severin joins and seems to be almost competing for the spotlight with Kevin for a time. However, Kevin soon regains the spotlight and seems to be driving the

piece to an ending several times. Kevin seems to have clearly identified himself as player "A", but Severin, seemingly almost in order to throw off the experiment, continues to keep the piece going.

After the piece, the musicians reveal that they were never completely sure who player "A" was. Todd seems to have been convinced that it was either Severin or Kevin, but he wasn't sure until the end. Kevin expresses concern that his request for repetition of the instructions gave away his identity. He says, "I have the feeling we're not doing exactly what you want, but you're getting something interesting out of it anyway."

MPS: Don't worry - I don't have a set agenda here. Let's do it again. I'd suggest that if you do get the A card, decide definitively which option (ending the piece or dropping out) you're going to do right from the start. You can be as obvious as you want; you don't have to be too subtle about it."

Jokes are made about various ways of making obvious endings, escalating into a humorous improvisation consisting of a pastiche of cliche endings.

Ender's Game - UST - 2:

Cards are redistributed, and the band begins again, this time with all three playing extended tremolos in an imitative, cyclical fashion. This, however, soon winds down; Todd seems to drop out, leaving Kevin & Severin to continue. Had Todd not joined in again with Severin when Severin began a new rhythmic motive, Todd (as player A) would have succeeded in carrying out the "drop out" task quite admirably. However, the piece picked up again with a brief ostinato, almost like a coda; again, Todd seemed to drop out just before the others. However, when the piece ended, it turned out that Kevin was in fact player "A". Neither Todd nor Severin seemed to have known this.

This is a good example of how even experienced improvisors can sometimes fail to communicate their role to the rest of the group!

Kevin's comment: "I was trying to end before you guys, and I was thinking "I'd

better do it soon"."

MPS: So you were trying to drop out at first?

Kevin: Yeah, but I couldn't tell how long these guys [would keep going]; I didn't want to make it too obvious, like by playing for 10 seconds and quitting. I thought the guys were probably going to go a bit longer, but then I got this feeling, "maybe I'd better drop out soon". And then [Todd] dropped out before I did!"

"Relayer"

This experiment was "composed" on-the-spot during the CRCA sessions as a way to focus on how agency is conferred by the group on a particular individual, or on how individuals can "seize" agency from the group. As a variation, and to allow a longer performance to develop, I decided to let the performers simply "trade solos" for several minutes.

MPS: OK, let's try trading solos - just keep it so one person is always soloing, and change soloists in a "round robin" (without making the order too predictable). Keep it shifting fairly rapidly, and make sure everybody gets at least a few turns.

The piece seemed to open with Severin as soloist, although he was playing a very diffuse style - basically slowly shifting clusters of notes. His solo seemed to draw to a close, but nobody picked up the ball for a minute or so, so Severin picked it up again, feeding in a strong melodic line. Todd seemed to pick this up but didn't carry it forward. Severin remained in the soloist spot basically through the rest of the improvisation.

Severin: It's interesting; we really don't play like this very often!

MPS: I love how you guys never take the easy way out!

(They could have accomplished the task easily, but instead chose to challenge themselves by exploring the boundaries between foreground & background.)

S: This makes you think more about whether what you're playing is foreground or background; I like to explore the edge between these. In this kind of ensemble, your options are more open.

"Love Story"

MPS: This piece is another "A-B-C" kind of deal; everybody has a role. The piece will begin with B & C playing, so we'll know who A is right away. B & C should not reveal their roles, though. Player B has to "seduce", if you will, player A to join with him. B should play in a way that attracts A, and C should try to prevent that from happening.

K: So C should never link up with anybody then?

MPS: Right.

Todd: Let's think about these in personal terms. C is trying to prevent the treaty from being signed... he's an anarchist! A is a neutral person. I don't think we should know who anybody is before we start!

MPS: OK, we can do that... but obviously, the person who doesn't start right away is going to be "A", but...

Todd: So, B & C are "vying" for A's affections?

K: Yeah - so it's like A is like C's daughter, C is the mom or dad, and B is a boyfriend that C doesn't like, so C is trying to break A and B up!
[Uproarious laughter... the group really seemed to like this narrative description!]

Love Story - UST (CD Track 31):

Playing begins at marker #2514. In a spontaneous, small act of "mutiny", the group decides to keep all of their identities hidden, and all 3 begin together. Severin starts up the piece with a long "pickup" note, which leads Todd into an aggressive vamp, with Kevin providing a halting solo melody in time with the vamp. S. plays a humorously dissonant counterpoint against Kevin's melody which has almost nothing at all in common rhythmically or harmonically with Kevin's melody or Todd's vamp. Severin's playing becomes more insistenly rhythmic at points, and he picks up on complex rhythmic relationships to Todd's piano playing such as triplets, seeming to be trying to draw Todd's attention away from Kevin. This led me to think that Kevin might be "A", Todd "B", and Severin "C".

At 2552, Todd drops the tempo quite a bit, lapsing into slow waltz time. (Note on the tape the tilt of Todd's head as he does this.) This feels like a capitulation on Todd's part toward Severin; his body language is disposed toward Severin, and his playing is now synchronized with Severin's, although Kevin remains soloistic, but contrapuntal - Severin has the lead for the moment. However, at 2565, Todd's head turns back toward Kevin, and shortly thereafter, he suddenly picks the tempo back up again with a very lively, dissonant vamp in changing meters (a fairly drastic way of gaining agency). Neither Severin nor Kevin a while to regain their "footing" from this maneuver. As a kind of "coda" to the piece, Todd begins dropping out intermittently, leaving Kevin & Severin to solo together for a while. Todd's behavior from 2552 to the end of the piece leads me to think that he might be "C", as his sudden shifts in tempo could certainly be read as trying to throw A and B off and make it hard for them to communicate. However, I would have had a hard time seeing Kevin & Severin as A and B, because they didn't seem to be making much effort to link up with one another, except during the coda.

When the piece ended, Todd turns to Kevin & says, "You were A, weren't you?". Kevin says, "Yeah. You were "C", weren't you?". Todd says, "No, I was B!". Kevin asks Todd, "Did you know before we started playing that I was A?" Todd says, "No, I didn't look."

In this performance, the players demonstrated an ability to communicate and perceive secretly established roles through musical communication alone. Kevin reveals however that he was unclear about the fact that A was supposed to try to join with B, and Severin reveals that he was deliberately trying to throw Kevin off by pretending to be B when in fact he was C. I explained to the group that they should try to stick to the scenario a bit more closely in the next round: "If you think you know who B is, you should demonstrate that you know by playing with B."

At 2720, a second performance of "Love Story" begins with a group count-off "1, 2, 3, 4!"

Again, no roles are revealed at the outset of the piece. The band begins with everyone contributing equally, more or less. Todd again playing his trademark "oom-pah" vamps, which he shapes dynamically in response to Kevin. Todd & Kevin move to a highly interactive, "call & response-ish" mode, whereas Severin seems to be trying to break them up, or at least stay independent of either of the others. It seems possible that Severin is playing the "C" role, while either Todd or Kevin is A. However, by 2788, Kevin has aligned his playing more with Severin's harmonically and rhythmically. His transition seems to indicate that he is A, and Severin is now a candidate for the "B" role. Todd's reaction to this is interesting: he begins playing a quotation from the folk tune "Jimmy Crack Corn", which is so out of context from the rest of the music that it functions as a strong indicator that he might be "C".

When the group ends, it's revealed that Todd was, in fact, playing the "C" role. Everybody seemed to know Kevin was "A", but there was less certainty about who B and C were. Kevin recalls one event in particular that led him to think Todd was C: "As soon as I locked on to Severin, then [Todd] went nuts!"

Take 3 of "Love Story"

At 2844: Todd is announced as "A". Severin begins with a grace note riff, while Kevin plays short melodic fragments. Todd picks up on Severin's riffs, imitating them almost literally. Clearly, he believes Severin to be "B". Todd and Severin remain locked in. Kevin tries to "break in" by imitating the 3-note lick, then by playing an insistent one note rhythmic vamp which is very tough to ignore. Todd and Severin do pick up on Kevin's tempo, but then break away from it again. Todd imitates Severin's glissandi on the accordion. Todd and Severin seem to have successfully protected their "union" from Kevin's attempts to break them up.

When the group ends, Todd says to Severin "You were B, weren't you?". To everyone's surprise, it turns out that, in fact, Kevin was B! Todd is clearly shocked by this, exclaiming "You shyster!". Kevin explains how his attempts to get Todd's attention failed, and how Severin was successful at fooling Todd into thinking he was B. Severin chuckles knowingly throughout the whole discussion, seeming to revel in his accomplishment.

3.3. Observations

The task of making collective, unison tempo or pitch changes in "Change

Together" was generally accomplished by players taking turns at initiating changes in random order. Both groups seemed to obey an implicit rule (which was never stated by me or anyone else) that a player should not take the lead by initiating a change more than twice in a row. Initiating a change was usually signaled by playing against the established pattern, such as the triplet pattern in the claves beginning at bar 12 of the transcription in Appendix B1. However, this technique was not always successful, as shown in this same example; the new tempo established by the clave player was not picked up on by the rest of the group in this case. Indeed, in these experiments, it often seemed that if the deviation from the established pattern was too exaggerated, the group did not decide to follow. In fact, I observed a common pattern in many improvisations whereby changes would be *signalled* by one performer deviating from the established norm. This player, however, would not actually *lead* the change; instead, the change leader would gradually alter their playing from the current norm to the new norm, effecting a smooth transition between the two. By distributing the roles of "change signaler" and "change leader", agency (and responsibility for decision-making) was distributed more evenly among the ensemble. Occasionally, a performer seemed to "accidentally" become a change signaler by playing a pitch or tempo that was just slightly outside the established one, which was misinterpreted as a signal for change. There seemed to be a large variance between the two groups regarding how much variation in one's part was permissible before being interpreted as a change signal. The more experienced group seemed more tolerant of change and better able to distinguish between variation and change signaling.

In "Love Story", the most often-cited "attention-grabbing" device in both groups was melody. Musicians taking on the role of player B would usually assume a melodic function, which tended to have a higher rate of "information per unit of time" than the accompanimental musicians' playing. The musicians generally adopted a spirit of cooperation which tended to produce a fairly clear delineation of roles; accompanists "stayed out of the way" to let soloists be heard. They did this by playing fewer notes, playing softer, or in a different register than the soloist.

The less experienced subjects seemed not to exercise as much care in picking their points of entry. Their entrances often sounded relatively arbitrary, cautious and tentative. By contrast, more experienced performers were much more judicious and deliberate about their entry points. This distinction could be due many factors, but the most obvious one to me is that with experience comes a higher level of confidence.

One interesting discrepancy between my instructions for "Love Story" (see above) and the reality of its realization in performance is that the "A" player often seems to join with the soloist in *accompanying*, rather than *sharing* mode. (See chapter 4 for explanations of these modes with respect to my analysis framework.) Since I did not explain these concepts to the participants, nor did I explicitly tell the participants what I had in mind by "joining with" the soloist, the performers demonstrated that both *accompanying* and *sharing* involve a perceptible affinity with the other performer. The difference, however, is that the accompanist always allows the soloist the space to lead, and always modifies her playing to conform to the soloist's changes rather than asserting her own ideas which match well with those of the soloist. The experiments revealed that both modes can be perceived as different kinds of "joining".

In "Ender's Game", "A" players seemed to prefer the task of making the group end rather than dropping out undetected. Leading the group to an ending point turned out to be fairly easy; in every case, the group ended at about the time player A wanted them to. In some cases, however, it wasn't clear to everyone who player A was. This would seem to indicate that musicians can be "subliminally" affected by the playing of another; a single player can exert a subtle influence on group behavior without necessarily making that influence felt at a conscious level. The musicians were also usually able to carry out the task of dropping out without causing the group to end, although this task seemed to be a bit more difficult. One player described his strategy as "finding a texture to hide in"; when such a texture was lacking, players seemed able to exert influence to create one.

"Ender's Game" turned out to be a study in leadership issues. Since the group was not told ahead of time who A was nor what their plan was, the first few

moments of the performances consisted of the group trying to establish these facts. It is particularly interesting to observe what happens when no leader clearly emerges after the first 30 seconds or so. In these cases, the group generally assumes that player A has chosen to drop out, thereby leaving the "leader" position available. Sometimes a player will step into the leadership role, to "fill the void" as it were, but if not, the resulting music has no leader. It is interesting to note the marked difference between performances which have a leader and those which do not. Performances with a leader are organized around the leader's actions; they have a focus and unity lacking in "leaderless" performances. However, music which is completely dominated by a leader can become uninteresting, because of a lack of "give and take" or counterpoint in the music.

In conclusion, I can say that in retrospect, after having completed my analysis framework, the micro-score experiments did provide some evidence for the salience of the structures described in the next chapter. They also demonstrate, in hindsight, the usefulness of the framework in analysing improvised performances like those generated by the experiments. However, I quite deliberately avoided the scientific method in the construction of these experiments. They were not created to "prove" the constructs in the framework to be "correct"; indeed, this would not have been possible because the framework was developed *after* the experiments were carried out. Instead, the experiments provided a "laboratory" environment in which to develop the concepts that underlie the framework. The experiments were certainly rewarding not just for me but for everyone involved.

4. Presentation of the Analysis Framework

In this chapter I present a framework for analyzing Western Improvised Contemporary Art Music (WICAM). The theoretical background of this framework is a synthesis of the material presented in the previous chapters combined with observations and speculations based on my personal experience as a listener, improvisor, composer, and computer music software developer. My exposition of the framework will be broken down into two main sections. In the first, I will describe the basic elements of musical interaction: agents (and their states), special events called "interaction events" or "i-events," and the media, both physical and stylistic, in which the interactions take place. In the second section, I will define a system of interaction modes which occur in WICAM and discuss the symbolic functions of each mode. I will also discuss the concept of "compound" modes, addressing some issues concerning the combination of multiple modes.

4.1. Elements of Musical Interaction

Webster's Ninth New Collegiate Dictionary defines *interaction* as "mutual or reciprocal action or influence." The verb *interact* means "to act upon one another." The word *analyze* is defined as "to study or determine the nature and relationship of the parts." This interaction analysis framework, accordingly, begins with a formal description of the major components of musical interaction, and of the relationship of these components to one another. Only after these basic structures have been fully identified will it become possible to discuss the higher-level constructs of the framework.

The framework's elements and their relationships to one another can be summarized as follows: in any interaction, there must be two or more *competent agents* which are capable of generating and interpreting musical information. The degree to which a musician is sending or receiving indicates their *state*. State changes generally occur during "interaction-events," or *i-events*, which are the fundamental

syntactical elements or "verbs" of musical interaction. The instrumental/stylistic/cultural context within which the entire interaction takes place is called its *medium*. These essential components: agents (and their states), i-events, and medium, each have several important defining properties, which are explained in the following sections.

4.1.1. Agents and Agency

Let us define an interactive musical agent as any intelligent entity which can competently produce and interpret musical signals according to the conventions of at least one medium, acting of its own volition to modify its behavior in order to optimize the performance of the group, and ultimately to provide an engaging listening experience for the audience. As discussed in chapter 2.2, there is an important distinction between the *intelligent* agents in musical improvisation and the "dumb" automatons of game theory. The key property of intelligent musical agents is a capacity to handle multiple, changing goals by generating new plans "on the fly." The concept of "musical intelligence" (cf. Rosenboom 1994) is central to this analysis framework. The perceptibility of intelligence in the agent (by both performer and audience) is critical to the perception of interactions as symbolic behavior. The "framing," in the Goffmanian sense, of all of the performers' actions as sincere, voluntary acts allows them to be interpreted as genuine, spontaneous expressions of their feelings and attitudes at the time of performance. This requirement, furthermore, eliminates from consideration here such environmental factors as room acoustics, weather, what one ate for lunch, etc. While these influences may be important, they do not function as "intelligent agents" within this framework.

An intelligent agent, in the most general sense, is any entity that can function intelligently in a variety of improvisational situations. Although no single agent ever has absolute control over a developing improvisation, each may obtain different degrees of *agency* at various points in the performance. *Agency* is the ability to influence the character of the music as perceived by the audience. Typically, a soloist will have greater agency than an accompanist, because accompanists are generally obliged to tailor their playing to support the soloist, making sure to leave him plenty

of musical "space" in which to make a statement. The soloist, therefore, has the ability in an improvised performance to directly control large-scale features of the music such as overall intensity, harmonic features, etc. (This, of course, assumes that the accompanists have "good will" toward the soloist and wish to cooperate and provide a supportive musical environment!) Another way of obtaining agency in a musical interaction is by defining sectional boundaries; such a conferring of agency occurs whenever a performer, by some act of musical signification, is able to initiate or terminate a section of music.

Unlike the agents described in cognitive science research such as Minsky's *Society of Mind* (in which the term "agent" refers to modular component processes of consciousness), agents in this framework are considered whole, singular, sentient entities. Agents in musical interaction are typically specially-skilled performers who have achieved competency as improvisors, although certain natural phenomena, animals, and sophisticated interactive computer music systems have been known to function as agents in musical interactions[1]. Traditional conservatory training is neither a pre-requisite nor as a guarantee of interactive competency. In fact, few musicians schooled in the traditional conservatory curriculum ever learn to function as competent interactive agents.

4.1.1.a. Competency

Agents in a musical interaction must possess a certain degree of competency in the production and interpretation of the musical signals produced by the other agents with whom they are interacting. This means that to achieve the potential for agency in a musical interaction, it is not enough for an agent merely to have an ability to affect, produce, or respond to musical signals; the agent must be "fluent" in the set of skills required to communicate in some way with other agents working in the same medium. Furthermore, the concept of competency carries with it a notion of personal responsibility for one's actions. All actions made by every performer, as well as all reactions to sounds made by others, are assumed to be completely voluntary - that is, completely under that performer's own conscious control. While an agent may try to effect a state change in others by sending various signals, it is completely up to the

[1] The question of free will poses some interesting philosphical problems in these cases which will not be addressed here.

other agents as to how or even whether to respond to these signals. There is no guarantee that a given signal will automatically trigger a given response. We also assume that an interacting agent acts according to his or her own self-interest; that is, they are behaving according to their own internal standards of beauty, rather than those imposed by someone else. We presume that the agent is acting with integrity – that their actions represent the true and accurate state of their musical thinking at the time of performance.

We may consider the following to be *core skills* of musical interaction, the mastery of which confers upon the performer the ability to act as an agent in a musical interaction:

1. The ability to make accurate judgements in real time about the "semantic intent"[2] of each performer.

2. The ability to accurately convey the semantic intent of their own musical ideas to other performers in real time.

There is an interdependence between these two competencies which mirrors the interdependence of the interacting agents. Each agent in an ensemble must possess both of these competencies, or the chain of communication breaks down, and the interaction becomes distorted and could be said to cease to exist altogether, because the agents are no longer able to communicate accurately. The level of interaction between two agents is thus only as high as that of the less competent agent. Just as a chess or tennis match between a master player and a complete beginner would be relatively uninteresting to watch, an interaction between a master improvisor and a complete novice would be musically uninteresting, because it would have few "interaction events" (see sec. 4.1.2) and would rarely achieve interactive "consonance" (see sec. 4.2.3).

The ability to achieve these competencies depends strongly on the agent's

[2] By using this term "semantic intent", I do mean to propose the modes of my analysis framework as a sign system used for the communication of a certain core set of inter-performer relationships. The ability to recognize and communicate these relationships must be present in order for an agent to achieve competency.

familiarity with the cultural context of the interaction. Consider, for example, the following interaction:

> Two women are having dinner at a restaurant. One woman is talking to the other about something of a very personal nature. During this conversation, a server comes to the table to clear away some of the plates. As the server is maneuvering awkwardly around the first woman, she says "Pardon me!." The first woman takes this as a sign that the server is interested in her conversation and wants her to repeat or explain something, when in fact, the server was merely excusing herself for invading the woman's personal space and was not interested in the conversation at all.

To jump ahead of ourselves a bit, we might use my analysis framework here to observe that the first woman mistakenly assumed that the server was attempting to *merge* with her conversation. Several factors may have contributed to this interaction "error". The first woman may have been so engrossed in telling her story that she failed to understand that the server was simply apologizing for her awkwardness; she may have also failed to identify the server' movements as being awkward or invasive in the first place. The first woman may also have been a somewhat self-centered individual who was accustomed to being the center of attention and therefore assumed that the server would be interested in what she was saying. Any of the above would be considered a violation of the first competency. On the other hand, the server may have used a tone of voice and/or movements of the body which indicated a higher level of interest than would be expected under the circumstances. This would be a violation of the second competency.

Both of the agents involved in this interaction displayed a certain lack of competency in this case, and the result was an interaction "error." Note that based purely on the phenomenological evidence, it is impossible to assign "blame" for this error to any single agent – a situation quite common to everyday interactions. Environmental factors play a role in defining competency as well. For example, the fact that this interaction occurred in the context of a casual restaurant in the midwestern United States made it at least conceivable that the server *might* be

interested in participating in the table conversation. In a more formal setting, this possibility might not even have existed, and the error might not have occurred. Thus we can see that in situations where roles are more rigidly defined (e.g.: waitpersons do not speak to patrons about matters unrelated to the meal), the chance for this sort of error is greatly lessened. Furthermore, the first woman might have a different notion of role boundaries than did the server. She may, for example, have been raised in a small town, where it was commonplace for people in public places to interact on a more intimate basis. These environmental factors constitute the *medium* in which all interactions take place.

Errors of a similar nature frequently occur in musical interactions, and are caused by a failure to exhibit competency by one or more of the performers involved. For example, a performer may send confusing or ambiguous signals about their concept of where the beat is, miscommunicate when they intend to make an entrance or exit, or fail to communicate whether they intend to increase or decrease the intensity of their playing. Agents may also misinterpret signals sent by other agents. What might be intended as an extremely intense gesture coming from one agent might be interpreted as a low-intensity statement by another. As in everyday interactions, responsibility for such errors is often distributed among the ensemble. This contrasts sharply with monoriginal performances, in which mistakes (wrong notes, rhythmic inaccuracies, missed entrances, etc.) are generally attributable to individuals rather than groups. This "distribution of responsibility" is an important distinguishing quality of heteroriginal music. Because of this distributed responsibility, and as evidenced by several statements from musicians documented in Berliner (1994), musicians generally improvise much more successfully with players with whom they have developed a long-standing rapport, or with whom they share a common cultural bond. Musical improvisation is a highly specialized skill that depends on extreme familiarity not only with the medium in which one is interacting, but with the musical personalities and competencies of the other players in the ensemble. Ensembles made up of very familiar, competent improvisors generally do make much more effective and engaging music.

Another important facet of improvisational competency involves the ability to recognize and recover from errors such as those described above. As George E. Lewis writes,

> Often in listening to improvisors I would turn to another person at a point in the music where it was clear to both of us listeners that a structural problem was occurring--the players were having trouble making a transition they were trying to do, somebody's idea of another's intention was disconfirmed, etc., or one person temporarily becomes unreachable by the other players. The attitude we listeners would have would be "let's see how they get out of this corner they've painted themselves into." For many listeners, part of the interest in listening to improvised music is in seeing and hearing the players work out solutions to "errors," rather than ascertaining responsibility. (personal communication).

4.1.1.b. Agent Systems

Agents can and do form "systems" by aligning their behavior along one or more musical parameters. A classic example is the way jazz drummers and bass players strive to play as a unit, primarily by achieving rhythmic unison. Berliner reports that

> the relationship between the drummer and bass player [is usually] the most critical. 'For things to happen beautifully in an ensemble', Charlie Persip metaphorizes, 'the drummer and bass player must be married. When I listen to the drummer and bass player together, I like to hear wedding bells.'

Such a "wedded" musical unit we will refer to as an "agent system." Agent systems function essentially as a single agent in nearly all aspects of their interactions. The Higgins/Blackwell excerpt from Coleman's *Free Jazz* presented in chapter 2 provides an example; during this passage, Higgins and Blackwell form a kind of agent system against which we can compare bassists Charlie Haden and Scott LeFaro, each of whom are playing quite independently of the other. The grouping of performers into "agency units" becomes especially important when examining the behavior of ensembles larger than two. Identifying agency units or "sub-ensembles" in a large improvising group is essential for managing the complexity of analyzing improvised

music.

4.1.1.c. Agent Communication States: Sending and Receiving

In "The Mathematical Theory of Communication" (1963), Shannon and Weaver presented a general model of communication systems including the following five elements:

> 1. An information source which produces a message or sequence of messages to be communicated to the receiving terminal.
> ...
> 2. A transmitter which operates on the message in some way to produce a signal suitable for transmission over the channel.
> ...
> 3. The channel is merely the medium used to transmit the signal from transmitter to receiver.
> ...
> 4. The receiver ordinarily performs the inverse operation of that done by the transmitter, reconstructing the message from the signal.
> 5. The destination is the person (or thing) for whom the message is intended.

I've collapsed this model into a 3-part system: sender/transmitter, medium, receiver/destination.[3] My model of improvisation assumes that during a performance, an agent is constantly both sending and receiving varying amounts of information, but acts at a given moment primarily as either a *sender* or a *receiver*. As was discussed in section 2.3.2, it is possible to determine, albeit in a more or less "fuzzy" way, the amount of information a musical agent is sending and receiving relative to the other performers. Musicians generate and perceive information "on many levels and to varying degrees" (as stated by Douglas Ewart, personal communication, 1996), so any system which attempts to measure musical information

[3] In extending the Shannon/Weaver model to musical performance, there is some ambiguity regarding the "destination" of the signal. Communication theory assumes a single recipient, whereas in a live musical performance there are always multiple recipients: the other performers, and the members of the audience, whether or not the performer is particularly focussed on one or the other. In the context of this framework, we are primarily interested in the **performer-as-listener**; the audience is assumed to be "receiving" the entire interaction process rather than being focussed exclusively on one performer or another.

must track many variables simultaneously. Fuzzy logic (see 2.3.2) provides formal mathematical models for multivariate situations such as determining the state of an interacting musical agent. One common application of such models in fuzzy system architectures is to sum all of the outputs of a number of "associative memory" modules (basically analysis functions yielding some kind of quantitative measurement) and then run them through a "defuzzifier" function to yield a Boolean (true or false) value. To apply fuzzy logic to the problem of determining the state of an interacting agent, we have to devise an algorithm for measuring the amount of information per unit time generated by a musician. I will not present any specific algorithms for accomplishing this task here; there are many different ways of "filtering" musical information, and to present even a reasonable discussion of this problem would take us far beyond the scope of this paper[4]. The framework tells us what to look for, but not how to look for it. It's possible (and valuable) to assume that many valid methods of measuring musical information do exist, and it would be counter-productive to try to define a single "correct" method. For our purposes, let us assume that we have devised some reasonably satisfactory way to measure the amount of information per unit time generated by a musician. Each agent, then, as well as each audience member, is continually applying principles of fuzzy logic to determine the overall information output level of each performer and comparing it to that performer's level of information input. At any given point, it is usually clear whether a performer is sending or receiving based on this analysis.

The outcome of this analysis determines an agent's *communication state.* When a player's total level of information output exceeds their level of information input by a certain degree, a fundamental shift occurs in that agent or agent system's perceived state from one of *receiving* to that of *sending.* Recall from the discussion of communication theory in section 2.6 that musical information can be measured in terms of the rate of change, or the amount of redundancy in the signal. The more a performer repeats herself, the less information is being sent, and therefore the more

[4] Such algorithms generally boil down to detecting the rates of change of some set of measurable parameters, such as pitch, rhythmic values, etc. Pattern- and event-detecting algorithms can be used to widen the analysis "window" and to provide "weighting" functions to assign different values to certain events. Grouping parameters in various ways can be important. Recognition of musical constructs can be interesting as well. Some promising directions are indicated by Chafe et al (1982), Bregman (1990) , and Pelz-Sherman (1992).

likely she is to be perceived as being in a *receiving* state (and vice-versa). Another way of defining communication state is that senders *initiate* musical ideas and phrases, whereas receivers *respond* to them. While a receiver may still contribute important new "information" to a performance, that information is complimentary to information from the sending performer. Receivers are the background against which senders are foregrounded.

The dialectical nature of musical interaction has a polarizing effect on the ratio of sending to receiving accomplished by each agent during a given section of a piece. If an agent perceives his level of information output to be on the high (sending) or low (receiving) side, she is likely to remain in that condition unless or until something triggers her out of that state. Experienced improvisors tend to settle into either sending or receiving states, because they know that without this stability, the music would become chaotic and incomprehensible. It also appears that in most group interactions, there is a collective force that normally operates to maintain an overall balance between the amount of sending and receiving going on at any given time. Too much sending, and the music becomes chaotic and wanders. Too much receiving, and the music becomes overly repetitive and boring.[5]

Shifts between sending and receiving roles provide the music with variety and development, without which it would eventually stagnate. Improvisors send clear signals to one another indicating when it's time for them to make the shift from receiving to sending or vice-versa. The level of interactive "entropy," or rate of state change in some performances can reach very high levels, with players changing states so rapidly that it becomes impossible to identify their communication state; their state becomes blurred with that of the other agents. At some point, if sustained long enough, rapid state changes are perceived as a *mode* of group behavior rather than discrete events attributable to individuals. Ensembles that choose to sustain continuous, rapid communication state changes for long periods of time are extremely rare. There are several possible explanations for this observation: for one, changing states takes a great deal of effort and musical assertiveness. It is also likely that musicians consciously avoid this kind of behavior because of the potentially damaging effects of frequent[6] state changes on comprehensibility to listeners. In a

[5] This "force" could simply be the result of all of the agents listening to each other.

typical performance, communication states usually remain fixed for at least several seconds to several minutes – long enough to allow each sender to make at least one complete musical "statement." This is yet another example of how improvisation imitates conversation.

To review: a sending agent generates information, producing signals with high rates of change. A receiving agent generates little new information, but instead either repeats or reinforces elements introduced by another agent or by themselves, or provides accompanimental or contrapuntal support. In jazz-based music such as Miles Davis' *Bitches Brew* or Steve Coleman's M-base compositions such as "Song of the Beginnings," it is usually fairly easy (though not always trivial) to separate senders from receivers, since this music is generally structured as a series of solos with varying degrees of continuous interaction by the rest of the ensemble. Such pieces make good "beginning exercises" in listening for communication state transitions, because the states are relatively obvious, yet the transition points are not always as predictable as in a traditional performance of a jazz standard, where the timing of state transitions is nearly always governed by the structure of the melody or "head," nor are the soloists as clearly delineated as in more traditional jazz performances. During any given section of Davis' "Pharaoh's Dance," for example, it is almost always possible to isolate one or possibly two players who quite clearly have "more to say" than the other players. Other players will step aside and give this player room to maneuver, interjecting a few notes only where appropriate (i.e.: between phrases of the sending agent).[7] "Pharaoh's Dance," for example, has the following series of primary sending agents (soloists):

3':32" - 5'35"	Miles Davis (trumpet)
5'40" - 7' 36"	Bernie Maupin (bass clarinet)
8'35" - 11'05"	Davis

[6] My personal limit for state changes is around one every 3 seconds. When performers change state faster than this, I tend to hear this as the "initiating/responding" interaction mode. Naturally, different listeners may have different thresholds for this perceptual transition point.

[7] In amplified performances or recordings such as *Bitches Brew*, sound engineers usually boost the volume of the sending agents. The performers may also step to center stage, and may have a spotlight trained on them by a lighting designer. All of these external factors greatly influence our perception.

11'05" - 11:50"	Maupin
11'53" - 12'55"	Wayne Shorter (soprano sax)
12'56" - 14'18"	John McLaughlin (electric guitar)

Figure 4.1: Soloists in Miles Davis' "Pharoh's Dance"

Davis' solos are particularly interesting examples of "sending" because they use very sparse, severely constrained pitch and rhythmic materials, and yet they manage to transmit a great deal of information by varying the metrical placement of notes, such as in this excerpt from "Pharoh's Dance":

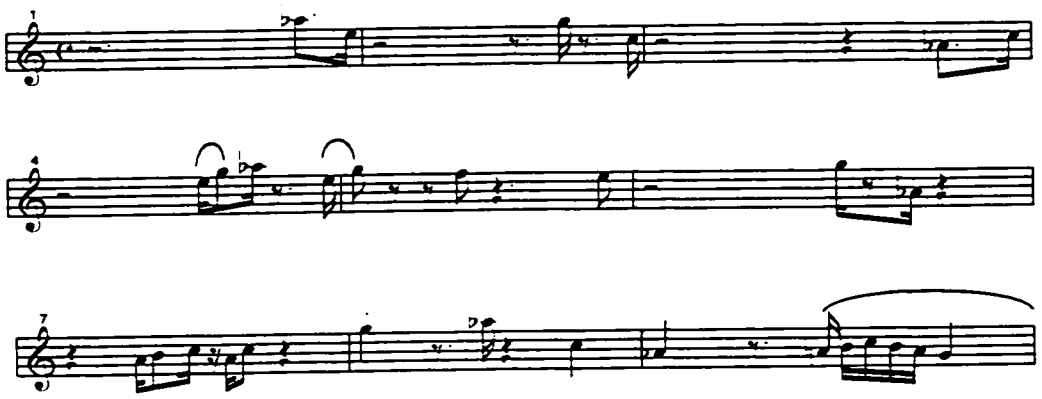

Figure 4.2:"Pharoh's Dance" excerpt

These two communication states, *sending* and *receiving*, are the fundamental "building blocks" of this analysis framework. It's important to distinguish between the communication *state* of a single agent (sending vs. receiving) and an interaction *mode* of a group of agents (*sharing, not sharing, soloing/accompanying*). "State" describes a single agent's behavior without considering its relationship to the whole, while "mode" describes the relationship of an agent to the rest of the group. [8] One

might question, however, whether additional communication states exist – for example, a state in which an agent is both sending to *and* receiving from another agent exactly the same amount of information as the other agent is sending to and receiving from the first. One could also imagine a condition where two agents have equal sending-receiving differences, but are not sending or receiving information *from each other*. While such conditions could possibly represent additional communication state values, it will turn out to be more felicitous, as we shall see, to formulate such situations as interaction *modes* of a group of agents rather than states of a single agent, inasmuch as these states require at least two agents to attain. I call such special state conditions "static" interaction modes. More complex modes can be constructed by combining these static modes in series; these are called "dynamic" modes. The static and dynamic modes will be enumerated and discussed further in section 4.2.

4.1.1.d. The "Spotlight" Phenomenon

In any WICAM performance, at any given time, there will be certain performers whose playing seems to be more foregrounded than that of the others. These performers seem to be sending more information than the others, thereby attracting more attention to themselves. We can imagine the attentions of the audience and of the performers as a kind of "spotlight" which is attracted to high levels of information and therefore tends to "illuminate" those performers putting out the most information. However, it takes more than a mere increase in information output to gain a place in the "spotlight"; the other performers must confer agency upon those in the spotlight by opening up the musical space and shifting into a receptive, accompanimental role. One can either purposefully step into the spotlight, or one can be "thrust" into it by the rest of the group. Being in the spotlight means becoming a "soloist" of sorts, although it is of course possible (though relatively rare) for a WICAM performance to have more than two or three simultaneous soloists. I have found this "spotlight" phenomenon to be an important aspect of analysis, and

[8] State and mode are completely separate concepts. For example, two agents may both be sending simultaneously, but this doesn't say anything about what mode they are in; they could be sharing or not-sharing, depending upon whether they were also *receiving* information from eachother.

will refer to it throughout the remainder of the thesis. Being in the spotlight means having been granted the opportunity to express oneself completely freely, with a certain degree of confidence that the rest of the group will support and not interfere destructively with this expression. This phenomenon also helps explain the "polarizing" effect on agent states toward either sending or receiving mentioned above.[9] The spotlight has the effect of dividing the ensemble between those inside and those outside of its "beam".

4.1.2. I-events

When musical information is successfully transmitted from one agent to another, a special event occurs. I call such events I-events (interaction events). They usually (but not always) manifest as a antecedent/consequent pair of musical signals, each "half" of the event being produced by the sending and receiving agent or agent system respectively. These musical events form evidence for the listener that two performers are, in fact, interacting with one another. They are distinct from solo events or planned group events; i-events can *only* happen when two performers are interacting. It is common for such events to be perceived as complete syntactical units or "phrases," as though the second agent were completing a thought begun by the first, or answering a question posed by the first. The *density* of i-events per unit of time provides the analyst with a quantitative measurement of how "interactive" a particular improvisation is. Learning to initiate and respond to i-events is perhaps the most important skill an improvisor must develop.

Most i-events contain a key, pivotal signal called a *cue*. An i-event cue is a signal which indicates to the receiving agent that a response has been requested. If the cue is successfully transmitted, the cue-response pair forms a perceived musical unit. Although it is tempting to assume that cues cause or "trigger" their responses, the relationship between cue and response in a true improvisation (as distinct from an "open form" composition, for example, with a planned set of responses to planned set of cues) is never directly causal, as the same cue can result in an infinite variety of responses depending on the broader context of the unfolding composition. There is no

[9] It is entirely possible, though purely speculative, that the traditional role of the spotlight in theatrical performances in the West whereby the primary action takes place in one area of the stage at a time plays a large role in shaping improvised performances.

single "correct" response for a given cue, although it is sometimes possible for sensitive performers and listeners to evaluate a response in terms of its appropriateness as a complement to its cue. An appropriate response often involves providing some sort of closure; a consequent to the antecedent produced by the cue. I-events are of paramount importance in creating forward motion and form in interactive music.

Cues are found in a wide variety of improvisational styles and cultures. Kaemer (1993), for example, writes:

> Among the Kpelle in West Africa a singer can indicate in several ways when a chorus is supposed to enter. One cue is the use of a descending melodic line; another cue is to decrease the amount of text within the melodic line. A third way is simply to use the vowels "ee" or "oo." Sometimes these cues are used alone, but to avoid ambiguity two or three of them are often used together. Cues of this nature are particularly important in group performances of improvisational types of music. (p. 118).

Similar kinds of cues can be heard in Balinese "Kecak" chant; three sharp, staccato notes are used to "trigger" the beginning of a new "volley" of hocketted singing. The three notes establish the tempo of the new section as well as defining its starting point. Cues of this nature are also quite common in Jazz improvisation. Berliner writes:

> In Miles Davis' quintet with Tony Williams, a dramatic leap to the trumpet's high register on a downbeat was often a signal for the group to switch from a floating rhythmic feeling or a two-beat feeling to a precise four-beat, swing feeling. Similarly, Fred Hersch has a clear sense of a group's expectations when he plays 'a loud rhythmic figure, or a complex cross-rhythm, or certain chords. It's a musical signal that means for the drummer to change what he's doing, to do something that provides something that provides some contrast to what has come before. Let's get out of our present format and take the music somewhere else.' (p. 366)

Cues usually have visible and/or tangible as well as audible properties. Eye contact and body movements are often used to establish or confirm i-events.

Drummer Louis Bellson describes this phenomenon in an interview as follows:

> When you play for singers, ... you have to know the personality; you have to know the singer; you have to be aware of him on stage; you have to watch his foot; you watch his hand... Because you see, if something is not right with Frank [Sinatra] as far as the tempo, he'll start patting his foot and give it to you. ... Or Frank will give a special hand signal which means: 'Come on! Let me have a little more of you, I can't hear.' Sounds like a coach, you know, giving signals.

When initiating or responding to a cue, a performer will generally make a physical motion toward its destination or origin. Likewise, a performer who is winding up a phrase will often make a physical gesture to indicate completion. If the phrase is an antecedent, the gesture is likely to be upward; if the phrase is consequent, the gesture is more likely to be downward.[10] These bodily movements can be considered a form of "marking" behavior, as well as a kind of "body language" which performers use to communicate with one another and with their audiences.

To generate an appropriate response to a given cue, a performer must first know what aspect of the cue to respond to. The performer must first select a sound she finds particularly interesting or important from among the various streams emanating from the ensemble. This selection process involves some degree of internal interaction with oneself – with one's musical tastes and perceptual filters. The process may happen so quickly as to appear completely unconscious, but it seems unlikely that the act of selecting a sound to imitate from among the multitude of options can be carried out without some degree of conscious thought. It is in fact this "internal dialog" which, according to the field of symbolic interactionism, generates the structure of all human interaction. As Blumer writes, "a network or an institution does not function automatically because of some inner dynamics or system requirements; it functions because people at different points do something, and what they do is a result of how they define the situation in which they are called on to act." (1969, p. 19)

I-events are often indicators of communication state changes. A musical signal

[10] This phenomenon was observed during the micro-score experiments on several occasions (see chapter 3).

becomes part of an i-event when it announces or arises from a state change in one or more agents. In the example below, agent **a** changes to a *sending* state, signaled by an abrupt change in rhythm (fast and varied to slow and steady) and dynamics (from *piano* to *forte*). When agent **b** responds in imitation, an i-event can be said to have taken place.

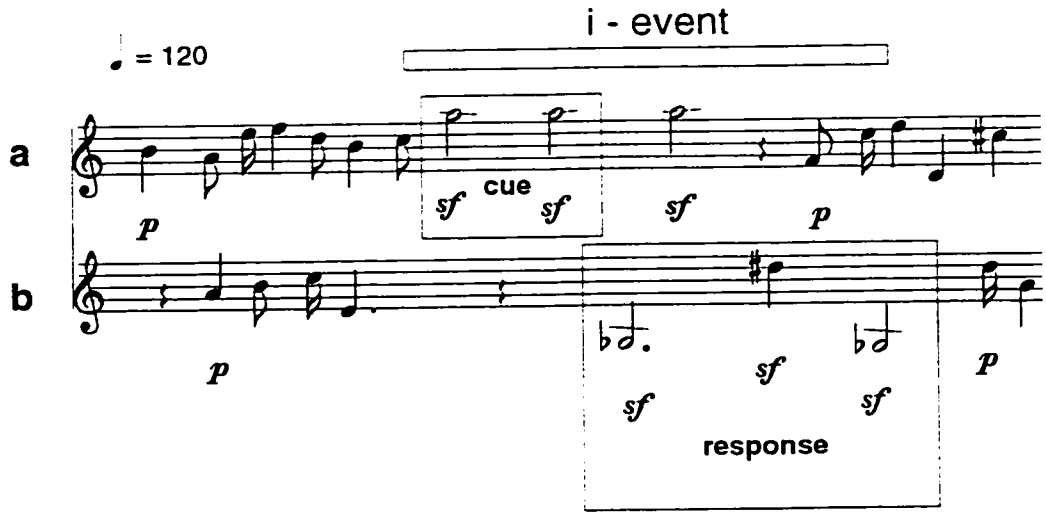

Figure 4.3: I-event example

The beginning and ending points of such events are often much more difficult to pinpoint than in the admittedly contrived example above, because state transitions usually occur more gradually.

In section 4.1.1, I discussed how the "framing" of i-events as genuine, spontaneous occurrences affects our perception of them. Because of the framing of improvised musical events in terms of everyday social interaction, the perception of i-events is fundamentally different from that of non-interactive musical "streams" (see Bregman, 1994). We may, for example, perceive an antecedent/consequent relationship between the multiple voices of a Bach fugue, but we do not generally ascribe the same kinds of symbolic functions to this relationship as we would were the events to occur spontaneously in the midst of an improvisation[11]. The same criterion applies to "open form" compositions in which a set of pre-arranged cues

[11] This is probably due to the fact that in fugues (even improvised ones like Bach allegedly pl: ed), the antecedent/consequent relationships were highly prefigured by the relatively constrained style of the music.

(gestural, visual, or musical) are often constructed by a composer in order to create "pseudo-i-events" – that is, improvised events that are "triggered" by some mechanism external to the performers themselves, such as a conductor or a video-based score. Even if such cues are used in an improvised order and the system of cues is kept successfully hidden from the audience, such interactions belong to an entirely different musical context and thus cannot be assumed to be amenable to analysis under this framework.

The following sub-sections illustrate several i-event types which may be observed in WICAM performances. These types are not necessarily to be construed as interaction *strategies* such as might be used in a generative application of the framework, but rather as events perceived by listeners in the audience. Performers may or may not even be aware of these structures; nevertheless they are the very fabric of musical interactions in WICAM.

4.1.2.a. Imitation

Imitation i-events are characterized by a prominent feature of a signal from one agent being extracted and re-used by another agent shortly afterward. The feature selected for imitation may be any parameter or combination of parameters. Imitation i-events are perhaps the most common type. There are many other kinds of i-events, however, and within the general class of imitation i-events, countless variations of which I have provided a few examples.

Examples A and B below illustrate a common form of imitation in WICAM: the dynamics and articulation from one signal are imitated, but other elements such as register, pitch class, and interval are varied:

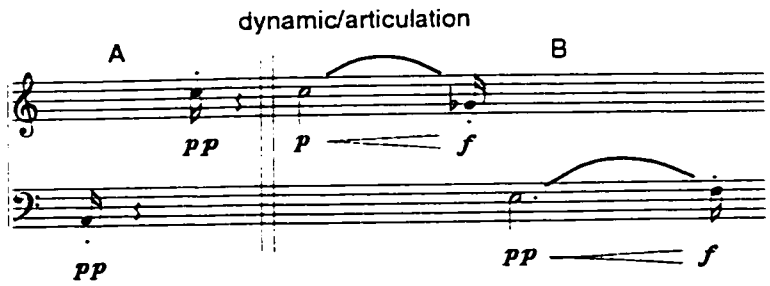

Figure 4.4a: Imitation I-event example

In imitation examples C and D below, specific pitch and/or rhythmic features are imitated; pitch classes may be repeated verbatim but octave-displaced, or just the overall pitch contour may be preserved without strict pitch class or rhythmic imitation. We might call the latter a "tracking" or "shadowing" type of imitation i-event.

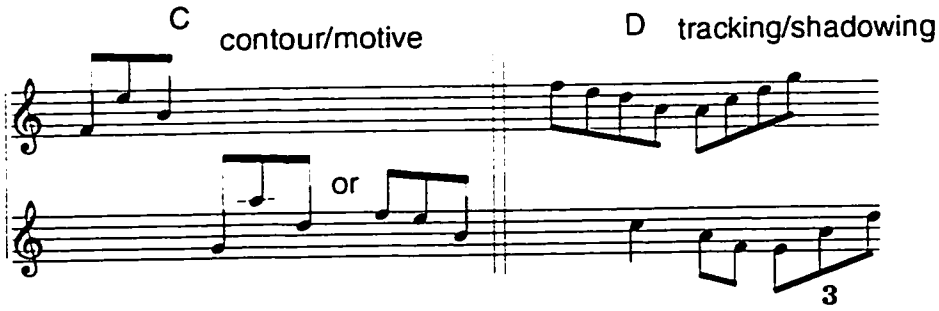

Figure 4.4b: Imitation I-event example

Examples E and F depict a special kind of imitation i-event in which some element of agent A is transformed by agent B. In example E, the pitch is maintained, but a new texture is created. In example F, a pitch is extracted from a complex of resonant overtones from a bowed cymbal – an event which, incidentally, would be extremely difficult to carry off in notated music, since non-linear sound-events like bowed cymbals are impossible to play predictably. Endless variations of basic imitation

techniques such as these are found in WICAM, such as example G, in which a rhythmic feature (acellerando) is imitated in retrograde to form a symmetrical phrase structure.

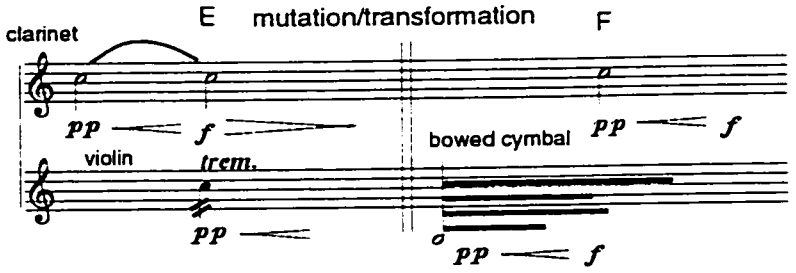

Figure 4.4c: Imitation I-event example

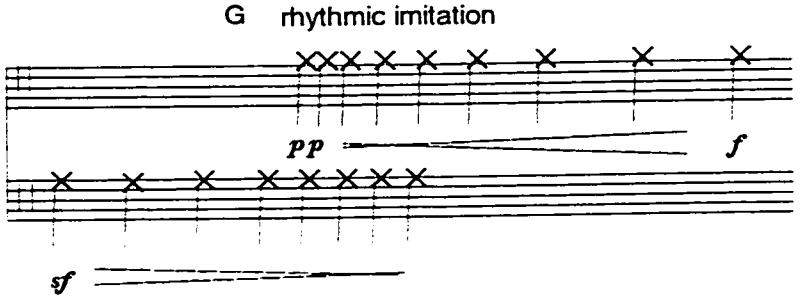

Figure 4.4d: Imitation I-event example

4.1.2.b. Question-and-Answer

Question-and-Answer i-events differ from imitation i-events in two important ways: 1) the response need not necessarily re-use any features of the cue; and 2) the response is consequential in relation to the antecedent cue, whereas in imitation i-events this is not necessarily the case.[12]

Question-and-Answer i-eventsthemselves come in many forms. Examples A and B demonstrate a common form we might call "triggering," where a very short,

[12] I will not delve into the question of how we discern "consequentiality" here, although it is certainly an important matter for further research.

usually loud signal from one agent provokes an immediate, more sustained response in the other, often beginning loudly and tapering off.

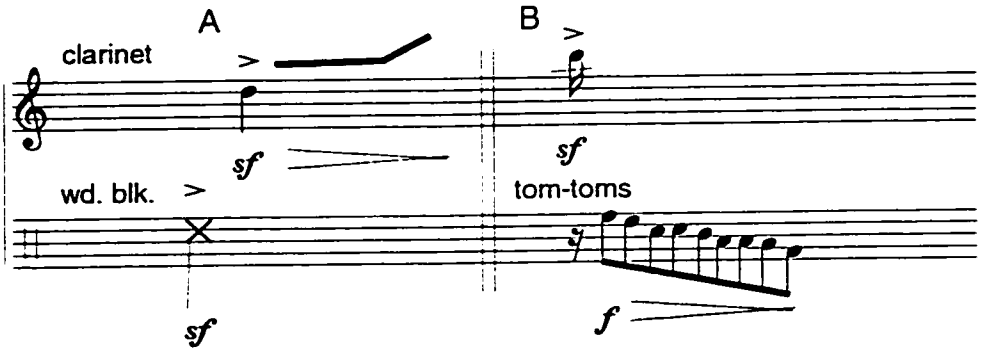

Figure 4.5a: Question-and-Answer I-event example

Examples C and D demonstrate a principle of perceived relatedness in operation: as long as the dynamics remain consistent across transitional boundaries, just about any response can be perceived as being related to any cue. An abrupt, dramatic difference in the volume of the response is generally perceived as less related to the cue. WICAM practitioners admit and encourage a tremendously wide array of possibilities in this regard, making the music extremely unpredictable and exciting.

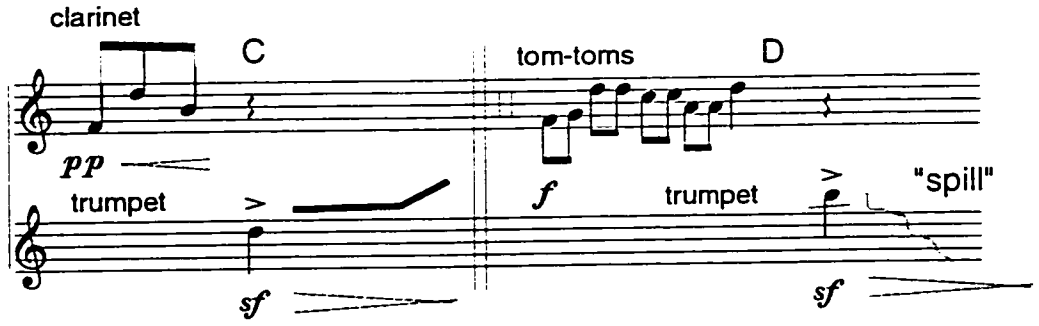

Figure 4.5b: Question-and-Answer I-event example

4.1.2.c. Completion/Punctuation

In this type of i-event, the first agent provides a cue strongly directed toward a predictable "destination" point, which the responding agent can easily predict and match up with. By a "directed" gesture, I mean one which a listener (whether inside or outside the group) can *predict* when the first performer's gesture is going to end, allowing for a second performer to complete or punctuate the gesture in synchrony with the first. When successfully done, this i-event type produces a strong feeling of a phrase boundary, similar to the function of a period at the end of a sentence. The cue events are typically either single-note crescendos, scale-wise movements or glissandi, or some combination of the two:

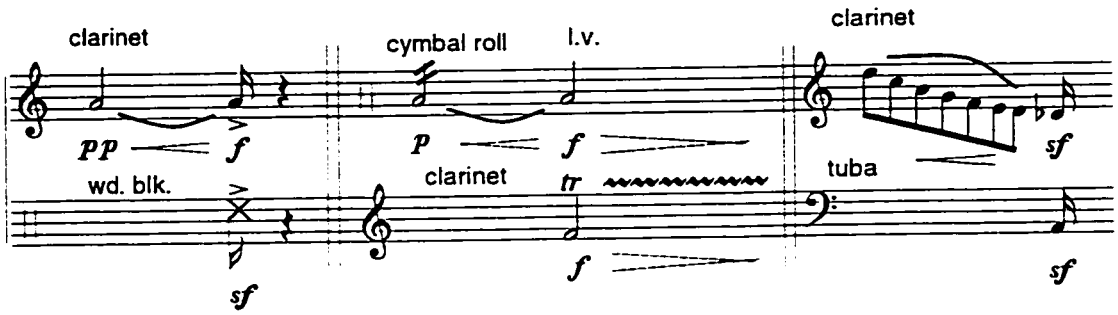

Figure 4.6: Completion/Punctuation I-events

4.1.2.d. Interruption

An *interruption* i-event is somewhat like an "anti-cue" – a signal from B telling A to stop immediately. The initiating agent provides such a cue by playing a very extended non-directional gesture, which the responding agent interprets as a "request for interruption." Rather than providing completion, the responding gesture serves as a "cutoff" of the cue, and provides a new point of departure for a completely new idea.

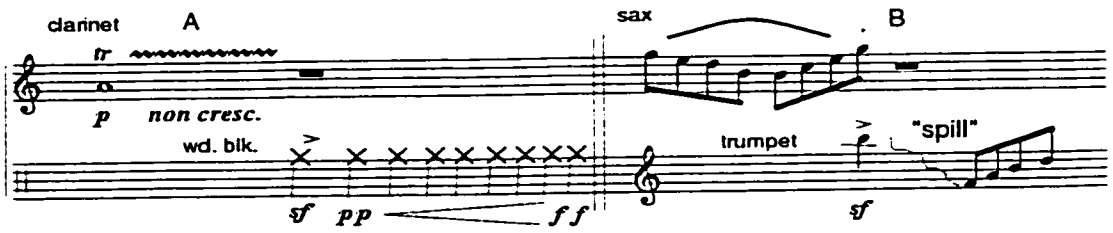

Figure 4.7: Interruption I-events

4.1.3. Medium and Mediation

The medium of musical interaction is, quite simply, anything and everything that *mediates* between the performer's actions and the audience's perceptions. Musical interactions, for example, are constrained and enabled in various ways by the properties inherent in the physical medium through which agents send their signals: *sound*. One of the more remarkable properties of sound, for example, which is often taken for granted, is the fact that multiple sound "streams" can occupy the same sonic "space." Unlike physical or chemical interactions, the "objects" (signals) which embody musical interactions *can* (and often do) occupy the same location in both space and time. This is not to say that simultaneously sounding streams do not affect the way we perceive their aggregate - they do all the time, of course - but generally speaking, interactions between a small number of performers can occur in "full duplex": all parties sounding simultaneously.

In addition to the purely physical aspects of sound and light, the *media* of musical interaction must be considered in a much broader sense. In this framework, we will also consider the medium as a style of artistic expression – the "sound world" in which the interaction takes place. This expanded notion of *medium* takes into account the *cultural symbology* of the performers and their audience as well as the instrumental apparatus and the physical medium through which the musical signals travel. As noted in section 2.1, the Saussurian notion of syntagm and paradigm roughly correspond to the signal and medium of musical interaction. All signals are *mediated by* the medium in which they are sent. The medium may not, as McLuhan's

famous phrase suggests, literally *constitute* the entire message, but it is clearly essential to understand how a given medium operates before a message can be understood or even clearly formulated. For example: in the quiescent sound world of a typical improvisation by Derek Bailey, a screeching saxophone might sound harsh, angry, and violent, whereas the same saxophone playing placed in the turbulent, ecstatic sound world of John Coletrane's "Ascension" might be perceived as joyful and exuberant.

Another important aspect of musical medium is the musical instrument itself through which a performer expresses their ideas. Musical instruments all carry with them vast complexes of associations by their very sound, and by the physical movements required to play them. Tones played on musical instruments invoke a flood of past experiences with those instruments from which listeners are often incapable of divorcing themselves. Playing sparse, atonal chords on the piano may remind a listener of the piano works of 20th century composers Anton Webern or Morton Feldman; flute techniques producing a high degree of wind noise may conjure references, intended or not, to the Japanese shakuhachi tradition; fast, wild saxophone playing may trigger associations with late John Coltrane, etc. Additionally, playing different instruments in different registers requires widely divergent levels of physical exertion. A note in the highest register of the piano, for example, may sound plaintive, sweet, even ethereal, whereas a note in the highest register of the trumpet is more likely to sound harsh, strident, or triumphant due to the physical effort involved in producing it. These mediating effects of traditional musical instruments have led many WICAM practitioners to seek out less constrained sound production techniques. Electronics have, for many performers (Alvin Curran, Richard Teitelbaum, and The HUB, to name but a few), proved particularly liberating. Other musicians, such as Jin Hi Kim, exploit the mediating qualities of their instrument, making these qualities an integral part of their musical identity.

4.1.4. The Role of the Audience

Audiences and performers clearly do interact, and in many cases this interaction no doubt plays a role in shaping the interactions among the performers on stage. Like the role of the Medium, this framework does not really deal with the audiences role

extensively, but I will offer a few general observations here.

The nature of performer-audience interaction in WICAM is highly dependent on the venue and cultural background of the audience. It seems there are two kinds of venues and audiences commonly found today – the "European concert hall" model, where audiences in a grid-like seating arrangement listen in silence and applaud at the ends of solos or at the end of a piece, and the "African-based" model, where audiences may become much more participatory, shouting, stomping, etc. to show approval at any time during the performance. WICAM venues and audiences seem to tend toward the European concert hall variety, as evidenced by live recordings. Unless audience participation is specifically called for, it tends not to happen.

There is some evidence from the micro-score experiments that one's perspective affects how one listens. Performers tend to focus on those events which may be directed toward them or which may be responses to their signals, whereas audience members tend to hear "the big picture." Nevertheless, I do not feel that this distinction warrants a separate treatment of interaction analysis structures for each listener "type" (performer vs. audience member), since the fundamental modes and the relationships between them are not dependent on one's perspective as a listener; they exist whether one happens to hear them or not, just as a piece may still be in the key of C even though no one in the audience realizes it. Furthermore, the distinction between audience and performer is muddied by the fact that the other performers can serve as a kind of "internal audience" for each ensemble member. I have therefore opted to generally avoid making a distinction between audience and performer here.

4.2. Interaction Modes

As noted in section 2.1, semiotics provides the very useful notion of analyzing symbolic behavior at two levels, or domains, called the *syntagmatic* and *paradigmatic*. The syntagmatic domain is concerned with the linear unfolding of the events in time, whereas the paradigmatic domain deals with the enumeration and relationship of the *structures* of communication which a musician uses to convey musical ideas. The syntagmatic domain is often described as "horizontal," that is,

existing along the "x"-axis typically used in graphs to denote the passage of time, while the paradigmatic domain is usually described as lying along the vertical, or "y"-axis. These terms, horizontal and vertical, are in turn commonly used to refer to the melodic and harmonic aspects of music. Leach (1976), in fact, uses melody and harmony as a metaphor for the syntagmatic and paradigmatic domains of communication. Another such metaphor might be to compare the syntagmatic and paradigmatic to the time and frequency domains of signal processing theory. One might consider the Fourier transform to be a paradigmatic (frequency domain) representation of a syntagmatic (time domain) signal. Of course, such transformations cannot be carried out on music or language by mathematically "pure" or algorithmic means; however, the analogy is useful if we examine the process involved. Three important aspects lie at the heart of all such transformations. The first is some kind of *parsing* of the signal into small, analyzable segments, be they words, notes, sentences, phrases, or what have you. (In signal processing theory, various "windowing" techniques are applied to an audio signal to carry out this step.) The second step is the *classification* of these segments into patterns. The third step is *organizing* these patterns into a system of relationships to one another. Such a process is certainly feasible with grammatical languages, and, I maintain, with the "pseudo-language" of musical interaction as well.

As stated in Chapter 1, the "language" of heteroriginal music is based on *relationships* between improvising performers. It is possible to group these relationships into a limited number of *modes*, which are based on or analogous to patterns of everyday human social interaction. These modes of musical interaction can be seen as syntagmatic units of musical signification which function within a paradigmatic sign system, much as the harmonic functions of traditional Western music theory (tonic, dominant, etc.) have been shown to do by semioticians such as Tarasti and Iazetta. To coin a phrase, the mode is the code. Heteroriginal music always operates on both syntactic and paradigmatic levels simultaneously, much as traditional jazz musicians must consider harmonic function at the same time that they develop the unfolding melodic syntax. I have discussed in section 4.1. how at the syntagmatic level, information exchanges between performers give rise to communication states (sending vs. receiving). Analysis of these information

exchanges over time makes it possible to observe patterns of state flux among the members of a group. These patterns constitute the various modes of musical interaction. I have identified eight such modes, which are represented in the diagrams below:

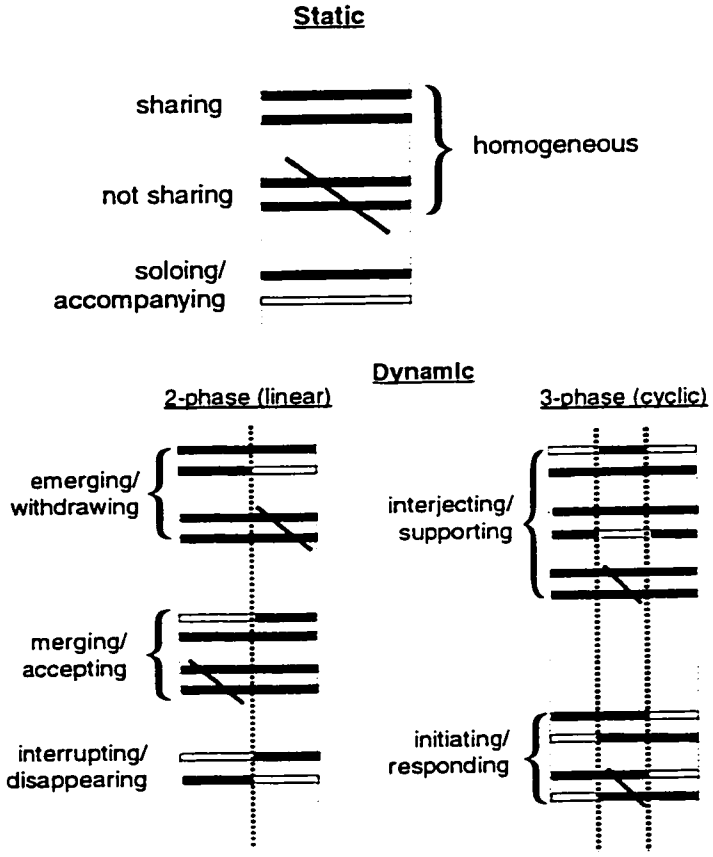

Figure 4.8: Static and Dynamic Interaction Modes

This diagram uses a highly simplified notation to represent each interaction mode. The vertical dashed lines represent arbitrary beginning and ending points defining an interaction time span. Such a time span could be as long as an entire piece or as short as a few seconds. The black horizontal bars represent periods of high information output (sending); the white horizontal bars represent periods of high information input (receiving). Each interaction mode has been identified by a word or word-pair in gerund form. These terms have been chosen deliberately to be as general as possible, while still capturing the vast complex of symbolic emotional and social implications which are essential to their syntactical functions. *Sharing*, for example,

implies a high level of affinity, intimacy and bonding associated with love or strong affection. *Emerging/withdrawing* could manifest in one of two ways: the group is either emerging from a state of *sharing* into a state of *soloing*, or withdrawing into a state of *accompaniment*. The former could be taken symbolically in many ways: as an act of rebellion, or taking leadership, or expressing a dissenting opinion. The latter might be seen as acting timid, or as getting out of the way, opening up some space for the other agent, and so on. The symbolic functions of the interaction modes will be discussed in more detail in section 4.2.3.

Although I have used only two lines to represent each mode, the modes can be applied to groups of arbitrary numbers of performers by the formation of *agent systems*, and through the aggregation of modes. The modes represent relationships between a given agent or agent system and some other agent or agent system. In each of the static modes (*sharing, not sharing, and soloing/accompanying*), the states of both parties are fixed throughout the entire time span, whereas in the dynamic modes, the state of one or more party changes. *Sharing* and *not sharing*, in which there is neither a change nor a difference in the sending/receiving behavior of either party, are called *homogeneous* modes. In both of the homogeneous modes, the roles of both parties remain constant and identical throughout the entire time span, which is why these modes alone have a single-word description. The heterogeneous modes all have two-part names, "*interrupting/disappearing,*" for example, in order represent the perspective of each agent system.

The modes focus on the relationships between system pairs in order to break down the complex interactions into their simplest components. However, interaction modes may be combined in may ways. For example, a single pair may operate in multiple modes simultaneously, to varying degrees. This is possible because interaction modes are hierarchically "nestable," in the sense that one can apply them at several levels of analysis, from a single phrase to an entire piece. The same kinds of relationships that underlie the large-scale formal divisions of an improvisation may be seen to operate at the more local levels as well. For instance, we may categorize an entire improvised solo in the context of an ensemble performance as an example of soloing/
accompanying (s/a), but the solo may also be seen to consist of many sub-sections,

some of which may involve modes other than s/a. Although the performers may be interacting in *sharing* or *not sharing* mode for brief periods, the overall mode of s/a may still predominate.

I will explore the issue of mode combinations further in section 4.2.4. In the sub-sections which follow, I will explain each of the modes in more detail, providing musical examples of each.

4.2.1. The Static Modes

As stated above, when interacting in each of the static modes, the communication states (sending vs. receiving) of both systems are fixed throughout the entire time span. The static modes are, in a sense, the "parent" modes of all the others, since each of the dynamic modes is composed of a sequence of two or more static modes. There are three static modes: *sharing*, *not sharing*, and *soloing/accompanying*. Each will be explained in the sub-sections below.

4.2.1.a. Sharing (affinity)

Improvising musicians can express, through their playing, either affinity or antipathy with the rest of the group. When musicians expresses affinity with one another during a performance, we can say that these musicians are "sharing" a common musical "space," or sharing (sending and receiving) information at an equal rate. The expression of affinity through the exchange of sonic symbols is a very deeply-ingrained behavior not just in human beings but in many species of animals as well (Masson and McCarthy, 1994). This mode is denoted by two black lines, meaning that both systems are in a state of perfect equilibrium between sending and receiving information. All agent systems are sending the same amount of information to one another and receiving the same amount of information from one another, often at the same time (full duplex).[13]

Important features of *sharing* include:

1) sharing of musical materials: the performers strive for balance in the "major" parameters: note density, loudness, rhythmic and harmonic "language," etc.[14]

[13] Note: sharing mode explicitly requires all performers send to and receive from one another as opposed to sending to one and receiving from another, or sending to nobody in particular.

[14] Although WICAM performers may occasionally share materials in a very literal, obvious way,

2) shared phrase structure: the performers start and end phrases together

3) high i-event density[15]

Like all of the mode definitions, there is no direct stipulation here of the overall energy level or quality of the music this mode may admit, but there is a tendency in both of the homogeneous modes (*sharing* and *not sharing*) toward the extremes of the energy spectrum: either very high or very low levels of information exchange seem to characterize the homogeneous modes. Perhaps for this reason, homogeneous modes are rarely maintained for long periods of time.

It is important to draw a distinction between agents engaged in *sharing* versus agents acting as an *agent system*. In the former case, there is still a give-and-take between the two agents, but that give-and-take is so evenly balanced as to yield a state of perfect interactive harmony. In the latter case, the agents are not sending and receiving information to and from each other, but are literally acting as a single entity which sends and receives information as a unit.

4.2.1.b. Not Sharing (independence)

This mode is represented by two black lines with a hash mark intersecting them. In this mode, all agents are senders, and none are receivers. No perceptible affinity exists between the performers. This mode is often characterized by extremely high energy levels with many voices sounding simultaneously and independently, but it may also take the form of extremely sparse sections of music in which each musical statement seems completely unrelated to what came before. It is, in its most extreme form, the absence of interaction. However, there is a spectrum between "pure" *sharing* and *not sharing*. Where a group lands on this spectrum is determined by the quality and density of the i-events occurring.

Important features of *not sharing* include:

1) independence of musical materials

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this is usually done with great subtlety. Direct imitation of phrases is seen as a "cheap" or banal device and is rarely used to establish *sharing*. Roscoe Mitchell, for example, "hates it when you make obvious imitations of phrases", according to George Lewis (personal comunication).

[15] A strong presence of any of these factors is enough to communicate the "sharing" relationship, e.g., Homecoming, 2:14 - 2:49, where the sharing of pitch materials and phrase boundaries is sufficient to create a feeling of sharing, even though the actual i-event density is rather low . This is the case for "not sharing" as well.

2) independent phrase structure

3) low i-event density

Monson (1996) describes the state of *not sharing* quite succinctly in the following passage:

> In reacting to the continuous changes in an improvisor's solo, rhythm section members display their hearings of the musical events and their understandings of appropriate musical responses. Their responses also indicate what musical events they take to be most significant. Musicians who miss opportunities to respond or to enhance their accompaniment ... are often said to be "not listening" to what is going on in the ensemble. (p. 83)

However, one key difference between WICAM and mainstream jazz is that in WICAM, *not sharing* does not necessarily carry the negative connotation of "not listening." In mainstream jazz, musicians are generally expected to *always* be interacting. In WICAM, it is quite common for performers to *willfully and selectively* ignore other members of the ensemble in order to "problematize" a given texture. Again, the Higgins/Blackwell excerpt from Coleman's *Free Jazz* provides an example; during this passage, Higgins and Blackwell do not *appear* to be listening at all to what bassists Charlie Haden and Scott LeFaro are doing. It's as though they are off in a "parallel universe" from the bassists. However, that doesn't necessarily mean they are not *really* listening to Haden and LeFaro; they are simply not engaged in interactions with them. Most likely, though, the listening activity of each member of each agent system is much more focussed on the other members of the system than on those outside the system.

Not sharing will often produce a feeling of chaos, disharmony, or disintegration, and may in fact be used with great effect to symbolize these qualities. On the other hand, *not sharing* can also produce a "Zen-like" calm beauty in which each sound is appreciated for itself, without symbolic attachment. In the context of monoriginally-composed music, *not sharing* has been achieved through rigorous indeterminacy – Cage's chance operations, for example, are a method of producing *not sharing* behavior in a group of performers. In interactive music, *not sharing* requires great discipline on the part of the performers in order that they *not* be

perceived as being influenced by the signals of the other agents.

Although they are polar opposites, the homogeneous modes of *not sharing* and *sharing* are easily confused. Audiences unable to perceive the interconnections of all the "shared" events may perceive the mode as *not sharing*, or may perceive shared connections between events that were not intended by the performers. *Sharing* may also easily degenerate into *not sharing*; if either agent falls out of this mode, *sharing* is no longer happening, just as a single instrument playing out of tune can cause an ensemble's sound to become inharmonious. The fine line between these two fundamental modes is what can make interactive music so exciting; whereas monoriginal music must go to extreme measures to produce this state, heteroriginal music is constantly teetering on the boundary between *sharing* and *not sharing*. Indeed, it is to a great extent the dynamic between these two states, not unlike that between tonic and dominant tonal areas in Classical harmonic theory, which gives improvised music its sense of tension and directional structure.

4.2.1.c. Soloing/Accompanying

In this mode, the agents assume the respective roles of soloist and accompanist. The soloist is in the "spotlight" (see 4.1.1.d.), and is sending information to the accompanist, who is receiving that information and responding appropriately to indicate its successful transmission. In this mode, the job of the accompanist is every bit as challenging as that of the soloist, for the accompanist must exercise restraint, listening carefully to and following the soloist at all times, while simultaneously inventing interesting counterpoint to the soloist's unfolding performance. According to Pressing's "resource allocation" model of human information processing (see 2.3.1), we might say that the accompanist's resources are typically *more* stressed than those of the soloist, since the accompanist must operate in multiple modalities simultaneously. However, it is the soloist who carries the burden of inventing the primary ideas and laying down the phrase structure.

The sounds of the accompanist are generally quieter, more predictable, and less diverse than those of the soloist. They support and acknowledge the soloist, "punctuating" the music and filling out the spaces between the soloist's phrases. *Soloing/Accompanying* can be very similar to *sharing* – i-event density is typically

very high in this mode, and musical materials may be shared – but phrase structure is totally under the control of the soloist, and there is usually a very conscious effort made on the part of the *accompanying* agent to stay out of the spotlight and leave the soloist(s) plenty of space within which to express themselves.

4.2.2. The Dynamic Modes

Dynamic modes are composed of multiple phases during which different static modes dominate. The dynamic modes presented here can have either 2 or 3 phases.[16] The 2-phase modes are transitional and *linear*; they unfold gradually over time as a progression from one static mode to another. In this sense, linear modes are like protracted i-events. Multiple instances of linear modes may overlap or "elide" into one another, whereby the second half of one pair becomes the first half of the next. The 3-phase modes are "cyclic" patterns; they are essentially oscillations between two static modes. A cyclic pattern may repeat several times during a given section of music without changing the fundamental mode of interaction.

4.2.2.a. Emerging/Withdrawing

This linear mode is characterized by the emergence of one agent from a shared communication state to a sending, soloing state, or by agents starting in *sharing* mode and moving gradually to *not sharing*. Depending on how this process is actualized, this mode can have either an uplifting, triumphant interpretation or it can symbolize disintegration, dissolution, or abandonment. If the process is actualized by an agent actively taking on a sending role, it will sound more positive. If the process occurs by way of an agent withdrawing into an accompanimental role, it may sound more negative, like surrender or abandonment.

4.2.2.b. Merging/Accepting

Simply the retrograde of *emerging/withdrawing* (moving from a non-sharing state to a *sharing* state), this mode can symbolize "reunion," "consummation of

[16] While I do not exclude the possibility of dynamic modes with more than three phases, the inclusion of such modes here seems likely to yield little useful information to the analyst, since the problem of mode identification then becomes practically unbounded.

love," or "reaching an accord." It is especially effective if the density and overall intensity of the music increases over the course of this mode's actualization.

4.2.2.c. Interrupting/Disappearing

This linear mode occurs either when a soloist is suddenly interrupted by another agent who "steals" the spotlight away from the soloist, or when the soloist abruptly "disappears" from the spotlight, effectively handing over the spotlight to their accompanist. This mode is basically the analytical framing of a single *interruption* i-event (see 4.1.2.d) inside a larger musical phrase. It's important to distinguish repeated occurrences of *interrupting/disappearing* from *initiating/responding*. The difference is that in *interrupting/disappearing*, one agent ends either before the next one begins (*disappearing*), which triggers the state transition, or the first agent is literally cut off by the second (*interrupting*). In *initiating/responding*, the state change happens more gradually, and neither agent interrupts the other or in fact even withdraws completely from the engagement.

4.2.2.d. Initiating/Responding

This cyclic mode is perhaps the most common of all interaction modes. It generally takes the form of "call and response," or "question and answer," or "turn-taking." It consists of the following three phases, as depicted in figure 4.8:

1 - soloist agent A makes an initial statement

2 - agent A cues agent B (during this phase the agents enter a state of either *sharing* or *not sharing*)

3 - agent B responds to the statement, becoming the new soloist

This characteristic "statement-cue-response" pattern can be heard in virtually every WICAM performance at some point or another. As mentioned earlier, when performers exchange sending & receiving states very rapidly, it tends to be perceived as "initiating/responding" (*i/r*). The important thing that distinguishes *i/r* from *s/a* is the evenness of the exchanges; no single agent predominates the texture.

When large ensembles are in this mode, it is possible to hear the spotlight moving constantly around the ensemble, since the responding system need not be the initiator of the previous cycle. This mode forms the basis of Pauline Oliveros' composition "New Sound Meditation," in which players alternate between imitating sounds from others and making new sounds from their imagination. The trick to making this piece work musically is to stagger everyone's rhythm of new sound creation such that there are only one or two new sounds being introduced at a given time, as too many new sounds appearing all at once will tend to dilute the "focus" of the music, making it impossible for a listener to follow the give and take of the interactions. Good improvisors will tend to fall into this staggered rhythm quite naturally, although it may require a bit of rehearsal for an inexperienced improvising group to master this technique.

4.2.2.e. Interjecting/Supporting

The characterizing factor of this cyclic mode is that one *supporting* agent remains in a constant state, providing a kind of "cantus firmus," drone, or "vamping" type of activity, while the other agent constantly changes state, *interjecting* new statements sporadically and perhaps whimsically. This can result in a number of possible patterns, three of which are displayed in figure 4.8. Note that it is possible for the *supporting* agent to either remain in a *sharing* state with the *interjecting* agent, or not; the *supporting* agent's response to the interjection determines whether the mode during the interjection will be *sharing* or *not sharing*.

4.2.3. Symbolic Functions of the Interaction Modes

As stated in chapter 2, these modes of musical interaction can be seen semiotically as syntagmatic units of musical signification which function within a paradigmatic sign system. The previous sections of this chapter dealt with the syntagmatic aspects of the interaction modes. In this section, I will discuss the symbolic functions of various modes at the paradigmatic level. The symbolic function of each mode depends upon the interpretation of the listener, according to his or her cultural beliefs. By establishing an oppositional relationship between the states of *sharing* and *not sharing*, however, the *sign system* represented by the framework encourages a dialectical interpretation of form in musical interaction which has its basis in the Hegelian process of change in which a concept or its realization passes over into and is preserved and fulfilled by its opposite.

Each of the interaction modes has a matrix of potential symbolic functions based upon their cultural associations. The musical act of "merging," for example, has a certain meaning to the musicians and audience, as do the musical acts of "sharing" agency, "supporting" each other, "interruption," "imitation," etc.. We may, for example, speak of a musical gesture or a series of phrases as being "seductive" in nature, thereby turning the musical interaction into a sexual narrative. In a more platonic sense, "merging" with another player might simply mean "establishing a dialogue," letting the other player(s) know you're listening. Another kind of "joining" symbolism might be to frame the interaction as a kind of competition or "duel." "Interruption" might be taken to symbolize a threat, dissatisfaction, impatience, etc.. The "keying" of an interaction mode, in the Goffmanian (frame analysis) sense, often depends on extra-musical cues from the performers: facial expressions, body movements, etc. Such cues can significantly strengthen the symbolic impact of an interaction. For example, a duet between two musicians engaged in *sharing* may be interpreted as a playful duel if the performers continually attempt to throw each other off balance, especially if each feigned "attack" on the other is accompanied by a knowing smile or laughter. (I have personally observed this kind of interaction during

several live performances.)

In improvised music, these symbolic aspects are very much present at the foreground level; indeed, these symbolic interactions are the very *materials* of the music, rather than mere by-products or expressive nuances. The symbolism of the music is therefore generally quite palpable and easy to detect. This is especially the case when the tempo of the music is slow, and the texture is sparse. In some cases, the symbolic aspects can take on an exaggerated, almost comical quality. The improvised duets between Eric Dolphy and Charles Mingus on the 1964 recording "Live from Town Hall" are an example of this. In other improvised musics, particularly those which utilize a large number of musicians and which involve extremely rich, constantly shifting textures and fast tempi, the communication of the symbolic narrative is shifted to the collective level. In sections of Coletrane's *Ascension*, for example, all of the players are playing very dense material almost all of the time. They seem to make their entrances and exits without any particular regard for how these actions might be interpreted individually. The overall symbolic gesture or metaphor of this music thus becomes a collective cry for freedom, an expression of spiritual ecstasy. Further evidence of the tendency of performers to engage in narrative framing of their interactions was found in my micro-score experiments, in particular the way the Un-Sound Trio realized the "Love Story" score by inventing a dramatic scenario and assuming roles (maiden, suitor, and overbearing mother) which provide a *motive* for each player (see sec. 3.2.2).

The syntactic aspect of each interaction – that is, the way its internal events unfold over time – determines its category. However, each mode also has a specific *functional* or paradigmatic relationship to each of the others. One convenient way of conceiving this relationship is by way of analogy to traditional harmonic functions (tonic, dominant, sub-dominant, etc.), in the sense that each mode tends to generate a different level or kind of tension or relaxation, which tend to logically follow one another in a certain order. A suggested mapping of interaction modes to harmonic functions is as follows:

Static Modes	Static Harmonic Functions

sharing	= tonic (I)
not sharing	= dominant (V)
soloing/accompanying	= subdominant (IV)
Linear Modes	**Linear Harmonic Functions**
emerging/withdrawing	supertonic, diminished or secondary
merging/accepting and	dominant (e.g.: ii7, vii°)
interrupting/withdrawing	
Cyclic Modes	**Cyclic Harmonic Functions**
interjecting/supporting,	modal/extended harmony
initiating/responding	(e.g. iii, vi, Dorian, whole tone scales)

FIgure 4.9: Interaction Modes analogized with Harmonic Functions

In all WICAM performances, there is an implied tension between *sharing* and *not sharing* to which we can form a strong analogy with tonic and dominant harmonic relationships. *Sharing* and *not sharing* may also be considered analogous to *consonance* and *dissonance*, especially in the Greimasian sense described by Tarasti in the following passage:

> The description of musical tension starts from the realization that the 'being' of music is the same as consonance or state of rest, whereas the 'doing' of music is the dissonance or contradiction demanding resolution or continued elaboration. Consonance and dissonance should be conceived of not only as properties of vertical harmony but also as linear, temporal formations. The notion of dissonance can even be extended to cover whole sections and movements. For instance, as a whole the storm movement in Beethoven's Pastoral Symphony represents "dissonance," musical action, in relation to which the entire last movement confirms the pastoral euphoria of F major. The same holds true for the relation between the first and third movements of the "Waldstein" Sonata. Therefore, the Greimasian categories of S > O and S < O (subject conjuncted to or disjuncted from its object) can be interpreted in music in a broader sense as consonance (subject possesses its object) and dissonance (subject lacks its object). (p. 104)

To take this analogy one step farther, the "subdominant" mode,

soloing/accompanying, can serve as a transition state between the two poles of *sharing* and *not sharing*, but can also be a temporary resting place of moderate stability. The linear modes correspond the the harmonies which are specifically transitional, leading from one harmonic space to another. The cyclic modes, being more stationary in nature, simply lend a new "color" – a variation or enhancement – to an established area, as in switching from C major to C minor, or piling up like intervals as is often done in Jazz harmony to enrich the sound of a triad with 7ths, 9ths, 11ths, etc., or by using static harmonic structures such as whole tone scales or stacked fourths.

It is tempting to make more of this analogy between Classical functional harmonic structures and interaction structures in WICAM – to demonstrate how both systems stem from a common dialectical world view which is somehow innately "Western." However fascinating such speculation may be, the background research necessary to support such an argument would take us far beyond the scope of this paper. For now, we will have to be content to consider this analogy merely as a useful tool which allows us to conceptualize the relationships between interaction modes using methods very familiar to all musicians schooled in Western harmonic theory.

4.2.4. Combining Interaction Modes

While it should be fairly clear how to identify interaction modes among groups of two agents or agent systems, when the number of systems exceeds two, things can get much more complex. Each system has the potential of establishing any of the interaction modes with any other system. This situation becomes difficult to represent graphically, because each player can exhibit multiple modes simultaneously. It is simplest to think in terms of an individual agent or agent system A's relationship to another agent or agent system B at any given point in time. The aggregation of these relationships forms a matrix of simultaneously evolving interactive structures which makes improvised music so dynamic. It is, in fact, quite unusual for an entire group to be interacting in a single homogeneous mode, such as when everyone is *sharing* or *not sharing*. It is far more common for larger ensembles to develop sub-units which

may subsequently act as agent-systems in forming interactive relationships with each other. For example, in a traditional jazz trio, the bassist and drummer may be interacting in *soloing/accompanying* mode, but when joined by a third party, say a pianist, the bassist and drummer may shift into *sharing* with each other so that they can function as a unit to accompany the pianist. Or, they may remain in *soloing/accompanying* mode, forcing the pianist to chose whether to

- join in with the soloist (*sharing*)
- join with the accompanist (*sharing*)
- join with neither player (*not sharing*)

Note that *sharing* with two players who are not themselves *sharing* may seem difficult to imagine. What can and does happen, however, is a *mediating* mode whereby, for example, a performer enters into a *sharing* or *accompanying* relationship with two other performers. This is a special mode which can only exist between a group of three or more agent systems. Figure 4.10 below shows some examples of mediating relationships between three agent systems (S1, S2, and S3). In each trio, the system marked with the (m) mediates between the other two.

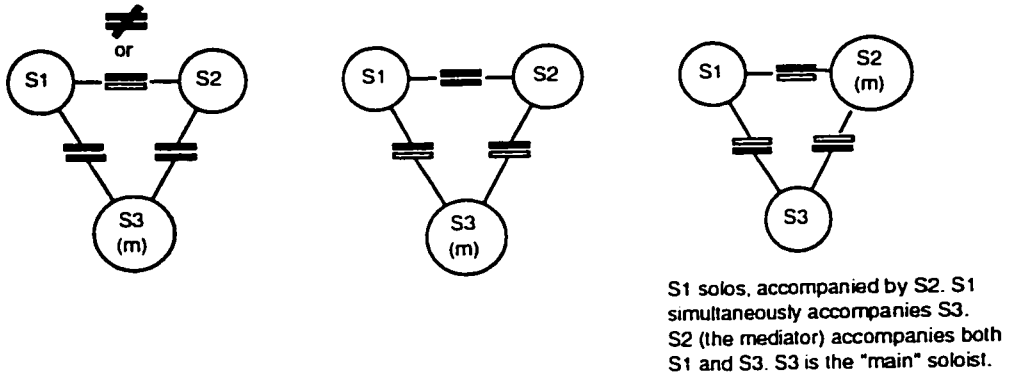

Figure 4.10: 3-way interactions

The trio example above could be represented by the third system in figure 4.10, with S1 being the bassist, S2 being the pianist, and S3 being the drummer. If pianist S2 had chosen to get into *sharing* mode with bassist S1, who was accompanying the drums (S3), the pianist would thereby most likely "inherit" the accompanying relationship of the bassist to the drummer. By taking on a mediating role, however,

the pianist ends up accompanying both the bassist and the drummer.

Many other 3-way mode combinations are possible. Figure 4.11 shows two "homogeneous" combinations (where all three systems share the same mode):

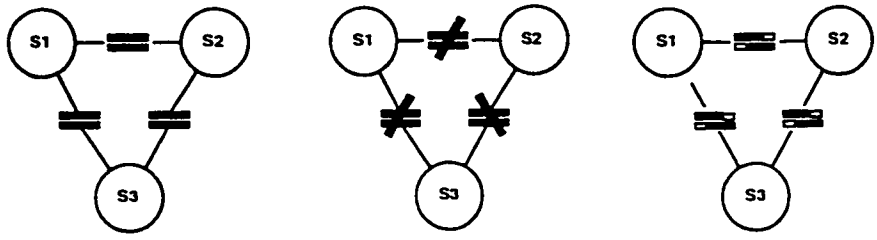

Figure 4.11: Homogeneous 3-way interactions

Figure 4.12 shows some non-mediating, heterogeneous examples:

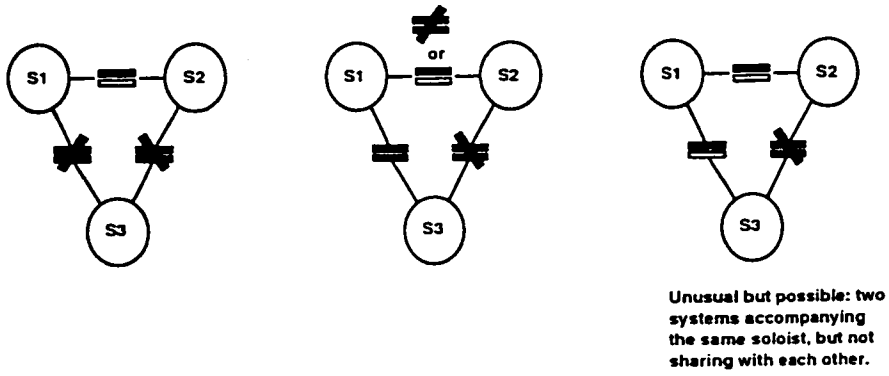

Figure 4.12: Non-mediating, heterogeneous 3-way examples

While I do not exclude the possibility of more interaction modal patterns occurring in the three-system space beyond those mentioned here , nor of finding patterns among groups of more than three agent systems, it makes sense to conclude our explorations here, with the assumption that the modal patterns identified already provide us with plenty of grist for the analysis mill. In Chapter 5, I will employ the framework presented here in the analysis of three WICAM performances, which should serve to further clarify the utility of the framework.

5. Analyses of Improvised Performances

In this chapter, I present three analyses of improvised performances from the recorded literature, making extensive use of the framework presented in the previous chapter. The three excerpts chosen are quite diverse in terms of style, instrumentation, and character. This diversity helps to demonstrate the adaptability of the framework to a wide variety of musical styles that fall more or less under the "umbrella" of WICAM.

5.1. *Detour Ahead*, Bill Evans and Scott LeFaro

The Bill Evans trio (Evans on piano, Scott LeFaro on bass, and Paul Motian on drums) was noted for pioneering a style of "simultaneous improvisation", in which the bass and drums are freed from their traditional time-keeping roles. Evans stated (in a radio interview with pianist Marian McPartland) that his group "almost never" rehearsed, and yet because each member had such a high level of trust in one another's abilities, they were able to interact to a degree seldom paralleled in Jazz. Although this group's music falls squarely on the "jazz side" of WICAM, it is included here as an example of the strong influence of the interaction structures of traditional jazz improvisation upon those of WICAM performances, and also to point out the flexibility of the framework in analysing non- or quasi-WICAM performances.

The excerpt transcribed in Appendix A.1 is taken from the CD "Waltz for Debby" on Riverside Records (OJCCD-210-2), recorded live in a New York nightclub on June 25, 1961. It contains the final "head" and coda of the trio's rendition of the jazz standard"Detour Ahead", track 4 (6:25) through the end of track 4. In this excerpt, the roles of soloist and accompanist clearly shift between Evans and LeFaro. The excerpt begins with Evans in the soloist role, typical of the return to the head in jazz performance. However, at bar 7, Evans begins to drift away from the melody – a clear signal for LeFaro to take over the soloist role. Bar 7 is transitional; by bar 8, LeFaro has clearly picked up on Evans' cue and takes over

as soloist for the next two bars. As evidence of this shift, Evans' playing drops down to a few sparse notes in the right hand, offset on weak beats 2 and 4, while his left hand maintains a steady "comping" pattern. LeFaro, meanwhile, moves into the high register of the bass, performing highly engaging, rhythmically diverse melodic statements completely devoid of accompanimental function. Thus, bars 1-8 of this excerpt, taken collectively, demonstrate the mode of "initiating/responding", inasmuch as LeFaro's bass figures can be heard as a response to Evans' earlier statements. Note the distinction between this kind of careful, gradual hand-off of agency as opposed to a sudden interruption or dissapearance.

At bar 9, Evans returns to more soloistic behavior, but LeFaro continues to hold his own; thus bars 8 - 11 form an example of "merging", which functions symbolically to bring the phrase to a gentle resolution, underscored by Motian's cymbal roll throughout bars 10 and 11. LeFaro's F-Db lick on beat 3 of bar 9 functions beautifully as both an accompanimental device to outline the harmony and as a way of maintaining his agency in the interaction, since the move to Db is somewhat unexpected and the high F preceding it unusual in both register and metric placement. (LeFaro repeats essentially the same device on beat 4 of bar 11.) Through bars 10 and 11, Evans and LeFaro are in "sharing" mode; each demonstrates equal agency through playing that is perfectly balanced in the amount of information sent and received. There is even a brief moment of rhythmic synchronization on the triplet figure at the end of bar 10, which further cements this feeling of unity. The coda, a prolongation of the final C major chord of the tune, contains a final "hand-off" of agency, a short "initiating/responding" statement which symbolically leaves the piece in an unresolved state, almost as if the piece had ended on a relative minor or "extended" harmony instead of C major. (In fact, LeFaro's final trailing note lands on A rather than C.)

Throughout the excerpt, and in fact through much of the music made by the trio, Motian's drumming stands in a "mediating" relationship to the bass and piano of LeFaro and Evans, in the sense that the drums simultaneously accompany both parties. Since this relationship is basically static throughout the excerpt, it is not depicted in the score, and there is little more to say about it here.

This track is listed on the CD as "take 2". It is very interesting to compare this performance with the same section from "take 1" of the same tune. The differences are astonishing, exemplifying the degree to which this trio was able to create unique and spontaneous performances. It's clear that the trio was in no way "rehearsing" the ending of the piece in take 1, but the second take is much more effective, due in large part to the clearer and more decisive use of interaction modes.

5.2. *Homecoming*, George Lewis and Roscoe Mitchell

This excerpt (see Appendix A.2) is taken from track 9 of George Lewis' CD *Voyager*(AVAN 014, 1993) from 1:51 to 3:27; a densely-packed duet between Lewis on muted tenor trombone and Mitchell on soprano sax. This piece appears as the only all-acoustic track on the CD; the other tracks feature Mitchell in duets with Lewis' interactive computer music system, "Voyager". As such, it stands apart as a sort of "benchmark" against which the other tracks may be compared in terms of how the performers interact.

This excerpt was chosen from among several sections of the piece which are bracketed by relatively long periods of silence. These sections are remarkably clear in their segmentation, almost as if they were planned in advance. According to Lewis (personal communication), however, there was no pre-performance plan, nor were there any edits in the recording; it represents a single "take" from a session which included two or three, mainly "so that [Lewis] could try different mute combinations for timbral purposes, to find a satisfying relationship to Roscoe's soprano sound". Lewis writes of his role in this piece:

> [Roscoe] possesses a very strong and single-minded performance persona, with which I had to interact. I think of the piece sometimes as the trombone dancing around a central, relatively static core, dodging and feinting. The dodging itself becomes static in response to the core, giving the piece its central unity. (personal communication)

Lewis' comment suggests a certain predisposition toward placing Mitchell in a

position of greater agency, and indeed, Mitchell does seem to have the "upper hand" during the first part of the piece, tending to initiate and terminate the duo's phrases, for example. However, later in the piece, Lewis seems to initiate more interaction events, establishing the "dodging" behavior as another kind of agency in the interaction.[1] The 1'50" leading up to the beginning of the excerpt transcribed in Appendix A.2 begins in *sharing* mode, with each player putting forth an equal amount of information, carefully balancing their statements against one another's. The care with which their parts are balanced during this introductory section is, in itself, evidence that they are listening closely to each other, even though their phrase boundaries are independent and there is a relatively low i-event density. However, at around 51", Mitchell begins to shift into a more aggressive style, inserting increasing numbers of longer notes that rapidly swell to *fortissimo,* bursting out of the dainty, pointillistic texture of the introduction. At 1:00, Lewis begins to react to this change. By now, the mode has decidedly shifted to *soloing* (Mitchell)/*accompanying* (Lewis), although Lewis' playing is still highly contrapuntal, somewhat in the manner of Dixieland Jazz. At 1:20, an important i-event takes place which marks a strong phrase boundary: Lewis' scale-wise, descending C-Phrygian cadence against Mitchell's *tenuto* G stands out dramatically as a moment of strong affinity amongst an otherwise highly contrasted section. At 1:38, another such moment occurs, with Lewis' repeated, upward, short-long gestures (reminiscent of traditional English hunting calls, but with Jazz inflections) seeming to finally grab Mitchell's attention. Having thus obtained the soloist role (for the moment), Lewis manages to wind down this section by repeating this figure in a *ritard* and *diminuendo* ending in a long, sustained low E over which Mitchell adds a final, punctuating high G#.

The transcription of the excerpt in Appendix A.2. contains annotations regarding the modes used and highlights some important interaction events using arrows to indicate the initiator of the events. Although punctuated with i-events, the excerpt is a remarkable example of the use of the *sharing* mode. There is an almost

[1]It is interesting to note the connection between Lewis' concept of "stasis" in the comment above and my notion of "agency". It would seem that one way of obtaining agency is simply to "stick to one's guns".

perfect balance of information output from the two performers. Lewis' playing tends to be busier note-wise, but Mitchell's playing is more dynamically volatile, and more interruptive, with more sharp attacks and sudden, unexpected swells. Mitchell also makes more extensive use of timbre shifts, such as the gently distorted A-flat beneath Lewis' brief "solo" moment starting at around 2:02. The players phrases almost always start and end together; they almost seem to breathe at the same times (note esp. 2:27 and 2:42). There is even a hint of a shared tonal center – F major – the outline of which lends an even greater sense of "consonance" to the excerpt. I have also noted some very sophisticated transference of materials such as the interval Eb-B which Mitchell plays at 2:22, picked up by Lewis at 2:27 as the melodic outline of his phrase, and Mitchell's scale-wise figure just before 2:27 which Lewis imitates in his melody. This "crosstalk" of ideas further reinforces the impression of *sharing* in this music. It is almost as if the music were being made by a single organism consisting of the two musicians. Sharing mode is seldom sustained for long, however, and indeed, the performance veers somewhat abruptly away from *sharing* into a brief episode of *not-sharing* beginning at 2:49 (triggered perhaps by Lewis' venturing off into new rhythmic territory), where each of the performers seems to be developing independent ideas. Soon, however, the performers resume interacting, starting with a brief section in *merging* mode at about 3:00 (characterized quite literally by gradual rhythmic synchronization). The performers end up in *sharing* mode again after their *merging* episode finishes around 3:12, but they conclude this section with a brief *initiating/responding* section. Ending in this mode leaves this excerpt feeling unresolved, which propels the performance forward into the next section quite effectively.

5.3. *April One*, Joseph Celli, Jin Hi Kim and Shelly Hirsch

The "sonic universe" of this piece is a highly exotic blend of virtuoso vocal noises, reed sounds, and the percussion and strings of Kim's amplified *komungo* (a six stringed Korean instrument which originated in the 4th century, used in both traditional court music and "peasant" music). Throughout the piece, we hear a

particularly strong affinity relationship between Celli and Hirsch, whose articulated, plaintive, emotionally-charged performances stand contrasted against Kim's more austere expressions. Both Hirch's and Celli's are extremely agile "wind-driven" instruments, and Celli's sound has a very vocal, almost "crying baby"-like quality. Celli's role is that of the "drone", providing a continuous and relatively stable but highly responsive (one might say almost erotic) accompaniment to Hirsch's vocal gymnastics. Celli's continuity of tone becomes so expected that any breaks in the tone take on heightened significance. Kim's gestures are much more sparse, tending to be interruptive in nature, thereby taking on a kind of conductor-like "phrase-marking" role.

The excerpt's interaction event density is extremely high, and the most common i-event type by far is *question/answer*. The predominant mode of the excerpt is therefore *initiating/responding*. Thus we could describe this excerpt as fairly "dissonant", interactively-speaking, although there is an extended period of "sharing" between Celli and Hirsch from 0:56 to 1:16. As with the Lewis/Mitchell transcription, I have traced the initiators and responders by the use of arrows in the score. Note that events can be triggered by more than one initiator, and that, again, the initiating event can be silence, especially if preceded by a sustained sound. Both of these are exemplified by the i-event at circle A. Events sometimes seem to explode outward, impacting the other two members in different ways (e.g. Hirsch's tongue roll at 1:16). Several "completion/punctuation" i-events, usually involving two of the three players, can be found (note the B circles). The string scrapes between 0:50 and 1:05 seem to coincide with the peaks of Hirsch's and Celli's expressive swells, for example.

Like the Lewis/Mitchell performance, there is a high degree of self-consistency and internal development within each part. Note the pattern denoted A and A' in Kim's playing, for example. This kind of development underscores the importance of sequence extrapolation identified by Hofstaeder as an important component of musical intelligence (cf. chapter 2.3.3). Such consistent

developmental expression not only makes for more interesting music, but also helps the other performers better predict and respond to one's playing.

Although not specifically noted in the analysis, this excerpt could serve as an example of the "mediating" relationships mentioned at the end of chapter 4. The role played by Celli throughout much of the excerpt is essentially simultaneous accompaniment for both Hirsch and Kim, whose interactions with each other might seem more direct were it not for Celli's mediation. It's as though Celli's reactions introduce a "delay" between cues from Hirsch to Kim (or vice-versa) and their response from the other performer. Celli's choice of instrument for this excerpt is particularly well-suited for such a role, given its lack of definite pitch, its relatively constant timbre, and relatively small dynamic range.

6. Conclusions

Group improvisation is a manifestation of complex cultural, emotional, and intellectual forces, the roots of which extend deep into our ancestral past, the effects of which project forward into our future. A clear grasp of these forces is essential to developing a deep, structural understanding of contemporary improvisation. The concepts and constructs put forth in this thesis, as I have shown, can help solidify our understanding by providing a framework within which to organize and evaluate our observations and ideas. Perhaps most importantly, the framework provides some criteria for measuring certain aspects of improvised music, a few of which are reviewed below.

6.1. Measuring Interactivity in Improvised Music

6.1.1. Quantitative Measurements

In Chapter 4, I proposed the concept of *interaction events* (or *i-events*) as "atomic units" of interaction. The number of these events per unit time, or interaction event density, can be used as a quantitative measurement of the degree of interaction between performers. It is interesting, for example, to compare the three excerpts analyzed in chapter 5 along this axis. In *Detour Ahead,* there are five i-events in the span of about 1 minute, or about .083 i-events per second. In *Homecoming,* I counted 15 i-events in 96 seconds, or .156 i-events/second. *April One* has 25 i-events in the first minute, for an i-event/second ratio of .42. We might take this measurement as an indication that April One is the most interactive of the three pieces. One problem with using i-events as a metric in this rather simplistic way, however, is that it does not account for time spent in *sharing* mode, during which i-events become harder to recognize. We might consider *sharing* one extended i-event, or a series of many small i-events so densely packed together that they do not register as i-events according to the definition in chapter 4. A piece with long sections of *sharing* may have fewer distinct i-events but may be just as

interactive as one with fewer *sharing* sections and more i-events; *Homecoming* and *April One* are an example of this. The extended *sharing* sections in *Homecoming* offset its relative lack of i-events as compared with *April One.*

I-events also give us a way to measure the strength of affinity between two agents. More i-events mean stronger affinity. While there may be other means of establishing affinity relationships between performers, it is my contention that a high i-event density is the best predictor of audience perception of affinity. In WICAM, it is not enough for performers to have similar qualities; we have to be convinced that the performers are, in fact, listening and responding to each other and not simply inhabitating the same musical space. It is certainly possible for musicians to employ very similar materials and yet convey no sense whatsoever that they are listening to one another; yet two musicians can employ radically different materials and still interact in *sharing* mode.

Another quantitative metric of interactivity is the degree of distribution of agency in the performance. We measure this by counting up how many interaction events were initiated by each performer. In the Evans/LeFaro example, Evans initiates nearly every i-event, making this a very "one-sided" interaction. In *Homecoming,* 7 of the 15 i-events are initiated by Mitchell, the other 8 by Lewis, making this a very even agency distribution. In the first minute of *April One,* the agency distribution is as follows: Hirsch: 7, Celli: 3, Kim: 15. In general, it seems fair to say that the more evenly agency is distributed among performers in a piece, the more "interactive" in nature the piece is likely to be perceived. However, such statements always invite further validation. In order to discover how broadly we can apply these observations, we would want to make certain that the i-event density and distribution measurements were not being confounded with non-interactive characteristics such as density of notes per unit time, or sheer "musical complexity", or "unpredictability", or even simply tempo (Balzano, personal communication). Devising and carrying out psychological experiments to isolate these parameters would be a highly interesting area for future research.

6.1.2. Qualitative Measurements

The interaction modes defined in chapter 4 also give us a way of ascribing qualitative categories to sections of interactive performances. By looking at how much of the overall performance is devoted to each of the modes, we can get a sense of the general "flavor" of the interaction. Using the analogy of consonance and dissonance, we might say that a piece in which *sharing* mode prevails is more consonant than one in which *not-sharing* is the dominant mode. (*Homecoming*, for example, is a very "interactively consonant" piece.) Or, if there is abundant use of the "linear" modes, the piece will have a strong feeling of forward motion (as does *April One*). On the other hand, music generally seems more interesting if it contains a variety of interaction modes. Any piece which focuses exclusively on a single mode will quickly tire most listeners, just as would any piece which remained on one tonal center for too long. The variety and rate of change between modes determines the "interactive volatility" of a performance.

6.2. Effective Interaction Strategies

In theory, my analysis framework could provide a means by which performers can attain a high degree of consensus about what they are doing when they improvise. To my view, this group consensus is essential to competent musical communication. For example, if one performer thinks he's *soloing* while the rest of the group thinks he's *not sharing*, the poor, deluded soloist might feel like the rest of the group has abandoned him; his playing, as well as that of the group, will probably lack conviction due to this mismatch of conceptions. In an ideal improvisation, each performer should have a very clear idea of the mode of interaction occurring at any given time, and their role in that interaction should be recognized and agreed upon by everyone else in the group.

In addition to the framework itself, however, there are some general principles which did not seem to fit into the framework proper, but which nonetheless seem to be important strategies for successful group improvisation which I have discovered during my research. They are therefore included here.

6.2.1. Lag Time

Consider the following thought-experiment. Create a number of audio recordings of three different versions of my micro-score *Change Together*, where a group of percussionists is asked to collectively produce changes in the group's tempo. Version 1 would be performed as indicated. Version 2 would involve the use of a conductor who would direct the tempo changes for the group. If recordings were made of these two versions and played for a group of listeners who were not present during the performances, would they be able to distinguish between the two different versions (conducted vs. conductorless)? More importantly, *what would be the criteria for these distinctions?* In other words, what auditory evidence would we have that the musicians were in fact getting tempo cues from each other during the performance, rather than simply following an arbitrary external timing reference? Ironically, this evidence would most likely take the form of synchronization *errors*! However, there is probably a fairly narrow range of acceptable error, beyond which we would doubt that the musicians were listening to each other *at all*. This experiment might yield a result which would look something like this:

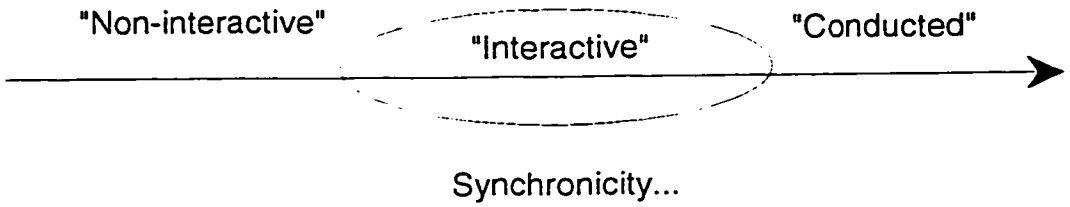

Figure 6.1: Synchronicity and plausibility in interactive performance

Somewhere between the infinite space of performances too synchronous to be believably performed without a conductor, and performances so asynchronous as to fail to yield the impression of any interaction whatsoever, lies a grey area where listeners would believe that the performance was carried out interactively. In particular, *sudden changes* in tempo on the part of the group as a whole would be a dead giveaway that the piece was conducted.

This simple thought experiment has particularly important implications for

creating plausible human-computer musical interactions. Because computers can very easily track things like tempo fluctuations with extreme accuracy, we must design some amount of "lag" into such systems, lest they be perceived as too unnatural. Humans, like most natural, physical, dynamical systems, tend to react to sudden changes in input with at least *some* degree of lag. Consider, for example, the time it takes for one's pupils to adjust to the lights being suddenly turned on in a dark room, or the way an electric burner remains hot for several minutes after the current has been turned off. Introducing a "lowpass filter" on behavioral changes has the effect of making a system seem more "committed" to its current behavior. Improvising musicians must constantly balance the impulse to respond immediately to change with the current direction of their own output. Like good dance partners, it does no good if one or both players are constantly tripping over each other trying to match the moves of the other. We expect our musical partners to have some idea of where they are going at all times, and to demonstrate that idea by their reactions. Furthermore, in some interactive musical communities (the AACM, for example), abrupt transitions are expressly avoided.

The "lag" principle is not completely unique to improvised music. Meyer (1961) wrote of an analogous principle as a valuable property of "great" monoriginal music. Meyer writes of a melody by Bach:

> Thus it would seem that in this case at least value has something to do with the activation of a musical impulse having tendencies toward a more or less definite goal and with the temporary resistance or inhibition of these tendencies.

The lag principle can also be said to apply to the "dominant prolongation" device commonly employed by Beethoven and his successors to create tension, especially just before the recapitulation in a piece in sonata form. The whole point is to set up an expectation of change, and then to temporarily frustrate that expectation.

An example of this principle in operation can be found in the recording "Art Ensemble of Chicago - Live". The state transition points and large-scale sections are

fairly easy to hear in this recording: 4:36 (train calls & percussion), 5:35 (bass & drums swing groove), 6:22 (trumpet & saxes enter), 8:10 (Favors sets up new groove for "Checkmate"), 13:20 (Bowie's "solo" over a gradually dissolving texture), 19:20 (switch to primarily membranic percussion texture with flutes), 26:00 (6/8 march), 29:18 (2/4 "funky" groove w/solos by Bowie, then Mitchell), 34:35 (fast, "chaotic swing" on cymbals w/sax & trumpet solos, gradually thickening texture, slowly building to a peak), 48:30 drums dominate, etc.. This formal structure and the resulting tension curve is shown in the figure below:

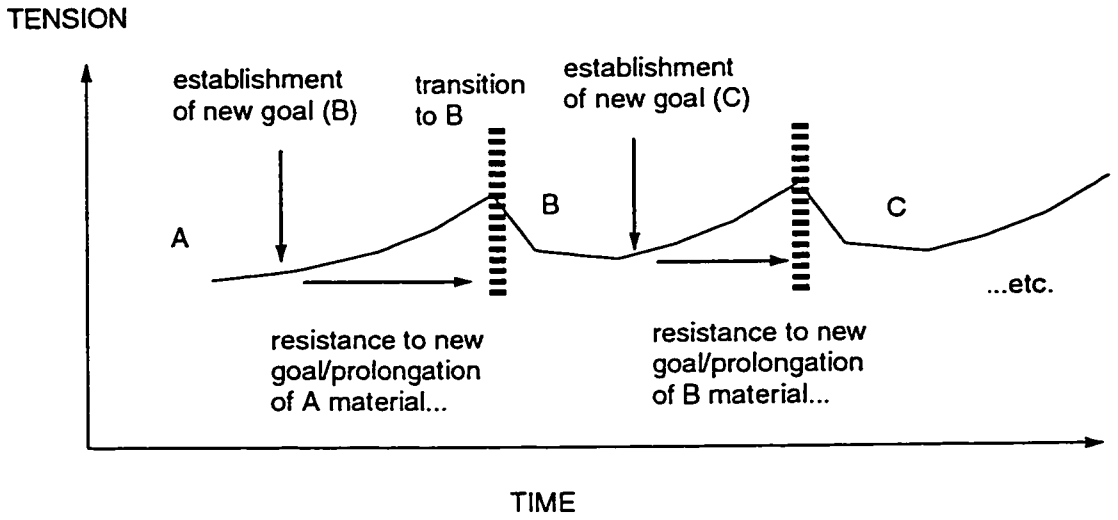

Figure 6.2: Formal patterns in Art Ensemble of Chicago performances

One might view much of the Art Ensemble's music (certainly, at least, this recording) as a progression through a series of "vacuum" states; somebody "punctures a hole" in the musical fabric, thus "problematizing" the texture, which creates pressure to follow in that direction.[1] However, that pull *must* be resisted, lest the music wander too much.

6.2.2. Balance and the "Gap-fill" principle

Improvisors frequently exploit a well-known compositional device called the

[1] This kind of problematization could be read in the Gatesian sense as a type of "Signifying".

"gap-fill" principle. Stated simply, this is the act of filling in musical "gaps" left open by others or themselves. A prolonged avoidance of activity in a previously-hinted-at area of the parameter space will tend to create a desire for this activity. Like a vacuum, the avoided activity seems to pull the music inexorably toward itself by virtue of its non-existence. The resulting tension increases in direct proportion to both the length of the avoidance of the goal and the degree of "intensity" in the sound. Each member of a performing ensemble has the responsibility to help the group attain a mutually-agreed-upon optimum level of tension. This requires that performers develop (usually through a history of playing together, or, as Lewis writes, through "immersion in the improvisation '-scape' as a whole"[2]) a common notion of intensity calibration, and a general agreement on the desired relationship of time and materials.

Another kind of "gap-filling" occurs at the level of "orchestration", or participation by the various performers in an ensemble. Sensitive musicians may keep a mental inventory of which performers have been most active over the course of a performance, so that everyone gets a chance to express themselves as fully as possible. Frequently, this principle manifests on the large time scale in each performance being given a "solo" of sorts; if not literally a solo (playing without accompaniment), then at least a period where all other performers are playing accompanimental roles.

6.3. Indications for future work

6.3.1. Working with more diverse informants

Among my plans for future work is to continue the micro-score research with more diverse groups of musicians. For example, neither the UCSD graduate students nor the UnSound trio had been playing together for more than a few years; it would be interesting to gain insight from musicians with even more collective experience. I would also like to work with musicians from other countries and with stronger influences from various traditional musics. In the future, I plan to solicit

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2 personal communication, October 1997

broader interest these experiments as a means of collecting more data and wider perspectives.

6.3.2. Transduction of musical energy

Improvising in a "free" style with a group of sensitive improvising musicians may be compared to blowing on a set of wind chimes outdoors on a breezy day. By modulating the amount of energy one sends out, one can set the chimes in motion. Once the chimes are ringing, they may continue for some time on their own, but if you stop blowing, eventually they will return to a state of rest. If the wind picks up, however, the chimes might ring on their own. One can't precisely control the rhythms and pitches that may sound at any given moment, and the overall nature or "personality" of the chimes (their weight, length, tuning, etc.) is fixed before you even begin, but it is certainly possible to exert some *influence* over when the chimes sound and over the general *density* of sound through a process of "transduction" of musical energy, whereby the signal produced by one performer is converted into another form, as manifested in the playing of the other performers.

This dissertation has focussed more on the audible *results* than on the internal, cognitive *mechanics* of this transduction process, which are far less tangible. I have identified many of the forces and elements I believe to be involved in shaping this process, but a complete study of how musical signals are transmitted, interpreted, combined with a musician's own unique personality and history would require an even more extensive probing into the psychology of improvisation. Hopefully, the framework provided here will provide some structure which could make that study more tractable. For example, a researcher could investigate the cognitive processes involved in each of the interaction modes, or investigate the "cognitive anatomy" of the various kinds of interaction events identified herein.

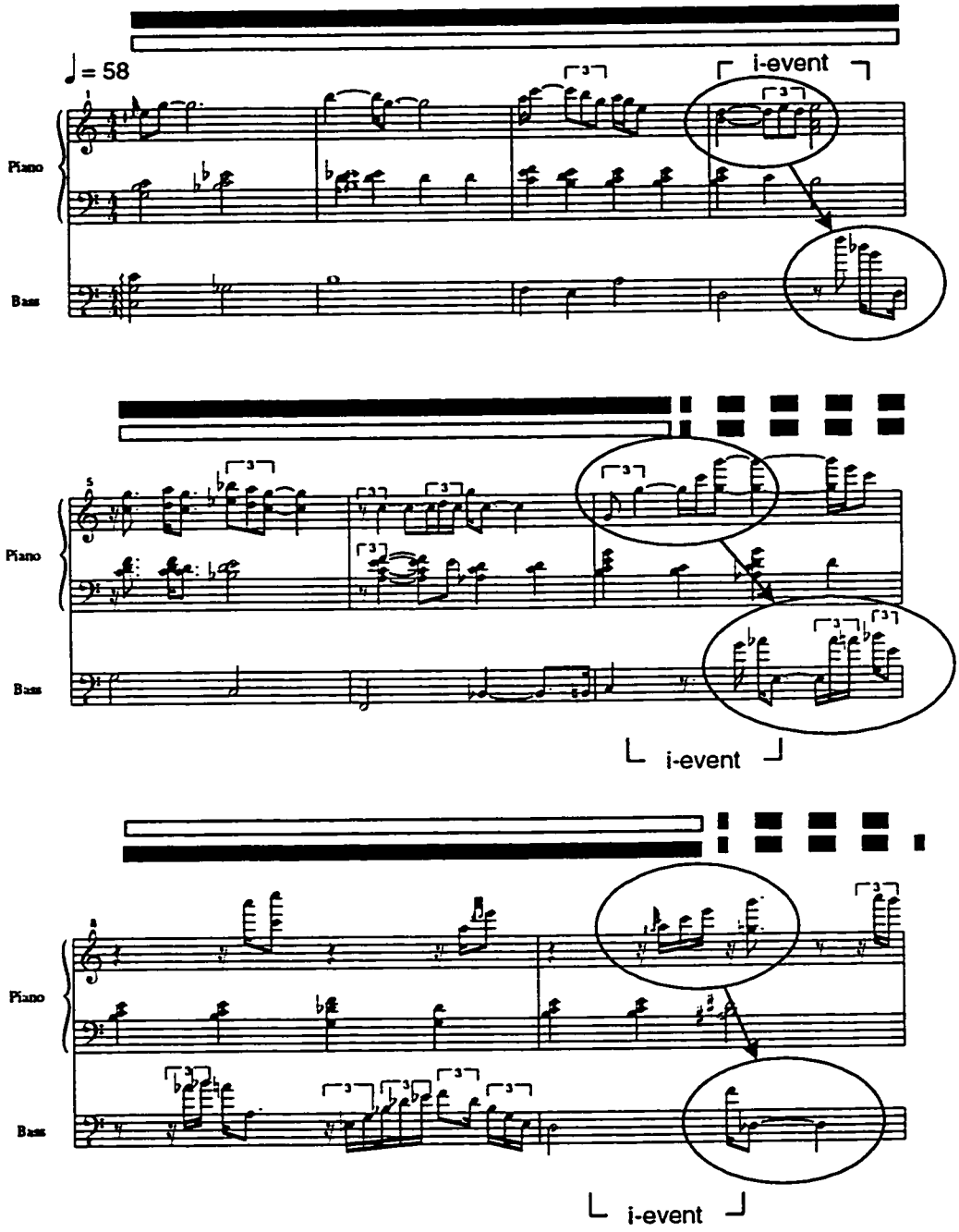
6.3.3. Using the Framework as a Generative System

Like many analysis frameworks, this one holds the potential to be used not only for analysis, but also in the *generation* of improvised performances. I plan to

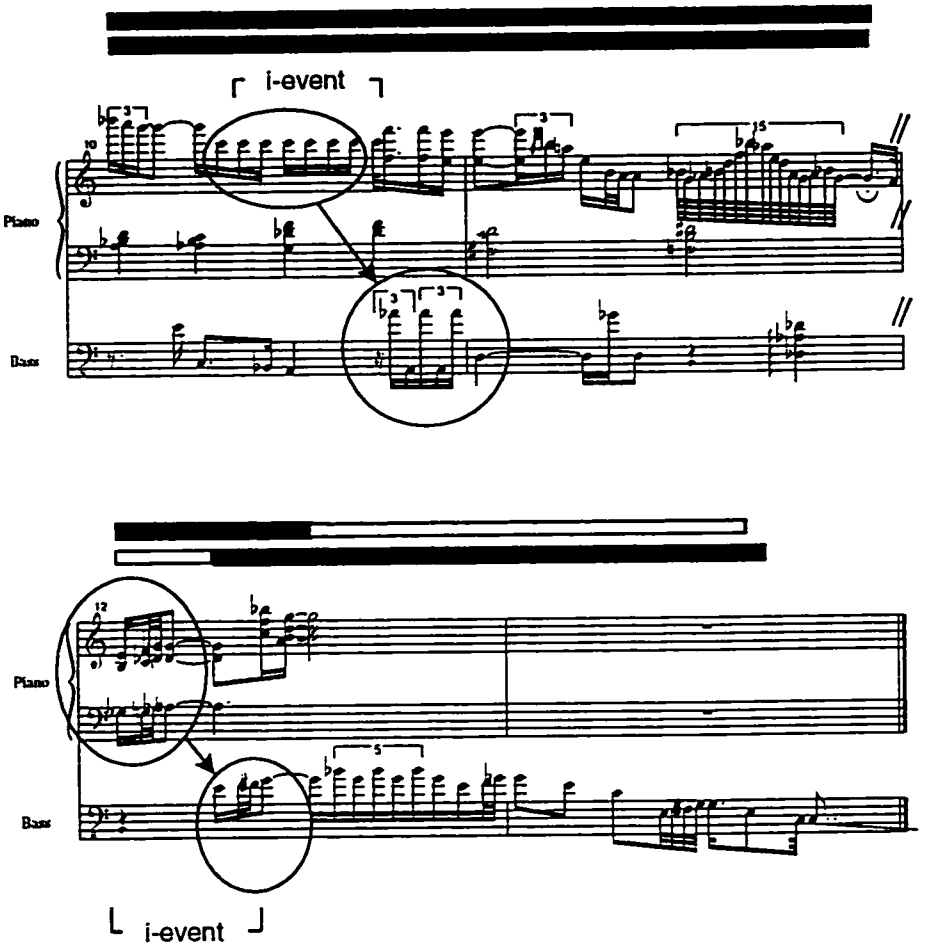
assemble a group of musicians who will become familiar with the constructs presented here, so as to make possible the creation of graphical or text-based scores in which the only referent specified is a series of interaction modes. These modal structures, like Jazz "changes", could serve as the foundation of an infinite number of realizations by different groups. My expectation is that by serving to build consensus among performers about exactly what is is they are doing, this framework will help to foster more engaging and fulfilling musical interaction.

Appendix A: Analysis Transcriptions

A.1. *Detour Ahead*, Bill Evans and Scott LeFaro

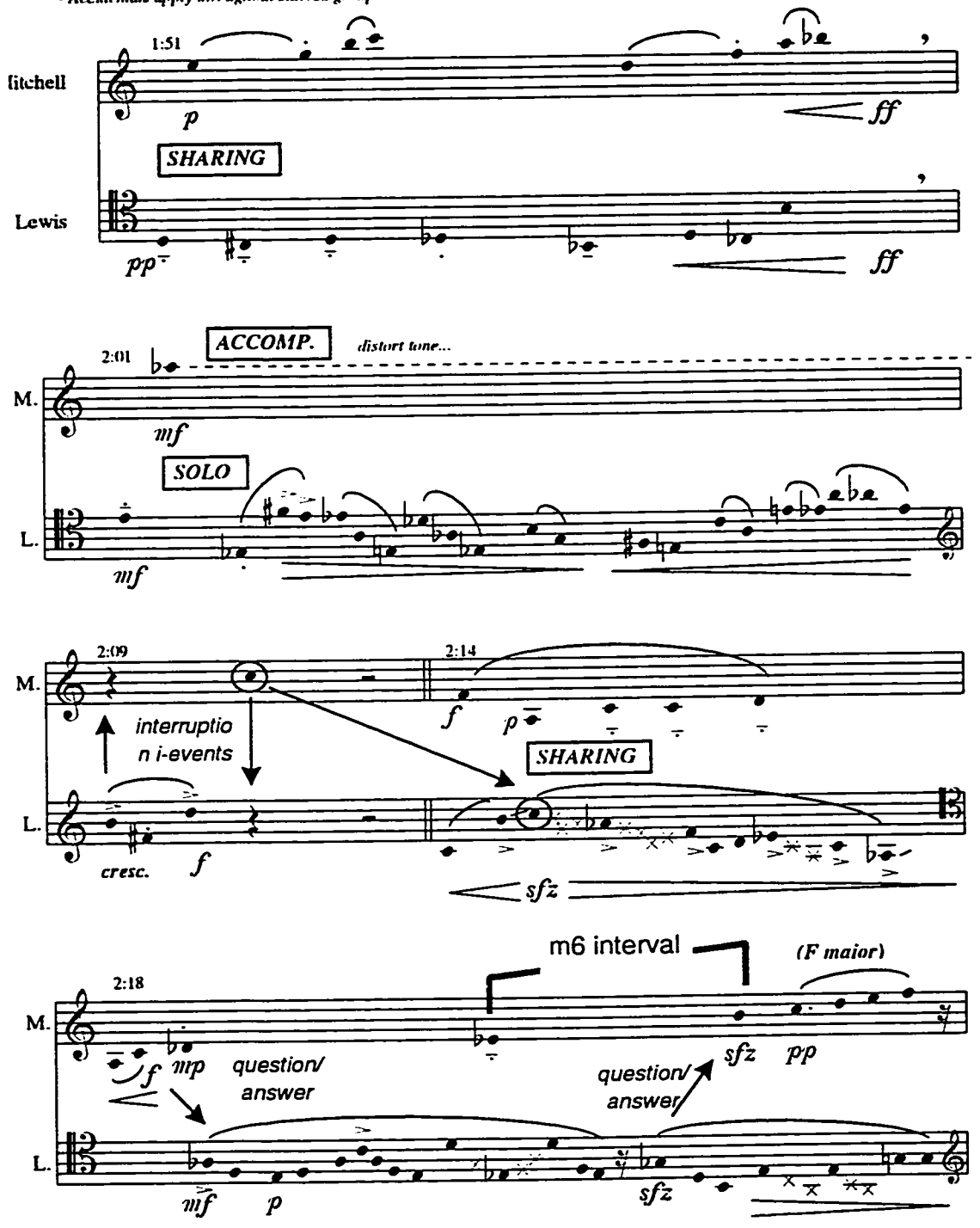


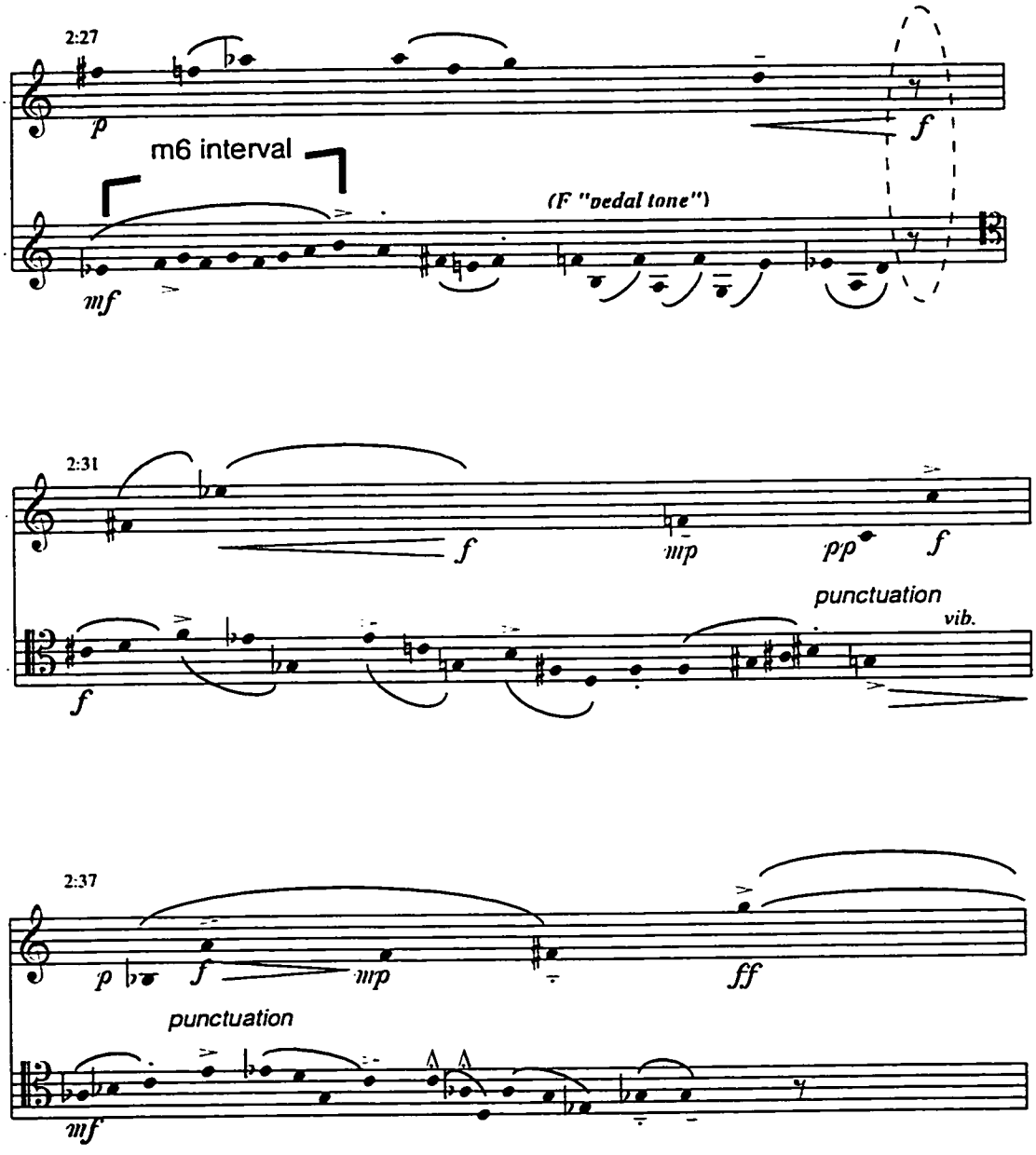
A.1. *Detour Ahead*, Bill Evans and Scott LeFaro, p.2

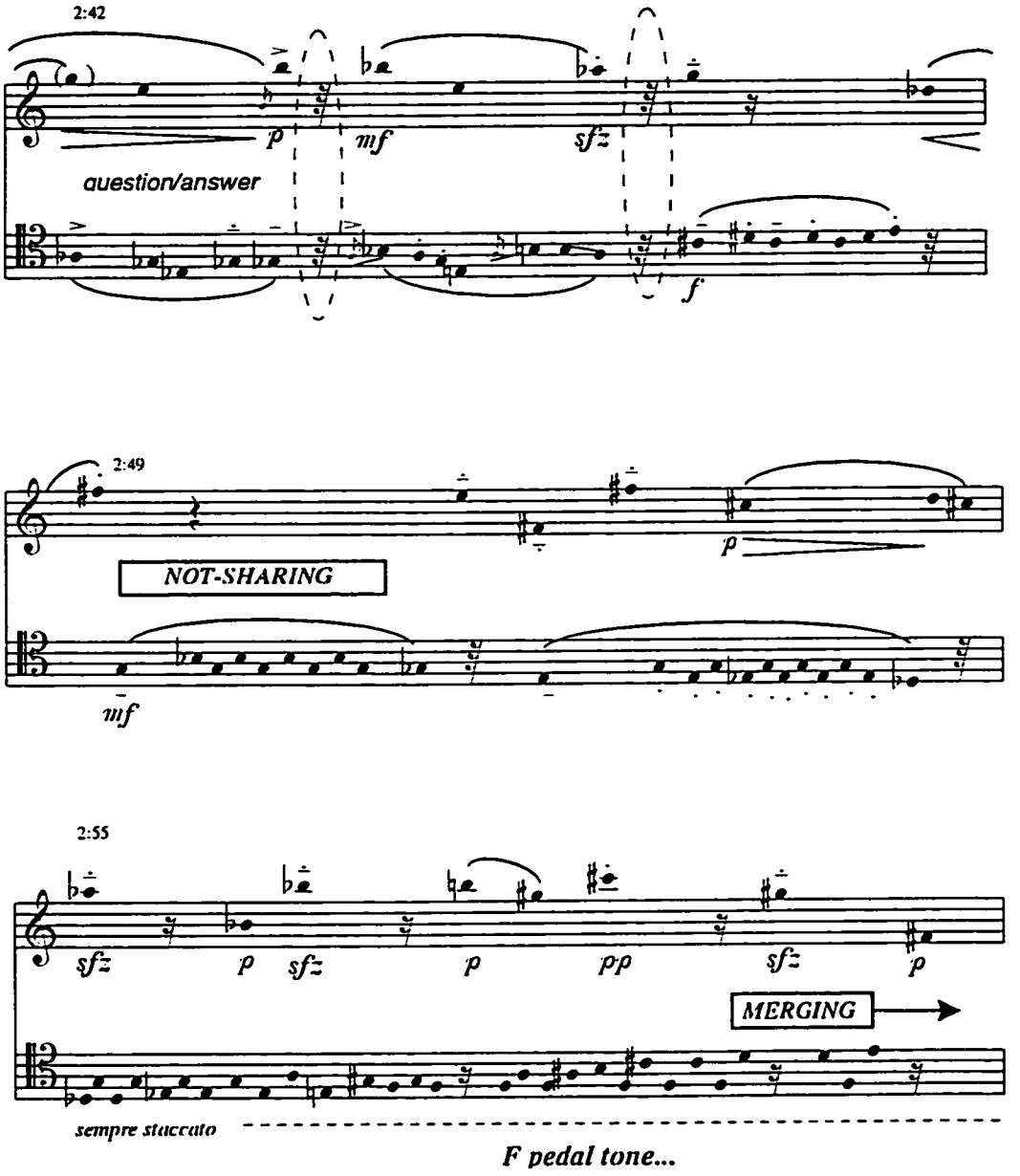


A.2. *Homecoming*, Roscoe Mitchell, soprano sax, and George E. Lewis, trombone

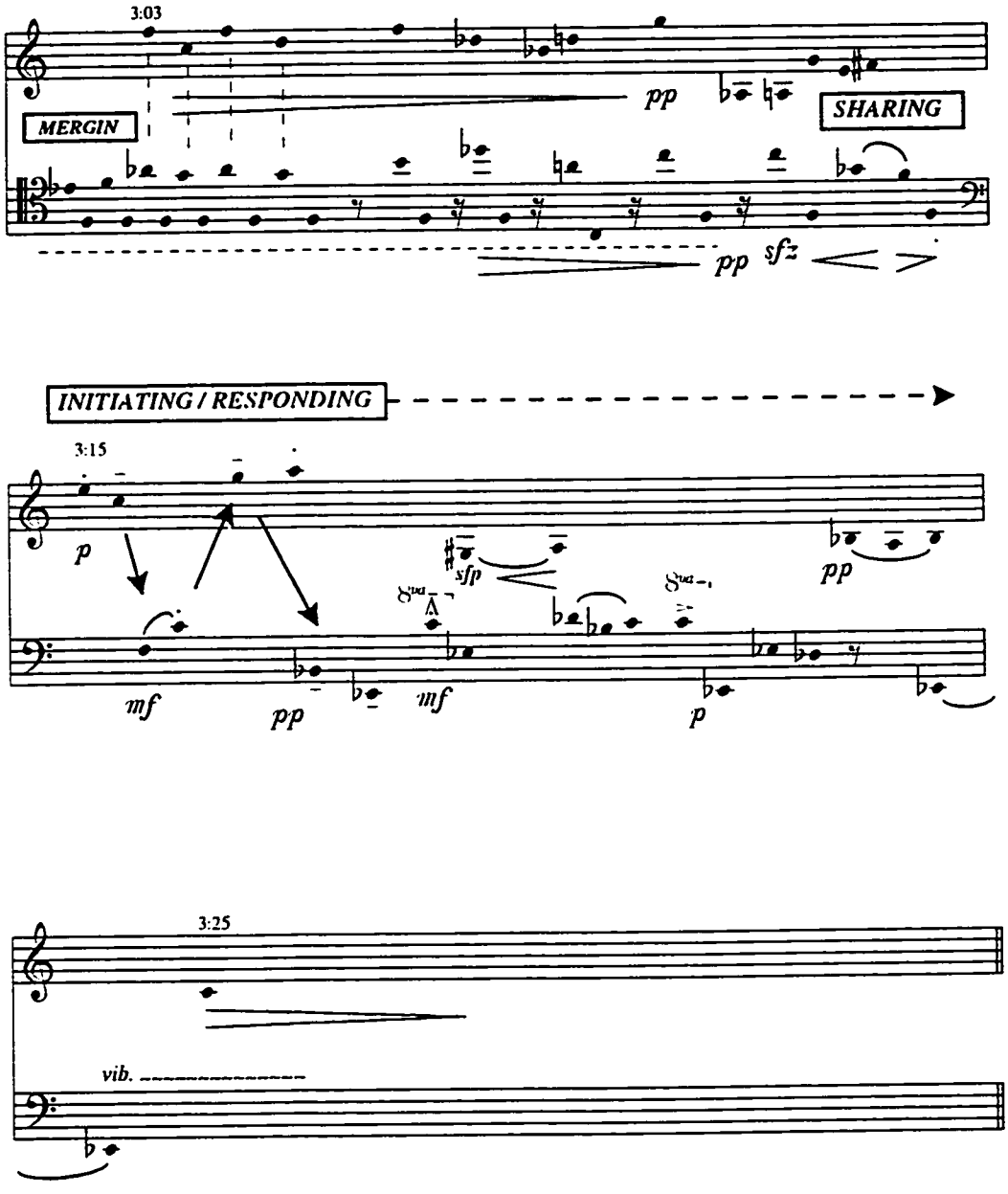
- *Time scaling is not constant. Tempo is indicated by start times at beginning of each line.*
- *Accidentals apply throughout slurred groups.*



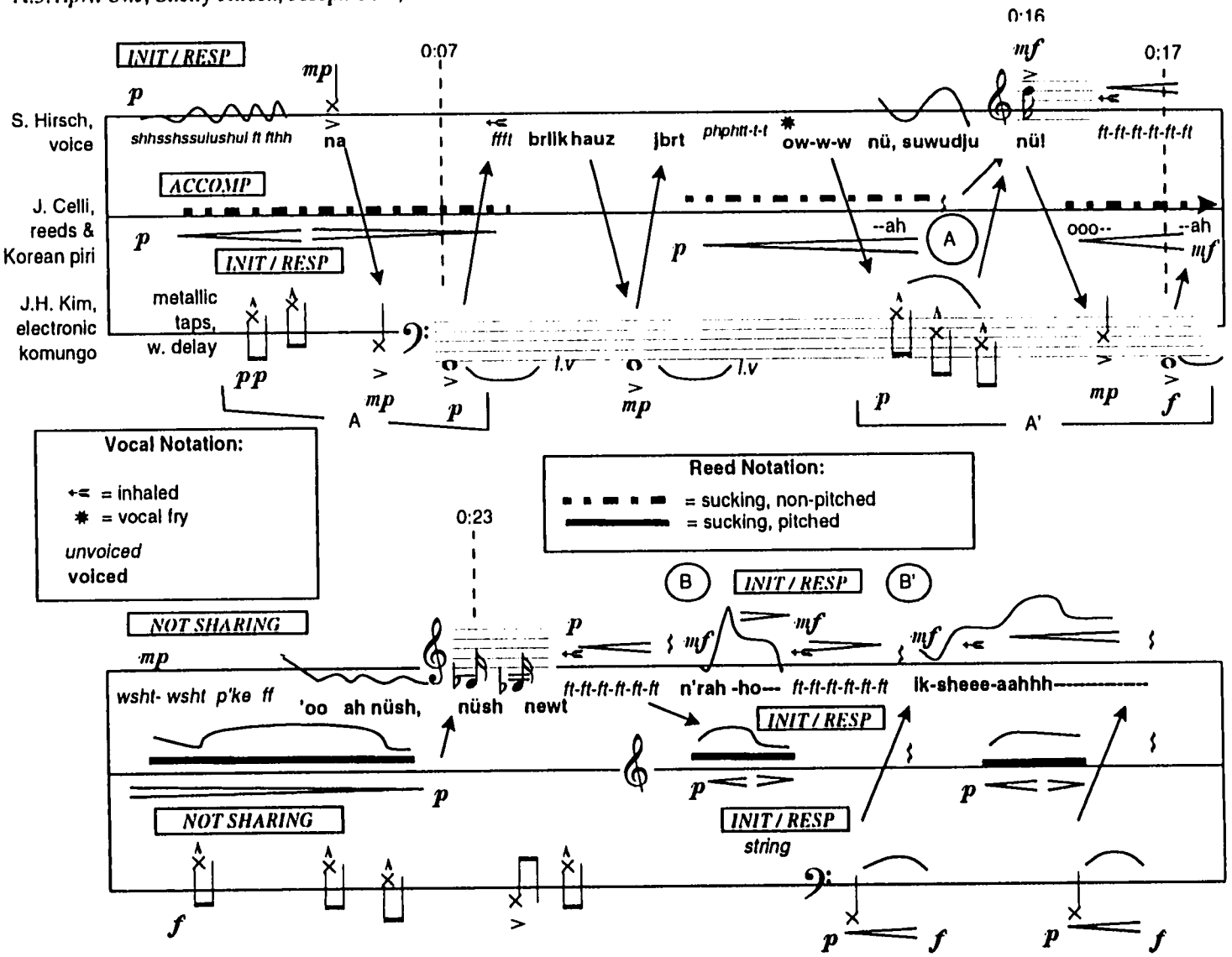

2:27
p
m6 interval
(F "pedal tone")
f
mf
2:31
f
mp
pp
f
punctuation
vib.
f
2:37
p
f
mp
ff
punctuation
mf


2:42
p
mf
sfz
question/answer
f
2:49
NOT-SHARING
p
mf
2:55
sfz
p
sfz
p
pp
sfz
p
MERGING
sempre staccato
F pedal tone...

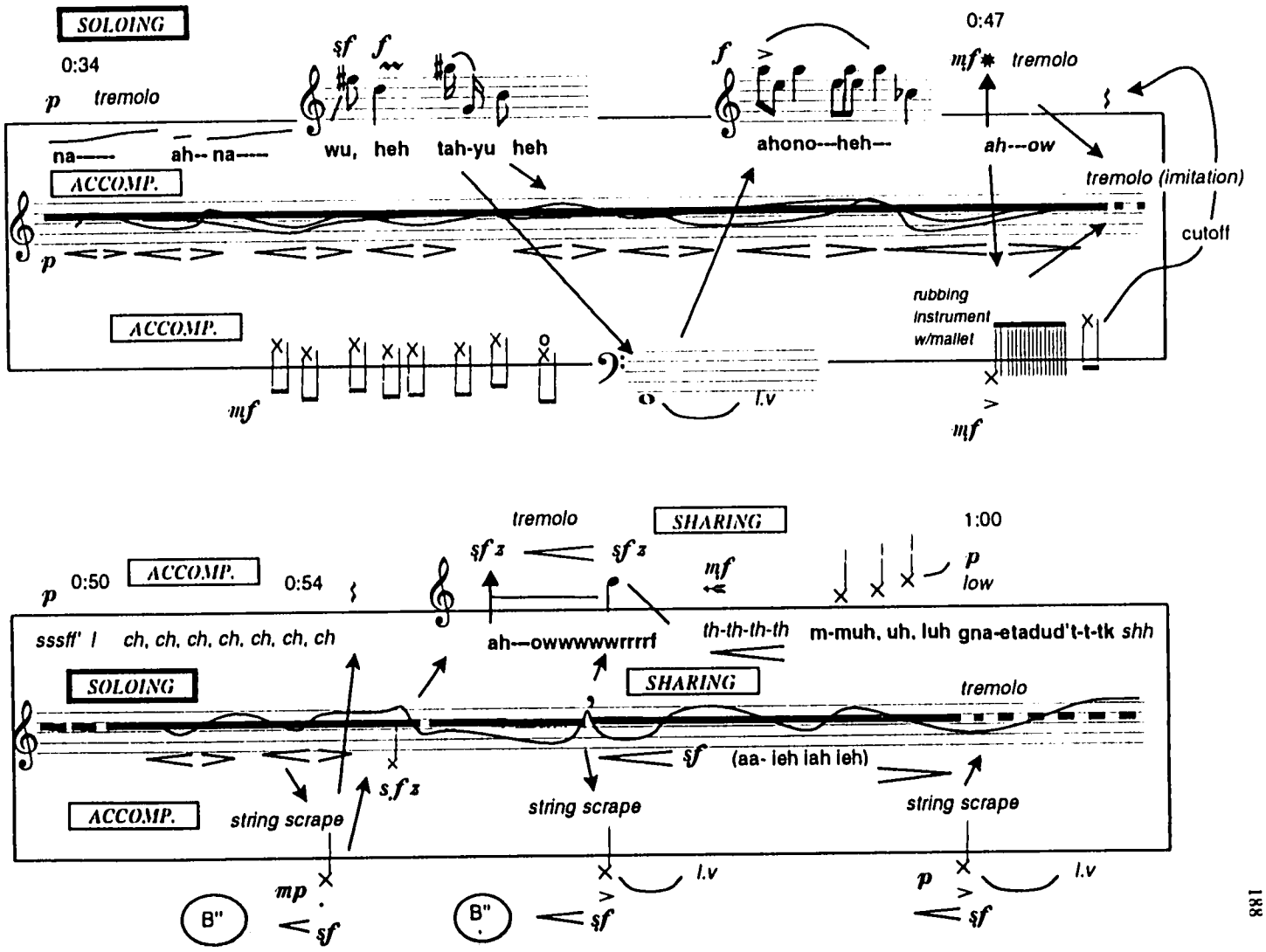
A.2. *Homecoming*, p. 4



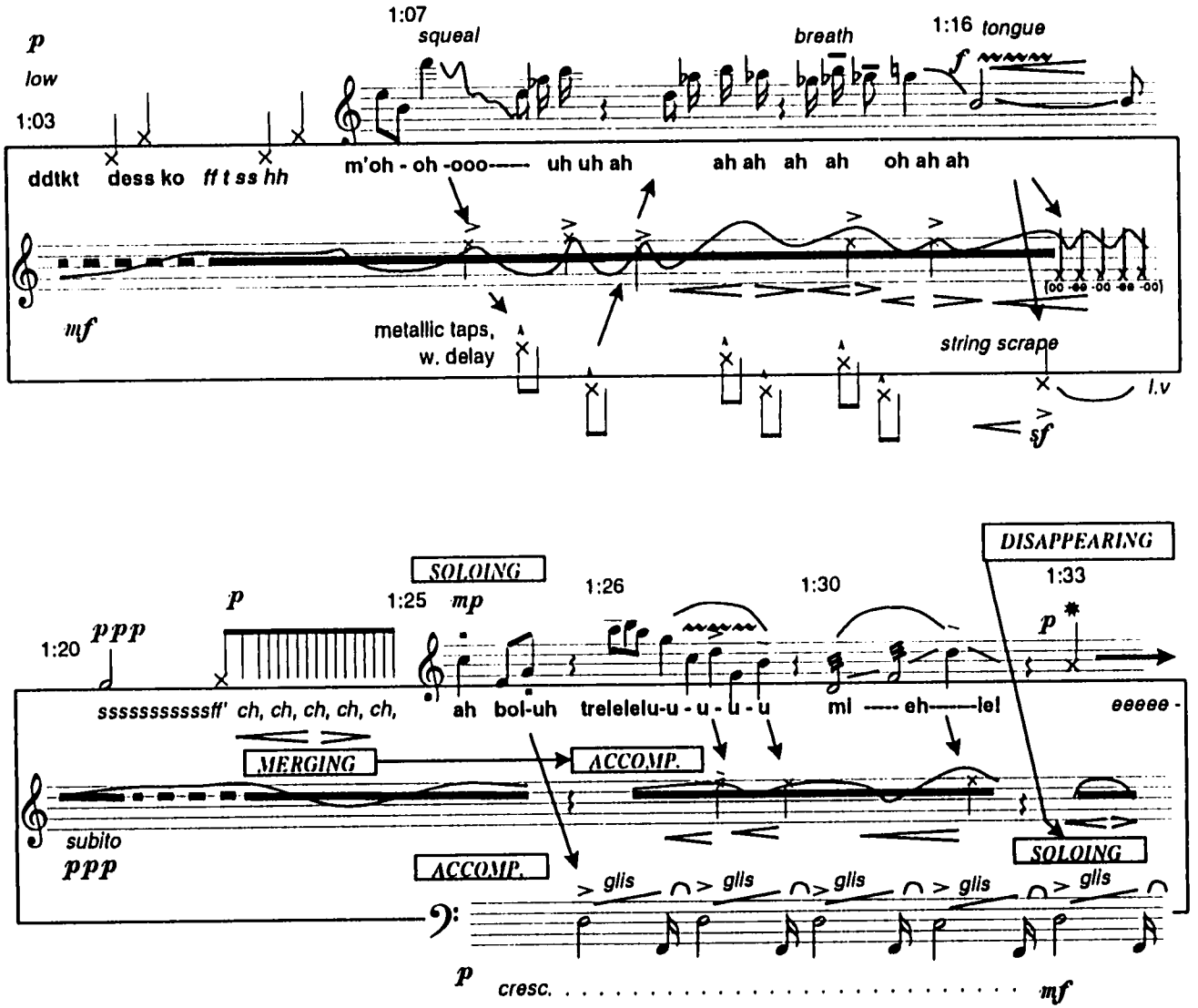
A.3. *April One*, Shelly Hirsch, Joseph Celli, and Jin Hi Kim



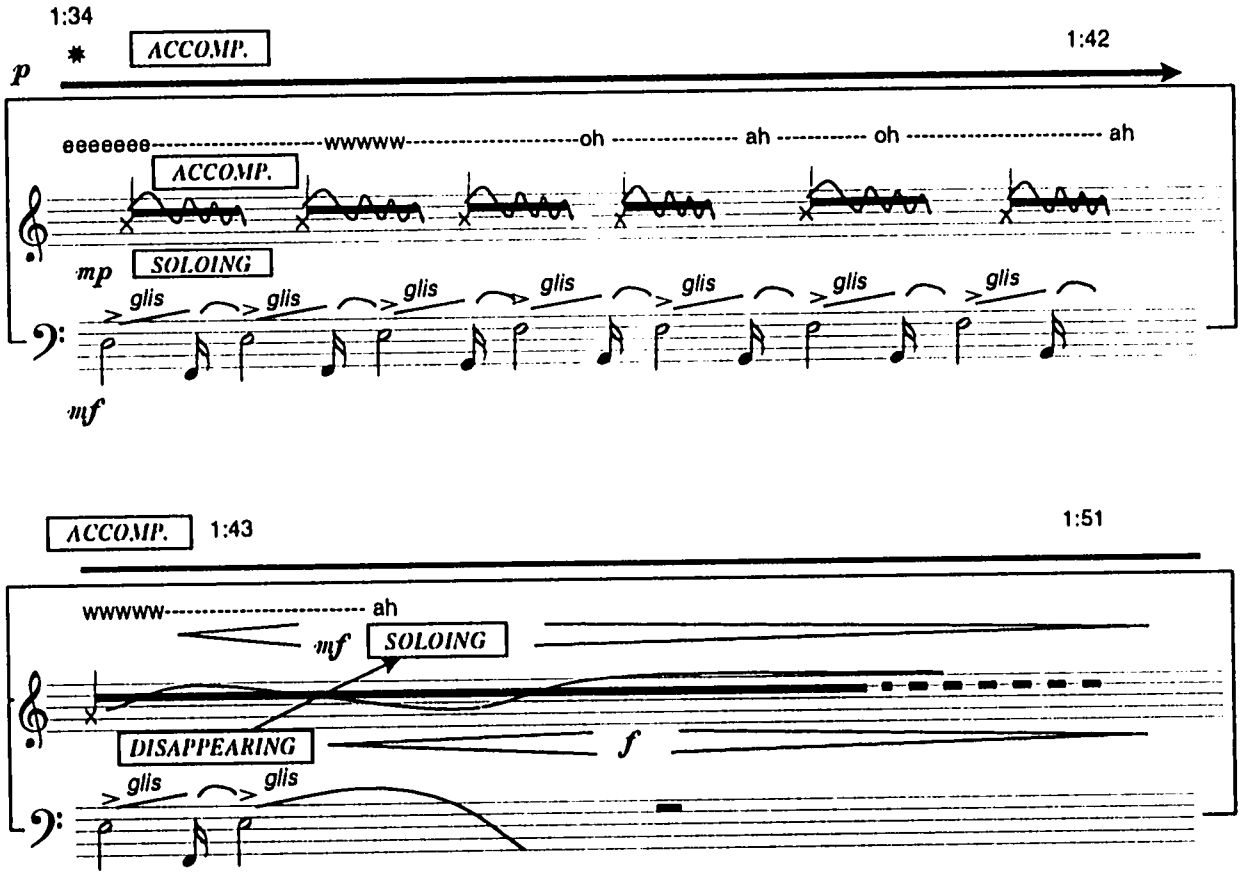
A.3. *April One*, Shelly Hirsch, Joseph Celli, and Jin Hi Kim, p. 2



A.3. *April One*, Shelly Hirsch, Joseph Celli, and Jin Hi Kim, p.3

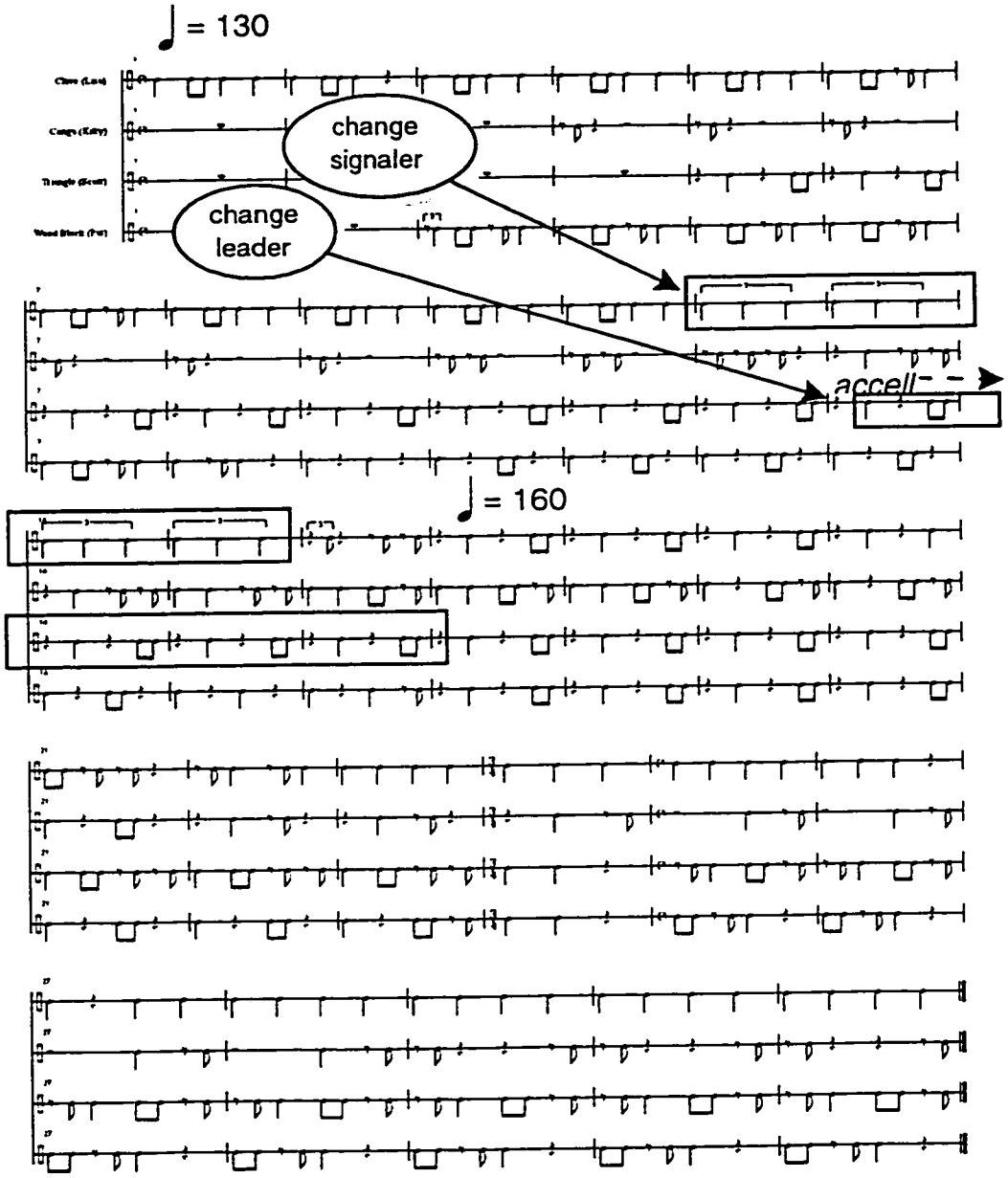


A.3. *April One*, Shelly Hirsch, Joseph Celli, and Jin Hi Kim, p.4



Appendix B: Micro-score Transcriptions

B.1. "Change Together", UCSD Graduate Students



transcription by Harold Fortuin

Discography

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Internet Resources

Record Catalogs:

Electronic Music Foundation: http://www.emf.org/cdcat_improv.html
Music and Arts: http://www.musicandarts.com

Web Sites:

European Free Improvisation: http://www.shef.ac.uk/misc/rec/ps/efi/ehome.html
Improvijazzation Nation: http://www.ccnet.com/~dmic27/improv.html
Berkeley Improvisation scene: http://astro.berkeley.edu/plonsey/beanbenders.html

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