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MUSIC PERCEPTION IN BLIND STUDENTS: COGNITIVE, INTONATIONAL AND NEUROPLASTIC FOUNDATIONS OF ARTISTIC THINKING

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Abstract

This article examines the cognitive, intonational, and neuroplastic foundations of music perception in blind students. Shifting from a clinical perspective, the research analyzes the psychophysiological mechanisms that support professional artistic thinking. Key findings highlight that musical perception in the blind is an "intonational-figurative" process involving universal cognitive functions like analysis and synthesis.

Cross-modal neuroplasticity allows the visual cortex to be repurposed for auditory and tactile processing, leading to superior high differentiation of pitch, timbre, and rhythm. Additionally, the use of Braille musical notation fosters highly developed structural and motor memory because the system necessitates memorizing individual parts separately. The study concludes that the absence of vision does not reduce musical potential but instead triggers a functional reorganization. This creates a non-compensatory but alternative, highly organized model of perception characterized by deep auditory concentration, imagination, and analytical depth.

Keywords: *music perception; blind students; artistic thinking; intonational thinking; musical cognition; neuroplasticity; auditory imagery; inclusive music education*

Musical perception is a complex and multifaceted process that includes not only auditory sensations, but also cognitive, emotional, and sensory aspects. The perception of music can be considered not only from the psychophysiological side, but also from the aesthetic-psychological, socio-psychological... and other socio-communicative types of musical activity (Nazaikinsky, E.V., 1972). In the context of blind musicians, this process becomes particularly important, since the lack of visual perception requires the development of alternative ways of interpreting and analyzing musical works. The musical perception of blind people is a unique phenomenon in which auditory and sensory abilities play a key role. The nature of the musical perception of the blind requires careful analysis and is investigated at the intersection of musical theory, psychology, and physiology.

In contrast to the clinical and special education approach, the present study focuses on those psychophysiological mechanisms that ensure full-fledged professional musical

perception and artistic activity of blind musicians. This idea can be traced in V. Kholopova's research: "It does not require proof that music exists only in human perception, and the actual reality of a work can be considered and evaluated only as a psychological reaction to it." (Kholopova, V. N., 2000). Musical perception, therefore, is formed not only based on individual sensory capabilities but also in the context of the cultural environment, the system of musical language, and educational practices. This provision is of particular importance in relation to blind musicians, whose musical thinking and perception develop in a different sensory organization, but within the same cultural and artistic patterns.

Musicologists B. V. Asafyev, Yu. N. Sokhor, V. V. Medushevsky emphasize that musical thinking and musical perception should be considered as forms of artistic thinking based on the intonation-figurative nature of music. B. Asafiev allows us to consider musical perception as a form of active participation of the listener in the unfolding of musical thought. Music exists as a process of intonation, and its perception presupposes comprehension of the logic of intonation movement (Asafyev, B. V., 1971). In the context of teaching and performing practice of blind musicians, this position becomes particularly important, since the oral-auditory and intonational nature of musical thinking becomes dominant. Consequently, musical perception is interpreted not as an isolated sensory act, but as a form of thinking that obeys the general laws of human cognitive activity. In this aspect, it should be studied in the context of universal psychological mechanisms such as analysis and synthesis, semantic education, and a holistic reflection of reality, which allows us to consider musical thinking as a special case of general human thinking that does not directly depend on the preservation of the visual channel. At the same time, musical thinking acts as a special kind of artistic thinking, in which figurative-emotional and intonation-semantic processes play a leading role. In this case, musical perception is a form of artistic exploration of reality based on experience, expressiveness, and temporal organization of a musical image.

This approach emphasizes the autonomy of musical art in relation to visual forms of cognition and creates a theoretical basis for analyzing musical perception as a full-fledged aesthetic process and in conditions of blindness. In the absence of visual information, this system acquires a special configuration, including *the abilities of auditory orientation and spatial perception, the level of emotional perception, the use of cognitive strategies for analyzing and understanding music, and the availability of interpretation and expression capabilities*. All this determines the specifics of the musical perception of blind musicians and requires special scientific understanding.

Several researchers emphasize the strengthening of auditory analysis in people with visual impairment. This phenomenon is explained by the mechanisms of sensory compensation and cross-modal neuroplasticity, according to which, with loss of vision, the auditory areas of the brain expand their functional capabilities and participate in the processing of spatial and temporal characteristics of sound. Neurobiological research of A. Amedi and his colleagues convincingly demonstrate that areas of the cortex traditionally associated with visual modality are activated in the blind when performing auditory and tactile tasks, which is directly related to musical perception and learning (Amedi et al., 2005).

Auditory perception in blind musicians, as shown by (Ockelford, 2013) and (Cross, 2001) is characterized by a high degree of analyticity and imagery. Music is mastered through auditory, tactile, and proprioceptive channels, as well as through developed imagination and memory. The researchers note that blind musicians are capable of subtly distinguishing pitch, timbre, rhythmic structures, and formative elements, which allows them to confidently navigate complex musical texts and achieve a high level of performance interpretation.

The musical thinking of musicians with limited visual abilities should be considered as a socially and culturally mediated form of artistic thinking, the development of which is determined primarily by the conditions of musical education and the involvement of the individual in the musical and communicative environment.

In conditions of blindness, the specifics of musical thinking and memory are manifested through compensation processes. Historically, typhlopsychology has had polar views on the thinking of the blind. Representatives of the early period E. Fricke, G. Strube, N. M. Shcherbina believed that blindness even accelerates the development of abstract logical thinking due to the absence of visual distractions. The opposite position was taken by researchers who believed that lack of vision inhibits intelligence (associationists, for example, K. Burklen) – due to the poverty of visual representations, the thinking of the blind, in their opinion, is limited and reproductive. Modern science has refuted both extremes.

As A. G. Litvak notes, blindness really complicates the development of thinking, especially with a lack of sensory experience; however, with purposeful training and upbringing, the intellectual capabilities of the blind are revealed according to the general norm (Litvak, 2006). The unity of the sensory and the logical is crucial: the blind man's thinking does not unfold in isolation from perception, but in constant reliance on auditory, tactile, and verbal representations. Z.Ermalovich emphasizes that in blind people, higher mental processes are actively involved in compensation: an inter-functional restructuring occurs, in which thinking, speech, imagination, logical memory, and voluntary attention take on a leading role in mastering the world around them (Ermolovich, Z. G., 2004).

Therefore, correctional and developmental training is aimed at enriching the sensory experience of the blind, developing ideas and concepts, which creates a solid foundation for the full development of thinking. Early researchers cited numerous testimonies about the outstanding memory of blind musicians. Thus, K. Buerklen noted that some blind people have a huge repertoire and "*their musical memory rarely fails them*." As examples, he cited the blind pianist F. Dulon, who knew 250 musical pieces by heart, the blind violinist G. Becker, who memorized complex works the first time, and the organist I. Labor, who played for hours from memory (Burklen, K., & Gander, V. A., 1934). These facts demonstrate the fundamental possibility of phenomenal memory development in blindness. However, systematic experiments have not confirmed the presence of any particularly increased mnemonic ability in all blind people. As early as the beginning of the 20 th century, A. Krogius, in the course of comparative experiments, found only a slight superiority in the memory of blind individuals: their volume of recall exceeded that of sighted individuals by only fractions of a percent (approximately 0.7–0.9%)(Solntseva, 2000). He explained the somewhat faster memorization in blind people by greater concentration of attention and the ability to rely on practical experience when memorizing.

In the musical practice of the blind, the specifics of memory are related to the peculiarities of working in the Braille system. Reading music requires alternating mastery of parts, which initially focuses the learning process on memorization. When learning works in the Braille musical notation, the student is forced to memorize the parts of each hand separately, since it is almost impossible to "*read*" the whole thing with two hands at once. As a result, the process of reading music for the blind is initially focused on memorization. The difficulty lies in the fact that each part sounds fragmented outside the context of the whole and is more difficult to comprehend emotionally. However, this way of working has a positive effect: the skill of strong voluntary memorization is formed, mnemonic techniques and logical strategies for mental processing of the material are developed. A blind student learns to identify the semantic units of a musical text and link them together, which strengthens memory and facilitates subsequent playback. This strategy forms: developed auditory memory, logical structural memory, motor-muscular connections, and stable mnemonic techniques.

Learning a piece in Braille notation involves the analytical processing of a musical text and the identification of semantic units. As a result, strong long-term memorization and a high degree of internal auditory control are formed. Consequently, the musical memory of the blind has a structural and meaningful character.

An analysis of the results of empirical research shows that specially organized

activities can significantly develop the necessary abilities even in the absence of vision. Considering the thesis about the restructuring of interanalytical connections and individual sensory systems in the process of cognitive and labor activity of the blind, it can be argued that the development of musical and auditory functions in blind musicians can reach a very high level. The developed inner auditory thinking is closely intertwined with the motor sphere: The so-called «*pianistic hearing*» allows a blind performer to more firmly connect sound images with the motor sensations of playing an instrument. In some cases, compensation takes on the character of overcompensation: the desire to overcome a defect encourages a blind person to maximize himself in an accessible field. The phenomenon of absolute hearing is known, which is statistically more common in musicians who become blind early on (Ross et al., 2003).

The study of the psychological aspects of the musical perception of the blind based on scientific literature on musicology, musical psychology, and typhlopsychology allowed us to identify its specific mechanisms (*see Table 1*).

Table 1. *Psychological mechanisms of musical perception of the blind*

Psychological mechanisms	Substantive characteristics	Musicological significance
Auditory attention	It is characterized by high stability, selectivity, and the ability to switch between intonation, rhythmic, and timbre parameters of a musical text.	Provides a detailed auditory analysis of the form, vocal structure, and intonational logic of the piece.
Musical memory (auditory, logical, and muscular)	Auditory and muscle memory are dominant, compensating for the lack of visual memory; memory is structural and analytical in nature.	It allows you to hold large musical forms, work without visual scores, and build a holistic interpretation.
Musical thinking	It is implemented as intonation-figurative and analytical thinking based on auditory representations and generalizations.	Promotes the understanding of thematic development, drama and shaping
Imagination	Forms internal auditory and imaginative models of a piece of music without relying on visual representations	Ensures the integrity of artistic perception and the depth of interpretation
Associative and synesthetic thinking	Connects musical intonations with emotional, spatial, and tactile associations	Enhances the expressiveness of perception and promotes the imaginative comprehension of musical content.
Emotional and semantic experience	Emotion is not a reaction, but a structure-forming component of musical perception.	Defines individual interpretation and performance expressiveness

The physiological aspect of musical perception in the blind is associated with neuroplasticity and the redistribution of functions of sensory systems. Modern neurophysiological research (Amedi et al., 2005) demonstrates that in the absence of visual stimuli, the participation of the auditory cortex increases, and the visual areas of the brain can be involved in the processing of auditory and tactile information. This creates a neurophysiological basis for the subtle differentiation of pitch, timbre, and rhythm.

Modern neuroscientific research convincingly shows that congenital or early vision loss is accompanied by pronounced cross-modal neuroplasticity. A.Amedi and A.Pascual-Leone found that in the blind, the visual cortex is actively involved in the

processing of auditory and tactile information, including the analysis of spatial and temporal characteristics of sound. Neurophysiological data indicate that the brain of the blind undergoes a functional reorganization: sensory areas that are not involved in auditory activity in the sighted are connected to the processing of sound information. Thus, in the case of early blindness, activation of associative parietal-occipital regions of the brain is observed when performing musical tasks (Ross et al., 2003). The visual cortex of the blind is actively involved in processing auditory and tactile information. A functional reorganization of the brain is taking place, providing a more subtle differentiation of pitch and timbre, analysis of complex rhythmic structures, and enhanced spatiotemporal sound processing. This conclusion substantiates the thesis about the plasticity of the nervous system, which allows a blind musician to achieve *exceptional musical skills* due to the redistribution of functions between analyzers. Thus, the physiological restructuring of the brain provides the basis for highly analytical auditory perception, which is necessary when working with complex musical forms and polyphonic textures.

The presented psychological and physiological mechanisms demonstrate that the musical perception of the blind is formed as an integrative system in which hearing, thinking, memory, and neuroplasticity form a stable basis for professional musical thinking. This allows us to consider blind musicians not within the compensation paradigm but within the logic of an alternative, highly organized model of musical perception.

Summing up, we can conclude that musical thinking and memory of the blind have the same fundamental mechanisms as those of the sighted, but are formed in different conditions of sensory experience. The lack of vision leads to a restructuring of cognitive activity: hearing, touch, and speech mediation become dominant, involving thinking and memory in the compensation process. With proper training, blind students are able to successfully master the most complex musical tasks, relying on a developed inner ear, strong memory, and logical and analytical strategies. It is along this path that the unique features of the musical thinking of the blind are formed – deep auditory concentration, reliance on memory and imagination, high abstraction of thinking while striving for concretization through sound.

Thus, musical perception in the context of blindness is an integral psychophysiological and artistic process that is formed on the basis of general patterns of musical thinking and specific conditions of sensory organization. The lack of vision does not reduce the potential of musical perception, but changes its support, enhancing the role of hearing, memory, imagination, and motor tactile mechanisms.

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