

Music Computer Technologies as a Tool for Implementing the Polymodality of Musical Perception in the System of Contemporary Musical Education

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Annotation. The article reveals psychological aspects of the perception of music and a person's interaction with it when using music and computer technologies, which are a software and hardware complex (a music computer, a keyboard synthesizer, a DJ console, software, etc.) in conjunction with its application methodology in creative work and music training. Revealing the contradictions characteristic of the educational field "Art: Music," the authors propose and use in their research an interdisciplinary (psychology, neurophysiology, pedagogy, informatics and information and communication technologies) approach in a holistic consideration of the phenomenon of music in connection with the phenomena and processes of its perception, (re) construction, broadcasting. The main problem is designated as the need to identify and take into account psychophysiological factors that affect a person when interacting with music. The goal is to study the effect of convergence of music and computer technologies, manifested through the phenomenon of polymodality of the artistic image perception; it is achieved while using the analysis of existing interpretations of polymodality, as well as connotations and classifications of synesthesia, including examples of the technological and cultural manifestation of the polymodal nature of perception (syncretism of arts, associativity as a method of interpreting an artistic image). Conclusions are presented for discussion on further prospects of studying the polymodality of perception and representation of the artistic image of a musical work as one of the main distinguishing features of the convergence effect that has been updated in music and computer technologies, as well as conclusions on the need to study the effect of virtualization, use the potential of these technologies and the polymodal nature of human perception for a holistic understanding of works of art.

Key words: perception, information, convergence, musical education, music and computer technologies (MCTs), polymodal perceptual system, synesthesia, syncretism, artistic image.

1. INTRODUCTION

Problems of digitalization of musical education

The process of total informatization (including digitalization) changes the world of modern man in everything related to social, cultural, economic and other relations, leading to the replacement of previous forms of organization and technologies with new ones, whose effect has not yet been studied, which means that it cannot but arouse interest.

Under these conditions, teachers will have to objectively evaluate those contrasting projections (from very or restrained optimistic to the most fatal) that are expressed in relation to technological innovations.

In musical (both in general and professional) education, a picture similar to other educa-

tional areas is observed, characterized by a number of contradictions:

- on the one hand, the emergence of new digital means of creating and broadcasting music (including those used as instruments in the process of teaching art), of course, opened up new creative and educational opportunities (the use of audio, video recording of the performance of music by the student for reflection, more objective assessment and subsequent correction; more active connection of not only hearing, but also other sensory channels when working on sound editing in computer programs-applications, when working with notes in computer music editors, etc.),

- on the other hand, neither foreign nor domestic education, despite some attempts and successes (introduction of the professional

profile "Music Computer Technologies," the master's program "Music Computer Technologies in Education" - [1]; European projects "Soundcool," "Into School" and others) did not determine through which organizational forms, methodological principles, monitoring mechanisms, etc., it is necessary to realize the potential of new technological achievements in the secondary school, in higher school and in the family;

- on the one hand, specialists implementing innovations in a certain direction could not do without cooperation with fellow scientists studying the same phenomena and processes within their profile,

- on the other hand, attempts to introduce new means, firstly, are not always systematic and balanced, secondly, they often meet not real or at least formal support among a certain part of their professional community, but hidden or explicit opposition (we will leave a review of the reasons outside the scope of this article).

We see ways to eliminate such contradictions in the application of an interdisciplinary approach and a holistic consideration of the phenomenon of music, including those manifested in the form designated as "e-music" (K. Yu. Plotnikov - [2] et al.), together with phenomena and processes associated with its perception, (re) construction, broadcasting, etc. The need to choose precisely such methodological positions, where systemic analysis should be obtained, is dictated by the very nature of the two main observed complex objects - "music" and "man," in addition to being also in the position of the subject of activity, directly or indirectly related to music.

The special complexity of issues of musical education (in the context of which this study is carried out) has always been the need for integrative knowledge of the basics and intricacies of acoustics, electrodynamics, etc. (from physics), facets and features of creativity, a specific type of musical activity, age restrictions, etc. (from neurophysiology, psychology, pedagogy), provisions of musical theory, facts and certain canons (from music history, aesthetics, cultural studies), etc.

A similar tendency to apply an integrative approach is manifested, among other things - in the search for a subject common to various scientific disciplines, for example, "integrative musical psychology" (E.V. Barashkova and others - [3]) - for musicology and psychology, "musical and psychological anthropology" (A.V. Toropova - [4]) - for psychology, musicology, pedagogy, philosophy, etc. This, as never before, became relevant with the emergence and development of the phenomenon of music and computer technologies (hereinafter - MCTs; I. B. Gorbunova - [5] et al.), that is with the advent of new opportunities and risks (it is important to note: evaluated in comparison with what the recognized classical methods allow!) when using for training both amateur musicians and professional musicians.

Achievements and disappointments, to a large extent - "spontaneous" (referring to such an insufficient measure of study, conventionality, management for educational purposes), the dissemination of MCTs have updated the need for a comprehensive study of this phenomenon.

It should be noted that the object of a separate study should become virtualization as a phenomenon of cyberculture, since artistic understanding and the subsequent embodiment of any ideas in musical material that creates the effect of virtualization is increasingly associated with the use of MCT in the field of musical culture, which can be interpreted as an artificially created medium. It was observed that the elements of the musical text, being a form of substitution for psychological phenomena, experiences, act as an instrument for virtualization of the musical culture itself [6, p. 170; 7; 8].

One of the most important characteristics of the MCTs, according to the authors' hypothesis, is convergence in the general scientific and pedagogical understanding it as a qualitatively new form of integration (for example, according to [9; 10] et al.), which manifests itself in the possibility of more active human interaction with musical material not through one, but immediately through several sensory channels.

With all the enrichment and complication of the potential of the MCTs as a new creative educational environment, the main problem of musical education remains, as in the pre-digital era, the identification and accounting of psychophysiological factors that affect a person when interacting with music (which he or she sings, plays, composes, listens, processes, etc.).

In the context of this understanding, the purpose of this study is defined as the study of the effect of MCT convergence, which at the modern level of technologization manifests itself through the phenomenon of polymodality of perception and representation, considered by psychology and a number of other related sciences (including, of course, pedagogy) and relevant in the context of solving educational problems in the field of artistic creativity.

Understanding Polymodality

In the context of the digitalization of education

Polymodality is studied from the point of view of neurocognitive mechanisms of perception (for example, according to the proposed neurocognitive model of musical perception - S. Koelsch - [11]), in connection with the formation, interconnection and coordination of postural, visual signals and object manipulation skills (J. Rachwani et al. - [12]), in identifying mechanisms of attention (S. Merz and others - [13], including - tracing the effect of multimodal distracts on attention concentration - P. J. Matusz and others - [14]) and thus - on the effectiveness of the learning process - P. R. Pei-Luen et al. - [15]), as well as - from the point of view of cultural, historical and practical-methodological aspects of the formation of musical consciousness (N.V. Morozova and others - [16]).

Connotations embedded in the concept of "polymodality," in the context of research conducted in other scientific areas, allow the term to be used there. For example, L. Ya. Dorfman, studying the personal mechanisms of the creative process, introduces the concept of "polymodal Self," investing in "I-

concept four submodalities: Author's Self, Embodied Self, Turned Self, Echoing Self" - [17, p. 291]. The phenomenon of multimodality in dualism with synesthesia (it will be described below) is studied in transport logistics, in linguistics - [18], etc. At the same time, even within the framework of the general psycholinguistic direction, some researchers (for example, Ward J. and others - according to [19]) proceed from the fact that the metaphor arises from synesthesia, while others (S. Ullman and others - [ibid.]) consider synesthesia as an ancient, universal form of metaphor.

As one of the most highly-demanded for practice issues G. Cromley points out the study of the following aspects of poly (multi) modality:

- the degree of exertion of working memory (person) due to information coming from different sensor systems;
- the difficulty of processing by a person the information that comes at a high pace (for example, in animation, in complex diagrams, etc.);
- the problem of memorizing the source of a specific part of information with its multisensory nature and streaming;
- adequacy of semantic conclusions in the perception of information addressed to different modalities and submitted by a series of texts (including the problem of their consistency among themselves);
- identifying and exploiting the benefits of encoding information through multiple modalities;
- the problem of possible deviations from reliability, which is related to the fact of manipulative (primarily and more often - visual) effects - [20].

Among the studies in the area of psychology of music and creative work of interest, it is worth highlighting the work of N.V. Morozova, who is considering the use of polymodality resources to reveal the figurative content of music, its verbal and non-verbal representation when organizing various types of a student's musical activities. It is worth noting that the researcher points out among the psychological foundations of the devel-

opment of figurative thinking the law of figurative-emotional unity of musical perception and thinking and the law of unity of consciousness and activity - [16]. The authors of this article speak from the same positions in the current study, including highlighting the most important in the presented list of analyzed works of other scientists.

Building the concept of sound and image integration, G. Athanasopoulos and M. Antović offer a model of polymodal perception of musical form, which includes such levels as:

- 1 – fine motor skills,
- 2 – spatial and temporal concepts,
- 3 – “The Bouba-Kiki Effect” (correspondence between the sound of the word and the geometric form) and widely cultured (including through the process of teaching music) connotations,
- 4 – cultural symbols mastered in social interaction,
- 5 – two-component integrity of musical knowledge and socio-cultural context,
- 6 – verbal communication with other musicians in connection with the skills obtained when mastering music,
- 7 – individual associations based on personal life experience - [21, p. 83].

O. Doehrmann and M. J. Naumer, studying the relationship of the resulting meaning and processes of audiovisual integration, rightly point to multisensory as the quality of the human brain - [22]. Referring to their predecessors (A. Martin, 2007, R. F. Goldberg and others, 2006, G. A. Calvert and others, 1997 - [ibid.]), they report that this mechanism of human brain work derives knowledge about objects, including information about their sensory properties, while the cognitive processes performed occur in a sensory-specific way, affecting the corresponding cortical regions. It is worth highlighting separately the conclusion of the authors' data that in cases of formation of deep connections between modal subcomponents, "the representation of one component alone may be sufficient to jointly activate the cortical representation of its analogues in other sensory modals" - [ibid., p. 147].

To sum up the interim results, the authors of this article recognize as more consistent with the known facts (obtained by psychophysiology, neurophysiology of the human brain, neuropsychology, etc.) B. M. Galeev's viewpoint based on them; who, in concert with the logic of the general development of science and the history of this issue, gives a holistic analysis of the phenomenon of polymodal perceptions and highlights:

- a coordinated sensory action that reflects reality,
- mutual sensibilization - change of susceptibility (mutual activation of system elements) of sensory organs,
- reflection in consciousness of those connections that arise and are revealed in the process of synergistic reflection of reality, organized as associative interaction - synesthesia – [23].

Synesthesia as a "product" of a polymodal perceptual system

Within the framework of the human psyche, synesthesia (R. E. Cytowic - [24] et al.) is a manifestation of the complex work of sensory science, which is precisely polymodal in nature. Being, on the one hand, one of the basic, on the other hand, vaguely or implicitly aware of the mechanism of perception, synesthesia can manifest itself:

- at the level of neural processes and at the level of primary reflex reactions,
- when constructing "images" of various modalities (which are defined as the main subject of this study by the authors of this article), and following or simultaneously mental processes characterized by the integrativity of consciousness mechanisms.

A.A. Zaichenko and M.V. Kartavenko summarize:

- some researchers accept synesthesia as an "anomaly" (based on pathological cases; A. Welleck, H. Heirman et al.);
- others - as a result of the impact of something extraordinary - narcotic drugs, meditative techniques, etc., on the body (including on the senses, on the brain; S. Khozuziy, R. Kadosh et al.);

- others - as a special level of development of personality consciousness, characterized by a holistic subjective perception of polymodally presented reality (C. Osgood, S. L. Rubinstein and others);
- others - as a phenomenon of undifferentiated work of sensory paths going from analyzer systems to the cortex of the cerebral cortex (S. Baron-Cohen, A. R. Luria et al.) - [25].

Another principle of classification (see [ibid.]) separates:

- true synesthesia (true-synesthesia - cases recorded by psycho-physiological methods, primarily related to medical, neurological observations; R. Citovik, D. Eagleman et al.),
- pseudo-synesthesia (pseudo-synesthesia - experiences recorded in the study of cognitive processes, in the practice of aesthetic perception, artistic collaboration in creative work, and using methods of psychology and aesthetics.

Among the various options for classifying synesthesia, the authors of this article consider the most accurate one that was proposed by B.M. Galeev - [23], in which two "clinical" classifications (these are artificially modeled abnormal forms of real sensations and associations of a neurotic nature) are opposed by the "norm" in the status of cultural fact (represented by synestheses, firstly, of associative origin, secondly, by those based on previous synestheses and produced in the process of artistic, musical and other types of creative arts.

A. A. Zaichenko and M. V. Kartavenko, including based on studies by authors, whose works are [26; 27; 28] et al.) - analyze and the authors of this article note the following (which is important in the context of a study conducted for the benefit of music education subjects): in linguistics, synesthesia is usually considered as a linguistic universality, "with the power of which the connection of feelings and sensations is recorded verbally," and in art history science (and practice) synesthesia is understood as "an associative, metaphorical mechanism for transferring the meaning and qualitative properties from one

subject to another" [25, p. 6]. It should be added, however, that the process of creating synesthetic experience (through associations) goes beyond linguistics and art, since it is carried out not only at the aesthetic level, but also at the physiological level, in the mode of operation of the second signal system.

H. Heirman - [25], noting that life is a continuous synesthetic experience, shows in his adapted diagram G. Casagrande an inter-aesthetic level / common sense level as mixing in any order (in the processes of decoding and integration) separate perceptions (audio, visual, tactile, sniffing, taste).

All cases of synesthesia, including what the psyche receives as an image of sensory (visual, kinesthetic, etc.), manifested in artistic activity, are all from the category of information of consciousness (according to A.V. Toropova - [4]), while the unity of verbal, visual, auditory and other sensual forms accompanied by emotional images of the object, according to the main hypothesis, is a reflection of the objective world - according to [25]).

As a result, the authors speak about a synesthesia with we understanding of its norms, but not its pathological deviations which "are possible for any complete systems which are in an action field of external and internal fluctuations. But, being an exception, <... > cannot be considered an essential manifestation of the < human > psyche "[22, p. 160].

We suggest that in the cases described (R. E. Cytowic [24] and others) of activation of such abnormal effects of the manifestation of synesthesia (which are caused by sensory deprivation, narcotic and other types of intoxication, the practice of meditation, etc.), there is no "fusion" of protopathic components (which explanation B.M. Galeev suggests.), and, caused by the switching of the brain's activity from its neoplasms (through which verbal thinking is carried out) to an older part, which, in the conditions of the formed deficit to the information processed in the "usual" way, represents the situation with a sensual flow that at that moment reflects the work of the senses, as well as traces of synaptic connections (implicitly pre-

served facts) of the deep memory of the neo-cortex.

The admissibility of this assumption is indicated by the data obtained in recent years by neurophysiologists who have identified when studying the brain with a new instrumentation (tomographs of significantly pain-neck resolution, etc.) a system called default and associated with processes of internal thinking based on the activation of commemorative traces.

Another argument in favor of the above assumption is the statistics on brain activity of visual information cited by E.P. Kharchenko and A.N. Shepovalnikov. By this it is meant that the fact that the retina of the human eye receives about 10 billion bits of information every second, but only up to 10 thousand bits reach the visual cortex, and the amount of information involved in creating a conscious visual image is already less than 100 bits per second. Scientists conclude: "Such a small stream of data should not be enough to form an image, if this stream of information is the only one. Internal brain activity appears to be involved in the process "[28, p. 25].

Syncretism in Art

As a reflection of the polymodal nature of reality perception

Syncretism can be considered as another (as well as synesthesia, but external, expressed by man through artistic activity) feature of the manifestation of the phenomenon of polymodality, under which there is an undivided function of thinking and perception (which was studied and described by G. Spencer, L. S. Vygotsky and others), it is expressed in synestheses of sensations, including when perceiving artistic images.

In the context of this study, two indicative, well-known manifestations of syncretism are worth noting:

- syncretism, manifested by the insignificance of the holistic sensory image of the object, which is a characteristic feature of perception in childhood (according to the studies of J. Piaget, E. Klapared et al.);
- the merger of the main forms of artistic creation in primitive art, which began to re-

turn from the beginning of the 20th century and is especially actively used in the information era (the prevalence of syncretic types of art, replication of syncretic genres - clips, performances, etc.).

Both of these examples of syncretism are current, especially for the pedagogy of general and (pre) professional education; will consider correct at the same time art creation is complete, but allocating in it the procedural, productive and personal parties (T.A. Barysheva), in each of which "with a psychological basis of associative and creative activity, emergence of the metaphorical, "remote" associations of creative level is sensory (sinesteziya) and perceptual (polymodality) systems, which allows to attribute them to basic creative parameters" [29, p. 141].

In the procedural sense, the MCT turns the musician (both professional and a student) to various sensory systems: to see notes, touch the instrument, hear a sound result; in productive - they lead (as in any creative act when interacting with art) through the generation of an artistic image, the integrity and individual details of which are individual synesthesia-associations of a particular person (with his or her unique life experience and features of the functional morphology of the human brain [30]). Procedural, as well as - through our "product," creative work (we, first of all, talk about music) forms the personality of the individual, while personal qualities affect the authentic (or imitative) manifestations of the creative process in a particular person.

The technological capabilities of the MCTs, including as part of the manifestation of the polymodality effect, is a new instrumentation, creatively mastered at different levels by both a student and a professional musician and includes "software algorithms that regulate the behavior of the computer system during interaction with the performer, <... > interfaces - sensors and controllers that allow you to transfer information from the performer to the computer" ([31]).

The essence, which is represented by the phenomenon of polymodality itself as one of

the "mechanisms" of the psyche, and that outwardly depicted feature of the cultural and creative expression of polymodality by man, which is called the syncretism of the arts, is, as A.V. Toropova explained, "information about the diversity of being < which is contained > in a hidden state in the psyche of man as in integrity, having images and meanings of greater integrity, to which he or she belongs <...> At the physical level, this is the integrity of the continual and discrete, at the psychological level - the unconscious and conscious. <...> Access to this information lies through the unconscious sphere of man and is opened in the form of folk syncretic mythology, high examples of art, scientific hypotheses "[4, p. 124].

With this view, the grounds on which, in the evolving conditions (new possibilities of modern information technologies), they propose to form a "new literacy" specialists of the State Institute of the Russian Language named after A.S. Pushkin: "By nature, a multimodal text is closer not to written sources, but to oral communication, when a person is affected not only by spoken language, but also by gestures, facial expressions, physical features, and the position of the interlocutor in space." [32] So contemporary musical education can and should be built without fail taking into account the best traditions of classical pedagogy with the strengthening of the holistic effect of polymodality, which allows competent application of MCTs.

Among the educational practices already being implemented in this direction, it is worth paying attention to:

- to the training course "Soft Mozart" by E. Heiner (see [33]), where MCTs when learning to play a keyboard musical instrument act as an interactive network educational environment;
- to the education and methods laboratory *Music Computer Technologies* of the Herzen State Pedagogical University of Russia in collaboration with the Academic Gymnasium No. 56 and secondary school No. 8 "Music" of St. Petersburg training courses "Music Computer Technologies," "Musical Informatics" and others, mastering which, stu-

dents understand the theoretical and technological foundations and subtleties of unity of the musical language;

- the comprehensive (when using MCTs) nature of training in modern digital sound engineering (at advanced training courses, professional retraining courses, etc. / Herzen State Pedagogical University of Russia and other educational organizations in the Russian Federation and beyond), where the solution of technological, cultural and artistic problems is organically intertwined;

- the individual nature of historically known cases of "color hearing" (N. A. Rimsky-Korsakov, A. N. Scriabin, B. V. Asafiev and others), which should be sensitively identified and supported in their students.

2. CONCLUSION

The authors, on the basis of the material analyzed and presented in the frames of this article, submit the following conclusions for discussion:

1. Polymodality, which earlier, before the appearance of the phenomenon of music and computer technologies, was a possible, but not mandatory quality of the creative and educational process, directly or indirectly related to music, has now become one of the main distinguishing features of the convergence effect manifested in MCT.

2. The presented problem of studying the effect of polymodality in relation to the MCT phenomenon, on the one hand, is acutely relevant and in view of ongoing intra- and interdisciplinary research, on the other hand, to draw hasty conclusions and be content with the suggestions made by the authors of this article, no other scientists have the right yet, since we are all only at the beginning of the path of mastering the potential of technological innovations, coupled with the study of the depths of the human psyche in order to improve the process of musical education.

3. Both polymodality and MCT are tools (created by nature itself - in the first case; created by man - in the second), which, undoubtedly, can and should help the student, listener, viewer perceive the production of art "as something holistic and self-valuable,"

enclosed in an art form that is "holistic, complete in itself and very vulnerable to < alien > invasions" (A. A. Melik-Pashaev [34]).

4. Using the technological capabilities of the MCT in terms of updating the effect of polymodality in the perception and representation of music requires competent methodological support and consists of:

- in the interactive nature of learning on an electronic musical instrument through the simultaneous connection of several sensory channels: kinesthetic (interaction with the keyboard), visual (orientation to the "running" line of note text on the screen/display), audio (sound control - editing timbre, volume, panoramic, texture, etc.);

- in activating not only traditional audio, but also visual, and kinesthetic channels during the work of the composer (both experienced and beginner), instrumentalist and sound engineer with musical text in digital format, with digitized audio music.

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