On the Role of Lyrics in the Music-Exercise Performance Relationship

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Highlights

- First experimental study to address the role of lyrics in exercise.
- We assessed psychological, psychophysical, and physiological variables.
- Musical accompaniment enhanced cycling cadence during submaximal cycle ergometry.

- The inclusion of lyrics enhanced cadence towards the end of the cycling task.
- Inclusion of lyrics had no bearing on affect, perceived exertion, or heart rate.

Abstract

Objectives. To examine the role of the musical constituent of lyrics with reference to a range of psychological, psychophysical, and physiological variables during submaximal cycling ergometry.

Design. Two-factor (Condition x Time) within-subject counterbalanced design.

Method. Twenty five participants performed three 6-min cycling trials at a power output corresponding to 75% of their maximum heart rate under conditions of music with lyrics, same music without lyrics, and a no-music control. Cycling cadence, heart rate, and perceived exertion were recorded at 2-min intervals during each trial. Positive and negative affect was assessed before and after each trial.

Results. A significant (p = .006) Condition x Time interaction emerged for cadence wherein participants cycled at a higher rate at the end of the task under music with lyrics. Main effects were found for perceived exertion and heart rate, both of which increased from min 2 through to min 6, and for affect: positive affect increased and negative affect decreased from pre- to post-trials.

Conclusions. Participants pedalled faster in both music conditions while perceived exertion and heart rate did not differ across conditions. The inclusion of lyrics influenced cycling performance only at min 6 and had no bearing on the remaining dependent variables throughout the duration of the task. The impact of lyrical content in the music-exercise performance relationship warrants further attention in order that we might better understand its role.

Keywords: affect, asynchronous music, cycle cadence, ergogenic aid, lyrical component

Introduction

The use of music in exercise and sport settings has become extremely widespread without a strong empirical basis to justify such ubiquity. Music is used as a means to enhance performance and evoke a range of physiological and psychological responses (Brownley, McMurray, & Hackney, 1995; Razon, Basevitch, Land, Thompson, & Tenenbaum, 2009). In particular, music has been shown to enhance positive affect, which bears strong influence on an individual‟s intention to exercise and subsequent adherence (Ekkekakis, Parfitt, & Petruzzello, 2011). Numerous studies have supported the use of *motivational music* to induce positive feelings during exercise (e.g., Crust, 2008; Hutchinson, Sherman, Davis, Cawthon, Reeder, & Tenenbaum, 2011). Typically, motivational music has a high tempo (> 120 bpm), catchy melodies, inspiring lyrics, an association with physical endeavour, and a bright, uplifting harmonic structure (Karageorghis, Terry, & Lane, 1999).

The benefits of music use in the exercise domain have been attributed to a *rhythm response* or entrainment to music rhythm that has been associated with greater neuromuscular efficiency (e.g., Bacon, Myers, & Karageorghis, 2012), and the limited processing capacity of the central nervous system (e.g., Razon et al., 2009). Music competes with bodily cues in efferent neural pathways and thus blocks unpleasant cues replacing them with more positive ones (cf. Rejeski, 1985; Tenenbaum, 2001). Music-in-exercise has also been linked with a phenomenon known as *emotional contagion*, which refers to the process by which an exerciser “catches” the emotion that characterizes a piece of music. The notion of emotional contagion has received support from research in neuroscience (e.g., Koelsch, Fritz, von Cramon, Müller, & Friederici, 2006; Molnar-SzaKacs & Overy, 2006), which shows that listeners internally mimic brain activity associated with the emotional content of music (e.g., sadness, happiness, or surprise).

Long-duration, repetitive exercise tasks such as rowing, running, and cycling, performed by recreationally active participants (not elite athletes) appear to be positively influenced by both asynchronous (background) and synchronous music (see Terry & Karageorghis, 2011, for a review). Additional benefits of music have been explained with reference to the dissociation effect (Rejeski, 1985), wherein music delays the onset of fatigue and allows individuals to increase work output/duration before internal negative sensations are perceived (Boutcher & Trenske, 1990). That is, perceptions of effort and fatigue diminish with the presence of music, thus participants are able to produce greater work output (e.g., Elliot, Carr, & Savage, 2004).

The aforementioned benefits are load-dependent to a degree, given that music does not appear to moderate perceptions of effort at high exercise intensities (e.g., Karageorghis, Mouzourides, Priest, Sasso, Morrish, & Whalley, 2009). Nonetheless, in direct contrast with the posits of extant theory (e.g., Rejeski, 1985; Tenenbaum, 2001), it does appear to moderate affect even at very high intensities (Hutchinson et al., 2011; Terry, Karageorghis, Mecozzi Saha, & D‟Auria, 2012). The neurophysiological concomitants of this benefit are as yet unknown; nevertheless, an important determinant of such affective qualities of music is the lyrical component, or words used in a song (Crust & Clough, 2006; Stratton & Zalanowski, 1994). While other constituents of music such as tempo (bpm) and loudness (dB) have garnered considerable attention from researchers (e.g., Brownley et al., 1995; Edworthy & Waring, 2006), there is a dearth of research into the possible influence of lyrics, despite numerous qualitative and anecdotal accounts of their potential influence (e.g., Bishop, Karageorghis, & Loizou, 2007; Priest & Karageorghis, 2008). Therefore, systematic investigation into the role of lyrics in the sport and exercise performance-relationship is warranted given both the widespread use of music in applied and research settings as well as the fact that lyrical music is often used in preference to instrumental music.

Research has shown that lyrics in music influence people‟s behaviour (see North & Hargreaves, 2008 for a review). For instance, Jacob, Guéguen, and Boulbry (2010) found that listening to prosocial song lyrics during the eating (lunch and dinner) period in a restaurant increased patrons‟ tipping behaviours, in terms of both the proportion of customers leaving a tip and the amount of money they gave per tip. Greitemeyer (2009) showed that exposure to songs with prosocial lyrics fostered prosocial tendencies by increasing prosocial thoughts, affect, and behaviour in different situations (e.g., empathy towards others in need, donations to non-profit organizations, etc.). However, findings from the study of the effects of music with and without lyrics on mood and emotions are equivocal. Stratton and Zalanowski (1994) found that the lyrics of a song had greater capacity to alter mood than music without lyrics. More recently, Omar-Ali and Peynircioğlu (2006) asked participants to rate the intensity of four emotions (happy, sad, calm and angry) in instrumental music or in music with lyrics. The authors found that melody had a stronger bearing on emotion than lyrics (Omar-Ali & Peynircioğlu, 2006). Nonetheless, in lyrical music, the lyrics “carry” the melody which adds a level of complexity in assessing the influence of lyrics and melody as singular phenomena.

Systematic investigation of the lyrical component of music is needed to further understanding of how the choice of lyrics can influence affective and performance-related outcomes. Lyrics may well relate to the task demands of repetitive exercise (e.g., the potentially powerful influence of general affirmations [e.g., “Search for the hero inside yourself”]), task-specific verbal cues [e.g., “Keep on running”], and positive self-statements [e.g., “I am the one and only”]). In particular, lyrical content has been suggested to be the musical constituent that is most likely to promote a dissociation effect and thus reduce perceptions of effort (see Crust & Clough, 2006). Lyrics have also been suggested to play a role in inducing optimal mood and emotional states in the domain of sport and exercise (Bishop et al., 2007; Crust, 2008; Terry & Karageorghis, 2011).

The purpose of the present study was to examine the role of lyrics with reference to a range of psychological, psychophysical, and psychophysiological variables during submaximal cycle ergometry. It was hypothesized that, at the same individualized workload, cycle cadence would be significantly higher in the two music conditions (music with lyrics [ML] and music with no lyrics [NL]) when compared to a no-music control (NM), with the ML condition eliciting the largest increase in cycle cadence (H_1); heart rate (a proxy for physiological stress) would increase equally across the three conditions throughout the cycling task (H_2); perceived exertion would be lower in the two music conditions when compared to NM (H_3); positive affect would increase and negative affect would decrease from pre- to post-test trials, in all three conditions (H_4), with distinct trends observed for positive affect (ML > NL > NM) and negative affect (NM > NL > ML).

Methodology

Ethical approval was gained from the ethics committee of the UK university at which the research was conducted and participants provided written informed consent. The research consisted of two phases: music selection (Stage 1) and the experimental protocol (Stage 2).

Stage 1: Music Selection

Participants. Forty-nine undergraduate students (M_{age} = 19.9 years, *SD* = 1.2 years) from a sport and exercise science undergraduate course at a university in northern England, UK volunteered to participate in the selection of motivational musical tracks for use in the experimental phase of the study. In keeping with the methodological guidelines of Karageorghis and Terry (1997), these participants were of a similar socio-cultural background and age profile to participants in Stage 2.

Measures. The Brunel Music Rating Inventory-2 (BMRI-2; Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006) was employed to select the tracks that would be used in Stage 2. This questionnaire was designed to measure the motivational qualities of music for use in an exercise environment. It is a single-factor, six-item instrument presented on a 7-point Likert-scale anchored by 1 (*strongly agree*) and 7 (*strongly disagree*). For the purposes of the study, participants were informed that the word "motivate" meant music that would "make you want to exercise harder and/or longer in a cycling performance task". The mean Cronbach alpha coefficient for the single factor reported by the authors was .89 (Karageorghis et al., 2006). Cronbach alpha coefficients in our study were .95 for both the rating of songs with lyrics and for the rating of those without.

Procedures. Participants were randomly assigned to one of two groups that were tasked with assessing the motivational qualities of eight tracks containing lyrics (n = 27; 15 males and 12 females; M_{age} = 20.1 years, SD = 1.3 years) or the same tracks without lyrics (n = 22; 13 males and 9 females; M_{age}= 19.7, SD = 1.0 years). The decision to use two independent groups was taken to prevent any intra-individual comparison of the two versions of each track, which were identical with the exception of the presence/absence of lyrics. Testing time and room conditions were the same for both groups. Participants listened to a baseline piece of instrumental calming/relaxing slow music (< 100 bpm) for 2 min before listening to the musical track that was subsequently rated using the BMRI-2 for 90 s. This procedure was repeated for each track in order to limit the influence of previous motivational tracks on responses to tracks being assessed. Music was delivered through a compact disc player (Bush Digital Portable). Volume (loudness) was standardized for all music tracks at 70 dBA, which is deemed safe from an audiological perspective (Lindgren & Axelsson, 1988).

Data Analysis. The purpose of the analyses employed in Stage 1 was to identify two tracks (i.e., a sufficiently long accompaniment for the 6-min cycling test) for use in Stage 2 with significantly ($p < .05$) higher BMRI-2 scores for the versions with lyrics. Data screening and diagnostic tests (normal distribution of data and homogeneity of variance) to ensure data were suitable for parametric analysis were performed (Tabachnick & Fidell, 2007, pp. 60–116). A separate mixed-model 2 (Group [lyrics/no lyrics]) x 8 (Track) ANOVA and follow-up analyses were computed to find the two pairs of tracks required for the experimental phase. Mauchly‟s test was used to check the sphericity assumption and where this assumption was violated, the corresponding *F* ratio was subjected to Greenhouse-Geisser adjustment.

Stage 2: Experimental Investigation

Participants. Given the dearth of studies examining the role of lyrics in the musicexercise performance relationship, we used our preliminary data to conduct a power analysis and thus establish an appropriate sample size. A power calculation (Faul, Erdfelder, Buchner, & Lang, 2009) based on a large effect size (η_{p2}= .28) indicated that 23 participants would be required. As a protection against experimental dropout and multivariate outliers, a total of 25 undergraduate students (11 women and 14 men; M_{age} = 20.8 years, *SD* = 1.3 years) from a sport and exercise science course at a university in northern England, UK were recruited to take part in Stage 2. These participants were not the same as those used in Stage 1.

Instruments and Procedures. All participants reported a liking for mainstream dance music and were physically active in accordance with the American College of Sports Medicine and the American Heart Association criteria; these entail partaking in 150 min (30 min for 5 days per week) of moderate exercise, or 60 min (20 min for 3 days per week) of vigorous-intensity exercise (Haskell et al., 2007). Participants were asked to refrain from consuming caffeine-based products and exercising for 24 hr prior to testing.

Graded exercise test (GXT). To establish the workload for each participant during the experimental and control conditions, they first performed a continuous and incremental graded exercise test on a cycle ergometer (Corival). This session also facilitated participants‟ familiarization with the cycling procedures and associated measurements of exercise intensity. With the ergometer in hyperbolic mode, participants performed a 5-min warm-up at 80 W after which the power output was increased by 40 W every 3 min until the point of voluntary exhaustion. Cessation of the test was determined primarily by a heart rate (HR) within ± 10 bpm of age-predicted maximum, volitional exhaustion or an inability to maintain pedal/cycling cadence above 60 revolutions per minute (RPM; Eston, Faulkner, Gibson, Noakes, & Parfitt, 2007). During the last 30 s of each increment of the GXT, we recorded HR using a heart rate monitor (FS1) and ratings of perceived exertion (RPE) using Borg‟s (1982) 6-20 scale. Past research has shown the appropriateness of these measures for assessing effort and perceived exertion during physical work (see e.g., Hardy & Rejeski, 1989).
Prior to commencing the test, participants were instructed in how to respond to the RPE scale using the procedures described by Morris, Lamb, Cotterrell, and Buckley (2009). Linear regression was subsequently used to calculate the power output for each participant, which corresponded to 75% of their maximum heart rate (HR_{max}) attained during the GXT. The

calculated power output was then used as the exercising workload during the experimental and control trials. This workload was selected on the basis of previous training studies that have used heart rate as a method by which to control exercise intensity (e.g., Kaikkonen, Yrjämä, Siljander, Byman, Laukkanen, 2000), and because the psychophysical effects of music are attenuated beyond this intensity (see Rejeski, 1985; Tenenbaum, 2001).

***Experimental exercise trials*.** The experimental conditions were presented in counterbalanced order and comprised music with lyrics (ML), the same piece without lyrics (i.e., an instrumental piece; NL) and a no-music control (NM). Each condition consisted of a 3-min warm-up at 50 W followed by a 6-min exercise bout at the pre-established workload for each participant. The cycle ergometer was set in order that workload remained constant throughout each 6-min trial, independent of the cycling cadence selected by the participant. Measures of RPM, HR, and RPE were monitored and recorded every 2 min during each trial, with RPM obscured from the participant's view to discourage engagement in any goal-setting strategies during testing. Music was delivered through in-ear phones (iPod) connected to a compact disc player (same as above). Volume (loudness) was standardized for all testing procedures at 70 dBA. *Uninvited* by Freemasons and *Firestarter* from The Prodigy, the two songs selected in Stage 1 were edited in order to be played for 3 min each, thus matching the test duration. During the NM condition, a blank compact disc was played. All conditions were performed at the same location, at the same time of day (± 2 hr), and were completed within 10 days of the GXT.Participants were also instructed to complete the International Positive and Negative Affect Schedule Short Form (I-PANAS-SF; Thompson, 2007) prior to and immediately after each trial. This questionnaire has 10 items presented on a 5-point Likert scale anchored by 1 (*never*) and 5 (*always*). Sample items include "inspired" (positive affect; PA) and "upset" (negative affect; NA). Participants were instructed to answer each item using a “how do you feel right now?” response set. The Cronbach alpha coefficients reported by the author are .78 for the PA subscale and .76 for the NA subscale. Cronbach alpha coefficients in the present study ranged from .71 to .92 for PA and NA pre- and post-trial in each condition.

Data Analysis. Similar data screening and diagnostic tests were used to those detailed in Stage 1. A two-factor 3 (Music Condition) x 2 (Time) within-subject RM ANOVA was computed for RPM and MANOVAs using the same model were computed for PA and NA, and RPE and HR. Oneway RM MANOVA was computed to assess mean RPE and HR data. Pairwise comparisons with Bonferroni adjustments were used where necessary.

Results

Stage 1: Music Selection

Data screening of the BMRI-2 results revealed that there was one case that exhibited multiple univariate outliers and this was deleted prior to further analysis. Overall, the BMRI-2 data did not meet the normality assumption owing to substantial positive standard skewness and positive standard kurtosis (> 3.29) in five cells of the analysis, therefore a logarithmic transformation was applied to normalize these data (see Tabachnick & Fidell, pp. 86–91). A mixed-model ANOVA on the transformed BMRI-2 scores showed a significant Group x Track interaction, $F(4.89, 224.79) = 6.62$, $p < .001$, $\eta_{p2} = .13$, and a main effect for track, $F(4.89, 224.79) = 8.38$, $p < .001$, $\eta_{p2} = .15$. Tracks with lyrics (*M* = 1.14, *SE* = .02) were not, overall, rated as significantly ($p = .526$) more motivational than tracks without lyrics (*M* = 1.12, *SE* = .02). However, for the tracks for which the version with lyrics was rated as more motivational than the version without, follow-up analyses using standard errors indicated significant ($p < .05$) differences between the two versions of *Uninvited* (ML: *M* = 1.34, *SE* =

.04 and NL: *M* = 1.07, *SE* = .04 [transformed data]) and the two versions of *Firestarter* (ML: *M* = 1.20, *SE* = .05 and NL: *M* = 1.04, *SE* = .05 [transformed data]). Accordingly, these two tracks were selected for use in Stage 2 (see Table 1 for details of all eight tracks).

Stage 2: Experimental Phase

One univariate outlier was identified and reduced by modifying the raw score towards the mean, to a unit below the next less extreme raw score (Tabachnick & Fidell, 2007, p. 77). The data were normally distributed (standard skew./kurt. < 2.58) with the exception of the negative and positive affect data which showed moderate positive skewness in four cells of the analysis, which necessitated a square root transformation to exhibit normality.

Interaction Effects

The two-factor RM ANOVA for RPM revealed a significant Condition x Time interaction, $F(4, 96) = 3.89$, $p = .006$, $\eta_p^2 = .14$, with a large effect size. Follow-up tests indicated that at min 6, RPM was significantly ($p = .010$) higher in the ML (*M* = 100.60, *SE* = 4.63) condition when compared to NL (*M* = 96.20, *SE* = 4.70), but that there were no such differences at min 2 and 4 (see Figure 1). The same interaction in a RM MANOVA was nonsignificant for PA and NA, Hotteling‟s Trace = .13, $F(4, 92) = 1.51$, $p = .194$, $\eta_p^2 = .06$. In a separate RM MANOVA, the same interaction was nonsignificant for RPE and HR, Pillai‟s Trace = .119, $F(8, 192) = 1.52$, $p = .152$, $\eta_p^2 = .06$.

Main Effects

There was a condition main effect for RPM, $F(2, 48) = 18.49$, $p < .001$, $\eta_p^2 = .43$, associated with a large effect size, with pairwise comparisons indicating that the highest RPM was recorded in the two music conditions ($p < .001$). There was also a time main effect for

RPM, $F(1.15, 27.70) = 31.66$, $p < .001$, $\eta_p^2 = .57$, again associated with a large effect size, with pairwise comparisons indicating that RPM increased in a linear manner throughout the duration of the 6-min exercise bout ($p < .01$; see Figure 1).

There was no condition main effect for PA and NA, Hotteling‟s Trace = .01, $F(4, 92) =.14$, $p = .966$, $\eta_p^2 = .01$, although there was a main effect for time, Hotteling‟s Trace = 4.03, $F(2, 23) = 46.32$, $p < .001$, $\eta_p^2 = .80$, associated with a large effect size. Stepdown *F* tests indicated differences for PA, $F(1, 24) = 68.53$, $p < .001$, $\eta_p^2 = .74$, and NA, $F(1, 24) = 28.93$, $p < .001$, $\eta_p^2 = .55$, with pairwise comparisons revealing that PA increased from pre- to posttask while NA decreased ($p < .001$; see Table 2).

There was no condition main effect for RPE and HR, Pillai‟s Trace = .15, $F(4, 96) = 1.98$, $p = .104$, $\eta_p^2 = .08$, although there was a main effect for time, Pillai‟s Trace = .74, $F(4, 96) = 14.11$, $p < .001$, $\eta_p^2 = .37$, associated with a large effect size. Stepdown *F* tests indicated differences for RPE, $F(1.13, 27.12) = 39.41$, $p < .001$, $\eta_p^2 = .62$, and HR, $F(1.15, 27.62) = 56.78$, $p < .001$, $\eta_p^2 = .70$, with pairwise comparisons revealing that both RPE and HR increased in a linear manner throughout the duration of the task ($p < .001$; see Table 3).

Discussion

The present study examined the role of the musical constituent of lyrics with reference to a range of psychological, psychophysical, and physiological variables during submaximal cycle ergometry. Two main findings emerged: First, musical accompaniment per se resulted in a higher cycling cadence and this was manifest without any corresponding increase in perceived effort or heart rate. The condition with lyrics elicited a higher cadence (RPM) than the condition without *only* at min 6, therefore H_1 is partially supported. Second, the inclusion of lyrics had no bearing on the remaining psychological (affect), psychophysical (RPE), and physiological (HR) variables therefore H_2 is accepted, while H_3 and H_4 are not supported by the present data. Main effects for time were found for RPE and HR, both of which increased from min 2 through to min 6 of the task, and for affect: positive affect increased and negative affect decreased from pre- to post-trial.

The present findings reveal that both music with lyrics and music without elicited significantly (p = .006) greater mean cycling cadence (RPM) throughout the cycling test than the no-music control condition. This adds to an emerging literature that supports the potential of music to aid physical performance (e.g., Crust & Clough, 2006; Terry et al., 2012). In addition, the findings support those of previous studies that used similar protocols, and reported no changes in physiological indices (e.g., blood lactate) with a concomitant increase in RPM (e.g., Lim, Atkinson, Karageorghis, & Eubank, 2009). An increase in cycling cadence without a corresponding increase in heart rate could be attributed to participants‟ entrainment to the rhythmical qualities of music, which is likely to engender more efficient movement patterns (Terry et al., 2012). Recent research by Bacon et al. (2012) has found that participants required 7% less oxygen when cycling in time to the beat of the music when compared to an asynchronous music condition at a slightly slower tempo. Similarly, in the first study to examine the effects of synchronous music with elite athletes (triathletes), Terry et al. (2012) found that oxygen consumption was 1.0-2.7% lower with music (whether motivational or neutral), when compared against a no-music control.

The matching of a music programme to the requirements of a given activity has been identified as an important factor in this research domain (Atkinson, Wilson, & Eubank, 2004; Karageorghis et al., 1999). In line with past research (e.g., Elliott, Carr & Savage, 2004), participants in our study may have derived benefit from the rhythmical qualities of the music (tempo ≥ 128 bpm) in terms of maintaining a regular kinetic pattern. Nonetheless, contrary to expectations, exercising with music with lyrics did not result in higher cycling cadence when compared to exercising with music that had no lyrics. This study is the first to experimentally examine the impact of lyrics in the music-physical performance relationship; hence, a direct comparison with previous findings is somewhat challenging. Previous research does indicate, however, that music differing in its motivational qualities elicits significant differences during exercise (Elliott et al.; Karageorghis et al., 2006, 2009). Also, fatigue may inhibit participants from processing lyrical content in a similar way to that at rest (cf. Tenenbaum, 2001). Despite the fact that past empirical research has not addressed this issue directly, it seems entirely plausible that such syntactical content would be challenging to process at high exercise intensities owing to the automatic attentional switching that takes place beyond the anaerobic threshold (Rejeski, 1985).

In the present study, the higher cycling cadence reported in the two music conditions was not accompanied by concomitant increases in perceived exertion; this supports the findings of similar studies (e.g., Lim et al., 2009). The primary reason for a lower perceived exertion despite the higher work-rate relates to the dissociation promoted by music listening, which limits the fatigue-related sensations transmitted via the efferent nervous system (Hutchinson et al., 2011; Rejeski, 1985). Given that most research in this area has focused on protocols of longer durations than our 6-min submaximal test (e.g., Boutcher & Trenske, 1990; Karageorghis et al., 2009), further research examining a longer bout of exercise accompanied by an entire music programme with and without lyrics is recommended.

As expected, the present findings showed an increase in positive affect and a decrease in negative affect post-exercise, for all conditions. This is in line with past research that supports the beneficial role of exercise with reference to a range of psychological state variables (e.g., Carels, Coit, Young, & Berger, 2007). Nonetheless, contrary to expectations, the inclusion of lyrics had no bearing on participants‟ affective states. This does not concur with past findings, which have shown an enhancement in affect during music conditions when compared to control (e.g., Boutcher & Trenske, 1990; Karageorghis et al., 2009; Terry et al., 2012).

Limitations and Recommendations

Music selection in the present study was conducted at rest whereas experimental testing required participants to perform a submaximal exercise task. It is common, in the field of sport and exercise sciences, to conduct music selection while participants are at rest. The approach in our domain mirrors that in mainstream psychology wherein studies of the influence of lyrics have generally been conducted with participants in a restful state (e.g., in a restaurant setting; see Jacob et al., 2010). Nevertheless, given the specifics of the sport and exercise domain, researchers in this field might consider conducting music selection under conditions that mirror the modalities and intensities of the activity that will be used in subsequent experimental trials. Currently, the BMRI and its derivatives require respondents to rate a given piece of music with an exercise task in mind, rather than while actually performing that task.

The tracks used in Stage 2 of the study were pre-selected in Stage 1 according to their motivational properties for exercise by participants of a similar socio-cultural background and age profile to participants who took part in Stage 2 (cf. Karageorghis & Terry, 1997). Past research has shown that it may be beneficial to include self-selected pieces in the study of the music-performance relationship (e.g., Razon et al., 2009; Terry et al., 2012). Although a wide range of music has been used in past research to examine its effect on performance, such music has generally not been selected with explicit reference to its lyrical content. From an applied practitioner perspective, the lyrical content of music can enhance affect as well as provide positive affirmations or task-related verbal cues (e.g., Crust, 2008; Priest & Karageorghis, 2008). Moreover, had the present protocol been of a longer duration, symptoms of fatigue may have been more likely to impinge on attentional processes, rendering the exercise to be more pleasurable in the presence of music (e.g., Elliott et al., 2004).

In the present study, neither the meaning of the lyrics nor how participants interpreted them was considered. The songwriters‟ intended meaning compared against the typically diverse interpretation of listeners indicates that future researchers might consider both the lyrical content of tracks and individual interpretations (Priest & Karageorghis, 2008). Researchers should also account for the possibility of lyrics being heard via auditory imagery during a no-lyrics condition; the selected songs in the present study were top 10 hits in the UK charts and thus generally well known. Both of the aforementioned limitations could be assuaged through the use of music that was previously unfamiliar to participants.

Conclusions

The present study supported the notion that carefully selected music can engender an ergogenic effect in an exercise task. Participants‟ cycling cadence increased in a short duration, individually fixed-load cycling bout when compared to performance in a no-music control condition. The presence of lyrics bolstered the ergogenic effect of the music only in the closing stages of the task (min 6), although the tracks with lyrics were delineated as being more motivating for exercise than the same tracks without lyrics. Sport and exercise psychology researchers suggest that lyrics can play an important role in sport and exercise settings through the affirmations or task-relevant cues they provide (e.g., Bishop et al., 2007). Thus, the lyrical content of music warrants further investigation in order that we might better understand its role and harness its motivational and affective properties.

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Table 1

BMRI-2 Scores (Mean and Standard Deviation) for Tracks with Lyrics (ML; n = 26) and Tracks without Lyrics (NL; n = 22)

Track No.	Song Title	Artist	Music Condition	BMRI-2
1	Now You're Gone	Basshunter	ML NL	12.31 (6.12) 11.41 (4.64)
2	It's Over Now	Big Ang. ft. Siobham	ML NL	14.19 (7.83) 15.60 (5.95)
3	Yeah Yeah	Bodyrox	ML NL	15.42 (7.59) 19.09 (7.98)
4	Perfect (Exceeder)	Mason vs. Princess Superstar	ML NL	14.27 (6.60) 15.32 (5.75)
5	Uninvited	Freemasons	ML NL	23.15 (7.34) 13.45 (6.99)
6	I Like To Move It	Real2Real ft. The Mad Stuntman	ML NL	11.88 (5.44) 12.45 (7.76)
7	Crazy In Love	Beyoncé	ML NL	17.73 (7.60) 18.41 (7.29)
8	Firestarter	The Prodigy	ML NL	18.42 (10.53) 12.27 (6.09)

Note. The descriptive statistics recorded here are pre-transformation.

Table 2

Positive Affect (PA) and Negative Affect (NA) Values (Mean and Standard Deviation) before (pre-trial) and after (post-trial) Cycling under Conditions of Lyrics, No Lyrics and a No-music Control

	Music condition	Pre-trial	Post-trial
PA	Lyrics	15.48 (4.11)	19.24 (4.07)
	No lyrics	15.44 (3.97)	19.56 (3.56)
	No music	15.52 (3.08)	18.40 (4.01)
NA	Lyrics	7.44 (2.96)	6.40 (2.10)
	No lyrics	7.56 (2.77)	6.16 (1.62)
	No music	7.72 (3.33)	6.28 (2.21)

Table 3

Heart rate and RPE Responses (Means and Standard Deviations) at 2, 4, and 6 min while Cycling under Conditions of Lyrics, No Lyrics, and a No-music Control

Heart Rate (bpm)	2 min	4 min	6 min	Overall
Lyrics	136.84 (14.37)	141.64 (23.09)	154.52 (19.24)	140.20 (13.56)
No lyrics	139.00 (13.35)	148.84 (17.43)	154.40 (21.13)	145.40 (15.26)
No music	136.77 (12.49)	142.80 (14.63)	144.52 (32.49)	140.49 (14.03)
RPE	2 min	4 min	6 min	Overall
Lyrics	10.76 (1.98)	12.08 (1.89)	13.68 (2.11)	11.83 (1.66)
No lyrics	10.72 (1.70)	12.36 (1.68)	13.68 (2.10)	11.84 (1.49)
No music	11.16 (1.89)	12.52 (1.56)	13.96 (2.26)	12.16 (1.54)

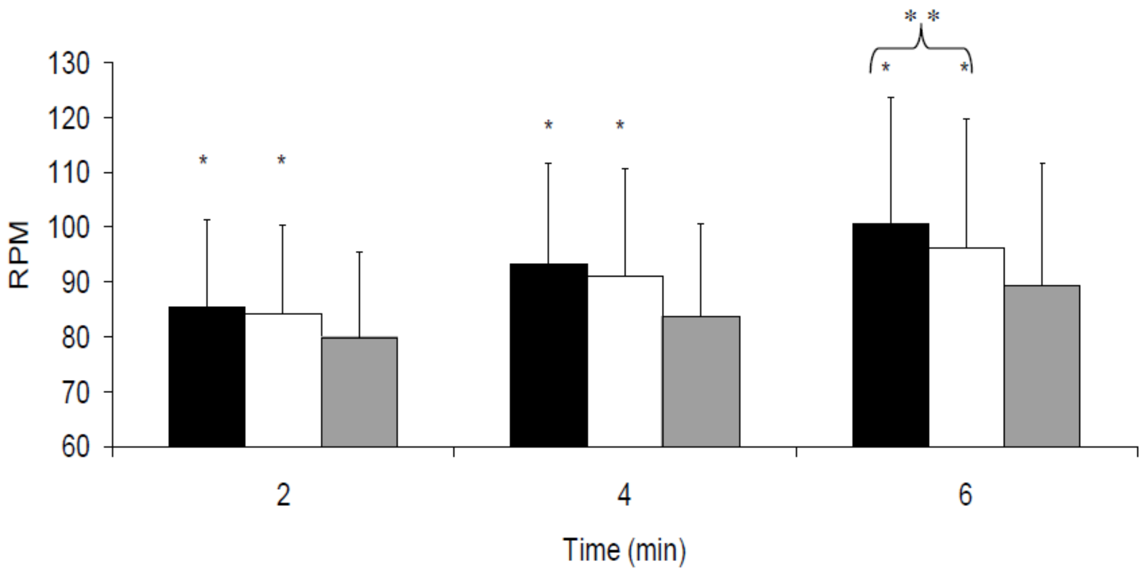

Figure 1. Mean RPM responses at each 2 min interval during the 6-min cycling trial for ML (black bar), NL (white bar) and NM (striped bar) conditions. T-bars represent standard deviation. *Differs significantly (p = .006) from NM condition. * *ML differs significantly (p = .010) from NL.