

MUSICAL COGNITION-INTERDISCIPLINARY CONNECTIONS

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ABSTRACT

The twentieth century has allowed many disciplines to reflect on the neurological structures and psychic processes that accompany the studied phenomena: this is also the case of music, which benefits from the help of psychology and neurology in understanding and explaining concrete phenomena related to the artistic act (whether it is composition, interpretation or the perception of the message of the work of art). Research on music cognition aims to understand the nature of listeners' musical knowledge, its acquisition, and the influence of this knowledge on encoding, organizing, understanding and performing musical patterns.

Key words:

Neurology, music, psychology, semantics, cognition.

INTRODUCTION

The twentieth century has allowed many disciplines to reflect on the neurological structures and psychic processes that accompany the studied phenomena: this is also the case of music, which benefits from the help of psychology and neurology in understanding and explaining concrete phenomena related to the artistic act (whether it is composition, interpretation or the perception of the message of the work of art). "Research on music cognition aims to understand the nature of listeners' musical knowledge, its acquisition, and the influence of this knowledge on encoding, organizing, understanding and performing musical patterns" (Tillmann, 2005: 795).

Music (and art in general), along with its related processes, is involved in "prominent age-related differences in the development and aging of the frontal-parietal brain network, which affect several cognitive functions, such as attention, executive control and evaluation" (Li, Muschter, Limanowski, Hatzipanayioti, 2021: 199-221), thus by the entire psycho-physiological and neurocognitive phenomenon of the person. Theories related to musical cognition are related to what it means to decrypt the musical message, the semantics, the hermeneutics of the work of art. Thus,

fields on the interdisciplinary border between philosophy, anthropology and ethnomusicology are involved, outlining a type of "paradigm that is applicable cross-culturally and includes the processes of both listeners and performers" (Walker, 2000: 27-42).

Cognitive psychology is the scientific study of human mental processes such as attention, language use, memory, perception, problem solving, creativity and reasoning. For most people, music is already an important part of daily life: "music is often linked to mood. (...) A certain song can make us feel happy, sad, energetic, or relaxed. Because music can have such an impact on mindset and well-being, it should come as no surprise that music therapy has been studied for use in managing numerous conditions" (Ulbricht, www.psychologytoday.com/gb/blog/natural-standard/201306/music-therapy-health-and-wellness).

Music cognition represents a growing research domain, which involves behavioral, neurophysiological, theoretical and computational perspectives, cognitive sciences (cognitive psychology and neuroscience, neuropsychology, computational modeling and linguistics), all of which are put at the service of the understanding and inner functioning of musical processes within the artistic human being.

MUSIC COGNITION IN THE COMPOSITIONAL PROCESS

a. MUSIC AND THE COMPLEXITY OF INTERDISCIPLINARY ANALYSIS FACTORS

Cognitive musicology is a "branch of cognitive science concerned with computationally modeling musical knowledge with the goal of understanding both music and cognition" (Laske, 1999: 7.). Cognitive musicology is part of the broader, interdisciplinary field of music psychology: "this field seeks to model how musical knowledge is represented, stored, perceived, performed and generated" (Vuust, Heggli, Friston, Kringelbach, 2022: 287-305). Even the simplest melodic artistic acts involve multiple processes in the brain, which process the understanding of everything that happens: the stimulus reaches the auditory cortex (within the temporal lobe) which processes the sound heard primarily from the point of view of pitch and volume. The rhythm is processed by the left frontal cortex; tonality is assessed by the prefrontal cortex, so music is able to access many different brain functions.

Otto Laske brings to the forefront of cognitive musicology semantic concepts of primary importance, such as those relating to "meaning making and sense-making" (Laske, 2023: 149.), essential in the exercise of the musical act (at all its levels) and in the relationship with the understanding of music (the fundamental process of which music exists). Diana Deutsch also intended, in her volume on musical psychology "to interpret musical phenomena in terms of mental function—to characterize the ways in which we perceive, remember, create, perform, and respond to music. Music had no

established position within psychology and few music theorists acknowledged the relevance of empirical research. " (Deutsch, 2013: XIII).

The complex processes involved in learning music have short and long-term effects on the development of linguistic, social or mathematical skills, because "the interaction between musical education, speech, attention and discipline has already been proven and taken for granted by the great ancient Greek thinkers. (...) Among the positive effects of learning music, the first positive effect is mentioned in terms of language ability, and the effectiveness of music training has also been demonstrated in the case of dyslexics" (Kováts, revistaprofesorului.ro/efectele-cognitive-ale-educatiei-muzicale-efectele-de-transfer-ale-activitatilor-muzicale).

Music is perceived in the complexity of the factors that make it up as a relatively ordered phenomenon, which also orders other related aspects (even in its most modern hypostases): "music cognition analyzes how listeners succeed in these processes, and it aims to specify listeners' knowledge about a given musical system and its acquisition, structure, and use in perception and performance" (Tillmann, 2005: 795). Cognitive neuroscience constantly testifies to the personalized context in which the musical act is perceived, regardless of the stage in which it is assimilated (composition, performance, reception), because understanding these situations involves undeniable individual experiences (education, environment, culture, antecedents).

The musical phenomenon has unique biological and psychic data in structuring a bio-physiological response to artistic stimuli: "neural information processing in brain circuitries that underlie the different senses not only operate very fast (on the order of <20 ms), but also at very different speeds. Whereas hearing and seeing operate, respectively, in the range of 3 ms or 15 ms, the tactile sense operates in the 1 ms time range" (Li, Muschter, Limanowski, Hatzipanayioti, 2021: 199-221).

Another field of musical neurocognition would be that of psychoacoustical models: if they exist, how they are structured and what effect they have on musical phenomena related to the compositional, interpretative or receptive act (the differentiation of responses to stimuli such as noise and musical sound - artistically articulated - being studied from multiple perspectives).

b. NOISE AND MUSIC IN CONTEMPORARY ART AND LIFE

Noise (irregular/static, MEANINGLESS product of indeterminate sound) – as a mode of noise pollution (and not only!) – has been analyzed in its relation to the consequences it can cause at the neuropsychic level: "noise, especially ambient noise, appears to affect cardiac measures (i.e., increasing heart rate) quite consistently, accompanied by poorer cognitive performance. (...) There seems to be a consistent relationship between noise and cognitive performance, but the relationship with music is

contradicting. Noise and music differ in their acoustic properties. Noise can increase risks of certain cardiovascular diseases (...) and negatively impacts cognitive performance" (Chee, Chang, Cheong, Malek, Hussain, Vries, Bellato, 2024, p. 224). Ambient noise tires and consumes because it does not serve a meaning, a meaning that should reach a public.

Ambient noise tires and consumes because it does not serve a meaning, a meaning that should reach a recipient. The noise intentionally used in the modern musical act, however, has other functions, which allow it an expressive role in the development of the work of art. Thus, noise becomes art, it is invested with a semantic horizon and thus reaches an area of existence opposite to the first situation presented: the differentiation is made on the aesthetic-expressive level (spiritual, if it is religious music), although the strictly sound manifestations can be the same.

Noise in modern music stimulates the audience to search for a deeper, symbolically configured meaning, requesting its communication with soul resources. Artistically validated noise becomes autonomous and aesthetically profiled in a world where auditory stimuli are multiple, aggressive, diverse and... questionable. "Noise and music could potentially influence electrodermal or pupillary measures and cognitive performance independently. (...) There is insufficient evidence to reach a conclusion with respect to music and noise and their effects on autonomic activity and cognitive performance" (Chee, Chang, Cheong, Malek, Hussain, Vries, Bellato, 2024, p. 224).

World Health Organization considers noise as the second highest environmental stressor from the public health perspective; when the level of noise exceeds 90 decibels it becomes a source of stress and affects the health in both physical and psychological perspectives. Noise, however, also has a negative effect on the peace of mind that the soul needs to grow, to find itself. Urbanization, industrialization, increasingly abundant circulation, the media, other means of noise pollution, ambient music freely, unfiltered listened are all factors that can bring to the fore the harmful effects of noise on musical cognition: "the impact of Noise stress is not just limited to the auditory system, but also has the potential to target any other system. Noise impairs cognition by increasing oxidative stress, alteration of the neurotransmitter level and by epigenetic modification.

Noise can potentially lead to neurodegenerative diseases. The effect of noise on health can include: noise-induced impaired cognition on neurobehaviour, brain areas which are predominantly affected by noise-induced oxidative stress, alteration of the neurotransmitter level in various brain regions, alteration of the molecular mechanism induced by noise stress on brain cellular level, noise-induced deterioration of the morphological structures of brain and epigenetic modification by noise on brain" (Arjunan, Rajan, 2020: 113-136).

Regarding the relationship between noise and neurotransmitters, studies have shown that "the stress can border the molecular level in a living organism. (...) Noise can alter the molecular mechanism in the brain. Limited studies denote that noise disrupts the neuronal cell function by molecular level. (...) Many studies have evidenced that the vulnerability may emerge from stress effects on higher cortical and limbic structures. (...) There is increasing evidence that noise stress impairs cognition, motor coordination, eating. (...) The adverse effect of noise includes metabolic and anatomical changes in neurons, reduced dendritic count, impaired memory, cognition and locomotor activity" (Arjunan, Rajan, 2020: 113-136).

Auditory stress has effects not only on the cognition process, but also on the affective, emotional, spiritual life, on the entire human ontological spectrum: "certain types of auditory stimulation (e.g., some music genres or sounds at specific frequencies) have been proposed to affect cognitive functioning, i.e., improving or worsening cognitive performance during certain tasks or activities. (...) The potential positive impact of music on cognitive performance began to be researched several decades ago when music-related improvements in spatial task performance were first reported (the "Mozart effect" - improvements in cognitive functioning following exposure to Mozart's music). (...) Certain types of auditory stimulation could lead to changes in mood, affecting cognitive performance" (Arjunan, Rajan, 2020: 113-136).

Auditory stimulation and music can affect cognitive and attentional performance. (...) Ambient noise affects heart rate variability, with consequences on cognitive performance and attention. Humans are spiritual and biological organisms with rich symbolic and cultural capacities. A full understanding of music cognition must unify the study of faith, biology and culture. A wide category of the public accuses the modern music of the 20th century and of the beginning of the 21st century of the fact that the sonorities are abrupt, rigid, dissonant, aggressive and fragmented, and the meaning conveyed through them bears the same characteristics. Therefore, noise and its use for artistic purposes become subjects of primary interest of the act of musical cognition, which require explanations and argumentations that allow the public to understand modern compositional means as having a well-determined semantic role, even if it is out of old habits.

"Stress is a fundamental perception that discerns both life and evolution. In life, stress affects social, psychological and physiological environments which can simultaneously impinge on wellbeing. (...) Stress is an unavoidable circumstance in our life. Due to urbanization and modern lifestyle noise pollution/ stress has increased tremendously in our day-to-day life. Noise becomes a hazard to the physical, mental and social wellbeing of an individual who works in a noisy environment or to those who are vulnerable to exposure to noise. Various studies have reported that chronic

exposure to noise deteriorates brain function and may lead to neurodegenerative disease" (Arjunan, Rajan, 2020: 113-136).

c. OTHER EFFECTS OF MUSIC COGNITION IN EVERYDAY LIFE

But music has effects in specific cognition and in other areas of human life: within music and language acquisition skills, The Suzuki method in music education emphasizes learning music by ear over reading musical notation and preferably begins with formal lessons between the ages of 3 and 5 years: "one fundamental reasoning in favor of this education points to a parallelism between natural speech acquisition and purely auditory based musical training as opposed to musical training due to visual cues. The role of music in pre-natal development is a reality studied by medicine and music too: extensive prenatal exposure to a melody has been shown to induce neural representations that last for several months.

Music affects language acquisition throughout long term music training processes or music therapy sessions: "music has a certain effect on both physiological (brain, natural system...) and psychological side of people in different life stages" (Huang, 2023: 174). The role of music therapy in cognitive disorders shows that music can be used in different therapies with great success: "listening to music is not perceived as a chore because it is enjoyable, however our brain is still learning and utilizing the same brain functions as it would when speaking or acquiring language. Music has the capability to be a very productive form of therapy mostly because it is stimulating, entertaining, and appears rewarding. (...) Music training modified reading and phonological abilities even when these skills were severely impaired. By improving temporal processing and rhythm abilities, through training, phonological awareness and reading skills in children with dyslexia were improved" (www.myaudiosound.co.uk).

CONCLUSIONS:

Music cognition represents a growing research domain, bringing together music cognition, music theory, other cognitive sciences (cognitive psychology and neuroscience, neuropsychology: "the goal of music cognition research is to develop a scientifically rigorous understanding of the psychological processes underlying music perception, appreciation and production. Unlike neuroscience, which focuses on identifying neural substrates of mental processes, music cognition prioritizes understanding how information flows through the human mind. (...)") (cms.mus.cam.ac.uk/research-areas/music-cognition). Modern compositions are the ones that launch a broader challenge than before for what musical cognition means, the way it contributes to the understanding of the musical message and of the world, in general, with the help of sound art.

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