The Art and Science of Music Interventions in Sport and Exercise

Conceptual Approaches to the Application of Music in Sport and Exercise
There have been a number of attempts to develop conceptual frameworks to guide researchers and practitioners interested in music applications in the domain of sport and exercise. The purpose of this paper will be to outline these conceptual approaches, delineate the underlying mechanisms responsible for the effects of music, and present the main trends that have emerged in empirical research. Such trends might serve to guide the construction of evidence-based music-related interventions. Three principal applications of music will be expounded: First, pre-task music that entails the use of music *prior* to a task – most often as a type of mild stimulant or sedative; second, in-task music that entails the use of music *during* exercise and can be applied in two forms – *asynchronously* when it is played in the background without any conscious attempt by the performer to synchronise their movements with its rhythmical qualities, and *synchronously* when conscious synchronisation does take place; third, post-task music wherein music is used *after* sport or exercise activity to aid recovery from physical fatigue or injury. This paper will provide a general overview of this field of scientific endeavour with the intention of facilitating a full understanding of the four papers that will follow.
Costas Karageorghis

Effects of Synchronous Music among Elite Endurance Athletes
Effects of synchronous music were investigated in two field studies. In Study 1, music effects were assessed among two elite triathletes and six elite runners during three training runs. A custom-designed *i*Phone application was developed to record in-task RPE, feeling states, mood responses, distance run, cadence and heart rate data. Compared to the no-music condition, participants ran, on average, 7.5% and 7.2% further but reported lower RPE and more positive feelings and mood responses when running to synchronous music (d = .35) and a music-led condition (d = .29), respectively. In Study 2, nine elite ultra-distance athletes participating in 24-hr and 48-hr races listened to rotating playlists of synchronous motivational music, neutral music, audiobook and silence delivered by *i*Phone. During the 18-24 hr period, motivational music was associated with a 14 sec, 18 sec and 27 sec per 400-m lap improvement compared to silence (d = .39, p < .01), neutral music (d = .54, p < .001) and audio book (d = .54, p < .001) conditions, respectively. Collectively, findings supported the judicious use of music interventions among endurance athletes.
Peter Terry [Speaker] Michelle Curran, Alessandra Mecozzi Saha, Ross Bool [Co-authors]

Examining the Stability of the Exercise Heart Rate-Music Tempo Preference Relationship
A triad of experimental studies involving the present authors has addressed the relationship between exercise heart rate and preference for music tempo. The purpose of the present study was to examine the stability of the cubic (two points of inflection) exercise heart rate-music tempo relationship found by Karageorghis et al. (2011) in cycle ergometry using a different exercise mode (treadmill exercise) and to examine a number of psychological outcome variables. Participants exercised for 2-min at six exercise intensities (40%-90% maxHRR) and were exposed to musical tracks at four tempi (slow, medium, fast, and very fast) and a no-music control condition at each intensity. Music preference was assessed and participants were administered the Feeling Scale and Felt Arousal Scale during the task. Immediately after each trial, an attentional focus item, the short Flow State Scale-2 and items from the Intrinsic Motivation Inventory were administered. It was hypothesised that the cubic relationship found by Karageorghis et al. (2011) in cycle ergometry would re-emerge using treadmill exercise and that the most positive motivational outcomes would be associated with the highest music preference scores. Results did not support a cubic relationship but rather a quadratic relationship (p < 0.5). There was also a significant main effect for attentional focus (p < .05; η_p^2 = .24), wherein participants exhibited higher levels of dissociation in all music conditions relative to control.
Leighton Jones [Speaker], Costas Karageorghis [Co-author]

Psychological, Psychophysical and Ergogenic Effects of Asynchronous Music in Swimming
Research has assessed the psychological, psychophysical and ergogenic effects of music in a range of dry land activities that include 400-metre running, cycle ergometry, indoor rowing and long-distance running. Such work has shown that the judicious use of music can lead to a range of benefits that include enhanced affect, reduced ratings of perceived exertion, greater energy efficiency (i.e., reduced VO_2), and faster time trial performances. The purpose of the present study was to assess the psychological, psychophysical and ergogenic effects of asynchronous (background) music in

swimming. A sample of 92 volunteer Brunel undergraduates nominated six musical selections for use in the experimental protocol of Stage 2. Twenty six participants were recruited from Brunel University Swimming Club and they went through a 2-week habituation period with Speedo Aquabeat mp3 players prior to the experimental phase. They were then administered two experimental trials (motivational and oudeterous music at 130 bpm) and a no-music control during which they engaged in a 200-m freestyle swimming time trial. Results showed that participants swam significantly faster when exposed to either music condition relative to control ($p < .05$, $\eta_p^2 = .18$) and that the music conditions were also associated with higher state motivation ($p < .05$, $\eta_p^2 = .15$).
Costas Karageorghis [Speaker], Jasmin Hutchinson, Leighton Jones, Hannah Farmer, Metin Ayhan, Rachel Wilson, Joshua Rance, Stewart Bailey, Christopher Hepworth [Co-authors]

Music Applications with Elite Athletes
This applied paper chronicles a variety of music applications used with elite athletes, with particular reference to the Olympic Games. General examples include the synchronization of activities to music in order to capitalise on the well-established ergogenic effect, and using music asynchronously to, for example, induce an appropriate pre-performance mindset, or intensify responses to relaxation and imagery techniques. Specific examples of music use with elite performers include providing inspiration to bobsleigh and shooting medallists at the 1998 and 2000 Olympic Games, respectively; implementing pre-event arousal control strategies with boxing and rowing medallists at the 2000 Olympic Games; maintaining motivation and training cues during successful rehabilitation from chronic fatigue syndrome of an Olympic canoeist; intensifying visualisation strategies among a lawn bowls team at the South East Asian Games; as an adjunct to audio-visual entrainment, also known as brainwave training, during the trap shooting event at the 2006 and 2010 Asian Games, conditioning responses to specific music to promote ideal brain activity among clay target shooters at the 2008 Olympic Games; and using iPhone technology to deliver music interventions to shooters in preparation for the 2012 Olympic Games.
Peter Terry