Running Head: ATTENTIONAL STYLE AND ASYNCHRONOUS MUSIC

Moderating Influence of Dominant Attentional Style and Exercise Intensity on Psychological and Psychophysical Responses to Asynchronous Music

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Abstract

We examined independent and combined influences of asynchronous music and dominant attentional style (DAS) on psychological and psychophysical variables during exercise using mixed methods. Participants (*N* = 34) were grouped according to DAS and completed treadmill runs at three intensities (low, moderate, high) crossed with three music conditions (motivational, oudeterous, no-music control). State attentional focus shifted from dissociative to associative with increasing intensity and was most aligned with DAS during moderate-intensity exercise. Both music conditions facilitated dissociation at low-to-moderate intensities. At high exercise intensity, both music conditions were associated with reduced RPE among participants with an associative DAS. Dissociators reported higher RPE overall during moderate and high intensities. Psychological responses were most positive in the motivational condition, followed by oudeterous and control. Findings illustrate the relevance of individual differences in DAS as well as task intensity and duration when selecting music for exercise.

Keywords: Affect, Association, Attentional Flexibility, Dissociation, Motivation

Despite the burgeoning literature on the psychological and psychophysical effects of music, there has been a noticeable dearth of empirical investigations that address the role of dominant attentional style (DAS; Lind, Welch, & Ekkekakis, 2009). Unlike a trait, which is seen as a stable aspect of one's personality, *dominance* implies "a bias for one or other state in a given pair of states" (Frey, 1999, p. 13). An important factor in the study of the effects of music during exercise is that the musical experience is highly individual (see e.g., Priest & Karageorghis, 2008). Cognitive styles have been shown to affect the perception of an external stimulus such as music by focusing attention to the different features and aspects of the stimulus (Kreutz, Schubert, & Mitchell, 2008). Accordingly, DAS may contribute significantly to the variability of the effects of music during exercise.

Attentional Focus

Two distinct cognitive styles determine the ways in which exercisers allocate their attention focus relative to exertional experiences. *Association* is a cognitive strategy in which the individual attends to the body's internal cues such as muscle tension, breathing, and/or performance-related information such as pace or distance completed. Conversely, *dissociation* is a cognitive strategy in which the individual focuses their attention on task-unrelated cues, such as problem solving, daydreaming, or listening to music; thereby restricting the influence of sensory information from the body (Hutchinson & Tenenbaum, 2007). The individual ability to shift between association and dissociation during exercise, termed *attentional flexibility*, has been identified as a research topic that warrants further attention (Moran, 1996, p. 163).

The findings of early work indicated that elite distance runners largely have an associative attentional style (e.g., Morgan & Pollock, 1977) and are thus less likely than their recreational counterparts to derive benefit from dissociative strategies, such as listening to music.

Despite the intuitive logic and applicability of this principle, there remains the possibility that attentional focus is dynamic in nature and thus varies in accordance with situational demands (Lind et al., 2009). For example, there is tentative evidence to suggest that during low-intensity activities, elite athletes employ dissociative strategies (Masters & Lambert, 1989) given the appropriateness of such strategies to the situation. Nevertheless, the assumption that individuals with an associative attentional style derive less benefit from an external stimulus, such as music, than those with a flexible or dissociative DAS, has yet to be empirically tested.

Benefits of Music in Exercise and Underlying Mechanisms

In a recent review, Karageorghis and Priest (2012a, 2012b) summarized the main benefits of *asynchronous* (background) music on exercise: Music exerts an ergogenic effect, either through delayed onset of fatigue or increased work capacity, and influences psychological variables, such as arousal, and affective valence; typically increasing psychomotor arousal and rendering the exercise experience a more positive one. Music also has a related psychophysical effect, in that it influences the exerciser’s subjective perception of effort and fatigue, although such reductions only appear to manifest at low-to-moderate exercise intensities (e.g., Razon, Basevitch, Land, Thompson, & Tenenbaum, 2009). Whether such effects are consistent across participants with differing attentional styles has, to date, been solely a matter of speculation among researchers (Hutchinson et al., 2011; Karageorghis & Priest, 2012b).

One of the key mechanisms underlying these effects is that music distracts the listener from unpleasant stimuli associated with exercise. From a parallel processing perspective (Rejeski, 1985), it is hypothesized that dissociative strategies ameliorate the effects of fatigue by occupying limited channel capacity that is critical to bringing bodily-related sensory cues into conscious awareness. Rejeski notes that this is not a passive process, but rather an active one that is amenable to cognitive manipulations. This notion of continuous and dynamic competition between internal and external cues, together with the active channeling of sensory input into and away from focal awareness, forms the basis for the dual-mode model of affective responses to exercise (DMM; Ekkekakis, 2003). The DMM, along with Tenenbaum's (2001) social-cognitive model of perceived effort, postulates that at higher levels of fatigue, *bottom-up processes* direct attention more strongly than *top-down processes*. That is, as exercise intensity increases, internal, sensory cues will dominate attention, even when an athlete is strategically trying to maintain a dissociative, external focus (Hutchinson & Tenenbaum, 2007). Researchers have pointed to the physiological phenomenon of the ventilatory threshold (VT) as best representing this critical transition point during aerobic-type tasks (Ekkekakis; Karageorghis & Priest, 2012a).

Although ratings of perceived exertion (RPE) may not be amenable to external attentional manipulation during high exercise intensities, there is burgeoning evidence that music appears to alter how one interprets or responds to fatigue-related symptoms (e.g., Karageorghis et al., 2009). *Motivational music*, that is music with a fast tempo (> 120 beats per minute [bpm]) and strong rhythmic qualities that stimulates or inspires physical activity (Karageorghis, Terry, & Lane, 1999), has been shown to improve exercise-induced feeling states when compared to *oudeterous* (motivationally "neutral"; see Karageorghis et al., 1999) music and no-music control conditions (Karageorghis et al., 2009, 2013). Analogous findings were reported by Terry, Karageorghis, Mecozzi Saha, and D'Auria (2012) who compared affective valence scores across four exercise intensities (76%, 82%, 87%, and 99% VO_2 peak) and reported more positive affect in response to the motivational music condition compared to the oudeterous music and control conditions; a difference that was most pronounced at the highest exercise intensity. Moreover, both motivational and oudeterous music have been shown to positively influence state motivation during high-intensity exercise when compared to control conditions (Hutchinson et al., 2011; Karageorghis et al., 2013). Therefore, music that is sufficiently high in motivational qualities appears to "color" the interpretation of fatigue-related symptoms during high-intensity exercise.

Aims of the Current Study

The rationale underlying the present study was that, to date, there has been no research examining how individuals with different attentional styles respond to musical stimuli at varying exercise intensities. Moreover, the nature of the interaction of the motivational qualities of music with DAS is unknown. The use of motivational and oudeterous music in an exercise context, wherein physical load can be manipulated, provides a framework for such individual differences to be examined. Thus, the aim of the present study was to examine how exercise participants, who were grouped in terms of DAS (associators/dissociators/switchers), would respond to two music conditions (motivational and oudeterous) and a no-music control during treadmill exercise at three intensities (low, moderate, and high).

A range of outcomes was considered that spanned both psychological and psychophysical variables. Firstly, we examined state attentional focus to quantify the distraction effect of motivational and oudeterous music. Secondly, we included RPE[1] as an indicator of the psychophysical effect of music. Thirdly, we incorporated two measures of affective response to exercise: Affective valence (i.e., pleasure–displeasure) and *perceived activation*, which is "the degree to which an individual feels 'worked up' at a given time" (Frey, 1999, p. 5). The final measure was situational motivation, a gestalt state measure of participants' motivational experience, grounded at the situational level of motivation (see Vallerand, 2007).

Hypotheses

State attentional focus. We expected that participants would employ their dominant attentional strategies at low and moderate work intensities but at the high intensity, all groups would shift toward association (cf. Tenenbaum, 2001). All participants were expected to report greater dissociation in the two music conditions relative to the no-music control.

Ratings of Perceived Exertion. We hypothesized that RPE would be lower during the two music conditions at low and moderate intensities, but not at the high intensity owing to the predominating influence of fatigue-related symptoms on attentional processing (Rejeski, 1985; Tenenbaum, 2001). At low and moderate exercise intensities, dissociators were expected to derive greater benefit from the presence of music in terms of lower RPE than both associators and switchers. This was due to the fact that music listening, particularly to asynchronous music, is widely regarded as a dissociative attentional strategy (see e.g., Karageorghis & Priest, 2012a).

Psychological variables. We expected an enhanced psychological response (i.e., more positive affective valence, and greater activation and situational motivation) during the two music conditions when compared to control at both low and moderate exercise intensities. Moreover, we expected that the motivational condition would yield superior psychological effects when compared against the oudeterous condition (cf. Terry et al., 2012). At the high intensity, the enhanced psychological response was expected to manifest in the motivational music condition only (Karageorghis et al., 2009).

Overall, dissociators were expected to exhibit more positive psychological responses during the two experimental conditions when compared to associators, owing to the particular relevance of the distracting stimulus to them. Participants with a flexible attentional style (i.e., switchers) were expected to exhibit the least variation across the range of psychological variables, as they are predicted to be better able to adapt to both music and no-music control conditions (cf. Nougier & Rossi, 1999).

The present analysis also included time intervals within the exercise bout as an independent variable manipulation (minute 2, minute 4, and minute 6). No a priori hypotheses were set in relation to this variable and thus it was included to explore how participants would respond to musical stimuli during the course of a bout of short-duration exercise. It was also used in tandem with post hoc qualitative data to elucidate participants' individual strategies in the use of music during the exercise bout (see e.g., Priest & Karageorghis, 2008).

Methodology

Stage 1: Participant and Music Selection

Initial participant screening. Institutional ethical clearance was obtained for all three stages of the present study. A group of applied exercise science majors at a northeastern university (N = 138) completed an ACSM (2010) pre-exercise screening tool and the Attentional Focusing Questionnaire (AFQ; Brewer et al., 1996). Inclusion criteria were that participants were habitually active (as per ACSM guidelines, 2010) and deemed sufficiently healthy for exercise according to the pre-exercise screening tool, but not current intercollegiate athletes. Participants also had to be music listeners and free from any hearing impairments. Those participants not meeting the aforementioned inclusion criteria (n = 83) were eliminated from the initial participant pool. Based on the AFQ results, a composite variable of association and dissociation was computed (c.f. Masters & Ogles, 1998) to classify the remaining eligible volunteers as either *associators* (those with a dominant associative attentional style), *dissociators* (those with a dominant dissociative attentional style), or attentional *switchers* (those with a tendency to shift between the two attentional styles; Moran, 1996, p. 71).

A power analysis was conducted, using G*Power 3 (Faul, Erdfelder, Buchner, & Lang, 2009), to establish appropriate sample size for a 3 (Attention Group) x 3 (Exercise Intensity) x 3 (Music Condition) mixed-model design; the time interval factor, which was included for exploratory purposes, was not included in the power analysis. Alpha was set at .05 and power at .8 to protect beta at four times the level of alpha (Cohen, 1988, p. 5). Predicting a large size for the effect of asynchronous music compared to a no-music control ($f = 0.6$, Hutchinson et al., 2011), it was estimated that 34 participants would be required for a multivariate analysis. Using a table of random numbers, 13 from each group were invited to participate in the experimental phase of the study with the result that 13 associators, 10 dissociators, and 11 switchers were recruited ($N = 34$; 22 male, 12 female). Participant characteristics are presented in Table 1.

Music selection. A sample of 40 volunteer undergraduate students (26 male, 13 female; $M_{age} = 19.1$ years, $SD = 2.4$ years) from the same northeastern university were asked to nominate musical selections for use in the experimental phase. These volunteers shared a similar demographic profile to the experimental participants (see e.g., Karageorghis et al., 2013). The eight most frequently recommended tracks that met published guidelines for selecting music for exercise and sport (Karageorghis & Terry, 2011, pp. 211-218) were rated according to their motivational qualities for treadmill exercise by a panel of nine students (five females, four males; $M_{age} = 21.5$ years, $SD = 2.4$ years) using the Brunel Music Rating Inventory-3 (Karageorghis & Terry, p. 211). This procedure was undertaken to ensure that the tracks within each experimental condition would be equivalent in terms of their motivational qualities and would differ significantly ($p < .05$) between experimental conditions. Panel members were representative of the intended experimental participants in terms of age, gender, ethnicity, and socio-cultural background, but were not involved in the experimental phase.

Tracks were selected to construct two music conditions: the two highest-rated tracks were used for the motivational music condition while two middle-order tracks were selected for the oudeterous music condition (cf. Terry et al., 2012). The middle-order tracks matched the motivational tracks in terms of chart popularity and musical genre (Karageorghis et al., 1999). Track tempo in the experimental conditions was standardized at 130 bpm (see Karageorghis et al., 2010). A list of tracks can be requested from the first author.

Stage 2: Pre-test and Habituation Trials

During the first visit to the laboratory, participants' resting heart rate (HR_{rest}) and maximal heart rate (HR_{max}) were measured (see details in Table 1). HR_{rest} was determined following a 5-min period of seated rest, after which two heart rate (HR) readings were taken 1 min apart. The rest period was extended in the event that these two readings differed by more than 5 bpm. To determine exercise-induced HR_{max}, participants completed a progressive maximal exercise test (McConnell, 1988) to volitional exhaustion. From the subsequent data, target HR for the experimental trials was calculated for each participant using the heart rate reserve (HRR) formula (ACSM, 2010):

$$\text{Target HR} = [(HR_{max} - HR_{rest} \times \% \text{ intensity desired}) + HR_{rest}]$$

Experimental trials were conducted at 45%, 65%, and 85% HRR, representing low, moderate, and high-intensity exercise respectively.[2] During a second laboratory visit, participants were habituated to these three levels of intensity. For both the habituation and experimental trials, the task intensity (i.e., treadmill belt velocity) was adjusted by the experimenter until the target HR (± 3 bpm) was achieved, and monitored thereafter with any necessary adjustments made to ensure that the prescribed relative exercise intensity was maintained. Target HRs for the three task intensities are presented in Table 1.

Stage 3: Experimental Investigation

Apparatus and measures. A motorized treadmill (Noramco HS Elite) was used for testing and HR was collected via telemetry (Polar E600). Music was played on a portable stereo system (Sony CFD-G700CP Xplod), and music intensity (i.e., volume) was measured at ear level using a digital sound level meter (Extech 407730). Music intensity was standardized at 75 dBA; this sound level is typical of most exercise facilities and safe from an audiological perspective (Alessio & Hutchinson, 1991).

In-task measures. State attentional focus (SAF) was assessed using Tammen’s (1996) single-item Attention Scale, following procedures detailed by Razon et al. (2009). RPE was assessed by means of Borg’s (1998) 11-point scale with ratio properties. Affective valence was assessed using Hardy and Rejeski’s (1989) Feeling Scale (FS). Perceived activation was assessed using the Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985). Situational motivation (SM) was assessed using a 10-point state motivation scale (see Tenenbaum, Kamata, & Hayashi, 2007).

Post-task interview. In order to corroborate the findings with qualitative data and incorporate the viewpoints of experimental participants, a post-task interview was conducted. The interview followed a schedule of open-ended questions, and probing was used to elucidate the precise meaning given by the participants to their experiences during testing. The interviews were recorded digitally on a laptop computer (Dell Latitude E6410) using sound recording software (RecordPad) and transcribed verbatim prior to inductive content analysis.

Procedure

Participants completed a series of 7-min treadmill runs under three intensity conditions (low [45% HRR], moderate [65% HRR], and high [85% HRR]) crossed with three auditory conditions (motivational music, oudeterous music, and a no-music control condition) to create a total of nine conditions: (a) Low intensity, motivational music; (b) Low intensity, oudeterous music; (c) Low intensity, no music; (d) Moderate intensity, motivational music; (e) Moderate intensity, oudeterous music, (f) Moderate intensity, no music; (g) high intensity, motivational music; (h) High intensity, oudeterous music; and (i) High intensity, no music. A mixed-model design was used wherein participants completed all conditions once. The nine conditions were administered over three separate testing sessions, with three conditions (each separated by 5-min of rest) per session. The order of presentation was fully counterbalanced using a Latin square table. Testing sessions were conducted at weekly intervals, at the same time of day, following an identical pattern of diet and physical activity. Further, participants were asked not to eat within 2 hr prior to testing or consume caffeine within 12 hr.

Each experimental trial began with a 2-min warm-up (brisk walk), during which no music was played. Participants then commenced the 7-min test run with the appropriate exercise/auditory condition. HR was monitored continuously during testing and recorded at 60-s intervals. In-task measures were taken at minutes 2, 4, and 6 of the task. Upon completion of the task, the treadmill was slowed to facilitate a 2-min cool-down walk without music. The post-test interview was administered immediately following the final (ninth) condition.

Data Analysis

Data were screened for univariate outliers ($z > \pm 3.29$) and for multivariate outliers using the Mahalanobis distance method ($p < .001$). Following checks to ensure that the data were suitable for parametric analysis, four-way mixed-model 3 x 3 x 3 x 3 (Attention Group x Task Intensity x Music Condition x Time Interval) repeated-measures ANOVAs and MANOVA were computed. In cases where the sphericity assumption was violated in the ANOVAs/MANOVA, Greenhouse-Geisser adjustments were made to the relevant *F* test. Significant multivariate results were examined using univariate ANOVAs with Bonferroni adjustment to control for experimentwise error. Step-down *F* tests and pairwise comparisons with Bonferroni adjustments were used to identify where any differences lay. The post-test qualitative data were analyzed using inductive content analysis (see Marshall & Rossman, 2011, pp. 214–221), with statements being grouped together into thematic categories that were then further grouped until a point of redundancy was reached. This process was validated by two researchers with experience of similar analyses.

Results

Checks for univariate outliers indicated four univariate outliers ($z > \pm 3.29$) and in all instances, the score was adjusted by assigning the outlying cases a raw score on the offending variable that was one unit larger or smaller (as appropriate) than the next most extreme score in the distribution until $z < \pm 3.29$ (see Tabachnick & Fidell, 2007, p. 77). No multivariate outliers were identified. Tests of the distributional properties in each cell of the analysis ($k = 567$) revealed violations of the normality assumption in 21 cells (5%; standard skewness and standard kurtosis > $\pm$ 2.58). To deal with instances of significant negative skewness ($k = 10$) we ran *reflect and square root* transformations (Tabachnick & Fidell, pp. 86–91). To deal with instances of positive skewness ($k = 11$) we ran *square root* transformations. The transformations resulted in normal distributions in all variables that had exhibited non-normality with the exception of RPE in which transformation made no discernible improvement. There were seven instances of non-normality among the RPE variables and it should be noted that these data were not normalized prior to computation of the mixed-model MANOVA, given that transformation resulted in instances of non-normality in cells that were previously normally distributed. Collectively, the diagnostic tests and subsequent adjustments (transformations) indicated that the assumptions underlying mixed-model ANOVA and MANOVA were satisfactorily met with the exception of seven cells from the RPE data, which should be interpreted with caution; although ANOVA and MANOVA are reasonably robust in such instances (see Stevens, 2002, p. 261).

ANOVA and MANOVA results are presented in Table 2. Results were examined in a top-down fashion, inspecting the highest-order interaction term first and then moving down to interactions of the next lower order (i.e., three-way), until reaching the main effects. In many instances, the significance of the lower-order interactions was rendered moot by the presence of the higher-order interaction (Fox, 1997, p. 183). We report them for completeness, but in the interests of parsimony, we do not expound such findings, except where they pertain directly to our research hypotheses.

Attentional Focus Results

Interaction effects. A significant four-way interaction for attentional focus would indicate a different pattern of SAF response for each of the DAS groups across exercise intensities, music conditions, and time points. The significant four-way interaction (see Table 2 and Figure 1), indicated that when exercise intensity was low, there was no difference in the state attentional focus (SAF) of the three dominant attentional style (DAS) groups in any of the music conditions or at any of the time points. All DAS groups leaned toward a dissociative attentional focus during low-intensity exercise.

During moderate-intensity exercise two key differences emerged: Firstly, in the two music conditions, the groups were most closely aligned with their DAS; associators exhibited the greatest degree of association, and similarly, dissociators exhibited the greatest degree of dissociation. This effect was also present in the no-music control condition at minute 2, but in this condition group differences diminished over time, such that there was no difference in SAF by minute 6 (see Figure 1). Secondly, oudeterous music influenced the SAF of the three groups differently over time: The associative group became increasingly associative, the dissociative group became increasingly dissociative, and the switchers remained stable.

During high-intensity exercise, the associative group reported greater association than either the dissociators or the switchers during the motivational- and no music conditions. This difference was pronounced at the outset of the run (minute 2 and 4), but diminished over time as all groups became more associative in their focus, such that the effect was not evident at the end of the run (minute 6).

Main effects. The significant main effect for task intensity ($p < .001$) indicated that the higher the exercise intensity, the more associative participants' SAF was. Pairwise comparisons revealed that the difference in SAF between low- and high-intensity exercise was significant ($p = .001$), as was the difference between moderate- and high-intensity exercise ($p = .008$). The difference between low- and moderate-intensity exercise did not reach statistical significance ($p = .065$), although the difference between means was in the expected direction.

Following a significant main effect for music condition, pairwise comparisons revealed greater dissociation in the motivational music condition when compared to the oudeterous ($p = .014$) and no-music ($p < .001$) conditions. The difference between the oudeterous and no-music conditions also reached significance ($p = .005$).

Perceived Exertion Results

The significant Group x Task Intensity x Music Condition interaction revealed that at the high exercise intensity, RPE differed significantly ($p = .001$) among DAS groups in the motivational music condition; it was highest among dissociators, then switchers, and lowest among associators (see Figure 2). Associators appeared to derive the most benefit in RPE terms from both music conditions when compared to dissociators. Notably, RPE was higher among dissociators when compared to associators in the two music conditions. RPE was also higher among dissociators in the moderate-intensity control condition when compared to associators and switchers.

Affective Response Results

Interaction effects. Following the significant three-way interaction for Group x Task Intensity x Music Condition (see Table 2), a univariate analysis with Greenhouse-Geisser adjustments for FAS data revealed a large effect: $F(6.48, 73.22) = 3.89$, $p = .001$, $\eta_p^2 = .20$. Among associators and switchers during low-intensity exercise, perceived activation differed across the three music conditions. It was highest in the motivational music condition, followed by the oudeterous music condition, and lowest in the no-music control. However, during moderate- and high-intensity exercise, perceived activation was enhanced only by motivational music, with no significant difference between oudeterous music and the no-music control (see Figure 3). Among dissociators a different pattern emerged: During low-intensity exercise, perceived activation differed only between the motivational and no-music control conditions, with the former engendering greater activation. During moderate-intensity exercise, activation was enhanced by both music conditions compared to control, and during high-intensity exercise, there was no effect of music-type on activation (see Figure 3).

Following the significant Task Intensity x Music Condition interaction, follow-up univariate analyses showed a moderate effect for FS data, $F(4, 124) = 4.09$, $p = .004$, $\eta_p^2 = .12$. During low- and moderate-intensity exercise, affective valence was more positive with music than without, but there was no difference between motivational and oudeterous music. During high-intensity exercise, affective valence was more positive with motivational music compared to the oudeterous music and no music conditions. There was no difference between oudeterous music and no-music when exercise intensity was high (see Figure 4).

Main effects. The RM MANOVA revealed significant main effects related to our research hypotheses for DAS group and music condition.

***Attentional style group*.** Follow-up univariate analysis for FAS data revealed a large effect: $F(2, 31) = 5.98$, $p = .006$, $\eta_p^2 = .28$. Pairwise comparisons revealed that switchers reported the highest level of perceived activation followed by associators ($p = .050$) and then dissociators ($p = .002$). The follow-up univariate analysis for FS data was nonsignificant ($p = .637$).

***Music condition*.** Follow-up univariate analyses with Greenhouse-Geisser correction showed a large effect for both FS data, $F(1.43, 44.33) = 23.33$, $p < .001$, $\eta_p^2 = .43$, and FAS data, $F(1.52, 47.17) = 25.58$, $p < .001$, $\eta_p^2 = .46$. Pairwise comparisons revealed that affective valence was most positive in the motivational music condition followed by the oudeterous condition, and least positive in the no-music control; all differences at $p < .001$. Pairwise comparisons also indicated that perceived activation was highest in the motivational condition, followed by the oudeterous and then control conditions; all at $p < .001$.

Situational Motivation Results

Interaction effects. A significant four-way interaction (see Table 2 and Figure 5) revealed that at the beginning of the high-intensity motivational music condition, dissociators and switchers reported higher situational motivation (SM) than associators. Nonetheless, as the task progressed, SM declined among switchers and dissociators (by 11% and 9% respectively from minute 2 to minute 6), indicating that the motivational impact of the music waned for these groups. Contrastingly, SM showed a 9% increase over time among associators. Thus by the end of the run, there was no group difference in SM. A similar pattern was evident in the high-intensity oudeterous and moderate-intensity motivational conditions, and for switchers only in the low-intensity oudeterous condition (see Figure 5).

At both moderate and low task intensity, the SM of associators and dissociators differed across conditions; it was highest in the motivational music condition, followed by the oudeterous music condition, and then the no-music control. The SM of switchers did not differ across conditions at moderate task intensity, and this group maintained the highest SM in the no-music control. At low task intensity, the SM of switchers was enhanced by both music conditions compared to control, although a different time pattern emerged wherein SM declined over time in the oudeterous music condition, but increased over time in the motivational music condition.

Main effects. Following a significant main effect for music condition, pairwise comparisons revealed that SM was significantly higher in the motivational music conditions than in either the oudeterous (p = .026) or no-music conditions ($p < .001$). SM was also significantly higher in the oudeterous compared to the no-music control condition ($p < .001$).

Qualitative Data

Participants indicated that the presence or absence of music during the running task elicited three broad categories of response that related to attentional focus, affective state, and behavioral responses (see Table 3). In terms of SAF the majority (74%) of participants indicated that they used the music to facilitate dissociation from the task. However, eight participants (24%) indicated that they used the music differently depending on the task intensity, using the music associatively for the faster runs and more dissociatively for the slower-paced runs. Most of these participants (12%) were switchers; however associators (6%) and dissociators (6%) also described that they used music in different ways depending on the task intensity.

With reference to affective state, all participants with the exception of one (associator) indicated that the music had a positive influence on how they felt and that it was preferable to complete the task with music than without. In terms of perceived activation, most participants indicated that the motivational music raised their activation level while the oudeterous music promoted relaxation, or had no effect at all.

Motivational music, and to a lesser extent oudeterous music, led to behavioral responses in terms of greater task motivation and a pattern of *entrainment* or auditory-motor synchronization with the beat. Several participants commented on coordinating their running stride rate with the beat of the music; notably none were dissociators (see Table 3). Distinct differences in SM emerged between the motivational and oudeterous music. Consistent with the results of the quantitative analysis, all participants commented that the motivational music, in particular, made them want to work harder. Four participants (three switchers, one associator) specified that motivational music had the greatest effect during the high-intensity condition.

Most (42%) participants felt that the music had a consistent effect on how they felt throughout the trial, although 26% said the music was more beneficial at the beginning, and 12% said it was more so at the end. The following quote provides some insight into the ways in which participants might use music differently depending on the stage of an exercise bout: “In the beginning it helps get me going, then in the middle it stops me feeling bored, and at the end it helps me tough it out and keep going, even when I am tired” (associator). Demonstrating the complexities of the music-exercise relationship, several participants commented that the consistency of the effect was dependent on the track, the task intensity, or both, for example: “For high intensity it [music] starts off motivating me, but then, blah, it wears off” (dissociator).

Lastly, participants were asked to detail the music they would prefer to listen to during a low-, medium-, and high-intensity run. At low intensity the majority (88%) of participants said they prefer something “soft and flowing” or something “acoustic”. However, three participants (one associator, two switchers) said they prefer to have no music during an easy run. For a medium-intensity run participants’ responses were variable, but a noticeable pattern pertaining to attentional style was evident. Associators mostly said they would like something motivational and fast-paced. Specific suggestions included the artists David Guetta, Pitbull, and Linkin Park. In contrast, dissociators appeared far more influenced by the lyrical content of the music, and several suggested that the music selections should comprise of “anything I can sing along to”. There was less consistency among the switchers; three participants suggested upbeat techno music, while an equal number said they would prefer not to have music at all, and others said “it depends on my mood”. When it came to a high-intensity run, all groups said they would want music, with the vast majority opting for either rock or rap music; for example, “Some kind of rap or hard rock; something to make me push harder” (associator). Several participants also mentioned the importance of the emotional characteristics of a track for a high-intensity run. One associator referenced emotion, as well as the anticipation of an especially motivational segment of a song (a concept defined by Priest & Karageorghis [2008] as *segmentation*):

> For hard workouts I love Dubstep because of the intensity. It is angry music. When I listen to it I feel huge. There are parts of the song where it goes quiet, then the beat drops and it is like ‘boom’ and you wanna go crazy. I push harder at those times, definitely.

Discussion

The main aim of the present study was to examine how exercise participants who were grouped in terms of DAS would respond to two music conditions and a no-music control during low-, moderate-, and high-intensity treadmill exercise. The dependent measures spanned both psychological (state attentional focus, affective response, and situational motivation) and psychophysical (i.e., RPE) variables.

Attentional Focus

We hypothesized that all attention groups would exhibit greater dissociation in the two music conditions relative to control and this hypothesis was supported. This finding supports Terry and Karageorghis's (2006) conceptual framework for the benefits of music in sport and exercise contexts, where dissociation from unpleasant feelings is identified as one of the potential benefits exercisers might derive from listening to music. Indeed this was the first time that this prediction of the conceptual framework has been tested directly; previous studies had used versions of Borg's RPE scale rather than directly measuring attentional focus.

We hypothesized that participants would employ their DAS during low- and moderate-intensity exercise but at the high intensity, all groups would shift toward association (Tenenbaum, 2001). This hypothesis was only partially supported. Contrary to expectations, all DAS groups reported a dissociative attentional focus during low-intensity exercise. This finding is consistent with Hutchinson and Tenenbaum's (2007) findings wherein dissociation was the prevailing attentional strategy employed during low-intensity exercise. Our current results demonstrate that this finding is reliable, and still applies to those with an associative style. Our findings also lend indirect support to those of Masters and Lambert (1989) who reported that even elite athletes employ dissociative strategies during low-intensity training when such a strategy is appropriate to the situation.

As predicted, participants' SAF was consistent with their DAS at moderate intensity exercise. The three DAS groups appeared to be influenced differently by oudeterous music at moderate task intensity (i.e., dissociators became increasingly dissociative as the task progressed, while associators became increasingly associative, and switchers showed no change; see Figure 1). This finding is consistent with previous research that has demonstrated the greatest variability in SAF at moderate task intensity (Hutchinson & Tenenbaum, 2007). The finding that dissociators exhibited greater dissociation than associators and switchers in this condition would suggest that the qualities of the music are not as important to them as the presence of music per se at this intensity/time point. This finding highlights the necessity of further work to examine differences in responses between music conditions among dissociators.

As expected, all DAS groups exhibited a shift toward a more associative attentional focus during high-intensity exercise. A significant ($p < .001$) main effect for task intensity showed that the greater the exercise intensity, the more internally focused participants were. Thus Tenenbaum’s (2001) model was supported by the present findings. These findings are in keeping with with other research (e.g., Hutchinson & Tenenbaum, 2007; Razon et al., 2009) that has demonstrated an *attentional shift*, where internal, sensory cues begin to dominate attentional focus as exercise intensity increases. The present finding advances the extant literature by demonstrating that this shift occurs regardless of DAS.

During high-intensity exercise some interesting findings emerged pertaining to the independent variable of time interval, for which no a priori hypotheses were set. In the motivational music condition, attentional focus became increasingly associative for all three DAS groups as the task progressed (see Figure 1). Accordingly, it appears that motivational music initially functions as a distractor during high-intensity exercise but the effect is relatively short-lived, and does not hold for the duration of the run. This finding is consistent with the work of Atkinson, Wilson, and Eubank (2004) wherein music improved performance during the first few minutes of a 10-km cycling time trial. It is similarly consistent with Hutchinson et al.'s (2011) findings, wherein motivational music positively influenced peak power during a 30-s anaerobic test, but the effect did not last beyond the initial 5-10 s of the test. The implications of these findings are that the propensity of motivational music to facilitate a dissociative attentional focus during high-intensity exercise is limited. This supports the notion that music motivates rather than promotes dissociation during high-intensity exercise (Atkinson et al.).

Perceived Exertion

We hypothesized that the two experimental conditions would yield lower RPE when compared against a no-music control at both low- and moderate-task intensities. No differences in RPE were expected at the high-task intensity, in line with previous research (e.g., Hutchinson et al., 2011) and theoretical predictions (Ekkekakis, 2003; Rejeski, 1985; Tenenbaum, 2001). This hypothesis was not accepted as there was no main effect for music condition. However, a significant Group x Task Intensity x Music condition interaction effect revealed that motivational music affected RPE only among associators during the high-intensity condition. As well as not being concordant with our research hypothesis, this finding is inconsistent with theories deriving from the information processing approach to attention (e.g., Rejeski, 1985; Tenenbaum, 2001) and with previous research, which has shown that music has a greater influence on RPE at low-to-moderate intensity levels (e.g., Razon et al., 2009). Moreover, we had hypothesized that dissociators would derive greater psychophysical benefit from the presence of music than both associators and switchers. This hypothesis was not supported given that there was no main effect for group. The aforementioned interaction effect revealed that, at the high intensity, associators actually appeared to derive the greatest psychophysical benefit from the music conditions.

To date, the ways in which people use music to facilitate an attentional strategy have not been investigated. Our qualitative data indicate that there is considerable variability in the ways in which people use music during exercise. At lower exercise intensities, music was overwhelmingly used to facilitate dissociation, with participants detailing strategies such as singing along and “daydreaming” in response to the music. Contrastingly, at the high exercise intensity, participants described ways in which they used the music in a more associative mode (e.g., “I think about my stride”, “I am able to focus”). Thus, it seems that when exercise intensity is high, the music is coupled with the task demands to a greater degree. Moreover, this approach appears to be favored by participants with an associative DAS (see Table 3).

Kreutz et al. (2008) concluded that music processing depends on individual cognitive style as well as situational factors. Specifically, cognitive style orients listeners’ attention to particular elements of music, such as perceived emotion or musical form. This was evident in our interview data, where the associative participants identified elements such as “emotional intensity” and “rhythmic qualities” as being of importance to them, while dissociators highlighted the importance of melody. The idea that motivational music leads to reduced RPE among participants who exhibit an associative attentional style may warrant further investigation.

Dissociators reported higher RPE than associators or switchers during moderate- and high-intensity exercise. This may be due, in part, to an interruption of preferred attentional focus (i.e., dissociators find it harder to dissociate at moderate-to-high intensities). Using Nideffer’s Test of Attentional and Interpersonal Style, Baghurst, Thierry, and Holder (2004) showed that individuals prefer cognitive strategies that relate closely to their attentional strengths. Furthermore, Baghurst et al. demonstrated that performance was enhanced when participants were assigned an attentional strategy that was aligned with their preferred attentional style, while an alternative strategy had a debilitating effect. Despite the fact that the present study did not include a performance measure, it could be argued that higher RPE at the same relative workload demonstrates a similar debilitating effect. Given that attempts to use music as a dissociative strategy at high exercise intensities are likely to be unsuccessful, or at least short-lived (see Figure 1), a better strategy might be training in attentional flexibility, whereby runners learn to use different attentional strategies as appropriate for the task at hand. Our interview data indicate several ways in which music might be used to facilitate this.

Psychological Measures

We expected affective valence, perceived activation, and SM to be higher (or more positive) in the motivational condition, followed by the oudeterous condition, and then the no-music control. This hypothesis was supported. Affective valence was most positive in the motivational condition, followed by the oudeterous condition, and then the control. This effect was consistent across all independent variables (i.e., group, exercise intensity, and time interval), and the associated effect size was large ($\eta_p^2 = .43$). This result is consistent with previous studies (Edworthy & Waring, 2006; Hutchinson et al., 2011), as well as Terry and Karageorghis' (2006) conceptual framework. Thus, this robust finding appears to hold true regardless of task intensity, music tempo, and volume (Edworthy & Waring), and now DAS. Perceived activation was also highest in the motivational condition, followed by the oudeterous condition, and then the no-music control for all levels of task intensity and regardless of DAS. This is also consistent with Terry and Karageorghis' assertions regarding the arousal control properties of music. SM was highest in the motivational music condition, followed by the oudeterous music condition, and lowest in the control. We can conclude from this that our motivational and oudeterous music selection was appropriate, and that the three groups responded to the music as predicted.

The interactive effect of exercise intensity and music condition demonstrated that during low- and moderate-intensity exercise, affective valence was more positive with music than without, with no difference evident between motivational and oudeterous music. However, during high-intensity exercise, only motivational music had the same effect. In common with other recent findings (Karageorghis et al., 2009; Karageorghis et al., 2010), these results suggest that the motivational qualities of music matter more when exercise intensity is high. This finding indicates the need for careful music selection that is appropriate to the intensity of the task (see Karageorghis et al., 2011). Reflecting on the DMM, it is clear that at moderate-to-high intensities when there is greater variability in exercise-related affect, appropriate music selection is likely to make the exercise experience more pleasurable and this has implications for adherence.

For perceived activation, a Group x Task Intensity x Music Condition interaction effect emerged wherein during moderate- and high-intensity exercise, activation was only enhanced by motivational music among associators and switchers, with no difference evident between oudeterous music and the no-music control. However, among dissociators during moderate-intensity exercise, activation was enhanced by both music conditions, with no difference evident between them. There was no effect of music-type on activation among dissociators during high-intensity exercise. These results demonstrate that during moderate-to-high intensity exercise, associators and switchers may be more sensitive to the motivational qualities of music. Dissociators are stimulated by music per se (regardless of motivational quality) during moderate-intensity exercise, but this effect does not hold during high-intensity exercise. Interview data revealed that dissociators may use music in a different manner than associators and switchers. Specifically, dissociators described dissociative and arousal regulation strategies, whereas associators and switchers were more likely to report that music enhanced their focus and helped them adjust their running pace via the mechanism of entrainment (see Table 3). Taken collectively with the SAF and RPE findings reported earlier, it is plausible that the *ways* in which exercise participants use music play a salient role in its effectiveness. This is an important consideration that should be addressed in future research endeavors.

We hypothesized that dissociators would exhibit more positive affective valence and greater perceived activation in response to the two music conditions than associators. This hypothesis was not accepted as all groups responded in a similar manner; thus it appears that DAS does not moderate affective responses to music. We also hypothesized that dissociators would exhibit greater SM in response to the experimental conditions than associators. This hypothesis was supported in the moderate- and high-intensity conditions, wherein dissociators reported greater SM than associators during both music conditions. Nonetheless, when broken down by time interval, it became clear that this effect did not persist for the duration of the high-intensity run. Therefore, we conclude that dissociators may derive greater SM from experimental music conditions than associators, but when task intensity is high this effect is relatively short-lived. In the low-intensity conditions our research hypothesis was not accepted (see Figure 5).

Finally, we hypothesized that switchers would be able to adapt to both music and no-music control conditions so would show the least discrepancy across the range of dependent variables across these conditions. This hypothesis was not accepted in the case of SAF, RPE, or affective valence. For perceived activation and SM, the hypothesis was supported. Switchers maintained the highest level of perceived activation across intensity levels and music conditions. They also demonstrated the highest overall level of SM and the least variability across conditions. Thus it appears that those with a flexible attentional style are able to maintain higher states of arousal and motivation for a running task, regardless of the motivational nature of musical accompaniment. This conjecture needs to be corroborated by further empirical research.

Summary

The present study was conceived to examine the independent and combined influences of music and attentional style on a range of psychological and psychophysical variables during exercise at varying intensities. Our findings indicate that state attentional focus is predominantly dissociative during low-intensity exercise and becomes progressively associative with increasing task intensity; the greatest moderating influence of attentional style appears to occur during exercise of a moderate-intensity. Music facilitated a dissociative attentional strategy, with all participants exhibiting greater dissociation in the two music conditions; motivational music more so than oudeterous. Nonetheless, during high-intensity exercise this effect was short-lived and participants (specifically those with a dissociative or flexible attentional style) drifted toward association as the task progressed. The absence of an enduring distracting effect during heavy workload is attributed to the dominance of physiological cues during sensory processing; in concert with the attentional shift hypothesis (Razon et al., 2009).

We found no main effect of music on RPE, although when exercise intensity was high, RPE was lower among associators in the motivational music condition. For the variables of affective valance, perceived activation, and situational motivation, the interactive effects of DAS indicated that attentional style moderates the psychological effects of music in complex ways. Among associators and switchers exercising at moderate-intensity, activation was enhanced by motivational music only, while either music condition yielded the same effect for dissociators. Interview data corroborated this finding: Dissociators reported a preference for any music that they could sing along to during low-intensity exercise, while associators and switchers reported a preference for motivational and "up-tempo" music. Specific to affective valence, a task intensity by music condition interaction emerged wherein during low-intensity exercise the mere presence of music, regardless of its motivational qualities, was associated with more positive affective valence. Nonetheless, during high-intensity exercise, this effect was present only in the motivational music condition. This finding suggests that, in terms of affective state, the motivational qualities of music are more salient when exercise intensity is high. This is especially important when considering the variability of affective response at exercise intensities that exceed the VT (Ekkekakis, 2003) and the fact that the positive effects of music on feeling states can lead to increased adherence to exercise (DeNora, 2000, pp. 89–103).

A flexible attentional style was associated with higher activation and SM, and the least amount of variability in SM between conditions. Interview data shed considerable light on the ways in which exercisers might use music in both an associative (e.g., enhanced focus, entrainment) and dissociative manner, depending on attentional style and task intensity.

Limitations of the Present Study

Music preference is highly personal, and in many sport and exercise settings, music is self-selected. It is acknowledged that individual preferences and familiarity might enhance the drive to listen attentively to music, which might in turn influence its distractive qualities. However, as this was an original investigation, experimental control was deemed paramount; allowing participants to self-select music would have severely threatened internal validity (Karageorghis & Priest, 2012b).

A number of dependent variables were assessed at 2-min intervals during the running task. The use of in-task measures was critical to testing the load-dependent hypothesis of attentional focus. However, taking such measures during task engagement may force participants to remain vigilant about their state, which might inhibit the occurrence of dissociative thoughts. Our results demonstrate variability in attention focus across experimental conditions, indicating that this did not prohibit us from finding differences in SAF. Nonetheless, the fact that in-task measures may increase association should not be ignored.

Despite the fact that the physiological parameters of our high-intensity condition (i.e., 85% HRR) fall within the ACSM (2010) classification of "vigorous" exercise, average RPE values reported for the high intensity condition were only 3.75, or "moderate" to "somewhat hard" on Borg's (1998) 10-point scale. Theoretical predictions derived from the information processing approach to attention (e.g., Rejeski, 1985, Tenenbaum, 2001) hold that physiological feedback dominates the capacity of the nervous system during very high-intensity exercise, that is, at intensities that exceed the VT. Thus it is possible that our high-intensity condition was not sufficiently taxing, either in intensity or duration (7 min), to sufficiently challenge participants' capacity to attend to an external stimulus in the face of overriding physiological feedback. Physiological factors alone are not responsible for how individuals rate their perceived exertion (Borg, 1998, pp. 68–74), so we defer to the physiological measure (i.e., HR) to confirm that our participants were exercising at a high intensity (see Table 1). Nevertheless, studies incorporating a direct measure of VT would be useful to corroborate the present findings (c.f. Ekkekakis, 2003).

Practical Implications of the Present Findings

Practitioners should be aware that individual differences in DAS, as well as differences in the intensity and duration of exercise, appear to influence the psychological and psychophysical effects of music during exercise. It seems that when task intensity is low, all participants have a tendency toward dissociation, at which time they are the least discerning in terms of the motivational qualities of the music. During moderate workloads there is some variation in preferred music, with dissociative exercisers in particular enjoying something they can "sing along to". With a harder task, more motivation is needed from an external stimulus such as music. During high-intensity exercise participants seem to tune in to the emotional characteristics of a musical track, and the anticipation of an especially motivational segment of a song (i.e., segmentation; cf. Priest & Karageorghis, 2008) appears to enhance the motivational effect. Given that the beneficial effects of music appear to be short-lived when the task is highly physically demanding, it may be advisable for sport and exercise practitioners to vary aspects of the musical accompaniment, such as tempo or volume, or perhaps to strategically introduce music at specific times during a prolonged task when fatigue and/or boredom set in and productivity begins to drop. Recent research has demonstrated that periodic use of music can alter pacing strategy and positively impact performance during a high intensity running task (see Lima-Silva et al., 2012).

Conclusions

This is this first study to show that dominant attentional style can influence psychological and psychophysical responses to music in an exercise context. Existing theories (i.e., Ekkekakis, 2003; Tenenbaum, 2001; Terry & Karageorghis, 2006) were examined and the main predictions were confirmed in novel testing conditions, with the exception of RPE results, which revealed that RPE was lower among associators during the two music conditions when task-intensity was high. Interaction effects revealed complex ways in which DAS, task intensity, and time moderate the effects of music on state attentional focus, affective response, situational motivation, and RPE during exercise, adding considerably to the current body of work in this area. Additionally, new insight was gained into the ways in which exercise participants may use music in both an associative and dissociative manner, depending on DAS and task intensity.

End Notes

[1]We collected both overall (gestalt) and differentiated (peripheral and central) measures of RPE. Nonetheless, upon examination of the results, the differentiated RPE measures did not illuminate the subject matter beyond the contribution of overall RPE. Therefore, in the interests of parsimony and conceptual clarity, we decided to report only the overall RPE results.

[2]Intensities of 40%, 55%, and 70% HRR, were initially selected to align with ACSM (2010) classifications of low, moderate, and high-intensity exercise. However, during pilot testing these intensities were found to be insufficiently challenging in terms of eliciting the conditions necessary to test our research question. ACSM guidelines detail that persons with higher fitness levels require a higher training stimulus. Given our young, active population and the relatively short duration of each run, we ascertained that exercise intensities of 55%, 70%, and 85% HRR would be more appropriate.

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Table 1

Participant Characteristics with Means and Standard Deviations (N = 34)

Characteristic	*M* (*SD*)
Age (yr)	19.20 (4.90)
Resting HR	70.48 (10.58)
Maximal HR	192.70 (7.98)
Experimental HR	
Low	125.30 (8.29)
Moderate	149.20 (8.44)
High	174.40 (7.90)
Treadmill velocity (mph)	
Low	4.69 (.63)
Moderate	5.95 (.91)
High	7.66 (1.24)

Table 2
Mixed-model ANOVA and MANOVA Results

	F	Sig.	η_p^2
State attentional focus			
Between-subjects effects			
Attentional focus group	1.03	.368	.06
Within-subjects effects			
Group x Task Intensity x Music Condition x Time Interval	1.97	.039	.11
Group x Music Condition x Time Interval	2.50	.020	.14
Group x Task Intensity x Time Interval	1.65	.116	.10
Group x Task Intensity x Music Condition	.96	.454	.06
Task Intensity x Music Condition x Time Interval	4.81	.000	.13
Task Intensity x Time Interval	.40	.715	.01
Task Intensity x Music Condition	.76	.503	.02
Music Condition x Time Interval	3.02	.020	.09
Group x Task Intensity	1.14	.341	.07
Group x Music Condition	.21	.888	.01
Group x Time Interval	.31	.785	.02
Task Intensity	11.84	.000	.28
Music Condition	14.62	.000	.32
Time Interval	1.71	.200	.05
Perceived exertion			
Between-subjects effects			
Attentional focus group	.60	.555	.04
Within-subjects effects			
Group x Task Intensity x Music Condition x Time Interval	.54	.845	.03
Group x Music Condition x Time Interval	.73	.618	.05
Group x Task Intensity x Time Interval	1.92	.110	.11
Group x Task Intensity x Music Condition	3.93	.001	.20
Task Intensity x Music Condition x Time Interval	1.52	.192	.05
Task Intensity x Time Interval	39.37	.000	.56
Task Intensity x Music Condition	2.16	.092	.07
Music Condition x Time Interval	1.43	.242	.04
Group x Task Intensity	1.65	.182	.10
Group x Music Condition	3.58	.018	.19
Group x Time Interval	1.68	.195	.10
Task Intensity	122.72	.000	.80
Music Condition	1.00	.361	.03
Time Interval	51.83	.000	.63

(table continues)

	F	Sig.	η_p^2
Affective response			
Between-subjects effects			
Attentional focus group (affective valence)	.46	.637	.03
Attentional focus group (perceived activation)	5.98	.006	.28
Within-subjects effects			
Group x Task Intensity x Music Condition x Time Interval	1.32	.115	.08
Group x Music Condition x Time Interval	.95	.511	.06
Group x Task Intensity x Time Interval	2.08	.010	.12
Group x Task Intensity x Music Condition	2.32	.003	.13
Task Intensity x Music Condition x Time Interval	8.29	.000	.21
Task Intensity x Time Interval	2.01	.046	.06
Task Intensity x Music Condition	3.38	.001	.10
Music Condition x Time Interval	8.58	.000	.22
Group x Task Intensity	3.01	.004	.17
Group x Music Condition	2.35	.022	.13
Group x Time Interval	.99	.448	.06
Music Condition	13.52	.000	.31
Time Interval	1.57	.186	.05
Task Intensity	9.01	.000	.25
Situational motivation			
Between-subjects effects			
Attentional focus group	1.96	.159	.12
Within-subjects effects			
Group x Task Intensity x Music Condition x Time Interval	2.81	.006	.16
Group x Music Condition x Time Interval	0.13	.994	.01
Group x Task Intensity x Time Interval	1.56	.183	.09
Group x Task Intensity x Music Condition	2.14	.065	.12
Task Intensity x Music Condition x Time Interval	1.11	.360	.04
Task Intensity x Time Interval	0.84	.455	.03
Task Intensity x Music Condition	2.92	.045	.09
Music Condition x Time Interval	0.42	.756	.01
Group x Task Intensity	2.17	.084	.12
Group x Music Condition	1.02	.392	.06
Group x Time Interval	2.26	.104	.13
Music Condition	25.72	.000	.46
Time Interval	0.62	.479	.02
Task Intensity	1.95	.151	.06

Table 3

Results of the Inductive Content Analysis

Raw data themes (*k* = 67)	First-order themes (*k* = 7)	Second-order themes (*k* = 2)	General dimensions (*k* = 3)
Able to focus (A, A, A, D) Attended to beat (A) Thought about stride (A) Kept mind quiet (A) Good for frame of mind (A)	Enhanced focus		Attentional focus
Daydreaming (S, S, S) Took attention away from pain (A, D, D) Singing along to lyrics (A, D, D, S) Distracted the mind (A, S) Brought up memories (D) Lost focus (A) Didn't think about anything else (A) Task felt longer with no music (D, D) Run felt harder with no music (A, A)	Dissociation		
Felt better mentally (S) Enjoyed it (A) Uplifting (S) No music felt horrible (A) No music made me angry (A) No music felt awkward (A, D) No music was boring (D) Didn't like it with no music (A, D, S)	Mood state	Improved mood	Affective state
Oudeterous music was relaxing (D) Oudeterous music lowered arousal (D)	Relaxation	Arousal control	
Motivational music was energizing (A, A) Motivational music was exciting (A, D)	Arousal		
Motivating (A, A, S) Want to run faster (A) Tried harder with music (A, D) Pushed myself more (A, A, A, A) Wanted to run (A) Got me going (A, A) No motivation without music (S)	Motivation		Behavioral response
Ran to the beat of the song (A, A, S) Tried to keep pace with the music (A, A) Felt good for my stride (A, A) Felt smoother with music (S) Harder to keep up the high pace with no music (A)	Entrainment		

Note. A = Associator; D = Dissociator; S = Switcher.

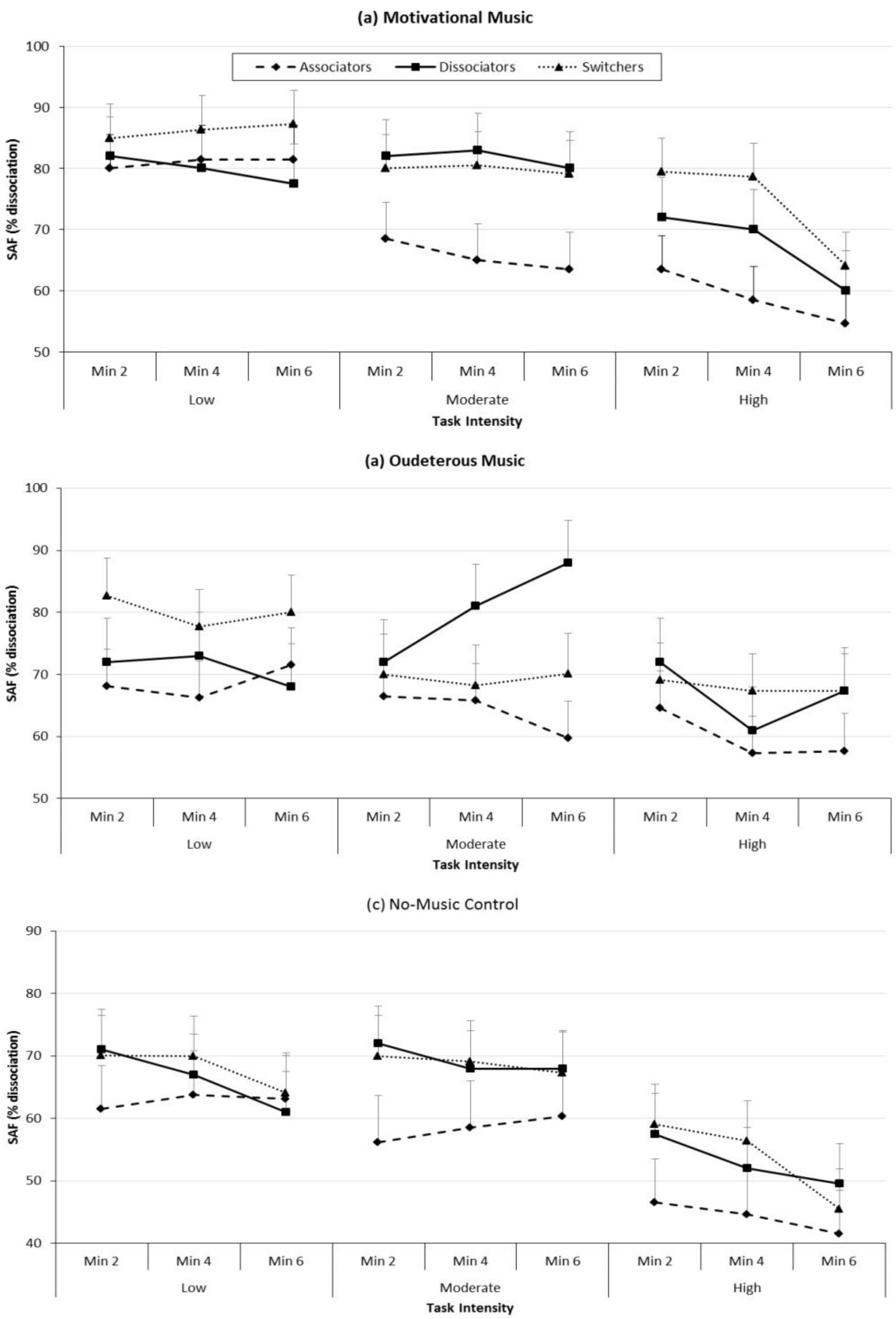

Figure 1. Group x Task Intensity x Music Condition x Time Interval interaction for state attentional focus (SAF; p = .039). Error bars represent standard errors and, to aid clarity, these are unidirectional.

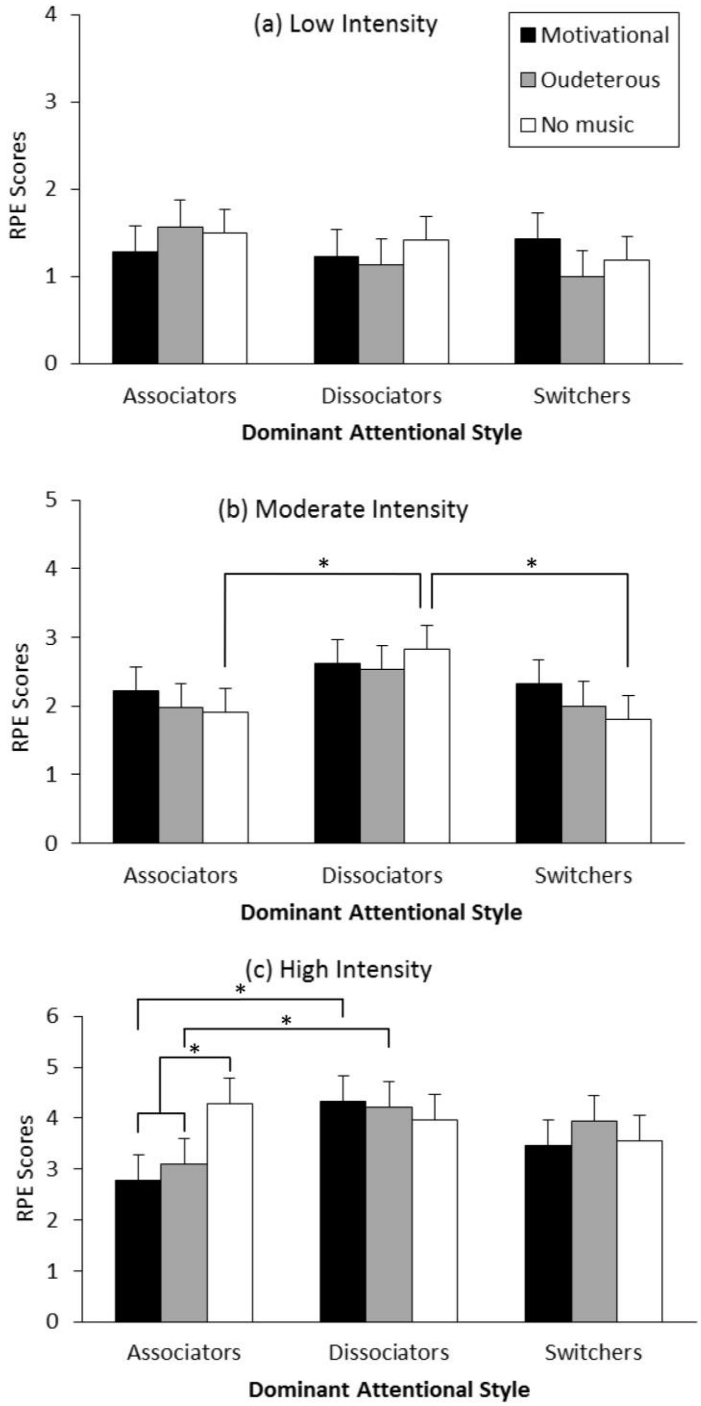

Figure 2. Group x Task Intensity x Music Condition interaction effect for RPE ($p = .001$). * $p < .05$. Error bars represent standard errors.

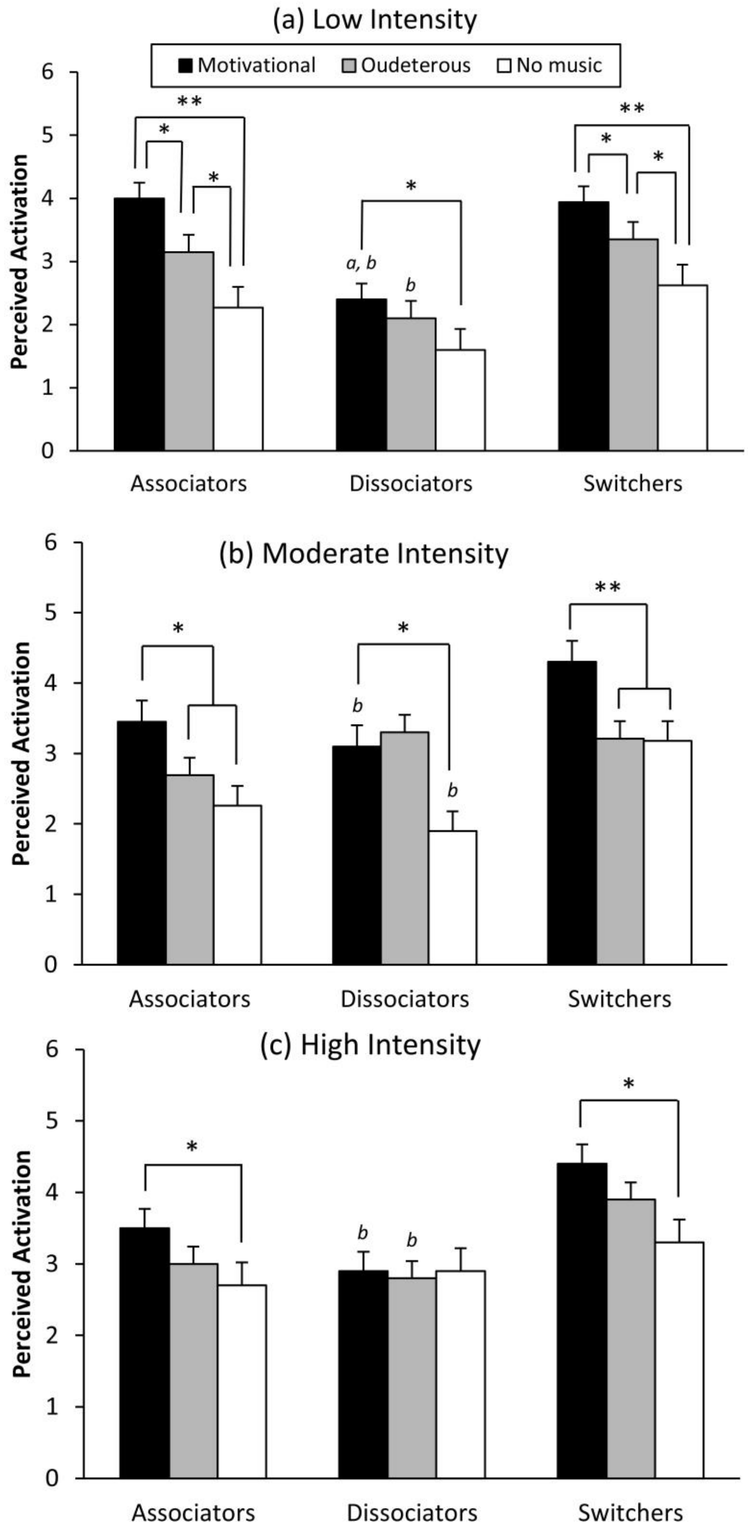

Figure 3. Group x Intensity x Music Condition interaction effect for perceived activation. * $p < .05$; ** $p < .01$. [a]Dissociator < Associator; [b]Dissociator < Switcher (all $p < .01$). Error bars represent standard errors.

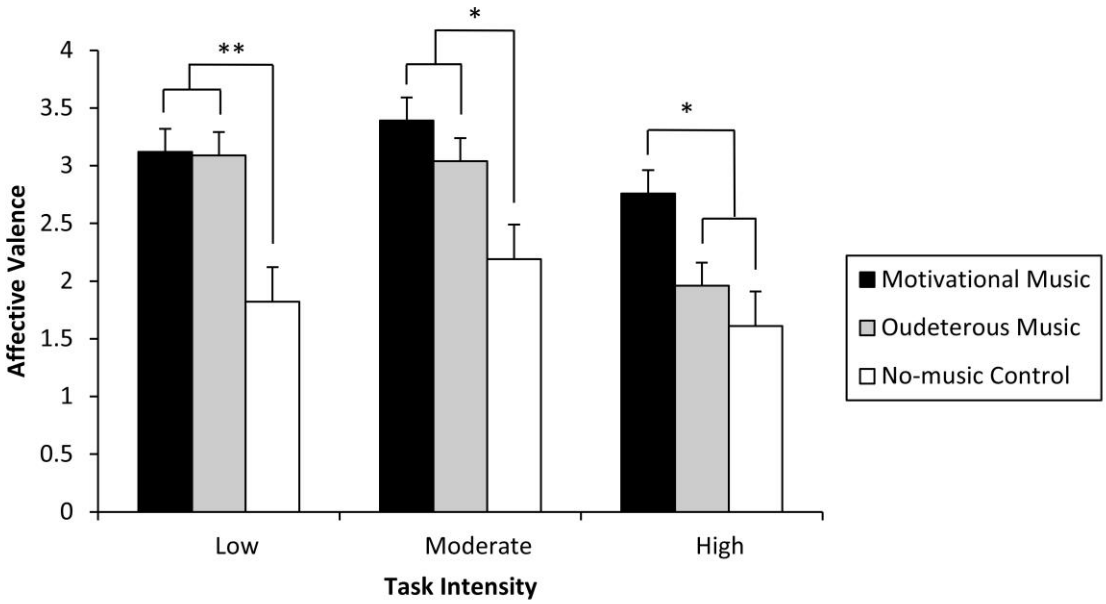

Figure 4. Task Intensity x Music Condition interaction effect (p = .004) for affective valence. * p <.05; ** p <.01. Error bars represent standard errors.

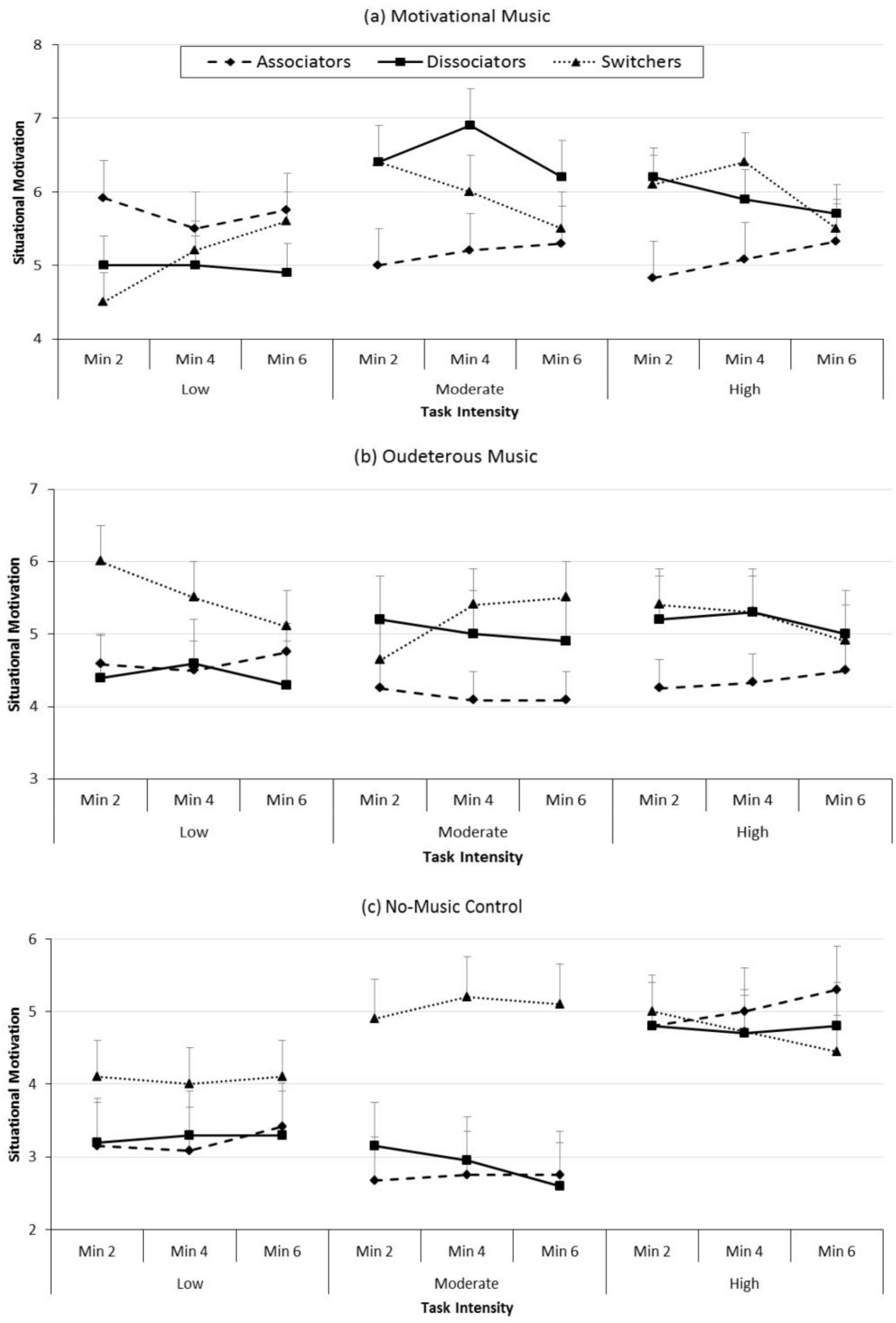

Figure 5. Group x Task Intensity x Music Condition x Time Interval interaction for situational motivation (p = .006). Error bars represent standard errors and, to aid clarity, these are unidirectional.