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# *Under Pressure*: Music-Related Interventions in High-Performance Domains

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The title of this chapter echoes that of a well-known song by supergroup Queen – *Under Pressure*. Anyone who is engaged in a high-performance domain, such as a sporting contest, a musical recital, or a marketing pitch to a high-powered executive board, will know only too well what it feels like to be under pressure. Nonetheless, dealing effectively with pressure is part and parcel of such high-performance domains; when you go for a walk in the rain you will expect to get a little wet, when you enter a high-performance domain you will expect to feel some pressure. Seen in this light, pressure is *perhaps* a sign of success.

For certain individuals, the pressure will serve to raise their performance to extraordinarily high levels while for others, the spotlight of public scrutiny can be overwhelming and they crack like eggs in an omelet (Clark, Lisboa, & Williamon, 2014; Neil, Wilson, Mellalieu, Hanton, & Taylor, 2012). When they disintegrate, a phenomenon that psychologists often refer to as 'choking,' it is often due to an excessive focus on the execution of key skills rather than allowing such skills to flow automatically. The awareness of one's own anxiety levels prompts a debilitating effort to consciously and falteringly implement skills that have long since become automatic and effortless. This distraction triggers a meltdown in which action is choked by endless negative speculations and other mental flight.

The purpose of this chapter is to explore the structured and systematic use of music as a means to optimize the mindset and outcomes for those involved in high-performance domains. The first section of the chapter deals with key concepts and some underlying scientific principles. The second section presents a conceptual framework that is intended to underpin the music-related applications that are presented in the third section (e.g., using music to prepare mentally for a concert performance). The content of the chapter is likely to be of particular interest to athletes, performing artists, business people, coaches, performance psychologists, financial traders, armed-forces personnel, surgeons, and teachers.

# The Special Role of Music

From the dawn of civilization, ancient cultures have sought to combine sounds in such a way that they influence the human psyche. With the evolution of such cultures, primitive forms of music morphed into ever-more artistically pleasing arrangements. Composers and musicians became increasingly adept in using musical works to alter the emotional state of their listenership. For example, the preeminent classical composer Ludwig van Beethoven (1770-1827) was famed for his ability to stir human emotions through the rich texture and intricate use of sonic tension and resolution in his works. Seemingly, there is a piece of music for every civic occasion as well as for almost every ritual and function of our private lives. Accordingly, through the ages, music became intertwined with a diverse range of human activities that included the worship of deities, soothing of tearful infants at bedtime, priming of soldiers facing battle, celebration of rites of passage, and synchronization of manual labor.

Musical compositions entail the organization of four primary elements: *melody*, *harmony*, *rhythm*, and *dynamics*. Melody is the part of a musical composition that is often the highest in pitch and colloquially known to as 'the tune.' It is the part that you might catch yourself humming or whistling along to. Harmony describes the combination of multiple notes and often serves to shape the emotional impact of the music. If you can imagine a barbershop quartet in full flow, that would be an example of four-part vocal harmony. Rhythm has to do with the tempo or speed of a piece of music—normally measured in beats per minute (bpm)—as well as the way that the music is accented over time. It is these accents that enable us to clearly distinguish between a reggae skank[1], a salsa montuno[2], and a Viennese waltz[3].

Rhythm is also the musical ingredient that prompts a physical response in the listener, such as the desire to tap the toes or dance. Dynamics concern the energy transmitted by musicians through their touch or breath to influence how loud their instrument sounds, particularly how this changes over the course of a piece. As we will discover later in this chapter, the emphasis

[1] A skank is a West Indian colloquialism representing the beat that characterizes reggae music. This entails a strong emphasis on the second and fourth beat of the bar.
[2] Montuno is a name given to the style of piano playing that typifies salsa music. It features a catchy, syncopated vamp that is repeated throughout the piece.
[3] A Viennese waltz is an early genre of ballroom dance characterized by three beats to the bar with a strong emphasis on the first beat of the bar – **one**, two, three, **one**, two, three, etc.

that is placed on such musical qualities can have a direct influence on an individual's mindset as they ready themselves for a superior performance.

## Music Applications

Music can serve three primary functions in performance domains. First, it can be used *pre-performance* to manipulate a performer's mindset prior to the activity itself. This application is salient in terms of engendering the appropriate type of imagery, cognitions, and the optimal level of activation in the performer. By this we mean that they see the 'right' pictures in their mind, have positive and not self-defeatist thoughts, and are suitably aroused for the task at hand. Generally speaking, fast, loud music has a stimulative effect so it can be used as part of a psych-up routine whereas soft, slow music has a sedative effect, which means that it can be used as a relaxant. A performance that requires deep concentration and fine motor control, such as playing Beethoven's *Moonlight Sonata* on the piano, would require far lower levels of arousal than a gross motor performance, such as a bench press in the sport of powerlifting. In addition, well-selected pre-performance music will prompt emotions in the performer that they wish to take into their activity. For example, athletes in combat sports such as wrestling and boxing often choose highly aggressive music to accompany their entry into the ring (see Sidebar 1).

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Sidebar 1: *Wrestling* with the choice of music

In US professional wrestling, the much-feared Steve Austin was well known for parading into the ring while accompanied by the chilling instrumental track *Stone Cold Steve Austin*. This heavy metal piece was composed especially for the Texan and served to embody his implacability in the field of battle. Austin's long-time rival Hulk Hogan chose *Real American* as his walk-on music. This brash, guitar-led anthem is said to represent America and real American heroes, as is evident in the lyrics of the refrain, which allude to a fight to maintain the ideals that Americans hold dear. Hulk's public persona as the 'small-town guy with a big heart' that the crowd should rally behind was entirely in keeping with his choice of music. For both of these heavyweight contenders, the primary purpose of the music was to say "Hey people, here I am …I am a mean dude, pumped up to the max, and ready to win big!"

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The second primary application of music entails its *in-performance* use. The music in this case accompanies a performance or training session. With this type of application, we exclude the influence of a musical work on an artist *while* they are performing, which is not a focus of the present chapter. With such in-performance use, there are two subtypes of application. The *synchronous* application of music is typified by the use of the rhythmic aspects of music as a type of metronome that regulates movement patterns. For example, the rowers on a dragon boat employ a drummer to coordinate their collective efforts in time and space.

The *asynchronous* use of music, as the term implies, entails the absence of *conscious* synchronization. It is when music is playing in the background during an activity to enhance the performance environment or lift the mood of the performer(s). A good example would be international beach volleyball championships that have loud asynchronous music blaring over the public address system. The astute reader will notice a potential oxymoron here: Although asynchronous music is often referred to as 'background music' owing to the lack of synchronization, it *can* be very loud!

The third primary application of music is its *post-performance* use. This is when it functions in a recuperative role and aids recovery from injury, competition, or extreme physical exertion (Terry & Karageorghis, 2011). Selections with a tempo in the range 60-90 bpm are recommended when using music post-performance, as this is close to the average resting heart rate. In addition, the emotional qualities of the music should be neutral or relaxing and played on soothing instruments such as strings, clarinet, or piano in order to facilitate recuperative feeling states (Karageorghis & Terry, 2011).

## How Music Affects Us

The literature pertaining to performance-related domains has focused on the *psychological*, *psychophysical*, *psychophysiological*, and *ergogenic* effects of music. The psychological effects relate to the influence of a musical composition on mood, emotion, affect (feelings of pleasure/displeasure), thought processes, and behavior. Psychophysical effects entail the psychological perception of one's physical state and therefore such effects are often assessed

in the sports domain using Gunner Borg's Rating of Perceived Exertion (RPE) scales (see e.g., Hutchinson, Karageorghis & Jones, 2015; Lim, Karageorghis, Romer & Bishop, 2014; Stork, Kwan, Gibala, & Martin Ginis, 2014). The psychophysiological effects have to do with how music influences physiological functioning, that is whether music listening changes heart rate, breathing rate, blood pressure, etc. Finally, music has an ergogenic effect when it enhances a performer's work output or causes higher than expected power output, endurance, or productivity. Figure 1 provides a visualization of elite triathletes' affective responses during a progressive running task on a treadmill. The athletes' feelings of pleasure were far more positive in the presence of motivational music when compared to *oudeterous* (music that is neither motivating nor demotivating), and a no music control.

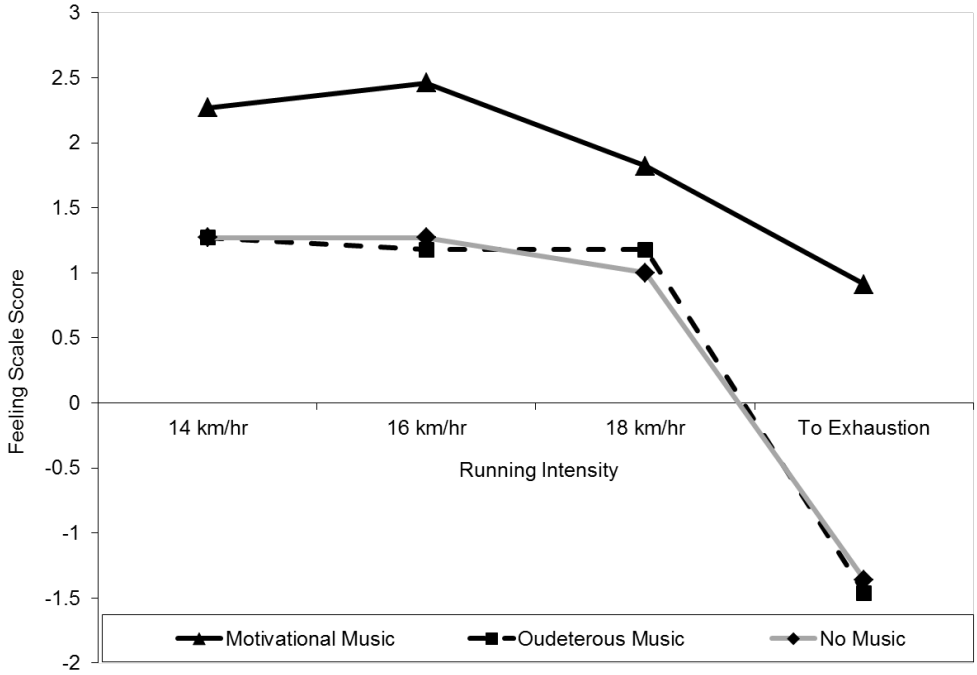


Figure 1

Feeling Scale scores of elite triathletes as the run to exhaustion progressed.[4]

Adapted from Journal of Science and Medicine in Sport, 15(1), P. C. Terry, C. I. Karageorghis, A. Mecozzi Saha, and S. D'Auria, Effects of synchronous music on treadmill running among elite triathletes, 52-57, © 2012, with permission from Elsevier.

[4] Note: There was a brief recovery period in between each of the four running intensities.

## An Underlying Conceptual Framework

I, Karageorghis, recently published a theory to predict the effects of music in the exercise and sport domain and an accompanying model that is *heuristic* in nature (2015). By heuristic I meant that the model is *instructive* and provides a holistic representation of relationships identified within the literature, as opposed to a mechanistic or factorial model that offers a series of explicit predictions. Herein, the theory and model are adapted to a broader range of high-performance domains and presented in brief as a conceptual framework to provide a backdrop for the range of music applications that follow in the second half of this chapter. It should be noted that this framework does not cover the influence of a piece of music on artists *while* they are performing that piece or to that piece. Rather, from the perspective of the performing artist, the theory pertains to how s/he might use music as part of her/his pre-performance preparation or post-performance recuperation. Figure 2 provides a visualization of the conceptual framework that describes the way in which variables pertaining to music, the listener, and the listening situation interact to determine a range of consequences in high-performance domains.

## Musical Factors

Musical attributes are referred to as “antecedents” in Figure 2 because they precede or cause the responses to music. Think of them as the beginning of a type of ‘chain reaction’ that takes place when a performer is influenced by a musical stimulus. These attributes are divided into *intrinsic* and *extrinsic* categories: Intrinsic qualities relate to the constituent parts of music (e.g., melodic and harmonic features, vocalizations, syncopation, etc.), whereas extrinsic qualities pertain to how music is interpreted by the listener and the associations of the pieces (e.g., how it reminds the listener of other things).

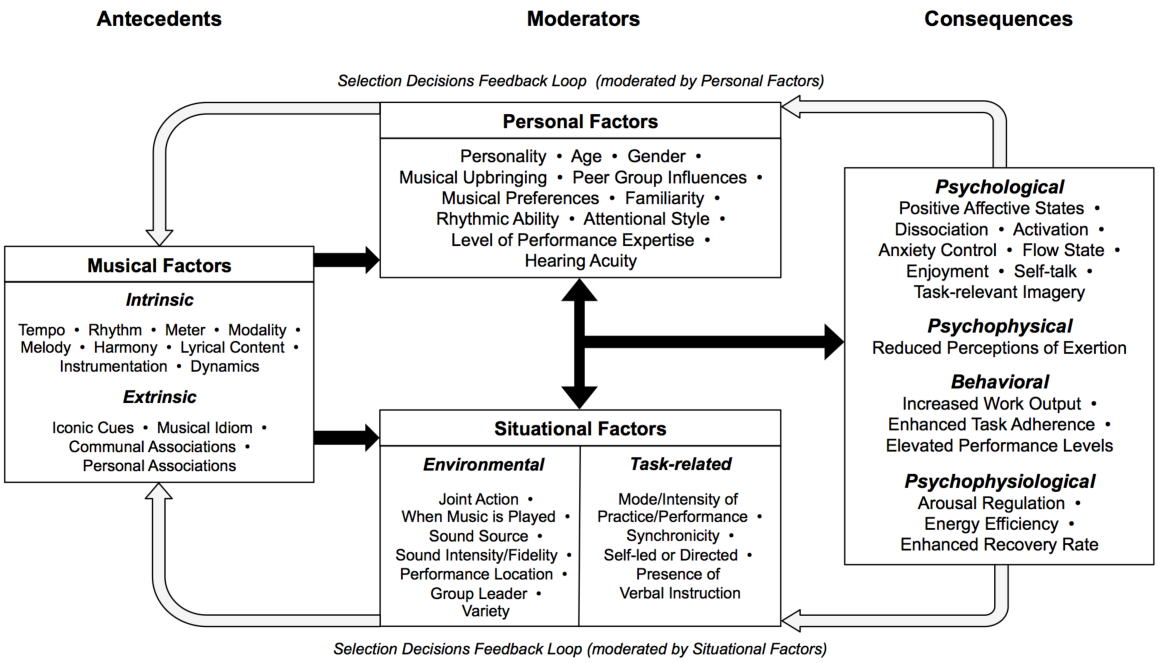


Figure 2

A conceptual framework of the antecedents, moderators, and consequences of music use in high-performance domains.

Adapted from Sport and Exercise Psychology (2nd ed., p. 301), by A. M. Lane (Ed.), 2015, London, UK: Routledge. © 2015, with permission from Routledge.

Among the intrinsic properties of music, lyrics play a salient role through providing affirmations or directing attention toward a particular image, thought pattern, or skill (e.g., a high trapeze artist using the track *I Believe I Can Fly* by R Kelly). The influence of the meaning of the lyrics (i.e., their semantic detail) depends not only on the way it is received by the performer but also the relevance of the information to the task at hand. A particular lyric can be highly emotive for a given performer, and even imbue them with feelings of invincibility, but have no influence whatsoever on another (Juslin, 2013a; Karageorghis et al., 2013; Sanchez, Moss, Twist, & Karageorghis, 2014).

Among music's extrinsic properties, *iconic cues* concern how structural elements of a musical work relate to the tone of certain emotions; for example, fast/loud music may sound 'lively' because there are commonalities with energy and excitement (North & Hargreaves, 2008). Given that such cues are grounded in the structure of music, the same music should hold similar 'iconic meaning' for people of different cultures (Fritz et al., 2009).

The conceptual framework distinguishes communal associations from personal associations (Juslin, 2013b). The former are often sparked and galvanized by the mass media. Thus they are likely to influence large sections of the population, albeit for different reasons. For example, the use of saxophonist Paul Desmond's jazz composition *Take Five* to promote the sale of Cadbury's *Twirl* chocolate bars on TV might well compel younger viewers to purchase the sweet snack when they 'take five.' In contrast, older viewers might associate the music in the advertisement with '60s chic' and Desmond's iconoclastic approach to regular jazz meter[5]. Given that the present-day youngsters did not grow up listening to the piece, they are more likely to associate the piece with the chocolate bar whereas the same association for older viewers is less likely.

On the other hand, personal associations pertain to our individual experiences of music. For example, the well-documented 'our song' phenomenon, which concerns how a particular piece of music can hold special meaning for lovers, reminds them of the time that they first started dating (North & Hargreaves, 2008). These associations are cultivated at a personal level but may involve the mass media; hence, there is some overlap with communal associations.

## Personal and Situational Factors: The Moderators

Moderators are factors that influence the *strength* of the relationship between a piece of music and one's responses to it (e.g., personality and peer group influences). There is a two-way relationship between personal and situational factors given that, in a high-performance context, the music should be *functional* or carefully coordinated with the tasks and specifics of what is required (Kodzhaspirov, Zaitsev, & Kosarev, 1986). The 'Situational Factors' are subdivided into *environmental factors* that concern aspects of the performance location and how it is set up, and *task-related* factors that entail how the performance is undertaken (e.g., the intensity of an athlete's training session or whether a musical recital is self-led or directed by a conductor).

[5] Regular jazz meter entails the use of four beats in a bar (quadruple time) whereas Desmond's *Take Five* was characterized by five beats in the bar (quintuple time).

Personal factors such as musical preferences and attentional style (i.e., associator vs. dissociator) interact with the situational factors to determine a performer's responses to music (Hutchinson & Karageorghis, 2013). For example, an associator who is training to music with a beat that matches their work rate is likely to attempt to use the music as a type of metronome to regulate their movements (task-related factor). As well as dealing with such individual-level responses, the conceptual framework also deals with responses to music at a group level (environmental factor).

*Joint action* entails coordinated and synchronized actions performed by a number of people who share common goals (Sebanz, Bekkering, & Knoblich, 2006); for example the members of an aerobatic display team. Accordingly, if the playing of a popular piece results in a surge of enthusiasm within a group (e.g., sports team, orchestra, workforce) that relates to the phenomenon of joint action (Sebanz et al., 2006), this surge is likely to have a positive effect on an individual who may not necessarily express a liking for that piece, resulting in a behavioral consequence (i.e., more effort expended). Likewise, if a particular piece is highly preferred by the leader of a group, this preference will have a direct influence on her/his subordinates through the nonverbal communication that the leader will exude (Priest & Karageorghis, 2008).

The literature also suggests that rhythm and tempo of music will lead to differential responses depending on the age and personality profile of performers and the nature of the task in which they are engaged (Clark, Taylor, & Baker, 2012; Crust & Clough, 2006; Deutsch & Hetland, 2012). To select music that is age-congruent, consideration needs to be given to the artist, musical idiom/style, and release date (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). Selections and musical styles that were popular during a performer's formative years are known to have a particularly powerful effect owing to the formation of preferences and associations during this time (Brattico, Bogert, & Jacobsen, 2013).

In considering the influence of personality on music selection (a personal factor), extraverts should generally prefer more stimulative music than introverts (Eysenck, 1967; McCown, Keiser, Mulhearn, & Williamson, 1997). Such music is characterized by a fast tempo, prominent rhythmical features, and exaggerated bass tones; the 2014 international smash hit *Happy* (160 bpm) by US artist Pharrell Williams would be a particularly good example of a stimulative track. The melodic and harmonic qualities of music will lead to differential

responses in the listener depending on their cultural background and musical upbringing. Westerners, for example, typically associate major-scale melodies and harmonies with positive feelings and happiness. Interestingly, in many Eastern cultures (e.g., Arabic and Persian), minor-sounding melodies and harmonies induce a similar response due to cultural differences in musical composition (Levitin, 2006).

Numerous studies have shown that the personal factors of gender and age moderate one's response to music in performance domains (e.g., Crust, 2008; Karageorghis, Terry, & Lane, 1999; Karageorghis, Priest, Williams, Hirani, Lannon, & Bates, 2010; McCown et al., 1997; Priest, Karageorghis, & Sharp, 2004). For example, in an exercise context, females rate the importance of rhythmic qualities and the 'danceability' of music more highly than males do (Karageorghis et al., 1999). However, males value the importance of cultural associations to a greater extent than their female counterparts (Karageorghis et al., 1999). Also, males report a preference for exaggerated bass tones and this may have to do with the fact that the male voice is generally about one octave lower than the female voice; this difference in voice pitch may account for how sound frequencies are processed by the brain (Priest & Karageorghis, 2008; McCown et al., 1997). In a study that examined members of a health club, it appeared that the younger members generally rated music as being more important to them than older members, additionally preferring contemporary and up-tempo selections (Priest et al., 2004). This finding is consistent with the known role of music in facilitating the formation of a cultural identity during adolescence (Tarrant, North, & Hargreaves, 2001). All age groups consider the churn or variety of music programs to be an important factor (Priest et al., 2004); over-familiarity with a particular piece of music can lead to a decrement in liking (see Berlyne, 1971).

Personality type (e.g., extrovert vs. introvert), musical upbringing—which goes hand-in-hand with cultural background—and hearing acuity are factors that are likely to moderate a performer's response to changes in musical dynamics. For example, if you are an extrovert, who grew up listening to heavy metal music, *and* are hard of hearing, it is unlikely that you will find episodes of soft music beneficial in preparation for a performance that requires engagement of the entire musculature such as sprinting or dancing.

## Consequences of Music Use

Consequences relate to the main responses and outcomes associated with music use in a performance domain. With reference to the literature in this field (see Karageorghis & Priest, 2012a, 2012b for a review), the two strongest and most consistent sets of consequences appear first (psychological and psychophysical) followed by behavioral consequences and finally psychophysiological consequences, which are the least consistent (see Karageorghis, 2015).

Among the psychological consequences, the literature reveals that music can facilitate performers' perceptions of *flow* states (Pain, Harwood, & Anderson, 2011). Flow is considered an elusive state of mind associated with complete absorption in a given task. Athletes and musicians have reported elevated levels of performance as a consequence of being in a state of flow, wherein their execution of the task at hand becomes almost automatic and effortless (Jackson & Kimiecik, 2008; Sinnamon, Moran, & O'Connell, 2012).

Many scientific studies illustrate how the consequences that are displayed in the model can be experienced in unison. In the exercise field for example, the use of well-selected music use can result in more positive affect that is coupled with greater work output (Elliott, Carr, & Savage, 2004; Karageorghis, Mouzourides, Priest, Sasso, Morrish, & Walley, 2009; Karageorghis et al., 2010). Similarly in the medical field, surgeons expend their energy more efficiently and report feeling calmer (anxiety control), when listening to music in operating theaters (Moris & Linos, 2013).

There is a feedback loop from the consequences back to the music factors that influences future selection decisions based on a performer's experienced outcomes. This feedback loop entails reflection on the consequences of music use with reference to the moderators. If an athlete or musician selects pieces of music that lead to positive consequences (see right-hand side of Figure 2), such selections are more likely to be used again and promote the selection of similar pieces (e.g., works by the same artist, in the same idiom or of a similar tempo/rhythmic feel). The converse also holds, wherein the experience of a negative consequence may lead to the deselection of a particular track or others like it.

There is a pronounced link between the intrinsic music factors and responses. For example, the *temporal* or time-related aspects of music such as tempo, rhythm, and meter can have a strong influence on arousal. Contrastingly, aspects such as melody and harmony are particularly important in terms of evoking an emotional response in the listener (Gabrielsson & Lindström, 2010; Juslin, 2013a). One of the central predictions of the conceptual framework is that the influence of music factors on human responses is moderated by a host of personal and situational factors that those working in high-performance domains should consider in how they select music.

## Music Applications in High-Performance Domains

In the remainder of this chapter we will use the theoretical model presented earlier (Figure 2) as a prism through which to explore a range of music-related applications. These applications will focus primarily on the pre-performance use of music, which we deem to be most relevant to the readers of this book (e.g., using music for mental preparation prior to a concert performance). There are, nonetheless, brief sections on the in-performance and post-performance uses of music. The musical examples that are provided are *indicative* and certainly not *prescriptive* given that musical preferences and aesthetics are rather idiosyncratic in nature (Liljeström, Juslin, &Västfjäll, 2012).

## The Application of Pre-Performance Music

In high-performance domains, music can play a pivotal role through forming part of a pre-performance routine and creating a mindset that the individual associates with superior levels of performance. Research has shown that music can have a *priming* effect, which means that it can activate certain thoughts in your mind and influence your motivation toward a particular task without your awareness (Goerlich, Witteman, Schiller, van Heuven, Aleman, & Martens, 2012; Loizou & Karageorghis, 2015; Loizou, Karageorghis, & Bishop, 2014). Thus, pre-performance music can be used to manipulate a performer's psychological state (see 'Consequences' box in Figure 2) and provide a bridge toward their higher purposes and goals.

Research has shown that individuals are largely unaware of the processes that underlie their perceptions, goal pursuits, and behaviors (Hagger & Chatzisarantis, 2014). Given that such processes play a pivotal role in high-performance domains, taking some control over them through the measured application of pre-performance music can facilitate a distinct pattern of thoughts and feelings that lead to a sense of personal mastery and control. Music is known to activate the emotional and movement-related segments of the brain such as the amygdala, temporal lobe, and cerebellum (Chanda & Levitin, 2013; Koelsch, 2010, 2014), and can therefore complement mental preparation in a broad range of performance domains.

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Sidebar 2: Antonio's big stage dream

Antonio is an operatic tenor with major ambitions. Prior to his birth, Antonio's family emigrated from a picturesque village near Naples in Italy to north London in the UK. Antonio's father was a skilled pastry chef who scrimped and saved to open a small bakery. While he worked, he would play his favorite Neapolitan songs in the background; the music conjured fond memories of his homeland and the much-loved relatives he had left behind (see 'Extrinsic Musical Factors' in Figure 2). Sadly, the master baker died prematurely in the early 90s and Antonio's eldest brother was obliged to take over the business. Antonio was just a teenager when his dad passed away but the doleful schoolboy had inherited a strong passion for Italian music. He went on to become one of the best classical singers at the music college in central London where he studied for three years. After graduating from the college, Antonio experienced financial hardship. Despite considerable personal anguish, he gave up trying to be a professional singer, because he could earn much more working for his brother in the bakery.

While at music college Antonio dreamed of joining the musical elite; he idolized the legends of his field such as Luciano Pavarroti and Mario Lanza, and was intent on following in their footsteps. Although he was generally comfortable with small and intimate performances, such as the college's lunchtime concerts or singing at the local Italian church, he was often paralyzed by fear when it came to performing in large concert venues. The nerves were so extreme that Antonio's mouth would dry up, his throat would feel constricted, and his broad frame would be debilitated by severe muscular tension. The impact of the nerves on his

performances was all too obvious with him forgetting his words, losing his timing, and sounding ‘squeaky’ rather than fulsome and well-rounded.

Following graduation, nerves had held Antonio back for over a decade and he had almost grown content with working for his brother and singing in Italian restaurants or at occasional amateur operatic productions. He knew that his voice was much stronger than that of the amateurs who surrounded him—in fact he relished being a big fish in a small pond—nonetheless he retained the fear associated with appearing in the concert halls. Antonio knew that there was a level of irrationality underlying his stage fright but it wasn’t until a chance meeting on the subway with his old singing teacher that he resolved to do something about this.

The teacher advised Antonio to use a recording of his favorite artist performing whatever piece or pieces he was to perform that night – this was to be done *en route* to the concert venue as a type of ‘pre-performance routine’. While listening to the artist, Antonio was to just ‘shadow’ the voice, without pushing vocally, and imagine himself performing in the artist’s body; dominant and totally self-assured on stage. The *skills* required to sing did not change between the small amateur venue and the large professional venue, so why should the mindset change? Hearing his favorite artist and adopting the persona of a Pavarotti or Lanza filled Antonio with unshakeable confidence and he was able to translate that positive mindset into his performances on stage. With this new approach, Antonio’s singing career ascended to a higher plane and a string of paid engagements followed. He still needed to work at the bakery but reduced his hours by half, so that in his mid 30s he had sufficient time to rehearse and rekindle his dream to sing on the big stage.

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Scientists maintain that music has a particularly strong influence on the brain’s unconscious processes (Levitin & Tirovolas, 2009; Scherer & Zentner, 2001). You will recall from the first half of this chapter that well-selected music can enhance how people feel in a general sense (affect), although it bears little influence on their perceived exertion at high exercise intensities (RPE; Boutcher & Trenske, 1990; Hutchinson & Karageorghis, 2013; Karageorghis et al. 2009). To a degree, such findings support the notion that the brain processes music at a subcortical or automatic level without conscious effort. It is precisely this apparent lack of a need for conscious processing that can make music an ideal form of

priming for people who wish to enhance their pre-performance routine. In essence, we do not need to think very much for music to influence our behaviors or how we feel.

Both stimulative and calming music has the potential to prepare people for superior performance. The precise choice of music will depend on an individual's desired mindset: for those riddled with anxiety and, in particular, somatic or bodily-type anxiety (as experienced by singer Antonio in Sidebar 2) the use of calming music can prove beneficial. In contrast, for those who find it difficult to get suitably 'psyched-up' for the big occasion and feel under-aroused, a stimulative selection (see e.g., Sidebar 1) can have the desired effect. This is referred to as *arousal regulation* and represents a psychophysiological consequence of music use (see Figure 2). In some instances, mood maintenance is the key and music that is neither stimulative nor sedative might be used to good effect. The use of music has the potential to influence the various aspects of anxiety. For example, calming music that has strong communal and personal associations (see 'Extrinsic Musical Factors' in Figure 2) can conjure the right type of mental imagery and/or thought processes (heroic images, overcoming adversity, motion-related thoughts, etc.). It may also merely distract us from our inner fears.

At the 2004 Athens Olympics, British middle distance runner Kelly Holmes used the soulful ballads of Alicia Keys such as *Fallin'* and *If I Ain't Got You* as an integral part of her pre-performance routine. Although the music was generally slow in tempo and rhythmically uncomplicated, the uplifting lyrics had an inspirational effect when Holmes was striving to focus on the task at hand and forget about the string of illnesses and injuries that had blighted her preparations. The music also helped Holmes to block out the burden of public expectation that had weighed heavily upon her shoulders. She managed the unprecedented feat, for a British woman, of winning gold medals in both the 800-meter and 1500-meter events.
It is hard to generalize from anecdotal examples such as that of Kelly Holmes given that performers experience anxiety in many different ways. Most people who perform in highly motoric events such as running, throwing, dancing, or weightlifting prefer quite stimulative music with which to prepare mentally. In contrast, those who perform in cognitive performance domains such as music and theatre, public speaking, or open-heart surgery prefer more calming music. When you have to process large amounts of information, engage the memory, or apply fine muscular control (e.g., playing the violin), a calm mental state is associated with superior performance and so the music choices of individuals might reflect this. The point we are trying to make here is that it is certainly not a case of 'one size fits all'

and individual performers will need to engage in some self-experimentation to find out what works best for them. Such experimentation is best done around events that are of lesser importance – never leave experimentation for career-defining events such as an Olympic Games or a solo performance at a major international concert venue.

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Sidebar 3: Olympian Michael Phelps' "listening bubble"

The American swimmer Michael Phelps has won more Olympic medals than any other athlete in history. He clinched six gold medals in the 2004 Athens Games and surpassed that incredible feat with an unprecedented cache of eight golds at the 2008 Beijing Games. He capped his Olympic career and sealed his name in the annals of sporting history with four golds and two silvers in the 2012 London Games. Phelps creates his own pre-competition "listening bubble" and immerses himself in a distinctly 'rapcentric' playlist. The artists Jay-Z, G Unit, and Eminem are among his favorites. On his pre-race playlist for both Beijing and London was the track *I'm Me* by Lil' Wayne, which includes a lyric about being the best and knowing the game so well that he could be officiating it! The tracks that he chooses have a self-affirming and often aggressive quality that serves to reinforce Phelps' desired mindset for the big occasion.

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So what are the characteristics of stimulating and calming music for pre-performance application? Amongst the intrinsic musical factors (see Figure 2), one of the key considerations is tempo or meter. Stimulating music will function to elevate resting heart rate; generally, music with a tempo in excess of 120 bpm is considered stimulative (cf. Karageorghis et al., 1999). Calming music will have a tempo in the range 60-80 bpm and music that is slower than this will have a tendency to send you to sleep (i.e., it is too sedative for high-performance domains). This is because the body's pulses such as heart rate and breathing rate *entrain* to the rhythmical qualities of music and in the instance of music slower than 60 bpm, the cardiovascular system is led toward a level of functioning that is lower than at normal resting levels. Calming music also tends to be rhythmically quite simple; think of slow-tempo classical works by Vivaldi, Handel, and Bach or for more contemporary examples, tracks by new-age artists Enya or Enigma.

Another important characteristic is instrumentation, with stimulative music being characterized by more percussive, often 'harsher' sounds, such as the driving beat of drums and the raucous rhythmic punctuation of electric guitars. Stimulative music also has pronounced bass frequencies or discernible bass lines that might compel the listener to move in time with the music. The instrumentation used in calming music on the other hand, might be comprised of soothing, 'warm' instruments such as strings, clarinet or piano. The key is for the performer to become absorbed in and comforted by the music, so that it eases the anxiety symptoms that they might be experiencing.

## The Application of In-Performance Music

In-performance music is perhaps most applicable to elite athletes who use it as a backdrop for training sessions and for some competitions (e.g., high-jump contests in which each athlete is accompanied by their chosen piece of music). In many other high-performance domains, the nature of the performance—playing an instrument, acting, speaking, etc.—would render the use of music wholly inappropriate. Given the application of in-performance music among athletes, and the fact that there is much that has already been written for this group of performers (e.g., Karageorghis, 2015; Karageorghis & Terry, 2011; Laukka & Quick, 2013; Terry & Karageorghis, 2011), this is a brief subsection that highlights some of the key application principles and provides one example from an endurance sport (see Sidebar 4).

One of the principal considerations in the application of in-performance music is whether to use it synchronously or asynchronously (see 'Task-related' box in Figure 2). The synchronous application takes a little more preparation as movement rates for different intensities of activity need to be established—we normally accomplish this using video analysis—with pieces of music selected and segued in accord with the desired work rate. An effective way to engender an ergogenic effect is to select music that is one or two beats per minute faster than the expected work rate. This promotes a slightly higher-than-expected work rate without any perceptible increase in exertion (see e.g., Lim et al., 2014), and serves as an effective technique for use with recreational and elite athletes alike (Karageorghis et al., 2009, 2010; Simpson & Karageorghis, 2006; Terry, Karageorghis, Mecozzi Saha, & D'Auria, 2012).

Both synchronous and asynchronous music will reduce an athlete's rating of perceived exertion at low-to-moderate work intensities and, if well selected in terms of personal and situational factors (see Figure 2), will also enhance their affective state and cognitions. To maximize the psychological and psychophysical benefits of in-performance music, select tracks with bright, major harmonies, engaging melodic figures, strong rhythmic qualities, and positive lyrical affirmations such as found in the tracks *Harder, Better, Faster, Stronger* by Daft Punk, *Jump To The Beat* by Stacy Lattisaw, or *The Power* by Snap!. An important point to note in the application of asynchronous music is that when a coach is giving instructions, it is best not to use music at all, as it can disrupt one of their essential functions – to apply their expertise in providing feedback to the athlete. Asynchronous music is best used during repetitive and mundane activities that require little verbal instruction such as stretching routines, circuit training, and cardio workouts. For technical sessions, music can be an unwanted distraction.

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Sidebar 4: Cheryl the triathlete

In her chosen discipline of triathlon, Cheryl excels in cycling and running, but is a relatively weak swimmer. This limitation has held her back from major championship success and is a cause of considerable frustration. She makes a concerted effort to improve by swimming at least 10 miles each week in training, a task that is often lonely and arduous with little variation. Cheryl's coach constantly seeks efficiency gains in her unpolished swimming technique. To this end, a key consideration is to relax and not expend excessive energy through unwanted muscular tension. With this in mind, Cheryl uses a waterproof MP3 player in her swimming cap – the *Speedo Aquabeat*. Her musical preferences tend toward soulful ballads and soft, relaxing music (see 'Personal Factors' box in Figure 2). The R&B diva Mariah Carey is her favorite artist. She associates Carey's uplifting lyrics and vocal dexterity over a five-octave span with the physical dexterity that she needs to excel over the triad of events that comprise the triathlon. The warm harmonies that characterize Carey's music create a positive mood while the flowing rhythms and slower tempi help Cheryl to relax and maintain an efficient and regular swimming cadence. The music provides a particular focus on long-duration swims and distracts her from the pain caused by the lactic acid that accumulates in her arms and legs. Sometimes the lyrical content of the music can provide a

significant mental boost and Cheryl feels as though she is being beckoned toward superior performance.

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## The Application of Post-Performance Music

It is a given that all performers strive to give the best of themselves on stage, at the lectern, or in the hotbed of competition. The extreme levels of mental and physical effort that can be observed in high-performance domains necessitate effective strategies for recovery and recuperation. In the elite sport domain, recent literature has attached almost as much importance to recovery schedules as to the specifics of training regimens (Kovacs & Baker, 2014; Lunn et al., 2012; Nédélec, McCall, Carling, Legall, Berthoin, & Dupont, 2012, 2013). Given its ability to entrain bodily pulses, to distract the mind and re-energize the body, the judicious application of post-performance music has the potential to aid recovery and recuperation.

The environment is a central consideration when a performer wishes to relax and unwind (see'Environmental' box in Figure 2). Post-performance music can be easily combined with a sauna, a massage, meditation, yoga, or even a long soak in a hot bath. Similar to calming pre-performance music (60-80 bpm), recuperative music has a slow tempo or meter (60-90 bpm) and is characterized by the sound of warm, soothing instruments; jarring or irritating tracks do not work well where the goal is to calm or sedate. The slightly broader tempo range reflects the fact that in many performance domains the body's pulses are sped up and thus the music will facilitate a gradual and progressive return to resting levels. The inclusion of lyrics is not essential and more a matter of personal preference and situational specificity. For recuperative activities such as yoga or meditation, lyrics may not be desirable so that the level of distraction is minimized allowing the performer to find an inner tranquility. For other types of activities such as a sauna or hot bath, the performer might benefit from the distractive qualities of lyrics and even sing/hum along to maximize the reverie of their experience. Table 1 provides some examples of lyrical recuperative tracks along with some brief analysis.

In sequencing a post-performance music program, it is advisable to fully capitalize upon the principles of *entrainment*, wherein bodily pulses attune to qualities of the music, by beginning with tracks slightly above resting heart rate and ending with tracks slightly below

it. Adopting this approach enhances the relaxation response and heightens the pleasure of the recuperation or recovery session. The optimal duration of a recovery and recuperation session is 30-60 minutes and it is imperative for any potential distractions to be guarded against during this essential 'me time' (agents, managers, coaches, members of the press, phone calls, etc.). This time affords the perfect forum for an activity that is essential for superior performance: reflection. Music can both shape and guide this reflective experience. By way of example, the celebrated British comedian John Bishop whose most recent tour consisted of 26 live performances in a five-week period, describes how the soothing pieces of David Gray's album *White Ladder* help him to relax and unwind. Bishop revealed to the listeners of BBC Radio 4's *Desert Island Discs* "I played this album to death, it's become part of my DNA […] when I'm on tour, it's the thing that sort of eases me down, let's me go to sleep. So I listen to *David Gray* probably two or three times a week, put my headphones on, sit back and snooze and feel comforted" (Young & Bishop, 2012).

Table 1: Sample Lyrical Tracks for Recovery and Recuperation

| Track title | Artist(s) | Tempo (bpm) | Analysis |
|---|---|---|---|
| *Home Again* http://youtu.be/kJ4s3G7hgR4 | Michael Kiwanuka | 88 | This track greets the listener with a rather unusual time signature of 12/8 (twelve quavers per bar arranged in four groups of three). The guitar-led rhythmic structure feels immediately comforting while the rich and soulful voice of Kiwanuka is utterly entrancing. |
| *I've Told You Now* http://youtu.be/K3BLywhPiF4 | Sam Smith | 86 | With a warm guitar-led accompaniment, a tender falsetto vocal, and a harmonic structure that flows over you like a summer breeze, this track lulls you into an ever-calmer state. |
| *Maybe Tomorrow* | Stereophonics | 81 | A simple harmonic structure and |

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|---|---|---|---|
| http://youtu.be/2q9_ZEtuTR8 | | | gravelly vocal delivery ensure that the track is immediately absorbing. The lyrical content is quite uplifting, alluding to an idyllic and optimistic state of mind. |
| *Oblivion* http://youtu.be/VgXOPeobPcI | Bastille | 78 | Cushioned by a gentle piano accompaniment, lead singer Dan Smith showcases his angelic voice. When going into falsetto, Smith's vocal has a particularly soothing quality. |
| *I See Fire* http://youtu.be/mllXxyHTzfg | Ed Sheeran | 76 | The *chanteur de notre temps* at his glorious best; this track pacifies the mind and body with a tender vocal performance over the barest of instrumental accompaniments. |
| *Pachabel: Cannon In D* http://youtu.be/ThFe7Qer9Jk | Laura Wright | 74 | This baroque piece gently guides the heart rate toward resting levels. The articulation of the lyrics has a 'stretchy' quality achieved through a rounded, legato delivery. The harmonies are masterfully overlaid and a gentle ballad-like rhythm holds the track together beautifully. |
| *Don't Leave* https://youtu.be/_iOojt3a1Yw | Faithless | 72 | The defining feature of this track is a wonderful interleaving of male and female vocals. The beat is unashamedly laid back and the rich harmonies nudge the listener toward an ever-deepening state of tranquility. |
| *Clown* http://youtu.be/0OHX_ | Emeli Sandé | 68 | The prodigious Sandé soothes the soul with her popular ballad. The |

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|---|---|---|---|
| PA25Ok | | | vocal tone is breathtaking while the piano-string accompaniment serves as the perfect antidote to the stressors associated with high-performance domains. |
| *If You Wait* https://youtu.be/YjtR_zmMbGE | London Grammar | 63 | A magnificent vocal performance by Hannah Reid is the defining feature of this track. The haunting melody and instrumental simplicity are the keys to its success in facilitating recuperation. The piece might be described as a 'sonic hammock.' |
| *Breathe Me* https://youtu.be/Q0QBzX7zZBw | Sia | 60 | As this ambient track progresses, the listener is eased toward a state of serenity and transcendence. Sia's breathy and somnolent vocals serve to gently caress while transporting you to a land of complete tranquility. |

## Summary and Recommendations

Music-related interventions can be applied in a multitude of ways in high-performance domains (e.g., to promote task-relevant imagery, enhance self-confidence, and curb anxiety). We have presented a conceptual framework (Figure 2) that illustrates the interaction between the musical stimulus, the nature of the individual/s, and a host of situational factors in determining a performer's or group response to music. Importantly, the decision to select the same type of music for future performances is governed by a feedback loop. We encourage performers to experiment with different musical selections at times when the outcome of the performance is not significant, until they ascertain the pieces that work most effectively for them. These pieces can then be applied in preparation for those performances that might be career-defining. This process is analogous to trying on different items of sports apparel or a selection of stage outfits to gauge which makes you feel most comfortable and self-assured.

Music can be used pre-performance as a tool with which to manipulate psychological states. Prior to selecting music, individuals are encouraged to consider their desired mindset for successful performance. Soft, slow music can be used as a sedative and facilitates a calm mental state in performers; such a state is arguably most beneficial for those engaged in tasks that require large amounts of information processing, such as open-heart surgery or the recitation of poetry. Conversely, loud, fast music can be used as a stimulant to increase a performer's level of arousal; such a state is helpful to those who perform highly motoric tasks such as weightlifting or dancing. In addition, music can be used in-performance, either synchronously or asynchronously, although this application is perhaps most relevant to athletes. Used synchronously, music can function like a metronome, as performers can make a conscious attempt to match their movement patterns to the beat, thus enhancing energy efficiency and work output. Used asynchronously, music can lower a performer's perception of exertion and heighten affective states during a given task.

Music has the capacity to entrain movement patterns and the body's pulses without any conscious effort; much in the same way that when pendulum clocks are placed on adjacent walls, the pendulums will, eventually, swing in perfect synchrony with each other. This principle can be applied to many of the functions that music serves. For example, performers are encouraged to consider the post-performance applications, in order to facilitate

recuperation from physically and/or mentally demanding performances. A post-performance music program should commence at ~90 bpm and gradually decrease to ~60 bpm (see e.g., Table 1). Just as gravity pulls at a hot air balloon until it returns safely to the ground, so too can the music's calming pulse entrain a performer's heart rate back toward resting levels.

We hope that by applying the principles outlined in this chapter, you will develop a much fuller understanding of how music can be used in high-performance domains. Performers resemble finely-balanced weighing scales; a seemingly delicate push in the wrong direction can cause the scales to come crashing down. The crash of the scales is perhaps an apt metaphor for the phenomenon of 'choking' that is expounded throughout this volume. We encourage performers to use music in a structured and systematic fashion, in order to help tip the scales slightly in their favor. Music has the capacity to calm or excite an individual performer, unite a seemingly disparate group, stir a wave of enthusiasm in a team under duress, and elevate performance levels. Collectively, such benefits can counter the inevitable consequences evoked in this chapter's titular track: *Under Pressure*.

# REFERENCES


Berlyne, D. E. (1971). *Aesthetics and psychobiology.* New York, NY: Appleton Century Crofts.

Boutcher, S. H., & Trenske, M. (1990). The effects of sensory deprivation and music on perceived exertion and affect during exercise. *Journal of Sport & Exercise Psychology, 12,* 167-176.

Brattico, E., Bogert, B., & Jacobsen, T. (2013). Toward a neural chronometry for the aesthetic experience of music. *Frontiers in Psychology, 4,* 1-21.

Chanda, M. L., & Levitin, D. J. (2013). The neurochemistry of music: Evidence for health outcomes. *Trends in Cognitive Sciences, 17,* 179-193.

Clark, I. N., Taylor, N. F., & Baker, F. A. (2012). Music interventions and physical activity in older adults: A systematic literature review and meta-analysis. *Journal of Rehabilitation Medicine, 44,* 710-719.

Clark, T., Lisboa, T., & Williamon, A. (2014). An investigation into musicians' thoughts and perceptions during performance. *Research Studies in Music Education, 36,* 19-37.

Crust, L. (2008). Perceived importance of components of asynchronous music during circuit training. *Journal of Sports Sciences, 26,* 1547-1555.

Crust, L., & Clough, P. J. (2006). The influence of rhythm and personality in the endurance response to motivational asynchronous music. *Journal of Sports Sciences, 24,* 187-195.

Deutsch, J., & Hetland, K. (2012). The impact of music on pacer test performance, enjoyment and workload. *Asian Journal of Physical Education & Recreation, 18,* 6-14.

Elliott, D., Carr, S., & Savage, D. (2004). Effects of motivational music on work output and affective responses during sub-maximal cycling of a standardized perceived intensity. *Journal of Sport Behavior, 27,* 134-147.

Eysenck, H. J. (1967). *The biological basis of personality.* Springfield, IL: Thomas Publishing.

Fritz, T. H., Jentschke, S., Gosselin, N., Sammler, D., Peretz, I., Turner, R., . . . Koelsch, S. (2009). Universal recognition of three basic emotions in music. *Current Biology, 19,* 573-576.

Gabrielsson, A., & Lindström, E. (2010). The role of structure in musical expression of emotions. In P. Juslin & J. Sloboda (Eds.), *Handbook of music and emotion: Theory, research, and applications* (pp. 367-400). New York, NY: Oxford University Press.

Goerlich, K. S., Witteman, J., Schiller, N. O., van Heuven, V. J., Aleman, A., & Martens, S. (2012). The nature of affective priming in music and speech. *Journal of Cognitive Neuroscience, 24,* 1725-1741.

Hagger, M. S., & Chatzisarantis, N. L. D. (2014). An integrated behavior change model for physical activity. *Exercise and Sport Sciences Reviews, 42,* 62-69.

Hutchinson, J. C., & Karageorghis, C. I. (2013). Moderating influence of dominant attentional style and exercise intensity on responses to asynchronous music. *Journal of Sport & Exercise Psychology, 35,* 625-643.

Hutchinson, J. C., Karageorghis, C. I., & Jones, L. (2015). See hear: Psychological effects of music and music-video during treadmill running. *Annals of Behavioral Medicine, 49,* 199-211.

Jackson, S. A., & Kimiecik, J. C. (2008). The flow perspective of optimal experience in sport and physical activity. In T. S. Horn (Ed.), *Advances in sport and exercise psychology* (3rd ed., pp. 377-399). Champaign, IL: Human Kinetics.

Juslin, P. N. (2013a). From everyday emotions to aesthetic emotions: Towards a unified theory of musical emotions. *Physics of Life Reviews, 10,* 235-266.

Juslin, P. N. (2013b). What does music express? Basic emotions and beyond. *Frontiers in Psychology, 4,* 596.

Karageorghis, C. I. (2015). The scientific application of music in exercise and sport: Towards a new theoretical model. In A. M. Lane (Ed.), *Sport and exercise psychology* (2nd ed., pp. 274-320). London, UK: Routledge.

Karageorghis, C. I., Hutchinson, J. C., Jones, L., Farmer, H. L., Ayhan, M. S., Wilson, R. C., . . . Bailey, S. G. (2013). Psychological, psychophysical, and ergogenic effects of music in swimming. *Psychology of Sport and Exercise, 14,* 560-568.

Karageorghis, C. I., Mouzourides, D. A., Priest, D. L., Sasso, T. A., Morrish, D. J., & Walley, C. L. (2009). Psychophysical and ergogenic effects of synchronous music during treadmill walking. *Journal of Sport & Exercise Psychology, 31,* 18-36.

Karageorghis, C. I., & Priest, D. L. (2012a). Music in the exercise domain: A review and synthesis (Part I). *International Review of Sport and Exercise Psychology, 5,* 44-66.

Karageorghis, C. I., & Priest, D. L. (2012b). Music in the exercise domain: A review and synthesis (Part II). *International Review of Sport and Exercise Psychology, 5,* 67-84.

Karageorghis, C. I., Priest, D. L., Terry, P. C., Chatzisarantis, N. L. D., & Lane, A. M. (2006). Redesign and initial validation of an instrument to assess the motivational qualities of music in exercise: The Brunel Music Rating Inventory-2. *Journal of Sports Sciences, 24,* 899-909.

Karageorghis, C. I., Priest, D. L., Williams, L. S., Hirani, R. M., Lannon, K. M., & Bates, B. J. (2010). Ergogenic and psychological effects of synchronous music during circuit-type exercise. *Psychology of Sport and Exercise, 11,* 551-559.

Karageorghis, C. I., & Terry, P. C. (2011). *Inside sport psychology*. Champaign, IL: Human Kinetics.

Karageorghis, C. I., Terry, P. C., & Lane, A. M. (1999). Development and initial validation of an instrument to assess the motivational qualities of music in exercise and sport: The Brunel Music Rating Inventory. *Journal of Sports Sciences, 17,* 713-724.

Kodzhaspirov, Y. G., Zaitsev, Y. M., & Kosarev, S. M. (1986). The application of functional music in the training sessions of weightlifters. *Soviet Sports Review, 23,* 39-42.

Koelsch, S. (2010). Towards a neural basis of music-evoked emotions. *Trends in Cognitive Sciences, 14,* 131-137.

Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience, 15,* 170-180.

Kovacs, M. S., & Baker, L. B. (2014). Recovery interventions and strategies for improved tennis performance. *British Journal of Sports Medicine, 48,* 1-5.

Laukka, P., & Quick, L. (2013). Emotional and motivational uses of music in sports and exercise: A questionnaire study among athletes. *Psychology of Music,* 41*,* 198-215.

Levitin, D. J. (2006). *This is your brain on music: The science of a human obsession*. New York, NY: Dutton Penguin.

Levitin, D. J., & Tirovolas, A. K. (2009). Current advances in the cognitive neurosciences of music. *Annals of the New York Academy of Sciences: The Year in Cognitive Neuroscience 2009, 1156,* 211-231.

Liljeström, S., Juslin, P. N., & Västfjäll, D. (2012). Experimental evidence of the roles of music choice, social context, and listener personality in emotional reactions to music. *Psychology of Music, 41,* 579-599.

Lim, H. B. T., Karageorghis, C. I., Romer, L. M., & Bishop, D. T. (2014). Psychophysiological effects of synchronous versus asynchronous music during cycling. *Medicine & Science in Sports & Exercise, 46,* 407-413.

Loizou, G., & Karageorghis, C. I. (2015). Effects of psychological priming, video, and music on anaerobic exercise performance. *Scandinavian Journal of Medicine and Science in Sports, 25,* 909-920.

Loizou, G., Karageorghis, C. I., & Bishop, D. T. (2014). Interactive effects of video, priming, and music on emotions and the needs underlying intrinsic motivation. *Psychology of Sport and Exercise, 15,* 611-619.

Lunn, W. R., Pasiakos, S. M., Colletto, M. R., Karfonta, K. E., Carbone, J. W., Anderson, J. M., & Rodriguez, N. R. (2012). Chocolate milk and endurance exercise recovery: Protein balance, glycogen, and performance. *Medicine & Science in Sports & Exercise, 44,* 682-691.

McCown, W., Keiser, R., Mulhearn, S., & Williamson, D. (1997). The role of personality and gender in preference for exaggerated bass in music. *Personality and Individual Differences, 23,* 543-547.

Moris, D. N., & Linos, D. (2013). Music meets surgery: Two sides to the art of "healing". *Surgical Endoscopy, 27,* 719-723.

Nédélec, M., McCall, A., Carling, C., Legall, F., Berthoin, S., & Dupont, G. (2012). Recovery in soccer: Part I – Post-match fatigue and time course of recovery. *Sports Medicine, 42,* 997-1015.

Nédélec, M., McCall, A., Carling, C., Legall, F., Berthoin, S., & Dupont, G. (2013). Recovery in soccer: Part II – Recovery strategies. *Sports Medicine, 43,* 9-22.

Neil, R., Wilson, K., Mellalieu, S. D., Hanton, S., & Taylor, J. (2012). Competitive anxiety intensity and interpretation: A two-study investigation into their relationship with performance. *International Journal of Sport & Exercise Psychology, 10,* 96-111.

North, A. C., & Hargreaves, D. J. (2008). *The social and applied psychology of music.* Oxford, UK: Oxford University Press.

Pain, M. A., Harwood, C., & Anderson, R. (2011). Pre-competition imagery and music: The impact on flow and performance in competitive soccer. *The Sport Psychologist, 25,* 212-232.

Priest, D. L., & Karageorghis, C. I. (2008). A qualitative investigation into the characteristics and effects of music accompanying exercise. *European Physical Education Review, 14,* 347-366.

Priest, D. L., Karageorghis, C. I., & Sharp, N. C. C. (2004). The characteristics and effects of motivational music in exercise settings: The possible influence of gender, age, frequency of attendance, and time of attendance. *Journal of Sports Medicine and Physical Fitness, 44,* 77-86.

Sanchez, X., Moss, S. L., Twist, C., & Karageorghis, C. I. (2014). On the role of lyrics in the music–exercise performance relationship. *Psychology of Sport and Exercise, 15,* 132-138.

Scherer, K. R., & Zentner, M. R. (2001). Emotional effects of music: Production rules. In P. N. Juslin& J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 361-392). Oxford, UK: Oxford University Press.

Sebanz, N., Bekkering, H., & Knoblich, G. (2006). Joint action: Bodies and minds moving together. *Trends in Cognitive Sciences, 10,* 70-76.

Simpson, S. D., & Karageorghis, C. I. (2006). The effects of synchronous music on 400-m sprint performance. *Journal of Sports Sciences, 24,* 1095-1102.

Sinnamon, S., Moran, A., & O'Connell, M. (2012). Flow among musicians: Measuring peak experiences of student performers. *Journal of Research in Music Education, 60,* 6-25.

Stork, M. J., Kwan, M., Gibala, M. J., & Martin Ginis, K. A. (2014). Music enhances performance and perceived enjoyment of sprint level interval exercise. *Medicine and Science in Sport and Exercise, 47,* 1052-1060.

Tarrant, M., North, A. C., & Hargreaves, D. J. (2001). Social categorization, self-esteem, and the estimated musical preferences of male adolescents. *The Journal of Social Psychology, 141,* 565-581.

Terry, P. C., & Karageorghis, C. I. (2011). Music in sport and exercise. In T. Morris & P. C. Terry (Eds.), *The new sport and exercise psychology companion* (pp. 359-380). Morgantown, WV: Fitness Information Technology.

Terry, P. C., Karageorghis, C. I., Mecozzi Saha, A., & D'Auria, S. (2012). Effects of synchronous music on treadmill running among elite triathletes. *Journal of Science and Medicine in Sport, 15,* 52-57.

Young, K. (Presenter), & Bishop, J. (Guest). (2012, June 24). In L. Buckle (Producer), *Desert island discs*. London, UK: British Broadcasting Corporation, Radio 4.