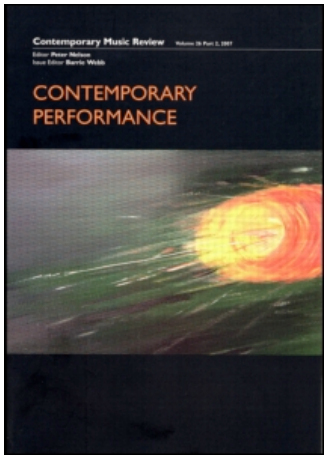

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Interacting with Latter-Day Musical Automata

George E. Lewis

The idea of music that somehow plays itself, or emerges from a nonhuman intelligence, is a common, transculturally present theme in folklore, science, and art. Over the centuries, this notion has been expressed through the development of various technological means. This paper explores aspects of my ongoing encounter with computers in improvised music, as exemplified by my most recent interactive computer music compositions. These works involve extensive interaction between improvising musicians and computer music-creating programs at the performance ("real-time") level. In both theory and practice, this means that both human musicians and computer programs play central organizing and structuring roles in any performance of these works. This paper seeks to explore aesthetic, philosophical, cultural and social implications of this work. In addition, the nature and practice of improvisation itself will be explored, since an understanding of this ubiquitous musical activity is essential to establishing the cultural and historical context of the work.

KEY WORDS: Interaction, Art Ensemble of Chicago, AACM, Improvisation, African-American improvised music, Timbre, Epistemology, Ontology, Sociology, Performance with computer.

On one of my first visits with Malachi Favors, the great contrabassist and co-founder of the Art Ensemble of Chicago, I discussed my interest in using computers to play music-somehow. Something I had read about — somewhere. Favors, deploying considerable detail that I am at pains to remember now, launched into an animated recollection of his visit with "this African brother who had instruments that played themselves."

In my ignorance of those years, I remember filing this remembrance under the category of "magic" — though Favors never used that word. In retrospect it seems obvious enough that this taxonomy was evidence of the heavy rational hand of the academy, leaning on my shoulder; indeed, I was fresh out of university. With its privileging of so-called "logic" and

"facts" over legend and oral narrative, the influence of "higher learning" made it more difficult for me to see that the nonrational is not the same as the nonimaginable, nor can it be identified with what is nonrealizable. Favors' vivid description of his meeting with this traditional musician, then, was describing a kind of technology, perhaps different from my own. It has become clear that the results, however achieved, essentially parallel the sort of thing I do with computers now.

My particular area of interest in working with musical computers involves performance interaction between music-generating programs and music-generating people. The issues raised by this work deal with the nature of music and, in particular, the processes by which improvising musicians produce it. These questions can encompass not only technological or music-theoretical interests, but philosophical, political, cultural and social concerns as well.

Throughout this essay, the term "improvised music" is used to denote a social location inhabited by an considerable number of present-day musicians, coming from diverse cultural backgrounds and musical practices, who have chosen to make improvisation a central part of their musical discourse. Media reports, scholarly essays and other literature about such musicians have tended to coalesce around "improvised music", a posteriori, as a catch-all term for a variety of musical forms.

One important model in the area of improvised music is the sort of "open" improvisation practiced by members of the Association for the Advancement of Creative Musicians (AACM), African-American musicians' collective, widely recognized for the variety of innovative musical ideas promulgated by its membership since its inception in 1965 on Chicago's nearly all-black South Side. Among the improvisor-composers working in this way are Muhal Richard Abrams and Fred Anderson (both founding members of the organization), Douglas Ewart, the Art Ensemble of Chicago, Anthony Braxton, and the author.

Another important and very different model of "improvised music" is practiced by the European "free" improvisors, such as Joelle Léandre, Derek Bailey, Misja Mengelberg, Alex Schlippenbach, Irene Schweizer, and Evan Parker. It is probable that the usage of the term "improvised music" in the sense that I am using it here began in this cultural milieu. A third strain within improvised music is the so-called "downtown (New York) school", represented most prominently by John Zorn (Litweiler 1984, Jost 1975, Bailey 1992).

In particular, the European form places great emphasis on the social necessity for the role of improvisor (see Bailey 1992 on this point), while the AACM model stresses a composer/performer orientation and the importance of asserting the agency of the African-American artist (Radano

1993). Both models regard the development of the improvisor as encompassing not only the formation of individual musical personality, but the harmonization of one's musical personality with social environments, both actual and possible.

The incorporation and welcoming of agency, social necessity, personality and difference is one of the features of improvised music which distinguishes it as a field from work which "incorporates" or "uses" improvisation, or that features "indeterminacy" or aleatoric practices. Working as an improvisor in the field of improvised music emphasizes not only form and technique, but individual life choices, as well as cultural, ethnic and personal location. At the same time, individual works reference an existing establishment of techniques, styles, aesthetic attitudes, antecedents and networks of cultural and social practice. Along this line, as the internationalization of improvised music proceeds, we see the emergence of improvisors that do not claim rootedness in either the European or American heritages, thereby re-identifying improvised music as a transcultural practice.

In the general, everyday-life sense, the activity of improvisation can be viewed as a domain-specific, structure-generating interaction within a particular environment complex. In the musical domain, improvisation is neither a style of music, nor a body of musical techniques. 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.

Humans have the capacity and the need for improvisation. In our everyday-life improvisations, we find structure in existing encounters, and create new structures. In analyzing music in structural terms, then, the questions of how, when, and why are critical, while the question of "if" is often merely particularist, pejorative or ethnocentric, rather than truly exegetic. While the existence of structured and unstructured musical entities is open to question in some quarters, it should be clear that structured and unstructured creative environments do exist. Musical improvisation can generate structure within both contexts.

Improvised musical interactions will be subject to various types of constraints, some of these being due to the local or nonlocal interaction of independent, asynchronously occurring structure-generating processes. For humans, the primary constraints upon musical improvisation in general are in the realms of the body, temporality, memory, and the physical environment. The intellectual and musical problem endemic to structure-generating activities such as improvisation (or any other musically generative or creative activity) is that we are not always aware of the constraints

that we are functioning under as we work, or why we decide upon certain actions.

Given the above-mentioned historical antecedents, and the associated and concomitant social and cultural tropes, we can now identify "improvisor" as a functional musical activity role in world musical society. Other examples of such roles include "composer", "performer", "interpreter", "psychoacoustician", and various flavors of "theorist." In identifying the role of "improvisor", the notion of improvisation as "real-time composition" is implicitly disavowed. Once this construct is discarded, the notion of the improvisor as "performer" in the European "classical" sense comes into question, since in many cases, the piece that the improvisor is to "perform" is missing.

I do not, however, wish to present these musical activity roles as fixed constructions, but as potentials. Creating compositions for improvisors (again, rather than a work which "incorporates" improvisation) is part of many an improvisor's personal direction. Though the efforts of many exciting composers come to mind, I would refer reader to the work of Roscoe Mitchell, Anthony Braxton, John Zorn and Misja Mengelberg for examples of work that retains formal coherence while allowing aspects of the composition to interact with the extended interpretation that improvisors must do — thus reaffirming a role for the personality of the improvisor-performers within the work.

Similarly, a performance of *Voyager*, though stressing improvisational interaction, also requires of the improvisor a high degree of interpretative cognizance. The improvisor must be concerned with the sonic environment, historical antecedents and cultural cues that Voyager presents. In this sense, as with the work of the composers mentioned above, we may speak of "performing" an improvisation in a manner that parallels, though is not identical with, the activity of a performer in nonimprovised music.

The experience and practice of improvisation in improvised music privileges the role of musical sound as a carrier for history and cultural identity. Improvised music deemphasizes Western "classical" notions of form and structure in favor of the exchange of cultural and social narratives. Informed listening to improvised music, including my own work with computers, will involve attention to this process.

The acceptance of conceptualizations about improvisation which define the activity in terms of accepted roles within European and Euroamerican high-culture musical practice, however, can serve to obscure an understanding of the process of improvisation. In performances of improvised music, the possibility of internalizing alternative value systems is implicit from the start. The focus of musical discourse suddenly shifts from the individual creator to the collective, the individual as a part of global humanity.

Bebey (Bebey 1975) describes an incident wherein an accomplished African musician, after trying an instrument briefly, hands it back to its owner with the remark that he had no way of communicating with "someone who did not speak the same language" as he did. The metaphor, which in this case seems at literal as can be, is of musical performance on an instrument as communication between two subject intelligences. This notion is at variance with the hierarchical, highly moralistic model of "playing" an instrument characteristic of Western musical pedagogy, where, in an eerie echo of a colonial "pioneer" experience, the achievement of "mastery" of an instrument is often presented as the result of hard work, privation and striving for self-control.

Voyager (Lewis 1993) is the latest in my series of computer music pieces that are designed to function in a nonhierarchical interactive musical environment which privileges improvised music. Previous works include *Rainbow Family* (Davaud 1984, Ouvry-Vial 1992), and *Chamber Music for Humans and Non-Humans* (Roads 1985). Each piece in the series functions in some sense as an improvised concerto, where a single performer is engaged in dialog with a computer-driven, interactive chamber orchestra acting as a "virtual improvisor." A computer program analyzes aspects of an improvisor's performance in real time, using that analysis to guide an automatic composing program that generates complex responses to the musician's playing.

In *Voyager*, the computer system is not an instrument, and therefore cannot be controlled by a performer. Rather, the system is a multi-instrumental player with its own instrument, in this case a Proteus/2 (Emu Systems) sample player with a group of instruments selected for the piece. In this sense it is useful to consider Robert Rowe's taxonomy of "player" and "instrument" paradigms (Rowe 1992), although I regard the two models of interactive role construction, not as a fixed binary opposition, but as a continuum along which a particular system's computer-human interaction can be located.

The sixteen "players" in the "orchestra" are controlled by global "behavior specifications" that determine which instrumental combinations will occur and how they will be grouped. These combinations vary continuously throughout the performance. These behavior specifications are in turn determined in part by the analysis and development of pitch and velocity data, which is taken from the improvisor's playing via a so-called "pitch follower" — a device known to exercise its own creative options from time to time.

Musical decisions made by the computer are based on a feature extraction and development procedure, where analytic processes deposit their outputs into a block of variables which represent the state of the input at a given moment. Volume, velocity, sounding duration, interonset duration,

octave, register, interval width, pitches used, volume range, interonset duration range, frequency of silence, articulation and other important features are extracted and averaged over time. These features are used to guide the musical behavior of the program.

Other important musical choices are generated internally via random numbers. These processes provide much of the "personality" of the system, and include melody and harmony, orchestration, ornamentation, pacing, transposition, rhythm, and internal behavior decisions. These options can be characterized as involving whether and how to react to input, how quickly to alter data in a given parameter, or which parameters to alter.

In the absence of outside input, the complete behavior specifications are internally generated. In practical terms, this means that the computer program does not need to have real-time human input to generate music. In interactive terms, this means that improvisor can influence the computer's performance, but need not prod the computer during the performance. The computer's own musical behavior is the product of its own initiatives, and its response to outside input when the program has determined that such input is present.

Since in *Voyager*, the computer exhibits generative behavior independently of the improvisor, decisions taken by the computer have consequences for the music that must be taken into account by the improvisor. There is no built-in hierarchy of human leader/computer follower, no "veto" buttons, pedals, or cues. All communication between the system and the improvisor takes place sonically. A performance of *Voyager* is in a very real sense the result of a process of negotiation between the computer and the improvisor.

If an improvisor wishes to hear the program play in a certain way, the most direct route is to actually play in that way. After that, it's up to the system to deal with what it finds. This can be viewed as "getting the system's attention." If the improvisor can get the system's attention, not only is it possible for the improvisor to guide the system when needed, but the improvisor feels better about having the system take apparently independent initiatives, because the fact of the improvisor's influence has been established.

The notions of negotiation and computer agency separate my work from transformation-oriented interaction, in which information gleaned from a performer is directly manipulated in one or several possible domains (such as audio or MIDI), then reintroduced in possibly altered form into the performance environment. A performance of *Voyager* is conceptualized interactionally as two parallel streams of music generation, that of the computer and that of the human, each informed by the other's music — an improvisational, nonhierarchical, subject-subject model of discourse, rather than a stimulus/response setup.

In determining the kinds of sonic symbols that can "sound like music", cultural concerns play an important role. In African-American improvised music, for example, an improvisor is said to be looking for or possessing a "sound", "one's own sound." Moreover, the analytic skills of improvisors constitute an important part of this process (Fraser 1983). An improvisor can "sound like" another improvisor, as demonstrated by the numerous players who chose to "sound like" Coltrane, Miles Davis, or Derek Bailey. The notion of "sound" in improvised music may be seen as analogous to the Western compositional concept of "style", especially in a musically semiotic sense.

This notion of "sound" may be to a considerable extent independent of timbre, leading to the notion that timbre alone is not sufficient to identify an improvisor. For instance, many people play the alto saxophone, but for each person there can be a different "sound." In the ears of many listeners, Charlie Parker "sounded like himself" on either tenor or alto saxophone. Listeners familiar with the Parker style recognized him and could often distinguish Parker's music from imitators who were able to closely copy his saxophone "sound." This implies strongly that "sound", sensibility, personality and intelligence cannot be separated from one's phenomenal (not formal) definition of music, one's notions of personhood as transmitted via sounds, and the nature of how sounds become signs for deeper levels of meaning beyond pitches and intervals.

Interactive computer programs, such as *Voyager*, can also be said to have a "sound." Part of *Voyager*'s "sound" is embodied in its nonmotivic approach to form. A "state-based" model, in which a sonic environment is presented within which musical actions occur, is used as a basis for interaction. State-based rather than motive-based work is particularly common in improvised music, and is compatible with several different improvisational models. In this kind of improvisation, the global aggregation of sonic information, considered in a temporal sense, is privileged over moments of linear development. I refer the reader to the work of Evan Parker (Parker and Lewis 1980) for an example of state-based work, and to the work of Anthony Braxton (Braxton 1979, Braxton 1983, Radano 1993) and the late period of John Coltrane (Coltrane 1964, Porter 1983) for examples of block-structured, motivically oriented improvisation.

For the *Voyager* program, in addition to the idea of state, it is the sheer number of decisions, as well as their character and order of preference, that leads to a sense of directedness in the music that belies its humble origins in white noise. It is worth noting in this respect that the vulgar notion of "randomness" as being aimless is subverted by the scientific actuality of the use of "random" noise in process control and neural net applications as an element in objective calculation (see Kosko 1992). Moreover, so-called "randomness" itself, far from being without form,

has definite character as statistical distribution (see Dodge and Jerse 1985).

In practice, I have avoided the use of non-white noise random generators. The use of white noise allows me to filter the resulting stream of numbers in a conceptually simple and orthogonal fashion, where "tuning" the program for a desired musical result, or setting up input response parameters for interaction with improvisors, ultimately becomes a process of setting percentages. This manipulation of the many program variables whose values are determined by various filterings of white noise results in the emergence of complex global "personality." In Voyager-speak this global personality is called "behavior"; the set of variables that define the behavior is called the "behavior set", and an aggregate group of data values are called a "behavior specification."

Certain behaviors appear in systems only as their size and complexity reaches a certain level (Rosenboom 1993). If an interactive, adaptive input structure can generate a sufficiently detailed representation of what it receives, and if that data can be mapped to a sufficiently detailed output structure, then this accumulation of many small details of input and output representation can produce a musical output that may be perceived by an improvisor as analogous to various states that were experienced as the music was improvised. In this way, I believe, the emotional state of the improvisor may be mirrored in the computer partner, even if the actual material played by the computer does not preserve pitch, duration, or morphological structures found in the input.

This transduction of musical intentionality into or from sound, or "emotional transduction", is important to the construction of interactive work. This notion constructs physicality and performance as an intentional act, that is, an act embodying meaning, and announcing emotional and mental intention. On this view, interaction and behavior are carriers for a complex symbolic signal, and that notes, timbres, melodies, durations, and other music-theoretical constructs are not ends in themselves. Embedded in these objects is a more complex, indirect, powerful signal that we must train ourselves to detect, and that will one day be the subject of an expanded notion of music theory.

Charlie Parker told an interviewer, "Music is your own experience, your thoughts, your wisdom. If you don't live it, it won't come out of your horn." (Levin 1949/1994). The clear implication is that what you do live does come out of your horn. Moreover, the reference to Africanity and oral narrative is unmistakable when this statement is compared with Ibrahim Abdulai, whose response to the question "What is music?" was "Music is something which does not conceal things about us." (Chernoff 1979). If this experience has any validity, the nature of internal representation of a given interactive system would be audible to the trained

improvisor, based upon that system's performance and the improvisor's experiences with it.

Perhaps emotional transduction cannot be shown to exist in an "objective" way, but I can give a example that could prove instructive. Many people familiar with the sound of wind chimes have noticed that they can tell the difference between the wind's performance and that of a person who is shaking it. Or a dog might be jingling a chain, making a sound very different from that a person might make with the same chain.

The point I wish to emphasize here is that although the chain can be said to possess a "timbre", timbre is not the only sonic cue available to a listener. Rather, aspects of how the keys are played, how the sound varies in its performance over time, seem to have an enormous impact upon one's perception. The same can be said of computer music instruments, where one computer program might perform with a given "timbre" (in the commercial MIDI sense of that term) in quite a different way from a person playing a keyboard, or even another program that operated differently.

The other important notion that animates *Voyager* is that of the locally intelligent orchestra, where local decisions taken by individual players percolate up to the global level, where the overall form is maintained. My model in this regard is the Javanese gamelan orchestra, where a large number of players playing a relatively fixed composition nonetheless have considerable latitude in interpretation, even at primary levels such as pitch, duration and rhythm. Control of musical process is shared among actors, with inter-player communication taking place without necessarily involving a central authority.

The success of such an orchestra can be seen to depend not only on the performative skills of the players, but upon their real-time analytic capabilities, their ability to "know just what the music needs." In this context, "improvisation" is characterized according to its interactional, social or intentional role, acknowledging how intentionality of process affects the musical result. For example, "kembangan" (literally "flowering") refers to an improvisation that adds beauty. "Isen-isen" ("filling") is an improvisation that "pleasantly fills a vacuum." On the other hand, "ngambang" ("floating") refers to musicians who are improvising without a clear knowledge of where the music is going, and "ngawur" ("blunder") denotes an out-of style or irrelevant improvisation (Susilo 1992).

In a sense, *Voyager* can be seen as incorporating aspects of this heterarchical approach to large-group musical interaction, while appropriating (via timbre) and even signifyin(g) on (Gates 1988) aspects of the nineteenth-century European orchestra. At the same time, the role of conductor is eliminated by substituting, in the structure of the generative

program, local control of behavior groups (the primary "actors") for global control by a centralized authority.

This refers once again to the possibility of an improvising orchestra. In the area of improvised music, various models have been proposed, such as the AACM Experimental Band (Radano 1993), the Globe Unity Orchestra (Dean 1992, Litweiler 1984, Globe Unity Orchestra 1993) and the work of Sun Ra (Geerken 1994).

Eventually one arrives at the notion of a non-Eurocentric computer music, that is, an area of musical discourse using computers that is not regarded culturally and historically as a branch of European contemporary concert music, and is not necessarily modeled as a narrative about "composition." For now let it be said that a non-Eurocentric computer music might embody the assumptions and cultural markers embedded in a non-European point of view, just as the overwhelming majority of European and European-American-based computer music research and compositions rest upon the belief systems and cultural practices of European concert music.

For instance, the master narrative of control, already remarked upon with regard to notions of how a musician encounters an instrument, is retained in that branch of computer music concerned with the construction of "controllers." These linguistic terms may have served to constrain the conceptualization of possibilities for new kinds of "non-controllers" — "involvers" or "enablers" — that allow for performance contingency, and even for a kind of agency on the part of the instrument (see Collins 1991 for a discussion of "trombone-propelled" electronics).

My work with *Voyager* indicates to me that the notion of independent computer agency merits serious consideration. Moreover, recent work by Wessel with "instruments that learn" (Wessel 1991a) indicate that such agency is not incompatible with the notion of a musical instrument. Indeed, in certain contexts "performance with" may be more empowering than "performance on." The intercultural references sprinkled through Wessel 1991b, about improvisation with musicians who have gained experience with modes of musical discourse lie outside of Western musical practice, indicate that new research in computer music need not privilege existing European models. The collaborations that Wessel describes with composer-instrumentalists Kim Jin Hi, *Torikai* Ushio and Roscoe Mitchell are clearly driven technologically by improvisation-centered rather than composition-centered musical practice.

Finally, the work of The Hub, Daniel Scheidt, Ed Osborn, David Behrman, Larry Polansky, Nick Didkovsky, the late Martin Bartlett, and many others, I believe, points to a kind of musicality with computers that challenges accepted ideas about how we are to experience music. Their music makes reference to ideas about music, performance and composition

from cultures beyond the Western experience, stressing the impact of interaction on an expanded definition of music.

The *Voyager* experience has led me to the notion of a kind of computer music embodying African-American cultural practice. Such music, my own tradition, incorporates improvisation as an important, though not a defining characteristic. Despite the orientation of this paper toward improvisation, an African-American computer music need not exclude nonimprovised work, such as score-following activity. One could easily imagine a future Johnny Hodges interpreting a score translated into the computer medium by a future Duke Ellington.

For example, Thompson (1983) has identified several "ancient African organizing principles of song and dance that crossed the seas from the Old World to the New." Among these are (1) percussive performance style, (2) propensity for multiple meter, and (3) overlapping call and response. Baker (1984) refers to a "blues matrix", a multiply-mediated background in terms of which literary and musical utterance from the African-American perspective may be interpreted.

The African-American composer Olly Wilson (quoted in Floyd 1983) identifies six tendencies characteristic of African-American music-making. These include (1) rhythmic and implied metrical contrast, (2) singing or playing in a percussive manner, (3) antiphonal or call-response activity at several architectonic levels, (4) high density of events in a relatively short time frame, (5) contrasting timbres and (6) physical body motion.

Moreover, bringing epistemological and the ontological speculation into the concert hall is part of the discourse embedded in *Voyager* as a musical experience. I view the performance practice that I have developed for Voyager as part of a process of teaching people how to find order in improvised music, without necessarily transforming the performance space into a classroom. This is consistent with the instrumental dimension or tendency in African musical organization, or what Thompson calls "songs and dances of social allusion." I believe that *Voyager*'s performance possesses these characteristics, but not as top-level goals of the composition. Instead, the cultural milieu from which the work springs can be seen as possessing these characteristics, and Voyager is a part of that matrix.

In the postmodern moment, the virtual and the real are locked in a permanent struggle for power. Sensory icons characteristic of everyday experience form the taking-off point for many virtual experiences that either affirm or deconstruct these icons. For instance, in *Voyager*, the timbres used in the piece reflect my preference for real-world timbres over synthetic, nonreferential ones. In this way I assert my traditionalism, or rather my affinity with popular culture, which for the most part has found abstractly conceived, algorithmically synthesized timbres less appealing than sampled

real-world sounds, as demonstrated by the success of the digital sampler in popular and especially "hip-hop" musical production (see Rose 1994).

Descriptions of the advent of virtual reality, the presumed successor to the merely interactive, often resurrects the Hellenic notion of the uselessness and even the dangerousness of the body that Hal Foster has described (in Foster 1983). If Los Angeles is now deemed too difficult to manage, perhaps a CD-ROM of it will be more tractable, fun, "better" than the real thing. The notion of virtuality explored by Voyager, however, contradicts the idea that computer-driven musical interactivity is primarily about the technical replacement of "real" musicians with their virtual counterparts. Instead of a virtuality that attempts to hegemonize the physical, the goal is one where virtuality and physicality interact to produce a hybrid that strengthens on a human scale. Seen in this light, virtuality should enhance, not interfere, with communication between us.

Conclusion

For me music is a powerful symbolic way of doing philosophy, of doing sociology, of manifesting resistance and presenting alternative models of thought in realms not directly related to music-technical concerns. Far from being non-referential, pure, or abstract, I see my music as taking a direct part in the dialogue about our planetary situation. In *Voyager*, music results as a byproduct of discourse in another realm.

Avoiding scientism on the one hand and anthropomorphism on the other, I don't feel the need to "scientifically" prove the validity of any process I use to get my music to sound the way I want it to sound. I feel utterly free to work in an intuitive way while programming computers to create improvisations. This necessary combination of the utterly logical and the completely intuitive is what attracts me to this kind of work. The aim is to present a glimpse into one way that such pieces might be constructed, not to show how it must be done, or to aver that this program "proves" that this is the way we think about or hear music.

With this in mind, it becomes easier to see that *Voyager* is not really a "work" in the modernist sense — heroic, visionary, unique (Foster 1983). Rather, I choose to explore allegory and metatextuality, the programmatic, the depictive — and through embedded indeterminacy, the contingent. Ultimately, the subject of *Voyager* is not technology or computers at all, but musicality itself.

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