The Effects of Running to Music and Receiving Individual Preference for Running with or without Music on Psychological and Performance Outcomes

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Submitted under the supervision of Dr. Beth Lewis to the University Honors Program at the University of Minnesota-Twin Cities in partial fulfillment of the requirements for the degree of Bachelor of Science, *summa cum laude* in Kinesiology.

December 2022

Acknowledgements

I would like to express my sincere gratitude to my research advisor, Dr. Beth Lewis. Your commitment to others is inspiring, and I am thankful to have had the opportunity to learn from you. Thank you for bringing me into your lab, guiding me through the research process, and challenging me to reach my full potential. A year ago, I was intimidated by the thought of conducting an original research study. You helped me take this project one step at a time and reassured me that it would all work out in the end. I am immensely grateful for your constant support, advice, and encouragement.

I would also like to thank Dr. Chelsey Thul and Tyler Dregney for serving on my committee. Dr. Thul, I have loved getting to know you over the last four years, and I am so appreciative of your mentorship. You helped me determine my career path and research interests, and I am grateful for the professional, academic, and life advice you have given me. Your passion for teaching motivated me to put forth my best effort and find the joy in learning. Thank you for all the classroom speaking opportunities you gave me as well, to recruit participants for my study and potential applicants for ACR Homes. Tyler, I enjoyed getting to know you through class and Journal Club. You were an excellent TA, and it was helpful to hear your perspective as a graduate student. Thank you to both of you for serving as readers for my thesis.

I am also grateful for my family's love and support throughout the last four years. Mom, you have encouraged me to pursue my curiosities, shoot for the moon, and persevere through challenges. To my dad, I appreciate your reminders to have fun and not take myself so seriously. Joe, thank you for all your support and practical advice, especially when faced with obstacles. And to my brother Jeff, you may not always know what I'm up to here in Minnesota, but you have always encouraged me to forge my own path and pursue what makes me happy.

Abstract

Physical activity has numerous mental and physical health benefits. However, most Americans do not adhere to the recommended physical activity guidelines. Increasing affect and enjoyment and decreasing perceived exertion during a workout have been shown to improve exercise adherence. Prior literature suggests that two factors may impact affect, enjoyment, and perceived exertion while exercising and in turn increase exercise adherence: music and autonomy. The purpose of the present study was to simultaneously explore the effects of music and autonomy on psychological and performance outcomes with a 2x2 study design. Participants (n = 40) were asked if they preferred to run outside with or without music. They were then randomly assigned to receive or not receive their preference. Participants completed questionnaires before and after the run. Running with music did not have an impact on psychological nor performance outcomes. However, receiving your preference to run with or without music improved participants' affect, specifically tranquility, positive engagement, and revitalization. These findings are important because responses to exercise may impact exercise adherence. Future research with a larger and more representative sample is necessary to further explore the role of music and autonomy on psychological and performance outcomes.

Table of Contents

Introduction

Regular exercise is related to improved physical and mental health, reduced disease risk, and improved affect over time. The Centers for Disease Control and Prevention (CDC, 2021) reports that regular physical activity (PA) reduces the risk of cardiovascular disease, type 2 diabetes, metabolic syndrome, and some cancers. It is recommended that adults perform 150 minutes of moderate-intensity activity or 75 minutes of vigorous-intensity activity per week; however, most adults do not meet this requirement. It is imperative to find strategies to increase exercise motivation and adherence.

An increase in enjoyment and affect and a decrease in perceived exertion have all been found to mediate the effects of exercise interventions on adherence (Jekauc, 2015). Affect and enjoyment are therefore related to PA adherence, but the challenge is finding ways to improve these variables. Affect refers generally to feelings and emotions, and enjoyment specifically describes feelings of pleasure towards a particular experience. The current literature suggests that exercising with music has the potential to improve affect, decrease perceived exertion, increase enjoyment, and improve performance compared to exercising without music (Hutchinson et al., 2018; Karageorghis & Priest, 2012; Potteinger et al., 2000; Terry et al., 2012; Yamashita et al., 2006). Further, music appears to yield the best psychological and performance outcomes when it is self-selected (Cole & Maeda, 2015; Dyrlund & Wininger, 2008; Nakamura et al., 2012). Finally, based on Self-Determination Theory (SDT), the literature suggests that having autonomy and making choices that align with your preferences increases performance, motivation, positive affect, enjoyment, and energy in exercise interventions (Banting et al., 2011; Moustaka et al., 2012; Nix et al., 2012; Puente & Anshel, 2010; Wulf et al., 2014). Therefore, both music and autonomy have the potential to improve PA performance and adherence. However, no studies

have simultaneously looked at the role of music and the role of individual preferences for running with or without music on psychological and performance variables.

The current study will contribute to the literature by exploring whether everyone should listen to music while they run or only those who prefer to listen to music. This study will explore potential ways to increase exercise participation by examining how music and preference for listening to music while exercising impacts affect, perceived exertion, enjoyment, and performance.

Literature Review

Effects of Exercising with Music on Psychological and Performance Outcomes

Listening to music while exercising has the potential to improve both psychological and performance outcomes (Hutchinson et al., 2018). Studies have suggested that exercising with music may increase enjoyment and affect and decrease rating of perceived exertion (RPE) (Campbell, 2014; Potteiger et al., 2000). This would make exercise more enjoyable, positive, and comfortable and potentially result in increased exercise adherence and motivation (Jekauc, 2015). Music may also improve performance outcomes such as intensity, speed, energy efficiency, and heart rate variability (Hutchinson et al., 2018; Karageorghis & Priest, 2012; Yamashita et al., 2006).

Psychological Outcomes and RPE

Several studies have examined the effect of listening to music on psychological outcomes such as enjoyment, affect, and RPE (Campbell, 2014; Potteiger et al., 2000.)

Enjoyment

Campbell (2014) explored the impact of exercising with or without music by asking undergraduate students to walk for 20 minutes on a treadmill at a moderate pace. Enjoyment

significantly increased in the music group relative to the non-music group, suggesting that music may improve enjoyment during low-intensity exercise. Hutchinson et al. (2018) found similar results among participants exercising at a higher intensity. Active adults participated in one exercise session that included no music and one that included self-selected music. Participants rated the music session more enjoyable than the no music session. Dyrlund and Wininger (2008) conducted a similar study among young adults and examined three different treadmill speeds. Regardless of the treadmill speed, enjoyment was higher when listening to music than when not listening to music. These studies suggest that music may increase enjoyment during exercise regardless of the intensity of the workout.

Affect

Studies have also examined the impact of listening to music while exercising on affect. Campbell (2014) used a pre-post design to examine the effect of moderate pace treadmill walking on mood among undergraduates assigned to either a music or no music condition. Mood was improved in both conditions, but there were significantly greater increases in the music condition. Terry et al. (2012) found similar results among elite triathletes during intense exercise. Their results indicated that listening to either neutral or motivational music while running on a treadmill improved feeling states compared to the no-music control. It is possible that the impact of listening to music while exercising on affect varies with the intensity of the workout. A study compared the effects of sensory deprivation, music, and a no-music control on affect at three different intensities for 24 women cyclists (Boutcher & Trenske, 1990). The intensities were light, moderate, and heavy, and were defined as 60%, 75%, and 85% of each participant's maximal heart rate respectively. The music group listened to their preferred music, the sensory deprivation group wore opaque goggles and earplugs, and the no-music control neither listened

to music nor wore goggles or earplugs. The music group demonstrated higher affect than the deprived group at moderate to heavy intensities but not at low intensity, which contradicts Campbell's findings. Thus, music may have a positive impact on affect during exercise, but it may depend on the intensity of the workout.

RPE

Finally, many studies have explored the effects of listening to music while exercising on participants' rating of perceived exertion (RPE). Campbell (2014) found that there were no differences in RPE between the music and no music groups while walking on a treadmill at a moderate pace for 20 minutes. Similar results were found when comparing three different treadmill speeds; listening to music did not impact RPE (Dyrlund & Wininger, 2008). However, in that study, they suggested that there may have been effects on RPE that were masked by the effects of exercise intensity. Contrary to the results of Campbell (2014) and Dyrlund and Wininger (2008), Potteiger et al. (2000) did find differences in RPE when listening to music while exercising. They examined the effect of music on RPE in cycling among 27 physically active participants and found that all music conditions, including upbeat, classical, and self-selected, reduced RPE. Neutral and motivational music may also decrease RPE while running compared to a no-music control (Terry et al., 2012). A reduced RPE may improve exercise motivation and adherence by allowing the participant to feel more comfortable during exercise (Yamashita et al., 2006).

Like affect, it is possible that the impact of listening to music on RPE depends on the intensity of the PA. In Boutcher and Trenske's study (1990), they found that the music group demonstrated a lower RPE than the sensory deprivation or control group at low to moderate intensities but not at high intensities. Yamashita et al. (2006) also found that music of choice

reduced RPE during low but not high-intensity exercise. They hypothesized that this may be due to a distraction effect that occurs during low-intensity exercise when the discomfort is low. It is possible that during high-intensity exercise, the discomfort is too great for music to mask, and the participant is more aware of their exertion levels. More research is needed that examines the effect of music on RPE levels across different intensities.

Psychological Outcomes and RPE Summary

Listening to music during exercise appears to increase enjoyment and affect and decrease RPE, all of which are correlated with increased exercise adherence. Some studies found no impact on RPE. Additionally, the effects of listening to music while exercising on affect and RPE may depend on the intensity of the PA. These conclusions are supported by a 2012 literature review that found listening to music of choice while exercising resulted in improved affect and decreased perceived exertion when below the anaerobic threshold (Karageorghis & Priest, 2012). Therefore, listening to music while exercising may make the exercise experience more enjoyable, positive, and comfortable for the participant, resulting in increased adherence.

Performance Outcomes

In addition to the potential benefits of exercising with music on psychological outcomes, there are also potential benefits of exercising with music on performance outcomes. For example, listening to music while running may increase self-selected exercise intensity. Hutchinson et al. (2018) conducted a repeated measures study that compared self-selected music to no music during treadmill running. Running on a treadmill with music corresponded with increased self-selected intensity when participants were asked to maintain a “good” feeling. Intensity was measured with respect to each participant’s ventilatory threshold. They also found

that affect was not negatively impacted by the increased intensity, suggesting that music may encourage people to exercise harder without decreasing their affect.

Speed and energy efficiency may be increased as well when listening to music while running. A literature review on the effect of music in exercise concluded that listening to music of choice while exercising resulted in improved speed as well as energy efficiency (Karageorghis & Priest, 2012). Music therefore may encourage people to run at a faster pace.

Yamashita et al. (2006) took a different approach to examining performance by exploring the effects of exercising with music on heart rate variability. Less heart rate variability is suggestive of increased performance. They found that listening to music while cycling resulted in less variability in heart rate at varying intensities compared to when cycling without music. Lastly, a study examined the effect of music on treadmill running performance outcomes in triathletes and found that both neutral and motivational music improved running performance by increasing time to exhaustion and decreasing oxygen consumption (Terry et al., 2012).

Impact of Autonomy on Psychological and Performance Outcomes

Music is not the only variable that may impact psychological and performance outcomes while engaging in PA. Autonomy also has the potential to improve these outcomes, as explained by Self-Determination Theory (SDT). SDT suggests that self-determined motivation as opposed to externally controlled motivation results in better cognitive, affective, and behavioral outcomes in addition to enhanced motivation and participation (Moustaka et al., 2012). SDT encompasses three needs including autonomy, competence, and relatedness. This section will focus specifically on autonomy and how incorporating people's individual preferences and allowing for choice may improve psychological and performance outcomes.

Making decisions about how one exercises based on preferences may increase exercise performance. Wulf et al. (2014) explored the impact of autonomy by randomly assigning participants to choose the order of their assigned four exercises or pre-determining the order for the participants. Both groups were told to complete as many sets and repetitions as possible. The group randomly assigned to the autonomy condition completed significantly more total repetitions than the control group, suggesting that autonomy may increase exercise engagement.

In addition to increasing performance and engagement, making autonomous decisions may also increase motivation and energy. A study randomly assigned participants to an autonomy-supportive condition in which participants could choose their workout and self-select their music or to a control condition in which the workout and music was specifically assigned. (Moustaka et al., 2012). The autonomy-supportive condition resulted in increased attendance, increased feelings of fulfillment of autonomy and competence needs, and increased regulation and intrinsic motivation relative to a control condition. Participants in the autonomy-supportive exercise condition also reported feeling more energized and alive than the control condition. Nix et al. (1999) found similar results that autonomy may increase energy in their study looking at the impact of autonomy on happiness and vitality during card sorting. They asked participants to complete the Wisconsin Card Sort task and assigned participants to sort the cards freely or follow specific instructions. The group with more autonomy reported increased energy. The authors noted that this finding may be applicable for increasing energy during exercise. Taken together, autonomy has the potential to increase performance, motivation, participation, energy, and fulfillment.

Autonomy may also affect heart rate, RPE, enjoyment, affect, and exercise frequency. Banting et al. (2011) examined the impact of autonomous motivation priming on several exercise

variables by randomly assigning participants to an autonomous motivation prime group, control motivational prime group, or no motivation prime group. The priming was done using a word scramble sentence task. The autonomous prime group exercised at a higher heart rate with lower RPE and greater enjoyment, suggesting that intrinsic or autonomous motivation may improve both psychological and performance outcomes. Puente and Anshel (2010) found similar results in their observational study examining the effects of autonomy on psychological outcomes and exercise frequency in college students. Participants were asked to complete questionnaires on fitness instructor style, perceived autonomy, enjoyment, affect, and PA adherence. They concluded that autonomy was significantly correlated with enjoyment, positive affect, and exercise frequency, suggesting that autonomy improves psychological and performance outcomes.

It appears that autonomy may increase exercise performance, motivation, frequency, energy, enjoyment, and affect while decreasing RPE (Banting et al., 2011; Moustaka et al., 2012; Nix et al., 1999; Wulf et al., 2014). Providing people with autonomy allows them to make decisions based on individual differences and preferences. Therefore, it is important to account for individual preferences when engaging in physical activity.

Effects of Music Selection Autonomy on Psychological and Performance Outcomes

In addition to examining the effect of music or no music on exercise and performance, researchers have also examined the effect of having a choice for type of music (Dyrlund & Wininger, 2008). Dyrlund and Wininger (2008) compared enjoyment among those who listened to their preferred or non-preferred music at different treadmill intensities. Specifically, participants ran on a treadmill at one of three exercise intensities with their most preferred music, least preferred music, or no music at all. The preferred music group experienced greater

enjoyment than the non-preferred music and no music groups as long as participants were attentive to the music.

Dyrlund and Wininger (2008) also examined the impact of self-selected music on RPE and found no differences between any of the three music conditions. Although Dyrlund and Wininger did not find significant effects of self-selecting music on RPE, Nakamura et al. did. Specifically, this study examined the impact of preferred vs nonpreferred music on RPE in cycling among 15 adult men (2010). RPE was higher in the group listening to non-preferred music compared to preferred music or no music at all. In other words, participants felt they were exerting themselves more when listening to music that did not fit their preferences.

Not only could music preference influence enjoyment and RPE, but it may also impact performance. Cole and Maeda (2015) conducted a study to explore gender differences in endurance running. There were no significant differences in running performance for men based on music selection, but women performed better (ran further) with preferred music compared to non-preferred music. Listening to preferred music while running may therefore result in increased performance among women but not among men.

The above findings suggest that it may be important to listen to preferred music over no music or non-preferred music while exercising (Dyrlund & Wininger, 2008). Additional research is needed to determine whether preferred music increases performance in both men and women and whether it decreases RPE. Regardless, in studies exploring the role of music, self-selected music should be used to maximize results and mimic real-world scenarios.

Summary

Overall, the literature suggests that music may have beneficial effects on psychological and performance outcomes while exercising (Hutchinson et al., 2018). Having autonomy when

exercising may also be important to account for individual differences (Banting et al., 2011). This includes listening to your preferred genre of music and maximizing the choices you make in your workout (Dyrlund & Wininger, 2008). The existing literature has explored the role of music on numerous psychological and performance variables including enjoyment, affect, RPE, and speed (Campbell, 2014; Potteiger et al., 2000). The impact of gender, genre of music, exercise intensity, type of workout, and music preference have also been explored (Cole & Maeda, 2015; Dyrlund & Wininger, 2008). Additionally, the role of autonomy and individual differences has been researched as it relates to exercise outcomes (Puente & Anshel, 2010). Music and autonomy seem to yield similar benefits during running.

There appears to be beneficial effects of listening to music while exercising on psychological and performance outcomes (Hutchinson et al., 2018). However, there also appears to be benefits of making autonomous decisions that align with each individual's preferences (Nix et al., 1999). No study has examined these two concepts together. Does music have different effects on people who prefer to run with and without music? Should people who prefer to run without music listen to it anyway to enhance performance and psychological outcomes? Do people who prefer to run with music have worse psychological and performance outcomes when asked to run without music? These questions will be explored in the present study.

The study seeks to fill the gap in the literature by simultaneously looking at the psychological and performance effects of both music and autonomy. The purpose of this study is to determine the impact of both music and preference on psychological and performance outcomes using a 2x2 study design. There are two hypotheses for the proposed study:

H1: Participants running with music are more likely to experience increased psychological and performance outcomes when compared to participants running without music.

H2: Participants who receive their preference for running with or without music are more likely to experience increased psychological and performance outcomes when compared to participants who do not receive their preference.

Method

Participants

Convenience sampling was used to recruit potential participants between March and May 2022 through classroom presentations at the University of Minnesota and word of mouth. The study was advertised as exploring the effects of running with music and preference for running with music on thoughts and feelings. Inclusion criteria included: (1) Individuals 18 and older with no injury or medical condition that would prevent safe participation in a one-mile run; (2) not currently pregnant; (3) can read, write, speak, and understand English; and (4) have access to a portable music device with internet access and compatible headphones.

Interested participants contacted the researcher to participate in the study and were sent the pre-screening questionnaire via text or email. The questionnaire (see Appendix B) determined participant eligibility and asked participants if they preferred to run outside with or without music. Fifty-six interested participants completed the pre-screening questionnaire. Fifty-four participants met the inclusion criteria and were sent a scheduling email. The other two participants were excluded due to medical conditions that would prevent safe participation. Fourteen participants were no longer interested in participating after receiving the scheduling email or canceled prior to their scheduled session. Of the remaining 40 participants, 29 preferred to run with music, and 11 preferred to run without music. The 40 participants were randomly assigned to receive their preference (n = 21) or not receive their preference (n =19) for running with or without music, resulting in four groups (see Table 1).

Table 1

Participant Groups Distribution

	Assigned preference	Not assigned preference
Prefers to run with music	14	15
Prefers to run without music	7	4

Participants answered demographic questions on the pre-screening questionnaire regarding age, height, weight, race, ethnicity, student status, and physical activity (see Table 2). The final sample consisted of primarily Caucasian, highly active, young adult students of healthy BMI. There were no significant differences for age, BMI, race, ethnicity, student status, or Leisure Time Exercise Questionnaire (LTEQ) score between the two preference groups nor the two music groups.

The Godin and Shephard (1985) Leisure Time Exercise Questionnaire (LTEQ) was included in the pre-screening questionnaire to measure each participant's physical activity level. The four-item survey consists of three text entry questions regarding the frequency of engagement in strenuous, moderate, and mild exercise for 15 minutes minimum during a typical week. A weekly leisure activity score is calculated by multiplying the strenuous, moderate, and mild exercise by nine, five, and three respectively and then summing the results. Scores 24 and above represent high physical activity, 14 to 23 represent moderate physical activity, and less than 14 represent low physical activity (Godin, 2011). The questionnaire was deemed valid using VO2 max and body fat percentage (Godin, 2011).

Table 2

Participant Characteristics

Characteristic	Total Sample (n = 40)	Received Preference (n = 21)	Did Not Receive Preference (n = 19)	P-Value
Age (average in years)	23.35 (8.05)	24.48 (9.99)	22.11 (5.14)	0.258
BMI (average)	24.36 (4.42)	23.95 (4.89)	24.81 (3.92)	0.853
Race (%)				0.787
White	83%	81%	84%	
Asian	10%	14%	5%	
Native Hawaiian or Other Pacific Islander	3%	0	5%	
Black or African American	5%	5%	5%	
Hispanic or Latino (%)	3%	0%	5%	0.287
Current Student (%)	85%	86%	84%	0.894
LTEQ score (average)	53.90 (19.95)	52.64 (21.69)	55.29 (18.33)	0.822

Characteristic	Music (n = 18)	No Music (n = 22)	P-Value
Age (average in years)	22.22 (4.37)	24.27 (10.14)	0.277
BMI (average)	23.90 (5.14)	24.74 (3.82)	0.618
Race (%)			0.900
White	83%	82%	
Asian	11%	9%	
Native Hawaiian or Other Pacific Islander	0%	5%	
Black or African American	6%	5%	
Hispanic or Latino (%)	6%	0%	0.263
Current Student (%)	83%	86%	0.789
LTEQ score (average)	52.92 (16.40)	54.70 (22.80)	0.866

Notes: BMI = Body Mass Index. LTEQ = Leisure Time Exercise Questionnaire. Age, BMI, and LTEQ score are reported as means with standard deviation in parenthesis.

Pre-Post Measures

Participants completed the Exercise Induced Feeling Inventory, Feeling Scale, and Physical Activity Enjoyment Scale before and after the one-mile run (see Table 3). To follow is a description of each questionnaire.

Exercise Induced Feeling Inventory

The Exercise Induced Feeling Inventory (EFI) is a 12-item questionnaire assessing feeling states associated with PA (Gauvin & Rejeski, 1993). The four feeling states that it measures include: revitalization, tranquility, positive engagement, and physical exhaustion. The questionnaire utilizes a five-point Likert scale response format (0 = *do not feel* to 4 = *feel very strongly).* The questionnaire is scored by summing or averaging the three values for each feeling state sub score. The EFI demonstrates high internal consistency (Gauvin & Rejeski, 1993).

Feeling Scale

The Feeling Scale (FS) is a one-item questionnaire asking participants to rate how they currently feel on a 10-point Likert scale (-5 = *very bad to* +5 = *very good*; Hardy & Rejeski, 1989). The FS is a valid questionnaire to assess affect during exercise.

Physical Activity Enjoyment Scale

The Physical Activity Enjoyment Scale (PACES) is an 18-item questionnaire assessing exercise enjoyment (Kendzierski & DeCarlo, 1991). It utilizes a 7-point Likert scale response format with feeling statements on each end of the scale. For example, one statement reads, "I dislike it (*one*)/I like it (*seven*)." The PACES is scored by summing all 18 items. Eleven questions are reverse scored. The questionnaire demonstrates high internal consistency (Kendzierski & DeCarlo, 1991).

Assessments During the Run

Rating of Perceived Exertion

The Borg Rating of Perceived Exertion (RPE) scale was completed immediately following the run as a measure of perceived effort, exertion, breathlessness, and fatigue (Borg,

1998). It is a one-item questionnaire with a 15-point Likert scale (6 = *No exertion at all to* 20 = m*aximal exertion*). The Borg RPE scale demonstrates high reliability and validity (Borg, 1998).

Speed

Speed was calculated after the one mile run as a measure of performance. It was calculated as an average in miles per hour by dividing one mile by the time in hours that it took the participant to complete the run.

Table 3

Measure and Data Collection Time Points

Measure	Variable	Pre	Post
Leisure Time Exercise Questionnaire	Physical Activity Level	X	
Body Mass Index		X	
Exercise Induced Feeling Inventory	Affect	X	X
Feeling Scale	Affect	X	X
Physical Activity Enjoyment Scale	Enjoyment	X	X
Rating of Perceived Exertion			X
Speed			X

Procedure

Recruitment, Eligibility Screening, and Randomization

Participants were recruited through email and word of mouth between March and May, 2022. Interested participants were emailed a pre-screening questionnaire assessing demographic information, inclusion criteria, the LTEQ, and whether the participant preferred to run outside with or without music. They were also sent the dates and times of available sessions.

Eligible participants who signed up for a running session were randomized to receive or not receive the preference they indicated in the pre-screening questionnaire for running with or without music. Participant ID cards were created for these participants with their participant ID number on one side and “yes” or “no” on the other side. “Yes” indicated that the participant

would complete the one mile run while listening to music of their choice. “No” indicated that the participant would complete the one mile run without listening to any music. The participant ID number was used to ensure confidentiality. A handful of participants were unable to attend the study session in-person. These participants were emailed the study instructions along with their participant ID number, and they were allowed to participate in the study in the absence of the researcher and in their chosen location outdoors. The researcher was available by phone to answer any participant questions.

Pre-Run Questionnaire Administration

Upon arrival to the running session, participants were handed their participant ID card to use for the informed consent form and the pre- and post-run questionnaires. Participants were asked to scan a QR code with their mobile device to access the informed consent form (see Appendix C). Following completion of the informed consent form, participants were instructed to scan another QR code to access the pre-run questionnaires (see Appendix D). The participants who completed the study in the absence of the researcher were emailed the links to the informed consent form and pre-run questionnaire. Pre-run questionnaire completion took approximately 10 minutes. Participants were instructed to let the researcher know if they had any questions as they completed the questionnaires.

Run Procedures

After completing the pre-run questionnaires, the researcher showed the participants a map of the one-mile route and asked if they had any questions. Participants were then instructed to flip over their participant ID cards to determine if they would be running with or without music. If they were assigned to run with music, they were asked to get the music of their choice ready to play. Participants were instructed to begin the run whenever they were ready. The researcher

started a timer when the participant began running. Participants were staggered by a few minutes to prevent the participants from running together. Upon completion of the one-mile run, the researcher recorded the participant's time. Participants completing the study in the absence of the researcher were instructed to map out their own one-mile route and were notified via email whether they were assigned to run with or without music. They were instructed to time their run and email their time to the researcher following completion of the run.

Post-Run Questionnaire Administration

Upon finishing the run, participants were given a few minutes to rest and get a drink of water. They were then asked to scan a final QR code to access the post-run questionnaires (see Appendix E). The post-run questionnaires took approximately 10 minutes to complete. Participants left when they finished the questionnaire. Participants completing the study in the absence of the researcher were emailed the link to the post-run questionnaire.

Data Analysis

Data collection was completed in May 2022, and the data was entered into SPSS. Descriptive analysis was conducted for the demographic questionnaires including age, BMI, race, ethnicity, student status, and LTEQ. Between group ANOVAs were completed to examine between group differences on the demographic questionnaires.

Hypothesis One Analysis

A between groups ANOVA controlling for pre-run scores was conducted to examine the effect of listening to music or not while running on affect (FS and EFI), RPE, enjoyment (PACES), and performance (speed).

Hypothesis Two Analysis

A between groups ANOVA controlling for pre-run scores was conducted to examine the effect of receiving preference for running with or without music on affect (FS and EFI), RPE, enjoyment (PACES), and performance (speed).

Results

Internal consistency reliability is reported in Table 4. Using a threshold of $\alpha = .7$, all questionnaires, and therefore all variables were deemed reliable and included for the final analysis.

Table 4

Internal Consistency Reliability for Questionnaires

Scale	Items	Cronbach's Pre-Test	Cronbach's Post-Test
EFI – Positive engagement	3	0.744	0.906
EFI – Revitalization	3	0.733	0.908
EFI – Physical exhaustion	3	0.819	0.806
EFI – Tranquility	3	0.788	0.792
PACES	18	0.931	0.940

Notes: EFI = Exercise Feeling Inventory. PACES = Physical Activity Enjoyment Scale.

Hypothesis One Outcomes

Effects of Running with or without Music on Psychological Outcomes

Means and standard deviations for the pre- and post- test scores for the psychological variables were calculated. There were no significant differences between the music and no music conditions for any of the post-run psychological variables including enjoyment, affect, and RPE when controlling for pre-run scores (see Tables 5 – 8).

Table 5

Descriptive Statistics for Enjoyment

			Pre		Post	
Variable	Condition	Possible Range	M	*(SD)*	M	*(SD)*
PACES		18-126				
	Preference		103.19	(17.34)	102.28	(17.02)
	Not Preference		97.58	(15.73)	95.11	(18.10)
	Music		102.94	(14.13)	102.28	(17.02)
	No Music		98.55	(18.51)	96.64	(18.94)
	Total Group		100.52	(16.63)	99.17	(18.10)

Notes: PACES = Physical Activity Enjoyment Scale

Table 6

Descriptive Statistics for Exercise Induced Feelings

			Pre		Post	
Variable	Condition	Possible Range	M	*(SD)*	M	*(SD)*
EFI-Positive engagement		1 - 5				
	Preference		2.05	(0.67)	2.86	(0.61)
	Not Preference		2.00	(0.80)	2.30	(1.02)
	Music		1.94	(0.65)	2.69	(0.62)
	No Music		2.09	(0.79)	2.52	(1.04)
	Total Group		2.05	(0.73)	2.59	(0.87)
EFI-Revitalization		1 - 5				
	Preference		1.70	(0.81)	2.70	(1.00)
	Not Preference		1.70	(0.66)	2.02	(0.90)
	Music		1.48	(0.62)	2.50	(1.12)
	No Music		1.88	(0.78)	2.27	(0.91)
	Total Group		1.70	(0.73)	2.38	(1.00)
EFI-Physical Exhaustion		1 - 5				
	Preference		1.41	(0.93)	1.72	(0.96)
	Not Preference		1.84	(0.63)	2.29	(1.17)
	Music		1.67	(0.92)	1.80	(1.02)
	No Music		1.58	(0.75)	2.23	(1.15)
	Total Group		1.62	(0.82)	2.03	(1.11)
EFI-Tranquility		1 - 5				
	Preference		2.17	(0.98)	2.32	(0.88)
	Not Preference		1.81	(0.76)	1.53	(0.84)
	Music		2.00	(0.98)	1.96	(0.88)
	No Music		2.00	(0.82)	1.92	(1.01)
	Total Group		2.00	(0.89)	1.94	(0.94)

Notes: EFI = Exercise Feeling Inventory

Table 7

Descriptive Statistics for Feelings

			Pre		Post	
Variable	Condition	Possible Range	M	*(SD)*	M	*(SD)*
FS		-5 - 5				
	Preference		2.19	(1.57)	2.14	(2.52)
	Not Preference		1.74	(1.97)	1.63	(2.45)
	Music		2.00	(1.61)	1.94	(2.73)
	No Music		1.95	(1.91)	1.86	(2.30)
	Total Group		1.98	(1.76)	1.90	(2.47)

Notes: FS = Feeling Scale

Table 8

Descriptive Statistics for RPE

Variable	Condition	Possible Range	M	*(SD)*
RPE		6 - 20		
	Preference		14.43	(2.60)
	Not Preference		14.84	(2.01)
	Music		14.72	(2.32)
	No Music		14.55	(2.37)
	Total Group		14.63	(2.32)

Notes: RPE = Rating of Perceived Exertion

Effects of Running with or without Music on Performance Outcomes

Means and standard deviations for speed were calculated. There were no significant differences in speed between the music and no music conditions (see Table 9).

Table 9

Descriptive Statistics for Speed

Variable	Condition	M	*(SD)*
Speed (mph)			
	Preference	7.33	(1.46)
	Not Preference	7.14	(1.58)
	Music	7.38	(1.58)
	No Music	7.13	(1.45)
	Total Group	7.24	(1.50)

Hypothesis Two Outcomes

Effects of Preference for Running with or without Music on Psychological Outcomes

There were no significant differences between the groups that received and did not receive their preference for running with or without music on enjoyment or RPE when controlling for pre-run scores. However, there were significant between group differences for affect. The group that received their preference for running with or without music scored significantly higher on three out of the four feeling states of the post-run EFI when controlling for pre-run scores. Specifically, participants who received their preference for listening to music or not reported higher positive engagement ($M = 2.86$, $SD = 0.61$), $F(1,35) = 4.26$, $p < .05$ and tranquility ($M = 2.32$, $SD = 0.88$), $F(1,35) = 6.91$, $p < .05$ than participants who did not receive their preference for listening to music or not. Additionally, those who received their preference for listening to music or not reported higher revitalization ($M = 2.70$, $SD = 1.00$), $F(1.35) = 2.93$, $p = .063$ than those who did not receive their preference, but this was only marginally significant. There were no significant differences between groups on the FS.

Effects of Preference for Running with or without Music on Performance Outcomes

There were no significant differences between the groups that received and did not receive their preference for running with or without music on speed (see Table 9).

Discussion

Hypothesis One

The first hypothesis was not supported in that participants randomly assigned to listen to music while running did not experience increased psychological and performance outcomes compared to participants assigned to not listen to music.

Music and Psychological Outcomes

Enjoyment

There were no significant differences on post-run enjoyment between participants who listened to music and those who did not listen to music when controlling for pre-run enjoyment. This finding contradicts the findings of Hutchinson et al. (2018) and Dyrlund and Wininger (2008) who found that listening to music while exercising increases enjoyment. However, the PACES was designed to assess overall PA enjoyment, and it is unlikely that scores would change from a single bout of running. Hutchinson et al. (2018) utilized a visual analog scale to measure enjoyment with a scale ranging from "*very unpleasant"* to *"very pleasant."* Dyrlund and Wininger (2008) used the Intrinsic Motivation Inventory (IMI) interest/enjoyment subscale to measure enjoyment. These two questionnaires may be more sensitive to short term changes in enjoyment.

Affect

No significant differences were observed in post-run affect between participants who listened to music and those who did not listen to music when controlling for pre-run affect. This was true for the four subscales of the EFI and for the FS. This contradicts the findings of

Campbell (2014), Terry et al. (2012), and Boutcher and Trenske (1990), all of whom found that listening to music while exercising increases affect. However, Campbell (2014) and Boutcher and Trenske's (1990) results suggested that the effects of listening to music while exercising on affect may be dependent on the exercise intensity. It is possible that repeating the current experiment with different running intensities may result in a greater impact on affect.

RPE

No significant differences were found for post-run RPE between participants who listened to music and those who did not listen to music. This finding was consistent with the findings from Campbell (2014) and Dyrlund and Wininger (2008). In their studies that included treadmill walking and running, music did not affect RPE. In contrast, Potteiger et al.'s (2000) results found that exercising with music does decrease RPE. However, this study involved cycling instead of running. Terry et al. (2012) also found that running with music lowers RPE, but that study did not allow participants to self-select music. They specifically used neutral and motivational music, which may have been more effective at lowering RPE.

Music and Performance Outcomes

Prior studies found that listening to music while exercising increased exercise intensity, speed, and energy efficiency, and decreased heart rate variability (Hutchinson et al., 2018; Karageorghis & Priest, 2012; Terry et al., 2012; Yamashita et al., 2006). The present study found no impact of running with music on increasing participants' speed. However, performance was measured using average speed in this study, which may not be as sensitive to performance changes compared to equipment such as accelerometers and heart rate monitors.

Hypothesis Two

The second hypothesis was partially supported such that participants randomly assigned to receive their preference for listening or not listening to music while running experienced increased affect. More specifically, participants assigned to receive their preference for listening or not listening to music while running experienced increased revitalization, tranquility, and positive engagement.

Preference and Psychological Outcomes

Enjoyment

There were no significant differences on post-run enjoyment between participants who were assigned or were not assigned their preference for listening to music or not while running. This finding contradicts prior studies that found that autonomy increased enjoyment while exercising (Banting et al., 2011; Dyrlund & Wininger, 2010; Puente & Anshel, 2010). This discrepancy in findings may again be due to the PACES relatively low likelihood of detecting changes in enjoyment from a single bout of exercise. Dyrlund and Wininger (2008) and Banting et al. (2011) measured enjoyment with the Intrinsic Motivation Inventory (IMI) interest/enjoyment subscale, which may be more sensitive to short term changes in enjoyment. Puente and Anshel (2010) used the PACES, but it was an observational study examining the impact of a college physical education course instructor's teaching style on enjoyment. It was not given to assess changes in enjoyment from a single run, as was the case in the present study.

Affect

Prior studies concluded that autonomy in exercise may increase positive affect (Puente & Anshel, 2010). The current study's findings support this conclusion. There were significant or marginal significant differences on post-run positive engagement, revitalization, and tranquility between the group that received their preference and the group that did not receive their

preference for listening to music or not when controlled for pre-run affect. In other words, the group with more autonomy experienced greater improvements in affect. There were no significant differences between these groups on the physical exhaustion component of the EFI or on the FS. Regardless, the present study adds support to SDT in that autonomy in exercise has a positive effect on affect.

RPE

Existing literature found that autonomy may decrease perceived exertion without negatively impacting performance (Banting et al., 2011). Banting et al. (2011) concluded that autonomy during exercise lowered RPE while increasing heart rate, suggesting that autonomy resulted in greater objective exertion while lowering participant's perceived exertion. This finding was not replicated in this study given there was not a significant effect of participants receiving their preference to run with or without music on RPE. However, Banting et al. (2011) asked participants to rate their perceived exertion immediately following exercise, whereas participants in the present study were allowed to take a short break before scanning the QR code to the online post-run questionnaire. RPE is best measured during or immediately after exercise, so it is possible that the delay impacted the results of the present study.

Preference and Performance Outcomes

The current study found no significant differences in speed between participants who were assigned or were not assigned their preference for running with or without music. This contradicted prior literature that found autonomy resulted in increased exercise engagement and increased total repetitions in an exercise intervention (Wulf et al., 2014). The main difference between the studies is the Wulf et al. (2014) study included a series of four brief full body

exercises as opposed to running and used total repetitions as a measure of performance instead of speed.

Strengths of Study Design

The present study had several strengths. First, it utilized a novel 2x2 design that examined the effects of both running with music and preference for running with music. Second, participants used self-selected music, which more closely mirrors the real world than studies conducted in the laboratory. Third, participants were randomly assigned to groups. Lastly, all study measures were validated.

Study Limitations

The study was not without limitations. First, a convenience sample was used. The final sample lacked racial, ethnic, and BMI diversity, which limits generalizability. Second, some participants ran different one-mile routes for participant convenience. Third, due to scheduling challenges, some participants completed the run independently, outside of the scheduled study sessions and not in the presence of the researcher. These participants self-reported their running time, which may have introduced bias. Fourth, data collection took place over several months during which the temperature and weather conditions varied significantly. This may have influenced participants' performance. Lastly, the sample size was small for a 2x2 study.

Future Research

Future research studies should increase sample size and use a sample that is more representative of the population. It would also be beneficial to conduct data collection over a smaller time frame, using the same route, and always in the presence of the researcher to limit confounding variables. Future studies could also consider a multiple session intervention to gather more data. Additionally, enjoyment and RPE data may be more accurate if collected while

participants are still running or immediately after they finish running as opposed to several minutes after the run. Lastly, future studies could consider using a visual analog scale to measure enjoyment as was done by Hutchinson et al. (2018). A visual analog scale may produce more accurate results.

Practical Implications

This study has possible implications for people who run. Specifically, the results of the study suggest that listening to music while running may not influence your performance, affect, enjoyment, or perceived exertion. Additionally, receiving your preference for running with or without music may not have an impact on performance, enjoyment, or perceived exertion. However, receiving your preference for running with or without music may improve your affect and make you feel more tranquil, positively engaged, and revitalized. Even though this was not examined in this study, it is possible that improvements in affect may impact exercise adherence. In other words, those who prefer to run with music should run with music. Those who prefer to run without music should run without music. Autonomy appears to have more significant effects on psychological outcomes than the music itself.

Conclusion

Physical activity is important for both mental and physical health, yet most Americans do not meet physical activity guidelines. It is therefore important to find ways to increase physical activity adherence. Increased affect and enjoyment and decreased perceived exertion all mediate the effects of exercise interventions on adherence. Therefore, the current study sought to explore methods to improve those variables during running. A 2x2 study was used to look at the effect of both listening to music and receiving your preference for listening or not listening to music while running on psychological and performance outcomes. Results indicated that having autonomy

and receiving your preference for listening or not listening to music while running may improve affect. Thus, having autonomy over whether you run with or without music may be a beneficial way to improve both affect and exercise adherence.

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Appendix A

IRB Approval Form

UNIVERSITY OF MINNESOTA

Twin Cities Campus

Human Research Protection Program
Office of the Vice President for Research

Room 350-2
McNamara Alumni Center
200 Oak Street S.E.
Minneapolis, MN 55455

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irb@umn.edu
https://research.umn.edu/units/irb

APPROVAL OF NEW STUDY

March 4, 2022

Beth Lewis

651-423-4733
blewis@umn.edu

Dear Beth Lewis:

On 2/27/2022, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	The Effects of Running to Music and Individual Preference for Running with or without Music on Psychological and Performance Outcomes
Investigator:	Beth Lewis
IRB ID:	STUDY00015139
Sponsored Funding:	None
Grant ID/Con Number:	None
Internal UMN Funding:	None
Fund Management Outside University:	None
IND, IDE, or HDE:	None
Documents Reviewed with this Submission:	• Pre Screening Questionnaire.pdf, Category: Other; • Feeling Scale (Hardy & Rejeski, 1989).pdf, Category: Other; • Godin - Leisure Time Exercise Questionnaire.pdf, Category: Other; • Age, Height, Weight.pdf, Category: Other; • hrp-582-template-social-behavioral-consent-form (1) (2).pdf, Category: Consent Form; • Physical Activity Enjoyment Scale (Kendzierski & DeCarlo, 1991).pdf, Category: Other;

	• RPE (Borg, 1998).pdf, Category: Other; • Recruitment Email.pdf, Category: Recruitment Materials; • Music, Preference, and Running IRB (1).docx, Category: IRB Protocol; • Exercise Induced Feeling Inventory (Gauvin & Rejeski, 1993).pdf, Category: Other

The IRB determined that the criteria for approval have been met and that this study involves no greater than minimal risk.

This study was approved under Expedited Category(ies):

- (7) Research on individual or group characteristics or behavior or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

This study does not require continuing review. The revised Common Rule (2018 Rule) eliminated continuing review for most minimal risk research approved on or after January 21, 2019. However, the elimination of continuing review does not eliminate reporting requirements or submission of modifications for IRB review and approval. Information about 2018 Rule requirements and investigator responsibilities can be found in the Investigator Manual (HRP-103).

If consent forms or recruitment materials were approved, those are located under the Final column in the Documents tab in the ETHOS study workspace.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the HRPP Toolkit Library on the IRB website.

For grant certification purposes, you will need the approval and last day of approval dates listed above and the Assurance of Compliance number which is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA00004003).

Sincerely,

Clinton Dietrich, MA, CIP
Senior IRB Analyst

We strive to provide clear, consistent, and timely service to maintain a culture of respect, beneficence, and justice in research. Complete a brief survey about your experience.

Appendix B

Pre-Screening Questionnaire

Thank you for expressing interest in the music and running study. The following questions will collect information about you to determine if you are eligible for the study. Your name will be recorded along with this survey. Do we have permission to keep this information? If yes, please continue to the next screen. If no, you may discontinue this survey and contact the primary investigator, Anna Lalande, with questions or concerns.

Please answer these general questions so we can learn more about the individuals who are interested in participating in our study. These questions will not impact your eligibility for the study.

1. What is your full name? _____
2. How did you hear about the study? _____
3. Which of the following do you consider to be your racial group?
   - ☐ White
   - ☐ American Indian/Alaskan Native
   - ☐ Asian
   - ☐ Native Hawaiian or Other Pacific Islander
   - ☐ Black or African American
   - ☐ Other
   - ☐ Don't know/refuse
4. Which of the following do you consider to be your ethnic group?
   - ☐ Hispanic or Latino
   - ☐ Non Hispanic or Latino
5. Are you a student?
   - ☐ Yes
   - ☐ No
6. If you are a student, what is your academic major? _____
7. If you are a student, what is your year in school?
   - ☐ 1st year
   - ☐ 2nd year
   - ☐ 3rd year
   - ☐ 4th year
   - ☐ 5th year +
   - ☐ Graduate Student
   - ☐ Not currently a student
8. What is your age? _____
9. To the best of your ability, please estimate your current height in inches. _____
10. To the best of your ability, please estimate your current weight in pounds. ____

11. When running outside, do you prefer to listen to music or not listen to music?
   - ☐ I prefer <u>to listen</u> to music when running outside
   - ☐ I prefer <u>not to listen</u> to music when running outside

The following questions will help us determine if you are eligible for the study. Since this research study involves completing a 1 mile run, we need to ask you several questions about your health and physical activity experience to find out if you are eligible. All the information will be kept strictly confidential.

12. Are you age 18 or older?
- ☐ Yes
- ☐ No

13. Are you currently pregnant or planning to get pregnant?
- ☐ Yes
- ☐ No

14. Do you experience any of the following? (please check all that apply)
- ☐ chest discomfort with exertion
- ☐ unreasonable breathlessness
- ☐ dizziness, fainting, blackouts
- ☐ ankle swelling
- ☐ unpleasant awareness of a forceful, rapid, or irregular heart rate
- ☐ burning or cramping sensations in your lower legs when walking short distances

15. Have you had, or do you currently have any of the following? (please check all that apply)
- ☐ a heart attack
- ☐ heart surgery, cardiac catheterization, or coronary angioplasty
- ☐ pacemaker/implantable cardiac defibrillator/rhythm disturbance
- ☐ heart valve disease
- ☐ heart failure
- ☐ heart transplantation
- ☐ congenital heart disease
- ☐ diabetes
- ☐ renal disease

16. Do you have any other injury or medical condition that would prevent safe participation in a one-mile run?
- ☐ Yes
- ☐ No

17. Do you have access to headphones or earbuds and a compatible portable music device that also has internet access? (e.g., a smart phone and earbuds)
- ☐ Yes
- ☐ No

18. Are you able to read, write, speak, and understand English?
- ☐ Yes
- ☐ No

Congratulations! You are eligible for the current study. The student investigator, Anna Lalande, will be contacting you shortly to schedule your experimental session.

First Name _____
Last Name _____

Appendix C

Consent Form

Title of Research Study: ***The Effects of Running to Music and Individual Preference for Running with or without Music on Psychological and Performance Outcomes***

Investigator Team Contact Information: ***Anna Lalande***

For questions about research appointments, the research study, research results, or other concerns, call the study team at:

Investigator Name: Beth Lewis Investigator Departmental Affiliation: School of Kinesiology Phone Number: 612-625-0756 Email Address: blewis@umn.edu	Student Investigator Name: Anna Lalande Phone Number: 414-916-3147 Email Address: lalan013@umn.edu

Supported By: This research is supported by the University of Minnesota

Key Information About This Research Study

The following is a short summary to help you decide whether or not to be a part of this research study. More detailed information is listed later on in this form.

What is research?

The goal of research is to learn new things in order to help people in the future. Investigators learn things by following the same plan with a number of participants, so they do not usually make changes to the plan for individual research participants. You, as an individual, may or may not be helped by volunteering for a research study.

Why am I being invited to take part in this research study?

We are asking you to take part in this research study because you responded to an advertisement, email, or presentation and met the eligibility requirements required for the study based on the pre-screening questionnaire.

What should I know about a research study?

- Someone will explain this research study to you.
- Whether or not you take part is up to you.
- You can choose not to take part.
- You can agree to take part and later change your mind.
- Your decision will not be held against you.

- You can ask all the questions you want before you decide.

Why is this research being done?

The purpose of this research is to examine both the role of music while running and the impact of preference for listening or not listening to music while running on performance and psychological outcomes. Exercise is related to numerous health benefits and psychological benefits that the participant could experience. The benefits will likely be short in duration because it is a one-time intervention.

How long will the research last?

We expect that you will be in this research study for approximately 45 minutes. (15 minutes to complete pre-run questionnaires, 15 minutes to run 1 mile, 15 minutes to complete post-run questionnaires).

What will I need to do to participate?

You will be asked to complete pre-run questionnaires, participate in a 1-mile run, and complete post-run questionnaires.

More detailed information about the study procedures can be found under "What happens if I say yes, I want to be in this research?"

Is there any way that being in this study could be bad for me?

There are two risks associated with this study. First, it is possible that a participant would experience a cardiac arrest or some other medical event as a result of exercise. This risk is considered minimal. However, if you experience any adverse health reaction, please stop running and notify the investigator immediately. In the unlikely event of an emergency, the instructor will call for emergency assistance. The second risk is the participant could sustain an injury while exercising. This risk is also considered minimal, and participants will only be instructed to run if they pass the screening test. Additionally, to minimize the risk of injury associated with running, participants will be screened for medical issues that may make exercise unsafe or unwise. Participants will be advised to use/wear appropriate gear for running. If an injury or change in medical status occurs between recruitment and the intervention, the intervention will be postponed until the participant obtains written clearance from their healthcare provider to continue to engage in exercise.

Will being in this study help me in any way?

We cannot promise any benefits to you or others from your taking part in this research. However, exercise is related to numerous health benefits including reduced risk of heart disease, stroke, some types of cancer, and obesity. There are also potential psychological benefits including increased mood and decreased stress. If the participant completes the intervention, they could experience these benefits. The benefits will likely be short in duration because it is a one-time intervention. Information from this study may benefit other people now or in the future by exploring how music and autonomy impact the performance and psychological outcomes of running.

What happens if I do not want to be in this research?

There are no known alternatives, other than deciding not to participate in this research study. Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota.

Detailed Information About This Research Study

The following is more detailed information about this study in addition to the information listed above.

How many people will be studied?

We expect about 40 people will participate in this research study.

What happens if I say "*Yes, I want to be in this research*"?

I will ask you to report to the Physical Activity and Sport Science (PASS) Laboratory where you will be welcomed by the student investigator. First, you will complete an informed consent form and pre-run questionnaires. Upon completion, we will go outside, and I will talk you through a 1-mile route. You will be asked to run 1 mile at a moderate pace either with or without music. After the run, you will complete post-run questionnaires. When you are finished with the post-run questionnaires, you will be free to go, and your extra credit will be awarded. The entire process will take approximately 45 minutes.

Whether you receive your preference for running with or without music will be chosen by chance, like flipping a coin. Neither you, nor the investigator will choose whether you receive your preference. You will have an equal chance of being assigned your preference or not.

What happens if I say "Yes", but I change my mind later?

You can leave the research study at any time, and no one will be upset by your decision. Choosing not to be in this study or to stop being in this study will not result in any penalty to you or loss of benefit to which you are entitled. This means that your choice not to be in this study will not negatively affect your academic standing as a student or your future relations with the University of Minnesota. If you decide not to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Will it cost me anything to participate in this research study?

There will be no cost to you for any of the study activities or procedures.

What happens to the information collected for the research?

Efforts will be made to limit the use and disclosure of your personal information, including research study and medical records, to people who have a need to review this information. We cannot promise complete confidentiality. Organizations that may inspect and copy your information include the Institutional Review Board (IRB), the committee that provides ethical and regulatory oversight of research, and other representatives of this institution, including those that have responsibilities for monitoring or ensuring compliance.

We may publish the results of this research. However, we will keep your name and other identifying information confidential.

Whom do I contact if I have questions, concerns, or feedback about my experience?

This research has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Will I have a chance to provide feedback after the study is over?

The HRPP may ask you to complete a survey that asks about your experience as a research participant. You do not have to complete the survey if you do not want to. If you do choose to complete the survey, your responses will be anonymous.

If you are not asked to complete a survey, but you would like to share feedback, please contact the study team or the HRPP. See the "Investigator Contact Information" of this form for study team contact information and "Whom do I contact if I have questions, concerns or feedback about my experience?" of this form for HRPP contact information.

What happens if I am injured while participating in this research?

In the event that this research activity results in an injury, participants will be instructed to call their healthcare provider. Additionally, to be proactive, participants will be asked during the online screening if they have experienced any injuries.

Will I be compensated for my participation?

If you agree to take part in this research study, you will receive extra credit for certain courses for your time and effort. Kinesiology professors will be contacted prior to the study to see if they will offer extra credit for your participation, and they will address this extra credit opportunity in class. At the start of the study, you will be asked if you are participating for extra credit. You will need to provide the course number and professor name. At the conclusion of the study, the student investigator will let your professor know that you completed the study for extra credit.

Use of Identifiable Health Information

The results of this study may also be used for teaching, publications, or for presentation at scientific meetings. In any sort of report we might publish, we will not include any information that will make it possible to identify you.

Your signature documents your permission to take part in this research. You will be provided a copy of this signed document.

_____ _____

Signature of Participant Date

_____

Printed Name of Participant

_____ _____

Signature of Person Obtaining Consent Date

_____

Printed Name of Person Obtaining Consent

Appendix D

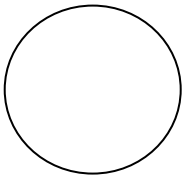
Pre-Run Surveys

LEISURE TIME EXERCISE QUESTIONNAIRE

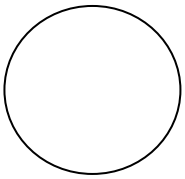
(Godin & Shephard, 1985)

1) Considering a **7-day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write in each circle the appropriate number).

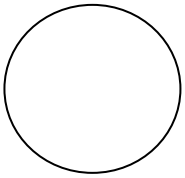
A) STRENUOUS EXERCISE
(HEART BEATS RAPIDLY)
(i.e., running, jogging, hockey, football soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)



B) MODERATE EXERCISE
(NOT EXHAUSTING)
(i.e., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)



C) MILD EXERCISE
(MINIMAL EFFORT)
(i.e., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking



2) Considering a **7-day period** (a week), during your leisure-time, how often do you engage in any regular activity long enough to **work up a sweat** (heart beats rapidly)?

Often Sometimes Never/rarely

Feeling Scale

(Hardy & Rejeski, 1989)

Please rate how you currently feel, by circling the appropriate number.

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

Physical Activity Enjoyment Scale

(Kendzierski & DeCarlo, 1991)

Please rate how you feel at the moment about physical activity. Below is a list of feelings with respect to physical activity. For each feeling, please mark the number that best describes you.

I enjoy it	1	2	3	4	5	6	7	I hate it
I feel bored	1	2	3	4	5	6	7	I feel interested
I dislike it	1	2	3	4	5	6	7	I like it
I find it pleasurable	1	2	3	4	5	6	7	I find it unpleasurable
I am very absorbed in physical activity	1	2	3	4	5	6	7	I am not at all absorbed in physical activity
It's no fun at all	1	2	3	4	5	6	7	It's a lot of fun
I find it energizing	1	2	3	4	5	6	7	I find it tiring
It makes me depressed	1	2	3	4	5	6	7	It makes me happy
It's very pleasant	1	2	3	4	5	6	7	It's very unpleasant
I feel good physically while doing it	1	2	3	4	5	6	7	I feel bad physically while doing it
It's very invigorating	1	2	3	4	5	6	7	It's not at all invigorating
I am very frustrated by it	1	2	3	4	5	6	7	I am not at all frustrated by it
It's very gratifying	1	2	3	4	5	6	7	It's not at all gratifying
It's very exhilarating	1	2	3	4	5	6	7	It's not at all exhilarating
It's not at all stimulating	1	2	3	4	5	6	7	It's very stimulating
It gives me a strong sense of accomplishment	1	2	3	4	5	6	7	It does not give me any sense of accomplishment
It's very refreshing	1	2	3	4	5	6	7	It's not at all refreshing
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

Exercise-Induced Feeling Inventory

(Gauvin & Rejeski, 1993)

HOW ARE YOU FEELING?

Instructions: Please use the following scale to indicate the extent to which each word describes how you feel at this moment in time. Record your responses by circling the appropriate number next to each word.

Feeling	Do not feel	Feel slightly	Feel moderately	Feel strongly	Feel very
1. Refreshed	0	1	2	3	4
2. Calm	0	1	2	3	4
3. Fatigued	0	1	2	3	4
4. Enthusiastic	0	1	2	3	4
5. Relaxed	0	1	2	3	4
6. Energetic	0	1	2	3	4
7. Happy	0	1	2	3	4
8. Tired	0	1	2	3	4
9. Revived	0	1	2	3	4
10. Peaceful	0	1	2	3	4
11. Worn out	0	1	2	3	4
12. Upbeat	0	1	2	3	4

Appendix E

Post-Run Surveys

Feeling Scale

(Hardy & Rejeski, 1989)

Please rate how you currently feel, by circling the appropriate number.

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

Physical Activity Enjoyment Scale

(Kendzierski & DeCarlo, 1991)

Please rate how you feel at the moment about physical activity. Below is a list of feelings with respect to physical activity. For each feeling, please mark the number that best describes you.

I enjoy it	1	2	3	4	5	6	7	I hate it
I feel bored	1	2	3	4	5	6	7	I feel interested
I dislike it	1	2	3	4	5	6	7	I like it
I find it pleasurable	1	2	3	4	5	6	7	I find it unpleasurable
I am very absorbed in physical activity	1	2	3	4	5	6	7	I am not at all absorbed in physical activity
It's no fun at all	1	2	3	4	5	6	7	It's a lot of fun
I find it energizing	1	2	3	4	5	6	7	I find it tiring
It makes me depressed	1	2	3	4	5	6	7	It makes me happy
It's very pleasant	1	2	3	4	5	6	7	It's very unpleasant
I feel good physically while doing it	1	2	3	4	5	6	7	I feel bad physically while doing it
It's very invigorating	1	2	3	4	5	6	7	It's not at all invigorating
I am very frustrated by it	1	2	3	4	5	6	7	I am not at all frustrated by it
It's very gratifying	1	2	3	4	5	6	7	It's not at all gratifying
It's very exhilarating	1	2	3	4	5	6	7	It's not at all exhilarating
It's not at all stimulating	1	2	3	4	5	6	7	It's very stimulating
It gives me a strong sense of accomplishment	1	2	3	4	5	6	7	It does not give me any sense of accomplishment
It's very refreshing	1	2	3	4	5	6	7	It's not at all refreshing
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

Exercise-Induced Feeling Inventory

(Gauvin & Rejeski, 1993)

HOW ARE YOU FEELING?

Instructions: Please use the following scale to indicate the extent to which each word describes how you feel at this moment in time. Record your responses by circling the appropriate number next to each word.

Feeling	Do not feel	Feel slightly	Feel moderately	Feel strongly	Feel very
1. Refreshed	0	1	2	3	4
2. Calm	0	1	2	3	4
3. Fatigued	0	1	2	3	4
4. Enthusiastic	0	1	2	3	4
5. Relaxed	0	1	2	3	4
6. Energetic	0	1	2	3	4
7. Happy	0	1	2	3	4
8. Tired	0	1	2	3	4
9. Revived	0	1	2	3	4
10. Peaceful	0	1	2	3	4
11. Worn out	0	1	2	3	4
12. Upbeat	0	1	2	3	4

Rating of Perceived Exertion (RPE) Scale

(Borg, 1998)

Instructions: Rate your perception of exertion during the 1-mile run. This feeling should reflect how heavy and strenuous the exercise felt to you, combining all sensations and feelings of physical stress, effort, and fatigue. Do not concern yourself with any one factor such as leg pain or shortness of breath, but try to focus on your total feeling of exertion.

Choose the number from below that best describes your level of exertion. Try to appraise your feeling of exertion as honestly as possible, without thinking about what the actual physical load is. Look at the scales and the expressions and then give a number.

Rating	How Hard you are Exercising
6	No exertion at all
7	Very, very light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very Hard
18	
19	Extremely hard
20	Maximal Exertion