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The Effects of Music Choice on Perceptual and Physiological Responses to Treadmill Exercise

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by

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ABSTRACT

This study investigated the effects of music choice on the ratings of attentional focus, affective valence, perceived exertion, and enjoyment during and after self-paced treadmill exercise of varied intensities. Thirty-four college-aged, healthy, active males and females volunteered to participate in the study. Participants completed 6 visits to the laboratory: the first visit was a medical screening to ensure safety of the participants. For the second visit, participants completed a maximal treadmill exercise test. On the third visit, participants completed the Brunel Music Rating Inventory-2 to determine their preferred and non-preferred music genres, and to self-select the low, moderate and high intensity exercise speeds that would be used in the experimental trials. During the last three visits, participants completed each of the three (preferred, non-preferred, no music) randomized and counterbalanced experimental trials. The Physical Activity Enjoyment Scale and the Feeling Scale were used to measure baseline and post-exercise ratings of enjoyment and affective valence. During exercise, the single-item Attentional Focus Scale, Feeling Scale, Borg 6-20, and Exercise Enjoyment Scale were used to measure attentional focus, affective valence, perceived exertion, and enjoyment, respectively. Results revealed a main effect for condition for affective valence and enjoyment ($p < 0.001$ for both interactions). A main effect was also found for intensity for attentional focus ($p = 0.002$) and perceived exertion ($p < 0.001$). Lastly, there was a main effect for activity revealed for affective valence ($p = 0.047$) and enjoyment ($p = 0.012$). Moreover, tests of between and within subjects factors revealed an

interaction effect for condition by intensity for affective valence ($p = 0.019$) and for condition by intensity by activity for perceived exertion ($p = 0.005$). There was a general trend for thoughts to be more associative as intensity increased in both groups. In addition, there was a general trend for thoughts to be more dissociative during the preferred music condition compared to the non-preferred and no music trial. However, these differences were only found to be significant in the active group. Furthermore, there was a general trend in the active group for affective valence to be more positive regardless of exercise intensity or music condition when compared to the inactive group. Both groups showed the highest ratings of affective valence during the preferred music condition, followed by the non-preferred and no music condition. In-task enjoyment ratings were highest during the preferred music condition when compared to the non-preferred and no music condition regardless of exercise intensity or activity status. The results did not reveal significant differences for ratings of exertion across music conditions, which does not support previous findings. In conclusion, the perceptual responses in this study, which represent affective valence, attentional focus, and enjoyment, were generally more favorable during the preferred music condition and in the active participants. These results support previous findings to suggest exercising while listening to preferred music may lead to an increase in physical activity adherence.

CHAPTER 1: INTRODUCTION

Rationale

Regular physical activity is important for prevention and treatment of many preventable chronic diseases. Despite the known negative effects of physical inactivity on health, quality of life, and risk for disease, research illustrates physical inactivity levels are high amongst the general population (Healthy People 2020, 2000). Healthy People 2020 found that 80 percent of adults do not meet the guidelines for both aerobic and muscle strengthening activities (Healthy People 2020, 2000). Moreover, research shows 50 percent of people who begin exercise will drop out within the first 6 months (Wilson & Brookfield, 2009). Therefore, research supports the need not only to increase physical activity levels, but also to increase motivation towards exercise participation and adherence.

Ebben and colleagues (2008) conducted a study to investigate college student's motives and barriers to exercise. Students reported enjoyment as one of the top reasons they exercise. Additionally, students reported more enjoyable exercise options would lead to an increase in their current physical activity level and a reasoning for physically inactive indivuals to begin exercising. A number of authors (Annessi, 2001; Karageorghis, Terry, & Lane, 1999; Schwarts, Fernhall, & Plowman, 1990) have proposed the positive effects of music on feelings states can lead to increased adherence to exercise. Many types of music genres and exercise modalities have been studied to support these findings; however, research is limited in terms of the effect of preferred music on the perceptual and physiological responses to exercise. The purpose of this study is to further investigate the effects of music; more specifically, to compare the effects of preferred and non-preferred music choice on ratings of affective valence, attentional focus, enjoyment, and perceived exertion, in both physically active and inactive males and females.

Problem Statement

The fact that physical inactivity levels are high leads to the question, how can individuals who are inactive become motivated to engage in physical activity? This presents a challenge in terms of motivating individuals not only to begin exercising, but also the need for motivation to achieve the recommended levels of exercise, and to maintain an active lifestyle. There is a growing amount of research to support the motivational and ergogenic effects of music on exercise performance and the perceptual and physiological responses to exercise. However, most of the research has focused on a particular genre or type of music such as a specific tempo, synchronous or asynchronous, and motivational music. Therefore, a gap in the literature exists relative to the effect of preferred and non-preferred music choice on perceptual and physiological variables including affective valence, attentional focus, enjoyment, and perceived exertion.

Research Variables

The independent variables for this study include the three music conditions: preferred music, non-preferred, and no music. The independent variables also include the two activity groups which are active and inactive. The dependent variables for this study were affective valence, attentional focus, enjoyment, and perceived exertion.

Hypotheses

Hypothesis 1. Compared to non-preferred music, listening to preferred music while exercising will result in greater enjoyment in-session and post-exercise.

Hypothesis 2. Compared to non-preferred music, listening to preferred music will result in lower ratings of perceived exertion.

Hypothesis 3: Compared to non-preferred music, listening to preferred music while exercising will result in higher affect in-session and post-exercise.

Hypothesis 4: Compared to non-preferred music, listening to preferred music will result in higher attentional focus in-session.

Hypothesis 5: Compared to no music, listening to non-preferred music will result in higher ratings of perceived exertion, more associative thoughts, and lower affect and enjoyment in-session and post-exercise.

Operational Definitions

Affective valence is defined as a general valence response of pleasure-displeasure. Affective valence arises without significant thought or cognitive elaboration (Ekkekias & Petruzzello, 2000).

Asynchronous music is defined as background music to which movements are not consciously synchronized (Karageorghis, Terry, Lane, Bishop, & Priest, 2012).

Synchronous music is defined as background music to which movements are consciously synchronized (Karageorghis, Terry, Lane, Bishop, & Priest, 2012)

Attentional Focus is defined as a cognitive strategy describing wherever the individual happens to allocate their attention to at any given moment.

Enjoyment is defined as an emotional-based construct that involves significant cognition about the totality of the experience and environmental context (Wankel, 1993).

Ergogenic effect is defined as a technique or substance used for the purpose of enhancing performance (Ergogenic Aids, 2017).

Non-preferred music is defined as music that is not considered to be motivating or enjoyable and preferred music is considered motivating and enjoyable.

Ratings of perceived exertion is defined as the degree of heaviness or strain experienced in physical work (Borg, 1998).

Self-paced is defined as a treadmill speed in which the individual chooses a desired pace.

Assumptions

The assumptions of this study are that participants accurately reported their activity levels, self-selected appropriate speeds for each exercise condition, and provided honest and accurate responses to all questions during each trial. The researcher assumes participants adhered to all instructions and gave the required effort during all trials.

Limitations

One limitation of this study will be the sample size and population demographics such as age and being relatively healthy, which may limit the generalizability of the results to other age groups and or unhealthy populations. The researcher did not specify a modality of exercise needed to be classified as “active”, in order to attract a larger sample size, and to potentially be able to increase generalizability of the results across various exercise modalities. A third limitation will be the lack of the familiarity participants may have with the perceptual scales or exercise in general. Efforts will be made to address this through a familiarization visit prior to the start of experimental trials.

Delimitations

A primary delimitation of this study is the participant characteristics, which is comprised of relatively healthy adults between 18 to 30 years of age. The researcher chose the age group due to the study being conducted on a college campus and to be able to recruit from a larger sample size. Participants were asked to refrain from any significant physical activity 24-hours prior to laboratory visits to avoid fatigue or delayed onset muscle soreness symptoms that could interfere with the exercise experience.

Significance

The key role of music in the exercise domain is to reduce perceived exertion and increase the amount of work performed, without a shift towards negative feelings (Ekkekakis, Hall, & Petruzzello, 2004; Hutchinson & Tenenbaum, 2006). Aforementioned research has identified a large population of inactive individuals; therefore, demonstrating a large population who can potentially seek the benefits of listening to music while exercising to increase motivation towards exercise participation, adherence, and tolerance. The goal of this research is to study the influence of preferential music choice on affective valence, attentional focus, enjoyment, and perceived exertion and to compare the effects among physical activity status. Moreover, the importance of this study is to determine if exercising to music, more specifically, preferred music, can affect the psychological and physiological aspects of the exercise experience. The findings of this study could support current literature and further research in terms of the effect of preferential music choice on exercise. Furthermore, the findings of this study could provide insight on how to motivate individuals to become active, maintain exercise intensity over time, and ultimately lead to the adoption of a physically active lifestyle.

CHAPTER 2: LITERATURE REVIEW

Introduction

The purpose of this literature review is to provide an overview of the rationale behind exercising to music by reviewing the psychological and ergogenic effects of music. It is organized by presenting a body of knowledge of where the research currently stands, the conceptual framework to explain the theories behind exercising with music, which includes previous studies to support the use of music during exercise.

Music and Exercise

The idea of exercising to music is not a new concept; in fact, research in the music and exercise domain dates back to the mid 1990's and has since then come a long way (Karageorghis & Priest, 2012). To date, research has looked at the effects of music use prior to and during exercise, as well as the use of asynchronous and synchronous music, and preferential music. Motivation is an important factor for encouraging initiation of exercise and equally important for maintaining an intensity level of exercise over a period of time. Music has been shown to capture attention, increase work output, and encourage rhythmic movement (Van der Vlist, Bartneck, & Maueler 2011). Moreover, these effects all have important applications to exercise.

There is an extensive body of literature to support the positive impact of listening to music prior to and during exercise on performance and the physiological and psychological responses including increasing motivation (Karageorghis & Priest, 2012). The factors contributing to motivation include being able to exercise harder and/or longer, providing a distraction effect, triggering or regulation of specific moods and emotions, control of arousal, evocation of memories and other cognitive processes, induction of flow state, and encouragement of rhythmic movement (Karageorghis & Priest, 2012). These responses may contribute to an ergogenic effect including improved exercise performance, reduced ratings of perceived exertion, and increasing work capacity (Karageorghis & Priest, 2012). Perceived exertion is defined as the subjective measure of intensity of effort experienced during exercise (Mohmammadzadeh, Tartibiyan, & Ahmadi, 2008). The primary factors influencing music responsiveness during exercise have been studied to better understand the potential ergogenic effects of music on exercise performance. These influential factors relating to musical qualities include: rhythm, melody, harmony, persuasiveness of the music, and associated memory that piece of music may carry (Karageorghis & Priest, 2012). The effects of music on the psychological benefits associated with exercise and performance appear to be strongest in self-paced, submaximal endurance-based exercise (Karageorghis & Priest, 2012).

Theories to support these effects and ideas date back decades and to the early behaviorists and performance investigators. B.F Skinner developed the theory that one's behavior is influenced by external factors, such as the environment one is surrounded by (Skinner, 1953). Brown theorized that noise may have a facilitative and dynamogenic effect on one's performance, as seen through significant increases in energy output and fatigue (Brown, 1961). Previous research by Gunnar Borg identifies the strong linear relationship among heart rate and exercise intensity (Borg, 1998). These findings demonstrate individuals are using cognitive strategies to process ratings of perceived exertion coming from physical sensations (Borg, 1998). The parallel processing model, which assumes all processes involved in a task occur at once has been widely used in studies that utilize self-reports of intensity such as rating of perceived exertion (Rejeski, 1985). More specifically, research using this model has focused on the cognitive processing strategies of association and dissociation. The process of dissociating has been observed in individuals who exercise, which involves focusing on cognitive stimuli that do not produce physical feelings of discomfort pertaining to the exercise they are performing (Rejeski, 1985). Furthermore, if you are able to dissociate, you may be able to block the feelings of fatigue, leading to a decreased level of perception of effort. Consistent with these findings, music has also been associated with a reduction in sense of effort during exercise (Rejeski, 1985).

Music and Ratings of Perceived Exertion

Potteiger and colleagues (2000) conducted a study to examine the influence of music on ratings of perceived exertion during 20-minutes of moderate intensity exercise. The study consisted of 27 physically active men and women, who were considered to be physically active. Each subject completed four 20-minute trials and were randomly assigned to 1 of 4 treatment groups (fast upbeat music, classical music, self-selected music, and no music) for each session. Heart rate, peripheral, central, and overall ratings of perceived exertion were measured every 5 minutes during exercise. The study concluded that regardless of the type of music, there was a reduced peripheral, central, and overall rating of perceived exertion when compared to the no music control group. These findings are consistent with research conducted early on, which found listening to music resulted in lower ratings of perceived exertion at light, moderate, and heavy exercise (Boutcher & Trenske, 1990). A similar study looked at the effects of music on ratings of perceived exertion and performance; however, this study included trained and untrained individuals who performed progressive exercise. This study consisted of 24 healthy college-aged students, who were separated into trained and untrained groups. Both groups completed two Bruce treadmill tests, with music and without music, over the course of 2 days. The results revealed a significant main effect of music on ratings of perceived exertion in the music condition compared to the no music condition. In addition, the results revealed a large effect of music on ratings of perceived exertion among the untrained subjects when compared to the trained subjects. The participant's time to exhaustion (performance) was longer during the music condition than the no music condition. This study concluded that when completing exercise without a motive, subjects mostly concentrate on the "struggle," resulting in higher exertion rates. Furthermore, the study found music to be a powerful external motive to cause distraction and excitement (Mohmammadzadeh , Tartibiyan, & Ahmadi, 2008).

Preferred Music Choice and Exercise

Nakamura and colleagues (2010) examined the differences between preferred and non-preferred music choice on continuous cycling exercise performance. The study consisted of 15 healthy, physically active and recreational cyclists, college-aged males. Each participant completed a preferred, non-preferred, and no music cycling trial at a critical power intensity. Heart rate, ratings of perceived exertion, and performance (distance), were recorded each minute. The results of this study found a statistically significant main effect for condition. More specifically, the preferred music condition was able to cycle a significantly greater distance than the non-preferred condition. Additionally, the study found the ratings of perceived exertion were significantly higher in the non-preferred and no music condition. Moreover, this study was able to conclude that listening to preferred music while cycling at critical power intensities, in comparison to non-preferred music, reduced the rating of perceived exertion rates, and increased cycling distance (Nakamura, Pereira, Papini, Nakamura, & Kokubun, 2010). A study was done to examine the effects of preferential music during endurance performance running and compared the effects among differences in sex (Cole & Maeda, 2015). This study included 20 women and 15 men who self-reported participation in endurance running. Each subject completed three 12-minute Cooper Tests for each of the following randomized conditions: preferred music, non-preferred, and no music (Cole & Maeda, 2015). The study found a significant music by sex interaction, which found women ran further during the preferred music than the non-preferred music condition. This study concluded the music by sex interaction is potentially due to women paying closer attention to the rhythmical qualities of music than men, which would lead to an increase in the pleasure sensation, and possibly explains the increase performance (Cole & Maeda, 2015). Although a a greater effect has been noted in women, listening to music while exercising may help to promote healthy habits by increasing motivation in both sexes (Cole & Maeda, 2015).

Perceptual Responses and Exercise

Although affective valence and enjoyment responses to exercise have been extensively investigated, it was not until recently that responses to varying intensities of exercise were studied. The influence of music on affective exercise responses was studied in trained and untrained runners during low, moderate, and high intensity exercise under three music conditions (Brownley, McMurraym, & Hackney, 1995). The results of this study found that compared to trained subjects, untrained subjects reported a more positive affective valence while listening to fast pace music during low and high intensity exercise (Brownley, McMurraym, & Hackney, 1995). Wininger and Pargman (2003) conducted a study to examine the factors contributing to exercise enjoyment. The results of this study indicated that music was the most important factor in terms of exercise enjoyment, which further contributes to regular engagement in physical activity (Wininger & Pargman, 2003).

Hutchinson & Tenenbaum (2007) define two distinct cognitive styles that determine the ways in which exercisers divide their focus relative to exertion experiences. Individuals differ in terms of attention style and can be considered as one of three categories: associators, dissociators, and switchers. "Associators" would be able to direct their attention to the body's internal cues, while "dissociators" would be able to focus on external cues or unrelated tasks, and a "switcher" would be able to do both (Hutchinson & Tenenbaum, 2007). Hutchinson and colleagues (2013) examined the topic of attentional flexibility by having participants complete varying intensity treadmill exercise (low, moderate, high) during 3 music conditions (motivational, oudeterous, and no-music). This study also looked at the affective response to exercise in terms of pleasure-displeasure (Hutchinson & Karageorghis, 2013). The findings of this study indicate that music was able to facilitate a dissociative strategy, regardless of attention style. The ratings of affective responses were most positive during the motivational music condition, followed by oudeterous, which is constant with previous studies and the conceptual framework (Karageorghis, Priest, Terry, Chatzisarantis & Lane, 2006).

Conclusion

According to the U.S Department of Health and Human Services (2008), running is one of the most common exercise modalities among adults and is recommended for maintaining or improving health. Despite the fact research illustrates listening to music while exercising has been linked to physiological and psychological benefits, it is well known that many running environments, such as sporting events or exercise testing, do not allow runners to listen to music. As stated previously, research in the exercise and music domain has been a topic in the field for quite some time; however, there is a lack of research in terms of preferred music compared to non-preferred music, leading to the aim of this research. Studies have revealed that preferred music choice has been shown to motivate an individual to enhance exercise performance by increasing adherence, intensity, and duration; however, the research is conflicting in terms of comparing the effects on activity status and use of preferred music (Karageorghis et al, 2011).

Previous research has found listening to music while exercising can decrease ratings of perceived exertion, provide a distraction effect, and lead to increases in performance and adherence (Ekkekakis, Hall, & Petruzzello, 2004; Hutchinson & Tenenbaum, 2006). If exercise can be perceived as less difficult, it is possible it may result in an increased desire to begin and sustain exercise, as well as the potential to exercise at a higher intensity. These results have important implications for physically inactive individuals who lack motivation to start exercising, for those who lack motivation to sustain exercise, and to encourage a higher work output during exercise sessions. The goal of this research is to further explore the differences in activity status on the effects of listening to preferred and non-preferred music choices on perceptual and physiological responses during varying intensity continuous running.

CHAPTER 3: METHODS

Participants

A total of 37 participants were recruited for this study. Three participants dropped out prior to completion due to medical or personal concerns. Thirty-four (14 inactive, 20 active) participants completed the study. Moreover, the study included 15 males (4 inactive, 11 active) and 19 females (10 inactive, 9 active). Participants had a mean age in years of 22 ± 3 (range = 19 – 30). The mean BMI for participants was 24.1 ± 6 (range = 15 – 41) and the mean body fat percentage was 19.9 ± 8.51 (range = 5 – 41). Maximal oxygen consumption was determined by a multistage, progressive treadmill test. The mean VO_{2max} data collected during maximal exercise testing was 40 ± 7 ml/kg/min (range = 25 – 53). A successful Vo_{2max} test was defined as reaching 19 or above on the Borg 6-20 RPE scale and reaching 90% of the individual's age-predicted maximum heart rate. Twenty-seven out of thirty-four participants attained an RPE of 19 or above during the maximal exercise test. Twenty-six out of thirty-four participants reached 90% of their age-predicted maximum heart rate (mean = 188 ± 11, range = 167 – 210). Physical activity status was determined based off of the American College of Sports Medicine Exercise Testing and Prescription Guidelines 10th Edition which are as follows: planned, structured physical activity of at least 30 minutes of moderate intensity activity, at least three days a week for at least 3 months (ACSM, 2017). Furthermore, self-report data for physical activity status indicated the inactive group completed between 0 –140 minutes of moderate intensity physical activity per week, and the active group completed 165 – 810 minutes per week.

All participants were students at the University of South Florida. Informed consent was obtained from all who participated in the research study in accordance with University of South Florida Institutional Review Board (IRB) guidelines. Each participant underwent a medical screening and health risk assessment, which was conducted by a licensed medical professional at the Health and Exercise Science laboratory prior to completing the maximal exercise test or the experimental trials. Individuals were included in the study if they were between 18 to 30 years of age and designated as low to moderate risk for cardiovascular diseases based on ACSM guidelines (ACSM, 2017). Each participant who completed the study was entered into a drawing for a gift card. Participant characteristics with means, standard deviations and ranges are shown in Table 3.1 on page 23.

Instrumentation

Ratings of perceived exertion during exercise were measured using the Borg 6 to 20 scale (Borg, 1998). Anchors ranged from "no exertion at all" at 6 to "maximal exertion" at 20. This scale is widely used in exercise science research as a means to monitor and prescribe intensity of exercise, it has been validated as a measure of discomfort, exertion, and has been found to have high reliability for intratest and retest measures (Borg, 1998). The Borg scale used during trials is shown in Appendix A.

Ratings of perceived enjoyment during exercise were measured using the Exercise Enjoyment Scale (EES), a single-item, 7-point Likert scale, and validated measure of exercise enjoyment (Stanley, Williams, & Cumming, 2009). The scale ranges from "not at all" at 1 to "extremely" at 7 with anchors provided at every integer (Stanley, Williams, & Cumming, 2009). The enjoyment scale used during trials is shown in Appendix B.

Ratings of physical enjoyment pre and post-exercise were measured using the Physical Activity Enjoyment Scale (PACES). The PACES is an 18-item, 7-point rating scale that asks participants to indicate how they feel at the moment about exercise (Kenzierski & DeCarlo, 1991). Anchors are provided at every item with 2 contrasting statements, in which the participants are asked to indicate the strength of the agreement. The pre and post enjoyment scales used during the trials are shown in Appendix C and D.

Affective valence was measured pre-exercise, during exercise, and post-exercise using the Feeling Scale (FS). This is an 11-point scale, which ranges from -5 to +5. Anchors are provided at 0 “neutral” and all odd integers ranging from “very good” at +5 to “very bad” at -5 (Hardy & Rejeski, 1989). The validity of this scale was tested through 3 experiments, which collectively showed validity in using this scale to measure affective valence during exercise (Hardy & Rejeski, 1989). This scale is used to measure the emotional component, meaning, participants are asked to rank the sensation of effort while running on the treadmill as pleasant or unpleasant. The affective valence scale used during trials is shown in Appendix E.

Attentional focus was measured during exercise using a single-item scale, which ranges from 0 to 100, with “0” representing association: completely internal focus of attention such as on breathing or muscle cramps, and “100” representing dissociation: an external focus such as schoolwork or environment. Participants were asked to report what percentages of their thoughts were associative using a 0 to 100 scale. Therefore, if a participant reported 60 percent of his or her thoughts as associative, it was assumed the remaining 40 were dissociative thoughts. This scale is a validated measure of attentional focus and is noted to be an efficient tool to assess in-task activity (Tammen, 1996). The attentional focus scale used during trials is shown in Appendix F.

The Brunel Music Rating Inventory-2 (BMRI-2) was used to determine preferred and non-preferred music genre. This is a 6-item, 7-point scale, ranking from “strongly disagree” at 1 to “strongly agree” at 7. The scale was designed to aid exercise instructors and participants in selecting music for exercise (Karageorghis, Priest, Terry, Chatzisarantis & Lane, 2006). Research supports the validity and internal consistency of the inventory to standardize music in experimental protocols involving exercise (Karageorghis, Priest, Terry, Chatzisarantis & Lane, 2006). The genre of music that scored the highest was used during the preferred music condition and the lowest scored genre was used as the non-preferred condition. The music inventory used during trials is shown in Appendix G.

The health screening form was used to assess personal and family health history, physical activity level, as well as alcohol and tobacco use. The health screening form can be found in Appendix H. The physical exam form was completed by a licensed medical professional and clearly indicated medical clearance level. The physical exam form can be found in Appendix I.

Equipment

Heart rate measurements for the maximal exercise tests and all experimental trials were assessed through use of a Polar Heart Rate monitor. Blood pressure was measured by auscultation by use of a sphygmomanometer. Height and weight of each participant was measured to the nearest 0.5 inch and 0.5 pound, respectively, on the Health’ O Meter Professional scale. Body fat percentage was estimated through use of a hand held Omron bioelectrical impedance analysis. The familiarization and experimental trials were completed on a Cybex treadmill, and oxygen consumption was measured through a MGC CardiO_2 Ultima Series using a Track Master TM428CP Treadmill. A portable music system was used to play the music and the volume was standardized at level 35 on the device for all trials and participants. All data was collected through paper questionnaires and was stored in a locked filing cabinet in the Health and Exercise Science Laboratory at the University of South Florida.

Procedures

This study employed a within and between subjects experimental design and all experimental trials were randomized and counterbalanced. Participants were required to complete 6 visits in total. All visits were held in the Health and Exercise Science Laboratory at the University of South Florida campus located in Tampa, Florida. Participants were required to refrain from vigorous physical activity 24 hours prior to each session.

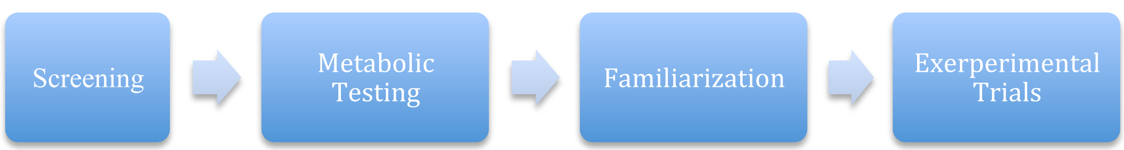

Figure 3.1 Order of Visits

First Visit. Participants were greeted and directed to a seated area where they were asked to read an informed consent document. All protocols were read aloud to each individual, and participants were encouraged to ask any questions or express any concerns regarding their participation in the study. After acknowledging understanding of and signing the informed consent form, individuals were instructed to complete a health history form. A research staff member then recorded the applicant's height, weight, resting heart rate, resting blood pressure, and body fat percentage. The health history document was presented to a qualified health professional to review for potential signs and symptoms of cardiovascular, metabolic, pulmonary, and musculoskeletal disease. Individuals were required to receive clearance from the medical professional in order to qualify for the study. All screening information was gathered using a health history and risk questionnaire form previously approved by the IRB. Participants received instructions for metabolic testing, which would occur on the following visit.

Second Visit. During the second visit, a progressive, multistage, maximal exercise protocol was performed on a treadmill. The expectations for maximal exercise testing were verbally communicated and explained to each participant. Participants were encouraged to perform the test with a maximal effort, and the test was terminated when the participant indicated they could not perform any longer. Each test began at 3.0 miles per hour (mph), increased by 0.5 mph every minute until 7.0 mph was reached, from there the treadmill grade increased by 2 percent each minute. Heart rate, blood pressure, ratings of perceived exertion, and expired gases were monitored in accordance with standard exercise testing guidelines (ACSM, 2017). To ensure safety, both heart rate and RPE were monitored continuously and recorded each minute throughout the progression of the test. Heart rate was measured using a heart rate monitor and exertion was estimated each minute using the Borg 6-20 scale (Borg, 1998). Upon completion of the test, participants were instructed to complete a cool-down phase until their heart rate returned to pre-exercise measures. Participants were then instructed to sit quietly for 5 minutes before a blood pressure and heart rate were taken post-exercise to ensure the participants safety. Expired gases were collected and analyzed continuously using a metabolic cart. Maximal oxygen consumption was identified as the largest volume of oxygen consumed per minute during the test. Criteria for verifying maximal exertion was as follows: a peak heart rate of at least 90% of age-predicted maximal heart rate (based on 220 - age) and peak rating of perceived exertion of 19 (on a 6 - 20 scale) (Maud et al, 1995).

Third Visit. Participants returned to the laboratory for a familiarization trial in which they completed the music questionnaire, selected treadmill speeds, and were familiarized with the scales used in the experimental trials. Participants were given 5 copies of the BMRI-2 and were directed to read the instructions and ask any questions they may have. Each participant listened to the same series of five pieces of music (Rock, Hip Hop, Country, Pop, Classical) that were previously selected by the researcher. Karageorghis and colleagues (2011) found the appropriate band of tempo for asynchronous music during exercise intensities in the range of 40 to 90 percent heart rate reserve is 125 to 140 bpm. This guideline was used for all music selection during all trials. Each piece of music was played for 90 seconds using a portable music player, allowing for at least one verse and chorus to be heard (Gluch, 1993). Following the delivery of each piece of music, participants were given 30 seconds to complete the questionnaire. The genre of music that was ranked the highest was used for the preferred trial and the genre ranked the lowest was used for the non-preferred music trial.

Next, participants self-selected a treadmill speed for each of the following exercise intensities: low, moderate, and high. Each of these intensities were based off a speed the individual believed they could maintain for 8 minutes each and fit within the verbal description they were given. Verbal cues were given to describe what each of these intensities should feel like; however, these cues differed from the phrasing used on the Borg RPE scale, in order to eliminate the possibility of participants feeling pressured to mock the RPE range given. Participants had four minutes to select a speed for the first 2 exercise conditions, and eight minutes for the last condition. The treadmill grade was not manipulated and was set at 0.

Participants were asked to verbalize responses to the 4 perceptual scales during minute 3:30 of the first 2 conditions and at minute 3:30 and 7:30 of the last condition.

Visits Four Through Six. The final 3 visits were comprised of the experimental trials. The experimental trials were randomized and counterbalanced, and each participant completed the same self-selected exercise protocol for all trials. Each 24-minute session was preceded by a 3 minute warm up and followed by a 3 minute cool down, which translated to 30 minutes on the treadmill. Each participant successfully completed each exercise condition. Heart rate was assessed pre-exercise, monitored throughout exercise, cool-down, and post-exercise through use of a heart rate monitor. Blood pressure was measured at rest and post-exercise by auscultation. Rating of perceived exertion was measured by use of the Borg 6-20 scale. Enjoyment was measured pre and immediate post-exercise through the Physical Activity Enjoyment Scale and was measured in-session through use of the Exercise Enjoyment Scale. Affective valence was measured pre, during exercise, and immediate post-exercise by use of the Feeling Scale. Attentional Focus was measured in-session through use of the single-item scale. All exercise tests and experimental conditions were completed in the Health and Exercise Science Laboratory at the University of South Florida, which allowed for environmental conditions to be controlled for all participants.

Pre-exercise. Each participant remained seated for five minutes before resting heart rate and blood pressure was recorded. Each participant received explanation of all scales and questionnaires that would be used during the trial. The participants were then instructed to complete the pre-exercise questionnaires (PACES, FS) based off of how their feelings towards exercise in general. The participants were then directed to the treadmill where they were prompted to begin the exercise trial.

During Exercise. Participants completed a 3-minute warm-up. Following the warm-up, the experimental exercise trials commenced and consisted of 24 continuous minutes; however, each of the 3 exercise intensities (low, moderate, high) consisted of total of 8 minutes each. The music was played through a portable speaker system at the same volume for all trials and subjects, which was initiated after the completion of the warm-up, and was terminated when the cool-down phase began. During all experimental conditions attentional focus, affective valence, exertion, and enjoyment were recorded at minute 3:30 and 7:30 of each of the 3 eight-minute phases (low, moderate, high). All in-session assessments were taken by asking participants to verbalize responses while being provided a visual reference. Heart rate was continuously monitored throughout all exercise sessions. Participants completed a 3 minute cool-down before exiting the treadmill.

Post-exercise. Upon completion of the cool-down, participants were instructed to return to a seat, where post-exercise heart rate and blood pressure were measured. Participants were then instructed to complete the post-exercise questionnaires by answering the questions relative to the exercise they just completed.

Statistical Analysis

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) and was completed in several phases. The first phase included a descriptive analysis of the sample and characteristics. The second phase utilized a series of repeated-measures ANOVAs for each of the dependent measures. Each ANOVA included (no music, preferred music, and non-preferred music) as within subjects factors and physical activity status (active and inactive) as between subject factors. Follow-up of paired samples t-tests were performed to identify where specific differences occurred within groups and independent t-tests were performed to determine amongst group differences. Criterion for significance was set at a probability of 0.05.

TABLE 3.1 Participant Characteristics with Mean, Standard Deviation and Range

	Activity Status	Mean ± SD	Range
Age (y)	Active	23 ± 3.1*	20-30
	Inactive	21 ± 2	19-28
Height (in)	Active	68 ± 4*	62-75
	Inactive	65 ± 3	61-71
Weight (lbs)	Active	164 ± 44*	105-271
	Inactive	147 ± 35	106-213
Body mass index	Active	24 ± 5	15-38
	Inactive	25 ± 7	17-41
Body Fat (%)	Active	17 ± 7*	15-38
	Inactive	24 ± 9	5-41
Systolic blood pressure (mmHg)	Active	118 ± 13	92-140
	Inactive	118 ± 12	98-132
Diastolic blood pressure (mmHg)	Active	79 ± 6	62-88
	Inactive	77 ± 9	60-88
Resting heart rate (beats/min)	Active	69 ± 14	43-95
	Inactive	77 ± 14	53-97
Maximal VO_2 (ml/kg/min)	Active	43 ± 5*	31-53
	Inactive	37 ± 7	25-48
Maximal heart rate (beats/min)	Active	190 ± 11	167-210
	Inactive	187 ± 11	169-207
Maximal RPE	Active	19 ± 1	16-20
	Inactive	18 ± 1	16-20
Maximal RER	Active	1.2 ± 0.1	1.1-1.3
	Inactive	1.2 ± 0.1	1.1-1.4

*denotes significant difference between active and inactive groups

CHAPTER 4: RESULTS

Self-paced Speeds

The speeds with the mean and standard deviation were as follows low (2.3 ± 0.9), moderate (3.9 ± 1.3), and high (5.3 ± 1.4). Follow up analysis provided by t-tests revealed a significant difference between the low to moderate, moderate to high, and low to high intensity speeds ($p < 0.001$).

Attentional Focus

Analysis of the data revealed a main effect for intensity ($p = 0.002$) but not a main effect for condition ($p = 0.06$) or activity ($p = 0.26$). Further analyses indicated no interaction effects ($p > 0.10$ for all interactions). Follow up analyses provided by t-tests noted several significant mean differences. Specifically, in the active group there was a significant shift towards more associative thoughts from low (mean ± SD = 71 ± 32) to moderate exercise (65 ± 34) ($p = 0.042$) during the preferred music condition. For the active group, in the non-preferred music condition, there was a significant difference between low (70 ± 28) to moderate intensity (61 ± 27) ($p = 0.006$), moderate (61 ± 27) and high intensity (41 ± 30) ($p < 0.001$), and low (70 ± 28) to high intensity (41 ± 30) ($p < 0.001$). Also, in the no music condition there was a significant difference from moderate (51 ± 23) to high intensity (35 ± 29) exercise ($p= 0.006$). In addition to the differences within intensity conditions, the analyses noted significant differences in attentional focus in the active group within music conditions. There was a significant decrease at low intensity between the non-preferred (70 ± 28) and the no music condition (55 ± 27) ($p < 0.001$) and between the preferred (71 ± 32) and no music condition (55 ± 27) ($p < 0.001$). Similarly, there was a significant decrease during the high intensity exercise between the preferred (56 ± 35) and the non-preferred music condition (41 ± 30) ($p < 0.001$) and a significant decrease between preferred (56 ± 35) and the no music condition (43 ± 31) ($p < 0.001$). The mean ratings and standard deviations for attentional focus at low, moderate, and high intensity across the three music conditions are depicted in Table 4.1.

Table 4.1 Mean Ratings for Attentional Focus with Standard Deviations

Intensity	Activity Status	Preferred	Non-preferred	No Music
Low	Inactive	68 ± 27	74 ± 22	67 ± 22
	Active	71 ± 32α	70 ± 28	55 ± 27 β
	Total	69 ± 30	71 ± 26#^	60 ± 25
Moderate	Inactive	70 ± 24	66 ± 25	65 ± 21
	Active	65 ± 34	61 ± 27*^#	51 ± 23#
	Total	67 ± 30	63 ± 26	57 ± 23
High	Inactive	58 ± 29	53 ± 35	54 ± 32
	Active	56 ± 35 β α	41 ± 30*^#	35 ± 29
	Total	56 ± 32	46 ± 32	43 ± 31

*denotes significantly different from low intensity
^ denotes significantly different from moderate intensity
# denotes significantly different from high intensity
β denotes significantly different from non-preferred music
α denotes significantly different from no music

Affective Valence

Since affective valence data was collected pre, in session, and post-exercise, an analysis was done to determine if there were any baseline differences between the results of the pre-feeling scale data. Analysis provided by t-test of the baseline feeling scale data revealed no significant differences ($p > 0.05$ for all interactions). Moreover, an analysis of variance was conducted to further examine baseline differences. Similarly, no baseline differences were revealed between feeling scale data across music conditions ($p = 0.683$).

Analysis of the feeling scale data revealed a significant main effect for condition ($p < 0.001$) but not for activity ($p = 0.140$) or time ($p = 0.949$). Further analyses indicated an interaction effect for condition by time ($p = 0.004$).

When analyzing the in-task data, a significant main effect for condition ($p < 0.001$) and activity ($p = 0.047$) was revealed, but not intensity. Furthermore, the analyses noted an interaction effect for condition by intensity ($p = 0.019$). Follow up analyses provided by t-tests noted several significant mean differences. The active group differences were noted at low intensity between the preferred (3.7 ± 1.2) and non-preferred (2.4 ± 2.0) ($p = 0.002$) and preferred (3.7 ± 1.2) and no music conditions (2.0 ± 1.5) ($p < 0.001$). Similarly, these differences were revealed during the moderate intensity exercise between the preferred (3.8 ± 0.9) and non-preferred music condition (2.2 ± 2.1) ($p = 0.001$) and between the preferred (3.8 ± 0.9) and no music condition (1.8 ± 2.1) ($p = 0.002$). These differences were also observed during high intensity exercise between the preferred (2.9 ± 2.3) and non-preferred (1.4 ± 2.5) ($p = 0.007$) and preferred (2.9 ± 2.3) and no music conditions (1.4 ± 2.1) ($p = 0$ .008).

Moreover, significant differences were also revealed for the inactive group between conditions and intensities. Specifically, differences were found at low intensity exercise between preferred (2.4 ± 1.4) and no music (0.9 ± 1.8) ($p = 0.002$) and between no music (0.9 ± 1.8) and non-preferred music conditions (1.8 ± 2.0) ($p = 0.034$). At moderate intensity, differences were found between the preferred (2.1 ± 1.5) and no music intensity (1.2 ± 1.5) ($p = 0.042$) and between the preferred (2.0 ± 1.6) and non-preferred music conditions (0.4 ± 2.0) ($p = 0.004$) at high intensity. Furthermore, differences were found in the non-preferred condition between moderate (1.5 ± 2.1) and high intensity (0.4 ± 2.0) ($p = 0.007$) and low (1.8 ± 2.0) to high (0.4 ± 2.0) intensity exercise ($p = 0.035$). The mean ratings and standard deviations for affective valence at low, moderate, and high intensity across the three music conditions are depicted in Table 4.2

Table 4.2 Mean Ratings of Affective Valence with Standard Deviations

Intensity	Activity Status	Preferred	Non-preferred	No Music
Low	Inactive	2.4 ± 1.4α	1.8 ± 2.0#	0.9 ± 1.8β
	Active	3.7 ± 1.2βα	2.4 ± 2.0	2.0 ± 1.5
	Total	3.2 ± 1.5	2.2 ± 2.0	1.6 ± 1.7
Moderate	Inactive	2.1 ± 1.5α	1.5 ± 2.1#	1.2 ± 1.5
	Active	3.8 ± 0.9βα	2.2 ± 2.1	1.8 ± 2.1
	Total	3.1 ± 1.4	1.9 ± 2.1	1.5 ± 2.0
High	Inactive	2.0 ± 1.6β	0.4 ± 2.0	0.9 ± 2.3
	Active	2.9 ± 2.3βα	1.4 ± 2.5	1.4 ± 2.1
	Total	2.5 ± 2.1	0.9 ± 2.3	1.2 ± 2.2

# denotes significantly different from high intensity
β denotes significantly different from non-preferred music
α denotes significantly different from no music

Exertion

Analysis of the data revealed a significant main effect for intensity ($p < 0.01$) but not for activity ($p = 0.140$) or time ($p = 0.949$). Further analyses indicated an interaction effect for condition by intensity by activity ($p = 0.005$). Follow up tests provided by t-tests noted significant mean differences for both the inactive and active groups for intensity of exercise. In the inactive group, significant differences were found during the preferred music trial between low (7.6 ± 1.2) to moderate (9.9 ± 1.8) intensities ($p < 0.001$), moderate (9.9 ± 1.8) to high (12.6 ± 2.4) ($p < 0.001$), and low (7.6 ± 1.2) to high intensity (12.6 ± 2.4) ($p < 0.001$). These mean differences were also revealed in the non-preferred music condition during the same intensity ranges (low 7.4 ± 1.1, moderate 9.8 ± 2.6, high 13.1 ± 2.4) ($p < 0.001$ for all interactions). In the no music group, mean differences in exertion ratings were noted between low to moderate intensity ($p < 0.001$). In the active group, mean differences in exertion ratings were revealed between low to moderate, moderate to high, and low to high intensity for all music conditions ($p < 0.001$ for all interactions). The mean ratings and standard deviations for exertion at low, moderate, and high intensity across the three music conditions are depicted in Table 4.3.

Table 4.3 Ratings of Perceived Exertion

Intensity	Activity Status	Preferred	Non-preferred	No Music
Low	Inactive	7.6 ± 1.2^	7.4 ± 1.1*	7.8 ± 1.6^
	Active	7.5 ± 1.1^	7.7 ± 1.2^	7.6 ± 1.3^
	Total	7.6 ± 1.1	7.6 ± 1.2	7.7 ± 1.4
Moderate	Inactive	9.9 ± 1.8#	9.8 ± 2.6#	10.3 ± 2.2
	Active	10.6 ± 1.8#	10.6 ± 1.7#	10.0 ± 1.8#
	Total	10.3 ± 1.8	10.2 ± 2.1	10.1 ± 2.0
High	Inactive	12.6 ± 2.4*	13.1 ± 2.4*	11.9 ± 2.8
	Active	13.0 ± 2.5*	13.1 ± 2.4*	13.1 ± 2.0*
	Total	12.8 ± 2.4	13.1 ± 2.4	12.6 ± 2.4

*denotes significantly different from low intensity
^ denotes significantly different from moderate intensity
# denotes significantly different from high intensity

Enjoyment

Since enjoyment was collected pre, in session, and post-exercise, an analysis was done to determine if there were any baseline differences between the results of the pre-physical activity enjoyment scale data. Analysis provided by t-test of the baseline enjoyment data revealed no significant differences ($p > 0.05$ for all interactions). However, an analysis of variance was conducted to further examine baseline differences, which revealed significant differences between baseline enjoyment data across music conditions ($p < 0.045$).

Analysis of the pre and post physical activity enjoyment data revealed a significant main effect for condition ($p < 0.001$), activity ($p = 0.017$), and for time ($p < 0.001$). Further analyses indicated an interaction effect for condition by time ($p < 0.001$).

When analyzing the in-task data, a main effect for condition ($p < 0.001$. and activity ($p = 0.012$) but not intensity ($p = 0.914$) was revealed. Follow-up analyses provided by t-tests noted several significant mean differences. Specifically in the inactive group, during low intensity exercise between preferred (5.1 ± 1.2) and non-preferred music (2.7 ± 1.1) ($p = 0.025$), at moderate intensity between preferred (5.0 ± 1.6) and non-preferred music (3.7 ± 1.5) ($p = 0.010$), and at high intensity exercise between preferred (3.9 ± 2.6) and non-preferred music (2.5 ± 1.2) ($p = 0.001$) and the preferred (3.9 ± 2.6) and no music conditions (2.8 ± 1.6) ($p = 0.017$). In the active group, mean differences were noted at low intensity exercise between preferred (5.1 ± 1.2) and non-preferred music conditions (3.4 ± 1.3) ($p < 0.001$), and preferred (5.1 ± 1.2) and no music (2.3 ± 1.1) ($p < 0.001$). At moderate intensity, mean differences were noted between preferred (5.0 ± 1.6) and non-preferred music (3.7 ± 1.5) ($p = 0.003$) and preferred (5.0 ± 1.6) and no music (3.3 ± 1.0) ($p < 0.001$). During high intensity exercise, mean differences were found between preferred (4.6 ± 2.0) and non-preferred music (3.3 ± 1.6) ($p = 0.003$) and preferred (4.3 ± 1.9) and no music conditions (3.0 ± 1.6) ($p < 0.001$). Additionally, in the non-preferred music condition a mean difference was noted between moderate (3.7 ± 1.5) and high intensity exercise (3.3 ± 1.6) ($p = 0.046$). The mean ratings and standard deviations for exercise enjoyment at low, moderate, and high intensity across the three music conditions are depicted in Table 4.4 on page 30.

Table 4.4 Mean Ratings of Exercise Enjoyment with Standard Deviations

Intensity	Activity Status	Preferred	Non-preferred	No Music
Low	Inactive	3.6 ± 1.7α	2.7 ± 1.1	2.3 ± 1.1
	Active	5.1 ± 1.2βα	3.4 ± 1.3	3.3 ± 1.1
	Total	4.4 ± 1.6	3.1 ± 1.3	2.9 ± 1.2
Moderate	Inactive	3.5 ± 1.5β	2.5 ± 1.2	2.7 ± 1.0
	Active	5.0 ± 1.6βα#	3.7 ± 1.5	3.3 ± 1.0
	Total	4.4 ± 1.7	3.2 ± 1.5	3.3 ± 1.0
High	Inactive	3.9 ± 2.6βα	2.5 ± 1.2	2.8 ± 1.6
	Active	4.6 ± 2.0βα	3.3 ± 1.6	3.2 ± 1.6
	Total	4.3 ± 1.9	2.9 ± 1.5	3.0 ± 1.6

# denotes significantly different from high intensity
β denotes significantly different from non-preferred music
α denotes significantly different from no music

CHAPTER 5: DISCUSSION

Recent studies have highlighted the potential of music to provide an ergogenic effect on exercise performance and the perceptual and physiological responses associated with exercise participation (Ebben & Brudzynski, 2008). Additionally, studies have reported enjoyable exercise options as a means to increase physical activity, and is noted as a main reason to participate in exercise (Ebben & Brudzynski, 2008). Furthermore, many types of exercise modalities and music genres have been shown to induce a positive mood state and may lead to an increase in exercise adherence (Annessi, 2001; Karageorghis, Terry, & Lane, 1999; Schwarts, Fernhall, & Plowman, 1990). Studies have examined many genres of music, specific tempos, rhythms, and synchronous or asynchronous music during exercise; however, there is a gap in the research in terms of the effect of preferred music choice on the perceptual and physiological responses during exercise. The current study examined a college-aged population and their perceptual and physiological responses by way of comparing no music, preferred, and non-preferred music genres during self-paced varying intensity exercise. The purpose of the present study was to analyze the effect of preferred and non-preferred music on attentional focus, affective valence, exertion, and enjoyment in physically active and inactive males and females during self-paced treadmill exercise. The hypothesis of this study stated that the perceptual responses would reflect the most positive experience during the preferred music condition, followed by no music, and the non-preferred music condition. The findings of this study provide evidence that suggests a need to further examine the perceptual responses to exercise performed during varying music conditions and intensities.

Attentional Focus

Music has been shown to be an effective means to reduce redundancy during exercise, which can be explained by the attentional processing theory (Karageorghis, 2006). The attentional processing theory explains how depending on the intensity of exercise, internal or external cues may predominate the processing capacity. Moreover, research would support exercising at low and moderate intensities allows external focus and exercising at high intensities would align with physiological cues that tend to predominate over external factors (Rejeski, 1985). Previous studies have found recreational exercisers and those with lower fitness levels can benefit from a dissociative attentional focus during exercise, which may be a solution to the way exercise is perceived (Silva, Ferrieras, & Follador, 2016).

There was a general trend for thoughts to be more associative as intensity increased, which is supported by previous findings (Silva, Ferrieras, & Follador, 2016). However, in the current study, the shift towards associate thoughts was only found to be significant in the active group. A relevant finding of this study is the significant difference in attentional focus across the three music conditions, which revealed a more dissociative attentional style in the active group. In both groups, there was a significant difference at low and high intensity when comparing the preferred music to the non-preferred and no music conditions. In both groups, there was a general trend for attentional focus to be more dissociative during the preferred music condition, followed by non-preferred, and finally the no music condition, which would support the hypothesis.

Affective Valence

The affective response to exercise is important for understanding the psychological aspect of exercise, but also for understanding and promoting adherence to physical activity. Previous findings have suggested that exercise bouts typically result in an increase in post-exercise affective ratings higher than or equivalent to baseline values (Parfitt & Burgees, 2006). The findings of this study support this postulation as there are no significant differences observed between pre and post-ratings of affective valence. There was a general trend in the active group of higher ratings of affective valence regardless of intensity or condition, which is parallel to the findings of the aforementioned study by Brownley and colleagues (1995). Additionally, in the inactive group there was a larger decrease in affective ratings, especially from moderate to high intensity. Another finding of this study is that in both the active and inactive groups, affective valence was highest in the preferred music condition compared to non-preferred and no music condition at all three exercise intensities, which supports the hypothesis.

Exertion

Karageorghis and colleagues (1999) found three mechanisms in which music produces positive effects on an individual during exercise. The first mechanism provides alterations of psychomotor arousal levels, the second enhances affective states during moderate and high intensities, and lastly is the narrowing of attentional focus, which results in a decreased bodily awareness and lower ratings of exertion (Karageorghis, Terry & Lane, 1999). Previous studies have found regardless of the type of music or activity status, music can cause a reduced rating of perceived exertion (Boutcher & Trenske, 1990). The theory behind this is believed to be due to focusing more on the "struggle" when exercising without music, resulting in higher ratings of exertion (Mohmammadzadeh , Tartibiyan, & Ahmadi, 2008). This study's findings suggest there are no significant differences between ratings of perceived exertion across music conditions, which does not support the hypothesis and is in opposition to the aforementioned studies. Heart rate was monitored throughout exercise during the familiarization and experimental trials, but it was not recorded. Therefore, the researcher was unable to determine the intensity that each participant was working at. Although analysis of the speeds revealed statistical significant differences between all intensities, the lack of significant differences between the ratings of exertion across music conditions, may be due to participant's self-selecting speeds that were not a true reflection of the intensity ranges they were asked to select. In other words, participants may have selected speeds that were easier than the intensity ranges proposed.

Enjoyment

Karageorghis and colleagues (2012) suggest emotions can be evoked while listening to music through memory, empathy and appraisal. Memory relates to the idea that music has the tendency to act as a trigger of an emotional event (Karageorghis & Priest, 2012). Empathy relates to the idea that the listener may be able to recognize or identify with emotions expressed by the artist or song (Karageorghis & Priest, 2012). Appraisal relates to the idea that the listener may be able to evaluate the personal significance of the emotions expressed in the song in relation to their own well-being (Karageorghis & Priest, 2012). A collection of previous research suggests that if an activity is perceived as enjoyable, it is more likely that an individual will engage in the activity more often (Wininger & Pargman, 2003). Moreover, a study examining the factors associated with exercise enjoyment found satisfaction with the music in the exercise environment to be a significant contributor to exercise enjoyment (Wininger &

Pargman, 2003). The findings of this study show a main effect for the pre to post physical activity enjoyment data for condition, time, and activity, as well as an interaction effect for condition by time. Additionally, in task enjoyment was higher regardless of intensity or activity status when comparing preferred music to non-preferred and the no music condition, which supports the hypothesis. These findings support current research which states, listening to preferred music provides a motivational component or ergogenic effect while exercising, and has been postulated to increase enjoyment and reduce ratings of exertion (Ebben & Brudzynski, 2008).

Conclusions

The purpose of this study was to examine the effect of music choice on the perceptual and physiological responses to self-paced treadmill exercise performed by active and inactive males and females. The perceptual responses in this study, which represent affective valence, attentional focus, and enjoyment, were generally more favorable during the preferred music condition, and in the active participants. These results support previous findings to suggest exercising while listening to preferred music conditions may lead to increase in physical activity adherence.

Based on these findings, exercising in preferred music conditions should be considered since attentional style, affective valance, and enjoyment appear to be more positive compared to non-preferred and no music conditions. Despite the known effects of inactivity on health, activity levels are still low amongst the general population, which highlights the importance of increasing positive feelings towards exercise in order to promote exercise adherence. It has been suggested that exercising without music can be monotonous, which leads to negative feelings toward physical activity, and may ultimately impact current or future exercise adherence (Silva, Ferrieras, & Follador, 2016). Furthermore, it has been noted that an individual's perception of exercise will have a direct influence on their participation (Silva, Ferrieras, & Follador, 2016). Perhaps, if exercising during non-preferred and no music conditions can be avoided, it may help to elicit the association of positive feelings with exercise and lead to increased adherence. Specifically, if an individual is able to perceive exercise in a more positive manner, such as higher affective valence, greater enjoyment, lower perceived exertion, or an increased ability to dissociate, it may lead to the association of positive feelings and increased adherence of an active lifestyle (Silva, Ferrieras, & Follador, 2016). Research in the music and exercise domain has been shown to produce the previously mentioned psychological and physiological effects to elicit a more positive exercise experience. Previous studies that have utilized self-paced exercise have been associated with more pleasant experiences, which also highlights an important factor to consider when prescribing exercise and working with populations who need to increase physical activity levels (Silva, Ferrieras, & Follador, 2016).

Some of the strengths in this study include internal validity, which was maintained through controlling the environment in which the participants completed the experimental trials. To ensure internal validity, all protocols and communication with subjects were scripted to ensure each participant received the same instructions. Additionally, the laboratory was set up the same way each time the participants came in for trials. Industry standard equipment was used for all baseline measures including body composition, heart rate, blood pressure, and metabolic testing. A strong attribute of the study was the small but well-trained staff, which allowed for testing conditions to be controlled for across all subjects and across experimental conditions, regardless of the research staff member leading the trial.

Some of the weaknesses in the study include external validity. The study included a small sample size, consisting of relatively healthy, young adults, which may limit the generalizability of the results across various populations. Physical activity status was not based off of participation in a required modality of exercise. Therefore, if participants were performing any modality of physical activity, they would be considered active as long as he or she was meeting the guidelines of 150 minutes of moderate activity per week for the past 3 months. However, this also meant a participant could be physically active, but not enough to meet the specific intensity or time requirements and therefore, would place them in the inactive category. This is a major limitation to the study and may be something future researchers would want to reconsider. Moreover, in terms of ecological validity, the environment in which the testing conditions were performed was not reflective of "real-world" activities. Participants were required to complete the trials in a laboratory setting, in which they were required to face a white wall with printouts of the variables being measured.

Results of this study provide a foundation for future researchers who are interested in exploring the perceptual responses to self-paced exercise. Future studies may wish to expand on the size and the target population (e.g., older age groups, overweight or obese, moderate to high risk for disease). Future investigations may also wish to narrow modality of exercise studied in order to better classify individual's activity status and to understand or compare the effects of music across exercise modalities. Another consideration for future studies examining perceptual responses in self-paced exercise, would be to have more strict means or guidelines of self-selecting intensity to ensure participants are adequately reaching the desired intensities. This study represents a novel attempt to better understand the exercise experience in terms of perceptual and physiological responses in relation to preferred music choice. While the findings of the study reflect benefits of preferred music on attentional focus, affective valence, and enjoyment, further investigation is necessary to examine the implications of music in the exercise domain.

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APPENDICES

Appendix A: Borg 6-20 Scale

Borg Rating of Perceived Exertion

6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Appendix B: Exercise Enjoyment Scale

Use the following scale to rate how much you are enjoying the exercise.

1	**Not at all**
2	**Very little**
3	**Slightly**
4	**Moderately**
5	**Quite a bit**
6	**Very much**
7	**Extremely**

Appendix C: Pre-Physical Activity Enjoyment Scale

Please rate how you feel at this moment about the exercise by circling the number that seems most appropriate.

1	I enjoy it	1 2 3 4 5 6 7	I hate it
2	I feel bored	1 2 3 4 5 6 7	I feel interested
3	I dislike it	1 2 3 4 5 6 7	I like it
4	I find it pleasurable	1 2 3 4 5 6 7	I find it unpleasurable
5	I am very absorbed in this activity	1 2 3 4 5 6 7	I am not at all absorbed in this activity
6	It's no fun at all	1 2 3 4 5 6 7	It's a lot of fun
7	I find it energizing	1 2 3 4 5 6 7	I find it tiring
8	It makes me depressed	1 2 3 4 5 6 7	It makes me happy
9	It's very pleasant	1 2 3 4 5 6 7	It's very unpleasant
10	I feel good physically while doing it	1 2 3 4 5 6 7	I feel bad physically while doing it
11	It's very invigorating	1 2 3 4 5 6 7	It's not at all invigorating
12	I am very frustrated by it	1 2 3 4 5 6 7	I am not at all frustrated by it
13	It's very gratifying	1 2 3 4 5 6 7	It's not at all gratifying
14	It's very exhilarating	1 2 3 4 5 6 7	It's not all exhilarating
15	It's not at all stimulating	1 2 3 4 5 6 7	It's very stimulating
16	It gives me a strong sense of accomplishment	1 2 3 4 5 6 7	It does not give me a strong sense of accomplishment
17	It's very refreshing	1 2 3 4 5 6 7	It's not at all refreshing
18	I felt as though I would rather be doing something else	1 2 3 4 5 6 7	I felt as though there was nothing else I would rather be doing

Appendix D: Post-Physical Activity Enjoyment Scale

Please rate how you feel at this moment about the exercise you just completed by circling the number that seems most appropriate.

1	I enjoy it	1 2 3 4 5 6 7	I hate it
2	I feel bored	1 2 3 4 5 6 7	I feel interested
3	I dislike it	1 2 3 4 5 6 7	I like it
4	I find it pleasurable	1 2 3 4 5 6 7	I find it unpleasurable
5	I am very absorbed in this activity	1 2 3 4 5 6 7	I am not at all absorbed in this activity
6	It's no fun at all	1 2 3 4 5 6 7	It's a lot of fun
7	I find it energizing	1 2 3 4 5 6 7	I find it tiring
8	It makes me depressed	1 2 3 4 5 6 7	It makes me happy
9	It's very pleasant	1 2 3 4 5 6 7	It's very unpleasant
10	I feel good physically while doing it	1 2 3 4 5 6 7	I feel bad physically while doing it
11	It's very invigorating	1 2 3 4 5 6 7	It's not at all invigorating
12	I am very frustrated by it	1 2 3 4 5 6 7	I am not at all frustrated by it
13	It's very gratifying	1 2 3 4 5 6 7	It's not at all gratifying
14	It's very exhilarating	1 2 3 4 5 6 7	It's not all exhilarating
15	It's not at all stimulating	1 2 3 4 5 6 7	It's very stimulating
16	It gives me a strong sense of accomplishment	1 2 3 4 5 6 7	It does not give me a strong sense of accomplishment
17	It's very refreshing	1 2 3 4 5 6 7	It's not at all refreshing
18	I felt as though I would rather be doing something else	1 2 3 4 5 6 7	I felt as though there was nothing else I would rather be doing

Appendix E: Affective Valence Scale

Use the following scale to rank the emotional component, i.e. how pleasant or unpleasant running on the treadmill feels.

+5	**Very good**
+4	
+3	**Good**
+2	
+1	**Fairly good**
0	**Neutral**
-1	**Fairly bad**
-2	
-3	**Bad**
-4	
-5	**Very bad**

Appendix F: Attentional Focal Scale

Attentional Focus

0	**Association**
100	**Dissociation**

Appendix G: Brunel Music Rating Inventory-2

The purpose of this questionnaire is to assess the extent to which the piece of music who are about to hear would motive you during exericse. For our purposes, the word 'motivate' means music that would make you want to exercise harder and/or longer. As you listen to the piece of music, indicate the extent of your agreement with the statements listed below by circling one of the numbers to the right of each statement. We would like you to provide an honest response to each statement. Give the response that best represents your opinion and avoid dwelling for too long on any single statement.

Strongly disagree In-between Strongly agree

1	The rhythm of this music would motivate me during exercise	1	2	3	4	5	6	7
2	The style of this music (i.e rock, dance, jazz, hip-jop, etc.) would motivate me during exercise	1	2	3	4	5	6	7
3	The melody (tune) of this music would motivate me during exercise	1	2	3	4	5	6	7
4	The tempo (speed) of this music would motivate me during exercise	1	2	3	4	5	6	7
5	The sound of the instruments used (i.e guitar, synthesizer, saxophone, etc.) would motivate me during exericse	1	2	3	4	5	6	7
6	The beat of this music would motivate me during exercise	1	2	3	4	5	6	7

Appendix H: Health Status Questionnaire

Participant ID Number: ______________

Medical History							
Check any that apply to you personally							
	High blood pressure		Arterial disease		Chest pain		Heart palpitations
	Skipped heart beats		Heart murmur		Leg/claudication pain		ECG abnormalities
	Shortness of breath		Chronic bronchitis		Emphysema		Asthma
	Cough on exertion		Coughing blood		High cholesterol		Blood disorders
	Low blood sugar		Diabetes		Dizzy spells/blacking out		Frequent headaches
	Stroke		Osteoporosis		Joint problems		Arthritis
	Hernia		Varicose veins		Frequent colds/infections		Thyroid disorder
	Kidney disease		Liver disease		Other:		
Check any that apply to your immediate family							
	Heart attacks		High blood pressure		High cholesterol		Stroke
	Diabetes		Heart defect		Heart surgery		Early death
	Lung disease		Thyroid disease		Other:		

Pregnancy	
Are you currently pregnant or trying to become pregnant? Respond with: yes or no	

Medications	
List any medications or supplements you are currently taking. Provide: name and reason.	

Hospitalizations	
List hospitalizations in the last 10 years excluding healthy pregnancies. Provide: year and reason.	

Other medical conditions	
List medical conditions that you have received treatment for. Provide: name and year of diagnosis	

Tobacco	
List any tobacco products that you have used in the last year. Provide: type, amount used, and length of use	

Caffeine	
List any caffeine products that you currently use including: coffee, tea, soda, etc. Provide: type, amount, and how long used.	

Alcohol	
List any alcohol products that you currently consume including: beer, wine, liquor, etc. Provide: type, amount, and how long used.	

Physical activity participation				
For the last three months, have you averaged at least 4 days/wk of aerobic exercise (walking, jogging, cycling, swimming, hiking, etc.) for at least 30 mins per session? Respond with: yes or no				
Do you ever have shortness of breath at rest or during mild exercise? Respond with: yes or no				
Do you ever have chest pain at rest or during mild exercise? Respond with: yes or no				
Describe the level of physical activity associated with your job. Respond with: none, light, moderate, or heavy				
List sport or recreational activity that has been typical for you over the last 3 months. Include: type (e.g. running, weight training), frequency per week, minutes per session, and intensity (light, moderate, vigorous)	Type	Frequency	Duration	Intensity
List exercise that has been typical for you over the last 3 months. Include: type (e.g. running, weight training), frequency per week, minutes per session, and intensity (light, moderate, vigorous)	Type	Frequency	Duration	Intensity

Items below require input on the part of research team. No need to respond.

Body weight status					
Height (inches)	Weight (lbs)	Body mass Index	Body Fat Percentage		

Appendix I: Pre-Participation Physical Examination

University of South Florida – Health & Exercise Science Lab

Baseline Information

Participant Name		Date of Exam	
Height		Resting HR	
Weight		Resting BP	

Medical Evaluation

	Normal	Abnormal Findings	Initials
General Appearance			
Eyes			
Ears			
Nose			
Throat			
Mouth			
Neck			
Heart			
Pulses			
Thorax			
Lymph Nodes			
Lungs			
Abdomen			
Hernia			
Gastrointestinal			
Genitourinary			
Neck			
Back			
Shoulder			
Arm			
Elbow			
Wrist			
Hand			
Hip			
Thigh			
Knee			
Ankle			
Foot			
Posture			
Flexibility			
Other			

Medical Clearance

	Cleared for all exercise/sport activities without restriction.
	Cleared for all exercise/sport activities except the following:
	Not cleared for exercise/sport activities.

Name of Medical Evaluator		Date	
Signature of Medical Evaluator			

Appendix J: IRB Approval Letter

USF UNIVERSITY OF SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX(813)974-7091

11/16/2017

Taylor Shimshock
Educational and Psychological Studies
6829 Bluff Meadow Ct
Wesley Chapel, FL 33545

RE: **Expedited Approval for Initial Review**
IRB#: Pro00032440
Title: The Effects of Music Choice on Perceptual and Physiological Responses During Treadmill Running.

Study Approval Period: 11/16/2017 to 11/16/2018

Dear Ms. Shimshock:

On 11/16/2017, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Protocol

Consent/Assent Document(s)*:
Informed Consent.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(4) Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

VJorgensen MD

E. Verena Jorgensen, M.D., Chairperson
USF Institutional Review Board