REGULATING PRE-PERFORMANCE PSYCHOBIOSOCIAL STATES WITH MUSIC

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To future students who read this, I have one piece of advice, READ!

"The more that you read, the more things you will know. The more that you learn, the more places you'll go" – Dr Seuss

ABSTRACT

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The present study aimed to investigate the effects of music on swimmers' pre-performance psychobiosocial states. We involved a purposeful sample of competitive swimmers (N = 17) in a 5-week intervention grounded in the individual zones of optimal functional (IZOF) model. Multiple findings were revealed. The first showed that pre-performance psychobiosocial states were predictive of subsequent performance. This was revealed by a high number of significant differences found between best and worst performance across modalities. Second, swimmers improved their ability to regulate pre-performance states through the use of music. This was shown through evidence that no significant differences were found across modalities between best and worst performance for experimental group swimmers, while significant differences existed for control group swimmers. The third major finding was that the use of music had a positive impact on swimmers' perceived effectiveness of pre-performance routines. This was revealed by a significant difference being found between experimental and control group swimmers on a subjective rating of pre-performance routines in time trials one and four. Furthermore, swimmers' qualitative reports indicated that music use was made more purposeful due to the introduction of a music intervention. Also found was that the two main types of music used were classified as 'pump-up' and 'motivational'. The current study provides preliminary evidence in support of the use of music during pre-performance routines to enhance the athletes' performance states. Athletes are encouraged to engage in the process of carefully selecting music in accordance with previously delineated optimal individualized performance related state profiles.

Keywords: emotions, IZOF model, music, pre-performance routines, swimming

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ABSTRACT

1 INTRODUCTION

Since the dawn of time humans have combined sounds together in order to create different forms of music. The creation of music has often been conducted in order to have an effect on those listening to it (Karageorghis & Terry, 2011). Through research into this effect it has often been concluded that the impact felt occurs at an individual level, with music often eliciting emotional responses which have in turn been accompanied by changes to one's physiological and cognitive state (Mas-Herrero, Marco-Pallares, Lorenzo-Seva, Zattore, & Rodriguez-Fornells, 2013). This effect has more recently become more closely scrutinised by sport psychology researchers as the popularity of music use during training and prior to performance has blossomed. This increase in popularity is no more evident than when watching a major multi-sport event such as the Olympics. In fact it has become so popular that the 2012 Olympic organising committee developed uniquely themed playlists for a variety of sports (Bishop, Wright, & Karageorghis, 2014).

The use of music within sport generally occurs through three main ways, either synchronously or asynchronously during performance or prior to performance. Due to the limiting of music use *during* performance by many sporting federations (e.g. IAAF) *pre-performance* music use is the most logical use of music to be studied in relation to its direct impact on performance in competition (Karageorghis & Terry, 2009). Perhaps surprisingly, this method of music use is also the one which has received the least amount of attention in previous research. However what has been acknowledged is that pre-performance music does have the ability to manipulate activation states, facilitate imagery, promote flow, enhance self-confidence, and elicit greater activation of the visuomotor areas of the brain. These effects all have also been known to continue to rise after finishing listening to music (Bishop, 2010; Karageorghis & Terry, 2009).

This evidence for the ability of music listening to elicit a positive impact prior to performance has intrigued sport psychology practitioners in their search for evidence based methods and strategies to promote to athletes for use in pre-performance routines (e.g., Bertollo, Saltarelli, & Robazza, 2009; Terry et al., 2006). Bishop (2010) in a review of research on pre-performance music use suggested that the next step for research to take was to examine how music could be used to help athletes consistently

bring about performance-enhancing emotional state profiles. This suggestion took into account previous research from Hanin (2000b, 2004, 2007) who proposed the individual zones of optimal functioning (IZOF) model (Hanin, 2000a) based on evidence of a relationship between an athlete's pre-performance psychobiosocial state and subsequent performance.

2 LITERATURE REVIEW

2.1 Emotion-Performance Relationship

The need to understand how to aid athletes in their pursuit of optimal performance has led to great interest in the study of the emotion-performance relationship. This understanding was initially sought through examining the relationship between anxiety and performance (see Jones, 1995). However, this avenue of research was criticised for its narrow focus and resulted in the promotion of research into the broader spectrum of the emotion-performance relationship (see Jones, 2003). While there is still no clear consensus definition for the term emotion, a traditional conceptualisation is that emotions are a product of the relationship between a person and the environment which surrounds them (Deci, 1980). An alternative approach has been to examine emotions as an experience. This experience is the product of a person's actions and reactions to the environment, their appraisal of their position within the environment and how this position relates to their goals associated with the situation they are in (Ruiz, Hanin, & Robazza, 2016). In relation to performance three types of experience are common: state like (situational), trait like – relatively stable, and meta-experiences (a person's awareness of and attitude towards these experiences). This process is inherently individualistic and dependent on the multidimensionality of the experience, i.e. form, time, content, context and intensity (Hanin, 2000a, 2004, 2007; Jones, 2003; Lazarus, 2000). Lazarus (2000) proposes that the focus should be on the ongoing process of this relationship rather than the structure. The focus then becomes on unfolding state of a person rather than on the more stable trait like qualities of the person. One model which proposes a unique approach to examining this relationship is Hanin's (2000) individual zones of optimal functioning (IZOF) model.

2.2 Individual Zones of Optimal Functioning (IZOF) Model

The individual zones of optimal functioning (IZOF) model proposed by Hanin (2000a) calls for a more multidimensional approach to understanding the emotion-performance relationship. The aim of the model is to provide a framework to help

describe, predict and better understand the emotion-performance relationship, information which in turn helps to inform and develop interventions to be used with elite athletes.

The model is based on four major features highlighted by the acronym which makes up its name. In contrast to previous theories (i.e. the inverted-U hypothesis, drive theory) the model is based on an idiographic approach, in which the focus is on *individual* patterns and structures of emotional experiences, as well as meta-experiences developed in relation to performance. The individual nature of athlete's experience has been shown in the individual nature of psychological factors present in Olympic champions (Gould, Dieffenbach, & Moffett, 2002). The second feature of the model is the in-out of *zone* premise for optimal and dysfunctional intensities associated with an experience. Optimal and Suboptimal zones of intensity, relative to separate modalities of one's state, are developed through an analysis of individual successful and unsuccessful performances. Current intensity zones are then evaluated in relation to these previously established zones. The third feature of the model refers to focus on *optimal* emotional patterns and intensity levels rather than preferred emotional patterns. The difference between these two is that an optimal functional state tends to include both pleasant and unpleasant emotions, dependent on the individual. The recognition and inclusion of unpleasant emotions in an optimal functional state makes it different to approaches which promote an 'ideal' or preferred state (i.e. 'flow'), which generally only account for positively toned emotions (Hanin, 2004). The final feature of the model details the emphasis which it places on that the model is a tool to understand the *functioning* of the athlete in relation to performance. Optimal performance is manifested in the athlete's ability to effectively recruit and use available resources, in contrast to dysfunctional performance which reflects an inability to do this effectively.

The IZOF model is also based on a number of basic assumptions which stem from the underlying notion that emotion is a component of responses, both adaptive and maladaptive, which occur in the person-environment relationship (Hanin, 2000a; Lazarus, 2000). The first of these is that emotions are triggered by a person's cognitive appraisal of the probability that they will achieve personal goals associated with situation they are in. The second assumption is that due to sports repetitive nature, performance and emotions patterns will develop. As these patterns develop the next assumption that is made is that these patterns will be specific to the individual, task and

setting and that this specificity is reflected in changes to the various dimensions (form, content, intensity, time and context) of the athlete's psychobiosocial state. The development of these patterns occurs in a bi-directional relationship with the surrounding environment. In essence this refers to the ability to the environment to have an impact on an individual, but also for that individual to have an impact on the environment, resulting in a dynamic process which is constantly unfolding. The final assumption is that emotion needs to be seen as a multi-dimensional concept. Since different emotions can be impacted differently by the environment as well as have differing effects on the performance process it is the interaction of these emotions which must be assessed (Hanin, 2000a, 2004).

This multidimensional approach to the emotion-performance relationship is also reflected in the five basic dimensions which can be used to describe the relationship as well as one's psychobiosocial state. The first of these dimensions is the *form* in which the experience manifests itself. The form in which this can occur in one of the eight modalities which can be used to describe one's psychobiosocial state, used to describe nearly the entire performance state. These modalities include: cognitive, affective, motivational and volitional modalities which represent the psychological aspect of the state; bodily-somatic and motor-behavioural modalities which represent the biological aspect; and, operational and communication modalities which represent the social aspect of the state (Hanin & Ekkekakis, 2014; Ruiz, Hanin, & Robazza, in press). The second dimension, *content*, is used to provide a qualitative description of each modality within the psychobiosocial state. This dimension is used to describe each modality in terms of its functionality (optimal-dysfunctional) and in relation to emotional content its perceived hedonic tone (positive-negative). Therefore each modality can be described in by a functional or dysfunctional descriptor and additionally emotion be described in four ways:: pleasant and functionally optimal (P+), pleasant and dysfunctional (P-), unpleasant and functionally optimal (N+) and unpleasant and dysfunctional (N-). Descriptions of these modalities can also include information as to its perceived facilitative or debilitative impact and how relevant or irrelevant that modality is to the task. The third dimension of a modality, its *intensity*, is used as a quantitative descriptor. The measuring of the intensity is conceptualised in this model using the in-out of zone feature. The IZOF model proposes that each individual functions optimally when each emotional (and non-emotional component) of the state is perceived as being felt within

an optimal intensity zone. This concept also extends to dysfunctional zones of intensity for each separate component of the state. These zones are formed from previous experiences and current performance is predicted in reference to one's current state in relation to these zones. These zones of functioning are formed for specific moments in time, which is reflected in the fourth dimension of this experience, *time.* This dimension reflects the time, in relation to performance, at which these experiences occur. Most research has focused on pre-competition emotional experiences, but these may not be sufficient in understanding performance outcomes, particularly in long duration events or team sports. The final dimension used to understand one's state is that of the *context* or the environment characteristic of the state and refers to all characteristics pertaining to situation the person is in, including interpersonal and intrapersonal dynamics within that situation (Hanin, 2000a).

Using these features and dimensions to develop an understanding of one's psychobiosocial state, the IZOF makes a number of predictions based on the relationship between this state and performance. The first of these predictions is that as the number of experiences the athlete encounters increases the more stable the pattern of emotions becomes. The stability of this pattern is also determined by the athlete's awareness of their emotions, hence the approach being more applicable to elite athletes who are generally more aware of their emotional state during performance. The second is that optimal performance can be expected, or is more likely to happen, when an athlete's psychobiosocial state, in terms of the intensity of perceived modalities, is close to previously established optimal performance zones of intensity and far from previously established dysfunctional zones of intensity. (Hanin, 2000a).

2.2 Psychobiosocial States

The above section details a model which proposes a framework which can be used to understand the emotion-performance relationship. The reader may notice, however, that the term *psychobiosocial state* is also dominant within the section. While previous research has largely focused on the emotion-performance relationship Hanin (2000a) proposed that emotions were a component of an athlete's psychobiosocial state. He defined this psychobiosocial state as "a situational, multimodal and dynamic manifestation of total human functioning" (pp. 739). In the same book, Lazarus (2000) in his discussion on how emotions influence performance noted that an athlete's emotional state was often linked with their physiological and psychological state. In the

above section the multidimensional approach to the form dimension of one's state reflects this psychobiosocial state approach. The following are brief definitions of each modality proposed to be within this state (Ruiz, Hanin, & Robazza, 2016):

Cognitive: the attentional processing component of the state. Included in this is an athlete's ability to concentrate, be alert and the ability to allocate the necessary attention and mental effort to relevant stimuli within the situation.

Emotion (Affect): emotion, within this conceptualisation, is seen as an organised psychophysiological experience which reflects the past, ongoing, and/or anticipation of future person-environment interactions. These interactions can occur through the predominance of a person over the environment, a balance between the person and environment, or the predominance of the environment over the person.

Motivational: the goal setting phase of the motivational state which comes before any action conducted towards the goal. This component reflects people's appraisal of a situation, its benefits and drawbacks, and all process which occur before taking action.

Volitional: the second component of the motivational process. This component of the state is reflected in a person's actions towards attaining a goal, including any self-regulation involved in initiating and maintaining actions until the goal has been attained.

Bodily-somatic: biological and/or psychophysiological components of one's state which are often related with emotion. This may be reflected in general feelings such as tension, relaxation, and/or feelings associated with specific body parts.

Motor-Behavioural: this component refers to an athlete's perception of their coordination and movement.

Operational: an athlete's perception of how effective their actions or task execution is at that moment in time.

Communicative: reflected in interactions between the athlete and those around them in relation to the execution of a task.

The conceptualisation of one's state as being manifested in multi-dimensional form has received substantial support in previous findings (Ruiz, Raglin, & Hanin, 2016). This interaction of emotions with other aspects of one's state has also been recognised by

researchers outside of the IZOF realm. In 2012 in an expert statement the British Association for Sport and Exercise Sciences (BASES) acknowledged the role that emotions played in influencing one's motivation and that emotion could be encompassed through physiological, cognitive and behavioural responses (Lane, Beedie, Jones, Uphill, & Devonport, 2012).

2.3 Psychobiosocial State Regulation

The aim for Hanin (2000a) in proposing the IZOF model was to introduce a framework which could be used to inform the future development of interventions and regulation strategies for use within elite sports. Due to the relatively new development of research into the psychobiosocial state, this research has largely focused on regulation of the emotional state. One of the first to show that using an IZOF based approach could be successful was Annesi (1998) who used the model to develop and evaluate the impact of psychological skills training programs to treat pre-competitive anxiety. To promote the use of the model in applied work Hanin (2000c) proposed an individualised emotion profiling (IEP) procedure. This procedure was based around developing an athlete's *awareness* of their emotional state. This procedure was detailed in his book, Emotions in Sport (2000), in which he provided forms which could be used to guide this process. Since its proposal this procedure has been used in a number of applied research studies and shown that it is an effective approach to use within high achievement sport (Robazza, Pellizzari, & Hanin, 2004), on an individual basis with a runner over a number of competitions (Woodcock, Cumming, Duda, & Sharp, 2012), and in work during a competition season with golfers (Cohen, Tenenbaum, & English, 2006). These studies have also shown that visual representations of optimal and suboptimal zones of functioning can be used to increase awareness (Woodcock, et al., 2012), as well as providing further support for the need to use this procedure on an individual basis (Robazza, et al., 2004).

Also found in IZOF based research is that the approach can be used in order to target multiple modalities of the psychobiosocial state. Robazza and colleagues (2004) in their study with multiple elite athletes found that self-regulation techniques could be used to target multiple psychobiosocial state modalities and that improved psychobiosocial states were related to improved performance. In 2012 Woodcock and colleagues in their study with a runner over a number of competitions found that the individualized procedure could also be used for non-emotional cognitive and

physiological modalities. Finally Bertollo, Saltarelli and Robazza (2009) in a study conducted with elite pentathletes found that through the use of pre-performance routines athletes were in the habit of regulating multiple aspects of the psychobiosocial state and not merely their emotional state.

2.4 Pre-Competition Routines

In elite sport one method through which athletes regulate their psychobiosocial state is through the use of a pre-competition routine. Through an examination of successful Olympic athletes, Gould, Eklund and Jackson (1992) found that medallists were characterised by their use of a systematic pre-performance routine which was used consistently and adhered to throughout a competition. These athletes perceived their pre-performance routine as paramount to their success and could often pinpoint deviations from this routine prior to an unsuccessful performance. Ten years after this study in a follow up with more recent Olympic athletes, Gould et al. (2002) found that Olympic athletes were characterised by their ability to regulate their arousal level, emotions and attentional focus. Unsurprisingly the use of a well-developed routine and plan has therefore been associated with the achievement of peak performance (Williams & Krane, 2001).

When athletes do employ a pre-performance routine it is often designed with multiple aims in mind. Aims of a pre-performance routine often include the regulation of arousal level, motivation, concentration, confidence, focus, as well as multiple components of their emotional and/or mood state (Bertollo et al., 2009; Gould et al., 2002; Terry, Dinsdale, Karageorghis, & Lane, 2006; Williams & Krane, 2001). In order to achieve these multiple aims athletes' pre-performance routines are often very idiosyncratic in nature aimed at attaining their individual optimal psychobiosocial state (Bertollo, et al., 2009). In a study conducted with elite athletes competing in the pentathlon Bertollo et al. (2009) found that athletes believed that there were three main aims for preparation strategies: emotional control, mental practice, and pre-competitive routines aimed to regulate physiological and communicative aspects of their state. In order to accomplish these three aims athletes are known to employ a variety of techniques and strategies through their own individual approach. This idiosyncratic approach to pre-performance routines is reflected in IZOF based studies which focus on developing athlete's ability to regulate their psychobiosocial state. Robazza et al. (2004) developed strategies and techniques which athlete's already used, arguing that these best

matched what the athlete needed and would more effective than practitioner selected techniques. These techniques and strategies often include various forms of relaxation techniques, imagery, self-talk, physical activation exercises, dissociating techniques and music listening (Robazza, et al., 2004; Terry, Dinsdale, Karageorghis, & Lane, 2006).

2.5 Music Use in Sport and Exercise

With the giant strides made in technological advancements made in the past decade and a half (the first IPod was released in 2001) the use of personal music devices has increased tremendously. This has resulted in the act of music listening becoming a highly individual experience (Hutchinson & Karageorghis, 2013) and a popular technique to use in the regulation one's affective state, both within sport (Terry, et al., 2006) and outside of sport (Saarikallio, 2012). Music use within a sporting context has become so popular that it has become rare to enter into either context and not see someone with headphones plugged into their ears. As this popularity has increased research into understanding its impact has also increased, primarily through three main types of effect: psychological, psychophysical and ergogenic. Psychological effects refer to the effect of music on one's affective states, cognition and behaviour. Psychophysical effects of music refers to the perception of perceived physical effort and is often tied in with psychophysiological effects which refers to the impact of music on physiological functioning, measured in through variables such as heart rate and blood pressure. The ergogenic effect of music refers to its effect on work output, in terms of power, endurance, productivity and strength (Karageroghis & Terry, 2009).

In the sporting context athletes generally try to use music in three main ways, two which entail the use of music while engaged in the physical activity and one in which music is used prior to being active or engaged in performance. The use of music while engaged in performance can occur through the use of asynchronous or synchronous music. Asynchronous music refers to music which is played in the background in order to make the context more pleasurable but is not used by athletes to consciously synchronise with movement patterns, i.e. the playing of music during a basketball game. Synchronous music refers to the use music which is listened to by athletes wanting to synchronise their movement patterns with the rhythmic or temporal patterns of the music, one of the most famous examples being the use of the song Scatman by Haile Gebrselassie in his smashing of the 2000m indoor world record. The

use of music prior to a performance is known as pre-task music and is most often used by athletes to regulate their arousal levels and affective state.

2.6 Impact of Music on Pre-performance Psychobiosocial State

While there has been interest in athlete's use of pre-performance music for over 20 years (Gluch, 1993) it has still received limited attention (Bishop & Karageorghis, 2009) but as it becomes evident that it is most often the most popular reason for music use by athletes (Laukka & Quick, 2011; Terry & Karageorghis, 2007) this is starting to change. This shift is perhaps aided by the fact that many elite athletes can be seen using music prior to performance, no more famous than Michael Phelps, the most decorated Olympian of all time, who is famous for having his headphones in until moments before every big race. As research has increased music has shown to have an impact on multiple modalities of an athlete's state (Bishop, 2010; Karageorghis & Terry, 2009). The following sections provide a brief detail of findings associated with each modality of an athlete's state music has been found to have an impact on.

2.6.1 Impact of Music on an Athlete's Emotional (Affective) State

One of the main ways in which music impacts an athlete prior to competition is through its effect on their emotional state. Music's effect on emotion has been greatly researched both within and outside of the sporting context. What has been suggested is that emotional responses to music stem from two broad sources (Karageorghis & Terry, 2009; Sloboda & Juslin, 2001). Intrinsic sources of a song refer to the structural characteristics of a piece such as its tempo, volume, melody and harmony. These *intrinsic* sources of emotion often help regulate the intensity at which the emotions are felt and manifest themselves through bodily or behavioural action tendencies. They occur due to creation, maintenance and disruption or confirmation of musical expectations. Extrinsic sources of emotion within a musical piece come in the form of iconic or associative sources of emotion. Iconic sources of emotion occur when the music resembles an event or agent which carries an emotional tone, i.e. rain drops or a door slamming. Associative sources of emotions occur when a relationship exists between the music and an associated, often non-musical, emotional message or memory. Often time's people associate a piece of music with a particular event or time in their life, and so any time they listen to the song memories of this time are triggered. These associations can also have a cultural basis and be common to specific population of people, for example listening to 'Eye of a Tiger' would trigger an associated emotion

for any person who has seen the movie series Rocky. These sources of emotion are often stronger determinants of the *content* of emotions felt, as well as the perceived experience of these emotions as pleasant or unpleasant (Sloboda & Juslin, 2001).

Due to focus on emotional regulation with sport psychology literature, the use of music as a pre-performance strategy has often been studied with this aim in mind. One such study was conducted with youth tennis players (Bishop, Karageorghis, & Loizou, 2007). Through this grounded theory research it became apparent that there were four main factors which helped to determine the emotive quality of a piece of music: extramusical associations, popularity of the song with friends and peers, popularity of the song within the larger cultural context (i.e. film soundtracks, music videos, etc.) acoustical properties, and identification with the artist or lyrics of the song. Every athlete within the study was found to use music in order to manipulate their emotional state, although the music which they chose to use for this purpose was highly idiosyncratic. One common theme in song choices though was that many were chosen for their extrinsic sources of emotion and all were chosen to promote a positive emotional state. In a more applied approach Lane, Davis and Devonport (2011) studied the effect of a music intervention on runners' emotional states and performance. This study found that music could be an effective emotion regulation strategy but that for this to occur participants had to be aware of the emotions they would likely encounter and how these emotions could impact their performance. They also proposed that the impact of music on one's emotional state did not only occur through the actual listening to music but also through the process of selecting of music to listen to. The effect of music on emotion has also received some initial support from findings within research conducted using neuroimaging techniques. In a study conducted with tennis players listening to highly arousing auditory stimuli evidence was found for activation within the subcallosal cortex, the area of the brain responsible for the processing of emotion (Bishop, Wright, & Karagoerghis, 2014). Findings outside of sport have also found evidence of music's effect on one's neocortex functioning as well as other emotion-processing limbic structures such as the amygdala. The evidence for these findings has been so extensive that music is now used in the investigation of emotion processing physiology (Bishop, 2010). What is interesting is that research ranging from Gluch's (1993) initial look at the use of pre-performance music to Bishop et al.'s (2007) study with tennis players, has only examined the use of music to promote and recruit

positively toned emotions. An avenue of future research may be to assess the viability to also inducing functional but negatively toned emotions, something which music has shown the ability to do outside of the sporting context (Sloboda & Juslin, 2001).

2.6.2 Impact of Music on an Athlete's Cognitive State

In studies conducted which have examined athlete's use of music, the use of it to 'get in the zone' or to achieve appropriate mental focus is often highlighted as one of the main reasons for its use (Bishop, et al., 2007; Laukka & Quick, 2011; Terry & Karageorghis, 2007). In one of the first studies to look at athletes use of pre-performance music Gluch (1993) found that music use could be broken down into two main purposes, its use in the regulation of one's emotional state (see above) and as a tool to aid in the regulation of one's cognitive state.

Music was used by athletes in their mental preparation for performance as well as in the initiation of memories associated with performance. This initiation of memories resulted in the recall of both sport and non-sport related experiences; however athletes tended to use music to recall memories associated with past performances. This recall of memories was most likely associated with another aspect which music was also used for, the initiation of imagery, which was the most common mental preparation strategy athletes linked music with. Due to evidence that imagery can facilitate improved performance (Vealey & Walter, 1993) the combination of music and imagery has been studied on numerous occasions. While imagery has been found to have the power to initiate imagery (Bishop, et al., 2007) findings in studies looking at link between the combination of imagery and music and impact on performance have proved to be inconclusive (Dorney & Goh, 1992; Pain, Harwood, & Anderson, 2011).

Another cognitive strategy which athletes may use music to initiate is to dissociate oneself from the situation they are in. Evidence of the use of music as a dissociative cognitive technique has been found within an exercise setting, in which exercisers use music to dissociate themselves from unpleasant stimuli associated with the exercise (Elliot, Carr, & Orme, 2005; Hutchinson & Karageorghis, 2013).While this strategy has not been specifically examined within the sporting context evidence does support the notion that athletes also use music to aid in dissociating from negative thoughts and feelings prior to performance (Bishop et al., 2007; Gluch, 1993).

2.6.3 Impact of Music on an Athlete's Motivation and/or Volition

As with the previous two modalities, impacting one's motivational state is also a popular reason for pre-performance music among athletes (Bishop et al., 2007; Gluch, 1993). In an exercise context current research suggests that the use of music may significantly affect a person's experience resulting in an increased likelihood of adopting and adhering to an exercise regimen (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006). Factors which play a role in the motivational aspect of a piece of music are proposed to be rhythm response, musicality, cultural impact and association, with impact factor occurring in a hierarchical structure (rhythm response playing the most important role and association the least). In this case rhythm response refers to the rhythmical elements of a piece of music (i.e. tempo), whereas musicality refers to pitch-related elements of the music such as melody, the tune, and harmony, how the notes are combined. Cultural impact refers to how popular the song is in the cultural context the individual is in and association refers to any extra-musical thoughts, feelings and images which may be provoked by the piece of music (Karageorghis, et al., 2006). The concept of motivational music has been more popular within research conducted in an exercise context, resulting in the development of a psychometric tool to measure the motivational quotient of a piece of music, the BMRI-2 (Karageorghis, et al., 2006). While the predecessor to this measurement, the BMRI (Karageorghis, Terry, & Lane, 1999), was intended to be used with both exercise and sport contexts, it has received little attention since its development.

2.6.4 Impact of Music on Athlete's Bodily-Somatic State

When Gluch (1993) conducted what is perhaps the first study to look at the use of pre-performance music the regulation of arousal levels was found as the predominant reason for athletes use of pre-performance music. Almost twenty years later Laukka & Quick (2011) in a survey of 252 Swedish athletes found the same result; the number one reason for athlete's use of music within sport was for pre-event activation or to get 'pumped up'.

Perhaps due to this popularity, as well as the ability to measure this impact in an objective manner, research into this construct has also been popular. In one of the first studies to look at this construct Dorney & Goh (1992) tested the effect of slow and fast tempo music on a person's rate while performing a dart throwing task. While results did not show any difference in performance both types of music were found to lower the

participant's heart rate. In a study conducted within a naturalistic sport setting the opposite of this result was found. This study which examined volleyball player's use of music during their warm-up time results showed that when music was listened to players heart rates were significantly higher. However, only fast tempo 'arousing' music was used in this study excluding the possibility to know whether a difference would have been found if a condition using slower tempo music had also been conducted (Eliakim, Meckel, Nemet, & Eliakim, 2007).

The use of fast and slow tempo music has also been shown to have differing effects on a person's epinephrine concentration levels. In a study conducted on the use of music during supramaximal cycling performance slower music was found to decrease the concentration level of plasma norepinephrine, while fast tempo music was found increase plasma epinephrine concentration levels. The differing findings suggest that music could be used to have an impact at the physiological level to either increase or decrease an athlete's somatic stress level (Yamamoto, Ohluwa, Itoh, Kitoh, Terasawa, Tsuda, Kitagawa, & Sato, 2003).

With technological advances in equipment to examine neural changes, music use has also been examined while being used during a reactive task. The music chosen to be listened to prior to this task was a popular track chosen by the researchers, listened to at 3 different tempi and 2 different volume levels. All music types resulted in a greater activation of the auditory cortex, with music played at a higher intensity eliciting the greatest activation. Also found was that this effect lasted beyond the period of music listening and into the subsequent choice reaction time performance (Bishop, Wright, & Karageorghis, 2014).

2.6.5 Impact of Music on Athlete's Motor-Behavioural State

One area which requires more attention within the literature is music's ability to impact an athlete's motor-behavioural state. Evidence has been found of music's capability to impact an individual's behaviour and action tendencies (Scherrer & Zentner, 2001) which indicates that this could be one are for future research to focus on.

2.6.6 Impact of Music on Athlete's Operational State

Very little research has been conducted into the effect of music on athlete's perception of the effectiveness of their actions or task execution. Perhaps most relevant is research into athlete's performance on performance tasks within a laboratory setting.

One such study found that listening to music elicits no change in performance on a reactive task. However, higher intensity music was found to yield improved performance in contrast to medium intensity music (Bishop, Karageorghis, & Kinrade, 2009). Arousing music, assumed to be similar to higher intensity music, has also been found to have a positive effect on performance in a 30 second Wingate test (Chtourou, Jarraya, Aloui, Hammouda, & Souissi, 2012). Other results have found that both motivational and oudeterous music have the ability to increase performance in a sub-maximal cycle performance test (Elliot, Carr, & Orme, 2005), as well as a stationary bike performance (Becker, Brett, Chambliss, Crowers, Haring, Marsh, & Montemayor, 1994).

2.6.7 Impact of Music on Athlete's Communication State

The use of music is often a highly individual experience (Hutchinson & Karageorghis, 2013) and due to this there is very little research into its impact on an athlete's communicative state. One study conducted within a team sport setting looked to provide a qualitative analysis of coach's perceptions of pre-performance music use. Music within this study was used by athletes by being played over a public address system while they warmed up prior to a match. Perhaps counter to what might be expected these coaches found that the use of music during this warm-up period had a positive impact on athletes, including increasing team cohesion. Key to this impact was the process of creating the music playlist as a team exercise (Yeats & Smith, 2011).

2.7 Mixed Methods Embedded Design: Embedded Experimental Model

Historically science has been conducted using one of two methodological designs, either quantitative or qualitative. During the mid-20th century a new method of research began to intrigue researchers, one which integrated both designs, opening up a vast array of new opportunities (Sieber, 1973). Since the acknowledgement of this third method of research and the rise in popularity in its use the need to understand its construct has become increasingly important. This has been made more difficult by the variety of ways in which it has been labeled, 'multimethod/multitrait research', 'quantitative and qualitative research' to name two. Creswell and Plano Clark (2007) acknowledged these alternate labels but proposed that mixed methods research perhaps best encompassed the research being done using this style of methodology. Under this assumption they provided the following definition for mixed methods research:

Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collecting, analysing and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone (Creswell & Plano Clark, 2007, pp. 5).

In the current study an embedded experimental model was employed. This is the most commonly used variant of the embedded design and is based around complementing an established quantitative experimental methodology with a qualitative dataset. This occurs with qualitative data collection occurring before, during, or after the collection of quantitative data (Creswell & Plano Clark, 2007). Figure 1 details the design in which qualitative data was collected both during and after the intervention.

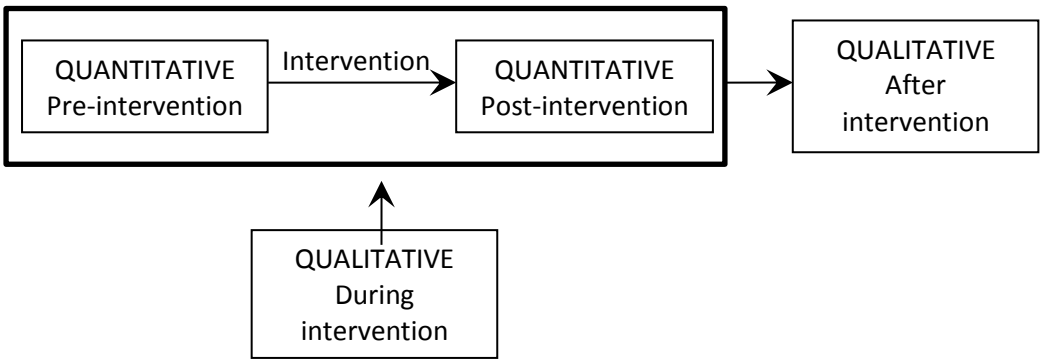

Figure 1

3 PURPOSE OF THE STUDY

This exploratory study aimed to describe the effectiveness of self-selected pre-performance music on the regulation of swimmers' psychobiosocial states. We hypothesised that: (a) pre-performance psychobiosocial states could be used to help predict subsequent performance; (b) swimmers would improve their ability to regulate pre-performance psychobiosocial states through the use of purposefully created pre-performance music playlists; (c) the use of pre-performance music would have an impact on swimmers' perceived effectiveness of pre-performance routines. In addition, this study explored beliefs or meta-experiences swimmers developed in association to

pre-performance music use and its impact on pre-performance psychobiosocial states and performance.

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