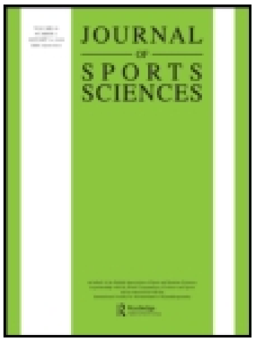

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BASES EXPERT STATEMENT

The BASES Expert Statement on use of music in exercise

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Abstract
The use of music during exercise has become ubiquitous over the past two decades and is now supported by a burgeoning body of research detailing its effects and the contingencies surrounding its use. The purpose of this statement is to present a synopsis of the body of knowledge, with selected references, and to provide practical recommendations for exercise practitioners regarding music selection. Following the identification of methodological shortcomings in early studies, researchers have been guided by new conceptual frameworks, and have produced more consistent findings as a consequence. The use of music has been found to yield ergogenic effects in the exercise domain while also promoting psychological (e.g. enhanced affect) and psychophysical (reduced ratings of perceived exertion) benefits. There is a paucity of research examining the longitudinal effects of music on key outcome variables such as exercise adherence.

Keywords: *Motivational music, ergogenic effects, rhythm, arousal*

Introduction

The use of music by exercisers and athletes has become commonplace but selection of music is often intuitive rather than systematic in nature. For this reason, sport and exercise scientists have considered the role of evidence-based music prescription for physical activity (see Terry & Karageorghis, 2011). In this statement, we provide an overview of salient research, as well as presenting a series of recommendations for practitioners and researchers. As our title suggests, the evidence we present refers primarily to exercise participants rather than elite athletes. For the interested reader, Bishop (2010) recently produced a review of music research relevant to the sports domain.

Background and evidence

Research conducted in the exercise domain prior to the mid-1990s was of variable quality and produced equivocal findings. This equivocality has been attributed to methodological limitations and the lack of a guiding theoretical framework (see Karageorghis & Terry, 1997). Researchers often misused musical terminology, operated poor music selection protocols, chose inappropriate measures, and failed to standardize important aspects of experimental protocols, such as playing music at a consistent volume. Developments in conceptual understanding and standardization of music selection (e.g. Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006; Terry & Karageorghis, 2006) have helped to rectify these limitations.

A significant body of research work has focussed on identifying factors contributing to the motivational qualities of music; that is, qualities that inspire the listener to exercise harder and/or for longer. Following more careful attention to music selection by researchers, a range of benefits have been shown in the exercise domain, including diversion of attentional focus (e.g. Nethery, 2002), triggering or regulation of specific emotions and moods (e.g. Priest & Karageorghis, 2008; Terry, Karageorghis, Mecozzi Saha, & D'Auria, 2012), evocation of memories and other cognitive processes (e.g. Priest & Karageorghis, 2008), control of arousal (e.g. Hall

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& Erickson, 1995), induction of flow state (e.g. Karageorghis, Vlachopoulos, & Terry, 2000), and encouragement of rhythmic movement (e.g. Karageorghis et al., 2009).

These responses to music may, in turn, promote an ergogenic (work-enhancing) effect. This effect occurs when music improves exercise performance by either reducing perceptions of fatigue or increasing work capacity. Typically, this effect results in increased work rates (e.g. Rendi, Szabo, & Szabó, 2008), endurance (e.g. Crust & Clough, 2006) or strength (e.g. Karageorghis, Drew, & Terry, 1996). The long-term benefits of music use have yet to be investigated thoroughly but are thought to include increased adherence to exercise programmes (Annesi, 2001). This is especially pertinent to music use in medical rehabilitation settings in which remedial exercise plays a role (e.g. physiotherapy, stroke, chronic pain, cardiac episodes; see Siedlecki & Good, 2006). Exploratory work has demonstrated the utility of music in these secondary care contexts where, owing to their condition, patients are in particular need of encouragement, affective enhancement, distraction, and stimulation (Karageorghis, Lim, Priest, Clow, & Forte, 2008).

Primary factors that influence responsiveness to music in exercise and sport settings include the musical qualities of rhythm, melody, and harmony. Secondary factors include the extra-musical qualities of cultural impact (i.e. pervasiveness of the music within specific cultural groups or society generally) and associations that a piece of music may carry (e.g. Heather Small's *Proud* is closely associated with the British team at the 2000 Sydney Olympics). The latest iteration of our conceptual model incorporates the influence of personal and situational factors (Terry & Karageorghis, 2006). The importance of such variables has only recently begun to receive close attention from researchers. Findings provide tentative evidence that variables such as personality and gender play a role in determining musical preferences and responses within exercise settings (Crust & Clough, 2006; Karageorghis et al., 2010). Males generally express a greater preference for bass frequencies than females (McCown, Keiser, Mulhearn, & Williamson, 1997), and extraverts tend to respond more favourably than introverts to lively musical selections (e.g. Crust & Clough, 2006). Furthermore, North and Hargreaves (2008) have identified the listening situation as a key determinant of the effects of music, whereby exercisers may have pre-conditioned expectations about the type of music that should be played in particular contexts (e.g. upbeat, arousing music in gymnasia).

The effects of music *prior to* exercise and sport have been examined by a relatively small number of researchers (e.g. Hall & Erickson, 1995; Karageorghis et al., 1996; Yamamoto et al., 2003). Pre-task music has been shown to act as an effective stimulant that can optimize arousal and psychological states (see Terry & Karageorghis, 2011). The effects of music *during* physical activity have also been investigated thoroughly, with at least 55 studies conducted to date. Use of asynchronous music (i.e. background music to which movements are not consciously synchronized) provides both psychological (e.g. distraction and enhancement of positive feelings) and ergogenic (performance-enhancing) benefits, which are especially apparent at low-to-moderate exercise intensities. Although the role of such music is typically motivational, it may serve to promote neuromuscular efficiency in repetitive activities of long duration, such as long-distance running (Copeland & Franks, 1991). Recent experimental work has investigated the relationship between heart rate (a proxy for exercise intensity) and preference for musical tempo (Karageorghis et al., 2011). Contrary to predictions (Iwanaga, 1995), the relationship was not linear, but instead characterized by a series of inflection points. Across a broad range of exercise intensities (40–90% maximum heart rate reserve), preferred musical tempo fell within a narrow band (125–140 beats per minute). This relationship has yet to be examined among older exercisers, and may possibly be different for that age group, given that maximum heart rate reduces considerably with age.

Synchronous music use (i.e. when an exerciser consciously moves in time with a musical beat) has been shown to provide ergogenic and psychological benefits in repetitive endurance activities. For example, motivational synchronous music used during treadmill walking improved time to voluntary exhaustion by 15% compared with a no-music control condition (Karageorghis et al., 2009). Other findings suggest that synchronous music may increase rhythmicity of movement, resulting in an efficiency gain that is associated with lower relative oxygen uptake ($\dot{V}O_2$) (Bacon, Myers, & Karageorghis, in press; Terry et al., 2012).

In steady-state aerobic exercise, motivational music has also been shown to improve affective states by up to 15% (e.g. Karageorghis et al., 2009). Similarly, music listening can be an effective dissociation strategy, reducing perceptions of effort and fatigue by up to 12% (Bharani, Sahu, & Mathew, 2004; Nethery, 2002). However, this distraction effect is proposed to be attenuated at higher exercise intensities ($> \sim 70\%$ $\dot{V}O_{2max}$), as internal feedback dominates due to the limited channel capacity of the respective afferent nervous system (Tenenbaum, 2001). Notably, the affective and attentional effects of music appear to interact, in that positive feelings can alter perceptions of effort (cf. Hardy & Rejeski, 1989). Recent research findings have challenged the notions espoused in extant theory (Rejeski, 1995; Tenenbaum, 2001) insofar as well-selected music appears to promote positive affect even at very high exercise intensities (e.g. Hutchinson et al., 2011; Karageorghis et al., 2009; Terry et al., 2012). The effects of post-exercise music, to aid recovery from training, competition or injury – known as *recuperative music* – are now beginning to receive attention from researchers (Jing & Xudong, 2008; Savitha, Mallikarjuna, & Chythra, 2010). Although initial findings are encouraging, further research is required before practitioners have a sound empirical basis for prescriptions they might make.

Conclusions and recommendations

Research evidence demonstrates that music has measurable and relatively consistent effects on the behaviour and psychological states of exercise participants. When carefully selected music accompanies exercise, the individual's performance (e.g. work rate) and psychological state (e.g. affect) are generally enhanced, which has important implications for exercise adherence. Currently, there is a sufficient volume of research to enable us to make evidence-based recommendations for music used *during* exercise. Our recommendations are that music should be:

- at least moderately familiar to the listener and reflective of their personal preferences;
- functional for the activity (i.e. rhythm should approximate the motor patterns involved);
- selected with the desired effects in mind (e.g. loud, fast, percussive music with accentuated bass frequencies as an arousal-increasing intervention);
- selected for its motivational qualities using some form of objective rating method (e.g. Brunel Music Rating Inventory-2; Karageorghis et al., 2006);
- characterized by prominent rhythmic qualities and percussion in addition to pleasing melodic and harmonic structures for repetitive aerobic and anaerobic exercise tasks – melody is the highest sounding part or "tune" of the music while harmony refers to sounding multiple notes together, giving music its emotional "colour" (e.g. happy, sad, ruminative);
- within the tempo band of 125–140 beats per minute for most healthy exercisers engaged in repetitive, aerobic-type activity (slower music is more appropriate for warm-up and cool-down) – this recommendation applies to the asynchronous application of music only; in its synchronous application, tempo should be matched to movement rate;
- accompanied by lyrics with affirmations of movement (e.g. "run to the beat") or generic motivating statements (e.g. "the only way is up");
- used in ways where safety is not compromised (e.g. exercisers should not use music when running or cycling near traffic).

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References

Annesi, J. J. (2001). Effects of music, television, and a combination entertainment system on distraction, exercise adherence, and physical output in adults. *Canadian Journal of Behavioural Science*, *33*, 193.

Bacon, C. J., Myers, T. R., & Karageorghis, C. I. (in press). Effect of music-movement synchrony on exercise oxygen consumption. *Journal of Sports Medicine and Physical Fitness*.

Bharani, A., Sahu, A., & Mathew, V. (2004). Effect of passive distraction on treadmill exercise test performance in healthy males using music. *International Journal of Cardiology*, *97*, 305–306.

Bishop, D. T. (2010). 'Boom Boom How': Optimising performance with music. *Sport and Exercise Psychology Review*, *6*, 35–47.

Copeland, B. L., & Franks, B. D. (1991). Effects of types and intensities of background music on treadmill endurance. *Journal of Sports Medicine and Physical Fitness*, *15*, 100–103.

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

Hall, K. G., & Erickson, B. (1995). The effects of preparatory arousal on sixty-meter dash performance. *Applied Research in Coaching and Athletics Annual*, *10*, 70–79.

Hardy, C. J., & Rejeski, W. J. (1989). Not what, but how one feels: The measurement of affect during exercise. The *Journal of Sport & Exercise Psychology*, *11*, 304–317.

Hutchinson, J. C., Sherman, T., Davis, L. K., Cawthon, D., Reeder, N. B., & Tenenbaum, G. (2011). The influence of asynchronous motivational music on a supramaximal exercise bout. *International Journal of Sport Psychology*, *41*, 135–148.

Iwanaga, I. (1995). Harmonic relationship between preferred tempi and heart rate. *Perceptual and Motor Skills*, *81*, 67–71.

Jing, L., & Xudong, W. (2008). Evaluation of the effects of relaxing music on the recovery from aerobic exercise-induced fatigue. *Journal of Sports Medicine and Physical Fitness*, *48*, 102–106.

Karageorghis, C. I., Drew, K. M., & Terry, P. C. (1996). Effects of pretest stimulative and sedative music on grip strength. *Perceptual and Motor Skills*, *83*, 1347–1352.

Karageorghis, C. I., Jones, L., Priest, D. L., Akers, R. I., Clarke, A., Perry, J. M. et al. (2011). Revisiting the exercise heart rate–music tempo preference relationship. *Research Quarterly for Exercise and Sport*, *82*, 274–284.

Karageorghis, C. I., Lim, H. B. T., Priest, D. L., Clow, A., & Forte, D. (2008). Impact of age-congruent, functional music in a physiotherapy rehabilitation setting: The Music in Rehab Project. In *Proceedings of the Music, Health and Happiness Conference*, Manchester, UK.

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

Karageorghis, C. I., Priest, D. L., Terry, P. C., Chatzisarantis, N. L. D., & Lane, A. M. (2006). Development and 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. (1997). The psychophysical effects of music in sport and exercise: A review. *Journal of Sport Behavior*, *20*, 54–68.

Karageorghis, C. I., Vlachopoulos, S. P., & Terry, P. C. (2000). Modelling of the relationship between exercise-induced feeling states and flow: An intuitive appraisal perspective. *European Physical Education Review*, *6*, 230–248.

McCown, K., 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.

Nethery, V. M. (2002). Competition between internal and external sources of information during exercise: Influence on RPE and the impact of the exercise load. *Journal of Sports Medicine and Physical Fitness*, *42*, 172–178.

North, A. C., & Hargreaves, D. J. (2008). Music and taste. In A. C. North & D. J. Hargreaves (Eds.), *The social and applied psychology of music* (pp. 75–142). Oxford: Oxford University Press.

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.

Rejeski, W. J. (1985). Perceived exertion: An active or passive process? *Journal of Sport Psychology*, *75*, 371–378.

Rendi, M., Szabo, A., & Szabó, T. (2008). Performance enhancement with music in rowing sprint. *The Sport Psychologist*, *22*, 175–182.

Savitha, D., Mallikarjuna, R. N., & Chythra, R. (2010). Effect of different musical tempo on post-exercise recovery in young adults. *Indian Journal of Physiology and Pharmacology*, *54*, 32–36.

Siedlecki, S. L., & Good, M. (2006). Effects of music on power, pain, depression and disability. *Journal of Advanced Nursing*, *54*, 553–562.

Tenenbaum, G. (2001). A social-cognitive perspective of perceived exertion and exertion tolerance. In R. N. Singer, H. A. Hausenblas, & C. Janelle (Eds.), *Handbook of sport psychology* (pp. 810–822). New York: Wiley.

Terry, P. C., & Karageorghis, C. I. (2006). Psychophysical effects of music in sport and exercise: An update on theory, research and application. In M. Katsikitis (Ed.), *Psychology bridging the Tasman: Science, culture and practice –Proceedings of the 2006 Joint Conference of the APS and the NZPS* (pp. 415–419). Melbourne, VIC: Australian Psychological Society.

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.

Yamamoto, T., Ohkuwa, T., Itoh, H., Kitoh, M., Terasawa, J., Tsuda, T. et al. (2003). Effects of pre-exercise listening to slow and fast rhythm music on supramaximal cycle performance and selected metabolic variables. *Archives of Physiology and Biochemistry*, *111*, 211–214.