The Self-Organising Work of Music

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In this paper, I will focus on the musical work as a *self-organising entity* within a systemic framework. In particular, two significant and inter-related systemic concepts will be mentioned: *self-organisation* and *open system*. Firstly, I shall explain the two concepts within the context of *systems thinking* with reference to a graphical model of *second-order cybernetics*. This section will conclude with a discussion of the difference between natural and artificial *self-organising systems*. I will then extend the systemic perspective, describing what I call *self-organising music*, and discussing my algorithmic composition *Ephemeron* as a case study.

1. INTRODUCTION

Theories that emerged during the second half of the twentieth century radically changed the way in which we experience and describe the world through science. Instead of the reductionist view (the tendency to reduce any complex entity to its fundamental components), the new epistemology treated everything as organised wholes, as systems. From a systemic perspective, we are not only interested in the individual components, but also in the way in which they relate to each other and function within the whole. Aspects of *systems thinking* such as *cybernetics*, *general systems theory* or the more recent *complexity science* have been developed, and have influenced many aspects of today's thought and practice, including the arts and music.

Numerous composers have been inspired by systemic notions and have applied them to music, including two who I have previously discussed in detail: Iannis Xenakis and Agostino Di Scipio (Kollias 2007, 2008). Whether these applications of systemic notions are direct (i.e. technical) or metaphorical (i.e. aesthetic), systems thinking has been a significant source of inspiration for music.[1] Barry Truax, another composer who uses systemic concepts in his musical thinking, points out the importance of the model of 'emergent complex systems' (Truax 2003). As he explains, this has many important applications to music, providing new models of sound design and composition, and potentially changing the role of the composer to that of guiding complex processes. According to Truax (2003), the role of the artist as the creator of all the details of the artistic result has now transformed into that of leading the process of the result's creation.

Our interest here is the work of music as a *self-organising entity*. I will discuss this within a systems-thinking framework, mainly using two inter-related systemic concepts: *self-organisation* and *open system*. I shall link these concepts with a graphical model of *second-order cybernetics* and conclude this section by considering the differences between natural and artificial self-organising systems.

Subsequently, I will define what I call *self-organising music*, applying the two systemic concepts to music. To clarify my point, I shall discuss my algorithmic composition *Ephemeron* (2008) as a case study.

2. THE OPEN SYSTEM

A fundamental concept in systems thinking, linked with the phenomenon of life, is that of the *open system*. Von Bertalanffy defines a system 'as a set of elements in interaction' (von Bertalanffy 1968: 83). In theory, systems can be closed or open. According to von Bertalanffy, closed systems are those 'which are considered to be isolated from their environment' (1968: 39). As Luhmann explains, a closed system is only a 'limit case: a system for which the environment has no significance or is significant only through specified channels' (Luhmann 1995: 7). Closed systems do not really exist in nature, but can be found in situations such as chemical reactions in a closed vessel. According to von Bertalanffy, the theory of open systems is a generalisation of physical theory, kinetics and thermodynamics (von Bertalanffy 1968: 102). He further defines the open system as 'a system in exchange of matter with its environment, presenting import and export, building-up and breaking-down of its material components' (1968: 141). Fundamental characteristics of life such as metabolism, growth, development, self-regulation, response to stimuli, spontaneous activity are attributed to 'the fact that the [living] organism is an open system' (1968: 149).

3. SELF-ORGANISATION

The discovery of the self-organisation notion was revolutionary for scientific studies in general since it allowed us to more accurately study living organisms. As the term suggests, a self-organising system is a

[1] I have previously demonstrated two personal applications of systemic principles in music composition (Kollias 2009b).

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system able to organise its own function. I will refer to two classic papers in the field that elaborate this notion (von Foerster 1960 and Ashby 1962). Von Foerster asserts that 'there are no such things as self-organising systems' without taking into consideration their environments (von Foerster 1960: 1). Thus von Foerster focuses the attention on the fundamental role that the environment has on self-organising systems. He summarises the following conditions (1960: 6):

1. A self-organising system is the 'part of a system that eats energy and order from its environment'.
2. 'There is a reality of the environment' – opposed to the solipsistic view that the observer is the only existing reality.
3. 'The environment has structure'.

As we can observe, a self-organising system is inevitably an open system, as it is depended on its environment, and they are in continuous interaction. Von Foerster indicates the difficulty of defining the boundaries between the self-organising system and its environment (1960: 7) since, even if the viewpoint of the observer is exact, it is not necessarily clear what he or she may observe. He refers to two important principles for the understanding of self-organising systems. First, Schrodinger's *order from order* principle, which its author considers as 'the real clue to the understanding of life' (quoted in von Foerster 1960). Second, von Foerster introduces the principle of *order from noise* (1960: 11). As he explains, not only is noise desirable, but it can also help the system adjust to a more appropriate state.

According to Ashby, the idea of self-organisation implies two meanings (Ashby 1962: 114–15). The first meaning concerns a system with separate parts that start to form interactions among themselves. It is what he calls the process of 'changing from unorganized to organized' (1962: 115). This is what he calls a *self-connecting* system, and is, for instance, what takes place in the nervous system of an embryo. The second meaning of self-organisation concerns 'changing from bad organization to good organization' as he puts it (1962: 115). In other words, it concerns a system that changes from an inappropriate way of behaving in a given environment to an appropriate way of behaving in this environment. As an example, a young child has the tendency to approach fire but subsequently learns to avoid it. Most of the time, with regard to the term self-organisation we refer to the second meaning. Ashby goes as far as to suggest that '*every* dynamic system generates its own form of intelligent life [and] is self-organizing in this sense' (1962: 118).

4. THE MODEL OF SECOND-ORDER CYBERNETICS

To make the above concepts more comprehensible, I will refer to the model of second-order cybernetics,

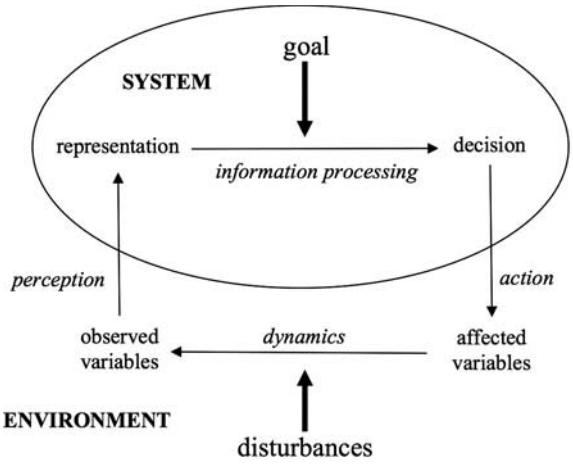

Figure 1. Model of a self-organising system (from Heylighen and Joslyn 2001).

which implies both an open system and self-organisation. Let us consider that the main function of cybernetics is to model a chosen part of reality. In second-order cybernetics the observer is also taken into consideration in the modelling process. From this perspective there is no model of reality without its observer.

The model of second-order cybernetics described by Heylighen and Joslyn (2001), offers a comprehensible description along with schematisation (Figure 1). In this model, we have a system that is in continuous interaction with its environment, based on a feedback cycle with two inputs. The first input is the *goal* of the system, which is to control the values of the system's essential variables. A variable can be any observable and consistent change which may interest the observer in his or her modelling process. The second input is the *disturbances* in the environment – in other words, all the processes in the environment that the system cannot control and which can influence the essential system variables.

The model functions in the following manner: the system *observes* (or senses) the environment's variables that interest it. Through the process of *perception*, the system *represents* the external variables 'inside' itself. This *representation* is always *processed* with regard to the system's *goal*, and the system *decides* on an *action* upon the environment. Consequently, this action will *affect variables* of the environment. The environment's dynamics will be influenced by these affected variables as well as by other variables not known to the system – that is, the *disturbances* in the environment. In conclusion, the variables observed by the system will be also be affected by the changes in the environmental dynamics, and thus the system will start again the cyclical process of perceiving and acting.

Note that the diagram in Figure 1 may give rise to certain questions. Is it possible to talk about

representation in natural self-organising systems?[2] Where are the limits between the system and its environment – to talk about the inside and outside of the system – as von Foerster asks? Nevertheless, even if it is a simple schematisation of the model, we can clearly observe fundamental aspects such as the interdependence of the system and the environment through continuous communication, or the order from noise principle.

5. NATURAL VS. ARTIFICIAL SELF-ORGANISING SYSTEMS

It is important to make some observation here regarding self-organisation. There is a fundamental difference between the self-organising principle *found* in nature and that which is *applied* in designed systems by human. In nature, self-organisation takes place *spontaneously* at each organisational level: for instance, the seemingly random motion of the subatomic level will emerge into a structured atomic level. Furthermore, possible changes in a 'higher' organisational level may influence a 'lower' organisational level. As Mitchell explains, all adaptive systems preserve balance between bottom-up and top-down processes, with an optimal balance shifting over time (Mitchell 2006). Although the mechanistic world view of a randomly ordered and purposeless universe is questioned, that does not qualify for the existence of a global designer, who creates any of the organisational levels.

On the other hand, by observing and simulating nature, man has managed to design mechanisms that can show characteristics of self-organisation: from simple self-regulating mechanisms such as the thermostat, to complex servomechanisms such as robots. Although an artificial self-organising system may seem as efficient as an adapted organism in a particular environment, in reality they are far from this.

What differentiates an artificial self-organising system from a natural one is the relationship with the environment. A live organism has emerged and has evolved through endless years of evolution in a particular environment. The organism is in fact an inseparable part of this environment. It has, and has always had, a continuous interaction with the environment, resulting in the organism being as it is at the moment of observation. For example, a frog that lives in a particular river has emerged as an organism in relation with the food it can find or the predators it has to avoid. If this species of frog becomes extinct, inevitable changes will occur in the ecosystem: animals fed by the frog will have fewer resources to survive and may decrease in population, whereas insects such as flies and mosquitos will be multiplied, which may in turn cause another set of changes to the ecosystem.

On the contrary, a self-organising machine is built within an environment perceived by humans and for a purpose designed by humans. There is no adaptation of a particular machine through the interactions with the environment, nor is there an evolution of a hypothetical species of machines. There may be a technological evolution in order to serve the predefined human goal more efficiently. A new model of the machine may be better adapted for the environment through the maker's observation and redesigning of the machine. Thus, the resulting evolution of the machine is imposed rather than self-organised.

In fact, by building a machine, humans define also the environment of the self-organising machine. This is a fundamental difference between a simple bug that can survive in a particular environment through endless years of evolution and a machine that can function correctly within certain circumstances because it was designed for these circumstances alone. Thus, it is necessary to consider that artificial self-organisation takes place on limited structural levels within the system.

6. SELF-ORGANISING MUSIC

Now let us take the systemic discussion into music. I have previously described *self-organising music* as 'the result of the interactions between some predefined structures and an occasional context of performance, through a particular interpretational model' (Kollias 2009a).[3] In other words, a self-organising work *emerges* during a performance from the interactions defined by an interpretational model, interactions between the structures constituting the self-organising work and the given context of performance. Here I will further discuss this idea.

A composer may start by conceiving a number of *structures* – or choosing among preconceived structures. These structures can be at any level of temporal organisation, from the micro-temporal domain to the macro-temporal domain. For instance, the composer may conceive structures by synthesising sounds, or by constructing the evolution of global changes in the piece. Structures are codified in such a way that they are identifiable and operational. The codification can be by visual means, such as graphic representation or conventional notation. The structures may vary from abstract concepts to very determined schematisations. In a cybernetic context, the predefined structures are the content of the information flow

[2]The concept of representation in respect to intelligence is in question as argued by Varela (1988) or the robotic research of Brooks (1991).

[3]In my article (2009a) where I define *self-organising music*, I refer to the term as 'self-organised music'. Although 'self-organised' is not incorrect, from now on I prefer to use the term 'self-organising' since it suggests a dynamic process and not a finite one.

exchanged between system and environment. The system – in our case a self-organising work – will try to observe changes in its environment – the context of performance – in terms of some predefined structures, and it will act upon the environment using also some predefined structures – not necessarily the same ones. For example, the composer may use as structures a sonic cluster variably determined, or a number of clearly defined notes and rhythms, or even programme an audio feedback mechanism. These structures will be subject to change during the performance in regard with specific changes within the perceived environment. The structures are 'predefined' in the sense that they are chosen before the performance.

A *context of performance* may include anything related to a performance occasion. In a systemic viewpoint, we can consider the context of performance as the environment of the system. It can be anything perceivable by the audience that can have an impact on the self-organising work. Or even, reversely, it can be anything that can be influenced by the work. The context of performance may include, for example, the acoustic characteristics of the space, the properties or the number of the microphones or speakers.

In addition, the composer creates, directly or indirectly, the *interpretational model*. In a systemic sense, that is the functional mapping between the predefined structures and each context of performance. In other words, the composer creates the way these structures are interpreted during any occasional performance. As Di Scipio puts it, the composer, instead of composing the music, 'composes the interactions' (Di Scipio 2003). In particular, viewed through our model of self-organising music, he or she creates the interaction between the predefined structures and any possible situation in which the work will be constituted. The interpretational model – in other words, the set of interactions – includes any potential system which will emerge during any potential performance.

Finally, to sum up and put the model into life, a self organising work emerges during the performance from the dialogue between the interpretational model and the occasional context of performance using the predefined structures. The self-organising work of music emerges as a dynamic complex entity. The work is born in the particular context of performance in which it also dies.

7. MUSIC WORK AS A SELF-ORGANISING ENTITY

One of the consequences of this approach is that the creative process of what can be considered as the potential musical work does not stop when the product of composing leaves the hands of the composer. In fact, when the composer completes the compositional process he or she does not even have an end product of a musical work. The occasional work will be only constituted during the performance as it depends each time on the context of performance.

This approach may sound as if there is a purely improvised work, an indeterminate work, or an aleatoric composition. This can be the case where the interpretational model is not stable, and thus left open to change during the performance. This could be the case if decisions were extensively given to the performer. Nevertheless, if the interpretational model is strictly defined, as it is the case with an electronic algorithm, then the sound result is neither determinate nor random and will be different and unpredictable each time. That is because there is *circular causality*[4] and *nonlinear dynamics*[5] from which the work will emerge each time.

A fundamental question that emerges is whether the work is always recognisable as one and the same work among different performances – the question of the work's *identity*. That is dependent on the recursion of the elements – of any possible organisational level – among different performances. The elements can be in any of the three major domains of a self-organising musical work: 'predefined structures', 'interpretational model' or 'context of performance'. For example, elements of recursion in the case of the context of performance include: the place of the performance (is it the same place or a similar one each time?), the public (are they the same or different people?), or the sound projection (is it projected from the same speakers?). Elements of recursion in the case of predefined structures may be: sound material (are there any recognisable sound elements that we can recall between performances?) or macro-form (is there a similar evolution in time?). Recursion within the domain of interpretational model refers to the similarity of interactions among predefined structures and thus it may not be as apparent. For instance, the manner in which a sonic element resonates within the listening environment can be perceived by the self-organising work and in turn change its subsequent evolution in time.

If there are no recursive elements within any of these three domains, the identity of the work across numerous performances is established due to the existence of more abstract factors, such as for example the work's title or programme note.

8. CONTROL VS. SELF-ORGANISATION

Above we discussed the differences between natural and artificial self-organising systems. Of course, self-organising music cannot escape from the second

[4]The term *circular causality* describes processes where the cause and the effect are mutually dependent.

[5]*Nonlinear dynamic systems* demonstrate unpredictable behaviour or even seemingly random behaviour. Their variables are difficult or impossible to be expressed in a collection of linear components.

category. Although the term may be misunderstood to suggest music that magically generates its own existence without the intervention of an external human agent, obviously this is not the case.

As we are talking about artificial creation, in the beginning there is always a human agent designing a part of the system. As mentioned before, this process takes place on a particular organisational level. In other words, even if the system is considered as a self-organising one, there is always a level at which control is applied. This control process of designing part of a system changes the system from the 'outside' before letting it regulate its own processes.

Let us take the extreme case of identifying a self-organising work in the more absolute sense. The composer frames part of a natural ecosystem, where there has not been any direct human intervention. Imagine for example that he or she defines the framework of perception within a tropical forest. So the work here is the sound environment of falling rain on leaves and soil, birds flying, insects crawling, and so on. The work will be a part of this natural ecosystem, with all sounds emanating from the interactions of its elements, be these living organisms or natural phenomena. Thus we can claim that the composer does not intervene with the natural self-organisation of the given environment that has started since the beginning of time. He or she simply allows everything to emerge spontaneously: in other words, the 'interpretational model', 'predefined structures' and 'context of performance'.

Several questions may arise here. Is it possible to be present in the environment and not influence it? Given that this is the only person to experience this, does it really qualify as a work of music? Alternatively, if we place an audience inside this spontaneous self-organised music ecosystem, will the ecosystem stay unchanged? Or in the other extreme, if there is no human observer in the framed sonic ecosystem, does it qualify as a work without any human presence? Does not the action of choosing and setting the framework make the composer part of the ecosystem?

9. *EPHEMERON*

Here I will discuss my own work *Ephemeron* (2008), firstly in order to clarify my points, and secondly to show concrete results of the applications of my research, and of course to satisfy the curiosity of those seeking to listen to and understand the resulting music.

The aforementioned work is an attempt to apply notions of systems thinking into live electroacoustic music. The sound result comes from an algorithm written in Max/MSP and using the 'external' *loudness~*, a sound descriptor of the perceptual attribute of loudness, created by Tristan Jehan. The algorithm receives sound from two to four microphones and projects the result through eight to twenty-one speakers. I have already described the work's structure functionally and spatially, and I have discussed its principles within a systemic framework (Kollias 2009a) so will avoid repeating the discussion here.

The main idea of *Ephemeron* is a live music organism, existing during the performance and fed by the sound of the audience's applause – applause always acknowledging the previous piece of music. In each performance, since the constitution of sound begins, a new musical work emerges – a new Ephemeron. The work is the sound result of its adaptation within the sonic-ecosystem; that is to say, the physical space observed through the sense of hearing – including the particular acoustic properties and any sound included within this sonic-ecosystem. The work emerges during the performance from the dialogue between the electronic algorithm ('interpretational model') and the 'context of performance', using different settings of audio feedback ('predefined structures').

Ephemeron's existence begins from the moment the process of the sound's projection starts from the speakers and its existence ends with the completion of the sound's emission. There is no *Ephemeron* before or after the performance. After the performance, it exists only as a memory, whereas before the performance it is only an expectation of its imaginary manifestation in the future. Nevertheless, the algorithm that can bring any possible *Ephemeron* into life is always in existence.

10. THE EPHEMERAL WORK

The notion of the work in this kind of self-organising music has an ephemeral character. As we show above, a musical work emerges during a particular performance from the dialogue between 'interpretational model' and the 'context of performance' using 'predefined structures'. Its emergence as a complex dynamic entity is framed from its birth and its death in the particular context of performance.

To go even further in this line of thought, we may not always be aware that even music of fixed medium, composed in a studio situation, has characteristics of open systems. Every time it is diffused, the work's constitution depends on the particular characteristics of the playback system, the acoustic characteristics of space, not to mention the particular social context. Even in this case the work's constitution depends on the particular 'context of performance'. Any unexpected sound event that may occur during the performance can critically influence the appreciation of the work. On the one hand, we can argue that our perceptual system has been taught to filter out anything considered as undesirable in a concert situation, like the creaking

of chairs, the breathing of the person sitting next to us, the sound of turning pages, the usual interferences of the light-projectors with sound system, and so on. On the other hand, some unexpected events may directly affect the perception or the diffusion-execution of a piece: an ambulance passing by, or a door banging. In some cases such unexpected events may be rather disturbing. In others, the unexpected event can be integrated into the perception of the whole context – one more example of the principle of order from noise.

Another aspect is that the *experience* of a work, even if it is a work of a stable identity, differs for each and every individual. This depends on factors such as the position of the auditor in the concert hall, or even his or her psychosomatic state. Imagine, for example, listening to a multi-channel composition from a central point in a concert space, or instead sitting on the back of the hall. Or imagine the difference between listening in the same situation after a glass of wine, or after a hard day's work. Moreover, the perception of the same piece is different every time it is performed for the same person.

It is the attribution of symbols, or any kind of signs, that makes a particular situation to be perceived as similar with another situation. Nevertheless, if we compare these situations, only a small part will be identical. As von Glasersfeld puts it:

> The living creature, be it fish, fowl, or human, thrives by abstracting regularities and rules from experience that enable it to avoid disagreeable situations and, to some extent, to generate agreeable ones. This 'abstracting of regularities' is always the result of assimilation. No experience is ever the same as another in the absolute sense. Repetition and, consequently, regularity can be obtained only by disregarding certain differences. (von Glasersfeld 1990)

Concerning acousmatic music written on a fixed medium, from the moment the composer decides the work's completion there is no intervention on what we could call *the level of creation*. There will be no more change, in this particular structural level (i.e. the level of creation) during the diffusion of the work. As there is no influence on this particular structural level during the 'context of performance', we can consider that particular organisational level as 'closed'.

Nevertheless, as we said above, a closed system is an extreme case. In reality, there are no systems completely closed or completely open. The completely closed case signifies a system that is absolutely unchanged by the environment, something inexistent. The completely open case refers to a system that is completely influenced by the environment, and thus cancels out any possible definition of its boundaries.

With regard to the acousmatic work, it is difficult to define the boundaries between the work's 'closed' level of creation, and the 'open' level of its 'interpretational model' during a given 'context of performance'. It is therefore more accurate to talk about *degrees of openness* of a work with regard to context of performance. For instance, an acousmatic composition of the fixed medium is classified as less 'open' to change during the performance than a planned improvisation or an interactive composition.

Concerning works written and performed by means of notation, the score is the part of the system that tends to be 'closed'. Nevertheless, the score is not the work itself but a detailed representation of it. A representation in such a manner will give to the performers the appropriate information, which, if executed in an appropriate way, will lead to the work's manifestation.

11. THE EXISTENCE OF THE MUSICAL WORK

In the instance of *Ephemeron*, when the work does not sound, the work is not there. There lies only the algorithm of potential works. There is also the expectation and possibly the memory of the work. In the case of a notated piece of music, the score contains the interpretational model, including the predefined structures, but it is not the work itself, as it is not manifested in a context of performance. The score is a set of well-defined symbols through conventions, representing a potential work to be constituted; but the work is not there.

The boundaries become indistinct if we are able to read notation and can recreate a portion of it in our imagination. Is this a valid constitution of the work? Or is it only a physical manifestation of sound that validates the existence of a work?

Perhaps we have studied a composition intensively, both in score and in concert. In an isolated and silent room, we are able to recreate the musical experience in our imagination in the finest detail, as if confronted by an actual performance. Is this a manifestation of the work through our perception, or does the physical absence of sound make it invalid? The difficulty here is only compounded considering von Foerster and Maturana's insight that 'in the nervous system there is no *a priori* distinction between a perception and a hallucination: both are merely patterns of neural activation' (paraphrased in Heylighen and Joslyn 2001).

12. CONCLUSIONS

I have presented the notion of a musical work as a self-organising entity, where a self-organising work of music emerges during the performance using 'predefined structures' between the dialogue of the 'interpretational model' – the set of composed interactions – and the

'context of performance'. The self-organising work will be only constituted during a performance, as in each instance it is dependent on the context of performance. The sound result is neither determinate nor random and will be different and unpredictable each time. The identity of a self-organising work is dependent on the recursion of elements in any of the three domains: predefined structures, interpretational model or context of performance. However, if there are no recursive elements within any of these three domains, the identity of the work across numerous performances is established due to the existence of more abstract factors, such as, for example, the work's title or a programme note.

There is a fundamental difference between the self-organising principle *found* in nature and that which is *applied* in designed systems by human. Natural self-organisation takes place spontaneously in each organisational level of the whole system. Artificial self-organisation takes place on limited structural levels within the system. In self-organising music, being also an artificial creation, there is always a level in which control is applied before we let the work regulate its own processes. By composing a frame around a part of a natural ecosystem, I show the difficulty of creating a self-organising work in its absolute sense, that is to say where self-organisation would take place at each organisational level. On the one hand, the presence of a human observer influences self-organisation of the ecosystem. On the other hand, the absence of any human factor does not necessarily make it a work.

My algorithmic composition *Ephemeron* is presented as a case study in order to clarify these points. *Ephemeron* emerges during the performance from the dialogue between the electronic algorithm (interpretational model) and the occasional context of performance using different audio feedback settings (predefined structures). After the performance, *Ephemeron* exists only as a memory, whereas before the performance it is only an expectation of its imaginary manifestation in the future.

The ephemeral character of any musical work is exemplified here. Even in fixed-medium music, the work's constitution depends on the particular context of performance. The experience of the same work differs for each and every individual, and differs every time it is performed for the same person.

This is related to the difficulty of defining the boundaries between the work's 'closed' level of creation, and the 'open' level of its interpretational model during a given context of performance. Thus, it is more accurate to talk about *degrees of openness* of a work in regard to its context of performance.

I close the article by considering the difficulty of grasping the existence of a musical work. If we consider that in the nervous system the distinction between a perception and a hallucination is not a priori, to the extent that we are able to construct a musical performance inside our imagination, might this not be a valid constitution of a musical work?

13. THE RECORDINGS OF *EPHEMERON*

You can experience here the sound result of two *Ephemera* (Sound example 1). Both music organisms' existences lie in the past. This is only a memory of them. Resulting from their original interactive constitution, I have put them together to form an acousmatic experience under the title *Sur la Construction de Réalités*. The first music organism presented here existed at the concert hall of ZKM, Germany on 26 February 2010, between 20′44″ and 20′51″ (0′00″–5′48″ on Sound example 1) and the second one at the concert hall of De Montfort University, UK on 7 May 2009, between 20′18″ and 20′23″ (5′24″–9′56″ on Sound example 1).

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