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Some Ontological Remarks about Music Composition Processes

Music composition processes can be envisioned as complex systems involving a plurality of operating levels. Abstractions of musical ideas are manifested in myriad ways and degrees, one of which is of course their suitability for implementation as algorithms, enabling musicians to explore possibilities that would otherwise lie out of reach. However, the role of algorithms (finite computable functions, in Turing's sense) is not to be simply reified in a composition.

Composers use computers not only as "number-crunching" devices, but also as interactive partners to perform operations where the output depends on actual performance. Composers are concerned with the creation of musical situations emerging concretely out of a critical interaction with their materials, including their algorithms. This task cannot be exhausted by a linear (a priori, non-interactive) problem-solving approach. Interaction is here matching an important feature of musical composition processes, giving room for the emergence of irreducible situations through non-linear interaction.

Irreducibility is perhaps a key word in this context, as we are dealing with music's categories and ends. Music is not dependent on logical constructs unverified by physical experience. Composers, especially those using computers, have learned—sometimes painfully—that the formal rigor of a generative function does not guarantee by itself the musical coherence of a result. Music cannot be confused with (or reduced to) a formalized discipline: even if music actually uses knowledge and tools coming from formalized disciplines, formalization does not play a foundational role in regard to musical processes. I will refer in this article to a "realist" ontological principle relying on "commitment to action" which can shed light on the nature of musical compositional processes in re-

gard to formal constructivism. Additionally, musical processes, at least from the composer's point of view, are not situations "out there" waiting to be discovered: they are rather to be composed (since they did not exist anywhere before being composed), and hence they cannot be considered properly as modeling activities, even if they use—and deeply absorb—models, knowledge, and tools coming from scientific domains (acoustic and psychoacoustic modeling, for example).

In fact, music transforms this knowledge and these tools into its own ontological concern: to create specific musical situations (musical "states of affairs"). To this end, a palette of diverse compositional instances is needed, including strategies for controlling and qualifying results and choices, according to a given musical project. These compositional instances, to reiterate, are not envisaged here in the frame of the traditional approach to algorithmic (automatic) composition: they are instead seen in the light of the ongoing paradigm shift from algorithmics to interaction (Wegner 1997, Bello 1997), where the general-purpose computer is regarded as one component of complex systems (Winograd 1979), and where the composer, being another component of these complex systems, is imbedded in a network within which he or she can act, design, and experience concrete tools and (meaningful) musical situations.

It is under this perspective, I believe, that the formal status of musical processes can be approached—in a certain way "revisited"—as I will try to do in this article, focusing on ontological questions. Computer music practice (computer-generated and computer-assisted composition) is of course the underlying frame of the discussion here offered, because these reflections have arisen from the author's daily exposure, as a composer, to a situation in which algorithms, choices, and "musical theses" are themselves confronted within an "action/perception feedback loop" which seems to con-

stitute definitively the pertinent instance of validation of musical processes.

Approaching Music's Ontology

Schönberg's Criticism of "External Calculus"

Schönberg states in his *Style and Idea* that "a purely external calculus system calls for a formal construction whose primitive nature is suitable only to primitive ideas" (Schönberg 1951). This remark points, in the particular language of its author, to the mismatches that may be caused by literal application of operations which may be successfully applied in other fields, but which are not guaranteed to function pertinently in a musical context, as long as they are not absorbed and transformed into elements proper to "music itself."

The Difficulty of Defining "Music Itself"

However, it can be argued here that the very idea of "music itself" encounters a major difficulty: nobody can say what music is, other than by means of a normative proposition, because "music itself" is in fact a non-demonstrable thing, and its practice is neither arbitrary nor based on physical or metaphysical foundations:

It is not because we know, in one manner or another (and without being able to say how), what music is that we also speak of atonal or concrete music as music. We use the word "music" according to certain rules, and these are neither very precise nor based on the "nature of things", even if they cannot be considered as arbitrary. (Bouveresse 1971, p. 318)

Certainly, we know that there is no necessity to define completely the concept of music in order to create, play, or listen to music. Furthermore, we know that the very existence of music, as a shared practice, would in fact be impossible if one should previously have to define completely the concept of music. This being the case, an ontology of mu-

sic should refer to the music's status cautiously, taking care to not fall into reductionist traps.

"Universals" Are Not Needed

On one side, there is no necessity to affirm the existence of "universals" standing above musical practices, whatever these universals might be: a Platonic Idea, the dogmatics of proportion, a normative foundation of harmony, and so on. Of course, there are primitive principles underlying musical practices, but these should not be qualified as foundations of "music itself," for this would negate the possibility of developing other musical practices related to different assumptions. Schönberg's famous statement about the "liberation of the dissonance" can be seen in this light: "the expressions 'consonance' and 'dissonance', if referred to an antithesis, are erroneous; it depends only on the capacity of an analytic hearing to become familiarized with the higher harmonics" (Schönberg 1951, p. 16). Evidently, there are many musical practices (including functional tonality) that are based precisely on the antithesis that Schönberg does not accept, as he is looking here for another reference concerning musical relationships. But this does not invalidate his statement about analytic hearing: on the contrary, his statement affirms the possibility of "music" beyond the musical world based on a given functionality (tonality, in this case) by stressing the fact that there may be other equally conceivable musical assumptions and constraints to which the perceptions of a given musical world are to be related.

Music Reveals Its Own "Creation Principle"

On the other side, there is an ultra-relativist thesis affirming that "music is everything we call music"; but to follow this line would mean to fall into another reductionistic trap, analogous to the first one. The example just referred to, showing the relationship between hearing (lower or higher harmonics) and specific musical assumptions and

constraints (specific kinds of relationships and functionalities, such as consonance and dissonance), tells us why it is so. We can understand, then, that in spite of many attempts at reduction, music-making remains an activity revealing its own "creation principle" where, to paraphrase Finsler (1996), "consistency implies existence," taking the word "existence" to mean the presence of a given state of affairs. We continue to use the word "music" according to certain rules, which are "neither very precise nor based on the nature of things" (in the words of Bouveresse, quoted above), to refer to musical practices that cannot be considered arbitrary. We do this while focusing on certain operations, categories, facts and ends that we determine to be specific to music, or at least to musical "possible worlds."

Of course, this use of the word "music" does not bring up the ultimate argument about the nature of music, but only refers to its existence in ontological terms, referring to a given state of affairs. A complementary "anthropo-logistic" argument may also be considered here, as musical practices exist within a given "style of life," or "a culture of one period," as Wittgenstein (1953) would say. On another account, Goodman's nominalism (Goodman 1976) may be evoked as well. But I will not discuss these matters further, as the aim of this article is not to engage in a discussion about current philosophical approaches: the aforementioned "creation principle," I think, may be sufficient to assess music "as is," without falling into reductionism.

Formalization Versus Commitment to Action: A Realist Ontology

As stated earlier, music uses knowledge from formal disciplines and creates a myriad of abstractions (operations encapsulating operations, etc.). However, we should assume that what falls under the heading of formal abstraction becomes, in music, part of the reality in which music develops its productive categories. A musical process includes a plurality of layers of operations of diverse kinds: it can certainly use formal tools as generative and

transformative devices; however, other instances are needed, involving concrete actions and perceptions, in order to qualify results and choices according to a given musical project. Here, formalization is not foundational, but operational, local, and tactical (see Sinaceur 1991 and Granger 1994). A (musical) system of symbols can be formally structured (i.e., built as a system including functions manifesting diverse degrees of abstraction) without being completely formalized, the last case arising, strictly speaking, when all non-defined symbols present in the system are properly enumerated (or, if preferred, when nothing is hidden). As Wegner noted with respect to other domains, the key argument against complete formalization of such things as musical composition processes is "the inherent trade off between logical completeness and commitment to action," because "committed choice to the course of action is inherently incomplete" (Wegner 1997).

We can recall here Finsler's ideas expressed in the 1920s and cited by Wegner as pioneering a "realist ontology," where a "creation principle" is posited: "concepts exist independently of formalisms in which they are expressed" (Finsler 1996). Finsler "went beyond Hilbert's formalism in applying the principle 'consistency implies existence', accepting the existence of concepts independently of whether they are formalized" (Wegner and Goldin 1999). We can easily paraphrase Finsler, substituting "concepts" for "musical ideas" to reinforce a "realist ontology" affirming that musical ideas exist independently of their possible formalization or even "constructability" (since they can emerge from a plurality of interactive factors).

Algorithms, Interaction, and Complex Systems

Evidently, using computers (the most general symbolic processors that have ever existed) drives music activity to an expansion of its formal categories. Computer algorithms (whatever the paradigm on which they are based) can be considered as formal constructs where reasoning is embodied in ma-

chines. Computer algorithms differ however from their pure logical (disembodied) ancestors by an important feature: they are dynamically oriented, involving networking with other machines as well as human interaction. Computer algorithms are embedded in complex (and heterogeneous) systems, within which they are used as processing tools.

As Winograd pointed out 20 years ago,

[C]omputers are not primarily used for solving well-structured problems, but instead are components in complex systems. . . . Programming in the future will depend more and more on specifying behavior. The systems we build will carry out real-time interactions with users, other computers, and physical systems (e.g. for process control). In understanding the interaction among independent components, we will be concerned with detailed aspects of their temporal behavior. The machine must be thought of as a mechanism with which we interact, not a mathematical abstraction which can be fully characterized in terms of its results. (Winograd 1979)

Computer music can be envisioned as one such complex system in which the processing power of computers deals with a variety of concrete actions involving multiple perspectives, in terms of time scales and levels of representation. This situation leads us to rethink basic issues related to composer-machine interaction, as Bello remarks:

Traditional approaches toward composer-machine interaction have been fundamentally based on the machine itself, with perhaps very little consideration placed on our external experiences in the world, particularly our interactive experiences. Many of the traditional approaches appeared to have been concentrating on a micro-world perspective, whereby well defined problems in composition and sound design have been explored. Such an approach ignores, or at least fails to acknowledge, the existence of an external interactive environment in which the composer is definitely a part. (Bello 1997, p. 30)

Constraints and the Composer's Posited Relationships

Composers build musical situations by creating constraints that act as "reflecting walls" inside which a tissue of specific relationships is spun (Vaggione 1997). I use the expression "constraint" in the sense of its etymology: limit, condition, force, and, by extension, definition of the degrees of freedom assumed by an actor in a given situation within self-imposed boundaries. In this broader sense, the composer's constraints are specific assumptions about musical relationships: multi-level assumptions that can be in some cases translated into finite computable functions (algorithms), and in other cases satisfied only by means of the composer's interaction (performance). Constraints are embedded at every level in the "world" posited in the musical work. We can also say, particularly à propos in this case, that a musical work presents, as Adorno has noted, a "thesis"—a musical thesis which encompasses all its dimensions, even the most elementary materials: "Everything that might appear in music as being immediate and natural . . . is, in reality, the result of a `thesis'; the isolated sound cannot escape this rule" (Adorno 1963, p. 319).

Can we say, in this case, that this thesis (posited world) and constraints (embedded specific assumptions) are specifications? Surely, but we must consider carefully the kinds of things (the classes) that are specified: local computable functions are on one side, with the classical condition of consistency satisfying a specification. On the other side, we find global instances (actors) controlling the multiplicity of local computable functions through interaction, with the non-classical condition of consistency as a state of affairs, and the satisfaction of a specification as something that is not formally granted, but must be reached through action: consistency "performed" by the composer. So musical thesis, constraints, and specifications (referring to the same "reflecting walls" metaphor at different perspectives) are not categories encapsulating linearities, but vectors of posited relationships that may or may not become satisfied,

depending on a certain way of interactively matching inputs and outputs. The role of the composer here is not one of setting a mechanism and watching it run, but one of setting the conditions that will allow him or her to perform musical actions.

Being Cautious with "Rules"

Debussy's saying, "The work makes its own rules," summarizes well the situation of the composer's constraints alluded to above. However, it seems necessary to be cautious when using the word "rule" in an artistic domain:

To be considered rightly as such, a rule must necessarily be followed many times. A private rule is already in a certain sense a contradiction in adjecto (Bouveresse 1976, p. 429).

Computer algorithms (which compute outputs non-interactively from their inputs) are generally quite consistent in regard to rules, in the classical (Hilbertian, so to speak) sense—in any case, to an extent that musical works never show. Concerning the latter, we can recall Donald Byrd's statements on common music notation:

The point is that the supposed rules of common music notation are not independent; they interact, and when the situation makes them interact strongly enough, something has to give way. It is tempting to assume that the rules of such an elaborate and successful system as common music notation must be self-consistent. A problem with this idea is that so many of the "rules" are, necessarily, very nebulous. Every book on common music notation is full of vague statements illustrated by examples that often fail to make the rule clear, but if you try to make every rule as precise as possible, what you get is certainly not self-consistent. (Byrd 1994, p. 17)

Someone can perhaps argue that the above description applies to a system of notation, and not to musical processes themselves. This criticism can also point to the existence of non-notateable music processes (tape music, improvisation). Facing these ar-

guments, I shall make the following remarks: (1) I consider that the intelligibility of music is always revealed in the hearing, and not in the score; and (2) if music were a "self-consistent formal system" in a Hilbertian sense, music notation would reflect this status, as, for example, Hilbertian notations (of logical reasoning systems) do.

Of course, another matter is considering musical notation from the point of view of Finsler's realist ontology, as referred to above, where consistency implies existence. Byrd acknowledges the necessity of vagueness or nebulosity of music notation "rules," as they articulate a complex system where heterogeneous referents (some discrete, some analogue) are strongly interacting. Even an operation which seems to be mechanical, such as orchestral part extraction, is difficult to realize with an algorithm of average complexity, owing to the superposition of information, some precisely quantified, some only globally qualified, some dependent on the simple graphical space of the page, some inscribed in a much more precise topological space. Only the musician who reads the score knows, for example, when it is time to turn the page—a function of the context conditioning his or her actions. This point is not irrelevant: it shows that music is constituted of actions and perceptions, and that these actions and perceptions are what is actually transmitted in the score and in the playing.

A Plurality of Representational Systems

There is no musical composition process (instrumental, electroacoustic, or otherwise) without representational systems at work—a plurality of representational systems, depending at which level or time scale we are operating. The problem that music composition gives rise to is the articulation of these representation systems, because the outputs of music's processes are interactively related to their (multi-level) inputs. A "note," for example (especially if we consider it from the perspective of an interaction between macro-time and micro-time scales allowed by computer means) can be seen as a chunk of multi-layered events covering many simultaneous temporal lev-

els, each one having its own morphological features that can be captured, composed, and described using adequate representational systems. We must take into account, however, the fact that some types of representation that are valid on one level cannot always retain their pertinence when transposed to another level (see Vaggione 1998 and Budon 2000). Composing music (creating musical morphologies) includes defining, articulating, and bringing into interaction these varieties of levels.

"Of What Use Is It To Know Before . . ."

Of course, every musical process contains "primitives" which derive from a specific common practice. One can say that "constraints" become "rules" if they exceed their use within a particular musical work to become part of a common practice. (In this sense I use the distinction, in order to avoid reference to "private rules," as discussed above.) The rules we learn at the conservatory are the result of a long historical effort of codification of evolving practices (each codification representing a vertical cut in this evolving body, freezing a given state in order to clarify its main characteristics). These rules (at least a good number of them) are pedagogical in nature. Their purpose lies in describing a certain musical practice so that we may imitate it to become "cultivated" musicians. As such, they must be collectively understood and validated. Often, the analyst-musicologist follows—albeit unconsciously—this approach, which lies at the root of much confusion concerning the role of musical analysis (to find the rules of a given work). Debussy's expression refers to this and was directed precisely against this amalgam, which reduces music to rules, thus ignoring the ontological status (the "creation principle") of a work.

With regard to artistic creation, an "insidious question," as Bouveresse would put it, comes to mind: "Of what use is it to know before, in whatever sense of the expression 'to know', what we will do later in a concrete case?" (Bouveresse 1971, p. 235). This is the kind of question often posed (to themselves) by young students who desire to become composers (this has been my personal case), as

they struggle to gain musical craftsmanship without yet realizing its inherent heterogeneity, i.e., the fact that music's "primitives" can always be modified, that new significations may emerge during a compositional process, changing and "enriching" the sense of any chunk of musical knowledge.

Beyond an Exercise in Style

Here lies what seems to be one of the sources of confusion regarding the nature of music composition processes: on the one hand, we must make as careful a distinction as possible between the collective rules and the composer's own constraints; on the other, this distinction seems irrelevant because, according to the "creation principle," the terms can always be modified. That is to say, any primitive (coming from a common practice or postulated *ad hoc*) is to be considered as a part of what is to be composed, in order to produce a musical work affirming itself as a singularity, beyond an exercise in style. Adorno was of course conscious of this dialectic: his statement about sound material considered not as something "given" but as a "result" of a musical thesis clearly points to this fact.

Action and Perception

I must recall that I am considering an ontology of music where action and perception are principal components. In any case, I assume that such things as thesis, constraints, choices, and so on would not be musically pertinent if they were devoid of implications touching directly on questions of action and perception, i.e., revealing a commitment to action that relies on perception as a controlling instance, hence as an ontological feature of the interactive situation itself.

So thesis and constraints are revealed through perception. They are to be heard, first of all, by the composer who is also a listener. The composer as a listener is the correlate of the composer as a producer: in order to produce music, an act of hearing is necessary, whether it be the "inner hearing" (the silent writing situation) of pure instrumental

music composition, or the "concrete hearing" of electroacoustic music composition. These situations involve variants (there are many others) of an "action/perception feedback loop" which can be defined as an instance of validation proper to musical processes.

Multi-scale Processes Validated by Perception

We must now consider a new situation arising from the use of computers for building musical processes. By using an increasingly sophisticated palette of signal processing tools, composers are now intervening not only at the macro-time domain (which can be defined as the time domain standing above the level of the "note"), but they are also intervening at the micro-time domain (which can be defined as the time domain standing within the "note") (Vaggione 1998). The micro-time domain is manifest at levels where the duration of events is on the order of milliseconds (Roads forthcoming). Operations realized at some of these levels may of course not be perceived when working directly: in order to perceive (and therefore validate) the musical results, the composer should temporarily leave micro-time, "taking the elevator" to macro-time. As a painter who works directly on a canvas must step back some distance to perceive the result of his or her action, validating it in a variety of spatial perspectives, so must the composer dealing with different time scales. This being so, a new category must be added to the action/perception feedback loop, a kind of "shifting hearing" allowing the results of operations to be checked at many different time scales. Some of these time scales are not audible directly and need to be validated perceptually by their effects over other (higher) time scales.

Any computer program dealing with audio data includes some kind of zooming facility. This is not a trivial feature, though. Since the different time-levels present in a musical situation strongly interact, morphologies can circulate from one level to another. However, such circulation cannot take place, in many cases, except under non-linear conditions: as noted, some types of representation

that are valid on one level cannot always retain their pertinence when transposed to another level. Thus, multi-level operations do not exclude fractures, distortions, and mismatches between the levels. To face these mismatches, a multi-syntactical strategy is "composed." Object-oriented programming strategies, as I have noted elsewhere, can help to encapsulate diverse syntactical layers into a multi-level entity (an object) able to integrate a given compositional network (Vaggione 1998). But this kind of situation needs to be constantly checked from a musical point of view. The action/perception feedback loop is here the pertinent instance where this situation can be musically controlled and validated.

Conclusion

What a composer wants comes from the "singularity" of his or her musical project—from the composer's manner of performing a critical act with relationships. Hence, composers can—at will—reduce or enlarge their operational categories or their field of control, producing and applying constraints as well as making the numerous choices necessary during the compositional process. In this article, I have stressed the fact that a musical process involves a plurality of layers of operations of diverse kinds. Musical processes can be produced using formal tools (algorithms) as generative and transformative devices, yet other compositional instances call for strategies relying on interaction in order to control and qualify results and choices. Using computers drives musical activity to an expansion of its formal categories. These categories are dynamic, precisely owing to the use of computers: vectorized, presupposing networking and interaction, including hidden terms, without which music creation would be reduced to the exploitation of a linear mechanism.

There is no musical process without representational systems at work—a plurality of representational systems, depending at which level or time scale we are operating. Algorithmic representations cover a substantial part of this plurality and are certainly pertinent, as they can match at least some of

the assumptions underlying a given music production system, especially when including the condition of interaction, revealing its many simultaneous levels of articulation as well as its direct anchoring in perception. This leads us to valorize what is perhaps the most important issue for an ontology of music: the fact that situations organized around the production of music would not be pertinent if they were devoid of implications touching directly on questions of action and perception. So the approach presented here presupposes a basic assumption, namely, that the meaning of any compositional technique, or any chunk of musical knowledge, arises from its function in support of a specific musical action, which in turn has a strong bearing on the question of how this action is perceived. Action and perception lie at the heart of musical processes, as these musical processes are created by successive operations of concretization having as a tuning tool—as a principle of reality—an action/perception feedback loop.

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