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ON PECULIARITIES OF PERCEPTION OF POLYPHONIC TISSUE (TO STATEMENT OF THE PROBLEM)

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***Abstract**: Perception of music in relation to the aspect of differentiation of polyphonic tissue is not a merely musicological issue. Its investigation must be carried out as part of a complex project that is at the intersection of music studies, physiology, psychology and pedagogy. The link between the proposed issue and the field of physiology is obvious, since musical perception is closely linked to certain cerebral pattern activities. Psychological aspect of this paper focuses on the perception of volume. Experiments in which the perception of volume was investigated using sounds, melodies and especially several voices heard simultaneously have not been conducted. This paper provides empirical evidence, which is part of a larger project that have been invested in for many years. An investigation of musical perception of polyphony and the peculiarities of its physical properties has pedagogical implications too, as it will promote the development polyphonic hearing and will encourage the understanding of polysemic tissue.*

***Keywords**: Polyphony, Psychology of Perception, Musikal Psychology, Volume of Perception, Polyphony of the Baroque, Polyphony of the XX century.*

Theissues connected with musical perception is traditional for both musicologists and psychologists' researches which is an indication to the interdisciplinary nature of the research subject. It is difficult for the sciences of only one direction to solve the problems brought before musical perception. As the development of the history of musicology demonstrates (G. Riman and E. Kurt's works), relying on the psychological data helps understanding of musical laws, its nature and specificity.[1] Psychology of musical perception does not lose its topicality even today and is a constantly developing direction. Regular specialized conferences are dedicated to these problems, common psychological forums form narrow thematic sections, publications are printed in the periodical editions.

While working on this research, we came across some experimental researches of foreign non-music scientists which were dedicated to the perception of polyphonic music. For example, the young scholars of the University of California state-what emotions polyphonic music arouses in listeners [1]; physicists and acoustologists dedicate their works to the problem of perceiving musical tones [2]; in psychologists' experiments it is established how the human distinguishes melodic and non-melodic voices during perception of polyphonic music [3].

The special interest was brought about by the article "Towards a Computational Model of Melody Identification in Polyphonic Music." Neither are the authors of this article musicians.

[1] The studies of musical perception mechanism were found in the works of the classic psychologists at the end of the XIX century - P. Helmholtz, K. Shtruff, G. Fechner. From the researches of the next stage should be mentioned the works of the Russian psychologists, L. Vigodski, B. Teplov. While investigating the mechanism of perception, the works of the Georgian psychologists, D. Uznadze (psychological theory of attitude) and G. Kechkhuashvili (the methodology of studying tonal organization of music). From the musicology works which are dedicated to separate issues of musical perception, we should mention the works of B. Afanasiev, I. Tulin, L. Mazell, V.Bobrovski. V. Medushevski's research is also known for the musicologists, which is dedicated to a listener's psychology; Y. Rags's On the Psychology of a Musical-Performer; E. Nazaikinsky's From the Position of the Perceptive Function on the Ear for Music.

ISSN 1512-2018

SørenTjagvad-is a researcher at the Austrian Research Institute for Artificial Intelligence and his co-author, Gerhard Widmer - works at the Department of Computer Perception at The Johannes Kepler University, Linz. Already in the introduction of the research, the scholars note that for the first time is an experiment being conducted whose purpose is to establish correlation between complexity and memory of certain melodies [4].

The listed scholarly articles are only small part of those works, which have been presented at the scientific symposiums and published abroad in recent years and which prove the problematic topicality of perception of polyphonic music.

Musical perception is a complex, entire process that encompasses the 'reading' and deciphering of a given musical work through not only the act of listening but through a specific aesthetic experience as well. We have already mentioned that for years musicologists have been researching different issues of perception psychology. But there is a direction, which has been studied the least. We mean polyphonic music, its specificity, its structures, developing potential and particularly-studies of regularity of perception of polyphonic music. Partially, it explains the author'sinterest in this problem.

Perception of polyphonic tissue, and we should repeat that, in general, that of musical perception is not a purely musicological issue. Its investigation must be carried out at the intersection of musicology and three sciences-physiology, psychology and pedagogy.

The bond between the proposed issue and the field of physiology is obvious, since musical perception is closely linked to certain cerebral pattern activities which were caused by the influence of separate musical irritants. Scientist physiologists (e.g. I.M. Sechenov) proved that there are the so-called analyzers in the cerebral cortex which carry out the analysis and synthesis of irritatorsimpact. There are two kinds of neural links in physiology:

- **within one analyzer-**such case is revealed when one modality influences the brains.
- **within the links of analyzers-**when a complex of irritators influences the brains.

On the example of music, in the role of more than one linked analyzer can be discussed the impact of several simultaneously sonorous sounds on the brain, as well as chords, melodies. It is within such complex inter-analyzer links, where perception of polyphonic music is carried out. Because of the links existing among melodies, a listener perceives features of music, its gist as the complex unity. Polyphonic music, as we know, does not represent only a numerical unity of voices, lines. The principle of their confluence defines the qualitative structure of polyphonic tissue. While discussing the specificity of the relation of sonorous polyphonic voices, we are aware that the organization of musical and expressive means included in the polyphony is not just their mere sum total, but the unity of the most complex level. Here, we should underline again the factor of voice independence since it represents the basic feature of polyphony.[2] Naturally, the main question of our research is as follows:

How many, independently developing voice can be simultaneously perceived by a musician?

It is quite understandable that this question is connected with perception not only physiology but psychology as well. It should be said that in the musical sciences this psychological problem has not been clarified. As for the psychologists' conceptions connected with the issues of perception, I will bring the classification accepted in the psychology of perception types which must be considered while researching perception of polyphony music. According to the prevalence of this or that analyzer during perception, in the psychology there are differed:

[2] It should be mentioned that this issue is not topical in the context of perception of harmonic multipart music, as in perceiving harmonic multipart music, there is no necessity of differentiation of its constituent voices. It is explained by the specific character of harmonious vertical, which is collated from the monolithic chord complexes and consequently, perception from the psychological angle in it, is connected with perception of vertical. While perceiving polyphony, the orientation on vertical constrains and impoverishes perception of voice movement and hinders multi-level, horizontal musical judgment. This is the reason why the problem of polyphonic tissue perception, in comparison with the harmonic one, is much more topical.

ISSN 1512-2018

- **visual perception**
- **auditory perception**
- **touching perception**
- **kinesthetic perception**
- **smelling and tasting perception**

Different kinds of perception are seldom separate, as a rule, they are united, resulting in establishing complex kinds of perception. For the musical art, all analyzers are topical except for smelling and tasting but **auditory perception**unconditionally prevails among the listed kinds.

From the psychological factors, which influence polyphonic perception, the most important is the volume of perception. The volume of perception-is one of the fundamental concepts of psychology. The researchers use it to describeperception processes and mechanisms and define it as follows:

The volume of perception - is a maximum number of objects and events, which can be perceived during the presentation of a row of stimuli .

Based on the data of multiple experiments, it has been proved that a human has an ability to perceive 4 to 6 objects at a time. The volume of perception is directly linked with the object and time of perception, with the memory of anexaminee and many other conditions. In the research experiments of the volume of perception, as a rule, researchers use different objects as irritators: figures, letters, syllables, dots. The examinees are shown different quantities for a short period of time to define the number of correctly identified objects.

Since the main objective of our research is to state what number of polyphonic voices a human can perceive, I have tried to find the experimental data connected with this problem. Unfortunately, the experiments in connection with the volume of perception of polyphonic voices have not been done. In any case, I know none of such. This is the reason why the statements of empirical nature are brought in the research, which are based on the experience collected from the long-standing studies of musical work.

I will give myself the right to express a presumption that the great polyphonists of musical art never needed the knowledge of the results of such researches. For instance, Bach's genius dictated him on the intuition level the number of those voices which a human can simultaneously hear and perceive as independent. Bach solved this issue unambiguously for himself - this number should not exceed 4. The statements of this conclusion can be found in any of Bach's polyphonic work. As an example, we can apply to Bach's "The Well-Tempered Clavier." It is known that, considering many factors, this masterpiece of Bach's has a didactic function. Among these factors we can name Bach's approach towards choosing the number of voices of fugues. The given scheme demonstrates a proportional correlation with the numerical indicators of fugues included in each tome of voice numeral indicator:

a 2 voci	a 3 voci	a 4 voci	a 5 voci
Book I			
1	11	10	2
Book II			
0	15	9	0

As we can see, in the first tome, only one fugue is two-voiced and two - five-voiced. But in the second there are only 3 and 4-voiced fugues. How might be such approach of the composer be explained? I think on the intuition level, Bach was aware that the ear of a performer of the polyphonic music must be exceptionally developed, because in perceiving polyphonic music, the main task is connected with the necessity of differentiation of different layers of texture as well as watching the movement of several melodious lines simultaneously. We can suppose that the composer also considered the fact that even the most refined, acute and skilled ear cannot perceive

ISSN 1512-2018

and, what's more, follow the horizontal development of more than four independent voices for a long time.

Interestingly, while writing two and five-voiced fugues, the composer applied to the diametrically different compositional and technological methods of performing fugue theme and texture. For a two-voiced e-moll fugue, he chooses such theme which is based on the concealed two-voiced principle, which creates a material layering, broadening of sonorous space creating an illusion of sonority of more than two-voices.

In the five-voiced cis-moll fugue, Bach applies to a different method. If we closely look at the fugue score, we can see that the composer never uses a simultaneous sonority of five voices (except for a code, which is given in a chord texture which fundamentally changes perception aspect). He seems to know the restricted abilities of our ear perception and cares about it. How does the composer behave? Simply, - he applies to the techniques of the voice separation.

As we get convinced, Bach (like other great polyphonists) was aware that the volume voice perception of polyphonic music is closely linked with the human's psycho-physiological abilities and in many examples of his works demonstrates this important proposition.

On the next stages of developing polyphonic music, the composers do not forget the traditions characteristic for Baroque epoch while creating polyphonic forms and give privileges to 3-4 voice polyphony.

The picture changes in XX century. In addition, this picture is not unambiguous. In a number of works, composers stay loyal to Bach's approach. In the scheme below there is reflected the number of fugue voices included in the large polyphonic cycles of the composers of XX century. In addition, it shows well a percent correlation of voice numbers with the fugue number and a predominance of 3-4 voiced fugues (in some cases the composers apply to only 3-voiced fugues):

a 2 voci	a 3 voci	a 4voci	a 5 voci
P.Hindemith "Ludus Tonalis"			
0	12	0	0
0%	100%	0%	0%
D.Shostakovich "24 Preludes and Fugues"			
1	11	11	1
4%	46%	46%	4%
R. Shchedrin "24 Preludes and Fugues"			
2	15	6	1
8%	60%	26%	4%
N.Gudiashvili "24 Preludes and Fugues"			
1	12	8	3
4%	50%	34%	12%
G.Japaridze "24 Preludes and Fugues"			
0	24	0	0
0%	100%	0%	0%

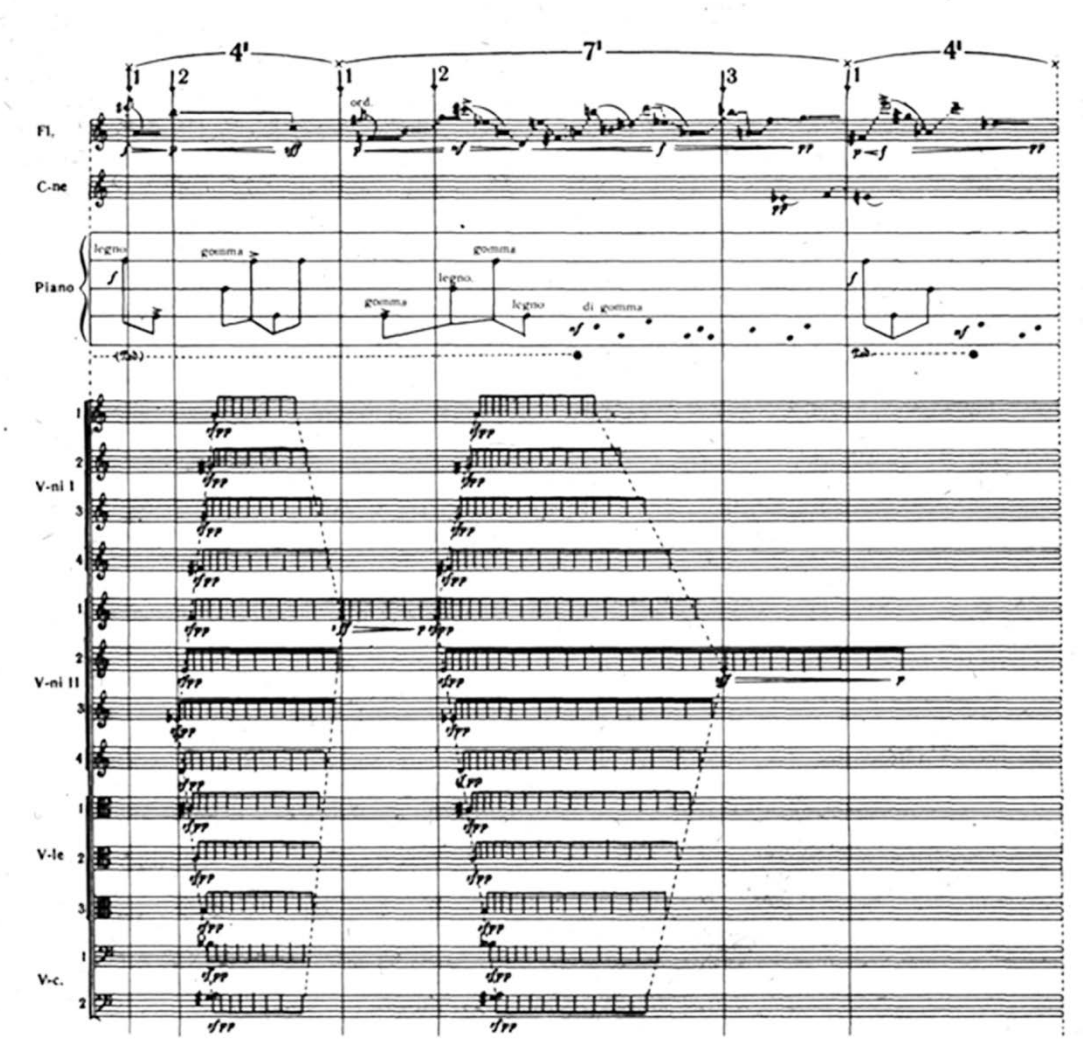
Furthermore, from the viewpoint of polyphonic judgment, new, quite interesting tendencies are outlined. The tendencies whose analyses demonstrate that perception of polyphonic music, in comparison with the previous eras, should subordinate an absolutely new logic. The thing is that in the music of the second half of XX century, often occurs violation of criteria characteristic for traditional polyphony and negligence of the terms which have been active for centuries. Such

ISSN 1512-2018

approach, naturally, radically changes the specificity of perception of new polyphonic music. Itis discussed by music composers and researchers. Here is what a famous French composer, Pierre Boulez writes:

"Our culture has added a lot of wealth and innovation to the concept of polyphony, today its expressive means are so refined that we sometimes doubt to fully **perceive** our own creation." [6:41] These words precisely indicate to the particular growth of the role of polyphony in the works of XX century composers. In addition, the composer justly indicates the problems connected with perception of new music. Frequently, the specificity of the typological polyphonic forms is expressed in the fact that auditory perception, by means even the most refined hearing means is incapable of catching its essence. The intensive inner existence of similar polyphonic structures can be found by means of the so-called "microscope" and most importantly, not by ear, but-**eye.**This phenomenon is noticed by modern composers and musicologists. We would add to P. Boulez's words above his statement connected with polyphonic judgment of the XX century composers: "there is polyphony which includes countless real voices, whose perception gets complicated just due to this multitude. At the same time, there is a four-voiced polyphony whose auditory perception with its contrapuntal tricks is almost impossible." [6:71] The first version of polyphonic structures is called **hyper-polyphony** and the other - **micro-polyphony**.

Silvestrov V. Simphony #2



It has been mentioned many times that musical practice has selected the optimal number of melodious lines for centuries. I will repeat that this is the number during which an ear for music can acquire the specificity of polyphonic tissue. It is obvious that the increase of voice number hampers an adequate perception. Consequently, during hyper-polyphony, an ear for music can catch not

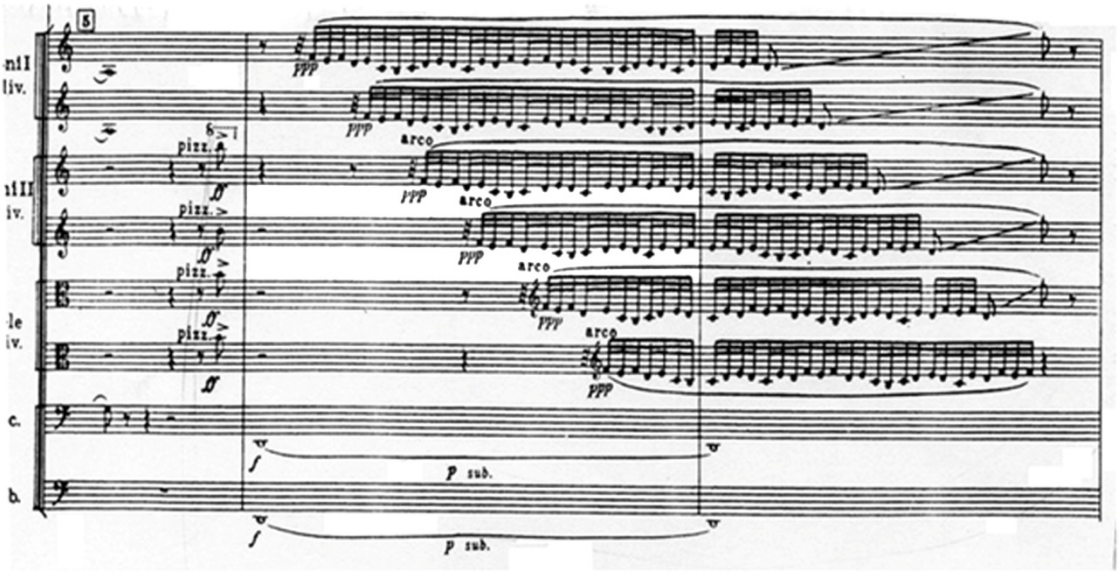
ISSN 1512-2018

independent separate lines but entire spatial and sonic complexes. As a result, a composer faces a problem: if he wants to compose music, for which a multi-level of musical space is important, as well as unity of different sonic units, priority of horizontal coordinate, in short-such music in which polyphonic logic of thinking prevails, then he is obliged, at least on the level of intuition,to take into account the volume of constituent voices or complex perception of polyphonic music which is characteristic for the human's psycho-physiology. As a result of this process, polyphony of melodious lines in the modern music is changed into layers' polyphony.

Instead of independent and free voices in the **polyphonic tissue of the layers** there are contrapuntal multi-voiced layers which are presented as a sonic complex in the hyper-polyphonic tissue. It should be noted that the unity of voices in one layer occurs due to the existence of one common indicator among them (it may be rhythm, common intonation model, timbre, etc.). For example, take one of the structures of the score of Giya Kancheli's Fifth symphony (sc. 28; ex.6). Here Kancheli presents polyphonic tissue consisting of three layers, which are complimentarily united. It should be underlined that Kancheli, as a rule, applies to **three-layered** polyphony. I am sure, like the majority of modern composers, who use new polyphonic forms in their works of art-e.g. sonoric counterpoint, layer polyphony, micro and quasi-polyphony, Kancheli also takes into consideration the abilities of the human's perception and gives priority to three layers.[3]

Micro-polyphony (G. Ligeti's term) occurs in the extreme time periods, when the musical movement is extremely fast. Here, particular compacting in time takes place. Except for the factor of time, the second, most important condition of micro-polyphony is a large number of voices. That is why, in the process of perception, as well as during the layers polyphony, "the eye" is adorned.

Kancheli G. Simphony #2



Let's make a conclusion: among the kinds of perceptions listed earlier, the analysis of certain works of the second half of XX century makes it clear that the priority of auditory perception is put under suspicion since **visual perception** is shifted onto the foreground.[4] I think this is what a famous violinist Shlomo Mintz meant when in one of the interviews he said: "Today people can listen more with their eyes rather, than see with their ears."

Musical perception, as it was mentioned at the beginning of the paper, is a pedagogical problem as well. It is important for everybody who deals with music-listeners, performers, music

[3] It is noticeable that the specificity of the Georgian composers' polyphonic judgment is national in its nature and is caused by different forms of transformation of the folk polyphony. E.g. the priority of exactly three-voiced nature for the Georgian folk song should be underlined in the research context. In this connection see [7]

[4] On New Polyphony Tissue, see [5]

ISSN 1512-2018

creators- composers. This is such a process which is connected with the auditory and graphic acquisition of a musical work, which unites a human's-listener's or performer's-logical and emotional origins during understanding a form and content of a work of art. It is totally comprehensible that the main task which occurs during perception of polyphonic music is connected with the auditory differentiation of several melodious lines, with simultaneous movement of different layers of the tissue. But the realization of this task is directly linked with the formation of polyphonic judgment. Polyphonic judgment, on its own, demands from its owner an active, well-developed inner audition. The ability of auditory differentiation of constituent voices of polyphonic tissue is born by the ear for music itself.

This is why, in the context of the presented research, we should particularly distinguish the most complex-polyphonic hearing out of numerous kinds of the ear for music, whose complexity is explained by the fact that analysis and generalization of the difficult complexes of irritators occur during polyphonic perception. That is why polyphonic hearing unites:

- **melodic hearing -** polyphonic complex consists of melodies
- **harmonic hearing -** melodies exist in the vertical correlation and are united in the harmonic complex
- **timbre-dynamic hearing -** individual voice is characterized by certain dynamics and timbre
- **rhythmic hearing** - individual voice has different rhythmic pulsation

It should be mentioned that all kinds of hearing represent entire complex and exist in active inner interaction. For me, as for an experienced practitioner educator, it is a pedagogical aspect of polyphonic music perception which is the closest. What's more, today polyphonic hearing is the least studied among the kinds of musical audition.[5] Unfortunately, practically there are no special methodology works dedicated to the definition of polyphony hearing and the issues of its practical development.

In my research, I have only approached an issue of correct upbringing problematic of polyphony hearing. I consider that for those, who are interested in the issues of musical perception, without the knowledge of scientific propositions of physiology and psychology, without profound knowledge of experimental research data from the pedagogical viewpoint, it will be impossible to put this question forward and, moreover, to solve it. This is the reason why, taking into account the time limit, in the offered paper I only put forward the necessity of further research of this important, topical issue since relying on the results of the peculiarities of polyphonic music perception, will encourage the development of polyphonic hearing and provide relevant understanding of polysemic tissue.

[5] It should be noted that in recent years appeared methodological studies, whose authors are mainly pianist-teachers. Researchers are discussing specific methods of polyphonic works and various aspects of development of students' polyphonic thinking . see:

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ISSN 1512-2018

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