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Effect of Self-selected Music on Affective Responses and Running Performance: Directions and Implications

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ABSTRACT

International Journal of Exercise Science 12(5): 310-323, 2019. The purpose of this study was to evaluate the effect of different types of music (i.e., self-selected, researcher-selected, and no music) on affective responses to an exercise task and the subsequent running performance, with an untrained population of college students in a field setting. Twenty-seven college students (17 female, 10 male, M_{age} = 22.11, *SD* = 5.12), ran one mile on three separate occasions and either listened to self-selected music, music selected by the researcher (i.e., *Audiofuel*), or no music at all. Affective responses were assessed before, during, and after each session, and mile time was recorded following the completion of each session. The results from our correlational analysis for levels of post-task enjoyment and running performance yielded significance, but only for the first running session, r (27) = -.505, p <.01. However, RM ANOVA's yielded non-significant outcomes for affect as well as performance time. In general, participants improved their performance during each subsequent session. Findings support the hypothesis that the use of self-selected music during exercise can promote positive affective responses.

KEY WORDS: Exercise, motivation, affect

INTRODUCTION

Music benefits sport and exercise performance and improves affect (26, 33). Sport-specific findings into the benefits of music include the use of pre-task music for the improvement of shooting performance among netball players and/or its use during task performance to benefit free throwing (34), as well as the use of warm-up music to enhance mood and performance in volleyball (52). Evidence also indicates that in repeated sprint test, athletes listening to motivational music decrease total sprint time and run faster compared to athletes not listening to music (13).

Extant research has frequently tested music use within laboratory settings, gauging its potential effects on treadmill or cycle ergometer performance, and resistance training tasks (3, 8, 18, 48). These works have yielded conflicting findings that could relate to the different intensity levels of those tasks. Specifically, findings have revealed that during submaximal performance, cyclists that listened to faster music were able to increase distance, power, and pedal cadence (48). On the other hand, when music was provided to a group of well-trained cyclists in a *high* intensity task, no significant positive improvements in completion time, power output, average speed, and cadence were observed (8). Other studies have yielded to results, which suggest that performance to some tasks (i.e., squat jump explosiveness) improve with music while music does not seem to influence some others (i.e., squat jump, bench press) (3). To that end, most work into the effects of music has prescribed asynchronous/motivational (6, 46), and self-selected music (3) for optimal improvement in performance. While a majority of previous literature investigating the effects of music on affect and performance have used researcher-selected or predetermined selections of music, the current study used true participant selected (i.e., self-selected) music. The rationale for this came from previous work that suggested that personal preference plays a vital role in maximizing the impact of music during the exercise experience (5). Furthermore, researchers have contended that previous familiarization with self-selected music and its resulting emotive qualities can generate greater benefits than music that is researcher-selected or somehow pre-determined (24). Consequently, recent research have largely used self-selected music during exercise tasks (1, 18, 36).

Of additional interest herein, researchers have also suggested that music can help improve affect (e.g., positive mood states, emotions, enjoyment, etc.) in sport and exercise (20, 34, 46). During submaximal or moderate workloads, music can be an effective way to divert one's attention from the unpleasantness that may be associated with the activity (26). Additionally, there has been investigation into the process of athletes selecting music in their sport preparation, in which selections are made to manipulate their emotional state (4). For instance, youth tennis players were observed to select music that would lead to improved mood, increase activation, and assist with visualization techniques to aid in their performances (4). Most relevant in the context to which this study was conceived is the use of music to induce arousal and positive feeling states, yet cope with negative physiological and psychological sensations within tasks of high intensity (22, 49). A potential mechanism for music to elucidate such effects is thought to occur from the motivational qualities—that is the rhythm response, musicality (which together form the musical qualities), cultural impact, and associations (the extra-musical qualities)—of the musical selections (21). However, due the heterogeneity of the musical selections of these studies, researchers are challenged to posit whether musical or extra-musical qualities are responsible for more positive affective responses (49).

Nevertheless, the presumed effects of music on exercise tasks of high intensity have been particularly inconsistent in regards to its potential to improve affective responses. To that end, in his effort-related model, Tenenbaum (49) suggested a potentially facilitative role of music as a dissociative (i.e., distracting) strategy, but only under low to moderate workloads. That is, when exercise loads are too intense, the ability to dissociate from the feelings of extreme fatigue and exhaustion is limited, regardless of the use of music or any other coping strategies.

Consistent with Tenenbaum's assertions, in his dual- mode theory, Ekkekakis (13) argued that exercisers typically derive pleasant affective responses up until or around the point of ventilatory threshold (VT)—the point at which ventilation begins to increase at a rate disproportional to that of oxygen consumption, due to the need to expend excess carbon dioxide that is produced during anaerobic glycolysis (2). It is at this stage where exerciser's pleasure in activity diminishes, and the disruption to the body's homeostasis is brought into awareness (13). Thus, music would be of limited effectiveness beyond one's ventilatory threshold. Recent literature however has challenged these approaches and shown that under intense exercise loads, positive affect and performance gains could still be experienced with the use of music (20). For example, in the course of a challenging swimming trial, swimmers who listened to music were shown to report more positive mood states such as greater enjoyment, positive thoughts, and happiness and were able to complete the task faster relative to others who didn't listen to music (22). Others have also reported that exercisers listening to music and watching a video reported higher ratings of affective valence, perceived activation, and experienced greater post-exercise enjoyment scores below *and above* VT beyond (20).

The purpose of this study was to further test the effects of music use with regards to performance and affects in a running task. Specifically, within the present study, we focused on affect rather than mood and emotion, which are at times used interchangeably. To distinguish between these terms, we denote affect as a neurophysiological state consciously accessible as a simple primitive non-reflective feeling, most evident in mood and emotion but always available to consciousness (41). Pleasure and displeasure, tension and relaxation, energy and tiredness are all examples of core *affect,* and while these are constantly experienced, they vary by nature and intensity (10). In contrast, *emotions* are more immediate responses to certain stimuli, which are categorized by a fairly brief time frame but higher intensity (12). Researchers have also elaborated on the term emotion by listing the concurrent factors of a common emotional situation (10): a) core affect, b) overt behavior congruent with the emotion (e.g., a smile or a facial expression of fear), c) attention directed toward the eliciting stimulus, d) cognitive appraisal of the genesis of the episode to the stimulus, f) the experience of the particular emotion, and g) neural (peripheral and central) and endocrine changes consistent with the particular emotion. Definitions of *mood* vary, but generally speaking, mood can be seen as "a set of feelings, ephemeral in nature, varying in intensity and duration, and usually involving more than one emotion" (28). To this definition, others have also added that moods last longer and are less intense than emotions, and typically lack a specific origin (10, 12). In the light of extant research, for one, bearing in mind the frequent use of laboratory settings for studies that investigated the potentials of music within exercise settings, the current study took place in a field setting i.e., a college running track. Furthermore, while most extant research into the effects of music have primarily included trained or elite athletes (8), the current study included a sample of untrained college students. Additionally, while more studies have focused on how music mediates either affective responses or outcome performance, in the current study we also aimed at identifying the type of music (i.e., self-selected music vs. researcher-selected music) to enable positive affective responses and optimal performance. Accordingly, we hypothesized that music use relative to no music would improve affects and performance. We also hypothesized that of the researcher-selected music, self-selected music, and no music, self-selected music would facilitate performance and positive affect more optimally than other conditions.

METHODS

Participants

Power analysis: A power analysis was performed using G*Power3 as means to establish an appropriate sample size. Based on a low to moderate predicted effect size (.2 to .5), an alpha level of 0.05, and power at .80 to protect beta at four times the level of alpha, the analysis indicated that between nine and forty-two participants would be necessary for inclusion in the study.

A convenience sample of 27 college-aged students (17 female, 10 male, M_{age} = 22.11, SD = 5.12), from a mid-size Midwestern college participated in this study. Participants were recruited through campus e-mail. At the completion of the study, participants received a compensation in the form of a $15 gift card for their participation. This sample size was selected in consideration of related research that used similar sample sizes (38, 39, 43). To be included in the study, participants must have adhered to low to moderate levels of activity (i.e., engaging in exercise no more than three days per week and at a vigorous intensity no more than two days per week over the last three months), and have access to an mp3 playing device with headphones. Participants with current injuries, cardiovascular disorder, and/or medical condition that would become apparent through completion of the Health History Form and Physical Activity Readiness Questionnaire were excluded from the study. Of the 27 participants, eight were freshmen, four were sophomores, six were juniors, four were seniors, and five were graduate students. A majority of participants were Caucasian/White (N =18), five were Latin American, two were African American, and two identified as being two or more races. Researcher's institutional review board has approved this study and no data collection occurred prior to this approval.

Protocol

Two 1/8-mile recreation center indoor track were used for testing. The second indoor track was used due to logistical constraints concerning the availability of the initial track. Both tracks were housed within the same university rec center thus had identical features. Also, no participant in this study had to change from one track to the other—that is, for each of the participants all of the three sessions were done at the same location. Performance (i.e., time to task completion) was assessed using a stopwatch. Measurement of time was rounded to the nearest second.

Demographic information: The demographic questionnaire gauged a number of socio-demographic variables including age, gender, major, year of study, number of times per week exercising, and intensity of exercise (i.e., low, moderate, high, or extreme).

Health history form: The questionnaire allowed participants to more openly indicate physical activity habits over the previous three months. It provided a qualitative account of what kinds of physical activity the participants are engaging in, as well as its intensity and duration. This was to make sure that participants were not too fit/well trained to be included in this study. Additional items allowed participants to indicate any past or present health concerns that may preclude them from participating.

Physical activity readiness questionnaire (PAR-G, 45): A seven-item, closed-ended ("yes" or "no") questionnaire, PAR-Q was used to identify whether the participant is physically healthy enough to engage in physical activity. The questionnaire has been adapted from the original 19-item version in which the current 7-items have been reported to be the most valid and reliable in identifying individuals who must adhere to a medical examination before participating in exercise (46). Coupled with the health history form, PAR-Q determined whether participants were healthy enough to adhere to study protocol.

Feeling scale (FS; 17): A one-item measure, FS was used to assess pleasure/displeasure (i.e., valence) on a scale ranging from +5 ("I feel very good") to -5 ("I feel very bad). FS is frequently used for measuring affective responses during exercise (8). A discriminant function analysis has indicated that the positive/negative dimension of the FS demonstrates core affective expression (17). In addition, the FS has been shown to correlate to other affective measures, including positive well-being ($r= .61$) and psychological distress ($r = -.69$) subscales from the Subjective Exercise Experiences Scale (34).

Physical activity enjoyment scale (PACES; 25): An 18- item scale, PACES was used to measure task-related enjoyment. Items on PACES are ranked on with a 7-point bipolar scale (e.g., "It makes me depressed—It makes me happy") used. Higher scores on the PACES indicate greater enjoyment levels associated with the task, whereas lower scores indicate reduced enjoyment levels associated with the task. The scale possesses good reliability (Chronbach's alpha= .93) and construct validity (25).

The Brunel Music Inventory-2 (BMRI-2; 21): A six-item scale, BMRI-2 helped measure how motivational the music was to a participant during task performance. The scores of BMRI-2 range between 6-42. Terry et al. (49) has identified scores above thirty-six as indicating "motivational music". The instrument has been used in studies using music to promote positive emotion (27) and mood (47). Consistent with previous studies, this measure was administered after running with musical accompaniment (27), serving as a manipulation check to ensure that music selected by participants contained motivational elements.

Preference questionnaire: A brief, two-item questionnaire helped follow up with participants regarding their experience. The first item of the questionnaire assessed which condition (i.e., self-selected vs. researcher-selected music, no music, see conditions below) participants would most like to repeat if provided a future opportunity. The second item of the questionnaire asked participants to provide an open-ended response as to why they would repeat the particular session. Previous research has used the preference questionnaire for similar purposes within similar protocols (20, 51).

Commitment check: A two-item scale helped assess participants' commitment to the running task. Specifically, on a Likert scale that ranged 0 (not at all) - 5 (very much), participants indicated how committed they were to the running task. Additionally, on a Likert scale that ranged from 0 (worst ever)-10 (best ever) participants indicated how well they think they performed the task.

Conditions: The study included three conditions, two experimental conditions with music (self-selected, and researcher-selected music (i.e., *Audiofuel*)), and a control condition with no music. Each participant completed each of the three conditions. For the "self-selected" condition, participants listened to a playlist (between four and eight songs in length) of music that would motivate them to a "great running performance". They were asked (via e-mail) to create this playlist prior to their first session and continue to bring it with their music-playing device and headphones to each subsequent session. In consideration of previous studies (3, 48), the decision was made to allow participant to autonomously make their musical selections. During the researcher-selected music condition, participants listened to pre-selected music downloaded (by the researcher) from the *Audiofuel* website during the running task.

Used in previous studies (27), *Audiofuel* is a program/web site that offers music-based training for running, walking, swimming, and indoor bike training. For the purposes of the current study, the subscribed program featured music specifically for running, with narration on the app on shifts in beats per minute (bpm) for which participants to adhere to. That is, a voice would prompt participants to run *with*, or in sync with the music tempo as it changed. The music featured in the app covered a spectrum of instrumentals (i.e. there are no lyrics per se) that incorporate a blend of jazz, electronic dance music, and pop. To accommodate participants varying in running experience and ability, the primary researcher downloaded musical "sessions" of different tempos (from 125-180 bpm). Leading up to the protocol, the (researcher selected, *Audiofue*l) music was selected based on the participant's projected mile time, which was communicated to the researcher one week prior to the first running trial. During the "no music" condition, participants did not listen to music in the course of the running task. Participants were informed of which condition they were assigned to moments prior to the running task. These three conditions were counterbalanced to help control for order effects within a repeated measures design.

Testing Procedure: Three testing trials occurred on three separate days with a one-week interval in between each session. Each session took approximately 20 minutes. To adhere to study protocol, and to be eligible for compensation, participants were required to maintain their same exercise regimens in between sessions.

Upon arrival to the running track, participants were asked whether they can run a mile, and whether they did, in fact keep their exercise routine unchanged. After a 5-minute warm-up and stretch, participants were asked to complete the FS assessment. Upon completion of these, participants were made aware of the condition in which they were assigned (i.e., self-selected, *Audiofuel* or no music). Next participants were instructed to complete a one-mile run with or with no music (i.e., contingent upon their assigned condition) as fast as they could. They were also instructed to report their affects during the run by means of the FS. Specifically, in the course of their run, every two laps, participants indicated positive or negative feelings by giving a "thumbs up" (positive) or "thumbs down" (negative) and perceived intensity of feeling with fingers of the opposite hand (0=neutral feeling; 5=highest intensity feeling).

At the completion of each run, mile time was recorded in minutes using a stopwatch. At this point, participants completed the commitment check and PACES as well as FS, BMRI-2. One week after the third and final run, participants were contacted via e-mail and asked to complete the preference questionnaire.

Statistical Analysis
This study consisted of an experimental design. Descriptive statistics were conducted for participants' age, gender, and year of school. Repeated measure analysis of variance (RM ANOVA) were used to analyze the data, including affective responses and time of completed mile (in minutes). For this method of data analysis, assumptions to be met included: independence, scale of measurement, normality (to be assessed through running descriptive statistics and observing distribution on histogram), and homogeneity of variance. Because the experiment was a within subjects design, a sphericity test was to be applied, and Maulchy's Test was thereby interpreted. Pearson's correlations were used to evaluate the relationship between affective responses and mile time. The correlation coefficient was considered significant if the p-value was <.05. All data analysis were conducted using SPSS 20 for Windows, with an alpha level set at .05 to determine significance.

RESULTS

BMRI-2 scores for the self-selected and *Audiofuel* music conditions were compared using a paired-samples t-test. T tests yielded a significant difference, $t = -5.15$, $p < .001$, Cohen's d = .96, with the self-selected condition displaying the highest mean ($M_{\text{self-selected}} = 36.93$ vs. *M Audiofuel* = 29.26). This indicates that self-selected music was reported as more motivational than *Audiofuel* music.

Music and Performance: Results of the RM ANOVA for running performance (i.e., time to completed mile) yielded no significant effect in mile time by music condition, $F\ (2, 25) = 1.25$, $p > .05$.

Table 1. Means for Mile Performance by Condition

Condition	*N*	*M*	*SD*
No Music	27	8.67	2.04
Audiofuel	27	8.70	2.07
Self-Selected	27	8.54	2.10

Enjoyment: Results of the RM ANOVA revealed that enjoyment was not significantly affected by the type of music condition $F\ (2, 52) = .545$, $p > .05$.

Valence: A 5 x 3 RM ANOVA was run to evaluate changes in valence by music condition, and yielded a non-significant interaction. However, there was a main effect of valence through the protocol, $F\ (4, 104) = 15.27$, $p < .05$, $\eta^2 = .370$. Pairwise comparisons indicated that participants' levels of valence significantly decreased from assessments 1 to 4 and, 2 to 3, 4 and 5, regardless of the music condition. There was not a significant main effect for music condition.

Affective Responses and Performance: Correlational analysis was performed for levels of post enjoyment by running performance (i.e., time to completed mile). Results yielded significant relationships between post-task enjoyment and performance. A moderate, significant negative relationship between enjoyment and performance emerged for only the participants' enjoyment on the first session, r (27) = -.505, p <.01. This indicates that participants rating higher indices of enjoyment post-run after the initial running session, performed better (i.e., lower total time) on the task. Otherwise, results revealed non-significant relationships between affective measures consisting of pre or post valence, enjoyment and performance.

Table 2. Pearson Correlation Matrix for Post-test Affective Responses and Performance

	Enjoyment Run I	Enjoyment Run II	Enjoyment Run III
Session I Run	-.505**	-.269	-.297
Session II Run	-.505**	-.283	-.240
Session III Run	-.470*	-.258	-.273

**Correlation is significant at the .01 level
*Correlation is significant at the .05 level

Condition Preference: Results of the one-item preference questionnaire gauging the music condition participant would most like to repeat revealed that 20 (74.1%) of the 27 participants would prefer to repeat the self-selected music condition. Six participants (22.2%) indicated they would prefer to repeat the *Audiofuel* condition, and one (0.04%) participant reported a preference for the no music group. Open ended follow-ups for choosing self-selected music revealed justifications such as "More enjoyable experience overall. Self-selected music was more motivating to me to keep running.", "…I feel more comfortable listening to my music because I am familiar with it.", "(self-selected) keeps me focused on the lyrics and not the running activity. It goes by faster.", and "I picked songs that I enjoyed that also had a fast tempo. This combined with the general attitude of many of the songs, made the running seem easier."

DISCUSSION

The purpose of this study was to examine the effect of different types of music on affective responses and the subsequent running performance in a sample of untrained college-aged participants within a field setting. Initially, we examined whether significant differences would emerge in mile time among runners undergoing different music-listening conditions (i.e., self-selected, *Audiofuel*, and no music). We hypothesized that listening to music would facilitate performance. We also hypothesized that runners would perform greatest in the self-selected music condition, indicated by lowest time to completed mile, followed by their performances in the *Audiofuel*, and no music conditions.

The results did not support this hypothesis. There were no significant differences in participants' mile times across conditions. These results are inconsistent to those that indicate an effect of music on running (27, 47) and other athletic performances (3, 22, 54). These findings are consistent with others who also reported no effect of music on outcome performance (e.g., 14, 51).

The conceptual model and related research depicting motivational effects of music (19), posits that music, through enhancing positive mood and affective responses may lead to psychophysical or ergogenic effects. However, it must be noted that the potential of music to help dissociate from unpleasant feelings is largely seen ineffectual at higher exercise intensities (40). Considering the untrained sample comprised in the current study, one can argue that while a mile run would seem fairly moderate to the relatively trained exerciser, this may have presented a considerable challenge for the present participants. Perhaps, the novelty of the exercise experience could also serve as a detriment for the runner, making it more challenging to disassociate themselves from feelings of fatigue and emotions of negative valence as compared with someone more physically fit, regardless if they are allowed music or not.

Finally, although not explicitly hypothesized we examined potential relationships between affective responses and running performance. Specifically, we considered that positive affective responses (i.e., enjoyment, valence, and energy) would increase as mile times decreased. This expectation was somewhat supported by the results, with the finding of a negative relationship in which those that enjoyed the task most during the no music condition were more likely to have improved performances (i.e., lower mile time) during this condition. Though previous research has linked higher exercise enjoyment to perceived self-efficacy, which may in turn lead to increased exercise adherence (24), it remains to be observed the extent that enjoyment to exercise benefits exercise performance. Nonetheless, indices of positive affective responses during this protocol, particularly with increases in enjoyment, bode well for a notion of continued exercise adherence as a result of improved affective responses to exercise (10).

Although not part of the present set of hypotheses, additional interesting findings emerged from the one-item preference questionnaire and subsequent open-ended clarification of the participants' preferred condition. Clear evidence emerged demonstrating a vast majority of respondents preferring to repeat the self-selected music condition. Moreover, participants cited this condition to be more enjoyable, motivational, comfortable, and facilitating an easier running experience.

These responses may represent the value of an often neglected qualitative approach in assessing the potentials of motivational music during an exercise task (22). In fact, others have come to similar conclusions with regards to the distracting and dissociative properties present in the music selections, as well as enhanced affective states, and behavioral responses to self-selected and motivational music (22). However, these studies reported subjective accounts from well-trained samples in highly controlled settings. Current results provide insight that these same benefits can be derived by an untrained sample within a field setting and this is important to consider.

Limitations and Future Directions: This study is not void of limitations. For one, the study involved field settings, which, may be well-served from an external validity standpoint, but only at the cost of compromising internal validity. Specifically, the use of an indoor running track at a university recreation center during open hours created environments that were relatively variable in nature—with some potential distractions (e.g., other walkers or runners on the track). This being so, one could argue that aspects of the environment, not the intervention, may have hindered or benefitted the running experience. Furthermore, due to space availability constraints, two locations with comparable dimensions were utilized for the purposes of this study. It should be noted however that participants ran on the same track for each of their sessions. These logistical constraints also limited our ability to incorporate a baseline trial to allow the participant to become acclimated to the physical and psychological requirements of the task. In addition, the relatively low sample size produced low power for this study, and made it more difficult to generalize the main findings of the study. We also acknowledge that self-report assessments may typically possess inherent limitations; however, such measures used for the purposes of this study were previously validated (17, 52). Participant attrition may also be viewed as a potential limitation. A total of 27 participants, out of 35 (77%) completed the full protocol (i.e., three, weekly running sessions). Approaches including increasing contact with participants, reminding them of their sessions, as well as repeatedly communicating the commitment requirements of the study could have minimized the attrition rates. Lastly, although we draw our protocol from published guidelines (22), the present participants' substantial autonomy in selecting music may have somewhat limited our results' internal validity. This said, the use of BMRI-2 as a manipulation check here helped us further determine whether the music they selected was truly motivational to them.

The findings from the current study can be expanded upon and applied amongst researchers and practitioners. Though not seeming to be influenced by the use of music, the finding that participants were able to improve their mile time performance, some even decreasing by minutes presents fruitful avenues to further explore. Specifically, researchers may investigate the influence of perceived self-efficacy on future exercise performance, as mediated by music, as well as potential relationship with affective responses. One possible method could be to manipulate self-efficacy by telling participants of their mile time "improvements" between sessions, and evaluate the subsequent level of enjoyment, activation, and valence in a similar format as the current study.

Furthermore, rather than providing participants with simple, open-ended instructions for selecting music (i.e., "choose music that you think would motivate you for a great performance"), a more scientific method of selecting music, as demonstrated by Karageorghis et al., (22), could enhance internal validity for this type of studies. Specifically, Karageorghis et al., featured a stage specifically devoted to the selection of motivational music with a separate sample of 92 participants, each nominating six musical selections, and eventually rating the 20 most frequently referenced selections on motivational qualities via the BMRI-2. Qualitative accounts of the rationale and thought process behind how participants select music for exercise may also be valuable for researchers and practitioners in the exercise domain. To that end, researchers may examine the music selections of the participants to see if patterns emerge within certain styles of music, and whether they are comparable to the selections observed to be motivational in previous studies (22.). With some indication of success in using the *Audiofuel* application for running purposes, researchers may benefit from comparing other applications that have been eventuated in positive exercise outcomes (i.e., Zombies, Run!; 36). Further studies using an untrained sample are also needed, preferably with larger sample sizes to have their findings more generalizable to the general population who adhere to exercise at levels below the recommended guidelines.

As a final word of caution, it should be noted that affective response is strongly tied to exercise intensity. If performance improves, intensity increases hence potentially confounding any comparison of the affective responses. Consequently, assessing affective response and exercise performance within the same study can prove challenging and researchers should consider this.

Implications: In light of the current findings, from a practical standpoint, prospective exercisers are encouraged to experience for themselves the effect that pleasurable, inspiring music can elicit in exercise settings. It appears that at the very least, the use of this music can distract experiences of displeasure associated with exercise, while the extent of its benefits has yet to be fully examined. Using music as a tool to sustain exercise may provide a solution to the barriers of lack of motivation and tiredness that deters individuals from adherence, and hopefully elevate daily exercise levels closer to levels recommended.

Practitioners on the other hand, including the ones engaging in exercise adherence consulting, are behooved to integrate some of these findings pertaining to the use of music in exercise settings to benefit exercise-adherence. Recognizing the barriers that can be overcame with the use of music, and the potential of music serving as a form of support and comfort represent a salient direction for practitioners to consider. To that, the present findings that indicate increased vigor at pre -post exercise are particularly promising when considering that lack of energy or tiredness is one of the most cited a barrier for exercise (9, 31).

Finally, in the light of these findings, researchers should also continue to identify populations who can benefit from increased exercise adherence (e.g., cancer patients, those with mental health disorders, and other clinical populations), and examine how music can be used to overcome the barriers inherent in each population. This is especially important considering that these populations are even more prone to sedentariness and its negative consequences (16, 18, 33).

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