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Electronic music in the perspective of semiotics

ABSTRACT: The aim of the present article is to describe the unique idiom of electronic music in the perspective of semiotics. The starting point of this reflection is an attempt at a definition of what electronic music is. It then moves on to questions concerning the explanation of the two main concepts of semiotics, sign and meaning. Here, the goal is to outline the general tendencies in interpreting these concepts in the context of Pierce's theory of sign and in the context of other concepts utilized in the field of narratology, i.e. diegesis and mimesis; with the aim of transferring these interpretations to the field of electronic music. The important nodes of this reflection are illustrated with specific examples of electronic musical works. The article also explores the semantic and cognitive attributes of electronic music and the relationships between them. The understanding of meaning in electronic music is explained in terms of analogies between the characteristics of cognitive processing of the sounds of everyday life and sounds utilized in electronic music.

KEYWORDS: electronic music, sign, meaning, semantic level, perception, cognitive process

Introduction

In order to examine electronic music in the perspective of semiotics suggested in the title, we must first answer the question as to how we should understand the term "electronic music" and the term "semiotics". These understandings determine the range of this perspective and the nodal points of this reflection.

We know that today the use of the term "electronic music" seems to have become more pragmatic. According to this view, "electronic music" can refer to music that employs electronic musical instruments (generators of sounds) and electronic music technology in its creation (manipulations and transformations of parameters of sound). Therefore nowadays electronic music includes many varieties and ranges from experimental art music to popular forms.[1] By "electronic music," one should understand here all the effects derived from the use of envi-

[1] In this reflection popular forms of electronic music will be excluded. What is more, we exclude from consideration music in which composer employs additional means, such as lights, colors or stage movements.

ronmental sounds, ambient music, turntable music, digital sampling, computer music, electronic modification of acoustic sounds, and music made from fragments of speech. However, also during live performances conventional sounds can be modified in real time using electronics, e.g. microphones (electroacoustic music). The source of the sound of electronic music can be "anything from ambient noise to live musicians playing conventional instruments."[2]

In turn, the term "semiotics" is increasingly the subject of lively debate not only among semioticians *per se*, but also among humanists, with musicologists among their number. Insight into the mechanisms responsible for making meaning leads us to the question: what is a "sign" in electronic music and also, consequently, what is the "meaning" in this music? Because of these questions, when reflecting on the subject of electronic music in the perspective of semiotics, the starting point will be an attempt to define the concepts of sign and meaning in relation to this music. One can also consider electronic music on three semiotic levels; relations between signs and the things to which they refer (the level of semantics), relations among signs in formal structures of this music (the level of syntax) and, finally, relations between signs and sign-using agents (the level of pragmatics). The complexity of these considerations is magnified by the lack of objective representation of electronic music, which makes it difficult to study. Therefore, as indicated by Jean-Claude Risset, this music "creates great difficulties for the musicologist who insists on carrying out rigorous, "objective" work."[3] What is more, an important issue in the overview of electronic music in the perspective of semiotics is the problem of communication between the composer of the music and the listener. If one can define communication as the process of transferring data and/or meaning from a source to a receiver, then that means that the receiver must decode the data, i.e., be able to distinguish the data as salient, and make meaning out of it. The first step to this decoding is the conscious perception of music. Perception not only provides us with knowledge about perception itself, as one of the elements — alongside memory and thought — in the process of cognising music, but is also a source of knowledge about music itself. Perception is a constructive mental process, which cannot be considered impersonally, if only for the reason that perception of music is dependent to a substantial degree on the listener's level of perceptual "training." Similarly, music cannot be cognised solely on the basis of its score, since its coming into being is closely connected to the activating of human memory and sound imagination.

[2] Thomas B. Holmes, *Electronic and Experimental Music: Pioneers in Technology and Composition*, second ed. (London: Routledge Music/Songbooks, 2002), 8.

[3] Jean-Claude Risset, "Foreword", in Thomas Licata (ed.), *Electroacoustic Music. Analytical Perspectives* (Westport, Connecticut, London: Greenwood Press, 2002), xv.

Sign and meaning in electronic music

Yet before the appearance of electronic music, sounds, generated from musical material, had never been used in music for their own sake, but for the expression of something. It is commonly believed that the expression plane in music (the sounds themselves) and the extremely varied content planes are linked together. In turn, Umberto Eco recognizes any given sign as an element of the expression plane, from which it follows as a consequence that it must be correlated to one or more elements of the content plane.[4] Bearing in mind that, according to him, the characteristics of a sign are that it can be substituted and interpreted, the conclusion seems clear — music is a sign.

Therefore, irrespective of the many varieties and ranges of electronic music, as well as sources and ways of generating sounds, it can be concluded that electronic music is a sign, because it is music — although not all would agree with that (?). However, this is music in which there is a dependence of the material on the vision of the composer, but also, conversely — the musical material *per se* has got the ability to inform the composer about the nature of a particular sound quality. The music makes itself concrete in the first moments of the juxtaposition of musical material, the forming of the mutual relationships in this material. One must remember that the musical material of electronic music is unique. What is important here is that the sounds of electronic music material are often generated by nature, or by human activity; that is to say, they are not related to the activity of instrumental music or language. These are anecdotic sounds. But there are also non-anecdotic referential sounds, generated by instruments or/and language, although — in electronic music — in the main they are electronically decomposed, transformed, destructured and/or amplified. According to Jean-Louis Di Santo, "non-anecdotic instrumental referential sounds belong more to musical or emotional analysis than to an analysis of the meaning" because "their form is more important than denotation."[5] However, sometimes a composer can reactivate "the power of denotation and connotation of the instruments," and then "these sounds enable composers to put notions together the same way they do with anecdotic sounds. Depending on the context and the intention put into the listening, they are interpreted either as referential sounds or instrumental sounds."[6] In this context, anecdotic sounds function on two planes (denotation and connotation), which can be simultaneously or separately used in music.

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[4] Umberto Eco, *A Theory of Semiotics* (Bloomington: Indiana University Press, 1976), 48.

[5] Jean-Louis Di Santo, "Referential Sounds, Symbolism and Semiotics", in *Proceedings of the Electroacoustic Music Studies Network Conference Meaning and Meaningfulness in Electroacoustic Music*, Stockholm, June 2012, accessed May 8, 2014, www.ems-network.org.

[6] Ibid.

At this point one should also recall Eco's remark about the meaning of signals or signs. He indicates that the meaning is not necessarily determined by whether they refer to actual objects, because the existence of objects to which signals or signs may correspond is not a necessary condition for their signification.[7]

Semantic paradigm

Consideration of the essence of sign and meaning in electronic music within the context of the semantic paradigm is not a subject that is often undertaken in musicological research. Nevertheless two approaches to this matter seem very inspirational.

One of them is the explanation of the issue of sign and meaning in electronic music based on Charles Sanders Peirce's sign theory.[8] Generally, his theory assumes particular relationships between a sign, an object and an interpretant. On the level of a sign he distinguishes a triad, the components of which refer just to a quality (*a qualisign*) or to the materialization, an embodiment, of qualisigns (*a sinsign*) as well as to a sign designed to be a sign, which is a concept (*a legisign*). The relationship between the sign and its object is also defined here by a triad: an *icon* — which is based on similarity, and can indicate a strict likeness (*image*) or show some parts of its object (*diagram*), and, finally, can also transpose the object into something else (*metaphor*); an *index* — which is directly related to its cause; and a *symbol* — which can be related to its object according to a law. Peirce also distinguishes a triad which determines the sign by its relation to the message itself (*rheme*, *dicisign*, *argument*).

Let us explain some of these relationships on the example of Karlheinz Stockhausen's composition — *Studie II* from the year 1954. As is generally known, Stockhausen wanted to generate only the pure tones of a frequency generator, "'pure' notes without overtones."[9] He wanted each sound produced synthetically and thus separately determined in its details. According to him "The conscious organization of music extends to the micro-acoustic sphere of the sound material itself."[10] Thus the sounds of *Studie II* are the signs which are understood to represent its object merely in its character, they are the signs of qualitative possibility (*rheme*). Such a musical sign functions mainly by its morphology and additionally by connotation. On the level of the relation between the sign and its object Stockhausen used *icons*,

[7] Eco, *A Theory of Semiotics*, 3–9.

[8] Charles Sanders Peirce, *Ecrits sur le signe*, (Paris, Seuil, 1978), translation from French to English found on the website: accessed December 16, 2012, http://www.helsinki.fi/science/commens/dictionary.html.

[9] Karlheinz Stockhausen, *Texte zur Musik* 2, edited by Dieter Schnebel. (Cologne: Verlag M. DuMont Schauberg, 1964), 23.

[10] Ibid., 22.

or more strictly, *images* of sounds. They are used for their morphologies and their juxtapositions are used for formal or aesthetics reasons, but not for their meaning which leads to reasoning, or in order to show something real. The pure tones used here are the *qualisigns*, because they are the signs of qualities by themselves. One must remember that — as is indicated by Di Santo — "the concept of musical piece will never be materialized as an object but by the idea that the sounds that are heard are related to one another and create a sound architecture or a group of sounds that have to be listened to in a larger unit."[11] On a level that deals with the possibility of existence before any materialization and any reaction to this materialization (the syntactic level), Stockhausen has assumed a fusion of the pure tones into new, more complex sounds, in order that the individual pure tone components should not have to appear as separately audible and easily identifiable. Therefore, he built a scale in which the interval between successive steps consists of the interval of 5:1 (two octaves plus just a major third) and is divided into 25 equal parts. This scale differs from the traditional tempered tuning system, in which an octave consists of twelve segments. This is a situation where, if a context in which a sound heard is directly produced by the object that caused it, at that time an *index sinsign* will be turned into a *legisign* by a specific intention (that is to say the composer's *intention*). The transformation is made possible because a *sinsign* can be both the materialization of *qualisigns* or the materialization of a *legisign* through its replica. But it is also important that *Studie II* is a composition recorded on tape. The opportunity of recording these sounds (the groups of pure tones) and reproducing them ad libitum by their decoupling from their cause (the generator) causes the *index* to become an *image* — the recorded sound is like the original one. In the case of electronic music, all actions such as filtering or mixing timbre, all modifications of *qualisigns* into a well identified *sinsign,* can be regarded as a *legisign*.

Another example of electronic music is *musique concrète*. The signs refer to reality and therefore the sign is a *dicisign*. For example, in *Étude aux chemins de fer* (1948) by Pierre Schaeffer, "concrete music" was created with real-world sounds. There are featured recordings of the noises made by trains running along railroad tracks. *Dicisign* is a sign which is understood to represent its object in respect of its actual existence. Referential sounds are placed one after the other (*metonymy*) to create a representation of reality and a linear discourse imitating the flow of time. This is music in which the musical sign mainly functions by denotation and additionally by connotation.

To describe the message itself Peirce has also used the term *argument*. *Argument* deals with the work based on the principle of replacement of one element by another that results from what was there before (*metaphor/substitution*). Musical signs function by connotation and denotation and can be substituted for one another in order to develop an idea until its conclusion. It seems that *Telemusik*

[11] Di Santo, "Referential Sounds, Symbolism and Semiotics".

(1966) by Stockhausen clearly explains this approach. According to the composer the recorded fragments are intermodulated on tape with electronic sounds and with each other to produce "odd hybrid-types" — modulating, for example, "the chant of monks in a Japanese temple with Shipibo music from the Amazon, and then further impos[ing] a rhythm of Hungarian music on the melody of the monks. In this way, symbiotic things can be generated, which have never before been heard."[12]

In Peirce's sign theory *rheme*, *dicisign* and *argument* determine the semantic paradigm, that is to say the relationship between signs and the things to which they refer. In turn, *intention/intuition*, *metonymy* and *metaphor/substitution* constitute the syntactic level of electronic music, which is characterized by the relationship among signs in the formal structures of this music. An intention/intuition in electronic music refers to the management of the quantitative choices (for example, the size of reverberation) or the qualitative ones (for example, the type of timbre). The metonymy management on the syntax level relies on the organization of qualities alone (*qualisigns*) within the structure of their materializations (*sinsign*). A metaphor determines the relationship of reference and substitution established on the basis of laws.

The second interesting approach to the meaning problem in electronic music is the standpoint in which the meaning is interpreted in the context of the *mimetic* and the *diegetic* aspects of this music. According to Anil Çamci, music, with regard to its temporal nature, acquires a narrative structure. As a consequence "The listener inevitably extracts a narrative from her musical experience due to the simple fact that a piece of music encapsulates a series of events between a starting point and an anticipated ending in the future. The extent to which the extracted narrative is concordant with the composer's design does not impact its materialization. This narrative, however, emerges in the abstract realm of the musical sound."[13]

However, one must note that electronic music uses anecdotic and non-anecdotic referential sounds "extending beyond the well-ingrained structures of traditional musical language" and therefore "this new material engages with the cognitive faculties of the listener, inducing a layer of meaning attribution amidst the continuum from material to affect."[14] A listener's musical behaviour proceeds according to a specific standard. Listening to an unfamiliar new musical material for the first time, a listener attempts to associate/match this material with his previous perceptual experiences, the effects of which he has assembled in his long-term memory in the form of cognitive schemata. If such association/matching fails, then the listener seeks new patterns for the information that is reaching him. Since the

[12] Karlheinz Stockhausen, "Electroacoustic Performance Practice", *Perspectives of New Music* 34, no. 1 (Fall) 1996: 74–105, 94.

[13] Anil Çamci, "Diegesis as a Semantic Paradigm for Electronic Music", in *Toronto Electroacoustic Symposium* 2012, accessed May 8, 2014, http://cec.sonus.ca/econtact/15_2/camci_diegesis.html.

[14] Ibid.

capacity of short-term memory is limited to a more or less constant quantity of perceptual units, and that limitation is independent of the quantity of information contained in each perceptual unit, the quantity of information that can be stored in that memory is determined by the way in which the listener forms a perceptual pattern from that information. If, while consciously listening to music, a listener recognises a pattern, then the quantity of perceptual units requiring further consideration decreases. As a listener acquires auditory experience, information that originally occupied several perceptual units is patterned on a lesser quantity of units, and space in the short-term memory is freed for additional information. In this way, over time, the perception of music experienced many times over changes. The patterns that emerge from the sounds of heard music enable the listener to draw conclusions regarding the structures those sounds embody. Listener's memories of previously observed sonic events remain as the references for processing new experience. Therefore, amidst the material's ascent to affect, there emerges a mediating layer of meaning attribution, and a new continuum from material to meaning to affect materializes. The mediation layer of meaning attribution, in the case of electronic music, has got both abstract and concrete nature. During the conscious perception of electronic music, the listener superimposes semantic representations over her physical experience of the sounds, and her affective appraisal of this music is imminently informed by this act.

We intuitively know that in electronic music there are various means that are used for the construction of narrative structures. Therefore, in this music narratives take on new forms. In the context of the *mimetic* and the *diegetic* aspects of electronic music, one can say that its *mimetic* aspects occur in the spatial domain of its performance space. As Çamci emphasizes, "Electronic music *presents* to the listeners sounds that *represent* events; it does not speculate about — or recount — sounds."[15] Moreover during representing extra-musical events, the connotations of sound are evoked in electronic music. That means that this music isn't narrated like — for example — poetry. At this point it is worth recalling that the *diegetic* aspect of poetry relies on the fact that the poet recounts events — speaking in her own person — as a narrator who is external to the immediate world of the story. On the other hand, the *mimetic* aspect of narration deals with an imitation of an event or a situation. In this context it seems clear that the more "abstract" (less anecdotic) sounds of electronic music material are less suitable for displaying highly representational qualities, which are needed in order to establish the intended *diegetic* aspect of this music.

In order to emphasize the nuances of the above explanation let us compare two musical works. The work by Francis Dhômont — *Espace/Escape* (1989) — combines the magnitude of the human experience of space. The sounds from different acoustic environments (from the flutter of the wings of a bird in a cage

[15] Ibid.

to the sounds of the airport hall-steps, conversations, aircraft noise) are synthetically summarized in the complex, stacking formations that provoke a considerable number of descriptions, which mostly identify sonic events and sources. This is an example of electronic music, derived from the acoustic physicality of human life and discovering of the spatial dimensions of the sounds, of what is possible in acousmatic projection (for example, the dimensions of proximity and distance or the directions: front-back, left-right). In the work by Iannis Xenakis, *Diamorphoses* (1957), there are sounds of jet engines, car crashes, earthquake shocks, textures of sliding pitches, and other noiselike sounds, and sometimes they are contrasted with thin, high bell sounds. According to Xenakis, he wanted "to mix timbres in order to arrive at a body of sound like white noise; to study the evolution of timbres, dynamics and register; to make unisons with attacks only with or without transposition; to make chromosomes of attacks."[16] In turn Joel Chadabe with regard to this electronic music has noted that Xenakis "[...] used recorded acoustic sounds modified by tape manipulations — changing speed, playing backward, splicing — and mixing, but without electronic processing such as filtering and modulation. His compositions, however, were not juxtaposed "objects," as in normal *musique concrète*, so much as they were complex sound masses that transformed in time as the result of shifting distributions and densities of small, component sounds."[17] The perceptual results of Xenakis's work can indicate a much more articulated sense of self. While in the case of the work by Dhômont perception assumes the role of an outside viewer who observes and reports the unfolding of certain events (i.e. "... has happened."), for the second work, the common tendency is to reflect through the first person (i.e. "I felt..."). In this sense, the perceptual experience of the first work can be likened to that of a representational acting performance, during which the audience is situated outside the *diegesis*. The second piece, on the other hand, could be interpreted as possessing more presentational qualities, as the responses display further involvement and a sense of being personally addressed.

Meaning in the cognitive paradigm

The nature of electronic music yields a distinct form of communication between the composer and the listener. The listener, as well as the composer, experience electronic music within a broader domain of cognitive associations to sounds. With the introduction of sounds that are not distinguished by the listener as being musical, the cognitive response to genre involves a distinct process of

[16] Nouritz Matossian, *Xenakis* (London: Kahn and Averill, 1986), 125.

[17] Joel Chadabe, *Electronic Sound: The Past and Promise of Electronic Music* (Saddle River, NJ: Prentice-Hall, 1997), 34.

meaning attribution. Increasingly, it is emphasized that the ways in which the listener experiences meaning of electronic music are similar to the ways in which the mind constructs meaning in everyday life. Just as sounds perception in the world around the listener cannot be described via the traditional musical language, sonic events of electronic music display features that fall outside the vocabulary of this language.

There are some important observations on the perception of environmental sounds. It is believed that our categorization of auditive stimuli is based on semantic features rather than perceptual ones. It seems that the emergence of meaning in the everyday mind binds to the cognitive processes, which integrate experience from our multiple perceptual domains and forms a centralized understanding of the world around us. Listening, also listening to electronic music, gives rise to meaning as a direct manifestation of the everyday cognitive process of finding meaning in the world around us. An experience in one domain almost always invokes connections with another. In turn, electronic music certainly uses knowledge from other domains as part of its meaning.

It must also be noted that meaning varies within the context. And therefore there may be kinds of meanings that can be explained in common language and shared or they may seem more idiosyncratic and personal. Gary S. Kendall argues that "Sounds may take on particular meaning depending on their context. They can take on the role of opening, closing, marking boundaries, and so on. For example, in Edgard Varèse's *Poème électronique* a church bell has the role of being the opening sound. When it returns later, it has the role of closing a major subsection. Then, too, another source of artistic meaning is the highlighting of novel sounds in the context of the art work. For example, electroacoustic art can strive to bring the acoustic background into the foreground of the listener's attention. These sounds could be unnoticed or simply inaudible."[18] One must also remember that ubiquitous contextual variation in meaning "is an inherent component in the meaning construction process."[19]

On the other hand, the essence of electronic music is often the use of the purely sonoric properties of the sound material for artistic purposes. Listeners receive a certain message issuing from the composer effectively when they respect the rules for interpretating the semantic units contained in that message. Hence the communicational competence between a composer and a listener often boils down to the ability to recognise communicational situations and the composer's selection of appropriate means for the creation of an auditively perceptible sound shape. This auditively perceptible sound shape results from the composer's auditory representations, which in turn reflect his thoughts, and influence the shape of

[18] Gary S. Kendall, "Meaning in Electroacoustic Music and the Everyday Mind," *Organised Sound* 15, no 1, 2010, 63–74, 65.

[19] Seana Coulson, *Semantic Leaps: Frame-Shifting and Conceptual Blending in Meaning Construction* (Cambridge: Cambridge University Press, 2001), 17.

the perceptual representations arising in the mind of the listener while consciously listening to music.

Electronic music is a difficult object of perception, because while listening to it the perceiver experiences the auditory images of highly complex musical structures. These produce highly complex and variable impressions, which for the listener may cause difficulties with perception. During the auditory reception of music, the listener makes a kind of selection of impressions, and extremely important here is the process of learning. The listener learns to differentiate the distinctive features of impressions. When a given piece of music is "heard through" many times, the ability to differentiate these features is enhanced, thanks to the process of learning.

Auditory perception is based on the identification and differentiation — through observation — of the sound images of heard music. The task of identification essentially involves the listener seeking the mental representation of a given sound image. Differentiation, meanwhile, concerns the assessment as to whether two sound images derive from the same configuration of musical structures or from different configurations. Research into perceptual processes in respect of the identification and differentiation of sound images indicates that these are processes for which different areas of the cortex are responsible. We conclude from this that among potential listeners to a given piece of music there may exist different levels of ability to identify and differentiate its sound images. This is conditioned by the cortical properties of their brains, since there may arise certain anatomical differences between the two hemispheres.

The retention of simple information obtained as a result of sensory registration takes place in the store of sensory information, which enables this information to be kept in the cognitive system until the phase of emotional assessment and then the phase of the recognition of the content of the stimulus (perceptual categorisation). In perceptual categorisation, the listener seeks in his mind the category to which the incoming information is best suited. The experienced listener also effects a schematisation. Categorisation and schematisation are not mutually exclusive processes; indeed, they are mutually complementary, since the construction of the standard that serves as a model in memory recall is based on the memorisation of an ever greater number of the distinctive features of the heard music, which are employed in their integration into a schema. Cognitive psychology links categorisation with schematisation in the sense that it treats the schema as a part of the perceptual process, a part which — as Neisser states — "is internal to the perceiver [listener], modifiable by experience and somehow specific to what is being perceived. The schema accepts information as it becomes available at sensory surfaces and is changed by that information [...]."[20] This reasoning contains the suggestion that there exists a certain set of innate perceptual elements, within which, besides

[20] Ulric Neisser, *Cognition and Reality: Principles and Implications of Cognitive Psychology* (San Francisco: W.H. Freeman and Co., 1976), 54.

the senses, there also exist schemata that control them. The schema, meanwhile, acts as a prototype for the classification of patterns into well-defined categories.

The everyday mind characterizes and organizes much of the activity in the world around us by utilizing the term *event*. This concept has quickly become a metaphorical way of organising and understanding the complexity of our auditory experience and participates in the construction of meaning in electronic music — not only in relation to the listener's understanding of single sounds, but also the understanding of groups of sounds and compositions as wholes. Universal properties of events can be captured in a cognitive schema.

The listener, in the phase of perceptual categorisation, makes use of a certain store of ready-made innate schemata and of schemata of "generalisation" employing prototypes which have the character of arithmetic means or modal values (the most frequently occurring images). In each case, the schemata, through their relative constancy and their connections with other parts of the auditory experience, enable the listener to recognise sound images which on the surface resemble nothing that the listener could have previously perceived.

In everyday life, the experience of events is interwoven with the flow of felt experience in its "distinctive qualities': tension, linearity, amplitude and projection. The everyday mind relates the dynamics of energy flow to felt experience, an innate part of every listener's feeling capacity and an intrinsic component of how the everyday mind experiences meaning. The embodied basis of such energy flow explains how listeners so easily relate sonic events to physical gestures. The felt qualities of experience are clearly recognised by listeners. According to Kendall, what is important here, is that "After the conclusion of an *event*, access to that *event's* history is limited to what was bound to the *event*. [...] Often what is retained is a general characterisation of the flow dynamics, a sense of the texture of the energy flow that could be captured with words such as *rough*, *bumpy*, *grainy*, *smooth* or *flowing*. When recalling the event, the listener may more easily retrieve an overall sense of the event's energy than the pattern of its flow."[21]

In the case of the perceptual categorisation of the sound images of electronic music (although not only), the role of invariants shaping a prototype may be played by the repetitiveness of a particular configuration of sensory features, which determines the qualitative relationship among sound images (linked to such parameters of the musical work as performance means, articulation, the pitch range of the musical material employed, dynamics and agogics).

The organisation of memory and the limits to our capacities for remembering have a strong influence on the way we perceive, and consequently on the shape of sound images and their temporal boundaries. Memory affects the listener's decisions as to when given sound images or their configurations end and others begin, and also as to the way in which sound images are connected with each other in the

[21] Kendall, "Meaning in Electroacoustic Music and the Everyday Mind", 66.

mental representation of heard music. Elements of musical structures occurring 50 milliseconds apart (which corresponds to a frequency of 20 sound events per second) accumulate, creating a level of blending of the sound events (often termed their "fusion"). In the auditory experience, this level is linked to the forming of the sensory features of musical structures, and the boundaries of this level result from limits as to the speed at which the neurons can process incoming information.[22]

The musical structures responsible for sound events occurring at intervals greater than 63 milliseconds participate in the second level of auditory experience. They are separately distinguishable, but are not so far apart from one another on the timescale as to cross the time limit of short-term memory (ave. 3–5 seconds per event). In the case of electronic music, these levels can be defined as levels of the forming of timbre and time patterns. Within the range of this level, there ultimately occurs the successive, simultaneous or successive-simultaneous grouping of elementary events endowed with particular sensory features. A proximity of pitch-range, of time, a similarity among the dominant sensory features, a common type of motion and a continuity to the flow of the music determine the integration of these events, which are subject to the above-mentioned criteria for grouping. The main difference between the level of grouping and the level of blending of events is that on the latter level the listener registers the boundaries between single formed sound objects with specific sensory features, whereas on the level of grouping he registers temporally expanded patterns comprising numerous events. The difference concerns the timescale. The boundaries between events on the level of blending have an immediate character, not exceeding the length of ultrashort (sensory) memory, but at the level of grouping, the events are sufficiently extended in time that short-term memory is required for their perception. However, these temporal differences are not absolute. Moreover, the duration of the recollections from sensory and short-term memory may coincide.[23] This is also the level of the forming of the listener's sound images and the composer's auditory ideas.

Configurations of the succession of sound images extended for a time exceeding the limits of short-term memory create mental representations of music that refer to the formal level of its experience. This level of experience is most often described by the listener metaphorically, the metaphors concerning movement within a physical space. Movement in large physical spaces requires the use of long-term (permanent) memory. The listener says of groupings of sound events formed in this way that they are "earlier" or "later", and describing the auditory experience he indicates that he becomes "lost" in the music, "finds himself in a particular place." The formal level and its articulation are linked to the structure and limitations of permanent memory. In contrast to patterns existing on the level of grouping, in which short-term memory is engaged, segments or sections on

[22] Bob Snyder, *Music and Memory* (Cambridge, Mass.: MIT Press, 2001), 25.
[23] Ibid., 31–45.

the formal level exist within a timescale that is too great for memory to be able to embrace them all "in the present".

According to Kendall "Whatever the context, the demands of the moment often surpass the listener's mental capacity to fully assimilate what is heard. But listeners are able to grasp the *gist* of what they hear, even when the details are too complex to follow. [...] *Gist* is a working sketch for meaning, a snapshot of essential relationships. In one sense gist enables the listener to keep up with the essentials of ongoing experience and in another sense it is a product of the listener's understanding of what is essential in the current context. *Gist* separates foreground from background, the prominent from the inconspicuous. What *gist* does not generally include is a sense of outcomes or consequences."[24] Additionally, broad sequences of events on this level do not automatically conserve their order in time. This order must be reconstructed — it is not a given characteristic. Thus for the links between the configurations of sound images on the formal level to be discovered, they must find their way, at least in part, into consciousness (by being summoned or recalled) from the permanent memory.[25] Rapid auditory events in electronic music — similarly as sound events in everyday life — occur within a short time frame. In this case it seems that the *gist* guides the listener to the level of organisation that is the primary carrier of significance and meaning — not the level of the individual auditory events, but the composite of the whole that is heard as a single event.

At this point, it is very important to realise that all the listener's experiences from the above-described levels are temporally interconnected as they occur. In actual fact, the different levels of experience are no more than differences between individual ways of processing information in the memory. Therefore, as Kendall emphasises, *gist* and *events* are part of the listener" s meaningful understanding.

Also important in music cognition are memory processes which enter the realm of non-declarative memory (implicit knowledge, which occurs automatically and exclusively in such a context in which it was assimilated). These are priming, sensitisation and habituation.

With the effect of priming, each stimulus presented sufficiently early contains a trace that modifies the correctness and facility of the recognition of stimuli appearing at a later time. Priming acts bi-directionally, and so the identification of further stimuli can be made easier or more difficult.[26] Sensitisation increases the attention devoted to stimuli which differ — be it only in some minor detail — from stimuli previously memorised. The memory has the chance to alter the information it contains. Habituation, meanwhile, is the opposite to sensitisation, as it involves

[24] Kendall, "Meaning in Electroacoustic Music and the Everyday Mind", 68.

[25] Snyder, *Music and Memory*, 69–72.

[26] Robert Sternberg, *Psychologia poznawcza*, trans. Ewa Czerniawska and Anna Matczak (Warsaw: WSiP, 2001), 69 [Eng. orig. *Cognitive Psychology*, 2nd. edn (New York: Harcourt Brace, 1999)].

the reduction of attention devoted to the analysis of stimuli that are already familiar.[27] Although it does occur that one of these memory processes dominates, barring exceptional situations these processes mostly act together, responsible for the evolution of our memory.

Finally, it is worth mentioning that, in the creation of meaning in the cognitive paradigm, of importance are such contextual clues as the composer of the work, knowledge of previous works that have been heard, attitudes toward sonic material, and so forth, and also, the confrontation of the meaning in relation to the spatial idioms in audio reproduction, which are linked to the technology of electronic music, creating some unique possibilities for the artistic meaning.

Final remarks

Electronic music as the subject of musicological reflection is still problematic because there is no stable compositional theory which could reflect and guide the process of its cognition, also from the standpoint of the issue of meaning in this music. Research dealing with electronic music has mostly focused on a purely perceptive method based on listening as a means of comprehending a musical work, or, it aims at comprehending the genesis of the musical work and investigating compositional sketches, scores, different types of technological data, etc. Meaning in music has been a topic of discussion throughout the history of the art form. But the perspectives on the semantics of music manifested considerable shifts in focus over time; in particular, cognitive research in the field of psychology has yielded a growing corpus of new studies. Moreover, computational analysis exploits the computer's ability to analyze sounds and recognize patterns within electronic music in a perceptually and musically meaningful manner. One must be aware that there are a number of specific ways in which a listener may experience the meaning in electronic music. The material and the language of electronic music diverge from that of traditional musical practice. Therefore it is necessary to adopt idiosyncratic approaches towards this music that will take into account the creation of meaning attribution on both the compositional and analytical levels.

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[27] Snyder, *Music and Memory*, 23–25.

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