

# Music and sports performance: a mini review of scientific perspectives

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**Abstract.** The utilisation of music within the realm of sport has witnessed a marked surge in popularity, with athletes increasingly incorporating it into their training regimens and competitive preparations. This mini review aims to provide a comprehensive and holistic, science-based overview of music's application in sport, spanning from its foundational theoretical underpinnings to its practical implementations. It synthesises key areas, including the underlying mechanisms of action through which music influences athletic performance, alongside an examination of scientific studies categorised by the timing of music intervention: pre-task, in-task, and post-task. Practical guidelines for optimising music selection and implementation are also discussed. Ultimately, this review highlights the considerable potential of music as a tool for regulating emotional states, enhancing physical performance outcomes, and optimising the overall training and competitive experience for athletes across a diverse range of sporting disciplines.

## 1. Introduction

The increasing integration of music into athletic preparation and training has propelled the study of its influence on the athlete's psyche to the forefront of sports science. While the deliberate manipulation of auditory stimuli to influence human behaviour has roots extending back to antiquity, it is the modern era, with its readily available personal listening technologies, that has witnessed a widespread adoption of music as an ergogenic aid and psychological tool within the sporting context. Historical precedents for this application are readily apparent. Greek philosophers such as Pythagoras and Plato, explored the potential of music to shape emotional states and promote desired behavioural responses, laying the groundwork for our contemporary understanding. Furthermore, the modern Olympic Games have played a role in formalising the link between music and sporting endeavour.

The current mini review seeks to provide a holistic, science-based synthesis of music's application within sport. Its aim is to traverse the landscape from the foundational theoretical underpinnings to the practical implementations, so often seen in the field. To achieve this perspective, the discussion will integrate a range of scholarly perspectives: (a) the underlying mechanisms of action by which music exerts its influence on athletic performance; (b) an

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analysis of pertinent scientific studies, organised according to the timing of music intervention: pre-task, in-task, and post-task applications; and (c) practical guidelines for optimising the selection and implementation of music within diverse sporting contexts.

Ultimately, this review seeks to illuminate the versatility and potential of music as a tool for enhancing athletic experiences. It will examine its applications in shaping emotional responses, managing perceptions of exertion, augmenting physical performance, and fostering team cohesion. By integrating theoretical constructs with empirical findings, the following discussion provides a robust and practical understanding of music's role in contemporary sport.

## **2. Results AND Discussion**

### **2.1 Mechanism of Music in Sport**

The ergogenic and psychological benefits of music in sport are underpinned by a complex relationship of neurophysiological and psychological mechanisms. Understanding these mechanisms is important for effectively harnessing music to optimise athletic performance. This section will explore the key processes through which music exerts its influence, focusing on its impact on affect and emotions, its capacity to induce dissociation and alter perceptions of exertion, and the fundamental rhythmic responses it elicits.

#### **2.1.1 Affect and Emotions**

Athletes frequently cited the regulation of arousal, modulation of affective states, and expression of specific emotions as primary reasons for using music. Within this domain, Juslin's [1] framework provides a valuable lens for understanding how music shapes emotional responses. The brain stem reflex refers to the immediate and unconscious physiological responses triggered by fundamental acoustic properties of music, such as tempo and loudness. Fast, loud music, for example, can stimulate the central nervous system, resulting in elevated heart rate and muscle tension, irrespective of conscious appraisal [2]. Rhythmic entrainment, another key mechanism, involves the synchronisation of bodily rhythms, such as heart rate and respiration, with the rhythmic qualities of music. This process can influence physiological arousal and motor coordination. Furthermore, evaluative conditioning highlights the role of associative learning, wherein repeated pairing of a particular piece of music with positively or negatively valence stimuli can lead to conditioned emotional responses. Finally, visual imagery plays a significant role, with music evoking memories and mental images associated with past experiences [3],[4]. For instance, a song associated with a successful performance can trigger positive emotions and enhance self-efficacy.

#### **2.1.2 Dissociation and Perception of Exertion**

Music serves as a potent stimulus for promoting dissociation, effectively diverting attention away from sensations of pain and fatigue [5]. This outward-type focus can be particularly beneficial during endurance activities. From a neurophysiological perspective, the afferent nervous system, responsible for transmitting sensory information (e.g., pain, fatigue), possesses a limited channel capacity. Consequently, sensory stimuli such as music can inhibit the transmission of physiological feedback signals associated with physical exertion, leading to a reduction in perceived exertion [6]. EEG studies have demonstrated that music is effective in downregulating theta waves in the frontal, central,

parietal, and occipital regions of the brain, a process associated with the suppression of fatigue-related symptoms [7]. While this sensation-inhibiting capacity of music is less pronounced at higher exercise intensities, affective stimuli such as music can still influence how athletes interpret the sensations of physical effort and fatigue.

### **2.1.3 Rhythmic Responses to Music**

Humans possess an inherent predisposition to respond to music, which stems from evolutionary roots. This innate responsiveness forms the basis for the potential benefits of music in sport, particularly concerning the coupling of perception and movement. This coupling is guided by recurring patterns in the structure of music. The concept of entrainment plays a central role, referring to the mutual influence between agents, enabling communication and reception of information about each other's actions. In the context of synchronous music and activities such as running, athletes align their movements with the musical rhythm [8]. While traditionally unidirectional (athlete following the music), technological advancements now permit mutual synchronisation, with devices adapting music tempo to the athlete's movement rate. The brain has a central pattern generator or pacemaker; this mechanism coordinates afferent nerve signals with efferent counterparts controlling movement [9]. Therefore, the supplementary motor area of the brain supports the perception and rhythmical ordering of movement tasks.

## **2.2 The Scientific Study of Music in Sport**

The integration of music into athletic contexts has garnered increasing scholarly interest due to its potential to enhance performance, facilitate recovery, and modulate psychological states. Examining the scientific literature reveals a nuanced understanding of how different types of music: pre-task, in-task, and post-task, exert distinct effects aligned with specific performance and recovery goals.

### **2.2.1 Pre-Task Music**

Pre-task or pretask music serves primarily as a preparatory tool to prime athletes psychologically and physiologically before exertion. The dichotomy of stimulative versus sedative music underpins many investigations into its functional effects. Stimulative music, characterised by high tempo, energetic rhythms, and motivating melodies, is associated with heightened arousal, increased motivation, and anticipatory excitement [10]. Conversely, sedative music features slower tempos and calming melodies, which can reduce pre-competition anxiety and promote relaxation [11].

Research has demonstrated that stimulative music enhances performance on anaerobic tasks such as sprinting and weightlifting by elevating physiological arousal levels conducive to high-intensity exertion [12]. In target-based sports, where explosive power and quick responses are crucial, the use of energising pre-task music can facilitate optimal readiness. For example, athletes who listen to high-tempo music before a weightlifting session often exhibit increased force output and confidence. Conversely, sedative music may be beneficial when aiming to reduce pre-competition anxiety, aiding in focus and mental clarity.

### **2.2.2 In-Task Music**

The application of music during activity, referred to as in-task music, has been extensively examined for its psychological and ergogenic effects. Specifically, the modes of synchronisation between music and movement, synchronous versus asynchronous, have

been central to understanding its impact. Synchronous music involves the exact matching of musical beats with movement tempo, fostering a sense of unity between the performer and the music. Several studies have underscored its ergogenic potential by promoting increased ratings of perceived exertion (RPE) and reducing the subjective experience of effort [13]. The psychological benefits include heightened motivation, improved mood states, and enhanced perceived rhythmicity, all contributing to improved performance. For example, runners who synchronize their stride rate with high-tempo music tend to maintain higher speeds with less perceived fatigue [14].

Asynchronous music, where the beat and movement are not perfectly aligned, has attracted considerable research interest due to its potential in diverse settings. While it may lack the immediate rhythmic entrainment benefits, asynchronous music can still evoke emotional arousal and shift attentional focus, thereby influencing performance indirectly. Some studies suggest that certain asynchronous music selections can serve as a distraction from fatigue or discomfort, improving endurance and mental resilience during prolonged activity [15]. Furthermore, asynchronous music provides flexibility for individual preferences and situational adaptations, making it a practical choice across varied sporting contexts.

### **2.2.3 Post-Task Music**

Recovery phases post-exercises are critical for physiological restitution and psychological regrouping. Respite and recuperative music, typically slow-tempo and soothing, are increasingly recognized for their role in facilitating recovery. Listening to calming music post-exercise has been shown to reduce heart rate, lower cortisol levels, and promote relaxation [12]. Athletes report that such music helps alleviate muscular tension and mental fatigue, fostering a state conducive to physiological repair and psychological rejuvenation. This holistic approach to post-task music aligns with the emerging consensus on the importance of integrating music-based interventions into comprehensive recovery protocols, thereby enhancing subsequent performance readiness.

## **3. Conclusion**

The scientific exploration of music in sport reveals its multifaceted capacity to influence performance and recovery. Different musical modalities serve targeted functions: pre-task music prepares athletes mentally and physiologically, in-task music sustains motivation and optimises effort, and post-task music aids in recuperation. The effectiveness of these interventions hinge on individualized selection, contextual appropriateness, and precise implementation.

Emerging research brings out the importance of understanding the complex mechanisms through which music interacts with psychological states and physiological responses. The integration of musical strategies into training regimens offers promising avenues for athlete development, provided these approaches are tailored and evidence based. As the field advances, continued interdisciplinary investigations will be vital to refine best practices, ensuring that music remains a scientifically supported tool for performance enhancement and holistic athlete wellbeing.

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