Working It Out: Examining the Psychological Effects of Music on Moderate-Intensity Exercise

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ABSTRACT. Exercise has been demonstrated to benefit mood and music may increase this effect. In the present study, exercise was hypothesized to increase pleasant and aroused mood, and decrease tiredness more significantly in those who listened to music. Listening to music while exercising was also hypothesized to lead to lower perceived exertion and higher exercise enjoyment. Participants (N = 148) recruited from undergraduate physical education courses completed 20 min of moderately paced walking, with or without a personal music player. Mixed model Analyses of Variance revealed that exercise significantly increased participant mood in all measured dimensions ($ps \leq .001$). Analyses also supported the moderating role of music to the effect of exercise on mood pleasantness because those who listened to music during exercise reported feeling significantly more pleasant after exercise than those who did not listen to music ($p = .009$, $d = 0.42$). Using an independent-samples t test, exercise enjoyment was significantly higher among participants who exercised with music ($p = .049$, $d = 0.33$). Because this study examined moderate-intensity walking, recommended by the Centers for Disease Control and Prevention (2011a) to those beginning physical activity, results demonstrated that music may provide a valuable and accessible addition to an exercise program. The theoretical implications of these results in promoting exercise adherence are discussed within the context of the theory of planned behavior (Ajzen, 1991).

Exercise is an essential contributor to both physical and mental health. The Centers for Disease Control and Prevention (CDC; 2011a) reported that regular exercise lowers the risk for developing cardiovascular disease, type 2 diabetes, and certain cancers. Exercise has been linked to immediate mood benefit (Hansen, Stevens, & Coast, 2001) and reduced risk of developing depression over time (van Gool et al., 2007), and exercise therapy has been demonstrated to be as beneficial as treatment with antidepressant medication in individuals with major depressive disorder (Blumenthal et al., 2007; Craft & Perna, 2004). Despite these findings, approximately 49% of adult Americans do not achieve minimum exercise recommendations (National Center for Health Statistics, 2011). Individuals' likelihood of engaging in exercise may be predicted in part by their judgments about exercise, and research has indicated that positive psychological response to exercise affects an individuals' beliefs about exercise, which increases their likelihood of exercising (Rhodes, Fiala, & Conner, 2009). Therefore, research on the moderators of the psychological effects of exercise is needed to effectively encourage a more positive exercise experience so that individuals may be effectively inspired to begin and/or maintain exercise routines.

Exercise can boost various dimensions of mood (Rocheleau, Webster, Bryan, & Frazier, 2004), and the mood benefit of exercise is a major predictor of exercise adherence (Papandonatos et al., 2012). Amplifying the mood benefit of exercise

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therefore has the potential to increase exercise adherence, and exercising with music may serve this purpose. Some research has suggested that, relative to exercising without music, exercising with music significantly benefits mood (Hayakawa, Miki, Takada, & Tanaka, 2000), results in increased vigor (Biagini et al., 2012; Hayakawa et al., 2000), and lowers levels of tiredness and fatigue following exercise (Hayakawa et al., 2000). However, other research has not supported the advantageous effect of exercising with music on tiredness and fatigue (Plante, Gustafson, Brecht, Imberi, & Sanchez, 2011). Although overall mood appears to increase from exercising with music, an effect for pleasant mood has not been directly indicated (Hayakawa et al., 2000). The present study investigated the effects of music and exercise on overall mood in the areas of pleasantness, arousal, and tiredness in order to corroborate current literature and extend findings to the lower intensity exercise modality of walking. Mood benefit from exercise may relate to perception and enjoyment of exercise.

Exercise enjoyment is also a predictor of maintaining the behavioral change necessary to adhere to an exercise routine (Papandonatos et al., 2012). One study indicated that, among participants engaging in high-intensity exercise, those exercising with music rated exercise as more enjoyable than those exercising without music (Miller, Swank, Manire, Robertson, & Wheeler, 2010). However, another study found no significant differences in enjoyment between exercising with music and a control condition without music (Plante et al., 2011). Because exercise enjoyment may impact adherence to an exercise routine, this variable was measured in the present study to address discrepancies in the literature and investigate whether the effect extends to lighter intensity exercise. If music is found to influence exercise enjoyment, it may be related to lower perceived exertion among music listeners.

Studies have indicated that listening to music may lower perceived exertion during physical activity, perhaps because music provides a distraction (Biagini et al., 2012; Karageorghis & Priest, 2012a). If individuals perceive themselves to be working less, they may work harder or for a longer duration of time. Therefore, if music lowers perceived exertion, listening to music may improve exercise performance and productivity. A recent meta-analysis indicated that those who listened to music rated their perceived exertion at approximately 10% less than those who exercised without music following low- to moderate-intensity exercise (Karageorghis & Priest, 2012b). In much of this research, however, participants were provided with preselected music from the researchers (Karageorghis & Priest, 2012b). The present research therefore sought to determine whether the influence of music on perceived exercise exertion extends to conditions where participants listen to self-selected music.

The purpose of the present study was to replicate and extend research on the various psychological effects of exercising with music. We predicted that exercise would have a significant effect on mood such that participants would rate their moods as more pleasant, less tired, and more aroused after exercise than before exercise. We also expected a significant interaction between exercise and music such that, although no differences would be detected between groups before exercise, participants who exercised with music would have more pleasant, less tired, and more aroused moods following exercise than those who exercised without music. Next, we hypothesized that those who exercised with music would have lower ratings of perceived exertion than those who exercised without music and that those who exercised with music would have higher ratings of exercise enjoyment than those who exercised without music.

Method

Participants

Data were collected from 148 undergraduate students at a southeastern university (107 women and 41 men). Participants' ages ranged from 18 to 52 ($M = 22.25$, $SD = 5.13$) with 43.9% White, 43.2% Black, and 12.9% other (5.4% multiracial, 2.0% Asian, 1.4% Native American, and 3.4% preferring not to answer). Seventy-three participants were randomly assigned to exercise with music, and 75 were assigned to exercise without music. Although exact numbers are not available, approximately four participants concurrently enrolled in psychology classes might have received credit for participation depending upon the discretion of their particular course instructors. Otherwise, participants did not receive compensation for their participation.

Materials

Before the study, participants were instructed to bring their iPods or MP3 players so that, if assigned to exercise with music, they could listen to their own self-selected music. All participants were instructed to walk at a moderate intensity for 20

min, the minimum exercise duration indicated to result in immediate mood benefit in several dimensions at moderate intensities (Hansen et al., 2001).

Measures

Mood response. Mood responses were measured within the Brief Mood Instrospection Scale (BMIS; Mayer & Gaschke, 1988) both before and after exercise for pleasantness using the Pleasant-Unpleasant scale (Cronbach's αs = .85 preexercise and .86 postexercise), arousal using Arousal-Calm scale (Cronbach's αs = .51 preexercise and .55 postexercise), and tiredness using the Positive-Tired scale (Cronbach's αs = .83 preexercise and .80 postexercise). In this measure, participants reported their moods on a four-item scale ranging from *definitely do not feel* to *definitely feel* in respect to 16 adjectives including *lively, tired, content,* and *fed up*. The BMIS has been indicated to have good factorial validity (Mayer & Gaschke, 1988) and good test-retest reliability in a repeated measures design (Mayer & Hansen, 1995).

Exercise enjoyment. After exercise, exercise enjoyment was measured on the short form of the Physical Activity Enjoyment Scale (PACES-8), which had a Cronbach's alpha of .88 in this sample and was demonstrated to have convergent validity in its correlation with related physical and psychological changes following exercise in a population of older adults (Mullen et al., 2011). The PACES-8 required participants to rate their appraisal of the previous physical activity on a 7-point Likert-type scale based on agreement to items such as "I find it pleasurable" and "It's no fun at all."

Perceived exercise exertion. Finally, participants were asked to rate their perceived exertion during exercise from 6 (*no exertion*) to 20 (*maximal exertion*) on Borg's Rating of Perceived Exertion Scale (RPE; Borg, 1982), a one-item measure widely used in exercise research (Karageorghis & Priest, 2012a) and validated in its high correlation with measured heart rate of exercise participants (Borg, 1982).

Procedure

Upon receiving institutional review board approval (IRB# 13-035 and IRB# 13-063) data collection was conducted throughout spring and summer semesters. Students attending various physical fitness courses were recruited during class time at the campus recreation center. Potential participants were provided with the Physical Activity Readiness Questionnaire (PAR-Q), a self-assessment tool which, based on answers to health questions, recommends either engaging in exercise or consulting with a physician before activity (Thomas, Reading, & Shephard, 1992). Participants were advised to follow PAR-Q recommendations based on their responses, but no participants were excluded by the researcher. Additionally, participants were given an informed consent form to consider and sign.

Upon providing consent, individuals were given the first mood survey (BMIS) to complete along with instructions randomly assigning them to one of two conditions: exercise with music or exercise without music. However, if participants had forgotten their iPod (approximately 11 participants total), they were automatically assigned to exercise without music. Participants with iPods assigned to exercise without music were offered the option of leaving their iPods in the locked classroom or carrying the devices with them while walking without wearing headphones.

Participants were instructed to walk at a moderate intensity on the indoor track at the campus recreation center for 20 min as timed by the researcher. To control walking intensity, participants in each data collection group were provided with specific guidelines for exercising at a moderate intensity as outlined by the CDC (2011b), described to participants as enough physical effort to breathe harder than normal, but at a level at which they would still able to carry on a normal conversation. After completing their assigned exercise, participants were provided with the final survey packet (RPE, BMIS, PACES-8). Upon submission of their completed surveys, participants were thanked and provided with a debriefing flyer.

Results

Data collection time (spring and summer semesters) was included as a between-subjects variable in Analyses of Variance (ANOVA), but no significant differences were found between these groups on any measured variables. Therefore, data from both collection periods were combined in subsequent analyses. Research has indicated that exercise motivation may differ by race, with White participants significantly more likely than Black or other participants to be motivated to exercise for psychological benefits such as enjoyment and revitalization (Egli, Bland, Melton, & Czech, 2011). Thus, analyses were conducted to identify potential differences in exercise response by race. No significant differences between racial groups (White, Black, and other) were detected within

mood, enjoyment, and exertion responses. Upon inclusion as a between-subjects variable in ANOVA analyses for mood dimensions, race did not significantly interact with other variables of exercise and music. Results of these analyses indicated that race did not have an extraneous influence on response to exercise within our sample.

All measures met the assumption of homogeneity of variance using Levene's test, but some groups did not meet the normality assumption assessed by the Kolmogorov-Smirnov test. Transformations failed to normalize distributions (log, natural log, and square root), thus where normality was violated, nonparametric tests were performed instead of the planned *t* tests to support ANOVA results. Scales with missing values were excluded from analysis, and degrees of freedom were adjusted accordingly.

Using three mixed-model factorial ANOVAs, the mood dimensions of pleasantness, arousal, and tiredness were investigated for the effects of exercise and music predicted in the first two hypotheses. In the first hypothesis, we predicted that exercise would significantly affect mood. According to the second hypothesis, we suggested that music and exercise would significantly interact to magnify positive mood effects. The first hypothesis was supported for all three mood dimensions. Mood was significantly more pleasant, $F(1, 134) = 27.77$, $p < .001$, $\eta_p^2 = .17$, less tired, $F(1, 134) = 32.08$, $p < .001$, $\eta_p^2 = .23$, and more aroused, $F(1, 134) = 12.07$, $p = .001$, $\eta_p^2 = .083$, after exercise than before for all participants regardless of group assignment. These results were confirmed using the Wilcoxon Signed Ranks test, $Z = -5.23$, $p < .001$, $Z = -5.57$, $p < .001$, and $Z = -3.18$, $p = .001$, respectively. Music also had a significant main effect on two out of the three mood dimensions. Mood was significantly more pleasant, $F(1, 134) = 4.45$, $p = .037$, $\eta_p^2 = .032$, and less tired, $F(1, 134) = 3.97$, $p = .048$, $\eta_p^2 = .029$, among those assigned to the music condition than those assigned to the no-music condition. These results were confirmed using the Mann Whitney U test for pleasant mood, $U = 1804.00$, $p = .027$. No differences were detected between groups in arousal, $F(1,134) = 1.29$, $p = .257$.

Contrary to predictions, music and exercise did not significantly interact in the main ANOVA analysis for any of the three mood dimensions for pleasantness, $F(1, 134) = 2.90$, $p = .091$, tiredness, $F(1, 134) = 0.64$, $p = .426$, or arousal, $F(1,134) = 0.004$, $p = .947$. However, because interactions were specifically predicted, simple effects were probed for significant differences (see Table 1). Mood pleasantness was not significantly different between groups before exercise, $t(137) = 1.27$, $p = .21$, but those who listened to music during exercise reported feeling significantly more pleasant after exercise than those who did not listen to music, $U = 1908.00$, $p = .009$, $d = 0.42$ (see Figure 1). A similar pattern was observed for tiredness in that there was no difference in mood before exercise, $U = 2075.00$, $p = .15$, but those who listened to music during exercise reported feeling less tired after exercise than those who did not listen to music, $U = 2003.50$, $p = .026$, $d = .37$. Finally, there was no significant difference between groups before, $t(137) = 0.83$, $p = .41$, or after, $U = 2028.00$, $p = .22$, exercise for arousal. These results contributed partial support of the second hypothesis.

Exercise enjoyment and perceived exertion data were also analyzed for group differences. Contrary to the third hypothesis, ratings of perceived exertion were not significantly less for those who exercised with music, $U = 2628.00$, $p = .78$. Supporting the fourth hypothesis, exercise enjoyment was significantly higher among those who exercised with music ($M = 40.58$, $SD = 9.97$) than those who exercised without music ($M = 37.47$, $SD = 8.95$), $t(145) = 1.99$, $p = .049$, $d = 0.33$.

Discussion

The present research replicated and extended a number of previous findings. Exercise had a significant effect on all mood dimensions, lowering tiredness and boosting aroused and pleasant moods, which aligned with widespread findings in current research (Hansen et al., 2001). The effects of exercise explained a significant portion of the changes between pre- and postexercise mood, accounting for 23% of the variance in tiredness, 17% of the variance in pleasantness, and 8% of the variance in arousal. The study also found a medium effect of music in decreasing postexercise tiredness ($d = .37$), which replicated previous research (Biagini et al., 2012; Hayakawa et al., 2000), and a medium effect of music in increasing postexercise pleasant mood, a previously unmeasured mood dimension. These results suggested that music and exercise may combine to increase energy and positive mood significantly more than exercise alone. With regard to exercise enjoyment, participants who listened to music during exercise rated their exercise as more enjoyable than those who exercised without music, and this effect size was medium ($d = .33$). The positive effect of music on

enjoyment has been indicated in previous research using high-intensity exercise (Miller et al., 2010), but this effect has not been previously supported for low- to moderate-intensity exercise (Plante et al., 2011).

Contrary to our predictions, no effect was indicated for perceived exertion. The findings of lower tiredness in those who exercised with music suggested the potential presence of this physiological effect. However, data were strongly leptokurtic, suggesting that walking intensity might have been fairly consistent among participants. Another possible explanation for lack of difference is that, in order to control exercise intensity, participants were given specific instructions to maintain a moderate walking pace. Potentially, the participants might have viewed the RPE scale as a "test" on whether they followed instructions and chose the response corresponding to a moderate intensity. Although *moderate* was not specifically worded on the RPE scale, participants were likely familiar with this scale because it was part of the physical education curriculum. On the other hand, the consistent data might have reflected that participants were simply following instructions, and intensity was sufficiently controlled. Additionally, no evidence of an interaction for the arousal dimension was obtained. Although it is possible that listening to music while exercising does not boost mood along this dimension, it should be noted that the Arousal-Calm scale demonstrated low internal reliability (Cronbach's αs = .55 preexercise and .51 postexercise), which might have inflated error variability.

As a society, people typically understand that they "should" exercise, but most Americans do not regularly exercise and therefore do not receive the health benefits (CDC, 2011a). Music may provide a potential avenue for intervention. Exercise enjoyment and positive mood changes following exercise were demonstrated to predict exercise adherence (Papandonatos et al., 2007), and these postexercise mood and enjoyment effects were enhanced by the use of music in the current study. Because those beginning an exercise regimen are recommended to start with moderate-intensity exercises such as walking (CDC, 2011), this study was especially applicable to those wishing to begin and maintain an exercise program. Also, instructing participants to listen to their own music in the music condition demonstrated that the mood benefits of music are easily accessible.

To situate the present findings within the larger context of health and exercise behaviors, it may help to consider the theory of planned behavior (TPB; Ajzen, 1991). According to the TPB, behavior can be predicted from intentions to engage in this behavior, although stronger intentions to perform a given behavior are predicted by positive attitudes, higher perceived behavior control, and positive subjective norms (Ajzen, 1991). The TPB has been particularly useful when predicting health-related behaviors, with meta-analyses demonstrating the utility of the TPB in explaining behaviors related to condom use (Albarracín, Johnson, Fishbein, & Muellerleile, 2001), health screenings (Cooke & French, 2008),

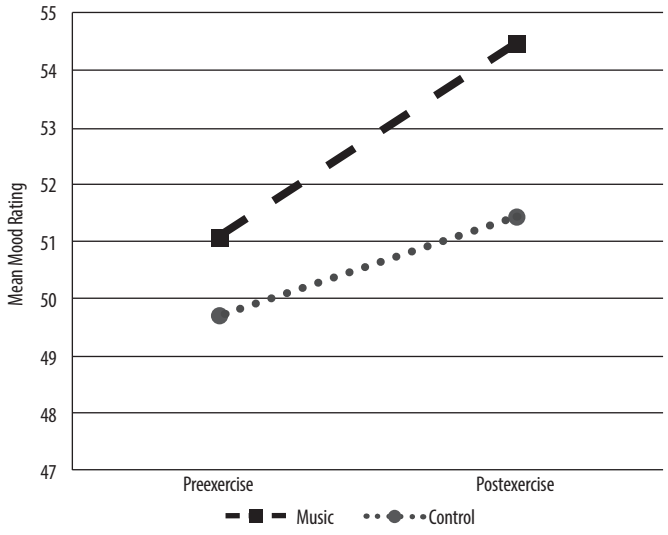
TABLE 1

Means for Each Mood Dimension for Music and Control Groups Before and After Exercise

Brief Mood Introspection Scale	Preexercise		Postexercise	
Pleasant-Unpleasant	*M*	*SE*	*M*	*SE*
Music	51.09	0.87	54.47	0.79
Control	49.70	0.84	51.43	0.77
Positive-Tired	*M*	*SE*	*M*	*SE*
Music	19.80	0.52	21.91	0.49
Control	18.77	0.51	20.40	0.47
Arousal-Calm	*M*	*SE*	*M*	*SE*
Music	25.77	0.45	26.67	0.44
Control	25.10	0.45	26.03	0.43

FIGURE 1

Pleasant Mood Means



Note. Changes in mean mood ratings within the pleasantness dimension for music and control groups before and after exercise.

and exercise behavior (Downs & Hausenblas, 2005; Hausenblas, Carron, & Mack, 1997). In each of these meta-analyses, attitude toward the target behavior was found to be the strongest predictor of behavior intentions, which has implications for the present research.

We have argued that listening to music while exercising may increase exercise adherence by boosting the positive impact of exercise on mood and exercise enjoyment. Within the context of the TPB, heightened positive mood and greater exercise enjoyment may create more positive attitudes toward exercise, which could increase intentions to exercise. An alternative or additional way that increased mood and enjoyment could increase exercise adherence is through anticipated affect. Anticipated affect refers to whether, after performing or not performing a behavior, a person expects to experience positive or negative emotions (Richard, van der Pligt, & de Vries, 1996). When considered as a separate component within the TPB model, anticipated affect significantly predicted behavioral intentions beyond the other three components of the model (Rivis, Sheeran, & Armitage, 2009). Therefore, positive mood and enjoyment when exercising with music may not only improve attitudes toward exercise behavior, but also increase the positivity of anticipated affect after performing exercise, improving intentions to engage in exercise behaviors.

Findings of the present research may provide important contributions to promoting physical and psychological health by helping individuals maintain productive and enjoyable exercise routines. Therefore, future research may address limitations in the present research. In our data collection, a small portion of participants who had forgotten to bring an iPod or MP3 player (approximately 11 total) were automatically assigned to exercise without music, which might have clustered forgetful, potentially less-motivated individuals into the no-music group. Although motivation may or may not affect psychological response to exercise, it could have potentially affected exercise performance. Additionally, an individual who brought an iPod but was assigned to exercise without music might similarly have exhibited less enthusiasm or motivation, which could have potentially affected exercise performance. On the other hand, in the current study, the music group (M = 10.62, SD = 2.35) and no-music group (M = 10.39, SD = 2.11) did not significantly differ in their ratings of exertion on the RPE scale (p = .77), which might indicate that participants in both groups exercised at a similar moderate intensity per instructions. However, future research may implement another measure such as a heart rate monitor in order to more accurately measure intensity and further ensure that no differences exist in exercise performance between groups. Furthermore, additional physiological measures may be used in the future to add depth to findings of the current study by determining whether BMIS mood dimensions of tiredness and arousal also correspond to accompanying physiological states.

Although positive psychological effects of music have been indicated for athletic (Biagini et al., 2012) and nonathletic populations (Hayakawa et al., 2000), future research might collect fitness information from participants to determine whether participants at various fitness levels respond differently to music. The data in this particular study were collected from undergraduate students enrolled in various physical education courses, and although these courses are required for all students to receive a bachelor's degree and might have reflected various fitness levels, the sample was not entirely representative of populations starting an exercise routine. Therefore, future research may choose to investigate the effects of exercise and music specifically from a population of individuals who do not regularly exercise to extend the findings of present research.

Furthermore, although the present study detected no differences in response to exercise by race (White, Black, and other), future research may investigate potential differences between racial groups comprising "other" or those not represented in this sample. Lastly, the benefits of music may be accessible to the individual as suggested in the present study, as well as to groups in fitness class settings (Hayakawa et al., 2000), so future research might continue to investigate the applicability of music and group fitness settings in maintaining exercise adherence. In conclusion, this study found additional support for the psychological benefits of exercising with music and extended the previous research by indicating the pleasant mood and exercise enjoyment effects of music during moderate-intensity walking. These results called for future research investigating the use of music in sustaining exercise adherence, particularly by strengthening predictors to future exercise behavior within the TPB.

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