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The Theoretical Conception of Rhythmical Organization and its Practical Manifestation. Some Examples of 20th-century Avant-garde Composers

1. Introduction

The heritage of composers associated with the Darmstadt School served as a model for the development of new music. Concerning the general principle of composition, one can note that the composers realized their musical ideas in very different ways. However, all of them were taking great interest in the question of the perceiving of rhythmic structures and of the experiencing of musical time, which led them to a radical change of style, and to breaking with the common musical language. Their concepts led them further and further away from what their audiences were able to catch and understand. The density and complexity of musical structures meant that they were not designed to be grasped in such a way as they unfolded in real time during the performance. The composers found a new way of thinking and working on their music in organizing musical rhythm and time. A composer's idea is characterized either by an intuitive approach, or else by a scientist approach, in which genuine knowledge about reality is acquired through scientific cognition, based on concrete results of research in particular scientific disciplines. In the works of modern composers, the coexistence and interaction of very different rhythmic structures illustrate some aspects of their new treatment of musical time and continuity.

As has been observed by Kramer, these new composers' strategies entailed new listening strategies, more flexible and creative (Kramer, 1998). Therefore one can note such modes of listening as (1) "deconstructing" by the listener of the musical presentation and reassembling the apparent musical events, (2) cumulative scanning of a series of self-contained "moments", (3) listening to the sensations of motion and continuity without comparison to familiar temporal patterns, and (4) perception of "vertical time" during virtual stasis in musical work. Music of this density and complexity demands to be heard repeatedly, or to be studied outside of performance time. In music – and that is the subject under discussion – the question is, how can musical context affect the listener's way of perceiving the passing of time, and how can musical time, whatever it is, continue to exist during the musical experience. To find the answer and the knowledge, one must know what kind of compositional ideas were born during the creative process.

2. The composers' strategies in their speeches and writings

Composers from the Darmstadt School have stereotypically been linked with serialism and/or strict formalism. However, their individual extensive theoretical writings and music indicate a wide range of different compositional strategies. These strategies include the main idea (or ideas) of creating a music structure, a set of concepts through which these ideas are defined and explained, and also the technical details of the creation process. What is interesting is that, on many occasions, it is the perception of rhythmic structure and time that is the main problem under consideration.

Of particular interest seems to be the approach of three composers: Karlheinz Stockhausen, György Ligeti and Gérard Grisey. Each of them represents a slightly eccentric and hard to conceive way of understanding and creating the temporal music dimension.

2.1. Karlheinz Stockhausen

Karlheinz Stockhausen is an example of an artist who never ceased to surprise us with his ideas and his musical works. At their centre was the quest for a new balance, based on an intimate connection between speculation and intuition. The role of intuition was limited to the selection of specific tools and procedures, and, after they had been used, the image of the musical structures would be formed.

On the other hand, his speculative manner of thinking and music creation was fully manifested in the crucial domain of his experiment – the musical time. In serial music, Stockhausen tried to control every different parameter by the same system of number-rows. The basis of his thesis as to "... *how time passes* ..." is to look at pitch and duration in exactly the same way (Stockhausen 1959). He explained all the musical parameters as *Zeitproportionen*: "Music consists of order-relationships in time; this presupposes that one has a conception

of such time. We hear alterations in an acoustic field: silence-sound-silence, or sound-sound; and between the alterations we can distinguish time-intervals of varying magnitude. These time-intervals may be called *phases* ... Our sense-perception divides acoustically-perceptible phases into two groups; we speak of *duration* and *pitches*" (Stockhausen 1959: 10).

His new morphology of musical time, reflected in the article, also introduced new terminology. However, it is worth mentioning that the new terminology was often criticized. It was pointed out that his technical language was his own invention, but the terms derived from acoustics did not possess their proper acoustic meanings (Backus 1964).

Stockhausen indicated that the difference between duration and pitch was not one of nature, but only of speed of vibration and of acoustic spectra. The length of the durations may be more or less than 1/16 sec, the threshold for perceiving pitch. From Stockhausen's point of view, the fact that, if the speed is increased, the impulses blend into one continuous sound that becomes a clearly recognizable pitch, confirms that duration and pitch are essentially related to each other. They only belong to two different "temporal realms" (*Zeithereiche*). He also introduced the concept of "scale of duration" and proposed a system of equally-tempered "fundamental durations" (Stockhausen 1959: 12), analogous to the equal temperament of fundamental pitches. As a result of this, the term "subharmonic duration-scale" means that (transposed to the pitch area) the durations in the scale form a subharmonic spectrum, i.e. an inversed harmonic spectrum. Stockhausen noted that serial music which uses this type of duration-scale has an excess of long note values (Stockhausen 1959: 13), and therefore he also introduced a harmonic series of proportions, equal to the overtone series ("harmonic duration-scale"), and ultimately, he created the "chromatic duration-scale".

It seems characteristic that modern composers tend to shun exact periodicity and repetition in favor of continuing development of musical structures, whatever they are. Although Stockhausen did not create a scale for regular and irregular repetition, he concluded: "In order to compare one group of phases [= time-intervals] with another, we make a distinction between 'periodic' and 'aperiodic' phase-groups, and, between these extremes, we distinguish a greater or smaller number of transitional stages (as deviations from either periodicity or aperiodicity, depending on which predominates)" (Stockhausen 1959: 10).

In the above context, Stockhausen also noted that if one omits, or ties, duration in the different layers in the "duration-spectra" to too great an extent, one runs the risk of "[doing] away with periodicity, and thus with the 'harmonic' effect of the whole formant-spectrum; one composes the time counterpart of 'noise'" (Stockhausen 1959: 29).

Stockhausen's strategy of using the temporal dimension of music covered also a discussion on performance and the perception of time. He introduced the term "time-field" (Stockhausen, 1959: 30), meaning a field with precise durational value at the centre and also with a certain bandwidth of freedom to either side of the centre. This is the delimited area of possibility, in which the value of the note could be performed. As a result of this reasoning, there are two ways of notating duration, a "pointillistic", i.e. exact, duration, and a "statistical" one, i.e. duration within the time-fields, which is useful in the perception of the macrostructure in complex musical events. According to Stockhausen: "Such a switch, from 'pointillist' to 'statistical' perception of time has become a further occasion for the statistical composition of fields. But this means that the elements themselves are no longer presented as discrete degrees of some scale or other ... Rather, a field-size, in the sense described above, is substituted for each discrete value" (Stockhausen 1959: 32).

At this point it is worth noting that "the statistical composition" has been linked to the concept of "mass-structure", in which, if the individual events are separately perceptible, then the statistical quality falls away, because the statistical quality requires crowding in a short period of time. Stockhausen explained the "pointillistic" style, of precisely specifying all the parameters for each musical events, as merely a special case of the mass-structure in which all variability factors are zero. Therefore the musical event is fixed compositionally as a point rather than a field. He has also stressed, that: "A particular number of single field-sizes gives a group-field. Here the size of the group-fields depends on the number and size of the single fields. Similarly, it is possible to start from group-fields of various sizes, and form these to arrive at the magnitude-proportions of the single fields" (Stockhausen 1959: 35).

In this context Stockhausen described his attitude towards continuity in music: "If a series of field-sizes served to present a time-structure in which the composed fields mediated between the pointillist and statistical extremes, then we should really be dealing with a new musical time-continuum: time as a discontinuum and time as a continuum would then merge in a supra-ordered concept of serial field-time" (Stockhausen 1959: 34).

Concerning the time-interval between musical events, Stockhausen said: "We experience the passage of time in the intervals between alterations: when nothing alters at all, we lose our orientation of time. Thus even the repetition of an event is an alteration: something happens – then nothing happens – then again something happens. Even within a single process we experience alterations; it begins, it ends" (Stockhausen 1958: 64).

And inspired by information theory, he also noted in the context of perception: "An apparent paradox is immediately explained: the greater the temporal density of unexpected alterations – the information content – the more time we need to grasp events, and the less time we have for reflection, the quicker time passes; the lower the effective density of alteration (not reduced by recollection or the fact that the alterations coincide with our expectations), the less time the senses need to react, so that greater intervals of experiential time lie between the processes, and the slower time passes" (Stockhausen 1958: 64).

According to Stockhausen, the unity of musical time is a convention, which is dependent on the choice of method of composition and associated with a strongly individualized conception of existence. It seems significant that he remained convinced that "the place of time is not within space, but it is a space". Stockhausen took most seriously the problem of rhythmic and temporal relations in music in his writing. He also saw multi-dimensionality of time and composition. The choice of method of composition was, for him, the choice of extremes, between which there are many stages.

2.2. György Ligeti

Ligeti introduced – in a sense – a psychological approach to music creation. The content of his dreams was manifested by himself in a particular formal/technical aspect and also in the general character of the corresponding work (Ligeti 1993). Finally, his music creation derived its norms from psychological logic, from the psyche of his feelings and the physiology of his sensations. He was deeply aware of his unique creative attitude. Therefore he was an independent composer, despite the trends within the highly active avant-garde musical milieu centered around the Darmstadt School. "I'm basically doing all I do in the most amateur way, just trying to realize something that I imagine in my ear, in dreams. I use techniques, of course, but I forget them after writing and I have no overall scheme or permanent procedure. People of my generation truly believed that music could be explained and structured in a pseudo-mathematical way, but I never believed that" (Benjamin 2007).

Musical works conceived by Ligeti were based on his extraordinary imagination. From this point of view, the fact that he said many negative things about the elementary application of serial principles to music is hardly surprising. He believed that: "Serial music is doomed to the same fate as all previous sorts of music; at birth it already harbored the seeds of its own dissolution (Ligeti 1965: 14). Integral-serial composition was born under the sign of the totally static; ... 'Rigidity' and 'static' are not meant as negative categories at all ... This music is like hanging carpets of mighty oriental quietness, because the forces that drive on the flow of the form have been de-activated" (Ligeti 1965: 16).

The perception of music was a very important factor which he took into consideration while working on the musical pieces. He wanted to achieve a single basic order that would produce analogous structures on the various levels of perception and understanding. Ligeti claimed that a musical event derived from imagination can only become audible if it is based on consistent principles. The inaudible structure does not justify the audible music, but a structure itself is necessary to know what the music should sound like. Therefore Ligeti believed: "In working out a notional compositional structure the decisive factor is the extent to which it can make its effect directly on the sensory level of musical perception" (Ligeti 1983: 131).

This had an impact on his understanding of musical form and time in music. Ligeti was interested in musical forms which are "object-like", rather than "process-like", and he was also interested in the non-teleological nature of musical time. As a result of this, the musical form – for him – was a process of temporal transformation. In terms of form, Ligeti identified the "balanced, or static form"; the "dynamic, restless, fragmented forms" (also called "interlocked" or "split"); forms "like a precision mechanism"; and the "kaleidoscopic" type, made up of "separate and contrasted musical shapes" (Ligeti 1983: 134–135). As to the non-teleological nature of his musical time, Ligeti said: "It is music that gives the impression that it could stream on continuously, as if it had no beginning and no end; what we hear is actually a section of something that has eternally begun and that will continue to sound forever" (Ligeti 1983: 84).

Ligeti created his musical structures in such a way that the time sense exhibited by such type of music, is – as has been determined by Jonathan Kramer – a "nondirected linearity". On the occasion of the performance of *Piano Concerto* composed by Ligeti, he referred to his compositional goal: "I favor ... music as structure that,

despite its unfolding in the flux of time, is still synchronically conceivable, simultaneously present in all its moments. To hold on to time, to suspend its disappearance, to confine it in the present moment, this is my primary goal in composition" (Ligeti 1988: 13).

Ligeti used rhythm as one of the determining factors in the shaping of a musical structure. In the case of his music, one could speak of "progressive metamorphosis of rhythmic constellations". What one should understand from his interviews or conversations is that Ligeti's "granular" conception of musical event creation and the perceived rhythm is based on emerging patterns and is different from the articulated rhythm. For example, he said: "What you perceive as rhythm is not rhythm coming from the succession of notes your fingers play. The actual rhythm of the piece is a pulsation that emerges from the distribution of the notes, from the frequency of their repetitions ... the accelerando of the rhythm is therefore the result of an increased frequency of a note, it is realized through a modified note distribution" (Ligeti 1983: 61); "what attracts me is the idea of superimposing several levels, several different time-girds moving at different speeds, and so very subtly achieving rhythmical deviations" (Ligeti 1983: 108).

Characterizing the temporal dimension and organization of Ligeti's music, one should also stress that Ligeti wrote the various rhythms in different tempi as well as by different subdivisions. This strategy produces an extremely complex relationship between the instruments, with virtually no coinciding of attacks. In the *patterns-meccanico* compositions, for instance, the rhythmic activity is of several types. These types include the readily audible pulsing rhythmic patterns – the effect of entrances and exits of pitches through the process of pitch shifts – and also the subtle rhythmic shadings of pattern-beginning accents. One can hear the acceleration and deceleration pulses, which are dependent on the frequency of the appearance of a pitch. As a result, there are rhythmic patterns in the absence of durational diversity.

Despite that, a key feature of Ligeti's style was the use of extraordinarily dense polyphony, complexes of musical timbre and structures so rich and intense that they virtually dissolved the distinctions of melody, harmony and rhythm; in terms of rhythm – or, perhaps more fundamentally, the flow of time in his music – he was one of the most original of all 20th-century composers.

2.3. Gérard Grisey

Grisey's approach to musical material is very much like that of a scientist investigating the nature of the sound, the musical event and its unfolding in time. During the 1990s, Grisey was fascinated with the processuality of time and form. He understood time in music in a particular way, not identifying it with the use of long and short rhythmic values of sounds. Instead, he considered that time was stretched out in all directions. Consequently, it needed to be stated what stretched-out time was, and how one should compose in order to achieve stretched-out time in a work without employing structures like chromatic clusters (as in Ligeti's *Atmospheres*). Grisey was convinced that the answer to this question would be the true starting point for spectralism (Bündler 1996).

For Grisey, real musical time was only a place of exchange and accord among a multitude of times (Grisey 1987). In compositional tradition, the time occurring within musical structures is interpreted as a straight line, which can be divided according to the proportions fixed by the composer. The listener perceiving the music stands, as it were, in the middle of this line. According to Grisey, such an understanding of musical time is a pure abstraction, not reflected in real perception. In actual fact – so Grisey held – time perceived by the listener to music is observed from the level of another time, which is strictly linked to the rhythm of our lives. The exchange and accord among various layers of time – between them there occur crossings and open spaces, which can, for example, converge – result from this dynamic, which in turn is an effect of the interactions that arise between the psychophysiological time of hearing (the rhythm of one's heart and breathing and being increasingly fatigued by listening) and the mechanical time of the sound. Asking himself the question how to treat time in music, Grisey claimed that there was no notion in the world which could state unequivocally that something lasts too long or not long enough. Everything depends on the kind of information being transmitted.

During a certain period in his reflections on music, Grisey was influenced by Conlon Nancarrow, who created music in a condensed time – the kind of music written for or by insects or small creatures. Grisey tried to integrate such an extremely condensed time with time related to the tempo of spoken language and with stretched-out time (Bündler 1996). He considered that the creation of music ought to refer to the direct composing of musical time, which can be captured in the act of perception, and not to time measured beyond the actual impressions – to chronometric time. Between two successive sound events, there exists

a "density of the present", of variable dimensions (Grisey 1978). Three kinds of time can be distinguished, depending on the relationship that exists between two successive events. Small differences between the events produce a natural passage of time, as it were – time with a specific velocity, analogous to the tempo of language. The occurrence of an extremely different event after a previous event disrupts the linearity of the passage of time: time contracts. If the succession of events is not surprising, and is even predictable, for the listener, then the "density of the present" increases and time expands. Focussing the experience of music on some detail – on the internal structure of a sound – also expands time; in this case, everything occurs as if in slow motion. Grisey ascribed this contraction and expansion of time to the existence of "holes in time", in its linear passage (Grisey 1978). He was interested in the way time was perceived not only by people, but also by other living beings. The effect of this reflection is the definition of expanded, stretched-out time as the time of whales. Grisey indicated that in the world of birds and insects, everything happens more quickly, and so he called contracted time the time of birds or the time of insects. Grisey understood music and the forms in which it is expressed not as a configuration of musical structures construed of sounds, but as pure duration. "What a utopia his spatial and static version of time was ... What a spatial view of musical time – but also what anthropomorphism there is in this image of man at the center of time, a listener fixed at the very center of the work to which he is listening! One might say that a truly Copernican revolution remains to be fought in music" (Grisey 1987: 242–243).

In other words, Grisey distinguished three layers in music that interpret time. The first is *the skeleton of time*, which is the basis for the musical structure and it is the equivalent of the temporal division for the musical events, but not the sounds themselves. The second, *the flesh of time* refers to the sound material itself. Grisey demanded the qualitative approach to time with regard to this layer (but in regard to *the skeleton of time* he indicated the quantitative approach). Finally, the third is *the skin of time*. It is related to the psychological and sociological aspects of music, and as Grisey stressed, it is the: "place of communication between musical time and the listener's time" (Grisey 1987: 272).

As to the perception of musical time, Grisey said that listeners needed: "A kind of exceedingly simple cues that can be perceived and remembered. We hold on to two kinds: the rhythmical periodicity and the harmonic spectrum (another kind of periodicity)" (Grisey 1978: 74).

Moreover, he observed that periodicity and aperiodicity possess important signification in musical expression. "Periodicity is irreplaceable; it allows a pause in the music's unfolding, the suspension of time and, sometimes, a redundancy – helpful to our powers of comprehension. When the musical structure demands it, we use it for its intrinsic qualities, avoiding both rejection and obsession" (Grisey 1987: 247).

In this context, one must add that Grisey defined the so-called "scale of complexity". The task of this scale is to show the degree of regular repetition in the succession of time points in musical works. It is the degree of predictability in the basic rhythmic structure for the piece. As can be expected, the periodicity shows the maximum predictability and at the same time the most regular repetition. The average predictability in this scale is a feature of the so-called "continuous-dynamic". It can be either a continuous acceleration or a continuous deceleration, using either adding/subtracting a constant duration to the preceding duration, or multiplying/dividing the preceding duration by a constant. "Discontinuous-dynamic" is less predictable, it possesses slight predictability. There are such situations, when, if an accelerando has reached a certain speed, we could make a sudden jump to a more rapid event-frequency and then continue our accelerando from there, or when the continuous-dynamic sequence indicates some deviations. "Statistical" in Grisey's scale possesses zero predictability and shows the least regular repetition. In this case the length of the temporal division is determined at random. As Grisey stressed, this is when there is no logical succession for the durations, "like a veritable white noise of durations" (Grisey 1987: 256). Finally, it is worth quoting Grisey's ideas concerning the relation between time perception and musical events in his own words: "Our perception of time is sometimes the opposite of how we remember it: in a busy day time can seem to pass quickly as we experience it, but on recalling the day we say 'what an interminable day!' Similarly, to a quiet day corresponds the perception of time passing slowly and the memory of a day soon over" (Grisey 1987: 272–273).

Through this example, he wanted to explain the possibilities of listening to music. One can focus on either its macrostructure – the case in which time passes at high speed and the listener can only grasp the overall musical structure – or its microstructure – the case in which the degree of alteration is small and the listener can focus on the sound qualities of the musical events. These possibilities were referred to by Grisey as "depth in music", and to control the "play with the zoom lens back and forth" he created the so-called "scale of sound proximity".

3. The musical exemplifications of the composer's ideas

One can observe the specific relation between the score and hearing the composition, between music's written and audible level. Some composers tend to allow themselves many exceptions from their compositional strategies. In such situations, the composer's musical intention is different from his theoretical ideas. But some of them are consistent in the use of their theoretical system. One should remember that, in the perception of musical time, there are many factors beyond the composer's control. First of all, it is dependent on the listener, namely, on his/her capability of memorizing of music movement. Let us look at some examples.

3.1. Karlheinz Stockhausen

Stockhausen's new morphology of musical time is reflected, for instance, in his *Zietmasse* (1955–1956) for five woodwind, *Gruppen* (1955–1957) for three orchestras, *Klavierstück XI* (1956), *Zyklus* (1959) for solo percussionist, and *Carre* (1959–1960) for four orchestras and four choirs.

One should note that the musical works mentioned above were written, more or less, at the same time. Moreover, they were embedded in the context of serial thinking and composing – or, perhaps more fundamentally – organizing which grew up around 1950. Their common feature is the integration of real space into the creative process, and also the attempt at converting all the time units of human experience into music. Space and time are very important in Stockhausen's creative work – in musical work and as a subject of theoretical reflection. Therefore, each of the mentioned works may be – to some extent – an exemplification of the composer's theoretical considerations.

In *Klavierstück XI* – which is celebrated for its "open form" – the rhythms for the entire work were composed first. All of the nineteen fragments that constitute the work were composed in accordance with a matrix system of serial polyphony. The rhythm matrices were serially reordered by number matrices and combined together to form the separate columns of the final rhythm matrix. The pitch structure of *Klavierstück XI* was achieved by translating duration proportions between adjacent durations, occurring within the rhythmic structures derived from the final rhythm matrix, into pitch fluctuation. In *Zeitmasse*, in turn, Stockhausen used a two-dimensional surface. In this musical work, one can find – on the one hand – either tempo-conformity or tempo-diversity, and – on the other hand – either metrical regularity or rhythmic irregularity. These combinations cover, for instance, parts which may be synchronized metronomically but pointillistically scattered, or parts which may be metrically regular but independently accelerating, retarding or stable in tempo. In this work, the treatment of tempo relationships goes beyond synchronization to address individual perceptions and articulations of groups and extended phrases. Let us see what Stockhausen said of *Kontakte*: "This is what I do in music. I go into the deepest possible layer of the individual sound. ... In *Kontakte*, I composed every sound from individual pulses which I spliced on tape. I made loops of one rhythm with individual electric pulses that I recorded on tape with a duration of one second, for example, and sped the rhythms up a thousand times ... so that in the evening I had [a sound of] about 1000 cycles per second. And one cycle of the 1000 cycles per second was my original rhythm" (Cott 1973: 76).

And finally, in *Gruppen*, space and time are elements of an unbroken and palpable structural continuum of the piece. A synchronous realization of up to three different temporal layers, running at different speeds, is possible due to three nearly equally scored orchestras, which are placed around the audience. As Stockhausen explained: "Each sound-source is now in a position to let its own time-space be experienced, and the listener finds himself in the midst of several time-spaces which in turn create a new, common time-space" (Stockhausen 1964: 71).

Almost all the elements of the serial method of organization are in a coherent relationship to the time structure. Twelve-section duration series are characterized by the same properties as the twelve semitones of the chromatic scale. This is the starting point and the foundation of the entire serial process of organization. *Gruppen* consists of a groups of sounds, noises and sound-noises which are completely independent units and each of them moves within its temporal space. There are short, characteristic figures whose constant recurrence forms a bond between the musical passages. Because of the irregular rhythms and the lack of a stable basic tempo, one cannot indicate consistent pulse throughout the work. The spatial separation of the groups results from the superimposition of several time layers having different tempi. This distribution of the groups facilitates the great freedom in the way the groups interact with each other. Consequently, the groups can follow each other, overlap with each other, accumulate above each other. Stockhausen emphasized that they can absorb each other, play with or obliterate each other, repulse or cling to each other, or merge. The specific rhythm/tempo-related structure determines the tension, which, in turn, enhances the bond between the musical

passages. Tempo and counting value (i.e. the fundamental duration), rhythmic make-up, length, density, pitch range, and direction of movement are fixed for each individual group. The timbral species of the individual groups are organized according to four different criteria: mixed, mixed and long sustained tones, monochrome, and alternating monochrome. Finally, all the groups (174) are used by the composer in four large sections of the piece, which, in turn, are divided into thirteen subsections. In *Gruppen* there are also the three "inserts", which are independent of serial predetermination.

The great researcher of Stockhausen's creativity and thought, Robin Maconie, some time ago pointed out four objectives which – in his view – the composer wanted to accomplish in this work. These are: "1) to pursue and regulate the composition of multiple tempo-structures stimulated by *Piano Piece I*; 2) to invent a functional notation for time corresponding to the tempered scale of pitch; 3) to discover a means of injecting flexibility and continuity into serial music which did not infringe existing serial principles; and 4) to write a work of major length with unlimited possibilities of continuation. Out of this mixture of formal and personal incentives came the system of group composition, and out of the system a new delicacy of imagery, plasticity of movement, and the rediscovery of musical space" (Maconie 1976: 114).

3.2. György Ligeti

In Ligeti's *oeuvre*, one can identify the compositional techniques which have been involved in his structural music of the 1960s and 1970s. His music of this period does not provide sufficient contrast of the material. It tends to be driven by evolution of structure and motion. Also during that time, what he created in his music was the flow of time rather than the rhythms. In the period from the 1970s up to 1985, Ligeti's musical language and structural approach shifted from one which had been focused upon processes based on canon or micropolyphony, to one which demonstrated an openness to the influence of a wide range of musical trends.

Among the main types of his musical forms was the "kaleidoscopic" type, which is made up of "separate and contrasted musical shapes". One of the most striking general features of Ligeti's descriptions of his music is his frequent recourse to his conception of the form-creating interval signals and his net-structure micropolyphony. The term "mistiness", which he introduced in his reflections about music, usually means a contrapuntal structure, a micropolyphonic cobweb technique. The net-structures (underlying structure) can be based on chromatic fluctuation of microstructures, on the expansion and contraction of interval constellations, and also they can be generated by constant chromatic transformation of triadic units or built on complex overlapping rhythmic relationships. Harmonic, interval, and rhythmic metamorphoses, in musical works which were based on the net-structures, became the main structural function of the form-generating surface patterns.

For some examples, metrical rhythm was entrenched in the String Quartet No. 1: *Mètamorphoses nocturnes* (1953–1954) for string quartet. But in both *Apparitions* (1958–1959) for orchestra and *Atmosphères* (1961) for large orchestra, Ligeti removed metre and pulse. In *Apparitions* one can find clustered structures which have no regular pulse, but are scored for convenience mainly in 4/4. This method would serve for many more of his musical works. In the first movement of *Apparitions* Ligeti positioned the clusters, and they are interspersed with more volatile events in a sequence of changing time signature. Constant variation of metre occurs in the composer's other scores from the 1950s. The changing bar-lengths and subdivisions create a wonderful elasticity. There is extremely slow tempo of crotchets = 40. In this composition there is a different time signature in nearly every bar. Ligeti employed the concept of "scaling", which involved – in the first movement of *Apparitions* – a "'repertoire of durations' planned with serial precision, but from more logical standpoint. He created a 'system of apportionment [in which] the length of the shortest element, multiplited by the number of times it appears in the piece, matches the total length of the longest'" (Ligeti 1983: 132).

The method of "scaling" results in constantly changing bar-lengths and makes the music sound unpredictable. The same system had governed *Artikulation* (1958) for four-channel tape. The second movement of *Apparitions* is also rhythmically fluid, but the effects are achieved through simpler means. Ligeti used polymetre, micropolyphony, and a sequence of sonic blocks. In *Lontano* (1967) for large orchestra, as in *Lux aeterna* (1966) for unaccompanied sixteen-part mixed chorus, one can note the signature metre 4/4 throughout, but again only to assist synchronization, never to imply accentuation. There is no beat. The micropolyphonic rhythms are notated within regular bar-lengths without any loss of plasticity.

Finally let us look at the temporal elements of *Ramification* (1968–1969) for string orchestra or twelve solo strings. In this piece Ligeti created four active rhythmic layers and a fifth layer of sustained tones. The layers are made up of triplets, sixteenth notes, quintuplets, and sextuplets, respectively. There is no rhythmic regularity, because the irregular grouping of the pitches constitutes the fluctuating chromatic microstructures.

Ligeti has applied the *pattern-meccanico* technique and microcanon. Therefore the small and large scale structures result from the repetitive patterns. Moreover, rests of different values are irregularly placed within the melodic cells. This, in turn, further differentiates the layers, which are already moving at different speeds. The layers have also undergone a process of acceleration, either through the occasional introduction of smaller beat subdivisions, or a systematic motion through successions of progressively smaller subdivisions. This is the example, in which – along with harmonic motion – Ligeti uses rhythm as one of the determining factors in the shaping of a net-structure's surface. The sense of time there are exhibited by the type of "nondirected linearity" and the progressive metamorphosis of rhythmic constellations. In this musical work, the perceived rhythm is based on emerging patterns and is different from the articulated rhythm (the various rhythmic structures in different tempi as well as in different subdivisions), but the rhythmic activities rely on the readily audible pulsing rhythmic patterns and the subtle rhythmic shadings of pattern beginning accents. Finally, the result is the presence of the rhythmic patterns but the absence of durational diversity.

3.3. Gérard Grisey

Grisey has created music which is closely related to his theory. The fourth movement of his cycle *Les Espaces acoustiques – Modulations* (1976–1977) for orchestra – can be an example of practical incorporation of his "scale of complexity" into the organization of musical time. Periodicity and aperiodicity are here used as important musical expressions. At the rehearsal number 12, one can experience that the time unfolds at a different speed than at the beginning of the musical work. Thus the time-perception – in this fragment of *Modulations* – is a result of gradual changes. From the state of disturbance and the irregularity of events, the composition unfolds to the point of maximum disordering, and then it gradually reaches the state of regularity. This is equivalent to moving over the scale from this unpredictable state, through the "statistical" one, until the most predictable condition, periodicity. The impression of periodicity has been created owing to the fact that every event happened on the downbeat in each measure, and the only exception from perfect periodicity are the changes in the time-signature in certain measures. The impressions of – to begin with – discontinuous-dynamic order – and finally – "statistical" disorder are the result of entirely irregular time-intervals between two events and the deviations (the events sometimes come "too early", and sometimes "too late" in passages, and the overall process is an example of deceleration). Moreover, at rehearsal number 37 – for example – the only thing the score shows is when the phrase starts, which pitches the phrase consists of, and when the phrase should end. In this fragment of *Modulations*, the notation does not indicate how long each note within the phrase should be, but the performer should distribute the notes within the given limits.

The particular treatment of musical time is concretised in the composer's work. In *L'Iône paradoxale* (1992–1994) for soprano, mezzo-soprano and orchestra, divided into two ensembles, Grisey referred to the visual logic characteristic of Piero della Francesca's fresco *La Madonna del Parto*. This reference is manifest in the title of the composition, the distribution of the instrumental ensembles and the structure of the work. *L'Icône paradoxale* is a kind of tribute to Piero della Francesco (1420–1492), a symbolic figure of the Quattrocento, author of the treatise *De perspectiva pingendi*, in which he analyses the perspectives used in painting. Grisey did not commonly employ poetical texts in his music, as they demand a natural tempo of narration – the time of language. In this work, however, the composer made use of part of the treatise, written in a highly technical language. The soprano and mezzo-soprano are treated here instrumentally – long-held sounds, devoid of melodic character – and the vocal parts are grounded on an analysis of sonograms of the spoken text. The large instrumental ensemble is divided into two groups intoning sounds in a high and low register, whereas the small instrumental ensemble is divided into two symmetrical groups, flanking the two vocal parts.

An analysis of the form of *L'Icône paradoxale* allows one to note the presence of two contrasting evolutionary processes – analogous to two diagonals, for which the point of intersection is fixed in the middle of a visual composition – and the temporal material is divided into different levels. Grisey modelled his shaping of the temporal material on the proportions contained in the fresco: 3-5-8-12. As a result, there appear four kinds of time. Time I is extremely compressed; its duration is entrusted to the group of instruments of the large ensemble in a high register. This group intones for 16 seconds a "contracted" version of the beginning of the work. This is a musically-obtained perspective which viewers employ when looking at a picture from a great distance – they can follow the indistinct distribution of colours and forms. This reduction in format is perceived through fragmentary progressions and repetitions. Time II is an analogy of time as linguistically perceived. The vocal parts accompanied by the small instrumental group perform a slow evolution, beginning

with the intonation of vowels and leading to the intonation of consonants, from colour to the obtaining of sounds similar to noise, long sounds contrasted with rhythms.

Time III is the timbral opposite of time I (it is interpreted by the second group of the large ensemble in low registers), although it is also linked to time II, linguistic in character. We observe here a sort of decompression of time II, obtained through the articulation in a slow tempo of the "noise" of the vowels contained in various texts by Piero della Francesco (in Latin and in Italian). Finally, time IV undergoes extreme "decompression". The whole of the orchestra intones a slow spectral punctuation, which – from the beginning to the end of *L'Icône paradoxale*, as always in Grisey's music – defines the presence of various harmonic fields.

In his introductory note to *L'Icône paradoxale*, Grisey concluded: "When times I and III cross, at the point where the diagonals intersect, a constant and periodic rotation fills all the sound space available" [Lorsque les temps I et III se croisent, au point d'intersection des diagonales, une rotation continue et périodique envahit tout l'espace sonore disponible] (Grisey 1996). The composition ends with a three-part stratification (the accumulation of times I, II and IV), followed by a brief coda invoking the complete spectral material (Castanet 2000: 36–38).

The specific treatment of time also refers to the interpretation of cosmic time. Such an idea inspired Grisey in another of his compositions: *Le noir de l'Étoile* (1989–1990) for 6 percussionists placed around the auditorium, audio tape and a retransmission of astronomic signals. The composer's interest in the sounds of pulsars arose from his meeting with the astronomer and cosmologist Joe Silk, in 1985. In the programme to *Le noir de l'Étoile*, Grisey stated (Grisey 1991), that in spite of the awareness that – with or without our participation – *0359-54* and *Vela Pulsar* would be continuing their endless revolutions and reach interstellar spaces, thanks to a radio telescope we can integrate their electromagnetic waves into a sophisticated cultural event – a concert. The moment of the pulsars' crossing of the sky is specified by a precise date. In order to use the effects of the pulsars' rotation as musical material in a musical work, the composer must – according to Grisey – combine the concert itself (the performance of a work) with the cosmic rhythm. In this context, the pulsars will determine not only the different tempos and pulsations of *Le noir de l'Étoile*, but also the exact moment of the work's performance. Grisey integrated music created by the tempo of the rotation of two pulsars (the remains of a supernova) into a tonal discourse. The acoustic effects derived from *Vela Pulsar* were pre-recorded, whereas the effects of *0359-54* were captured during a performance of *Le noir de l'Étoile* thanks to a radio telescope. The sounds created by a neutron star are the result of an audible transcoding of electromagnetic waves, and they can be heard in spite of the fact that it takes at least 15,000 years for them to reach the earth (Castanet 2000: 34). As Grisey noted in his preface to *Le noir de l'Étoile*, this is "music with pulsar obbligato!"

4. The observations from the analysis

The goal of these interpretations is to identify the nature of the relationships between selected compositional strategies manifested in the speeches and writings of the composers and their creative exemplifications in some of their works, and finally, to refer these findings to the conditions of music perception.

This review of theoretical writings and the music of Stockhausen, Ligeti and Grisey confirms the thesis that each of them pointed to a wide range of different compositional strategies. Their ideas and strategies largely relate to the problem of the temporal modalities and continuity of twentieth-century music. Although these composers – in certain pieces of music – tend to allow themselves many exceptions from their compositional strategies, their musical works – generally – demonstrate compliance with their theoretical ideas. On the example of their works, one can trace one of the main features of the shaping strategies of musical time and continuity. There is opposition between linearity and nonlinearity. Moreover, musical time is, indeed, not a single thing. One can observe a certain hierarchy of individual times with different rhythmic features. For this reason, there are many models of creation of musical time available for musical representation.

But not all the rhythmic structures, evident in a music score, can be related to perceptual goals. In the perception of rhythm and musical time there are many factors beyond the composer's control. First of all, it is dependent on the listener, namely, on his capability to memorize music movement. Listeners have to possess either the ability to engage in an intensely active involvement in the chain of realization of temporal modalities, or the ability to develop new modes of listening.

Cognitive musicology studies musical "habits of mind" such that musical processes are of greater interest to the researcher than musical content. A mental representation of a musical work is the result of the action of the nervous system, in particular the brain, of which the mind is a function. Music is a highly complex cognitive object, in which perception is possible thanks to the isolation and organizing of data provided by the sensory system.

Moreover, listener's expectation appears to shape many aspects of musical organization. If certain mental representations – preference rule systems, which are models of the perception of music (Temperley 2001: 292) – are present in the minds of listeners, it is likely that they are also present in the minds of composers. Not all the rhythmic structures evident in music can be related to, for instance, perceptual goals, especially in the avant-garde music. The mental mechanisms involved in musical expectations on the one hand are linked to biological adaptation (are innate), on the other hand are linked to culture context (are acquired, learned). The perceptual phenomenon in listening and certain constant relations have led to the formulation of many principles and concepts. The listeners' expectations are the result of a process of induction, in which generalizations are formed from a finite number of specific experiences. Listeners learn the contextual or contingent probabilities of neighboring or co-occuring rhythmic events. Contingent probabilities can be influenced by the number of prior rhythmic events that combine to influence a particular ensuing event. "Pointillistic" athematic serial music or, for example, *Gruppen* are not a perceptual problem for the listener. The contextual and contingent probabilities are being the foundations of perceptual organizations. In music such as *Ramifications* the sense of perceptual sound organization refers to recognitions of one or more independent streams, the perception of dynamic progressions and the transformation the seemingly amorphous "mechanical" sequences into a new structure. In music created by Griesey, there are the psychological mechanisms as the tendency to prefer stimuli to which listeners have been most frequently exposed (exposure effect), the music is designed to thwart the listener's ability to infer a regular meter (contrametric), and an event that follows after some preceding event generates consequent state. The habituation – the process of decreasing responsiveness to a recurring stimulus – appears also (Huron 2006: 409–422).

Computational models have contributed to understanding segmentation processes in music. The primary aim of Music Information Retrieval is to design methods to retrieve "musical information" from large databases using musical "content" rather than "meta-data". Audio files can be automatically segmented into a series of homogeneous sections, through the estimation of temporal discontinuities along diverse alternative features, such as timbre in particular. They decompose to frames and next stage in the analysis is to determine a novelty curvy that would indicate the temporal location of significant structural changes. The cited visualizations confirm the general observations from the musicological and the cognitive analysis. One can easily observe, for instance, the musical surface of the analyzed musical works from the envelope curve and some discontinuity of rhythmic events from the novelty curve.
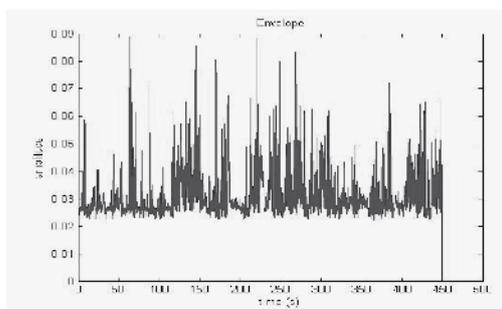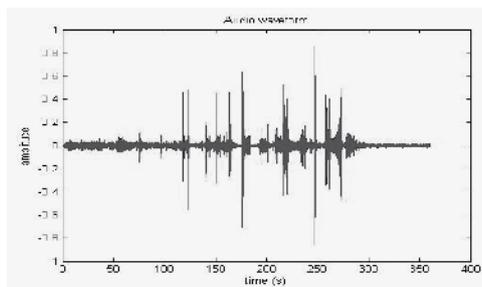

Example 1. Stockhausen, *Zeitmasse* –
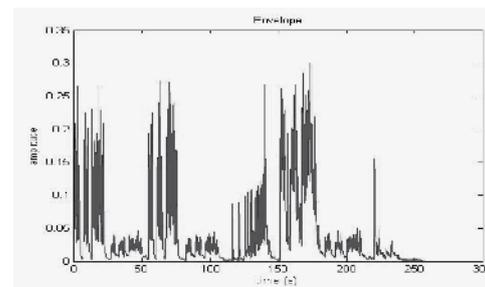the envelope of musical surface, from start to 450 sec.
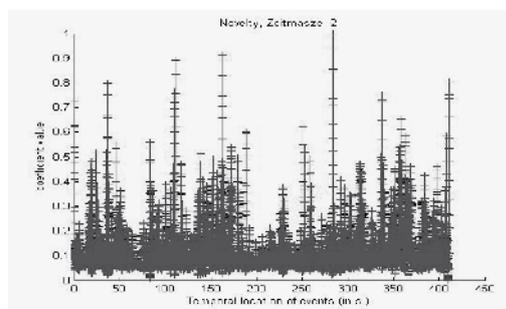
Example 2. Stockhausen, *Zeitmasse* –
the novelty curve, from start to 450 sec.
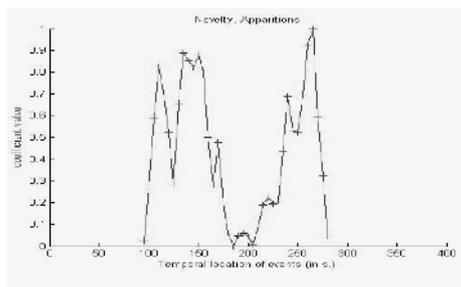
Example 3. Ligeti, *Apparitions* –
the novelty curve, from 100 to 280 sec.

Example 4. Ligeti, *Apparitions* –
the amplitude-time characteristic

Example 5. Grisey, *Modulations* –
the envelope of musical surface

5. Conclusion

In the context of the typology of musical time proposed by Kramer (1998), it seems reasonable to define the time created by Stockhausen's music as *moment time*. In this kind of time Kramer has emphasized the presence of a series of minimally connected sections that form a segment of an eternal continuum. Attention is also paid to the absence of beginnings and endings, and the self-containments of moments are perceived as entities. Finally, a coherent whole of such a composition is perceived by cumulative listening. In connection with the creative strategy adopted by Ligeti, musical time in his works has to be described as *nondirected linear time*. It is a result of the presence of a constant motion and the non-teleological nature of musical time. Listeners perceive this music as a *continuum* and they cannot predict where they are going in each phrase or section until they get there. As to Grisey's musical time, one can define it as *vertical time*. In his music there is the lack of phrases and temporal articulation. A single present stretched out into enormous duration, a potentially infinite "now", the total consistency – these are the main features of Grisey's strategy.

From the perspective of the traditional conception and creation of musical rhythm and time – before the activity of the Darmstadt School – it may seem that Karlheinz Stockhausen, György Ligeti and Gérard Grisey represented a somewhat eccentric and difficult to imagine way of understanding and creation of the rhythm and the temporal music dimension.

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Santrauka

Teorinė ritmo organizavimo koncepcija:
kai kurie XX a. avangardo kompozitorių pavyzdžiai

Kompozitorių, susijusių su Darmštato mokykla (pvz., Stockhauseno, Ligeti, Grisey), kūrybiniam palikimui nagrinėti reikia naujų analizės metodų. Šiems kompozitoriams jų kūryboje ir teoriniuose darbuose įtaką darė mokslininkai, domėjęsi paslaptingų ir ritmiškai sudėtingų garsų pasaulių tyrimais ir atradimais. Ši kompozitorių grupė muziką suvokė specifiškai – kaip grynąjį judėjimą, susijusį su laiko, kaip momentų serijos, koncepcija; kiekvienas iš tų momentų yra tam tikros vertės, nepriklausomai nuo to, kas jį seka ar kuriuos momentus eiliškumas leidžia numatyti. Tokiems teoriniams ir muzikiniams darbams buvo būdingas dėmesys ritminėms struktūroms, įprastinės muzikos kalbos laužymas, naujas požiūris į ritmo ir muzikinio laiko organizavimą, itin skirtingų ritminių struktūrų koegzistencija ir interakcija – naujai buvo interpretuojamas muzikinis laikas ir tęstinumas. Prireikė ir naujos (lankstesnės bei kūrybiškesnės) komponavimo ir klausymosi strategijos, nes tokios tirštos ir sudėtingos muzikos dažnai teko klausytis pakartotinai ir ją analizuoti papildomai, ne vien atlikimo metu. Straipsnyje teigiama, kad taikant šiuos naujus muzikos analizės metodus būtina juos sieti su kitomis, nemuzikologinėmis, disciplinomis. Pradedant analizuoti pasirinktus kū-rinius reikia perprasti pačių kompozitorių mąstymo būdą, susipažinti su jų požiūriu. Muzikos kūriniai, kuriuose kompozitorius atsisako melodijos kaip struktūrinio muzikos kūrinio vieneto ir kaip struktūrinio metrikos organizavimo dėmens, tampa puikia medžiaga tiriant pagal psichofizinę ir psichoakustinę arba kognityvinę analizę. Pritaikant kognityvines žinias ir kompiuterinę muzikologiją, tiriamuose muzikos kūriniuose tampa įmanoma nustatyti priežasties–pasekmės ryšius tarp kūrybinio proceso ir ritminių struktūrų formų bei muzikinio laiko organizavimo. Tokių tyrinėjimų tikslas – kompozicinių idėjų sąsaja su mokslu, muzikologiniu požiūriu ir tarpdalykine analize. Šitoks požiūris į ritmo organizavimą įvairiapusiškai praturtina analizuojamų kompozicijų suvokimą. Nagrinėjamą muziką galima pripažinti kaip opoziciją tarp lineariškumo ir nelineariškumo, o muzikinis laikas yra išties nevienalytis. Galima pastebėti tam tikrą individualių laikų hierarchiją su įvairiais ritminiais bruožais, taip pat išskirti ir ne vieną muzikinio laiko kūrimo modelį.