

# Anxiety in the musical context: somatic and performance repercussions in singing

## Abstract

This article addresses the neural factors mobilized in the context of singing performance, listing the potential benefits of the reactive instinct described as “anxiety,” generated as a means of optimizing musical performance; an organic response that, when excessive, becomes a factor that impairs the desired pitch. Moreover, the different mechanisms of physical and psychological harm to which musicians are subjected during and/or as a result of their profession are discussed, as well as possible strategies for mitigating and addressing this reality. Furthermore, it contextualizes the complex neuromotor integration required for singing and possible negative interferences of anxious exacerbation in the outcome of this performance; it also discusses the contrast of anxiety-attenuating performance through listening to music when the situation is different from the musician’s professional practice. Thus, by integrating neuropsychological, physiological, and artistic aspects, this article promotes a multidimensional review of the anxiety on vocal performance impacts, contributing to psychosocial reflections in the music and health field.

**Keywords:** social anxiety, professional voice, auditory perception, executive functions, occupational health

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## Introduction

When correlating health problems in specific population groups—and the consequent need for academic research for this purpose—despite the recognized and comprehensive versatility of musicians, there is still a contrast between the wide range of possibilities for these people to be affected and the incipient publications in the literature that discuss the occupational issues of these professionals, whether psychological (in mental health) or somatic (related to the other “physical” systems of the human body). In this context, despite the decade that has passed since its publication, Costa’s study<sup>1</sup> demonstrated the scarce volume of works with this approach from 2010 to 2014 (a proportionally reduced amount also contemporaneously); including in the proceedings of conferences specific to Brazilian academic production in music: the National Association for Research and Postgraduate Studies in Music (ANNPOM) and the Brazilian Association for Music Education (ABEM). Thus, aiming at magnifying discussions related to musicians’ health—with an emphasis on changes in the field of mental health—this article, which is the result of a master’s thesis, seeks to list the repercussions of an exacerbated presentation of anxiety in the musician’s vocal performance context.

## Anxiety: physiological and pathological dimensions

Regarding the emotional aspects of musicians, we propose highlighting definitions that describe physiological conditions, that is, those inherent to the proper functioning of the organism, and pathological conditions, which constitute a deviation from this proposition. This makes it possible to understand the relationship between music and those who perform it, which is often understood as paradoxical: musical practice as a protective mechanism that reduces anxiety levels and, in a diametrically opposite position, the same practice as an anxiety-inducing factor.

From this onset perspective, it is understandable that one of the most relevant issues of the 21st century is the term “anxiety,” which describes a physiological condition superimposed over “fear”; the

latter is an emotional response to imminent threat, which occurs with periods of enhanced autonomic excitability establishing a state of “fight or flight”; the former being the anticipation of a future threat that organically permeates muscle tension and a state of hypervigilance in preparation for confronting this stressor, associated with caution behaviors and/or avoidance of the anticipated reality in question. In other words, a priori, it is one of the usual reactions resulting from interaction with the world, but when it occurs in an exaggerated form over long periods of time, it constitutes a pathological condition.<sup>2</sup>

This situation of normality transgression is discussed in the review article by Moura et al.,<sup>3</sup> which lists the possibility of addressing the harmful excess and persistence of this emotional state through various psych educational techniques and clinical approaches to this entity, which constitutes a significant part of the cases treated in public health. Despite this multiplicity of therapeutic possibilities, the literature shows similarities in the effectiveness of implementing such models in a treatment context, as presented by Mauger<sup>4</sup> in his master’s thesis, in which patients undergoing psychoanalytic psychotherapy (the main object of study of the systematic literature review) showed a significant reduction in symptoms resulting from anxiety disorders, with similar efficacy to other treatments analyzed.

It is worth noting that the social environment/situation plays a key role in either aggravating or reducing anxiety levels. A clear example of this correlation is presented in the systematic review article by Malko de Bomfim, Carneiro, and Michels,<sup>5</sup> which analyzed bibliographic survey studies and booklets developed by the Oswaldo Cruz Foundation (FioCruz) with a focus on mental health and highlighted emotional distress, especially anxiety, due to the state of public calamity that led to social isolation with the advent of the COVID-19 pandemic. This context, especially because it required the loss of most of the usual social interaction in the community—which includes reduced job opportunities, associated with the fear inherent in the uncertainties of the future and the very prospect of health after a possible infection by the then-new microorganism—contributed to the worsening of each individual’s baseline anxiety state.

In line with this analysis, Nicolini's study<sup>6</sup> discusses the nuances of mental health issues in this unique period of humanity, adding that the cognitive tendency toward "negativity bias" has intensified emotional suffering, especially amid daily exposure to negative news. Furthermore, Silva<sup>7</sup> presented the tendency of 80% of the Brazilian population to become anxious during the aforementioned pandemic period, being more prevalent among young women with lower income and education levels and a history of psychiatric disorders.

In view of the aforementioned, considering the physiological dimension of anxiety, necessary for good musical performance, in a possible conflictual relationship with the performance situation itself, which can cause damage to the final delivery, as described in the Yerkes-Dodson Law:<sup>8</sup> some degree of anxiety is necessary to generate excitement to enhance performance; but that, in excess, it runs counter to this objective and detracts from the quality of the intended performance; we wish to elucidate these possible effects on the mental health of musicians, due to the characteristics inherent to their personality being exposed to the their professional practice context.

## Mental health issues in musicians

In the context of the performance situation itself, there is a reference in the DSM-V among social anxiety disorders (accentuation of the emotions of fear and anxiety described above in social situations in which the individual is exposed to possible evaluation by other people) called "music performance anxiety" or, more commonly in the musical environment, "performance anxiety," in the group of "specific phobias". This phenomenon, in the artistic context, occurs specifically in regular public performances, not recurring in situations that do not involve this music performance exposure, translating into marked fear or persistent anxiety related to the performance situation, associated with avoidance behaviors in this context; whereas these heightened emotions and the avoidance behavior itself are disproportionate to the apparent "threat" and thus cause significant suffering with social and occupational impairments.<sup>2</sup>

For Kenny,<sup>9</sup> the experience of musical performance anxiety (MPA) can represent a protective block against (re)experiencing an intensely painful emotion resulting from the humiliating feeling of a performance that is expected to be poorly executed, especially in people with perfectionist personality traits—excessively high and idealized self-demand behavior. In this regard, Wilson and Roland<sup>10</sup> address the predominance of concern and recurring focus on failures, which is associated with the unattainable goal of control to enhance the feeling of helplessness precisely in situations that escape this scrutiny.

Furthermore, in an adaptive understanding of the MPA genesis, Rocha<sup>11</sup> lists increased cognitive capacity and critical exercise as contributing factors to the apparent migration of the performance understanding as a playful expression during childhood, to a negative feeling of pressure based on experiences and interpersonal relationships (family or otherwise) throughout life, which is related to the interpretation of the world in light of one's technical skills and mastery, as well as the individual's own innate temperament. This combination of factors is corroborated by Craske, Stein, and Hermann,<sup>12</sup> who argue that the accumulation of poorly assimilated situations of conflict and abuse, results in trauma and, consequently, predominantly anxious behavior, which can be aggravated by substance abuse, for example. Thus, it is understood that a musician's sociocultural repertoire influences the way they perform; so that, depending on how anxious they are, they will tend to give a performance that is more or less influenced by the bodily changes mentioned above.

However, it is worth highlighting the undeniable amount of pressure that musicians are subjected to, resulting from the interaction between intrinsic performance aspects (results that meet the expectations of the contractor/audience) and extrinsic aspects (personal concerns and current physical and mental health). Illustrating this situation, the study by Hackenberg et al,<sup>13</sup> in a sample of 252 people between the ages of 18 and 75, 142 of whom were amateurs and 110 professionals, observed the following as anxiety-inducing factors: "expectations about the outcome of the performance," "unforeseen events during the performance," and "audiences with familiar faces" for both groups as stressors; while "audience size," although not very relevant for either group, was much more frequently cited by amateurs as a factor of concern than by professionals.

Also, within the context of the impact on this population, the literature review by Zorzal and Batista<sup>14</sup> highlights the prevalence of MPA among students and professional musicians, from the perspective of triggers related to the individual, the task performed, and the performance context itself, with an emphasis on the experience of anxiety exacerbation before, during, and after a live performance. In the analysis of the gender variable, a correlation with a higher prevalence of anxiety traits in females was observed, with frequencies varying according to age. It is noteworthy that MPA has a relatively high prevalence, especially among music students and novice musicians.<sup>14</sup>

Aiming at possible strategies to cope with Musical Performance Anxiety, the meta-analysis by Faur et al<sup>15</sup> lists psychotherapy, physical exercise, and alternative therapies as measures to mitigate MPA symptoms in the 14 studies selected for this investigation. In this context, exercising and choosing other healthier lifestyle habits is reflected in a lower frequency of occupational complaints, as shown in the exploratory study conducted with 349 German singers by Mathmann et al,<sup>16</sup> in which alcohol consumption and smoking (especially in risky behavior) in the sample studied was lower than in the general population; despite this, among the complaints related to the exercise of the profession, curiously, the highest prevalence of complaints was also found in the female audience.

In this potentially conflicting relationship between anxiety and performance, as previously explained, mechanical changes in the body can be observed, which ultimately lead to a decline in the artistic performance. However, this is a result that, in addition to the difficulties empirically observed by musicians, is closely linked to its core: impairments in auditory processing and executive functions secondary to persistent mood changes.

## Changes in executive functions and auditory processing in an anxious context: impacts on vocal tuning

Music-making is an act that requires the prior acquisition of external information for planning and execution. In this respect, Ferreira et al,<sup>17</sup> studied the requirements for achieving pitch accuracy in singing and thus highlight the following aspects importance: auditory perception, in the discrimination of frequencies and intervals; auditory memory, in the context of maintaining conscious musical patterns while singing; and the motor coordination necessary to ultimately produce the exact frequencies during vocal control. In addition to these ideas, the study by Rodrigues<sup>18</sup> reports the multiplicity of brain areas stimulated by music, including regions responsible for processing emotions; this even encompasses the possibility of using music as an inducer of therapeutic benefits, as in music therapy.

The act of correctly reaching sound frequencies when performing a song (musical tuning), especially in singing, comes from the interaction among prior knowledge of vocal techniques, the processing of information gathered from the environment, and the very support of the framework formed by bodily structures at the moment of performance. In this sense, the study conducted by De Moura et al.<sup>19</sup> explores the involvement of multiple brain structures related to language, memory, and emotions, focused on the musical perception construction and, consequently, the possibility that anxious exacerbation is a distracting interference factor in the sensorimotor articulation process. In line with this, the study conducted by Alves, Mancini, and Teixeira<sup>20</sup> delves deeper into the evidence regarding the ways in which auditory feedback is manipulated (changes in sound frequency and volume and auditory delay, for example) and their implications for the voice motor control. Therefore, considering the mutual influences of various origins, especially in the presence of anxious exacerbation, this is an area to be studied among musicians.

In order to understand the influence of anxiety exacerbation in the context of vocal performance, it is necessary to understand the complex neuronal interaction involved in acquiring information from the environment so that it can ultimately be processed and articulated in the vocal apparatus motor skills. A priori, “memory” is defined as the process of acquiring, storing, and recalling information; this set of skills is then didactically subdivided into sensory (tactile, visual/iconic, and auditory/echoic) and working memory (contextualization and management of information for the purpose of performing a task or developing a behavior) - included in short-term memory - and long-term memory.<sup>21</sup>

Due to the fact that singing is contextualized within the performance of a task, it is worth highlighting the multicomponent model of Baddeley and Hitch,<sup>22</sup> which advocates the subdivision of working memory into four main components: central executive (the brain’s attention system), visuospatial sketchpad, and phonological loop (management and temporary storage of information from images and sounds, respectively), and episodic buffer (management of information already consolidated, in comparison with new information acquired at the moment through the senses). Therefore, Mourão Júnior and Faria<sup>23</sup> relate the transcendental nature of working memory beyond a mere storage system: rather, it is a fundamental component of evoking this prior knowledge in the face of the imminent need for logical processing of information.

In this context, precisely because of its managerial nature in activity situations, working memory is part of the “executive functions” group which consists of a set of skills that, in a cohesive manner, allow individuals to direct their behavior toward goals in voluntary actions, in a self-organized manner that is appropriate to the intended goal in an efficient way.<sup>23</sup> However, even when seeking this fine control of concatenated actions, excessive anxiety interferes with obtaining the best result, as clearly shown in the study developed by De la Peña-Arteaga et al.,<sup>24</sup> in which, when subjecting the 179 components of the sample to functional magnetic resonance imaging at rest, the intrinsic relationship between the anxiety trait (obtained through the IDATE-trait response) and three resting-state brain networks was observed: Dorsal Attention Network (DAN) - responsible for voluntarily directing attention to relevant external stimuli (such as focusing on a visual object or task); Default Mode Network (DMN) - involved with internal thoughts (daydreaming, memories, future planning, self-reflection); and the Auditory Network - related to the processing of sound stimuli and auditory perception. This research indicates that, even at rest, information processing can be affected by an individual’s tendency to perceive various situations as anxiety-

provoking, especially based on the greater predisposition of subjects with high levels of anxiety traits to develop anxious and/or depressive mood disorders.

This intimate repercussion of sounds apprehended from the environment is illustrated by their protective capacity in terms of musical hearing, as explained in Silva’s dissertation,<sup>7</sup> which discusses the somatic (bodily) responses of relaxation when listening to music for this purpose, which enables a favorable environment for learning,<sup>7</sup> stress levels reduction;<sup>7</sup> and even the possibility of reducing anxiety, as in the composition “Weightless” by Marconi Union, through the heart rate and blood pressure reduction levels.

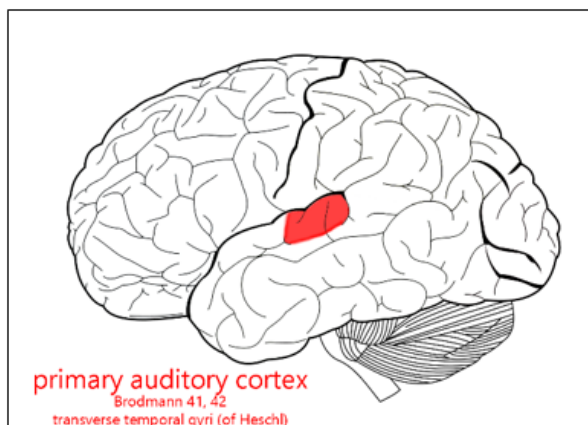
Still within the scope of managing information acquired from the external environment, Vieira<sup>25</sup> highlights the contribution of central auditory processing in the acoustic analysis of sounds and the auditory information organization, which, in turn, results in efficient vocal reproduction of what is heard; for this, clear hearing and efficient auditory processing in sequencing are essential: capture, perception, comprehension, and, finally, effective sound reproduction. This interrelationship between central auditory processing and accurate pitch execution is corroborated by Souza’s integrative review,<sup>26</sup> which reinforces the use of pedagogical optimization through temporal-frequency auditory discrimination activities, since vocal accuracy is the result of the apprehension of sounds from the environment combined with technical singing skills. Ferreira et al.,<sup>17</sup> in turn, reinforce the interaction among the various procedural mechanisms related to memory, auditory mapping, motor planning and execution, somatosensory and auditory perception and feedback<sup>1</sup> and the deficit in music-specific perception (amusia) itself.

Furthermore, the literature review by Muszkat and Carrer<sup>27</sup> addresses the neural interrelationship between components of auditory processing and musical performance, as well as its correlation with regions associated with language, emotions, and intellectual processing itself. This establishes the positive impact of musical experience on cognitive, emotional, and behavioral functions, which also implies improvement in individuals’ social aspects, based on the involvement of the auditory cortex - areas 41 and 42 (Figure 01) of the functional description of the brain made by Korbinian Brodmann in 1909, closely related to the associative region of the angular gyrus, Brodmann area 39 (Figure 02) - with subcortical structures such as the limbic system (Figure 03) and the brain stem (Figure 04).<sup>28</sup> The stimulation of these regions, therefore, beyond the improvement related to hearing and musical performance—represented, in musicians, by the increase in the physical volume of these regions in these professionals—transcends to the development of executive functions, such as short- and long-term memory. Furthermore, the authors address this musical experience (listening and instrumental and vocal performance) in the modulation of mood-related neurotransmitters, such as serotonin and dopamine (Figure 1-4). Based on this brain signaling at the moment the musical stimulus occurs, anxious behavior can cause negative interference: the so-called “Startle Reflex” - defined as the triggering of muscle contraction in response to an abrupt and intense stimulus as a form of self-preservation. This phenomenon is one of the possible markers that can be observed in an individual when faced with a stimulus of this magnitude, measured in humans through blinking in response to the sound threat.<sup>29</sup> In this regard, Bakker’s study<sup>30</sup> highlighted the heightened attention in these situations and, based on the reduction in anxiety symptoms in the sample evaluated in the study, a significant reduction in the reflex response was observed. This

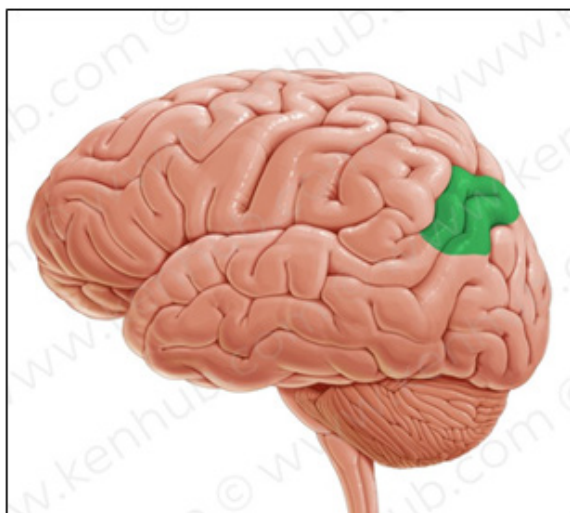
<sup>1</sup>Sensory system that receives and processes information from tactile, proprioceptive (body position awareness), and nociceptive (pain) neurons, as well as thermal and pressure sensations.



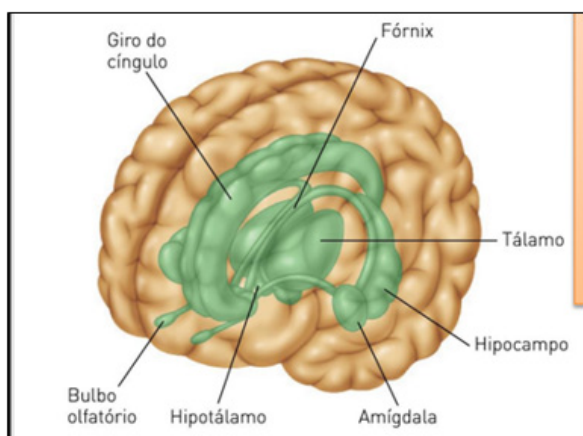
was corroborated by the study by Poli and Angrilli,<sup>29</sup> which found that women in the sample with higher levels of anxiety also reported a greater aversion to the emitted noise.



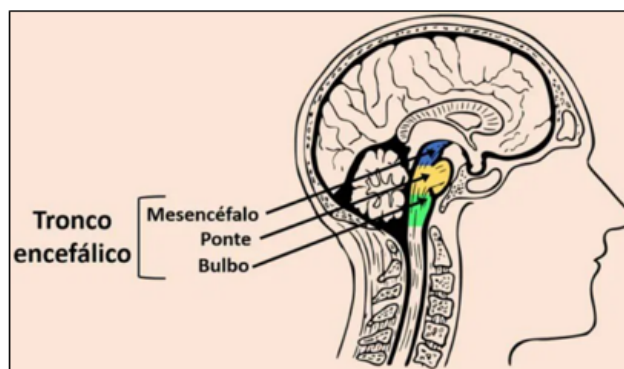
**Figure 1** Primary auditory cortex; Brodmann areas 41 and 42 (under the eponym “Heschl’s gyrus”/Transverse temporal gyrus). Available at: <https://uen.pressbooks.pub/neuroanatomy/chapter/brodmann-areas/>



**Figure 2** Angular Gyrus (Brodmann Area Number 39). Available at <https://www.kenhub.com/pt/library/anatomia/giro-angular>



**Figure 3** Limbic system anatomy.



**Figure 4** Brain stem. Available at: <https://www.todamateria.com.br/tronco-encefalico/>

## Discussion and conclusion

Therefore, there is an urgent need to discuss issues closely related to musical practice, especially in light of the recurring anxiety observed among musicians. This altered state, in turn, is reflected in nuances inherent in the neurological processes responsible for articulating prior information gathered in the performance environment for the desired artistic execution, which, in this distinct context of anxiety, can result in impairments in the idealized vocal tuning.

Furthermore, the ambivalent position of music in neurological processing stands out: sometimes it is used as a means of relaxation and concentration to improve a subject’s performance in executing a task, and sometimes it is the reason why information processing is taking place (as in a performance situation), which, in this case, may be a reason for a decrease in the final result. This fact confirms the discussion about the possibility of using music as a therapeutic mechanism; but precisely when it comes to musicians, who are responsible for producing these sounds, this protective effect is sometimes subverted, especially in the case of people with high levels of anxiety.

Therefore, understanding the interaction among anxiety, cognition, and vocal control is essential for both emotional protection and the performance required in their work. This is why further studies on the subject are encouraged, including the forthcoming results of the possible practical correlation among musicians with different levels of anxiety performing the same vocal tuning task in a test context, to be discussed in the final draft of the master’s thesis, in order to enable discussions for the preventive and therapeutic strategies development aimed at the musicians’ health.

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## Conflicts of interest

The authors declare there are no conflicts of interest.

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