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The performance anxiety influence on the motor coordination levels: A literature mini-review

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Abstract
The present mini-review aimed at studying the impact of performance anxiety on the fine motor skills. The articles were divided in 03 thematic axes: 1) Studies about the anxiety and performance mechanisms; 2) Experimental studies about the relations between anxiety and motricity and 3) Studies involving people who had anxiety disorders and its relation to motor performance. Despite many evidences about motor impairment under anxiety situations, the majority of the studies was not carried out with people who suffered from musical performance anxiety. On the other hand, there is a vast production in the sports science field that focuses on the fine motor skills impairment due to performance anxiety, which can potentially serve as a reference to the musical environment. It is recommended that new studies focus specifically on the musical performance anxiety contributing to the early and preventive approach to the motor problems due to performance anxiety.

Keywords: musical performance, musical performance anxiety, fine motor skills

Introduction

The demand for a performance efficiency, in many situations, exposes the individual to a psychological stress and fear, triggering a state of anxiety and compromising the motor skills [1]. The performance of the suboptimal abilities in people under pressure affects the future perspective of trained professionals, such as athletes, doctors and musicians.

Musical performance is a complex activity that involves various dimensions of the diverse practices that it congregates. The study of the music neuropsychological process is something that tries to understand the interrelation of the many fields that compose the musical performance. The complexity of the morpho functional adaptations as well as the cognitive abilities can be developed from musical training, such as spatial perception and mathematic calculation [2]. From this it can be surmised that the musical performance, "requires a high level of ability in diverse parameters such as motor coordination, attention and memory, which makes the activity particularly susceptible to the anxiety states" [3].

Therefore, the anxiety can exert a negative impact in performance situations, including the ones where the fine motor skills are required [4]. In musical practices, the relation between motor abilities and musical level is consecrated. It is necessary to have an experience of oriented and well planned practice to master a musical instrument. On the other hand, the level of demand can cause an increase in the expectation in relation to the performance, causing the performance anxiety. This is a very recurrent problem among music undergraduate students, where the demands tend to be high on the students' part as well as the great number of musical practices present since the beginning of the course which requires a satisfactory performance. The question is if the students have been able to deal with this challenge in a satisfactory way, or, if the incapacity to deal with situations of exposure have compromised some important abilities such as fine motor skills. The impairment of this motor valence can, for example, hinder the cords musicians' proficiency causing difficulties in tuning, whose efficiency depends on the position and strength in which the fingers are pressed against the mirror (Part of the cord instruments that uses the arc against which the fingers press the cords). Furthermore, there are authors that state that the impairment of motor coordination has been identified as a risk factor for the development of anxiety symptoms [5]. This finding could indicate, for example, the need for an early implementation of strategies towards the performance anxiety problems during the music course.

The original research project which originated this article intended to verify the musical performance anxiety impact on the fine motor skills among the students of the Music Course at UFSJ. The main hypothesis to be tested was that the subjects with greater levels of anxiety had the higher levels of fine motor skills impairment. Due to the impossibility of data collecting or application of tests in a presential way in the pandemic period, we opted to do a literature review about the theme. This focus is still little researched, which can be observed by the scarcity of articles that approach this question in a specific way. On the other hand, there is a satisfactory production about motor impairment caused by general anxiety states. It is good to remember that musical performance anxiety is only one of the innumerous states of anxiety listed in the anxiety spectrum, which can be fit in "social anxiety", according to the International Classification of Diseases (ICD) and the Diagnostic and Statistical Manual (DSM).

The main objective of this review was to contribute to furthering knowledge about the theme anxiety of the performance and its influence on the motor coordination.

Materials and Methods

A literature review was carried out with the following parameters:

Search terms:

- Impact of performance anxiety on fine motor skills review;
- Music performance anxiety and motor function.
- Refinement criteria:
- Publication date: 2010-2021;
- Idiom: English;
- Collections: PubMed, Scopus (Elsevier);
- Higher Level: journals reviewed by pairs;
- Topics: anxiety, music, psychology, medicine, humans.

The searches were carried out in the Journal Portal / The Coordination for the Improvement of Higher Education Personnel (CAPES). 418 and 754 occurrences were found respectively for the first and second terms of the search. In this universe, many of the articles were about themes that did not relate directly to the subject in question, so, at the end of the search, about 20 articles were selected which kept a closer relation to the central theme of this present review. Hereinafter, the main data which was divided in some sections for a better understanding, will be presented.

Studies about the performance anxiety mechanisms

There are innumerous studies that dedicate themselves to answer questions relative to the mechanisms involved in the relation between performance anxiety and motor control. Many of them focus on sport activities, others demonstrate the similarity between those and musical practices. Some of the main studies will be presented and discussed as follows.

Models of anxiety information processing postulate that the pathology of anxiety is associated to processing biases that consume cognitive resources and can hinder the capacity of processing environmental stimuli. Previous researches consistently indicated that the elevated anxiety has a negative impact in the cognitive and psychomotor performance [6].

The performance anxiety can deeply affect motor performance, even in specialists such as professional athletes and musicians [7]. These authors investigated the specific mechanisms of the motor impairment in these activities, and verified that in them there are more complex actions that occur in sequence, that is, individual actions which are set to develop a performance. This sequence of actions is, according to these authors, particularly prone to anxiety and is related to the activity in an area of the central nervous system denominated *dorsal anterior cingulate cortex* (check Figure 1 below).

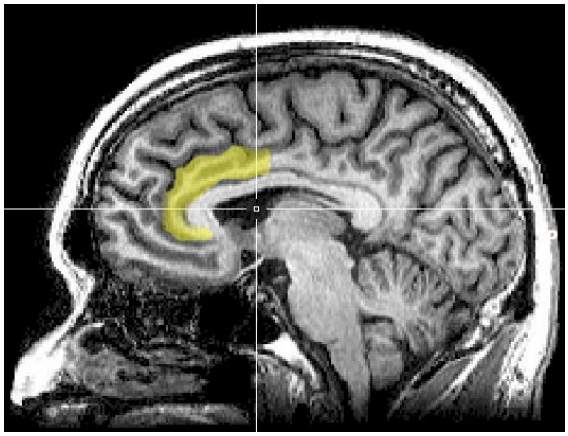

Fig 1: Dorsal Anterior Cingulate Cortex

The *dorsal anterior cingulate cortex* (dACC) is the frontal part of the cingulate cortex and looks like a "necklace" around the frontal part of the corpus callosum.

It is possible that these actions in sequence relate to the perception, selection and action of the performance impairment [8]. These authors proposed an integrated model between performance anxiety and cognitive performance, recognizing three operational levels that imply distinct functions: attention, interpretation and behavior. This net integrated to performance anxiety can affect different aspects of the action directed towards an objective.

Investigated how one of these variables can impact negatively on the performance under situations that generate anxiety: the attention [9]. That is, the anxiety-trait alters the balance between the systems of attention control impacting negatively on the performance of a pre-planned motor task directed towards an objective. And, the greater the movement complexity, the greater the motor impairment under anxiety situations. Electroencephalographic studies corroborate with the same conclusions, suggesting that performance anxiety promotes a reduction of the visual attention related to the task and that translates itself in a degradation of the performance precision [10].

Another mechanism proposed to cause the motor impairment in performance anxiety [11]. In this study started from the observation that the people who had Parkinson Disease (a disease that affects the motor control) had significantly higher anxiety scores. The mechanism that can be involved in this disease would be the reduction on the dopaminergic function. This is an evidence that physiological alterations caused by the anxiety states can impact negatively on the motor performance. Other alterations dimensions are also involved in this process. It was proposed a performance model of underlying mechanisms of the relation pressure-performance that involves the psychological, physiological and kinematics layers. In this study, the mediation analysis reveal that the muscular effort and activity mediate the performance decline [12]. The results confirm that the pressure caused effects on the performance through many ways.

Concerning the psychological dimension, it was demonstrated that the performance is only maintained if the executors are willing and are able to invest extra and proper resources on the task in question [13]. In this context, one of the principal variables would be self-confidence.

Experimental studies about the relations between anxiety and Motricity

The studies, in general, search to demonstrate the interference of the anxiety state on the individuals' motor proficiency. It was verified that, in moderate to high anxiety levels, the precision capacity of a tweezers movement was affected significantly compared to the control group [14].

Besides altering motor precision, anxiety can lead to "exaggerated distance perspectives which can hinder the performance in a physical activity" [15]. This study carried out two experiments that aimed at testing strategies to reduce anxiety and induce the perceived proximity to enhance the performance. Thus, they predicted that the intentions of implementations that reduce anxiety would enhance the visual proximity perceived by

the targets relevant for the objective, which would, indirectly, improve the performance.

Another dimension that affects anxiety is the judgment and performance situation (competition, for example). It was carried out a study with advanced level pianists. Through electromyographic measures they verified the state of the muscle contractions involved in a pianist practice in rehearsal and competition situations [16]. The results indicated that anxiety situations can adversely influence the pianists, interrupting their fine motor skills on stage and increasing the risk of occurring muscle-skeletal disturbances. Corroborating with This study, another study demonstrate that, in general, the motor precision change in pianists under anxiety situations was characterized by the reduction of synergetic movements between the finger responsible for pressing the key and the other adjacent fingers [17]. Besides, an increase in the temporal error during the performance under psychological stress was observed. These results suggest that the degradation of the fine motor control under pressure is mediated by the incoordination of the movements between the pianists' fingers.

On the other hand, one must stick to other variables that can also relate themselves to the motor performance under an anxiety context. Three different layers related to anxiety are being studied: attention, interpretation and behavior, which support the motor performance [18]. The results of this study suggest that the performance is influenced by different anxiety mechanisms that are independent of the operational memory ("know how to do") and that manifest themselves with greater intensity sometimes in the attention, others in interpretation or on behavior.

The "pressure situation" was systematized in the model proposed by Blascovich [19], called biopsychosocial model which proposes two axes through which the subjects deal with situations under pressure: THREAT X CHALLENGE. These authors who carried out the experiment in the context of surgeons in training, showed that subjects that evaluated the situations as challenges had a more efficient attention control and a motor performance superior to the ones who considered the situation as a threat.

Furthermore, there are studies that search to establish a beneficial relation of anxiety with regard to motor precision. An experiment was carried out in which the psychological stress and anxiety were manipulated in order to investigate the subsequent perceptive-motor learning [20]. The subjects were submitted to activities of arithmetic calculus training and a tweezer task of accelerated precision. There was a control group in which there were no actions that increased stress. Those exposed to the high mental anxiety and stress arithmetic task before the training reported elevated stress and anxiety levels, and showed movement of shorter times and a better retention of the movement precision and movement variability. The authors concluded that the response execution processes seemed to benefit from the elevated stress and anxiety states immediately before training, even when provoked by an unrelated task. Another study demonstrated the efficiency of training under stress conditions [21]. The study involving experienced basketball and target practice athletes showed that the training under premeditated stress conditions can exert a protective function on the real situations leading the athletes to show less anxiety scores, leading to a condition where the subjects do not show a perceptive-motor performance decrease.

Studies involving people with anxiety disorders and their relation to motor performance

In spite of the focus of this article be the anxiety performance, it must pay attention to the occurrence of comorbities with other anxiety disorders since this spectrum can affect motor performance. The literature data indicate that a specific phobia, generalized anxiety disorder, panic disorder with/without agoraphobia and major depression disorder (but not dysthymia) are common comorbities [22,23]. Furthermore, one third of the individuals that presented severe musical performance anxiety also showed a generalized anxiety disorder. There are studies that point to a prevalence of comorbities from 19 and 20% of social phobia and depressions, respectively [24]. This social phobia prevalence among musicians is about 10 times more prevalent than in the population in general. On the other hand, more recent studies indicate that the generalized anxiety disorder is the predictor of a stronger musical performance anxiety among all main types of anxiety in the Diagnostic and Statistical Manual (DSM) 5th version [25].

There are studies that investigate the motor impairment in anxiety and comorbity states. For example, the frequency and degree of motor impairment in children forwarded with anxiety disorders (AD) compared to children with attention deficit/hyperactivity disorder (ADD/ADHD), children with (AD) and ADD/ADHA comorbidities and non-referred control [26]. It was found that children with (AD) showed scores of total impairments significantly higher than the ones in control, but were not significantly different from children with ADD/ADHA or children with comorbities of AD and ADD/ADHA.

All the clinical groups showed similar profiles of motor impairment. A total of 19 (46%) children with AD scored below 5% percentile, indicating that the motor functions were hindered in many children with AD at a level that probably interferes in their daily life activities. These results support the notion that the evaluation of the motor function is important for the understanding of the daily challenges of children with AD. Other study showed that motor abilities are hindered in boys with "pure" anxiety disorders (without comorbities) [5]. Besides, the authors raised data that indicate that anxious children also perceived themselves to be less accepted by their peers and less competent in physical activities compared to the children in the control group.

Elevated scores for anxiety also seem to be related to motor impairment states in musicians [27]. It was verified that the psycodiagnostic analysis in patients with focal dystonia revealed higher levels of psychological traits related to elevated anxiety, stress and perfectionism in 40% of the patients. Although the motor results between these patients and those with an opposite psychological profile did not differ, the patients characterized by stressful and perfectionist personalities developed, in average, a dystonia ten years earlier than the rest of the patients.

The relation between anxiety and motor impairment, therefore, seem to have a two-way street. According to the presented studies, the evidences that the anxiety states affect the motor efficiency are vast and unequivocal.

The inverse situation- motor states relating to higher anxiety scores - are also shown. Therefore, it is of extreme importance that the diagnosis, as well as treatment therapies, can consider these different dimensions of the problem (anxiety ↔ motricity).

Discussion and Conclusion

The literature about the theme, despite being vast, is not specific with regard to musical performance anxiety. Despite the many evidences about the motor impairment in states of anxiety, the majority of the studies were not carried out with subjects who had musical performance anxiety disorders. This limitation becomes even more evident when the studies involving motor impairments and their relation to anxiety states are observed. Thus, there is a field of many investigations to be produced.

On the other hand, there are many analogous situations in the field of sport science that, potentially, can serve as reference for the musical environment. Many studies produced in the sport science can be applied to musical practice. Both areas deal with stressful situations, demands and search for better performances, Specially n competitions.

It is clear that new studies which focus specifically on the musical performance anxiety are necessary and can greatly contribute to the early and preventive approach of the motor problems due to performance anxiety.

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