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Reflections on the Neuroscience and Musical Performance

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Abstract

The neuroscience is a vast and fertile field for studies of musical performance because it established the understanding of musicality and nervous system to understand the process of functioning of the human mind in its most diverse potentialities. Since Music is a human manifestation and construction, its cognitive function makes it possible to capture the modulations of the feelings and the creative act and has been an excellent pivot for neuro scientific study in the understanding of how the brain processes the sound stimuli and organizes the musical functions. As the success in musical performance requires an exceptional excellent motor control, in addition to an in-depth knowledge of the musical structure demands a high demand of corporal work.

Keywords: neuroscience, musical performance, corporeality, musicality.

1. Introduction

Music and neuroscience are multidisciplinary interactions that enable us to broaden our horizons in a practice that integrates professionals who previously had their activities sectioned. The effort to bring music to the health sciences may represent the transcendence of a hedonistic musical practice based only on listening pleasure. On the other hand, the amplification of the vision of neuroscience itself, beyond the rationalist approach, which neglects the subjective and the relative expressed in the arts. Music is a human construction, entirely unprecedented, and it is the capacity of a specific mental production of our formation. Therefore, it cannot be absent from the formation of any person. After all, if it is constitutive of culture and therefore of human capacity, putting it outside of this human being formation is to fracture the formation that this human being must have (Cortella, 2015).

Music is one of the most direct expressions of human manifestation, without it there is a restriction of formation, an incompleteness. We can declare that, regardless of our will, it will never be passive in relation to the human being because it has an inseparable connection with its feelings, sensations and intelligence, acting intensely in addition to promoting evocations, associations and integrations of experiences.

The cognitive function of Music enables us to grasp the modulations of human feelings and the creative act generated has the potential to provide the transformation of being, reaching the sensibility and emotion capable of building a human identity. In this process words reach artistic expression, establishing an abundant interlocution between the inner and outer universe of man. Recent studies of neuroscience suggest that creativity does not depend solely on one region or one hemisphere of the brain. Instead, the entire creative process consists of the interaction of various brain structures in both hemispheres and the coordination of various cognitive and affective processes. As the main purpose of this new science is to understand the process of functioning of the human mind in its most diverse potentialities, Music and its creative processes, in turn, provide precise and valuable instruments for this purpose.

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While we observe in research that thought, knowledge, and memory are fundamental to the development of the human being, the various representations of contrast, color, movement, and depth provide tools for understanding how the world is apprehended. Neuroscience is a relatively new area, and the central and motivating agent of all neuroscience research is the nervous system. It arose with the objective of articulating knowledge about the nervous system produced independently by different disciplines. In particular, we highlight the significant integration between neurobiology, and its developments in neuroanatomy, neurophysiology and neuropharmacology, and experimental psychology with its ramifications in psychophysiology, psychopharmacology and cognitive psychology (Pinker, 2009). The integration of these different areas of knowledge has made the study of the central nervous system become much more sophisticated, refined and stimulating the advent of new perspectives on the human mind.

Music has been a great pivot for neuroscientific study in understanding how the brain processes sound stimuli and organizes musical functions (Muszkat, 2000). Musical processing involves a wide range of brain areas related to the perception of heights, timbres, rhythms, metric, melodic-harmonic decoding, implicit gesture and modulation of the pleasure and reward system that accompany our psychic and bodily reactions to music. In the last decades, the advance of the neurosciences has made possible a greater understanding and opening flanks of knowledge on the relation between music and nervous system. Techniques such as *Magnetic Resonance Imaging* (MRI) have made it possible, for example, to verify different volumes of specific brain structures such as the corpus callosum, motor cortex and cerebellum when comparing high performance musicians rather than musicians (Schlaug, Marchina & Norton, 2009). Recent research on neuroscience has contributed to the understanding between musicality and the nervous system. For Da Rocha and Boggio (2013) the techniques such as *Magnetic Resonance Imaging* (MRI) have allow the verification of different volumes of specific brain structures such as the corpus callosum, motor cortex and cerebellum when comparing high-performance musicians and non-musicians. In this sense, much has been discussed about neuroplastic effects resulting from musical training. Already studies with functional MRI (MRI) allow the establishment of correlations between specific brain areas and functions, musical abilities or sound processing.

According to Muszkat (2000), musical activity mobilizes large brain areas, both the phylogenetically younger (neocortex) and older, primitive systems such as the so-called reptilian brain that involves the cerebellum, brainstem areas and the cerebral amygdala. Sound vibrations, resulting from the displacement of air molecules, cause distinct movements in the ciliary (receptor) cells located in the inner ear and are transmitted to centers of the brainstem. The vibration frequency of the sounds corresponds to the location of the hair cells of the inner ear and the intensity of the sounds is directly related to the number of fibers that come into action. The more intense the sound, the more fibers come into play. There is a relationship between the location of the sensory cell in the cochlea and the frequency of vibration of the sounds. The frequency that most excites a sensory cell changes systematically from high (treble sounds) to low frequency (bass sounds). Thus, sound stimuli in the so-called ciliary cells are carried by the auditory nerve in an organized way to the auditory cortex (temporal lobe) (Muszkat, 2000).For Levitin (2010) the music is not only processed in the brain but affects its functioning. Physiological changes with exposure to music are manifold ranging from neurovegetative modulation of the variability patterns of endogenous heart rate rhythms, respiratory rhythms, electrical electrical rhythms, circadian sleep-wake cycles, to the production of various neurotransmitters linked to reward and pleasure and to the neuromodulation system of pain. Music training and prolonged exposure to enjoyable music increase the production of neurotrophins produced in our brain in challenging situations, which may determine not only increased neuron survival but also changes in connectivity patterns in so-called brain plasticity.

2. Musical Performance, Body and Emotions

One of the great themes in the musical environment is performance. The daily life of each musician is between study and performance and studies demonstrate that it is inevitably conditioned to the body-mind-instrument integration projecting then the desired artistic result. Musical performance requires a high level of skill in several parameters, such as motor coordination, attention and memory, which makes it an activity particularly susceptible to anxiety states. Success in musical performance, requires exceptional fine motor control as well as a deep understanding of the musical structure and performance tradition. Musical performance demands a high demand for body work. With regard to human activity is one of those that require higher fine motor skills. According to Magill (2000), such skills require control of small muscles, especially the muscles involved in hand-eye coordination, which require a high degree and precision in hand and finger movement.

It is up to the performer to provide the revelation of the written musical work and is therefore responsible for this process for which he should deeply understand the temporalities proposed by the work in order to contemplate the idealization of the flow instigated by the musical events present in the composition. Therefore, the interpretation will be developed in coexistence with elements derived from the study of the musical repertoire. A feature often used by musicians during performance construction is to associate music, images of places, situations, auditory images, images of the music structure itself, using what authors such as Lehmann (1997) and Rafael (1998) call of mental representations. The use of emotions as a guide to the construction of performance has proved possible thanks to many studies that prove the relationship between certain elements of the structure of music and performance with well-defined emotions. Despite the myths about the impossibility of studying emotions in music. Juslin (1997) demonstrates that in ideal circumstances it is possible to achieve a communication of emotions between the performer and the listener with 75% accuracy, and even in normal conditions this precision remains high for the so-called basic emotions, but very little precision is obtained in the nuances of the same emotion. For example, the performer is able to accurately convey to the listener that a musical piece is angry, but he can not accurately convey if this anger is tied to secondary emotions such as irritation, exasperation, fury, disgust, storm or envy. It has also been noted that amateur instrumentalists can achieve less precision than skilled instrumentalists, but amateurs can improve their accuracy in communicating emotions when they receive an appropriate feedback on their performance (Juslin, 1997).

3. Mind, Images and Performance

The process of preparation and performance of a musical work demands from the instrumentalist a set of knowledge, techniques and skills that could go unnoticed. During the process of preparation and performance, the musician needs to understand and put into practice a vast and complex range of musical knowledge that involves from the decoding and understanding of the symbols contained in the score, heights, dynamics, joints, movements, harmony, counterpoint, jointly with other musical knowledge that will aid in the process of construction of the understanding of the work. The performer must be aware that a musical piece contains a very large number of information that lacks the energy, time and space to be processed by the mind. Pareyson (2009) commenting on the reading of a work of art identifies different processes in this activity: decoding, mediation and realization. The interpreter, when studying a score, transposes these processes into the musical field: in the decoding of a score are related the musical codes with previously acquired theoretical-musical knowledge; in mediation, deciphered codes are evaluated and transformed into meaningful systems. The interpreter has to read the chord, think of the sound, the rhythm, the movement, which obviously requires a great deal of mental work. Therefore, the performer must learn to work according to his *mental time*, so that the construction of the internal representations happens efficiently (Holloway, 2003).

Although the movement sees as a whole, the sinuosities of effective execution require that the parts that make up this whole worked independently. This means that the performer must be aware of these sub movies, which together form the nation whole. In this way, the nation whole must divide, because the richness and diversity of sub-movements within the nation whole preclude their total apprehension unless these *sub-movements* diligently observed.

For the internal images to be elaborated, the information that comes to mind must be processed, which demands space, time and energy. This is because information requires time and energy to be processed, while at the same time requiring space to be stored (Pinker, 2009). Therefore, elaborating internal images involves effort, that is, work. Richerme (2007) states that by repetition, a certain sequence of conscious movements progressively passes into the domains of automatism, without necessarily having to lose consciousness about such movements.

4. Final considerations

The complexity and diversity of the processes in music and neuroscience requires more studies, through the investigation of problems ranging from the development of cognitive processes to the functioning of the brain in the presence or absence of sound and musical stimuli; learning, decoding, appreciation, and musical performance, significant aspects of the human mind can be elucidated.

Neuro scientific research has invariably aroused fruitful interest in music studies stemming from the synergy between mind and body, where memory, creativity, emotion, athleticism and intellect combine harmoniously. The musical making involves the total development of the body, calling forth the aural, tactile and kinesthetic consciousness. Working in an integrated perspective will cause highly positive changes in musical performance. The *look* on the body can and should be directed from various perspectives. We musicians need to explore them, reworking our doing. Whether it is from the study of motor development, motor learning, or corporeality (a more integrated perspective), it is necessary to rethink the musical practice.

With the recent studies of neurosciences, a very rich field for music research is being explored. The theoretical references used in the field of learning of musical performance demonstrate that there is a great distance in the field of musical reflection and practice, about the reflection of how the body can be considered in its integrality, in the teaching-learning process of musical instruments in relation to theories which already lay the groundwork for concrete action. Reflection on established practice reveals a mechanized and alienated body, a learning *without the body*. There is still much research to be done, but the need to interact with other enlightening fields of knowledge about the human issue, the body and the relations established since then, is visible so that the phenomenon gradually revealed.

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