Cybernetic Phenomenology of Music, Embodied Speculative Realism, and Aesthetics-Driven Techné for Spontaneous Audio-Visual Expression

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*Perspectives of New Music*

Vol. 54, No. 1 (Winter 2016), pp. 5-95

Published by: *Perspectives of New Music*

DOI: 10.7757/persnewmusi.54.1.0005


Page Count: 91

**Abstract**

This article deals with the philosophical idea of *worldmaking* pursued through techné, meaning the fusion of the technical means of artistic creation, theorizing, and analysis, but specifically occurring in a feedback loop involving introspection and computation (*cybernetic phenomenology*). The discussion ranges over a wide variety of topics, including (1) the history of music theory from Ancient Greece to the present (including a rebuttal to Daniel Chua’s (2001) account of music history); (2) emergent properties in music arising from *self-organization* (explored through the Ancient Chinese abstract strategy board game *go*); (3) the ontology of musical qualities (properties) and categories (including their relation to visual, tactile, and olfactory qualities and categories).

Various repertoires, artists, and philosophies are referenced. The essay analyzes aspects of Ligeti’s Violin Concerto, Carter’s String Quartet No. 5, and Lachenmann’s *Kinderspiel*. Connections to the author’s own previous analytical and theoretical work are also discussed in relation to his interactive algorithmic audio-visual works (such as *Fluxcations* and *FluxNOISations*). The *techné* of these is discussed in terms of logistics as well as aesthetic influences, including Wagner, Liszt, Stravinsky, Schoenberg, Crawford, Babbitt, Carter, Xenakis, Parker, Reich, Ligeti, Truax, Oliveros, Kandinsky, Miro, Pollock, Hofmann, Rothko, Louis, Frankenthaler, Moholy-Nagy, Newman, Richter, and Brakhage. The essay touches on philosophical ideas of Bergson, Whitehead, Deleuze, Harman, and Bogost, and more fully engages the philosophies of Nelson Goodman and Hannah Arendt in connection with artistic creation as relating to the theorizing and analysis of artistic works.

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THE CONCEPT OF WORLDMAKING AS TECHNÉ is a tantalizing prospect for adventurous or philosophically minded artists and musicians, taking it to mean that the creation of work is the creation of concepts, joining the efforts of theory and praxis in one process (techné), such that the results of our works are the expression of an ontological proposition (worldmaking). It is epistemologically productive while also being a unique expression of freedom, in the sense proposed by philosopher Hannah Arendt (1977, 1998).

My claim to worldmaking as techné is that my work as a music theorist-analyst has always to some extent fed into my compositional and improvisatory musical activities. Technology often plays a role. In my essay (Mailman 2009a) that asserts an imagined drama of
competitive opposition in Elliot Carter’s flute piece *Scrivo in vento* (and comments on its symmetries, quantitative flux, and Heraclitean dimensions), I interpretively analyzed the composition through a narrative lens, such that elements of the music are imagined as inhabiting a turbulent adversarial world akin to that depicted in the Petrarch sonnet that inspired Carter’s composition. Crucial aspects of that analysis involved computational analytic procedures prompted by my hearing, procedures whose output in turn enhanced my experience as a listener and sparked my imagination for interpreting its poetic and philosophic context. Such a cybernetic circle of introspective reception and computational analysis has embedded itself in my musical activities—as well as those of others—to the extent it now seems second nature. There’s no going back.

The feedback process model of artistic practice and reception swims against the tide of the fatuous cliché that artistry is magically inspired *ex nihilo*. I stress this because it is the feedback process aspect of the countervailing view that propels worldmaking as techné. Specifically, the lynchpin connecting recent and ongoing interpretive and creative practices of myself and some others is cybernetic phenomenology, which is both a receptive-perceptive and creative-constructive activity, to be explained further below.¹

Flexibilities of categorization and ontology that arise from cybernetic phenomenology relate to Nelson Goodman’s (1978) theory of world-making, exemplified in his assertion that “worlds differ in the relevant kinds they comprise” (10). New methods for defining and creating enable new relevant kinds to be identified or brought into existence. Thus new worlds are distinguished, or indeed made.

Like artistic works themselves, cybernetic phenomenological activities evolve out of past musical and other creative and interpretive practices. Yet that fact fails to forecast what has already started to happen. The flexibility of early 21st-century technologies is enabling technologically proficient artists to venture beyond what could be foreseen—even by its inspirers, such as the philosopher Henri Bergson. How could it be foreseen that such disparate phenomena as the buoyant color and morphological dynamism of Kandinsky’s paintings, the stimulus saturation of Scriabin’s synesthesia, harmonic palettes ranging from Wagner and Liszt’s to Schoenberg’s, to Varèse’s, to Partch’s, textural fluidities of Xenakis or Truax, or the propulsive processes of Ligeti or Reich, the expressively intricate rhythmic spontaneity of free-jazz improvisation, and the visceral visuality of modern dance could enact and activate each other, not just in some abstract poietic theory, but rather in physically experienced live
spectacles and audio-visual documents? This is beginning to happen, and is yet still only a basis of far greater expressive potential. Much of this present and future artistic activity—a new phase of artistic practice—can be understood, and also further motivated, through a synthesis of cybernetics, process philosophy, and cognitive metaphor (embodied mind) theory—a synthesis I will merely suggest but not undertake fully in this essay.

In the four sections that follow, this essay considers the historical background of techné as worldmaking in regard to music, and how recent and current practices build on, and in some ways transcend, these patterns. The first section, “Music as Worldmaking as Techné,” considers the evolution of music theory as techné and the tradition of music as worldmaking. The twentieth century sets the stage for a new intensified kind of musical inquiry, which contributes to a new technocentric embodied form of artistic inquiry and creativity. Therefore, the second section considers “The Technological Phase of Music Theory and Music Making” at the turn of the 21st century, including the cybernetic phenomenological approach of myself and others. The third section, “Instances of Intermedia, Interactivity, and Comprovisational Worldmaking in Creative Practice,” explores my own intermedia and interactivity creative practices, as evolving from my theorizing and analyzing of past musical repertoires (as well as visual art and dance works). This includes a discussion of comprovisation as well as algorithmic synesthesia. The final section applies cognitive metaphor and embodied mind theory to suggest how worldmaking as techné is a kind of pragmatic speculative realism pursued by forging unconventional embodied experience, for instance through algorithmic synesthesia.

I. MUSIC AS WORLDMAKING AS TECHNÉ

The connection between music and worldmaking as techné is perhaps unobvious. This is because its two binding connections (music-and-techné and music-and-world) are more or less mutually exclusive historically, one more or less displacing the other. Such mutual exclusivity is by no means logically necessary, but rather was a symptom of historical conditions that now hold sway much less. Nevertheless, these historical preconditions to the present situation suggest how the concept of worldmaking as techné seems new, yet also resonates deeply with pre-existing expectations of artistic practices and goals.
A. Music Theory as Technē

1. Music Theory’s Shift from Logos to Technē

The connection of music to technē cannot be taken for granted, as the strength of this connection has fluctuated. At its strongest, it primarily falls under the domain of music theory, but did not always do so. This is complicated by the fact that the definition of music itself has transformed significantly over the last two millennia. Now we tend to assume music as being repertoires of compositions or at least as relating to activities making sounds we hear physically with our ears. Yet this was not always assumed. In the era of the Ancient Greek civilization, it seems musica was less a physical manifestation of aesthetic ideals than an aesthetic ideal itself, especially under the influence of Plato’s neo-Pythagorean dictums. As such, musica was more an ideal than a physical experience, more theory than practice. In this respect it links to what we now call music theory—though it was by no means analogous to the whole of the now more inclusive field of present day music theory. While treatises on musical practice (composition) began to appear in the Middle Ages, the emphasis on music as an ideal to some extent carried forth through the Italian Humanist movement of the fifteenth and sixteenth centuries under the auspices of music theorica, which primarily elaborated the neo-Pythagorean/neo-Platonic paradigm for music (musica), what it is and how it ought to be learned and studied.

Daniel Chua (2001) in his study on “Vincenzo Galilei, Modernity and the Division of Nature” and Elisabeth Pace (2007) in her study on “The Techne of Music Theory and the Epistemic Domain of the (Neo-) Aristotelian Arts of Logos” each consider the evolution of musica (Western music and its theory) in ways different from each other, but each of which is relevant here. Music theory is typically traced back to Pythagoras in the sixth century BC. From that time moving forward it mainly concerns numerical ratios—the approach urged by Plato—rather than any account of how music is or might be heard, or how to compose it. Music sat alongside geometry, astronomy, and arithmetic in the medieval quadrivium. Compositional (praxis) treatises began to appear during the Carolingian period, around 800 AD, as part of Charlemagne’s campaign to unify liturgical practices within his empire; such treatises continued alongside those that treated numerical ratios (theorica) and during the Renaissance period became more formally divided into musica practica (composition and performance) and musica theorica (mathematical proportions and their history).

Pace (2007) contrasts technē with logos, and defines technē as the study of creation of that which could be otherwise (which characterizes
the poetic arts) as opposed to that which is necessarily a certain way (the mathematical arts). The way music can relate arises from doctrines of Pythagorean Platonism as I’ll explain in the next section. In any event Pace pinpoints music theory’s shift toward techné to the publication of Burmeister’s *Musica Poetica* (1606), a treatise that accounts for the artfulness of specific compositions by analyzing how the musical rhetoric of each is created. In this, and through this, music theory’s emphasis on techné increases markedly as music is made *instrumental*, in the sense of being used to effect persuasion; this puts it into the *trivium*, which includes techné. (Whether it’s the seventeenth century or the 21st century, technology of any era extends the instrumentalism of music. This is made even more vivid by Pauline Oliveros’s recent remarks that “every instrument is a prosthesis.”) “In the trivium,” writes Chua, “music becomes human and can be made infinitely malleable by the power of rhetorical persuasion” (2001, 21). In its new techné guise, as Pace explains, “music does not simply reproduce what is given in nature. Rather it avails itself of the properties of sound and the ability of the human mind to cognitively manipulate and construe objects of thought, all for the purpose of producing something *art-ful*, something that goes beyond (and sometimes against) nature in the service of historically fluid aesthetic goals” (2007, 182). Thus, concerned primarily with the techné of conventions of harmony and counterpoint, music theory continues in the seventeenth, eighteenth, and nineteenth centuries; that is, through the time periods of common practice tonality. (It was this period that bore the theories of figured bass, roman numerals, harmonic function, and *Formenlehre*.)

2. **The Performative Turn of Music Analysis and the Instrumentality of Music Theory**

Though it remains techné in the Aristotelian sense defined by Pace (2007), music theory as a discipline shifts its perspective on what its purpose is in regard to such techné. In the twentieth century, music theory becomes *instrumental* to analysis; it becomes an instrument in the service of analysis more than it was previously. Explaining this, Nicolas Cook (2002, 94–95) takes his cue from Schoenberg’s remarks that what we can sensibly aspire to is a “system of presentation—a system—whose clarity is simply clarity of presentation, a system that does not pretend to clarify the ultimate nature of the things presented” (Schoenberg 1922, 10–11). In this passage, says Cook, “Schoenberg spells out . . . the epistemological premise of a great deal of twentieth century music theory. Of particular interest is the suggestion that
analysis should aim not to replicate, in some veridical manner, but rather to complement the immediately perceptible and thus self-evident qualities of the music. . . . Analysis is performative, in the sense that it is designed to modify the perception of music—which in turn implies that its value subsists in the altered experience to which it gives rise.” Thus he remarks that analysis takes a “performative turn” in the early twentieth century, and, as implied by Schoenberg, theories serve as instruments (systems of presentation) for presenting such analyses. That is, music theories becomes more technical apparatuses that are instrumental to analyses of musical works—analyses that are, more than ever before, self-consciously interpretive in that they complement (rather than verify) what is already self-evident. Thus the “performative turn” implies that instead of there being only a single musical theory deemed valid, theories instead are themselves viewed as tools, instruments, apparatuses for different kinds of analyses serving different aims in regard to understanding, unpacking, critiquing, reverse-engineering music; this now puts the music theorist-analyst (now equipped with her own array of analytical techné apparatuses) alongside the composer-theorist as a practitioner of phronesis (the art of deciding how to implement techné). 4 In a sense (to be explained further in the next section), this puts the composer-theorist or theorist-analyst into the ontologically proactive position of worldmaking, with regard to the reception of each musical work or repertoire. But the ontological aspect of music theorizing extends yet more pervasively than that, both before and after the turn of the twentieth century, and in ways very significant to present and future worldmaking as techné.

3. *Music theory’s quantitative-computational proactive ontology*

Though it often focuses on pre-existing musical works or repertoires, music theorizing is ontologically proactive in the sense of positing new objects of thought and typically new systems of thought, and so is worldmaking, in Nelson Goodman’s (1978, 6–7) sense:

Worldmaking as we know it always starts from worlds already on hand; the making is remaking. . . . Much but by no means all worldmaking consists of taking apart and putting together, often conjointly: on the one hand, of dividing wholes into parts and partitioning kinds into subsequences, analyzing complexes into component features, drawing distinctions; on the other hand, of composing wholes and kinds out of parts and members and subclasses, combining features into complexes, and making connections.
Insofar as ontology is concerned, music theory, as techné, has always engaged in ontological acts in that it names and categorizes new kinds of events (intervals, chords, dissonances, etc.), procedures, forms, and to some extent properties as well (syncopation and dissonance can be viewed as qualities as well as events). As mentioned above, and elaborated on more below, the technology of a theory can enable new methods of definition and creation; thus analysis, theory, and composition intimately connect techné to worldmaking. This itself explains and justifies the role of the composer-theorist, a tradition that can be traced back to Hucbald in the ninth century, and includes Guido of Arezzo in the eleventh century, Rameau in the eighteenth century, and Schoenberg, Babbitt, Xenakis, and countless others in the twentieth.

Particularly striking examples are Rameau in the eighteenth century and Weber in the nineteenth, as explained by Jairo Moreno (2004). Rameau posits *fundamental bass* tones and implied dissonances; Weber posits *roman numerals* as representing a listener’s hypothetical hearing of chords in a stream of sound, each as relating to a contextually established tonic pitch. As Moreno explains, these theories (when compared to those of the sixteenth century—Zarlino’s, for instance) exemplify an evolution of the concept of listener-subject (*noesis*), a modern agential listener-subject who both influences and is influenced by theoretical representations of his hearing. Within this feedback-oriented tradition, composer-theorists have been significantly engaged in ontological acts, of three kinds: (1) positing new musical properties and entities based on listening and interpretive-analysis of previously existing works or mere acoustical examples; (2) devising new compositional or improvisational rules, systems, or technologies that manipulate the newly posed properties or entities; and (3) creating new works which directly exploit newly posed properties and entities, or which exploit systems or technologies that do so.

By the standards of our technological age, these ontological acts are somewhat conservative and modest. They share at least one noteworthy feature in common, which makes them relevant to the present situation: they all have a numerical or indeed computational character. In addition to the numerical scale-degree entities theorized by Rameau, Vogler, Weber, and Sechter in the eighteenth and nineteenth centuries, there is the interval-based symbol system of Hermannus Contractus in the eleventh century and David Lewin’s (1987) *generalized interval system* in the late twentieth. In the second category (devising new compositional or improvisational rules, systems, or technologies that manipulate the newly posed properties or entities) we may count Guido of Arezzo’s eleventh-century lookup table for generating pitches
from syllables and Heinichen’s seventeenth-century unfigured bass rubrics. Prior to the twentieth century, however, such system building was primarily retrospective, modeling pre-existing practices.

B. MUSIC MAKING AS WORLDMAKING: FROM ARCADIA TO UTOPIA?

In a sense, music was worldmaking before it was ever techné; that is, when the world was regarded as pre-ordained. As discussed above, Chua (2001), like Pace (2007), sees the late sixteenth-century shift of music from the medieval quadrivium (mathematical knowledge) to the trivium (rhetorical arts) as a pivotal change for music and its theory.

1. PYTHAGOREAN-PLATONIC MUSIC AS WORLD AND WORLD AS MUSIC

Chua also sees the earlier state of music as an equivalence between music and the world: music is the world; the world is music, the true world being its harmony, a configuration of charmed numerical ratios, the Pythagorean-Platonic idealized conception of the world, music, as one supernatural cosmic unity. As Chua explains:

In Plato’s account of creation, music tunes the cosmos according to the Pythagorean ratios and scales the human soul to the same proportions. This enabled the inaudible sounds of the heavens to vibrate within the earthly soul, and conversely, for the audible tones of human music to reflect the celestial spheres, so that heaven and earth could be harmonised within the unity of a well-tuned scale... As the invisible and inaudible harmony of the spheres, music imposed a unity over creation, linking everything along the entire chain of being. When music moves, the earth moves with it. Thus music is not simply an object in a magical world, but the rational agent of enchantment itself. (2001, 22)

As Chua continues, the sixteenth-century transfer of music from the medieval quadrivium to the rhetorical arts of the trivium is part of a drive towards the new (modernity). It entails the surge of instrumental music (which Vincenzo Galilei called the original polyphony), including its compromised tunings. All this entails, by Pythagorean-Platonic standards, an apocalyptic detuning of the world, which is to disenchant the world. In relation to this mythologizing of musica, “instrumental music... is the original sin of modern music. The ‘modern contrapuntists’ may write for voices, but their music is already unsung, because humanity has eaten from the tree of instrumental knowledge, which excludes modernity from the garden of Arcadia” (27). “To
disenchant the world, modernity had to sever the umbilical link of the [Pythagorean tuned] monochord, disconnecting itself from the celestial realms in order to remove music as an explanation of the world” (22–23). Thus music was the world until it was detuned and disenchanted.

2. MUSIC ONTOLOGY, MODERNISM, CREATIVITY, FREEDOM, EMERGENCE
In stark contrast to the present situation, the Pythagorean-Platonic idealized conception of the world, music, as one supernatural cosmic unity (music as world and vice versa), excludes the possibility of multiple musics. There was not a plurality of musical greatness but rather just a singularity: the harmonious perfection—an ideology that went unquestioned through the eighteenth century, and was barely challenged in the wake of Beethoven in the nineteenth.

Yet, once music is considered creative, instead of discovery of pre-existing heavenly truth, music’s techné is drawn into its creativity, inseparable from it. This is another reason why worldmaking as techné runs deep with music, for, as the composer-theorist Robert Morris (2010, 120) puts it, “method and result interpenetrate each other in creative work” and the issue of realist ontology becomes mute. Scientists, ever mindful of Occam’s razor, strive for a lean parsimonious ontology; yet artists are in the business of continuously redefining their own ontologies. As suggested by the process philosophies of Bergson (1911) and Whitehead ([1929] 1978), bringing new entities into existence is creativity by definition. And such creation is precisely the business of artists: using artifice to create.

Of course prior to the twentieth century, when stylistic convention circumscribed creativity, it would be a stretch to say that each creative musician was confecting his own entirely new musical world. The freedom of such total worldmaking comes later with modernism, exemplified in Harry Partch’s new tuning systems and invented instruments and Schoenberg’s development of twelve-tone music—new offshoots of which continue to emerge. System building is often recognized as a distinctive facet of twentieth century musical modernism.

Yet rather than the systems themselves, what I find more relevant to worldmaking are the unconventional (exotic) emergent qualities that such systems give rise to. These qualities, rather than rules themselves, account for the experiential value of such music. Focusing on emergent qualities, rather than rules, has the advantage of being able to relate repertoires that are more or less systematized, or barely systematized at all—the gamut runs wide.

It’s not necessarily self-evident how a set of rules can give rise to qualities recognizable as anything other than the rules themselves. Yet just this has been shown time and again; however, not with music. The
The relation between the rules of musical systems and the audible qualities that emerge from them seems to be more elusive than visual examples of self-organization presented by Mandelbrot and Wolfram, and the various emergent patterning witnessed in the Game of Life and in cellular automata (“gliders” and so forth). It is perhaps more profitable to discuss emergence in a new context that is, I hope, more transparent with regard to musical relevance. Therefore I now present a new demonstration of audible qualities emerging from a relatively simple musical system—that is, a system that exemplifies self-organization rendered in music.

First consider a series of alternations between two chords generated randomly, one pitch at a time. Example 1a shows this series, notated in half notes. (There is also an audio rendition. Heard as a passage of music (for strummed harp), some basic features—call them first order behaviors—immediately stand out: it projects a binary rhythm of alternation (accentuated by the alternating direction of arpeggiation); the density (cardinality) of the chords increases linearly; it’s canonic: once a pitch occurs, it recurs again on the corresponding beat in each subsequent measure, thus new instances of the canonic comes accumulate measure by measure, each echoing the same dux that started it all. All this, however, derives trivially from the alternation of incrementally built-up chords. For the sake of comparison to what is to come next, Example 1b represents (re-notates) the same passage on a tonnetz (tone map), in this case a tonnetz that places F₂ in the bottom left corner and radiates in minor thirds across (F₂, G♯₂, B₂, etc.) and major thirds upward (F₂, A₂, C♯₃, etc.). Black and white circles represent the notes of the strong-beat versus weak-beat chords.

Example 2a shows a musical passage having the same first-order behaviors (alternating content, increasing density, and cumulative pitch recurrence) but whose pitches are not generated randomly. Instead, the pitches are generated by playing the ancient Chinese two-player board-game Go, a game rich in strategy but which has relatively simple rules. Here a 7 × 7 tonnetz is interpreted as a Go board (goban) and the incremental note-by-note build-up of alternating chords is generated directly from the successive plays (placement of pieces) by the two opposing players, in this case me (black) playing against computer software (white). In the game, players alternate placing pieces (stones) in order to cordon off a greater open area (as compared to the opponent’s) while minimizing the number of pieces that are captured (by being directly surrounded by opponent pieces). As with any other strategic game, experienced players develop tactics and strategies optimized for winning. Example 2b shows the successive moves of the Go game aligned with the musical passage it generates.
Returning to the musical passage itself, in Example 2a, I draw your attention to a number of qualities strongly affecting its sound as it is heard, but none of which are direct consequences of the rules of the game that generated them. Call these second order behaviors:

i. At first the range is neither very narrow, nor very wide

ii. The range gradually widens; it also keeps filling in: it balances widening with filling in.

iii. As it progresses, the proportion of major and minor thirds (as compared to other intervals) within each chord increases noticeably.

iv. From one chord to the next, there are a great many notes and subsets that transpose by a major or minor third. Thus a major/minor third transposition oscillation quality tends to dominate.

v. [012] clusters (chromatic clusters) are virtually absent from chords.

Looking again at Example 1a, notice that none of these features (i–v) obtains in that randomly generated musical passage. The random passage exhausts almost the full range immediately, using the rest of the time merely to fill it in; it fills the space in an uneven clumpy fashion that has no particular intervallic preponderance; the notes of the downbeat and upbeat chords do not tend to relate by any close transposition; there are three [012] cluster subsets among the two chords by the end of the passage. The effect is somewhat jarring, having little continuity other than the de facto alternating accumulating pattern.

By contrast, the opposite features (i–v) in Example 2 create a distinctively smooth sound with its own particular atmosphere; not quite “tonal” in the usual sense, but yet quasi-triadic and reminiscent of Benjamin Britten’s music, for instance. This quality emerges from the optimal playing strategy employed by the two opponents, which is to build up, using as few pieces as possible, a wall as close as possible up against the other opponent’s emerging wall. Example 3 shows another example of music generated from a played-out game of Go. Notice it sounds much more like the music of Example 2 rather than like the random music of Example 1, and in fact shares the same features (i–v) that the Example 2 music has.
EXAMPLE 1A: ACCUMULATING ALTERNATING CHORDS RANDOMLY GENERATED. NOTATED ON A GRAND STAFF (SCORED FOR HARPS)
EXAMPLE 1B: ACCUMULATING ALTERNATING CHORDS RANDOMLY GENERATED. NOTATED ON A TONNETZ (DOWNBEAT TONES: BLACK; UPBEAT TONES: WHITE)
EXAMPLE 2A: ACCUMULATING ALTERNATING CHORDS
GENERATED WITH SELF-ORGANIZATION
(A GAME OF GO: GAME 1)
NOTATED ON A GRAND STAFF (SCORED FOR HARP)
EXAMPLE 2B: ACCUMULATING ALTERNATING CHORDS
GENERATED WITH SELF-ORGANIZATION
(A GAME OF GO: GAME 1)
NOTATED ON A TONNETZ (DOWNBEAT TONES: BLACK; UPBEAT TONES: WHITE)
EXAMPLE 3A: ACCUMULATING ALTERNATING CHORDS
GENERATED WITH SELF-ORGANIZATION
(A GAME OF GO: GAME 2)
NOTATED ON A GRAND STAFF (SCORED FOR HARP)
EXAMPLE 3B: ACCUMULATING ALTERNATING CHORDS
GENERATED WITH SELF-ORGANIZATION
(A GAME OF GO: GAME 2)
NOTATED ON A TONNETZ (DOWNBEAT TONES: BLACK; UPBEAT TONES: WHITE)
These features are not the rules—in fact they are more nuanced and intriguing than rules are—but rather are a consequence of what may happen when playing by the rules, or, putting it differently: these are tendencies and possibilities that distinctly characterize what plays out in the world constructed by the stipulated rules; these qualities emerge from the negotiation between goals and constraints. Unanticipated qualities emerge from any rule system of sufficient complexity, once activated. It is generally these qualities, rather than their rule-system source, that draw aesthetic fascination. Therefore, these qualities, once recognized, may then form the basis for yet another rule system, and so forth, in a perpetual semiotic-evolutionary chain of influence.

A few more words about emergence in this context: At a certain point the running of a computational or evolutionary process may suddenly produce a novel property—a sort of ontological eureka!; this is called diachronic emergence (Humphreys 2008). Yet in the passages of Examples 2 and 3, the qualities discussed are instead emergent in the sense that they are holistic qualities, qualities of the whole configuration (or a significantly large subset of it). That is, rather than being qualities of basic parts (pitch, duration, loudness of individual notes) these qualities instead emerge at a higher level of temporal experience, at a broader time scale. Such qualities are analogous to heat, humidity, and pressure, and are deemed synchronic emergent qualities (Humphreys 2008), since their emergence is not associated with a point in time or chronology. For the remainder of this essay assume synchronic emergent qualities, except where noted otherwise.

As I have explained previously (Mailman 2009b, 2010a, 2010b, 2010c, 2011a, 2012a), in temporal experiences such as music, perception of such synchronic emergent qualities usually entails some duration of time; awareness of such qualities is not necessarily immediate. Also they are not transparent; and furthermore being affected by such emergent qualities often does not entail knowledge or conscious awareness of the generative principles or rules from which, indirectly, they emerge. For instance, in an empirical study on music memory and cognition, Krumhansl (1991) presented listeners with excerpts from Messiaen’s *Mode de valeurs et d’intensités*, [A piece] written according to a unique compositional principle that rigidly couples values of pitch (chroma and octave), duration, and dynamics. Listeners heard test excerpts, which were judged in terms of whether or not they might have come from the piece (either from the part they had heard or from the remainder of the piece). Even in the first block of trials, listeners were able to recognize
segments from the part of the piece they had heard, suggesting surprisingly accurate memory for surface characteristics. Listeners were also able to generalize to the rest of the piece, accurately judging segments from the part of the piece they had not heard. (Krumhansl 1991, 401)

Another example is the work of visual artist-programmer Casey Reas, one of the two originators of Processing, the open-source programming language and environment for creating images, animation, and interaction. His algorithmically generated art works are made by defining an “element” as a “form” (a visual shape) and “one or more behaviors.” Though each of his generative art works has distinctive emergent qualities, the forms and behaviors from which they are generated are much less obvious.

In music, especially music such as classical Western art music of the seventeenth, eighteenth, and nineteenth centuries, much of the distinctive sound that typically orients listeners emerges out of conventional practices and may therefore be deemed conventional emergent properties. Examples are tonality and meter, each of which arises out of configurations of more basic properties of pitch and duration, for instance. Emergent properties, however, need not be conventional, and indeed need not even have pre-existing names, as I have shown previously (Mailman 2009b, 2010a, 2010b, 2010c, 2011a, 2011b, 2012b). The unconventional nature of modernist music, whether based on an explicit new system or not, typically brings forth unconventional emergent qualities, such as those in the tonnetz-Go generated music of Examples 2 and 3 (properties i–v). Such unconventional (exotic) emergent properties as found outside common practice repertoire deserve extensive study on their own accord, some of which is discussed in the next section.

One further note about emergence, also explored in the next section: The emergent properties such as tonality and meter, as well as properties i–v of the tonnetz-Go music discussed above, are basically conceived or experienced in a static way: they are present or absent. Yet this need not be the case. As I’ve shown (Mailman 2009b, 2010a, 2010b, 2010c, 2011a, 2011b, 2012b) an emergent property may also act dynamically. That is, during a duration of time, it may obtain to a varying degree. It’s not so much that the presence versus absence of the property can be fuzzy (although this could be as well), but rather that the intensity of the property itself may fluctuate.
II. THE TECHNOLOGICAL PHASE OF MUSIC THEORY AND MUSIC MAKING

The performative turn that makes music theories instrumental to music analysis evolves to a new stage by the end of the twentieth century. It synthesizes with another intermittent facet of twentieth century music theory and analysis: phenomenology, and started to do so in a way that begins to address the issues of studying unconventional music, including its emergent qualities.

A. PHENOMENOLOGY, QUALITIES, AND ONTOLOGY OF WORLDS

Phenomenology (inquiry through introspection on one’s own conscious experience), named by Hegel in the nineteenth century, got underway in the writings of Husserl (1913, 1964) in the early twentieth. Less well known is that in those early decades it was immediately taken up explicitly as an orientation for music analysis by, for instance, Ernst Kurth and Hans Mersmann (Rothfarb 2002)—though to some extent phenomenology aptly describes the working methods of previous music theorists, such as Rameau and Weber discussed above. By the 1980s, phenomenology was pursued again as an explicit engine of music analysis, by Clifton (1983) and Lewin (1986).

Lewin also further theorized music phenomenology by developing computational tools for sharpening its presentation and extending its technical reach. Specifically, Lewin (1981) developed a running vector, which is used to trace the competing prevalence of different pulse streams in Schoenberg’s piece for piano op. 19, no. 6. Lewin (1987) later applies the running vector to track the competing prevalence of different rhythmic motivic cells in a Brahms piano ballade. This happens to resonate with Mersmann’s (1922–1923) running comparison of two opposing melodic motives in a Haydn sonata; but Lewin uses computational precision to focus the phenomenological orientation. In the 1990s, such introspection-fueled computational cognitive modeling re-emerged in regard to yet other musical features: accent of climax in Roeder’s “A Calculus of Accent” (1994) and melodic contour similarity in Quinn’s “Fuzzy Extensions to the Theory of Contour” (1997). In all these cases the computational models were inspired by the author’s music listening experience. The qualities (pulse, accent, and melodic similarity), modeled through these innovative methods, each already has its own prior status (is already named) in the music theoretical lexicon, and are in this sense conventional, even though Lewin, Roeder, and Quinn demonstrate them in such unconventional repertoire as Schoenberg, Carter, Xenakis, Ligeti, and Reich.
In other words these are qualities (or models of qualities) that were already known to be relevant kinds of things in more conventional repertoire. Yet such repertoire as Schoenberg, Carter, Xenakis, Ligeti, and Reich need not consist only of the same relevant kinds of things as more conventional repertoire. They may be notated with the same old kinds of symbols and sonified in the same old kinds of acoustic signals (as the music of Bach, Beethoven, and Brahms, for instance) but there’s a world of difference to the sound and flow of the music of Schoenberg, Carter, Xenakis, Ligeti, and Reich, without the awareness of which, we would experience it as incoherent or dull. As Goodman (1978, 9–10) remarks: “Worlds differ in the relevant kinds they comprise. . . . A world may be unmanageably heterogeneous or unbearably monotonous according to how events are sorted into kinds.” I should emphasize may, because there is often enough ontological overlap between worlds such that we can make our way in one (a less familiar one) even while relying on the ontology of another (a more familiar one), especially if the categories of the ontology are generalized beyond their original context. This might be said about pulse, accent, and melodic similarity in regard to Lewin’s, Roeder’s, and Quinn’s work in relation to Schoenberg, Carter, Xenakis, Ligeti, and Reich.

Goodman (10) further elaborates this in a direction I wish to pursue:

While we might say that . . . some relevant kinds of one world are missing from another, we might perhaps better say that the two worlds contain just the same classes sorted differently into relevant and irrelevant kinds. Some relevant kinds of the one world, rather than being absent from the other, are present as irrelevant kinds; some differences among worlds are not so much in entities comprised as in emphasis or accent, and these differences are no less consequential.

Such issues of epistemology and ontology are sharpened by considering how various visual pattern recognition classification strategies are developed, for instance as explored through Bongard problems (Bongard 1970). As Ignazio Licata and Gianfranco Minati (2010) describe them:

Bongard presented one hundred problems. Each problem consists of twelve figures subdivided per six classes of two. The problem relates to finding what differentiates classes and what the figures of the same class share in common. They are very interesting and fascinating problems, because different solutions are possible depending on which description level is assumed. Each problem has its specificity, but all the problems, as they are solved, can display
background correlations which could be said [to contribute to] “The Bongard’s World Theory of Everything.” (2010, 4)

Two sets of Bongard squares are shown in Example 4. The images can be grouped and differentiated in various ways. Yet relevance depends on the goal, which in this case is to find a rule that unifies the six images on the left but excludes those on the right. For Example 4a we might focus the direction of the internal trajectory of the curved and angularized spirals, whereas in the world of Example 4b we might attend to which shapes are inside which other shapes.

Of course relevance is not usually just a binary choice, but is often usefully relativized. For instance, this can be stated in terms of color categories. As compared to green and blue, glaucous is perhaps a less relevant color category in our world (hence it is an obscure word rather than a standard one), but another world could be fashioned in which it is exactly the other way around, a world that contrasts with our own in that the areas on the cusps between our standard categories are emphasized at the expense of what are our standard categories. As Goodman remarks, some of the most striking contrasts of this sort are forged in the arts. Sure, we might favor a conservative or parsimonious approach to ontology, for reasons of pedagogy or to aspire to incremental “normal science,” but this may conflict with our ability to identify or cultivate awareness of what is most intriguing in the unconventional repertoire we are analyzing, or theorizing, repertoire that seems to inhabit or forge new worlds of experience. I sense the hindering effect of these ontological constraints particularly when moving beyond the note-to-note actions of these works (which, after all, are conditioned by the standard notation for acoustic instruments) to, rather, the unconventional long- and medium-range flows we experience, or may experience, as we hear them, their peculiar ways of projecting “form from the ‘comprehensive continuum,’” to use Adorno’s (1998, 197) phrase.

My own work demonstrates that, in such unconventional repertoire as this, long-range and medium-range form can arise from flux of intensity of one or more emergent properties, properties emerging in the hearing of the flowing surface of the music (Mailman 2009b, 2009c, 2010a, 2010b, 2010c, 2011a, 2011b, 2012b). Form in music is traditionally conceived in static (structural, four-square architectural) terms as crisp sections or segments as akin to the parts of a traditional building or other structure (2009b, 2010d); call that sectional, structural, or architectural form. Form from flux therefore is distinguished as dynamic form,14 which is form from flux of intensity as music elapses in time; and usually this is the flux of an emergent property.
TWO SETS OF BONGARD SQUARES IMAGES ON THE LEFT VS. RIGHT TO BE GROUPED (UNIFIED) AND DIFFERENTIATED (PARTITIONED) ACCORDING TO VARIOUS RULES

EXAMPLE 4A: LOOK FOR INTERNAL TRAJECTORIES

EXAMPLE 4B: LOOK FOR SHAPES INSIDE SHAPES
B. EMERGENCE AND EMERGENT PROPERTIES (QUALITIES)

Now, with their form-projecting role in view, it’s appropriate to consider (synchronic) emergent properties in more depth. By emergent properties (synchronic emergent properties or qualities) I mean something like what the philosopher John Locke distinguished as “secondary qualities”: those higher-level properties (macro-properties) that emerge from lower-level properties or configurations of lower-level constituent elements.\(^{15}\) Though merely a dictionary definition, the notion of emergence suggests a “process of coming forth, issuing from concealment, obscurity, or confinement.”\(^{16}\) There is often a sense in music that, as written (or preconceived) notes are animated in sound and in time, a sort of centrifugal force (or momentum) brings forth higher-level qualities not otherwise present. It is my claim that such higher-level properties (macro-qualities, secondary qualities) in music are indeed novel, in that they are new to this animated (higher-level) context, and are thus emergent, in some way or another, when taking into account the diverse ways we relate to music, including various modes of listening.

Take for example even the fairly mundane property temporal density (interonset density). How is it emergent? Consider how it presents new features that don’t exist at the lower level of its constituents. These properties are not merely resultants of properties of the lower-level consistent elements. To a listener, higher degrees of temporal density may prompt: (1) confusion of detail (a negative capability that enables other qualities to surface); (2) perceptual fusion or blurring (another negative capability that enables other qualities to surface); (3) a feeling of the sublime, of being overwhelmed: an affect arising from the previously listed qualities. Of course the sensations mentioned are not merely present or not, but rather depend on the intensity, the amount, or degree of temporal density (interonset density), which typically is not static but rather fluctuates. To the extent such properties do obtain at any given time, these are novel properties that do not exist at the level of individual notes that might be scrutinized in a musical score when time is stopped. Of course the degree (the intensity) of temporal density can be computed in terms of (it supervenes on) lower-level information (“basal conditions”), but the novel causal effects of it—the confusion, fusion, blurring, and sublimity, and so forth—which are experienced in the moment of hearing (the animated context), are not so reducible or predictable, and in this sense “transcend” the properties of the constituent elements. Computation of the quantitative amount of temporal density in a particular duration of time is, in a sense, merely resultant. Yet what warrants its distinction (from individualized attention to events) is some awareness of qualitatively different kinds of experiences it causes.\(^{17}\)
Thus emergence is *phenomenal*; it is not a feature manifested in the unperformed score, but rather is relative to observation, as the music is heard (or imagined) as elapsing (animated) in time. To clarify what I mean by this I’d like to focus, for a moment, on the more material oriented view of emergence advanced by Deleuze and Guattari (1987, 40) in their discussion of the Earth as a deterritorialized body without organs permeated by transitory particles. The self-organizing (sorting) processes these undergo, which Deleuze and Guattari call *machinic phylum*, are what give rise to properties we experience in the world. As Robin Parmar (2014, 10) explains it (quoting Manuel De Landa):

Consider as an example how sedimentary rock is formed, by “a ‘double articulation’ [that] transforms structures on one scale into structures on another scale” [De Landa, 1997, 62]. We start with a “multiplicity of pebbles of heterogeneous qualities,” eroded from mountains and carried downhill by water flows [60]. Rivers act as hydraulic computers, sorting out the pebbles into different sizes and shapes. (Remember that according to Turing all computations can be reduced to sorting exercises. Thus it is not an analogy to say that a river is a computer; it is a literal truth.) These pebbles are deposited on the sea bed and at different places along the alluvial flow. Then, “a second operation is necessary to transform these loose collections of pebbles into a larger-scale entity: sedimentary rock. This operation consists of cementing the sorted components together into a new entity with emergent properties of its own, that is, properties such as overall strength and permeability which cannot be ascribed to the sum of the individual pebbles” [60].

De Landa goes on to find similar processes in organic realms, notably the process of evolution in which genetic material is sorted and reconstituted into new forms [having novel properties].

My comment is that it is only because of our perspective that these could be considered distinct properties and be considered new. We have a perspective that treats things differently at different scales (and indeed is only able to observe a limited range of scales in space and in time), so when something occurs at a certain macro level we are able to acknowledge it having properties at that level; for instance, permeability. At the microscopic atomic level there is never any such permeability, but merely differences of configuration that only differ in degree (not kind) from configurations obtaining when the macro state is not permeable (or less permeable). It is for reasons like this that
emergence is inherently relative, in the sense of being phenomenal. Emergent properties such as overall strength or permeability, ostensibly properties of the matter, are phenomenal, depending, as it were, on the situatedness, disposition, and capabilities of an observer, who is able to distinguish “levels” of description because of witnessing phenomena from an appropriate scale or granularity, a scale or granularity from which there are appropriate distinctions of obscurity versus clarity and concealment versus transparency. For instance, for a creature of sufficiently small size, there might be no perspective from which a supposedly novel property could be observed; there would be no “issuing from concealment.” The condition of being concealed or obscured is observer dependent. For there to be a higher-level property (notably absent from lower levels), there must be a higher-level witnessing.

In regard to music specifically, the philosopher Luis Felipe Oliveira (2014, 25) asserts that “the very relationship between listener and work can be understood and described as a self-organized dynamic system,” with the significant possibilities of emergent properties arising from this coupling, which suggests that self-organization cannot be accounted for without including the observer. Or as Putnam (1979, 603–04) more generally characterizes it “there is, for Goodman as for late Wittgenstein, no sharp line to be drawn between the character of the experience and the description given by the subject.” Putnam goes on:

Experiential data, as Goodman points out in his discussion of apparent motion, are themselves doubly the result of construction and interpretation: construction by the brain itself, and construal through the need of the subject to use language and public concepts to report and even grasp what he “sees.” Comparison of theory with experience is not comparison with unconceptualized reality, even if some positivists once thought it was. It is comparison of one or another version with the version we take to be “experience” in the given context. (611)

Thus we should acknowledge that any such deference whatsoever to experiential data (to phenomenal properties, such as emergence) is somehow a nod to constructivist epistemology à la Piaget (1967). In regard to interpreting a text, the constructive role of the reader has been characterized by Boretz (1977, 104) as creating semantic fusion.18

In fact the constructivist role of the observer has more recently been taken up by Licata and Minati (2010) specifically in regard to emergence, “mesoscopic variables,” and creativity in modeling. “Creativity is conceived as the ability to [prompt the] emerging [of] unusual cognitive strategies to deal with the complexity of the relation
observer-observed” (2). As they explain, the most diverse, most preva-
ient, and perhaps most relevant kind of emergence is “intrinsic or
radical emergence, [instances of which are] non describable by a single
formal model because of the dynamical complexity of interactions
between system and environment” (2). As they continue:

The problem of . . . describing creativity finds its proper formul-
ation within the approach to emergence. In particular, the key
question is: once a process of intrinsic emergence—unforeseeable
on the basis of any available model—has occurred, how can we
analyze it, even partially, by computational tools? (Licata and
Minati 2010, 3; citing Licata 2008)

Rather than a deterministic path to modeling that might be assumed
(involving purely deduction or induction), their characterization
emphasizes abduction: “Mesoscopic state variables are invented by the
observer in a constructivist manner . . .” (Minati and Licata 2013).

The constructivist role of the observer is considered creative as it
relates to neither non-linear replication [diachronic emergence] nor
[merely] transposition of levels of description and models used
for artificial systems, like reductionism. Creativity rather lies in
inventing new mesoscopic variables able to identify coherent pat-
tens in complex systems. As it is known, mesoscopic variables rep-
resent partial macroscopic properties of a system by using some of
the microscopic degrees of freedom possessed by [its constituent]
elements. Such partial usage of microscopic as well as macroscopic
properties allows a kind of Gestaltian continuity and imitation
between levels of descriptions for mesoscopic modeling. (Licata
and Minati 2010, 1)

Although I would not claim their depiction of modeling of physical
phenomena in general exactly matches our approaches for analyzing
emergent flux in music, there is certainly a strong analogy, especially
encapsulated in their further remark that “configurations we detect in
the world are a homeo-cognitive ‘compromise’ between mind and
world” (4). Thus we find that emergent properties we are most inter-
est in are a hybrid between observation and creation.

As Putnam (1979, 603) says “the phenomenal has many equally valid
descriptions.” Consider that new music continues to be discovered and
created, often prompting new phenomenal descriptions. Yet moreover,
because emergent qualities are a hybrid between observation and
creation, it stands to reason that there are an indefinite number of such
fluctuating emergent properties in (or of, or from) music.
During the time it is experienced, a synchronic emergent property is a continuous *issuing forth from concealment*—even as its intensity may fluctuate. Yet we can also speak of how or when each such property issues forth for the first time ever, especially as they are partly *created*. In one sense such properties emerge when the music is initially composed, improvised, or performed. Yet in another sense they emerge when they are for the first time experienced (for instance, by a listener), but in yet another sense they emerge when they are formally (systematically) defined (such that they can be later recognized, deployed, or taught). So wherefore the emergence? Exactly *where* (or when) one senses this emergence is taking place depends on whether one is taking the point of view of the casual concertgoer, the score-reading analyst, the composer, a software programmer, a psychologist, a historian, and so forth. Thus the locus or loci of emergence is relative to one’s relationship or stance toward the music. Even the acknowledgment of emergence is so relative: one may find that what seems emergent to a listener in the fleeting moment can be found to be merely additive, resultant, supervenient, or reducible when subject to analysis out of time (the non-animated context). Each application of the term (or concept) “emergence” involves a shift of perspective, because things assumed to be always either objective and transparent, of subjective and ineffable, are instead regarded as neither of these, but rather as crossing between. This is a productive point of view, because it suggests a way of crossing an apparent chasm. Yet the question of exactly how or when an emergent quality emerges for the first time (its locus of emergence) is relative to one’s observational disposition.

C. THE EMERGENCE, REIFICATION, AND RESIDUE OF FEEDBACK

What is definite, however, is that if at some point in the past, the quality did not exist (was not manifested in music) prior to human musical activities, and then at some point later it is actually defined formally (systematically) such that new instances can be identified, or gauged, then the property can be said to have emerged (diachronic emergence begetting synchronic emergence), in the sense of *coming forth*, through some or other music activity, even if where and how are still open to question. A follow-up question might be to ask why bother making assertions of emergence if or when such assertions sometimes fail to pinpoint the origin or author of the property (its locus of emergence). My answer is that asserting emergence in music focuses attention on—so we don’t take it for granted—the fact that not only new art works (compositions) are being created (coming into
existence), but also new properties, which persist beyond (are exportable from) the work in which (through which) they were born, and so are world-defining (or world-expanding). Moreover not just the composers (or improvisers) are responsible for this world-expanding creative activity, but also so are the creative observers (theorist-analysts) who choose to think about and articulate what they are experiencing.

Among the indefinite number of fluctuating emergent qualities in music, some may be familiar, such as temporal density; for others I’ve invented metaphorical names, such as viscosity, hesitancy, smoothness, freshness, permeation, durational diversity, interonset volatility, and textural incline of pitch, each of which corresponds to a precise but flexible quantitative model. All these are shown to fluctuate in specific musical works already composed; yet typically they are not explicitly named or identified by their composers. The properties may emerge from enacting rules, as in the tonnetz-Go music above, but are not necessarily asserted by the rules, by the system, or by the composer who made them.

To consider emergence (emergent properties) in the artworks brings us into somewhat new, unknown territory for the simple reason that previous theorizing about emergence has focused on situations where we are observing the results (the effects, the properties, the qualities) of a natural complex system or of an artificial complex system designed to imitate a natural one. In such situations we either (1) can’t influence the design or initial conditions of the system (as in complex systems of nature), or (2) are interested in adjusting the design of an artificial system or its initial conditions primarily to emulate emergent properties already known from nature (for instance, self-similar morphology, flocking behavior, or consciousness). Yet artworks are human-made but creative, not just imitative. The artist may design, configure, or adjust a system in view of a particular imagined novel outcome; that is, in order to achieve or refine a certain anticipated emergent result that perhaps never happened before, and that therefore has never even been named. Hence techné is developed or refined in an adventurous what-if scenario, where the “what-if” can be a specific anticipated emergent property (or more likely an optimization of an ensemble of emergent properties, perhaps some stable and others fluctuating).

Thus, just as with listening, analysis, and theorizing of music, so also in composition, and improvisation, there are feedback processes which entail one of the touchstone features of both emergence and cybernetics, namely downward causation, which is higher-level events regulating lower-level ones (Campbell 1974); for instance, physical events being indirectly caused (or influenced) by mental events. Other examples are when evolutionary pressures of the environment affect
gene expression, or when an organism chooses behaviors to adapt to its environment, thereby indirectly influencing the micro-details of the environment.\textsuperscript{21} The important point, however, is that these feedback processes serve a different purpose in the artistic situation than they do in more typical instances of emergence. In the artistic situation the feedback processes are regulating toward (adaptive toward) an individualized novel outcome willed by the artist (in the case of composing) or negotiated by the theorist-analyst (negotiating between the facts in the score, his or her phenomenology of listening, as well as his or her own creative-intellectual inclinations).

An example of such feedback processes (including downward causation) in composition is the development of korvai in Carnatic music, whose relevance to this discussion I was recently reminded of.\textsuperscript{22} A korvai is a cadential rhythmic procedure involving the repetition of a rhythmic pattern at a systematically increasing pulse rate, forging an intricate interaction of beats and subdivisions (micropulses) that create hierarchically nested repetitions as well as a longer range process of acceleration designed to terminate on a particular prescribed beat in the future, and does all this while also maintaining a slow and steady underlying pulse. Also emerging from this are various syncopations, cross-pulsations, and other polyrhythmic artifacts, which differ depending on the particular design of the korvai (how the system is set up). When listening to a korvai, one experiences not only the steady underlying pulse and the predictable gradual acceleration and build-up of tension (or exhilaration), but also a uniquely variegated lively interplay that carries forth this process. To complete a korvai, the composer may have to shuttle back and forth between the micro-detail level and the macro-tension flux level, with the results each time feeding back into each other, until the overall results are satisfying. In such cases, a small-scale structural feature may be selected in order that a specific macro feature emerges when the system (the korvai in this case) is enacted.\textsuperscript{23} From the point of view of listener phenomenology, the stable and fluctuating holistic features emerge from the micro-details, but procedurally and conceptually the micro-details emerge from the desired holistic results, which may be highly individualized while also addressing aesthetic norms. The causation is bidirectional in a fashion that is peculiar to creative-artistic endeavors and therefore should influence our consideration of emergence in art works.

Another example which was recently brought to my attention is Lachenmann’s composition “Schattentanz” from his piano suite \textit{Ein Kinderspiel} (1980), which is described thus:\textsuperscript{24}
The pianist plays percussive rhythms in 12/8 using the two highest notes of the piano together, while at various times the lowest octave of strings are depressed silently or the pedal is engaged, allowing the “shadows” of the high pitches to resonate. The result is a highly constrained, ghostly exploration of the physical and acoustic construction of the piano. The pianist is not allowed to play any other notes in the normal manner, but by resonating the broadband noise contained in the transient attacks, the entire range of the instrument, the wood of its soundboard, the hardness of the hammers, and the operation of pedal mechanism are all revealed. From a first-time listener’s point of view, this “exploratory resonance” is as clear a case of an emergent property as one could hope for: the listener hears the high notes as the primary “composed” part of the piece, and slowly they come to be aware of the entire sound of the piano through the resonant “shadows” which emerge as a consequence. Compositionally, however, one could make a case that this resonance is in fact the primary compositional goal, and therefore he was forced to write the piece using the extremes of register. We can imagine the composer beginning with a concrete timbre in mind, or even an abstract timbral concept, and through trial and error the content of the piece emerging directly from the timbral constraints.25

I would add, however, that, a first-time listener might entirely miss some of this, for failing to know what to listen for, and is likely to benefit from some guidance in this regard. Yet another listener, perhaps one who is routinely engaged in composing, improvising, making sound art, or in modeling any or all of these, may, in some instances, be able to take Lachenmann’s composition as a mere prompt or stimulus for developing another composition, or an interactive system, or formalized approach to analyzing and listening to further instances of similar music, pre-existing or yet to be composed. In this sense, there is apparently wiggle-room as between intention, actualization, reception, and imaginative response, which together exemplify how awareness of emergent properties is a hybrid of observation and creation, as discussed above. In the examples just discussed, the composers did not discursively name or model the emergent qualities that seem so significant. And I don’t think the verbal descriptions I’ve offered do justice to their experiential specificity. Yet we need not leave it at that, staring—as it were—into a chasm. As I described above, the act of precisely defining such properties is sometimes left to the music theorist-analyst, who forges an appreciative aesthetic-receptive world for the music by means of music-analytic techné.
D. ANALYSES OF CARTER AND LIGETI

1. FORM-BEARING EMERGENT FLUX IN CARTER’S QUARTET NO. 5, MOV. 10

For instance, consider Elliott Carter’s Quartet no. 5. We can both gain and guide aesthetic experience of it by attempting to model one of its fluctuating emergent properties. The quartet’s tenth movement presents the four string instruments each proceeding at its own steady pulse; a four-part polyrhythm results. A flux of interonset intervals (IOI) arises from the interference pattern of the incommensurate pulse streams of the four instruments as shown in the interonset graph of Example 5.26 The flux itself serves as a vessel of form for the piece and is modeled as a qualitative intensity called InterOnsetVolatility (a.k.a.: TemporalClumpiness or RhythmicVolatility). To model this, let \( E_t \) denote the set of events that start at time \( t \), and correspondingly \( t_E \) is the time of this occasion \( E \). (Either \( E_t \) or its time \( t \) could be referred to as an occasion.) The interonset interval leading up to occasion \( E \) is the difference between its time and that of the preceding occasion; thus,

\[
\text{InterOnsetInterval}(E) = t_E - t_{\text{predecessor}(E)}. \tag{1}
\]

Now define InterOnsetVolatility as the standard deviation of these interonset intervals for each occasion \( E \) in the span \( S \).

\[
\text{InterOnsetVolatility}(S) = \text{Volatility}(S) = \text{StDev}(\text{InterOnsetIntervals}(E) : E \in S) \tag{2}
\]

The flux of the InterOnsetVolatility itself can be tracked as it changes over the course of the whole quartet movement. Since this is a quartet, the interonset volatility is computed for spans \( S \) each consisting of four consecutive occasions. The result is the dynamic form graph shown in Example 6, which includes timings from the Arditti Quartet’s recording.

As an offshoot of this computational modeling, I have developed sensor-controlled algorithms (implemented, for instance, in apps for sensor-equipped mobile devices such as the iPhone) that promote kinesthetic learning of such emergent flux (2012a, 2012d). Further details of the computational model and the analysis are reported previously (2009b, 2010a, 2012a). Coordinated audio-visual cues help as well: therefore videos of synchronized animated dynamic form graphs are presented online27 and in the latter publication (2012a) which also discusses the mobile app’s responsive generative algorithms.
Example 5: Visualization of the Flux of Interonset Volatility (a.k.a. Temporal Clumpiness) in Carter's Fifth Quartet, Movement 10
Interonset Volatility
(a.k.a. TemporalClumpiness)
as standard deviation of 4 consecutive interonset intervals
2. Form-bearing flux in Ligeti’s Violin Concerto

Ligeti’s Violin Concerto is another instance of a work whose long-range form is profitably analyzed in terms of flux of intensity of an unconventional emergent property. The start of movt. 3 of Ligeti’s Violin Concerto, shown in Example 7, exhibits one of his hallmark textures: a layering of descending patterns. In this case its overall pitch height remains stable—that is, when sufficiently long spans of time are considered (for instance, considering one measure at a time). The result is a pseudo-descending texture. At other times the status of the texture is unstable; the intensity of the quality is in flux, as in Example 8, which shows mm. 34–37 of the solo violin part in movt. 1 of the concerto.

Such flux can be modeled as a comparative (oppositional) vessel, which is a computational model based on thetis versus antethetis contextual sets. Specifically the vessel TexturalInclineOfPitch (abbreviated TIP) is a quality based on the number of ascents versus descents, regardless of distance. Its thetis contextual sets are composed of events each of whose pitch is higher than that of the pitch of its predecessor.

\[
TIP_{\text{Thetic}} = A = \{ e \mid P_{\text{Predecessor}(e)} < P_e \}
\]  

Correspondingly, antethetis events are each of those whose pitch is lower than the pitch of its predecessor:

\[
TIP_{\text{Antithetic}} = B = \{ e \mid P_{\text{Predecessor}(e)} > P_e \}
\]  

TIP continuously compares the size of the two opposing contextual sets over the course of the piece or excerpt. This can be defined as follows for a span \(S\) of duration \(w\) and ending at time \(t\), with thetis and antithetis sets defined as above in equations (3) and (4):

\[
TIP_{(t-w,S_t)} = \text{Proportion}(t-w, t, A, B) = \frac{\#(t-wA_t)}{\#(t-wB_t)}
\]  

Example 9 shows an excerpt that starts with a somewhat neutral degree of TIP (almost an equal proportion of upward as opposed to downward motions) that then starts to oscillate more drastically, then tending toward a preponderance of descents. Example 10 shows a similar pattern over the course of the whole movement, like a driver on an icy road gradually losing control of his car, until ultimately it swerves right off the road. Nowhere does Ligeti name or define the form-bearing emergent quality TIP, which quite clearly fuels the work’s dynamic form.
EXAMPLE 7: PSEUDO-CONTINUOUS DESCENT IN LIGETI’S VIOLIN CONCERTO, MOVEMENT 3, MM. 1–4
(VIOLIN 1 SECTION AND VIOLA 1)

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EXAMPLE 8: EXCERPT FROM LIGETI’S VIOLIN CONCERTO, MOVEMENT 1, MM. 34–37
STARTING WITH UPWARD AND DOWNWARD MOTIONS FOLLOWED BY A PROPENSITY FOR
DOWNWARD MOTIONS DESPITE AN OVERALL INCREASE IN PITCH HEIGHT THROUGH M. 36

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EXAMPLE 9: DYNAMIC FORM GRAPH OF THE SOLO VIOLIN PART OF LIGETI’S VIOLIN CONCERTO, MOVEMENT 1, MM. 26–35, NEUTRAL TEXTURAL INCLINE OF PITCH (TIP), FOLLOWED BY MORE EXTREME FLUX OF TIP

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EXAMPLE 10: DYNAMIC FORM FROM FLUX OF TEXTURAL INCLINE OF PITCH (TIP) OF SOLO VIOLIN ACROSS ALL OF LIGETI’S VIOLIN CONCERTO, MOVEMENT 1 (LONG RANGE DYNAMIC FORM SIMILAR TO MM. 26–35 WITHIN IT)

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This ontologically proactive computational modeling once again leads to productive techné. Through this modeling I was inspired to develop another interactively controlled algorithm; this because the basis of another sensor-controlled mobile app, called Vortex, which enables spontaneous manipulation of the TIP property. This I used to make the improvisation Vortex Colossus (2011), in which I was able to spontaneously steer trajectories of emergent flux similar to those Ligeti composed.

E. CYBERNETIC PHENOMENOLOGY IN MUSIC ANALYSIS

All of this computational modeling derives from my introspection on listening to this music; that is, from my phenomenology. But the unconventionality of the qualities modeled make them inaccessible to the usual verbal guise of phenomenology that is traditional in philosophy and in music listening oriented analysis prior to Lewin, Roeder, and Quinn.

Consider what typically happens in traditional listener phenomenology (concentrated introspection about past perceptual and cognitive experience). When the theorizing of a musical quality is pursued as traditional listener phenomenology, it leads to descriptive prose which another reader-listener imagines in sound in order to hear it for herself. Often this is a matter of categorizing the relation between specific notes, chords, beats, or other events, as serving a specific function among a handful of functional categories known in advance as part of a conventional music-theoretic ontology. Yet one cannot refer verbally to that which has no name. When phenomenological description reaches beyond pre-categorized discrete events, to new and often elusive emergent qualities, we find that communication of the phenomenology is blocked by limits of the conventional ontology.

By contrast when such a newly recognized quality is computationally defined, it is then more plausibly viewed as an ontological act, which is indeed not only pedagogically communicative but is also worldmaking. Or, if it is not making new worlds from scratch, it is (by identifying or systematically defining or modeling relevant kinds of entities, processes, or qualities) participating in and contributing to the rule-driven or procedure-generated worlds invented by composers. The rules and procedures are not the worlds; the worlds are the acting out of, the enacting, of these rules and procedures. Modeling and naming the emergent properties that arise through such enactive activities in these worlds—like the activities in the tonnetz-Go world—enhances the experiential value of hearing or observing these activities. It makes worldly facets more vivid or even reveals new worlds altogether.
Being inspired by phenomenology of listening, inevitably, such computational modeling involves ingenuity as well as trial and error in a feedback process of refinement. This feedback process of listening, phenomenology, and computational modeling is what I call *cybernetic phenomenology*. It is thus ideally suited for treating emergence in music. Through technological ingenuity and imaginative awareness this activity deliberately blurs the lines between discovery, assertion, observation, and creation. Once there are multiple ways to provide definition (not just verbal ways) it follows naturally that the process of defining becomes more fluid and consequently so does our ontology become more fluid, more flexible. *Techné* helps dissolve the metaphysical rigidity that supposes everything possible already pre-exists. Thus *techné* is not collapsing into logos (is not engaged in merely discovering what’s already there), although it often co-opts or adapts logos to serve other motivations. The ontological adventurousness implicit in cybernetic phenomenological music analysis is inspired by the process philosophies of Bergson, James, and Whitehead, for I am imagining, discovering, and devising unconventional (exotic) kinds of flux in music, and specifically newly conceived emergent properties whose intensities fluctuate.

**F. THREE APPLICATIONS OF CYBERNETIC PHENOMENOLOGY**

Once a perceived quality is modeled computationally, the model can be deployed in several ways: (1) to analyze and theorize yet more music, (2) pedagogically, to communicate and cultivate understanding and aesthetic appreciation of unconventional music, and (3) for creating more music or creating formal models or technology for creating music (improvised or composed) based on the models. For instance, this approach spurs the creation of music whose trajectories of flux suggest the activities of hypothetical meteorological or physiological systems, which have enticing associative, expressive, and affective potential. Possibilities for neoplasmatically generated music are also suggested by this approach (for instance if the intensity of a detected biological emergent quality is mapped to one of these computationally modeled musical emergent properties).

In some of my own work as a music theorist-analyst (Mailman 2009a, 2009b, 2010a, 2010b, 2010c, 2011a, 2011b, 2012b), teacher, and creative musician (composer-improviser), I have pursued cybernetic phenomenology and applied it in all three of these ways mentioned above. Mainly, my focus has been on modeling unconventional (exotic) emergent properties, specifically to show how compelling musical forms and expressions arise from their flux of intensity. This
aspect of cybernetic phenomenology is diagrammed in Example 11, detailed explanation of which was presented previously (2010b, 2012b, 2012c). Practices such as this in music theory, analysis, composition, and interactive system technology extend, with more deliberate systematic rigor, the thinking in experimental arts of the 1960s that spawned “cybernetically modeled performing machines, sculptures, and bizarre artworks that attempted to respond to their environment through feedback mechanisms and thus [blur] the lines between art, science, and research” (Salter 2010, 307). The technological practices of recent music theory and analysis, as modeled in Example 11, resonate with cybernetics theory proper and with the practices of computer music composers, which you can see by comparing the general ideas of feedback flow suggested in Example 11 with those in Alex Andrew’s (2009) diagram of process with adaptive control (Example 12a) and Simon Emmerson’s (1989) model of computer composition (Example 12b).

I did not yet mention a crucial aspect of such feedback process models that is at least hinted at by most of the diagrams shown so far. That is the importance of modeling the experience of streams of discrete events in terms of continuous quantity. In his recent study, Andrew (2009) attributes the shortfall of AI and earlier cybernetics research to their failure to acknowledge the importance of continuity; that is, continuous quantity. Andrew critiques the earlier cybernetician Gordon Pask for insisting on crisp classification as a necessary step in learning. Citing the nervous system, motor control, and learning, Andrew explains “at all levels life depends on complex regulatory processes having continuous character” (Andrew 2009, v). Therefore continuous variables should be seen as fundamental rather than peripheral. “Continuous measures enter into many tasks that are usually presented as discrete” (Ibid.). In fact their interconnection is also noted: “The remarkable ability of people and animals to learn from experience finds similar expression in tasks of both discrete and continuous nature and in tasks that require intimate mixing of the two” (Ibid.). Continuity permeates thought. Like the computational modeling of flux in music that I and others have pursued, Andrew’s characterization resonates with Bergson’s emphasis on continuity (temps durée, for instance) and qualitative intensity, but yet synthesized with Whitehead’s views on the importance and flexibility of acts of measurement—thus emerge intriguing points of contact between cybernetics (often associated with machines, which are presumed to operate in discrete steps) and process philosophy (which has always emphasized the continuously changing nature of reality as we experience it).
Example 11: Diagram of the Cybernetic Phenomenological Approach to Modeling and Enhancing Music Listening
FEEDBACK PROCESSES ASSERTED FOR CYBERNETICS AND FOR MUSIC COMPOSITION

EXAMPLE 12A: DIAGRAM OF PROCESS WITH ADAPTIVE CONTROL (ADAPTED FROM ANDREW 2009)

In these respects, we see now, just before and since the turn of the 21st century, a convergence between cybernetics and process philosophy, manifested in both analysis-directed theorizing and in creative practices. Indeed the experiential relation between discreteness and continuity is one of the central themes I explore not only in my analysis-directed theorizing of music but also in my intermedia, interactivity, and comprovisational worldmaking practices.

III. Instances of Intermedia, Interactivity, and Comprovisational Worldmaking in Creative Practice

Technological art provides new narrative opportunities. One way it does so is by forging new contexts for frustrating or enacting agency, contexts explored by digital media artist Toni Dove for instance (Salter 2009, 329) and which I discuss in relation to narrative interpretations of processive minimalist music (2013a). Another side of this relates to the experiences of qualitative change seen, heard, or felt, as discussed above. As I already suggested, some kinds of music analysis can draw attention to musical properties (the strategies that produce them as well their qualitative affect) that are sui generis, that is, properties that are not quite and not only texture, that are not quite and not only rhythm, that are not quite and not only melodic contour, like properties that are neither blue nor green but in between, or whose color is time dependent. In the artistic realm however the point is not just to formulate a new or unusual quality (which could be grasped synoptically), but rather to forge situations, or opportunities, that emphasize such qualities so they are experienced in the flow of time; hence, the connection between worldmaking and narrative. Herman (2009, 73–74) explains that the representational nature of narrative

conveys the experience of living through [a] storyworld-in-flux, highlighting the pressure of events on real or imagined consciousnesses affected by the occurrences at issue. Thus . . . narrative is . . . concerned with qualia, a term used by philosophers of mind to refer to the sense of “what it is like” for someone or something to have a particular experience.

In technological art, the particular experiences might derive from hypothetical worlds one step removed from our own. For instance, we might try to imagine different ways that the stimuli from our environment could be distributed (partitioned) across our distinct sense organs. Or we might try to imagine sources whose visual and sonic impression
consistently combines types of change and stasis in ways not normally encountered in our actual world, or that segregates types of change and stasis that are typically experienced as being paired with each other. Going further, we might dream that such imagined reality and the artificial means of simulating it might, at a certain point, become indistinguishable from each other. What might that transformation look or sound like? Finally, we may fashion an artificial physically immersive interactive world with real-time cause-and-effect that is highly systematized yet still partly indeterminate—systematized and indeterminate as our usual real world is, but not in the same way as our usual real world is; it’s a responsive world whose systems of cause-and-effect combine “real-world” physics with aesthetics-driven techné informed by cybernetic phenomenology of past music and visual art works.34

A. MOBILE APP COMPROVISATIONS

Food consumption is one of those experiential pleasures whose phenomenology intermingles the discrete and continuous; for instance, in regard to flavors, textures, quantities, and multiplicities: We are routinely aware that every flavor can vary in intensity and is transmitted through some or other texture which we are quite aware comprises its own component parts which we might or might not sense directly. The particularity of such flavors and textures, which we may enjoy, emerges from their molecular and super-molecular content and configuration. And texture as experienced inside the mouth emerges quite differently from the way it does through our hands. Also relevant is the experience of continuity without repetition, which is an implicit aspect of ingestion: you don’t eat the same raviolo twice. Yet we experience continuity in eating ravioli, including their continuous decrease in temperature from one to the next.35

To constructively explore such emergent aspects of experience, a recent phase of my cybernetic phenomenological activities involves programming generative algorithms for interactive technologies. The technologies are designed for *comprovisation*, which is a technology-based hybrid of composition and improvisation.36 Because most music does not represent aspects of our world in the straightforward way that visual art is often capable of doing, the opportunities for worldmaking through music have to be articulated and forged differently. Comprovisation stands at the cusp between the planned and spontaneous, between the deterministic and indeterminate, and between the embodied and disembodied; so it does cut across some usual categories. A distinctive feature of technological art is that no matter what categories you
(pre)define, there is always some way to forge experiences that cut across these categories.

Like a *compositional space* (Morris 1995), a comprovisational system is a hybrid between a composition and an instrument. This allows an instance of comprovisation to be a hybrid between a composition and an improvisation. Comprovisation is compositional in that the design of the system (the interactive algorithmic technology) is more aesthetically-intentionally specific than that of an instrument; thus the system verges toward being an open-form work in itself (as does a compositional space). An instance of the compositional aspect of comprovisation is that comprovisational algorithms generate complex streams of events that are spontaneously controllable, but the features controlled are statistical characteristics of emergent qualities (macro-properties) such as texture and harmony which are often manipulated to project long-range form in planned-out compositions, but which usually cannot be so manipulated in improvisation. Related to this is that comprovisation may involve the planned choreography of physical movements, some of which may infuse long-range form into the generated music (through gradual shifts of harmony or texture, for instance). Since it is not specific to musical sounds or the typical playing of a musical instrument, the concept of comprovisation also applies to visual imagery (motion graphics). These and other facets of comprovisation are discussed and illustrated in my previous essay “Improvising Synesthesia” (2013b) and other writings about Fluxations, which is also discussed below. Because they are technological, comprovisational systems generate streams of complexity that could not be simultaneously created and steered by a single person playing a musical instrument. Thus, by doing what couldn’t be done before, they enable a new opportunity to be exploited. By using sensors to provide input to comprovisational algorithms, our creativity and spontaneity become intertwined with computation whose design is aesthetically informed. This allows us to explore the ramifications of our own aesthetic intentionality. Thus such cyber-improvisation serves as a discovery process (for instance, as a simulation of a composition) as much as it serves as a mode of expression.

Among other things, comprovisational technology allows the user-performer to spontaneously but systematically increase or attenuate the intensity (the extent) of various kinds of diversity, using continuous controllers or sensors such as sliders and tilt-sensing accelerometers. These are continuous variables controlling discrete events stochastically, rather than being one-to-one mappings of gestures to events. In other words, these input variables control statistical profiles of collections of events such that their change is sensed holistically rather than directly or immediately. Thus the qualities that shift noticeably with intention
can only be sensed as emergent, emerging from the experience of the flow of multiple events. Although they are being manipulated as if they are primary (non-emergent) properties, they are actually still issuing forth from concealment in the algorithms which are too fast, complex, and indeterminate to be reckoned during the listening moment. That is, the properties are still emergent since they arise as surface artifacts of fast moving algorithms whose operations cannot be decomposed in any realistic context. The properties are unmistakably present (though to varying degrees of intensity). Though the intention (agency) of the performer can be sensed through macro-level shifts of the qualities, the inner workings of the qualities remain mysterious while they are being experienced.

The technology has resulted in a series of comprovisational non-repetitive ambient music works some of which were presented at a listening installation at the Seventh International Conference on Music Since 1900, in 2011 (Lancaster, UK), among them: Coriander Castle, Cinnamon Crevice, Cardamom Canyon, and Licorice Loops 1 and 2—each inspired by the hypothetical fusion of emergent properties of taste sensation (flavor) and texture re-imagined as a tactile experience of micro-landscape morphology.

How could that be? Typically the most obvious control exercised by a musician is the timing and the pitch of each individual sound, whereas features such as texture, composite rhythm, or harmonic palette are indirectly or less obviously controlled and usually cannot be gradually shifted in a controlled way. For instance, playing a conventional instrument, it would be difficult for a person to improvise a complex irregularly arpeggiating texture that maintains (repeats) a particular harmonic palette (quality) but while smoothly shifting (transposing) its constituent tones, without ever repeating any of its resultant contour patterns. And to do this while gradually attenuating (quantitatively decreasing) the interonset density while holding a steady underlying pulse and gradually thickening the texture (number of simultaneously occurring pitches) and meanwhile forging oscillations (waves) of the degree of sustain (increasing and decreasing durations) of individual pitched sounds, without ever repeating individual rhythms—such a feat would be impossible to do spontaneously. But all of this is feasible with comprovisation systems, which therefore reconfigure some of our typical expectations about continuity and repetition, the qualitative and quantitative, and determinism versus spontaneity, in regard to the micro- and macro-level aspects of musical experience.

In regard to smell, taste, and ingestion, we might know intellectually that these are, on a micro-level, affected by the morphology of molecules encountered inside our mouths and noses, but that is not how we
typically experience the smells, flavors, or even the textures of that which we ingest. Conversely, morphology is typically something we experience on a more macro-level, on the exterior of our bodies, through tactile experience, for instance. Knowing that these seemingly separate facets of reality are actually highly related might inspire us to try to transcend or upend their distinction through some other experience that parallels such a transgression, but in a different sense domain. For the reasons I explained above, music comprovisation is perhaps one such parallel. Through its creative actions (pragmatist acts) it perhaps helps us push the bounds of our usual consciousness of other kinds of experience.

Unusual experience in one sense domain may help shake up our minds about experience in another. By reconfiguring the more conventional relations between musical continuity and repetition, qualitative and quantitative, and determinism and spontaneity, comprovisation (the activity of doing it as well as resulting works such as Coriander Castle, Cinnamon Crevice, and so forth) might suggest hypothetical worlds that reconfigure inside and outside the body experiences, such that experiences like taste-olfactory sensation (flavor sensed in the mouth) and tactile sensation (touch sensed by the hands) are intermingled in a fashion that is a step removed from the usual.³⁹

B. THE CHAMELEON JELLYFISH SERIES

The affinity between the flux of exotic properties in music and exotic creatures in nature leads me to another phase of cyber-art, one inspired by Whitehead’s ([1929] 1978) multiple “actual worlds” ontology.⁴⁰ Although the algorithmically generated computer music-animations that comprise my Chameleon Jellyfish initially arose as a technical experiment, it was Whitehead’s metaphysics that inspired me to continue to develop the project, which ultimately consists of five audio-visual pieces:⁴¹ Song of the Chameleon Jellyfish, Lament of the Chameleon Jellyfish, Mating Ritual of the Chameleon Jellyfish, Chameleon Jellyfish Cyber-telepathic Transformation, and the addendum, Thought Experiments of the Chameleon Jellyfish.

As explained above, in technological art, the particular experiences evoking enticingly unusual qualia might derive from hypothetical worlds one step removed from our own. In this case, I am inspired by the idea of creatures with mysterious activities producing novel and noticeably pleasing effects. This provides new narrative opportunities to represent visual and aural experiences of continuous and discrete (smooth and crisp) flux. These are narratively suggestive in unconventional ways inspired by Lanier’s (2010) perceptive appreciation of a natural wonder:
the chromatophore camouflage choreographies of cephalopods, which he calls “postsymbolic communication.” In creative media, communication such as this perhaps supersedes Nelson Goodman’s (1978) symbol system view of worldmaking. Lanier’s idea of *postsymbolic communication* suggests a bypassing of discrete language-like symbols in favor of continuity-based interaction, interaction that exploits the continuity of time, of physical space, and of analog sensors (artificial or biological). It suggests a direct pursuit of adaptation and “self-tuning,” which is promoted by Andrew’s (2009) continuity-based cybernetics as well by my own computational modeling of dynamic form in unconventional musics. As it happens, as early as 1955 Elliott Carter declared his “dynamic and changeable approach . . . [which] tries to give musical expression to . . . unexpected types of changes and relationship uncovered . . . in the life cycle of insects and certain marine animals by biologists” (Carter 1972, 309, discussed in Mailman 2009a). The exotic qualia of the ocean’s visual music, real or imagined, seems rich in narrative potential, and apt for cybernetics-infused techné.

For the *Chameleon Jellyfish* series (2011–12), I added color, sound, and other features to a computer graphics algorithm called Puff, by Ira Greenberg, in order to depict what I imagined as the activities of a hypothetical sea creature equipped with chameleon-like color-transformative abilities and distinctive sonic projective powers, but with the translucency, morphology, and motion of a jellyfish. Nearly amorphous shapes constantly but smoothly change their morphology while color hue is shifting at a slower pace, and movement at a still slower pace; the triadic pitched sounds also shift simultaneously at different paces. Such “continuous actualization” is that which Kwinter (2001, 110–13) focuses on to characterize Kafka’s Bergsonian inflected narrative motif: metamorphosis as a *purely intensive* “passage from one state to another. . . . In Kafka, the ship of Being has been made rudderless and subject only to the peripeties of winds, currents, and tides.”

It would be too much to claim that attending to position-correlated microglissandi in an audio-visual work would automatically alert us to “continuous actualization” in the world around us. Yet precisely because it is such a contrived and circumscribed situation, it prompts us to shift from our usual way of attending. Watching the “continuous actualization” of the chameleon jellyfish, their different rates of smooth flux, perhaps primes us a little better for attending to analogous phenomena in the world around us (including its music) that might normally escape notice. This is partly because of how, in these works, stasis and flux, as well as correlation and indeterminacy, are configured differently in relation to each other as compared to how they are usually related.

To quote Goodman’s (1978) statement again:
While we might say that . . . some relevant kinds of one world are missing from another, we might perhaps better say that the two worlds contain just the same classes sorted differently into relevant and irrelevant kinds. Some relevant kinds of the one world, rather than being absent from the other, are present as irrelevant kinds; some differences among worlds are not so much in entities comprised as in emphasis or accent, and these differences are no less consequential. (10)

As mentioned above, glaucous is perhaps a less relevant color category in our world, but another world could be fashioned in which it is exactly the other way around, and as Goodman says, some of the most striking contrasts of this sort are forged in the arts.

In the visual arts, which are referential more often and more straightforwardly than music is, such forging could come down to merely depicting an imagined world that replaces sapphires and emeralds with sui generis sapphglaumeralds. Of course in the visual arts there are many more imaginative ways of cutting across standard categories, such as those exploited in the surrealist paintings of Magritte, Ernst, and Dali. It is no coincidence that their powerful instances of worldmaking involve deliberate representational distortions of our usual world.

Over the course of the Chameleon Jellyfish series, the viewer is forced to reconcile combinations and juxtapositions of stasis and flux, uniformity and diversity, singularity and multiplicity, interdependence and independence, sudden and smooth changes of color, distinct geometries and amorphous shapes, hard lines and soft edges that are similar to but yet a step removed from what one observes in nature. Song of the Chameleon Jellyfish presents micro-time-scale discrete changes of pitch (major triads) which move in smooth position-correlated transpositional trajectories on the longer-range time-scale while color hue and morphology mercurially fluctuate. Lament of the Chameleon Jellyfish casts a different affective tone by presenting portamento (continuous) micro-changes of pitch. The third video, Mating Ritual of the Chameleon Jellyfish, combines symmetrical and asymmetrical flux, and does so in a way that differs from how predetermined versus spontaneous behavior are typically encountered in our environment. The intention is that its peculiar combination of symmetrical and asymmetrical flux challenges spectators to decipher the independence versus co-action of the hypothetical creatures, who seem to simultaneously exhibit ritualistic and agential spontaneous behavior (Example 13). The creatures’ co-action is that they are perpetually mirroring each other’s shape; their agential behavior is that each is maintaining its own independent stream of color shifting. These precise but smooth maneuvers are examples of post-symbolic communication.
EXAMPLE 13: STILL FRAMES FROM *MATING RITUAL OF THE CHAMELEON JELLYFISH*, SHOWING BOTH RITUALISTIC (COORDINATED) AND AGENTIAL (INDIVIDUALISTIC) BEHAVIOR (LARGER COLOR IMAGE AVAILABLE AT WWW.PERSPECTIVESOFNEWMUSIC.ORG)
The algorithm that produced the fourth video, *Chameleon Jellyfish Cyber-telepathic Transformation*, is partly stochastic like the previous ones, but differs from the previous ones in two crucial ways, with ramifications for the resulting effect. In this case the creature gradually gets bigger and also is allowed to interact with the edge of the screen —indeed it can go off the edge of the screen—which is imagined as a sort of “cyber” tank which it is, or was, floating within. By removing the edge of the screen as a constraint, the state of the system can vary much more unpredictably, like nonlinear dynamical systems (chaos). Indeed it can evolve, or devolve. To the extent this evolution or devolution is a qualitative change (such as existential state), it’s an ontological eureka moment: *diachronic emergence*. The edge of the screen itself is imagined as a threshold or membrane between two opposing existential states of the creature: a simulation of an embodied entity that is generated artificially, versus a computational entity that is real but disembodied (or “cyber”-embodied). The flux between these two existential states is experienced by the viewer-listener because the visual and sonic behavior of the creature changes upon crossing this threshold, so that it is witnessed even when the creature goes off screen and in a sense loses its “physical” location, its presence being “relocated” into a cyber-realm (cyber-[dis]embodied). The change in the sonic behavior is that the pacing of the creature’s song is drastically stretched out so that what was a fidgety texture (micropolyphony) becomes a sort of disjointed counterpoint of melody and voice-leading (macropolyphony). In terms of visual behavior, when touching on or beyond the screen edge, the creature’s hue starts to take over the entire screen, as if it has swallowed, or enveloped, its own cyber tank, and thus wrested control of its own artificially induced predicament. This smooth takeover, as well as the smooth shifts of hue, are instances of continuity-based interaction (as opposed to linguistic-symbolic communication). Also, a quirk in the algorithm causes the sonic material to evolve in an additional way that affects both pitch and texture in an enchanting correlation. As it moves farther and farther off, it gradually filters out pitch events that are not part of an E major triad. Therefore as the creature becomes more and more cyber-(dis)embodied, the texture of its sonic stream becomes noticeably sparser and more triadic. Since the creature is slowly growing in size, even though it floats rather randomly (like a jellyfish), its tendency to go off screen (out of the cyber-tank and thereby become cyber-[dis]embodied) increases over time, so that the work has evolutionary form, experienced sonically and visually.
Stated in more fanciful terms: The evolutionary form of *Chameleon Jellyfish Cyber-telepathic Transformation* additionally depicts telepathic communication between jellyfish and digital system, gradually resulting in a transformation of the jellyfish’s consciousness into a more expansive cyber-cognition. The suggestion of such cyber-transformation exploits certain narrative capabilities unique to technological music, as I discuss elsewhere (Mailman 2013a). It is also a hypothetical exploration of the notion of *technoetics* proposed by Ascott (1998).

The fifth video, *Thought Experiments of the Chameleon Jellyfish*, explores exclusively the creature’s off-screen (out of the cybertank) states, and adds a new twist in that its generation was interactive. Specifically the background color was controlled in real-time as the other aspects of the algorithm ran on their own, which meant the rhythm of color changes, which are imagined as affects or emotions (also suggesting post-symbolic communication), could be made to mimic the more erratic rhythm of human emotions. The algorithm was also set to abandon the consistently amorphous jellyfish morphology in favor of a horizontalized (physically sedentary) disposition, which connotes the cyber-(dis)embodiment of the creature while simultaneously highlighting the ever shifting gradations of subtle versus stark color contrast. The exploration of subtle color changes and shifting line borders between contrasting color fields was inspired especially by the color-field paintings of Barnett Newman, as well as those of Mark Rothko, Hans Hofmann, and Morris Louis.

To forge a connection between cultivated aesthetic tastes and the attractively strange dynamism of living creatures is one of the potentials of cybernetic phenomenology–infused techné that I had intended to explore. In particular, in this case I wanted to explore the appealing contrast between gradual and abrupt changes of color and patterned-versus-non-patterned musical sound—phenomena that resonate with my experience of Gerhard Richter paintings, certain quasi-aleatoric musical works of Earle Brown and Witold Lutosławski, as well as the hours I have spent observing cuttlefish and jellyfish, especially at the Aquarium of Western Australia, in Perth.

C. THE FLUXATIONS HUMAN BODY INTERFACE FOR COMPROVISATIONAL COMPUTER MUSIC

The physical motions of the body, and their use as input sources in a digital performance system, demand their own techné, as discussed by Wilson-Bokowiec (2010), for example. In the Fluxations Human Body
Interface for Comprovisational Computer Music (which I developed in coordination with collaborator Sofia Paraskeva), such body-as-digital-performer techné is synthesized with the ontologically adventurous cybernetic phenomenological approach to music which I discussed above (Mailman and Paraskeva 2012a, 2012b, 2012c). Our system uses an infrared (depth sensing) video camera (Kinect) and custom designed, built, and programmed sensor gloves to provide input to my Fluxations music generating algorithm, which runs as a looping RTcmix script in a Max patch. OpenNI and PrimeSense’s NITE middleware interpret the infrared video stream to produce the OSCeleton datastream from which raw and computed values serve as continuous control variables for emergent quality intensities realized continuously by the Fluxations music-generating algorithm. Rather than triggering individual sounds, the algorithm produces a textured continuous stream of sound (although it also has a limited ability to trigger sudden bursts of sound through a single glove-mounted button). So far it has been demonstrated in New Jersey, London, New York, Montreal, San Diego, and Santa Barbara (Mailman and Paraskeva 2012a, 2012b, 2012c).

1. **Techné of Intermedia: Tri-modal Mappings and Bi-modal Media**

A second phase of the Fluxations human body interface (presented in Montreal, New York, San Diego, and Santa Barbara) involves spontaneously controlled animated generative computer graphics I programmed. The generated graphics coordinate noticeably with the generated music, creating an immersive world, whose correlated audio-visual trajectories are expressively steered and sculpted like fluid by the motions of the human moving through continuous space. Its prismatic particle systems and fluctuating continuities of color, texture, and harmony are regulated by the planned or spontaneous actions of the performer. The generative algorithms are designed to maximize both variety and coherence of the musical and visual experience, including cross-modal relations between them and evolving emergent patterns of the particles (Mailman 2012e).

In one sense, the emergent qualities instantiated in this way would be more definitive if the bodily motions were choreographed in advance. (This is true despite the indeterminate, stochastic, contribution of the steered algorithms.) Yet I am more drawn to exploring the potential of such systems in regard to spontaneity. In my view, to design an interactive system for fixed composition is a bit like designing clothes for a mannequin. Instead, as I explain in “Improvising Synesthesia” (2013b), I’ve been intrigued by how improvisation with such a system as Fluxations entails certain indeterminacies of interational intention.
EXAMPLE 14: IN HARMONIC SPACE 5, STOCHASTIC PITCH POOLS ARE GENERATED FROM THE CYCLE OF PERFECT FOURTHS AND PERFECT FIFTHS. BACKWARD AND FORWARD POSITIONS OF THE BODY SELECT FOR HOLLOWER HARMONIES (FEWER PITCH CLASSES) OR FULLER HARMONIES (MORE PITCH CLASSES)
EXAMPLE 15

(A) LATERAL MOVEMENT (LEFT TO RIGHT OR VICE VERSA) TRANSPOSES THE PITCH-CLASS SETS AROUND THE PITCH-CLASS CIRCLE. THE DISTANCE TRAVELED AFFECTS THE CONTINUITY OF HARMONY.

(B) INCREMENTAL TRANSPOSITION OF PITCH-CLASS SETS, INFLUENCING HARMONIC CONTINUITY IN TERMS OF MORE VS. FEWER COMMON TONES (MORE VS. LESS CONTINUITY), WHICH DEPENDS ON THE DISTANCE OF LATERAL MOTION.
As in the everyday world we experience, nearly every nuance of our movement produces some effect through elaborate semi-predicable systems of cause and effect. And so it goes with Fluxations, too. Through an intricate techné of interactivity-to-algorithm parameter mapping, Fluxations provides its own musical and visual art living environment; not one that mimics the everyday world, but rather one that maximizes one’s ability to explore and experience a coherent interweaving of sights and sounds I have found aesthetically appealing in works by great composers, painters, and visual artists. What I have learned from theorizing, analysis, and casual observation, I have programmed into the generating algorithms.

The techné derived from cybernetic phenomenology applied to previously created works of others is applied to the creation of the interactive system to create a new immersive world of fluid dynamism. This techné is also fused with the techné of simulating real-world physical systems, such as the velocity responsive motion of particles in fluid. The affective results of artistic developments and real-world physics become fused in the synthetically immersive environment of Fluxations.

The harmonic space (controlled by forward-backward and lateral position) is carefully designed to be both spatially logical and incremental while providing the ability to navigate the harmonic sound worlds ranging from medieval drones and organum, to Steve Reich and Terry Riley, to Wagner, Liszt, Schoenberg, Varèse, Stravinsky, and even microtones, vaguely evoking the aural ethos of Harry Partch. One of the harmonic spaces is based on the cycle of fifths and becomes fuller as one moves forward, as shown in Example 14. The background color of the generated visual imagery also becomes lighter, and eventually white, as one moves forward. Moving laterally transposes the pitch-class set incrementally, as in Example 15. The resulting emergent flux is more or less continuous depending on the performer’s front-versus-back position, as shown in Example 16, because it depends on the proportion of tones held invariant when the pitch-class set is transposed, a proportion that changes depending on the fullness (cardinality) of the pitch-class set, which changes according to front-versus-back position. This is designed so that some trajectories within the space produce subtle pitch transpositions that evoke the nuanced harmonic shifts I have enjoyed in Steve Reich’s music; other trajectories evoke Wagnerian, Lisztian, Schoenberrian, or Varèsián harmonic shifts. Moving laterally also smoothly shifts the hue of the background color. Such gradual shifts of hue are designed to evoke the nuanced dynamisms of color I have enjoyed in abstract modernist paintings.

Thus new aesthetic syntheses arise by enacting the logistics of the interactive system.43
EXAMPLE 16: COMPARING THE EFFECT THAT DIFFERENT FRONT-BACK POSITIONS HAVE ON CONTINUITY DURING LATERAL MOVEMENT: FORWARD MOTION INDIRECTLY DECREASES THE EFFECT OF LATERAL MOTION, BECAUSE AS PITCH CLASS SETS INCREASE IN SIZE (CARDINALITY) THEY DIFFER LESS FROM EACH OTHER (SHARE MORE COMMON TONES) WHEN TRANPOSED. IN THIS WAY, THE DEGREES OF CONTINUITY IN THE SPACE VARY.
Aspects of the texture, its *viscosity* versus *fluidity*, are controlled by lowering and raising the body, as shown in Example 17. The possibility of manipulating this directly was inspired by similar textural fluctuations I admire in music of Renaissance composers such as Dufay and Isaac, as well as in modern works by Ruth Crawford Seeger and Robert Morris. This textural flux was originally modeled through cybernetic phenomenological analyses of works by these composers.

**EXAMPLE 17: TEXTURE IS CONTROLLED PARTLY THROUGH VERTICAL DISPOSITION OF THE BODY**

(A) VARYING DEGREES OF *VISCOITY* INFLUENCE THE TEXTURE SIGNIFICANTLY (NOTE THAT ALL THREE EXAMPLES HAVE THE SAME ATTACK DENSITY AND RHYTHMIC VOLATILITY)

(B) *VISCOITY* (VS. *FLUIDITY*) IS CONTROLLED BY CROUCHING VS. STANDING UPRIGHT.
The range of color hue of the large ellipses and the kind of pitch-class set chosen by the algorithm are both controlled by the performer’s forward-backward location; backward position chooses narrower ranges of hue and smaller pitch-class sets. We see, for instance, looking ahead to Examples 18a and b, when I am in the back position (away from the camera), the ellipses are blue, then moving slightly forward in c and d, the hue range expands to include purple, and then expands further in e and f to include a broader range of hue: the whole rainbow.

The ability to manipulate the diversity of durations (how widely they vary above and below an average as opposed to being uniformly the same) was also inspired by analysis of Crawford Seeger’s music (Mailman 2010c) as well as various accordion and bandoneon music by Piazzolla. In the Fluxations system, *durational diversity* increases to the extent the performer separates his or her legs from each other, which also controls the variability of the disappearance-rate of ellipses presented in the visual imagery.

Timbre also varies interactively, in coordination with the generated visual imagery. Wrist flexing effects continuous degrees of attack hardness as well as whether large crisp ellipses accompany the attack sounds. (Their size is inversely proportional to the pulse speed [temporal density] of the generated music.) The system is designed so that a low-pass filter dampens the timbre as the performer’s hands are brought closer together, similar to the way vowel sounds in speech are shaped by how we open and close the mouth, which acts as a filter. This aspect of the music’s timbral flux was inspired by the vowel based “sound color” music of Wayne Slawson. In tandem, the background color of the visual imagery darkens to black as the low-pass filter is closed by the hands.

Continuous degrees of syncopation and homophony are also controlled by wrist flexing and body twists, allowing the performer to spontaneously traverse various textural rhythms that simulate those as diverse as Reich’s, Stravinsky’s, Babbitt’s, and Charlie Parker’s. The system is designed to enable traversal of textural granularities ranging from the metallic pointillisms of Xenakis, to the dense washes of Truax, to the gradual ethereal evolutions of Oliveros. The *techné* of the algorithm and the interactivity are designed to balance the competing demands of coherent continuous spatial logic, on the one hand, with stylistic diversity, on the other.

The Fluxations and FluxNOISations interactive systems are like continuous spaces, and therefore, for the most part, do not have discrete moves, like a game of Go does—or the playing of a piano keyboard, for that matter. Although in Fluxations and FluxNOISations individual discrete sounds are generated by the systems to create their
textured streams, these are not triggered individually by the performer (except for occasional button-triggered bursts) but rather are triggered automatically in succession. That is, the discrete sounds are generated in a continuous stream whose qualities (including the rate and regularity of the succession) the performer-user manipulates as the stream flows. These systems’ interaction is predominantly continuous, to enable the projection, or creation, of gradual macro-level processes, smooth trajectories of changing emergent behavior, both sonic and visual. In both cases the shifts are subtleties within complexity.

2. ENTAILMENTS OF THE MAPPINGS
In such a situation, in order for there to be any clarity in the interactivity, certain trade-offs had to be made, especially in regard to timbral variety in the case of Fluxations. For instance the mapping that is most obvious when observing the interactivity of Fluxations is the low-pass filter controlled by the distance between the right and left hands (as detected by motion-tracking technology). If this sound color (steady-state frequency spectrum) aspect of the timbre was additionally affected by other bodily movements, then the hand-distance mapping would be severely obscured, both for the user-improviser and for the observer-listener. As discussed above, there are other aspects of timbre, but some of these impinge on textural parameters. For instance, as explained in connection with Example 17, the average duration (viscosity versus fluidity) of each individual sound in a Fluxations stream is controlled by the height of the highest part of the body at any moment (head or hand, whichever is higher). With the body crouched low to the ground, long duration notes sustain and blend into each other (it’s muddier at the bottom like a body of liquid might be), whereas standing up with a hand raised above the head, an extremely staccato pointillist texture is realized (like wet drops shooting through the air). Intermediate postures (such as normal standing with arms down) produce intermediate textures (interpolating between the extremes just described). Also as explained above, the distance between the right and left feet control the diversity of durations of notes. With the feet spread widely apart, a stochastic (random) variety of durations occurs; as the feet are brought gradually closer together, the range of durations gradually becomes more uniform. The variety to uniformity is always centered on the average duration, which is controlled by the height of the hands or head, as explained above. If the amplitude envelope aspect of the timbre were affected by some other bodily movement, that would obscure the durational aspects of texture controlled by the hands and feet. Thus these timbre limitations arose from principled logistics of the system design.
To enhance the timbral variety somewhat, the decision was made to enable the mix-in of a vibraphone sound to each note (wrist-flex controlled attack hardness explained above) but only such that this feature could, at the will of the user-improviser, be entirely withheld, through feasible positioning of one’s body (holding the wrist bent inward). It is quite feasible to independently change one’s feet distance, hand distance, or hand/head height while also maintaining one’s wrist at one or the other extreme angle of flex. (Wrist flexing is gauged by a flex sensor mounted each of the Paraskeva wireless gloves.) The decision was made to map it so that when flexing the right hand palm-inward the vibraphone sound would be absent; but the more the right hand is flexed backward (palm out) the more vibraphone sound is mixed in, thereby allowing the softer organ-accordion-harmonica family of timbres to gain a harder edge, and also enable the user-improviser to forge trajectories between these timbral extremes. Nevertheless, despite the various efforts to enhance the timbral variety of Fluxations, its timbral palette is in the end somewhat limited. Partly this is a price to pay for having complexity that can be spontaneously controlled in a systematic way, through body movement in a continuous space. There are also technological limitations (a restricted number of variables and sensors) which will eventually be overcome. Actually the timbrally limited nature of Fluxations prompted the design of the next system, FluxNOISations, to focus mainly on timbre (with simultaneous wood, metal, and water-paper-rock streams whose timbres are controlled by elbow and shoulder positions). In Fluxations, by contrast, primarily the goal from the beginning has been to explore the resources of pitch, texture, and rhythm (which have been developed so intricately in acoustic compositions as analyzed) in the context of spontaneous embodied interactivity, and in systematic connection with real-time generated visual imagery.

3. Generated Visual Imagery of Fluxations

As with Fluxations’s audio component, the algorithmic and interactive techné of the visual imagery are designed to coordinate continuous spatial logic with visual aesthetics inspired by abstract paintings, sculptures, and film. Examples 18, 19, and 20 show chronologies of individual frames taken from screen capture footage of Fluxations Full Body Comprovisation no. 1 and no. 2 (2012).

For various reasons, Full Body Comprovisation no. 2 provides a better starting point for examining the visual world of Fluxations, including its use of color, which is inspired largely by the color theories and demonstrations of Johannes Itten (1970) and Josef Albers (1963). In Examples 18a, b, and c, a lateral move causes the hue of the background to
smoothly shift from orange to yellow to green. In Examples 18c, d, and e, movement forward causes the background color to brighten from medium green, to light green, to white, after which, in Example 18f, it darkens to black as the hands are closed (also closing the low-pass filter, dampening the timbre). This move allows the bright colorfulness of the larger ellipses, and their fading transparencies as well, to contrast against and blend with the now dark background in a different way than they relate to the white background a few frames earlier (Example 18e).

During the whole passage, various changes to the medium and large ellipses are effected by my movement forward in the space. At first I am toward the back, so the color hue is limited to only blue (and a single pitch-class in the music)—though the system compensates for this by presenting various shades of the blue hue. Moving forward, the range of hue expands to include purple (Examples 18b and c) and then the full rainbow (Examples 18d and e). After initial appearance, each medium and large ellipse fades in transparency, a visual feature inspired by the paintings of Kandinsky and the lumino-kinetic art of Moholy-Nagy. As the large ellipses fade, they are also programmed to wobble and pulsate slightly, a feature inspired by the prismatic color flux of some of Stan Brakhage’s films, such as *Text of Light* (1974).

The configurations of small particles fluctuate according to particle system physics: their velocities are proportional to their proximity to the source of disturbance, which in Fluxations comes from performer’s left hand. Also the size of the particles is inversely correlated to the height of the left hand. Meanwhile, the hue of the particle system fluctuates smoothly according to what angle I am facing. The hue of the particle system shifts from green to blue to pink in Examples 18a, b, and c, as I turn from sideways to forward-facing, but the particles remains pink from Examples 18c to f.

Excerpts chosen from *Full Body Comprovisation* no. 1 better illustrate the morphological, kinetic, and textural behavior of Fluxations’s visual world. In Examples 19a, b, and c, my body is low to the ground, creating a viscous texture in the music and making the particle system’s particles larger. I am in a somewhat forward position so the background is almost white and the medium ellipses varied in color—reminding me of some of the paintings of Helen Frankenthaler. The slight changes of position of the particle configuration from 19a, to b, to c, exemplify the continuity strived for in the design of the system: the continuity of physical space is mirrored by other sorts of continuity in the virtual space. The continuous but irregular motion of the particle system, for me, resonates with the fluid morphologies I observe in paintings by Kandinsky, Miro, and Pollock.
EXAMPLE 18: STILL FRAMES FROM A VIDEO SCREEN CAPTURE OF FLUXATIONS: FULL BODY COMPROVISATION NO. 2
(LARGER COLOR IMAGE AVAILABLE AT WWW.PERSPECTIVESOFNEWMUSIC.ORG)
EXAMPLE 19: STILL FRAMES FROM A VIDEO SCREEN CAPTURE OF FLUXATIONS: FULL BODY COMPROVISATION NO. 1
(LARGER COLOR IMAGE AVAILABLE AT WWW.PERSPECTIVESOFNEWMUSIC.ORG)
EXAMPLE 20: ADDITIONAL STILL FRAMES FROM A VIDEO SCREEN CAPTURE OF FLUCTUATIONS: FULL BODY COMPROVISATION NO. 1
(LARGER COLOR IMAGE AVAILABLE AT WWW.PERSPECTIVESOFNEWMUSIC.ORG)
In Example 19d, the particles are much smaller as I have raised my body upright. Their configuration is still recognizable from Example 19c, despite the different texture the smaller particles now create. The background color shifts to blue as I have moved backward in physical space. The particles enlarge again in Examples 19f to m, as I lower my body. With my hands close together (effecting the dark background) I gently rock back and forth the system of enlarged particles, whose floating vertical arrangement of bright particles, against the dark background, reminds me of irregular crevices of bright pigment which recur in the paintings of Clyfford Still.

Example 20 shows frames from later in the comprovisation, when I use a sensor glove to trigger a slowly expanding cloud of wobbling bubbles. Because a different harmonic space was chosen (as compared to Comprovisation no. 2) the hue range of the bubbles centers around yellow (correlated to chromatic, ic1-generated pitch-class sets). The bubbles fade in transparency as they disperse. The background lightens (from dark to light green) during this process because I moved forward in the space, thus complementing one already triggered process (the sudden burst and gradual dispersion of bubbles) with another continuous process effected through continuous movement (the gradual lightening of the background color). The immersion entails discrete and continuous influence on the audio-visual environment, which responds in both abrupt and continuous ways. Yet the complexity of the interaction is systematic so as to be instrumental to expression.

Notice how the visual imagery of Fluxations is similar to, but yet a step removed from, the visual environment we routinely experience. As in the visual environment we routinely experience, the visual imagery of Fluxations’s environment juxtaposes crisp well-defined large shapes with amorphous configurations of smaller ones, and intermingles discrete entrances of ellipses with continuous shifts of color, density, transparency, position, velocity, size, shape, and endurance. The ability to project distinctions of color similarity versus color contrast help shape the temporal flow and chronological form of the comprovisations. Of course all of this imagery differs from routine reality in that its objects and substances are not quite familiar, at least not in the particular combinations presented here. The aesthetics of music, visual art, and the logistics of interactivity converge to create a system of cause-and-effect response that constitutes its own expressive immersive world.

Despite its networks of aesthetics-driven external references, Fluxations is an immersive world unto itself, with its own cyber-physiological weather patterns of viscosities, durational varieties, densities, hollowness and fullness, consonance and discord, timbral and luminous
brightness and darkness, expansions and contractions of color hue, flowing and flickering particles, continuities of opacity and transparency, trajectories, textures, swarms and singularities, synchronies, and syncopations, and all the multitudinous fluid interactions between these, simultaneously ambient and focal to both observers and participants. This “storm in the computer,” to use De Landa’s (2011) phrase, is steered from the outside (stochastic algorithmic music and graphics forged kinesthetically by spontaneous input from the human body) and projected back out to communal space to be seen, heard, and felt (by the human body) and is thus a peculiarly immersive cyber-embodiment.

At several points in the improvisations, a gradual change is effected both aurally and visually, thus creating a cross-modal gradient of qualitative intensity. Such passages simultaneously affirm Bergson’s emphasis on smooth change of intensive quality (which characterize temps durée) and refute Bergson’s rejection of cinematic time as unreal and incompatible with the experience of temps durée. I say this because all computer graphic animation is created in discrete frames (like cinema) yet the palpable smoothness of the experience—made even stronger by being presented simultaneously in visual and aural modalities—affirms Bergson’s notion that the experience of flux of qualitative intensity is the primary mode of temporal experience. Yet, inspired partly by Bergson, the design practices of Fluxations are encouraged by my music theorizing and analysis as well as the recent critique of cybernetics by Andrew (2009): These practices intermingle the continuous with the discrete, the smooth with the crisp, trying to optimally balance aesthetic variety of the generated music and visuals with spatio-logical coherence for its interactivity, so that the ear, eye, mind, and body are pulled together as a whole into the aesthetically varied experience.

IV. PRAGMATIC SPECULATIVE REALISM PURSUED BY FORGING UNCONVENTIONAL EMBODIED EXPERIENCE

Above, I discussed Chua’s (2001) characterization that music’s transformation into instrumental-expressive techné entails a “detuning” of the world that represents its disenchantment. He describes how modernity takes music out of its ancient cosmic position in the celestial supernatural realm, “collaps[ing] it into ‘reality’ as an audible fact, divorced from celestial values.” Yet doesn’t such pessimism lose power, in light of all else I discussed since?
A. PHENOMENOLOGY OF THE REMOTE

I discussed emergence and cybernetic phenomenology through much of this essay obviously for a reason. Unconventional (exotic) emergent qualities are hard to get at, hard to learn, and difficult to communicate about; their ontological status is almost paradoxical.

Yet they’re worth it. Whether it be the qualities emerging from the rules of Go, from the compositional procedures of Ligeti or Carter, from the secret motivations and transformations of fictitious jellyfish, or the ones that emerge multi-modally from the cyber-immersive, aesthetic systematics of Fluxations, such emergent flux rewards our attention. The processive feedback approach of cybernetic phenomenology is a strategy for addressing the situation, an approach that points in both scientific and artistic directions—often with the two intertwined.

Some of the best music starts as noise. Media philosopher Ian Bogost (2012) sings such praises to the tune of noise, what the philosopher Graham Harman calls “black noise”:

Harman uses the name “black noise” to describe the background noise of peripheral objects: “It is not a white noise of screeching, chaotic qualities demanding to be shaped by the human mind, but rather a black noise of muffled objects hovering at the fringes of our attention.” . . . As philosophers, our job is to amplify the black noise of objects to make the resonant frequencies of the stuff inside them hum in credibly satisfying ways. Our job is to write the speculative fictions of their processes. (Bogost 2012, 32–34)\(^\text{49}\)

Bogost calls this alien phenomenology and considers it a pragmatic speculative realism.\(^\text{50}\)

B. PRAGMATISM, EMBODIMENT, TECHNOLOGY, AND WHAT’S BETWEEN US

Pragmatism prompts us to seek real engagement, not just pontification, with the phenomenological road-less-traveled. Everyday language finds a way to bridge from concrete familiarity to unfamiliar abstraction, often through either narrative or conceptual metaphors, which build up from various analogies and mappings. Such is the basis of Lakoff and Johnson’s (1980, 1999) theory of cognitive (conceptual) metaphor and embodied mind.

Their theory proposes that certain schemas facilitate conceptual mappings between diverse experiences, called cross-domain mapping. One of the crucial ones is the verticality image schema, which, for instance, relates positive and negative emotions, as well as large and small
quantities, to high and low positions in space: verticality. Consider that any mapping based on continuous quantity could, in some way, exploit the verticality image schema. In order to be learned—that is, as an analogy, literally and figuratively analog—the fluctuating intensity of an unfamiliar emergent quality may be reckoned in terms of intensive flux of more routine qualities we experience.

Previously (2009a, 2010b) I explained how such thinking figures into music analysis, enabling us to relate fluctuating emergent properties in music (such as melismaty or pitch variety) to other fluctuating emergent properties (such as stock-market value, temperature, or humidity), for the purpose of interpretive narrative or hermeneutics, as diagrammed in Example 21. Conceptualized this way, such mappings amplify and extend natural worldly experience by prompting the listener, reader, interpreter to imagine new affective responses. Theories of embodiment suggest that concepts are learned through the medium of the body; for example, by relating quantitative flux to vertical motion we can experience with our bodies. In fact the neuroscientist Rodolfo Llinas (2001) declares: thinking is internalized movement. That is an instance of embodied mind. If anything, it is through the fuel of embodiment that technological (interactive, immersive, synesthetic) art can serve as an engine to drive pragmatic speculative realism.

Writing on Whitehead’s processive metaphysics as relating to aesthetics and media theory, Steven Shaviro (2009, 28) remarks that “mental operations do not necessarily involve consciousness.” In response to unconventional affective stimuli, the embodied mind continuously adapts and tunes itself, with or without being conscious of this, and Whitehead would argue that this process is driven by affect, as all cognition is filtered through emotion, which forms the basis of experience. “For Whitehead, affect precedes cognition” (Shaviro 2009, 14) It is often through the sense organs of the body that affect is, shall we say, effected. So how do you learn something utterly foreign?

If, as Llinas says, thinking is internalized movement, then it seems the ability to think (as a listener, composer, improviser, analyst, critic, theorist) of fluctuating viscosity, melismaty, harmonic hollowness, durational diversity, or any other intensity-varying emergent quality would be significantly enhanced by the experience (or even the observation) of moving one’s body to effect such change. Indeed this is kinesthetic learning: learning from the outside in (Mailman 2012a). Upon approaching an utterly foreign phenomena: you live it to learn it. Experienced through first-person or observed bodily participation, mappings of physical movement to utterly foreign emergent properties amplify and extend natural worldly experience by conjuring synthetic experiences that prompt new affective responses.
EXAMPLE 21: CROSS-DOMAIN MAPPING BETWEEN MUSICAL AND NON-MUSICAL PROPERTIES, BASED ON THE VERTICALITY IMAGE SCHEMA
Technology provides the opportunity, in ways infinitely flexible. Citing Cunliffe (1994), an essay by Sagiv, Dean, and Bailes (2010, 306) remarks that “by sharing computational process or data, one may be able to establish creative exchanges between different modalities, and these may be cognitively and emotively interesting.” They call this algorithmic synesthesia. As discussed above, Fluxations is perhaps an example—one, however, that does not explore algorithms for their own sake, but rather exploits them pragmatically to optimize a balance between competing demands: immersive interactive expressivity on the one hand, and musical and visual aesthetics on the other. Among other things, the purpose of Fluxations is to provide the opportunity to immersively and expressively explore unconventional emergent properties of music and visual art that I have admired. The exploration is also conveyed, in the intersubjective space of public performance and documentation. I consider myself extremely fortunate to live in a time when all this is possible.

Each such active exploration exemplifies a particularly valuable sort of freedom, precisely because it is not, or does not seem to be, regulated by imperatives of or from the pre-existing natural world. As McGowen asserts, in paraphrasing Hannah Arendt’s philosophy:

Freedom must be pure, completely spontaneous, a totally unexpected intervention into the causal change. As such, the free act is quite literally a “miracle” (169), an event with no causal antecedents, a radical beginning that brings something new into the world (167–69). (McGowan 2011, 155–56; citing Arendt 1977)

Thus our intersubjective public space (for instance, of artistic performance and documentation)

signifies the world itself, in so far as it is common to all of us and distinguished from our privately owned place in it. This world, however, is not identical with the earth or with nature, as the limited space for the movement of men and the general condition of organic life. It is related, rather, to the human artifact, the fabrication of human hands, as well as to the affairs which go on among those who inhabit the man-made world together. To live together in the world means essentially that a world of things is between those who have it in common, as a table is located between those who sit around it; the world, like every in-between, relates and separates men at the same time. The public realm, as the common world, gathers us together and yet prevents our falling over each other, so to speak. (Arendt 1998, 52)
Through the kinds of endeavors I’ve been discussing (composition, analysis, theorizing, improvisation, system design, and so forth), this public realm is made richer through individuals forging and sharing varied connections (mappings that are conceptual or cross-modal perceptual) that did not pre-exist in our natural world, but which perhaps enliven our experience of it nevertheless. These endeavors are pragmatic for being creative embodied actions, not just pontifications. Yet they bear no destructive force. Nor are they coercive.

C. THE PHRONESIS OF ENCHANTMENT

Thus worldmaking is not necessarily a utopian rejection of the world as it is. On the contrary, in the spirit of pragmatic speculative realism, I’d prefer to consider it an imaginatively productive attempt to re-engage with the world on new terms, new categories, and new cross-categorizations. In other words, worldmaking is not an exclusion of reality but rather a change of attitude toward it, a bracketing of reality, what Husserl calls epoché. Moreover worldmaking as techné is a particularly pragmatic, proactive mode of doing this, a mode that does not merely assert new definitions to be grasped synoptically, but rather presents experiences or opportunities for such experiences. For example, technology enables us to enact newly created cognitive metaphors, embed new mappings into embodied action. That is, it enables us not only to infuse cybernetics into phenomenology but also, from there, to infuse imagination into embodiment, fantasy into physiology. Forging strange scenarios of multi-sensory flux: if anything this actually re-enchants the world.

As Bogost remarks: “The science fiction writer Robert A. Heinlein advocates speculating about possible worlds that are unlike our own, but in a way that remains coupled to the actual world” (Bogost 2012, 29–30). Obviously music is rarely depictive in the straightforward way that visual art often is. But I will leave it to others to debate whether and what music is actually fictional, because I know my engagement with it is real and purposeful. Experiencing the flux of unconventional emergent properties (for instance in music) has the effect of amplifying, rather than negating, features of the world we seem to live in, features that were perhaps inaccessible or obscured when the world was perceived only through the streamlined elegance of its platonic-pythagorean “tuning.”

Seen in this light, as compared to the platonic-pythagorean re-entially passive mode of existence, worldmaking as artistic theory and
practice (techné) is thus a proactively positive form of adaptation, and one that enchants, rather than disenchants, the world. What is world-making as techné? It is what Bogost calls “constructing artifacts that do philosophy” (Bogost 2012, 85). In embodied experiential form, proactive and enacted, this is appreciative commentary, positive critique, of the diverse richness of worldly experience. What better enchantment is there?
Notes

1. It relates loosely to the artistic and discursive activities of telematics pioneer Roy Ascott (see Shanken 2003). By comparison, however, cybernetic phenomenology usually has a narrower focus and a more analytical epistemological orientation, the adventurousness of which is somewhat cautiously incremental yet still open-ended in principle.

2. Brian Kane (2014, 113) actually distinguished two different kinds (scopes) of techné discussed by Aristotle, the first being a more narrow one, which is imitating nature, and another broader one that complements what nature does not already supply. It is the second type that corresponds to Pace’s account of music theory.

3. This was an impromptu remark Pauline Oliveros made on June 14 at the conference Skin—Surface—Circuit: Embodying the Improvisatory, ICASP-McGill Center for the Critical Study of Improvisation Interdisciplinary Conference, Montreal, June 14–16, 2012.


5. Ashby (2009) persuasively describes tonal practice as legalistic rather than scientific law—that is, as law articulated through its contravention; as I explained it (2013a), tonal practice represents a constraint of possibilities that, for the purposes of musical narrativity, mimics the physical, social, and psychological constraints of the real world we live in.

6. I use the term exotic to denote that which is perhaps a combination of unusual (statistically rare) and which is enticingly strange in how it differs significantly (not just trivially) from that which is most usual. In regard to cultural products and people the term has unfortunate political baggage in that it connotes an “othering” stance. In using the term exotic I have in the mind the more neutral ways the term has been used to characterize, for instance, certain atoms and subatomic particles (positronium and exotic baryons), or financial products, such as “exotic derivatives” and “exotic options,” which are contrasted with the “plain vanilla” variety.
7. A self-organizing system is a system that exhibits regularities that arise without a plan or leader, but emerge from the interactions of the parts of the system” (Chemero forthcoming).

8. Sound Example 1 is found at http://www.perspectivesofnewmusic.org/soundexx/.

9. Sound Example 2 is found at http://www.perspectivesofnewmusic.org/soundexx/.

10. The software is Goban v.3.2.1.2 from http://www.sente.ch/software/goban/.

11. Sound Example 3 is found at http://www.perspectivesofnewmusic.org/soundexx/.

12. There are various philosophical issues with this somewhat loose definition of emergence but they need not concern us here. (The issues pertain to reductionism and supervenience, for instance.)


14. This use of the term dynamic form in relation to music traces back to a less formalized version of the concept asserted by Mersmann (1922–1923). See also Rothfarb (2002).

15. Philosophers Alexander Rueger (2000) and Paul Humphreys (2008) have called this synchronic emergence (as opposed to diachronic emergence which is a property that unpredictably arises at a point in time or in the chronology of a process).

16. This is a definition of emergence from the Oxford English Dictionary, cited by Batterman (2002).

17. The reader could compare my description here to the touchstone five tenets of emergentism proposed by Jaegwon Kim (1999) as well as Paul Humphreys’s (1997a, 1997b) discussion of a “fusion” operation and his distinction between emergence and mere supervenience. It’s also worth mentioning that temporal density (TD) can be realized from various completely different systems of micro-details, from which emerge qualitatively different manifestations of TD, even if having the same quantitative intensity of TD or the same trajectory of flux of intensity of TD. As Robert Batterman (2002, 76) explains, “Multiple realizability gives us good reasons for thinking that certain important intertheoretic reductions, as typically understood by philosophers, will not be possible.”
18. Boretz (1977) describes a feedback process whereby, through reading a text, he develops a “mental image” (its role is not so different from that of vessel in dynamic form theory) which serves as a sort of filter. He explains that he refines and re-applies this filter to that reading, which in turn results in a unique “determinate feel” coming from the (now filtered) text. It is this “mental configuration” stimulated by the original close reading that “in turn uniquely transforms what that mental image was, emerging bonded in what I want to call a semantic fusion. . . . My theory of reading, therefore, is what I want to call attributive: that is, it isn’t descriptive or explanatory of anything; what it does is ascribe properties to and thereby determine what there is. And if my verbal portrait of that theory were a bit more refined, it would mention that some components of my mental landscape are slots for entities that might be called ‘stretches-of-print-received-as-thought’ slots, in a landscape of such slots which might be called a ‘thought-slots-in-an-array-configured-by-logical-connections’ landscape. This mental landscape would continually expand to accommodate subsequent thought-slots in further logical connections, asserted or implied” (Boretz 1977, 104).

19. Actually, the continuation of this remark resonates strongly with methods of dynamic form analysis discussed since 2009 (Mailman 2009b, 2010a, 2010b, 2010c, 2011a, 2011b, 2012a, 2012b, 2012c, 2014) if certain terminological substitutions are made (shown in square brackets): “Mesoscopic state variables [vessels and vessel components] are invented by the observer [music theorist-analyst] in a constructivist manner and represent clusters of agents [events] taking on the same values at the same time [within a suitable time span, a docket]. For instance, the value taken by a mesoscopic state variable at time \( t_i \) [could represent] the number of elements [events] which have the same [within a range of values] value of some microscopic state variables such as the same distance from their nearest neighbors, the same speed, the same direction or the same altitude over time [e.g., same pitch, or interval, duration, or timbre, etc.]” (Minati and Licata 2013, 58, italics original).

20. In Minati and Licata’s (2013) subsequent refinement of these ideas, they write that “The invention by the observer of a suitable mesoscopic level of description is related to its constructivist role, which in this way is theoretically embedded in this approach intended as a research strategy. For instance, mesoscopic variables
may be identified by considering clusters of microscopic variables used for components and at suitable threshold values” (54).

21. The concept of *downward causation* was proposed by Donald Campbell (1974) in relation to biological systems. It has recently been extended substantially into a theory of *practopoiesis* (Nikolić 2015), which can be understood as a form of a second-order cybernetics, or cybernetics-of-cybernetics (Heylighen and Joslyn 2001; Foerster 2003).

22. Numerous times I have experienced the emergent qualities of körvai, but it was an anonymous reader of an earlier draft of this essay who suggested they be mentioned in the present discussion of emergent properties in music. My description of the development of körvai paraphrases that reader’s comments.

23. This is of course an instance of extreme sensitivity to initial conditions (the “butterfly effect”), a touchstone of deterministic nonlinear systems considered in chaos theory.

24. The example of Lachenmann’s “Schattentanz” was brought to my attention by an anonymous reader.

25. This description of Lachenmann’s “Schattentanz” is a direct quote from an anonymous reader, which comports with my own assessment from listening and viewing the score.

26. In a longer, more comprehensive form, this analysis of movement 10 from Carter’s Quartet no. 5, and also Ligeti’s Violin Concerto, are recently published in conference proceedings (Mailman 2012a) and are discussed more extensively in Mailman 2010b.

27. An audio-synchronized video illustrates this flux in the tenth movement of Carter’s Fifth Quartet. Use password *body* at the following: http://vimeo.com/fluxations/carterqt5tenflux.

28. I had previously (2010b, 2012a) called this vessel *Upward* because greater magnitudes of it correspond to a prevalence of upward moves (downward moves being considered a depletion of this quality).

29. This is a summary of a longer argument presented at an interdisciplinary conference at Cornell University (Mailman 2012b).

30. Consider two examples of logos being exploited for practical or even *phronetic* motivations: (1) The quadrivial study of harmonic ratios (so called “canonics”) exemplifies logos, but was applied in
musica practica treatises to guide the technique of tuning a monochord. As an anonymous reviewer of this essay has noted, Guido’s inclusion of the Gamma pitch in his monochord division makes this much simpler to carry out than it was in the earlier middle ages; Guido proposes doing this division of the canon as an ear-training exercise for students, as well as a route to understanding the tuning of scales. (2) As I explained in the “computation” section of “Seven Metaphors” (Mailman 2012c), the more open-ended listening stance called legein (listening with, listening in readiness) can be enhanced by extending one’s repertoire of defined listening strategies. In many instances, as I’ve tried to show, this can be done by formally defining myriad vessels of form, each of which corresponds to a specific listening “angle.” To define such vessels formally, in a mathematical computational sense, so they can be communicated intersubjectively, requires logos. In this way logos is co-opted to advance legein.

31. Neoplasmatic means the manipulation of actual biological material.

32. Process philosophy designates a focus on the dynamic nature of being, which has been articulated in various ways by Heraclitus, Hegel, Bergson, James, Whitehead, Deleuze, and others. In process philosophy emphasis is placed on the continuously changing nature of reality as we experience it; for instance, through our senses and our consciousness. Thus process philosophy contrasts with Western metaphysics’ more usual prioritizing of static persistence and regularity that supposedly underlies experiential flux, as theorized in the writings of Plato, for instance.

33. Goodman (1978, 11) proposes a hypothetical time-dependent color designation, grue. “Grue cannot be a relevant kind for induction in the same world as green, for that would preclude some of the decisions, right or wrong, that constitute inductive inference.”

34. Some aspects of the latter are covered previously in Mailman (2013b), “Improvising Synesthesia.”

35. Further parallels between music listening and digestion are explored in the “Listening as Digestion” section of my essay “Seven Metaphors” (Mailman 2012c).

36. The term comprisovision is used by Dudas (2010), Bhagwati (2010), and myself (2013a, 2012e). It relates to the concept of “interactive composition” offered by Chadabe (1984).


39. Certain aspects of my thinking on this are influenced by Evelyn Glennie’s (2008) assertion that “hearing is basically a specialized form of touch” and Oliveros’s assertion that “every instrument is a prosthesis” (see note 3).

40. In regard to the term *exotic*, see note 6.

41. Published at http://the-open-space.org/joshua-banks-mailman/.

42. In that improvisation is the responding to the unforeseen or even unorthodox, it has been rightly elevated to a coherent ethical-philosophical stance by Gilbert Ryle (1976), George Lewis (2007), and Arnold Davidson (2011). As Ryle (77) remarks: “[if someone] is not at once improvising and improvising warily, he is not engaging his somewhat trained wits in some momentarily live issue, but perhaps acting from sheer unthinking habit. So thinking, I now declare quite generally, is, at the least, the engaging of partly trained wits in a partly fresh situation. It is the pitting of an acquired competence or skill against an unprogrammed opportunity, obstacle or hazard” (Ryle 1976, 77). I take from this that there is an awareness value in improvisation that is comparatively attenuated in composition.

43. Beyond what is explained in this essay, further details of the dataflow and mapping strategies are explored in “Improvising Synesthesia” (2013b) and in “Pragmatist Ironist Analysis and Embodied Interactivity” (forthcoming 2017).

44. This mapping was stimulated by my exposure to Wayne Slawson’s sound color theory (1985, 2005) and compositions, such as *Rapt Soft* (2000), which he realized with his C-sound embedded voice synthesizer system called SYNTAL.


47. Fluxations Full Body Comprovisation no. 1 and no. 2 exist in digital video format in the Interactions area at http://www.joshuabanks.mailman.com/.

48. Chua does not clarify whether he is explaining his own beliefs in terms of historical-mythological doctrine or merely explaining a point of view that would have been held by Vincenzo Galilei or Max Weber, as influenced by historical-mythological doctrine.

49. I thank Jonathan De Souza for bringing Bogost’s writings to my attention.

50. This may seem similar to Ascott’s (2008) syncretic thinking (“seeking likeness in unlike things”) but is yet something else.

51. One lesson from the recent field of behavioral economics (Ariely 2008) is that often such unconscious mental operations can be shown to be unexpectedly consistent, indeed unintentionally systematic.

52. An example of this is the awareness of our own bodies. As Krueger writes, “Awareness of your body is a vital part of experiencing the medium [of ambient interactive systems such as Videoplace, Glowflow, and Psychic Space]. When you find that bending an elbow has one effect and tilting your head has another, you discover a new way of relating to your body” (1983, 50). Further fascinating aspects of this and related phenomena are explored by Salter (2010, 303–48).

53. Algorithmic synesthesia in relation to interactive systems is discussed further in “Improvising Synesthesia” (Mailman 2013b).

54. This is, in a way, a creative kind of self-regulation (self-regulation pursued artistically) toward the end of greater happiness, in the sense described by Irtem (1971), which cannot be pursued, let alone attained, under the passive platonic-pythagorean program of merely observing the default harmonic “tuning” of the world.
References


Perspectives of New Music


Boretz, Benjamin. 1977. “What Lingers on (, When the Song is Ended).” *Perspectives of New Music* 16/1: 102–09.


———. 2010c. “Emergent Flux Projecting Form in Ruth Crawford Seeger’s Quartet (1931).” *Analysis of Music by Women Composers Session, Committee on Status of Women, Society for Music Theory,*


Cybernetic Phenomenology of Music


