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Mini Review

Musical Practices: A Tool for Sustainable Cognitive Reserve

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Abstract

This mini review aims at raising evidences that the musical practices can contribute for a better cognitive autonomy improving the performance in daily activities. The scientific production of this theme began in the 19th century and has become very robust lately. In this article, questions related to neurological bases of musical processing and how they relate themselves to the cognitive performance, are raised. The strategies to build a sustainable cognitive reserve are important for the subjects' autonomy, especially, for the elderly population. Musical practices are constituted as one of these resources. Such contributions facilitate the human being potential to deal and solve daily problems in a more efficient way.

Keywords: *Musical Practices; Cognitive Reserve; Musical Processing; Cognitive Performance; Music Neuropsychology*

Introduction

This mini review aims at correlating the cognition concepts to the musical practices besides relating these activities to the cognitive functions mobilization. The daily experience with this kind of mobilization contributes a lot to build a cognitive reserve.

The present article searched to pinpoint questions regarding the historical interface aspects between psychology and music and relate data that contribute for a better understanding of the cognitive processing and its relation to musical practices. Furthermore, it searches to raise evidences which demonstrate the possible applicability of the musical practices to improve the cognitive efficiency.

Relations between music and cognition

Music encompasses a universe of stimuli that are learned according to the cognitive processing channels. One of the first studies guided towards music neuropsychology was published in the 19th century-1865- by Boillaud. In this pioneer study, the aim was to verify eventual deficiencies in the understanding of various musical attributes secondary to brain damage.

The interest in the cognitive and neurologic bases of musical processing has generated a high production of studies in this area. Currently, there are three major fields of investigations inside music cognition: the acoustic- "sound science, properly expressed"- the psycho-

acoustic, that is "the study of how the brain perceives the sound and, at last, the psychoacoustic of music, "that exam aspects of musical perception and performance" [1].

In this respect, there are studies that search to establish a relation between the psychoacoustic of music and the dimension of the execution or expression [2]. In the performance elaboration there are processes of mirroring that facilitate the codification of expressive gestures in sounds and the decoding of sounds in expressive gestures. Such gestures give significance to the human sensorial-motor involvement with music.

Recent studies in neuroscience show the positive impact of musical practices in cognition and brain development [3]. In this respect, there are evidences that the musical practices help to improve the performance levels in other areas in which the mobilization of different abilities is necessary. It was shown that the individuals' language processing that had the habit of musical practices is faster [4]. The principal cause raised for this is that musicians can have a bigger short term verbal memory. The proximity in which the verbal and musical languages are processed explains, in part, this phenomenon [5]. Both are processed in the brain temporal region.

Despite the differences, there are important similarities between these processes (music and speech):

- They develop over time and have a crucial temporal dimension to physically characterize the music and the speech;
- Time is one of their more relevant perceptive dimensions;
- They can be symbolized as sequences of temporal intervals, that are perceived as a "rhythm";
- They are composed by temporal intervals that possibly differ in duration and acoustic markings composed by frequencies with different properties generating metric expectations.

In this process it is considered that "humans are particularly rhythmic beings. Decades of research showed that human brains are tuned with the fine degrees of rhythm information in music and speech" [5]. On the other hand, the most efficient process of the rhythmic notions and of speech relates itself to other cognitive function: attention. Participants with extensive formal training in music show a superior performance in temporal discrimination tasks which demand attention [6]. It is possible that this better temporal discrimination relates itself to a better spatial perception [7]. These two parameters (time-space) in fact, relate to each other. To perceive space in a clearer way, indicators such as rhythm, speed or pace, which are time units, provide a concept of complementarity about the special idea.

An interesting data is that music, for its complexity, "has the capacity to involve aural, cognitive, motor and emotional functions in all subcortical regions of the brain and these capacities are relatively preserved in aging" [8]. These characteristics make music a promising tool for the approach of neurological diseases related to senescence. This music complexity involves various aural processes such as "to perceive aspects such as symmetry, repetition and imitation" [9]. Besides, the aural dimension connects itself to other cognitive, motor, and emotional aspects that establish an interface with the fine motor control in the instrumental practice situation [9]: For the performance to occur there is the need of a cognitive plan capable of establishing a communication intention of a coherent musical discourse established in the interpretation, and of a physical plan, to complete what was established in the interpretative plan.

Therefore, the musical stimulus seems to contribute for the cognitive gain. There are evidences of this gain in a short term in: intelligence, spatial abilities, speech awareness, verbal memory, prosody processing, sound processing and neurological development [10]. On the other hand, the long term effects depend on other variables such as interest, the continuous and deliberate practice in the studies and perseverance.

There are studies that search to demonstrate this effect of the musical practices in elderly people [11]. Therefore, "learning to play an instrument induces structural and functional changes in the brain due to the continuous activation of the subjacent brain regions or

the ones involved by this leaning process". These stimuli cause structural changes in the brain areas of vision, hearing, syntactic processing, executive functions and work memory. Besides, more recently, it was shown that the association between musical training and the neuroplasticity benefits extends themselves to older individuals to whom the plasticity is even weaker. Specifically, it was verified that, in comparison to older adults with little or no experience in musical training, older musicians showed an increased neuroplasticity in the auditory brainstem and cortex. These authors point out that: (...) this discovery is particularly intriguing because it suggests that the musical training can have lasting effects as far as the lifelong musical involvement can potentially compensate the neuroplasticity declines related to the age in the brain auditory processing associated to normal aging.

Another interface of music with cognition is its capacity of affecting positively the situations of overcoming the cognitive dissonances such as unpleasant emotions [12]. There are reports of improvement in test performances of students who listen to music during their academic activities. These students tolerate better the stress situations in this kind of activity and reach a better academic performance - "the Mozart effect".

Listening to certain kinds of music can affect the capacity to deal with cognitive dissonances [13]. There are evidences that listening to classical music with an allegro and vibrant character has a positive impact on creativity. This is highlighted as the competence of the 21st century. Creativity is generally defined as a generation of ideas, insights or solutions of original problems (that is, new ones) and destined to be useful. The principal effect of this practice was in the divergent creativity. This kind of creativity involves the production of multiple answers from the available information, making unexpected combinations, recognizing the links among remote associations or transforming the information in innovative solutions.

These abilities seem to be associated to the senescence challenges. Such challenges are named fluid intelligence [14], that is, the "capacity of thinking abstractedly and solving problems". This ultimately requires the mobilization of the cognitive functions in general, among which we highlight memory, attention and executive function.

Conclusion

The strategies to build a sustainable cognitive reserve are important for the subjects' autonomy, above all, for the elderly population. Musical practices are constituted as one of these resources.

The scientific production on this theme began in the 19th century and has been very robust lately. Such contributions facilitate the human being potential to deal and solve daily problems in a more efficient way.

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Conflict of Interest

There were no conflicts of interest in this study.

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