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ENCOURAGING GUIDELINES IN NEUROMUSICOLOGICAL RESEARCH REGARDING CLASSICAL MUSIC'S USAGE IN SONIC THERAPY - WHEN SCIENCE BECOMES MAGIC

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SUMMARY. In systematic musicology as a branch of music psychology we found an intriguing orientation called cognitive neuroscience of music, or neuromusicology. It studies the function of the brain in music processing, the way music perception and production manifests in brain. Compared to other analytical models of music cognition, the mapping of the brain's functioning serves to examine the outcome of music rather than its process, and as the music therapy methods discussed reflect, most approaches follow this ontological direction. As recent scientific researches shows, the brain mapping technique differentiates moment of listening, playing classical music or improvising. In the light of the research findings, our main focus was to get to know and understand how our musical brains functions during classical music audition so we could argue from a scientific approach not only the existing therapeutic methods used in music therapy, but the perception of classical music in the present. In the master class "Dialogue of the Arts", we explore with our students in all grades the possible links between music and other artistic and scientific disciplines. One of the most exciting aspects of this is music and brain research, an incredibly fast-developing field whose results could reinforce the place and role of classical music in contemporary society, reinforcing existing broad-based promotion of classical music education (Kodály, El sistema etc.)

Keywords: music cognition, neuromusicology, sonic therapy, classical music, models of therapy.

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Introduction

No matter how old you are, music affects you. No matter how strong you are physically, mentally, spiritually, music affects you. No matter if you play or just listen, music affects you. No matter if you listen to it attentively or just passively, music affects you. It affects your brain, it affects your cells, and it affects your heart and soul. Yehudi Menuhin said that the primarily role of music is to help human beings in finding the fragile point that can bring the body and soul into a state of balance and harmony: "…music builds on our most beautiful human endeavours and has a profoundly healing effect, creating harmony of physical and spiritual, intellectual and emotional life, uniting body and soul."[2]

Our musical memories tell of several listening experiences, which focus mainly on our human qualities. We all remember the hypothesis about the poorly sleeping Count Hermann Karl von Keyserlingk and his harpsichordist Johann Gottlieb Goldberg, who ordered from J. S. Bach's the *Goldberg Variation*, the epitome of Baroque variation art. The composer wrote on the title page the following text – without any specific dedication to the Count: "Clavier Übung in which there is an aria with various variations (...) for the enjoyment of those who love it."[3] Bach hoped that his work would be a joy to play, as well as a joy to listen to. We now know, as brain research has shown, that music is beneficial for the functioning of the human brain and is also an intensive contributor to the balance of the psyche.

Everyone has their own unique and personalised list of classical music that can either move you to tears or give you chills. For the famous conductor Esa-Pekka Salonen Maurice Ravel's *Mother Goose*: *The Fairy Garden* represents that music which he considers to sum up the adjective of perfection in a musical composition and causes altogether that magic space-like sensation from which he doesn't want to return. The pianist Daniil Trifonov stated that Messiaen's *Vingt Regards sur l'Enfant-Jésus*: *Le Baiser de l'Enfant-Jésus* put him in a uniquely meditative state, the piece reflecting a boundless sonic space. These aesthetic emotions are influenced by our sensitivity and taste for the art of music. Professor István Angi emphasizes

[2] Menuhin, Yehudi and Davis, Curtis, W.: *The Music of Man*, In: *** *Anthology for music aesthetic studies* (Antológia zeneesztétikai tanulmányokhoz) (Ed. Tamás Kedves), Edited by Nemzeti Tankönyvkiadó, Budapest, 1997, 12.

[3] Original in German: „denen Liebhabern zur Gemüths-Ergetzung verfertiget"/ a second translation in English: "prepared for the soul's delight of music-lovers." See: Williams, Peter: *Bach: The Goldberg Variations*, Cambridge University Press, 2004, p. 3.

the duality of aesthetic emotion in his system of music aesthetics. As he says in one of his interviews, "one is a direct emotion, the other is a stored emotion (...) I called one *emotion*, the other *affectivity*. (…) When you enjoy something, you like it, you are in an emotional state."[4] About the affectivity he points out: "These experiences only come about if you have had a similar or even approximately similar experience. And that inner experience works within you to create the outer experience."[5] Defining the impact of classical music on people, as we can already see, is a multi-factorial formula. What can be stated with certainty in this formula, however, is that this effect is always linked to emotion.

In the paper entitled *Brain connectivity reflects human aesthetic responses to music* by researchers certify that musical aesthetic experiences via dopaminergic pathways activate the same reward networks in the brain as basic sensory pleasures.[6] We also learn that, in this reward system, aesthetic judgement and moral decision-making share the same neural network. The regions of the brain where thee neural activity in emotion and reward processing are: the nucleus accumbens (NAcc), anterior insula (aIns) and medial prefrontal cortex (mPFC). Although these emotional and reward systems are found in all humans, not everyone experiences intense emotional reactions to music, and research to date has shown mixed results. In order to identify individual differences, the research presented in this study analysed the following parameters: the individual's emotional reactions to music (including chills), personality, and the degree of musical background and engagement with music. Two groups were separated, 10 people who reported consistently experiencing chills when listening to music (chill group) and 10

[4] Csákány Csilla: *The discreet charm of the pharmacy balance* (*A patikamérleg diszkrét bája*). In: *Magyar Művészet*, X./2., Edited by Magyar Művészeti Akadémia Kiadó, Budapest, 2022, p. 81.

[5] *Idem*.

[6] "While pleasure from aesthetics is attributed to the neural circuitry for reward, what accounts for individual differences in aesthetic reward sensitivity remains unclear. Using a combination of survey data, behavioral and psychophysiological measures and diffusion tensor imaging, we found that white matter connectivity between sensory processing areas in the superior temporal gyrus and emotional and social processing areas in the insula and medial prefrontal cortex explains individual differences in reward sensitivity to music. Our findings provide the first evidence for a neural basis of individual differences in sensory access to the reward system, and suggest that social–emotional communication through the auditory channel may offer an evolutionary basis for music making as an aesthetically rewarding function in humans." Sachs, Matthew E., Ellis, Robert J., Schlaug, Gottfried, Loui, Psyche: *Brain connectivity reflects human aesthetic responses to music* In: *Social Cognitive and Affective Neuroscience*, Oxford, 2016, 884–891.

participants who reported rarely or never experiencing chills when listening to music (no chill group). The two groups were also matched by gender, age, personality factors and degree of musical education[7].

One of the most intriguing results of the research is that the volume of white matter connectivity was significantly correlated with a participant's tendency to experience chills: "the more frequently a person reports experiencing chills, the larger the volume of white matter connectivity among these three regions of the brain."[8]

The magic of music

In tribal culture, music activities certainly were considered magical. Music was present in almost all communication, healing processes, and even in combat readiness as reinforcement. Music aesthetics has a strong bond analysing texts in documents from different eras of art history. Even the ancient Greeks recognised the importance of music in developing the mind and soul. In Plato's writing about the *State*, Socrates and Glaucon return again and again to song and music as a crucial means of education. The interplay of rhythm, melody and speech, the relationship between attention, discipline and the learning of song and music, was proven by the great thinkers of antiquity to be taken for granted. For centuries, music has been used to heal and enhance our emotions. According to a Greek legend, Asclepius laid a sick man in the middle of the amphitheatre and tried to heal him with special sounds. In the 6th century BC, Pythagoras relaxed his students by playing the harp. The last published work of the recently deceased professor of music aesthetics, István Angi, was an essay on the concept of *magic of sound*. In his belief music has magical powers, but its power is fragile. "The power of music lies in its magic: the magic of sound."[9] A long series of questions and exchanges seek to validate the ideas of composers and music listeners about their experience of music, while at the same time outlining a very personal and broad field of force in the definition of the concept.

Studies show that music decreases blood pressure, reduces anxiety, boosts memory, sparks creativity, improves productivity, reduces stress levels, supercharges brainpower, fights depression, insomnia, relieves pain, puts you in a better mood. We can find telling examples in the book of the

[7] for detalied description see: pp. 886-887.
[8] *Op. cit*. p. 889.
[9] Angi István: *Essay on the magic of sound* (*Esszé a hangvarázsról*). In: *Helikon*, XXXI. 2020/21 (803).

American neurologist Oliver Sacks' book *Musicophilia: Tales of Music and the Brain*[10], where he describes specific cases where music has acted as a medicine for patients suffering from various diseases.

Does listening to music for short periods of time temporarily improve spatial task performance? This question became famous by a 1993 article in the journal *Nature* by Frances H. Rauscher, Gordon Shaw and Katherine Ky, who found that students who listened to an excerpt from Mozart's *Sonata in D major for Two Pianos* K. 448 for 10 minutes performed better on a test of spatial logic than those who listened to meditational music or had no musical experience. However, the results obtained when the original experiment was repeated did not reach the scores reported in the scientific article. The question arises: did differences in the subjects' musical background, abilities, interests or inclinations cause the variation in results? In 1998, the authors of the original experiment tried to relate the different results to different experimental designs and procedures[11]. The existence of the Mozart-effect has been disputed by several research groups. In 1999, Christopher F. Chabris and Kenneth M. Steele, in a paper entitled *The Mozart effect: prelude or requiem?* highlights that the positive cognitive changes in listeners as a result of listening to Mozart music have a neuropsychological explanation, which he calls *enjoyment arousal*, which he argues also operates when reading a literary work[12]. So when emotions are involved, music definitely affects us. The opposite is also true: without feeling, music cannot be understood, music cannot affect us. The Hungarian music psychologist and musicologist Stachó László mentions an interesting case study in this context. The mind of the exceptionally gifted young man, suffering from *savant* syndrome, who was studied by John Sloboda and his colleagues, functioned exemplarily on a cognitive level: "he was excellent at memorising and playing back tonal musical material on the piano (...); his errors were characteristically regular and tonally meaningful, i.e. if he made a mistake, he substituted notes or motives which could in fact have formed valid variants of the composition. Despite his excellent abilities in this respect, however, his playing - as described by John Sloboda and his colleagues - was completely empty: unfeeling, mechanical, and therefore unenjoyable."[13]

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[10] Sacks, Oliver: *Zenebolondok (Musicophilia: Tales of Music and the Brain)*. Akadémiai Kiadó, Budapest, 2007.

[11] Lois Hetland: *Listening to Music Enhances Spatial-Temporal Reasoning: Evidence for the "Mozart Effect"*. In: *The Journal of Aesthetic Education*, Vol. 34, No.3/4, 2000, pp. 105-148.

[12] E. Glenn Schellenberg: *Music and Cognitive Abilities.* In: *Current Directions in Psychological Science* Vol. 14, No. 6, 2005, pp. 317-320.

[13] Stachó László: *How do we make sense of music?* (*Hogyan nyerünk értelmet a zenéből?*) In: *** *Music Psychology Textbook* (*Zenepszichológia tankönyv*) (ed. dr. habil. Vas Bence) University of Pécs, Faculty of Arts, Institute of Music, 2015, pp. 173-174.

Scientific research and methodology exercises

The rapid advances in brain research in recent decades have given us increasing insight into the complex workings of the brain. Constantly improving mapping techniques are revolutionising our understanding of the complex and enigmatic functions of the human brain. In Donald A. Hodges' paper[14], we find five premises that neuroscientists have laid down in their research on the relationship between music and the brain. Our incredible neural machinery is capable to process and forward to psychological terrain the mysteries of music. Brain researchers have carried out extensive studies including analysing the responses of foetuses to music, the effects of music on the elderly, including Alzheimer's cases or other cognitive dementias. They have also tested people with special talents, be it musical talent or those with savant, Williams or Asperger Syndrome. They have analysed neurological responses to music of people with no previous musical training compared with those of trained musicians. All these approaches reflect the following findings[15]:

- The human brain has the ability to respond to and participate in music.
- The musical brain operates at birth and persists throughout life.
- Early and ongoing musical training affects the organization of the musical brain.
- The musical brain consists of extensive neural systems involving widely distributed, but locally specialized regions of the brain: cognitive components, affective components, motor components.
- The musical brain is highly resilient.

Brain researchers have focused their study formerly on neurons. A neuron is an ensemble of a nerve cell and its extensions that is specialised to receive and conduct nerve impulses. When someone learns a new skill (playing an instrument musically), neurons in the brain make connections with other neurons in so-called synapse nodes. Synaptic connections create neural circuits that enable complex actions. When people repeat an action many times, they strengthen these synaptic connections[16]. Over the past fifteen years, research has focused on non-neuronal cells in the brain, known as glia cells, which have been shown to play an active role in maintaining neuronal

[14] Hodges, Donald A.: *Implications of Music and Brain Research.* In: *Music Educators Journal,* Vol. 87/2, 2000, pp. 17-22.
[15] Hodges, Donald A.:*Op.cit.*, p. 18.
[16] Walter, Donald, J. and Walter, Jennifer, S.: *Skill Development: How Brain Research Can Inform Music Teaching.* In: *Music Educators Journal*, Vol. 101/ 4, 2015, pp. 49-55.

health. In addition, they produce myelin, a substance that plays a crucial role in regulating how fast neurons transmit their messages[17]. Myelin is a material that covers the nerve fibres in a protective manner and has a spirally coiled structure. Each myelin-forming cell forms a sheath for only one axon. Myelinated axons, also known as pathways, make up the white matter of the central nervous system. It influences learning, brain function and coordinates communication between different brain regions. Several studies show that it is possible to achieve gradual brain function and structure development with increasing musical expertise and training. In the study entitled *Electrical Neuroimaging of Music Processing Reveals Mid-Latency Changes with Level of Musical Expertise* the group of researchers focused "on the effect of musical training intensity on cerebral and behavioral processing of complex music using high-density event-related potential (ERP) approaches. Recently we have been able to show progressive changes with training in gray and white matter, and higher order brain functioning using (f)MRI [(functional) Magnetic Resonance Imaging], as well as changes in musical and general cognitive functioning. The current study investigated the same population of non-musicians, amateur pianists and expert pianists using spatio-temporal ERP analysis, by means of microstate analysis, and ERP source imaging. The stimuli consisted of complex musical compositions containing three levels of transgression of musical syntax at closure that participants appraised."[18]

Similar research has been going on for decades in the Mozart Brain Lab (MBL) in Belgium. In addition to brain research brain mapping was the main objective of making music therapy treatment and training available to as many people as possible. The MBL is the largest laboratory worldwide for auditory brain stimulation. It was founded by Jozef Vervoort in 2002. Brain mapping is a proven tool for their research and treatment methods. This allows them to build up a detailed picture of the human brain. To do this, they use a technique called auditory brain stimulation, which detects and delineates the activated parts of the brain of a patient exposed to sounds of different frequencies, pitches and durations. The patient listens to Mozart music, Gregorian chant and his/hers mother's voice, filtered to retain only the high frequencies, which activates brain synapses, therefore auditory brain stimulation is used to create new neural connections in the brain. The sound is delivered to the ear by special headphones that also work with air and bone conduction. Brain Mapping is used to monitor the positive effects of the therapy.

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[17] Walter, Donald, J. and Walter, Jennifer, S.: *Op. cit.*, p. 50.

[18] James, Clara E., Oechslin, Mathias S., Michel, Christoph M., Pretto, Michael De: *Electrical Neuroimaging of Music Processing Reveals Mid-Latency Changes with Level of Musical Expertise*. In: *Frontiers in Neuroscience*, vol. 11, 613, 2017, p. 1.

This method is based on theories of hearing and listening formulated first by Alfred A. Tomatis, who was a French otolaryngologist and inventor. His method is called the Tomatis Method or Audio-Psycho-Phonology (APP). The Tomatis method improves speech and language skills, communication and behaviour. It also helps people in therapy with balance and coordination difficulties, as well as treating depression and anxiety symptoms. Tomatis has developed a highly effective treatment using the APP method, linking the ear, brain, body and psyche, and has sought solutions to auditory perception problems that may underlie many psychological disorders. One of the developers of this method, Paul Madaule, presents an interesting experiment called *Earobic*. In his study we find that the participants of this exercise heard a recording of a Mozart work. "In the first half of the recording, the lower frequencies of the music are progressively filtered out to leave only the higher overtones. During the second half, the frequencies are reintroduced in the reverse order so the music ends as it started, in its full spectrum."[19] The comments from the audience after the exercise were: they felt "taller", "lighter", "more energetic", "peaceful inside". The last part, with its full frequency spectrum, was interpreted as a new dimension of music with more dense textures.

The impact of music in the study of brain mechanisms

The neuroscience of music or neuromusicology uses brain imaging techniques in order to observe and analyse brain activity while listening to music. Its research interests include the analysis of the parameters of musical sound (pitch, absolute pitch, melody, rhythm, harmony, structure, etc.), the study of musical performance, auditory-motor interactions, the interface between music and speech, musician vs. non-musician processing modes (differences, similarities), imagination, memory, attention, development, etc.

About the impact of musical experience on our nervous system the neurobiologist professor Nina Kraus, who researches the neural coding and plasticity of speech and music explains that children who suffer of linguistic deprivation can make great progress with music studies.[20] The impact of the community music programme initiated by Nina Kraus is measurable and presents highly positive outcomes. In this programme participating children aged between 6 and 10 years were assigned and randomly selected into two study groups (44 children in total). Those in the first group were assigned to a music education for one year prior to the community music program, the

[19] Paul Madaule: *The Listening Ear.* In: *American Music Teacher*, Vol. 55, No. 2, 2005, p. 39.
[20] Nina Kraus: *Music is the Jackpot: "Of Sound Mind: How Our Brain Constructs a Meaningful Sonic World"*, ARTSpeaks Conference, 2021.
In: https://www.youtube.com/watch?v=SzDjn7XDbcQ, accessed: 2022.04.05.

other group started immediately with the music programme (*Harmony Programme*). "While the effect of the community music programme on brain responses were only detectable after two years, the brain responses following the instrumental music participation resulted in significant changes after just one year in the brain's ability to process auditory stimuli."[21]

The *Institute for Brain and Creativity* at the University of Southern California is working with similar experiments. The Institute's work has applications in the diagnosis and treatment of neurological and psychiatric disorders, child development and education. One of the objectives of the *Brain and Music Programme* of the Institute is to analyze and interpret the impact of music studies on brain development, in terms of psychological (emotional, cognitive, social) and neural functions. Peter Rubin, contributing editor at WIRED[22] presents how the Functional Magnetic Resonance Imaging (fMRI) measures brain activity during music listening. Daniel J. Levitin, the author of *This is your Brain on Music* confirms the result of the test, "when music enters and then gets shuttled off to different parts of the brain it stops at specialized processing units in auditory cortex, they track loudness, pitch, rhythm and timbre etc. There is visual cortex activation when you're reading music as a musician or watching music. Motor cortex when you're tapping your feet, snapping your fingers, clapping your hands; the cerebellum which mediates the emotional responses; the memory system in the hippocampus hearing a familiar passage finding it somewhere in your memory banks – music is going on in both halves of the brain, the left and the right, the front and the back, the inside and the outside."[23]

One of their interesting brain activity mapping tests was made on the brain of a two-time Grammy winnig musician,[24] who was asked to create original music. The areas that were active before - the ones that deal with motor skills and sounds were even more active. But it was way more blue in front of his brain – that is the prefrontal cortex and its associated with effortful planning and conscious self-monitoring and it's blue because it's less active. The prefrontal cortex appears to be shutting down in these moments of high creativity. The musician is letting go of these conscious self-censoring or self-monitoring areas that normally are there to help control that output.

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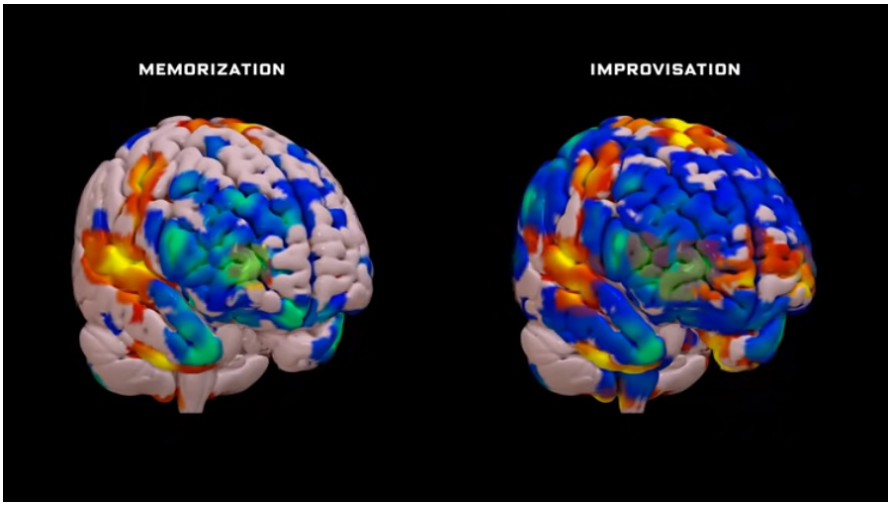
[21] Csépe Valéria, *Zene, agy és egészség (Music, brain and health)*. In: *** *Zene és egészség (Music and health)* (ed. Falus András), Kossuth, Budapest, 2016, p. 35. (26-42)

[22] WIRED is a monthly US magazine, published in print and online, which aims to show a world in constant transformation. It highlights how technology is changing every aspect of our lives - from culture to business, science to design. The breakthroughs and innovations revealed can lead to new ways of thinking, new connections and new industries. See: www.wired.com

[23] *How Does Music Affect Your Brain?*, *Tech Effects*, WIRED. In: https://www.youtube.com/watch?v=HRE624795zU, accessed on: 2022.03.31.

[24] *Idem.*

Figure 1



1. Brain Mapping of a Musician: Comparison between Moments of Memorisation and Improvisation

Researchers of this institute demonstrate that a musician's brain whilst playing music engages in his brain motor systems, timing systems, memory systems, hearing systems etc. They also emphasise that after several years of practicing music, children present changes in their brain structures: they have stronger connections between the right and left hemispheres and that can make them better, more creative problem-solvers

Music therapy types, models and approaches

Music therapy is concerned with changing the human state of consciousness through music. The changes in state of consciousness brought about by the induction of music include changes in mood, social activity, a better understanding of the patient's own emotions, and in general: the experience and processing of unconscious psychological content. Like other art therapies, music therapy also attaches great importance to symbol-making[25], the practice of symbolic expression of psychological trauma, and the "paving" of a path that helps the patient to a kind of creative self-healing. Three types of music therapy exist. *Receptive* music therapy is when the therapeutic work is done through the discussion of emotions, experiences

[25] See chapter: *Symbolic Play in Music Therapy* chapter in Darnley-Smith, Rachel and Patey, Helen, M.: *Music Therapy, Creative Therapies in practice*, Sage Publications, 2003, pp. 119-120.

and thoughts mobilised by the music listened to. *Active* music therapy is when the participants communicate and improvise with the help of sound-producing instruments or musical instruments (e.g. Orff instrumentarium) or with their own voice. No prior musical training is required. *Complex* music therapy is when the experiences and feelings mobilised by music are expressed through improvised movement or any kind of visual arts activity, and the experiences are shared verbally if possible[26].

In the following we will look at methods that work with the therapeutic effects of listening to classical music.

Guided Imagery Method

Many examples from the history of music suggest visual association in the listener, if we think, for example, of Vivaldi's musical metaphors of a splashing stream or Debussy's play of light on the surface of the sea. The intersection between sound and image is extremely fertile. We mention in this context the book entitled *Seeing Sound, Hearing Images*[27] edited by Bianca Țiplea Temeș and Nicholas Cook, which is a cross-disciplinary endeavour where authors present their specific view on musical composition, musical performance, notation theory, performance practice etc. through the lens of visual associations.

One of the methods relying on this value-added dialog between audio and visual art is called **Guided Imagery and Music**. It was elaborated by violinist and music therapist Helen Lindquist Bonny (1921-2010). It is considered to be a receptive music therapy where it is used in-depth approaches to music psychotherapy in a creative process in which listening to music evokes images in the patient. Helen Lindquist Bonny in the late 1960s started her research analysing the effects of music on imagination. Her first book regarding these aspects was entitled *Music and Your Mind: Listening with a New Consciousness* and was co-written with Louis Savary.

The audition examples used in the method are mostly drawn from the Western classical tradition. The images produced by audition integrate the emotional, archetypal and transpersonal processes of the mind and represent problematic aspects of the psyche. The images are generated spontaneously, facilitated by the therapist. The guide helps to reflect on the experience afterwards and may use creative media such as artwork and mandala painting. In addition to alleviating the patient's symptoms, encouraging the display of internal images has been reported to have positive existential outcomes by therapists working with the GIM method.

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[26] Bunt, Leslie: *Music Therapy. An Art Beyond Words.* Taylor & Francis, Routledge, 1994.
[27] *Seeing Sound, Hearing Images*. Editura MediaMusica, Cluj Napoca, 2017.

Ringató, **Kerekítő** and the **Kokas method**

At the turn of the 20th century in Hungary, it was the composer and music educator Zoltán Kodály who was the first to expound on the positive physiological and psychological effects of listening to and practising classical music. Some of his relevant thoughts on this subject are: «Good music definitely has a general educative effect»; «The purpose of music is: the better knowledge of our inner world, its enlightenment and fulfilment»; «There is no complete spiritual life without music. There are regions of the soul into which only music can illuminate». His teachings were not only important in the development of choral life and music teaching methodology, but also paved the way for the development of musical activities such as the **Ringató**, **Kerekítő** and the **Kokas method**. The first two focus on the intellectual and social development of young children, where the auditory repertoire is based on children's songs and folk songs. Big and small movements are associated to the rhythm of the music - based on a narrative coordinated by the session leader and always enriched with new and new elements. The Kokas method is based on similar principles, except that it also uses classical music auditions and, because it is aimed at older age groups, it combines additional opportunities for listening to music, such as visual association and structured movement.

The late Hungarian music educator and music psychologist Klára Kokas (1929-2010) developed a method of listening to music that added creative pedagogical approaches to the Kodály concept of music education. The principles of her method are based on the recognition that movement, activity and creative work are the best ways for children to develop focused attention and perception of classical music. She used an age-appropriate, holistic approach to help them perceive classical music. The Kokas approach combines intense concentration on listening to music with different ways of responding to music immediately (movement, visual representation). The aim is not only to gradually develop and enhance auditory perception and musical appreciation, but also, and more importantly, to explore interpretation and the expression of one's own emotional inner world. She was convinced that every child can "feel" also contemporary classical music without knowing its structure or message. Major-Bácskai Alexandra refers to Kokas's pedagogy as one full of play and tale – the ideal creative terrain for children's cognitive and emotional development. Here is an excerpt from one of the activity starter games: "My name is: joy. My name is: fairy tale. My name: melody. My name: play. My name: bubble. I call you by your name. I'll put your name in a song. I wonder at your name. With your name I'll hold your hand. I'll caress your face with your name. With your name I'll spin around. We put our names in the palm of our hand. We'll draw around our names. We put our names to

sleep. My name can be dotted. It can be shiny. It can be veiled. Your name can be leapy. It can be inspiring. It can be curious. It can be grumpy. It can be defiant. Our name is a gift."[28]

After all: it is magic - concluding thoughts

If someone asks in the 1500s why grass is green, the answer would have been because God made that so. If someone asks in the 1600s the same question, the answer would have been, because grass contains chlorophyll, our eyes capture the colour and transfers that colour-signal to the brain, the brain receives it and thus we know that is green, because God made that so. Scientific, acoustic experiments show us, that music has a highly organisational effect on its surroundings, including the human body. We know that classical music through its inner content has a huge effect on our soul. Philosophers and aesthetes have debated the subject for centuries[29], contemporary research in neuromusicology, music psychology, music therapy methods and applications explore the thousands of nuances of the issue.

By analysing the effect of music on the workings of the human brain, neuroscientists can discover novelties in their studies that they would not be able to with any other cognitive process. Through music, we can have a deeply and uniquely human experience of discovery and emotion that is alien to other cognitive processes. Music's insight into the processes of human cognition is a uniquely powerful experience that cannot be replaced by any other form of experience. The scientific approach to music leads us for a better understanding the depths of human cognition and the emotions of the soul. Scientific knowledge of music is not demystification. It's more mysterious than ever. What we previously felt about the effect of classical music on us, we now begin to know. But this knowledge brings more and more questions, and again suggests how many wonders lie ahead us on this road. Would knowing the microcosm of our inner world help us to know the macrocosm?

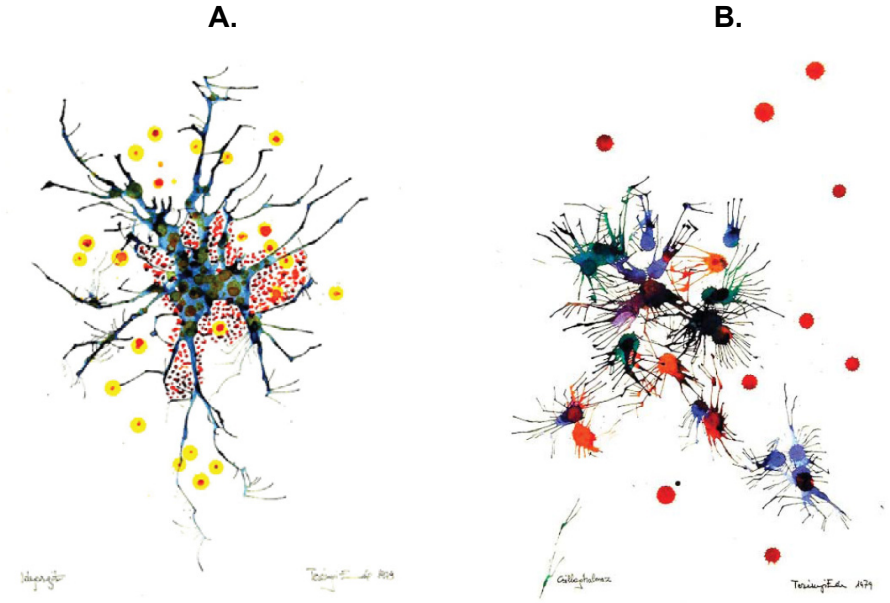
The similarities of Transylvanian composer Ede Terényi's visual representation of the nerve cell and the starry night sky could give us hope in this direction. "The eye that seeks the invisible captures the form and colour of what it sees. (…) The fact that the Earth and the Sky meet in his thoughts (…)

[28] Major-Bácskai Alexandra: *Kokas Klára pedagógiája*. (Pedagogy of Klára Kokas) In: http://epa.oszk.hu/04100/04185/00006/pdf/EPA04185_tudomany_es_hivatas_2020_02_075-083.pdf, Accessed: 2022.03.30.

[29] *** *Anthology for music aesthetic studies* (Ed. Kedves Tamás), Nemzeti Tankönyvkiadó, Budapest, 1997.

are well illustrated in his paintings in the *Genesis* series: *Nerve Cell* and *Cluster of Stars*", writes Alice Hausmann-Korody[30]. Neuromusicology certainly points in a direction that can endow science with the power of magic.

Figure 2



2. Ede Terényi's Graphics (A. Nerve Cell; B. Cluster of Stars)

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