Musical Notation, Electronic Technology and Cybernetics; a Pragmatic Perspective

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Abstract

Composition traditionally means notation and formal organization. Conversely many modern musical works that utilize electronic technologies do not rely on formal notational systems. This paper makes the case for compositional systems, which do not adhere to traditional forms, and in particular those that do not elevate notation as the final musical artifact.
Two main areas will be examined: Firstly, the pragmatic philosophical position, as it relates to technology, which argues that text based forms such as notation are unnecessary in works that utilize electronic media.
Secondly, the consideration of a systematic framework that facilitates composition with electronic technologies that does not rely on notation, namely Cybernetics.

1. Musical Notation

The practice of composition since the Second World War has embraced electronic and non-musical technologies in an ever-increasing symbiotic relationship. The use of these modern technologies, in some cases, has undermined the necessity for traditional notation. Particularly where pieces are either predicated by the technology (for example, Steve Reich's "Pendulum Music" (1968)) or where the piece is the result, not of formal musical experimentation but of a 'non-musical' process (Alvin Lucier's 'Music for Solo Performer' (1965) for example).

To understand the position of notation within these modern works, and its relationship to what we might term the 'finished piece of music', it is useful to frame notation within a pragmatic philosophical context, in particular the notion of the technological means and the artistic ends. "Pragmatism advances the thesis that theory is a kind of practice. Pragmatism also embraces liberalism. In contrast to the Cartesian tradition, it also affirms embodiment and engagement of the senses in human experience. It also asserts the formative power of technology in human affairs."(Coyne, 37)

First expounded by the philosopher John Dewey (1859-1952) and later expanded on by Marshall McLuhan (1911-1980), pragmatic philosophy divides mans interaction with technology into three board epochs:

The first being the *pre-technological era.* Here means and ends are integrated; tools do not signify anything other than themselves and their use in achieving short-term goals. The forms preserved in preliterate societies today exemplify music of this era. Here music is not notated but improvised. The act of playing music is often a transformative process as part of a rite or ritual. Music is not only a product of practice it is also a tool in itself. It provides both a means (of say inducing altered states of consciousness in a battle trance for example) and also mitigates the ends (for example, of forming a collective identity and battle cry when advancing into conflict) (Joseph Jordania, 2006). Here music formed as group activity, where the music makers and the audience are one in the same. Meaning is derived by collective action and interpretation.

The second epoch is the *technological age* in which means and ends are separated; means are subservient to ends and text is the dominant technology of this era. This separation of means and ends begins with Plato's abstractions of perfect forms and is perfected in Cartesian Dualism. Music of this era begins with the abstraction of musical notation and culminates in the romantic era of the 19th century. Here notation and instrumentation are the technological means. However, the technology in itself seldom mitigates the ends, it mealy describes it. The end is not only the piece of music it is also the intended emotional significance. Dissemination of meaning is seen to be hierarchical; imbued by one individual, namely the composer, for interpretation by musicians and subsequently an audience.

The third age is the current *scientific/ electronic* era. Here means and ends are partially reunited. Means may now direct process and point to new discoveries.

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According to the pragmatic philosopher Larry Hickman, in the modern era "Theory became a tool of practice and practice a means to the production of new effects. Theory no longer had to do with the final certainty but instead, as working hypothesis, with the tentative and unresolved." (Hickman in Coyne, 38).

In the scientific/ electronic paradigm, the means mitigate the ends and in some cases they converge with no single entity taking precedence in the creative process. Electronic and digital tools are the dominant technologies of this era. Music of this epoch is mitigated by electronic technologies, which take precedence over notation as a way of recreating a musical experience in another time and place and in some cases the electronic means utilized within a composition mitigate the outcomes to such an extent that the 'medium becomes the message.' In this type of musical work meaning is no longer disseminated hierarchically but is more often formed by a negotiation, between the composer, technology and the audience.

Marshal McLuhan believed that with the invention of the Guttenberg printing press, Renaissance man had traded 'an ear for an eye.' But with the invention of the telegraph, McLuhan asserted that humans had shifted back into the aural-acoustic world, which he termed the 'post-literate society'. He further postulated that the post-literate society shared many characteristics with the pre- literate society; he states that in the second (rational) epoch the visual sense was dominant but in pre and post literate societies the auditory sense is foremost.

It is therefore reasonable to assert that in the post literate society, notation is no longer the dominant technological means in the compositional process but mealy a tool that may be selected from a series of options. In many cases, particularly where technology mitigates the end result, notation is often redundant, both as a creative tool and a storage medium for accurate reproduction.

"For McLuhan, in the electronic era 'the action and the reaction occur almost at the same time'. Electricity produced a great historical reversal in making things instant again." "Electric writing and speed pour upon humans, instantaneously and continuously, the concerns of all others are known and we become tribal once more; the human family becomes one tribe again within the global village (McLuhan in Coyne, 45)

It is perhaps then no coincidence that within this context the type improvisational forms found within pre-literate societies have seen a resurgence in modern times. The burgeoning use of graphical scores may also be seen as part of this paradigm; here the usurping of the technology of traditional notation sees the blurring of means and ends which mirrors the way in which electronic technologies are often utilized to the same effect within composition.

2. Cybernetics and Music

However, it is important to distinguish between certain musical practices that employ technology as many of these still point toward the logocentric, technological age while others adhere

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to the less hierarchical scientific/ electronic model. Creative musical works that utilize electronic technologies tend to fall into two board camps, which (to borrow from the cybernetician Stafford Beers terms) I shall call, the *Reductive* Paradigm and the *Generative* Paradigm.

In the Reductive Paradigm, all the parameters of systems that employ electronic means in the compositional process are predesigned and orientated toward a known goal. These systems seek to eliminate problems such as circular causality and paradoxes. Their aim is to produce 'perfect' structures that reduce or eliminate errors. This approach stems from traditional, formal, score based composition and (in electronic terms) is related to the field of Artificial intelligence. The field of Music Informatics exemplifies this paradigm. Here, musical parameters; notes, frequency information or metadata, are reduced to information that may be manipulated for the purposes of score design, analysis, mimicry, recognition or categorization. Technology is employed as a *means* to an *end*, with the priority on the *ends*; the technology is only a tool in producing the end result (Coyne, 1995).

To provide some concrete examples, this might be: a composer utilizing the Sibelius sequencing software to produce musical works or a computer program that can recognize specific composers works and can also imitate such or a software program that can recognize melodies, harmony's and lyrics and cross reference these with a library of recorded works. This field also encompasses some forms of systematic composition, particularly those with fixed goals.

It is notable that in all these cases the emphasis is on pitch over timbre and that the act of composition is achieved by *human* intelligence; compositional parameters are defined by *human* agency with specific *human* goals. This is a 'top down' process, where all the structures within the system are defined by the composer and controlled to produce a fixed result. They are closed systems. If the composer or software designer, whishes to approach anything like intelligence within the software design (as is the case in recognition and mimicry), it is a very computationally expensive process (i.e. uses large amounts of memory), as all possible parameters within the compositional system must be known beforehand.

Conversely, the Generative paradigm involves the symbiotic process of music creation between the technology and the composer. It embraces circular causality as a central tenant and sees errors as a vital part in any systems capacity to learn. Here the *means* mitigate the *ends* and in some cases converge, with no single entity taking precedence in the creative process. This is a 'bottom up' approach, meaning the systemic or technological aspects act as a 'seed' that will 'grow' the composition (this is in opposition to the A.I. approach where the entire 'tree' must be known in advance) (Eno in Toop, 2004).

This approach is related to the field of Cybernetics. The root of the name Cybernetics comes from the Greek κυβερνήτης (kybernētēs), which refers to the art of steersmanship when piloting a boat. Here, the control of the output is not imposed from 'above' (not hierarchical) but is a balance between

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all parts of the system. Examples of this type of approach would be: a composer influencing an algorithmic process in real-time, the layering of sound in a non-linear, semi randomized process or soundscapes that react to changes in the environment in which they are imbedded. (Toop, 2004)
These works are often reflexive or self-referential and outcomes are not fixed but instead adhere to a 'class of goals', which can produce unintended or unpredictable outcomes.

Heuristics are often employed in this type of creative enterprise; these are not algorithms or an aleatoric processes; they don't produce set results or chance outcomes but instead, results which are unpredictable but adhere to a 'class of goals'. Here errors are not seen as anomalies to be expunged from the process (as in A.I.) but as a vital part in any creative or learning process.

A good way of describing an heuristic would be to imagine that you wanted to go to the top of a mountain. If you were to do this using a system like artificial intelligence you'd have to describe every obstacle, every rock or nook or cranny of the mountainside and provide a map of this, requiring a huge amount of information. Alternatively, if you were to use an heuristic, you'd simply give the instruction "keep going up' and this simple command would bypass the need for all the extraneous information about the environment. So it's a very simple set of instructions that adheres to a known criterion, which can be changed as you go along, to achieve a class of outcomes. (Beer, 1994)
To Quote Stafford Beer- in a Cybernetic system "we may define some initial parameters, run the program and then ride the dynamics of the system in the direction we wish it to go". (Beer, 1994)

Generative and real-time compositional processes adhere to this model. Central to these modes of composition and cybernetics is the concept of the feedback loop. Feedback is the mechanism by which a system is able to reinforce or suppress stimulus without prior knowledge of the environment. In a living organism a *criterion of stability* is embedded in feedback mechanisms and this allows for the possibility of autopoiesis (a self sustaining organism). Feedback mechanisms can appear to be intelligent. However, the amount of data needed to create this type of command and control is extremely minimal.

Feedback loops are central to many engineering systems, one such example is a lavatory cistern, which is a very simple but effective feedback loop; as the handle is flushed the ballcock sinks to the bottom of the tank, thus opening a valve that fills the tank again with water. When the ballcock floats to the top of the tank on the ascending tide of water, this closes the valve. This system 'knows' nothing of its environment but its behavior has some characteristics of intelligence (Beer, 1994).

In order to create a much more sophisticated system (one capable of musical composition) numerous feedback loops are required. Switches (or criterions of stability) may be set to reinforce or suppress stimulus based on a continuous feedback process, which tests the composition for certain oppositional parameters. This is a dialectic, conversational process that exists within an environmental context.

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These parameters may be any information that the sound world might offer: amplitude, frequency, rhythmical content etc. The machine may then shape this material into a compositional structure, either alone or with human interaction. Cybernetic works are ephemeral and each iteration is unique

This all begs the question, why would we take the cybernetic route to making a compositional system rather than an artificial intelligence approach? Firstly, Musical notation is a good tool to use with computers if you wish to produce music that adheres to the western art tradition. However, as Dennis Smalley, amongst others has pointed out, notation is a poor descriptor of many modern electronic music's; this is particularly true when the medium mitigates the message in a symbiotic creative process. It is perhaps then pertinent to look to metadescriptors (beyond notation) that speak to what is common between both computer and human.

Secondly, as Douglas Hofstadter points out, Artificial intelligence is not able to solve the problem of computer compositions sounding creative or original (Hofstadter, D. 2007). And according to the technological philosopher Richard Coyne, computer interfaces are also very poor at interacting with human behavior in a meaningful or creative way (Coyne, 1995). There are some good reasons for this; the lack of feedback mechanisms in many AI systems and the Cartesian dualism that permeates much of this research being just two. Finally, AI makes systems based on the Cartesian paradigm function more 'efficiently', whereas Cybernetics focuses on sustainability, which encapsulates the creative act and creativity as fundamental elements. So in order to create a self-sustaining musical system that can respond to its environment and interact with a composer in a meaningful way, we must turn to the more pragmatic approach that Cybernetics offers.

To summarize: New forms of compositional structures are akin to primitive forms of musical practice, where performance and process are mediated by technologies, and ends or outcomes are not fixed but held within a frame of ritual or ontological beliefs. Within this context, the technology of notation can be seen as the dominant technology of a past era and not of the current time; new technologies are directing us toward an expanded musical epistemology and an otology, which is more akin to the pre-literate society than the literate.

Composers such as Lewis & Bebe Barron, Herbert Brün, Roland Kyan, Brian Eno, Agostino Di Scipio, Gordon Pask, Xenakis and John Cage, amongst others, have laid the theoretical and creative foundations for utilizing cybernetics within musical composition. Cybernetics offers an engineering framework that allows composers to design electronic musical systems that are meaningfully interactive or self-creating without needing to utilize notation. It also adheres to the pragmatic position, which sees the blurring of means and ends in the compositional process.

AI views computers as tools- the artificial thinking machine is a subservient entity.
Cybernetics offers an alternative view, one in which computers may be vibrant, symbiotic entireties that may partner us in our creative acts,

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assisting and enhancing our creative endeavors in reflexive, innovative and interesting new ways.

This is fertile ground that is seeing a resurgence in modern times as the nature of technology becomes evermore ubiquitous, personalized and symbiotic.

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