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EFFECT OF LISTENING TO MUSIC DURING WARMUP
ON WINGATE ANAEROBIC TEST PERFORMANCE

by

Russell P. Fox

A thesis submitted to the Graduate College
in partial fulfillment of the requirements
for the degree of Master of Science
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EFFECT OF LISTENING TO MUSIC DURING WARMUP ON WINGATE ANAEROBIC TEST PERFORMANCE

Russell P. Fox, M.S.

Western Michigan University, 2016

The primary purpose of this study was to determine whether or not different music conditions would affect performance on the Wingate anaerobic test. We also sought to explore the effect of music on psychological variables such as, rating of perceived exertion (RPE)

16 subject (8 males, 8 females) listened to either pre-selected music, self-selected music or white noise during a 10-minute warmup, cycling at $50 \text{ Rev}\cdot\text{min}^{-1}$ for 10 minutes with a light resistance of one kilogram. Once the warmup was completed they performed a Wingate Anaerobic test against a resistance of 7.5% of their body mass in kilograms.

There were no significant differences in Peak Power, Mean Power, Fatigue Index, or RPE. There was also no significant difference in the Subjective Exercise Experience (SEES) variables of Positive Well-being (PWB), Psychological Distress (PD), and Fatigue (FAT) between the music conditions and white noise.

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INTRODUCTION

Music can be heard today at virtually all sporting events and fitness facilities. Music is an expression of individuality; Frith (1996) explains that music is an experience of our identity and this identity comes from the social process of interaction with the music. This is evident in the sporting arena: at a football game where a Marching band is playing, a hockey game where a sound system plays rock and roll to rally the crowd, gymnastics and figure skating where the individual selects their own music, and the individual athlete who puts headphones on during their warmups in order to psych themselves up. However, the same fast upbeat music could be detrimental when concentration and coordination are required. Eliakim et al. (2007) noted that slow music could be beneficial to those who compete in events that require concentration and focus such as a diver or an archer. Bishop et al. (2007) found that music could also be used as a sedative to calm an athlete down. For the athletes that participate in individual sports, listening to music with headphones may help them take their focus off the upcoming event and reduce nervousness. For the gymnast, the music is a way for them to help keep the rhythm of their routine. When an athlete wants to calm down they will usually listen to slower tempo music. As an example of arousal regulation, Olympic gold medalist Dame Kelly Holmes British middle distance runner specializing in both the 800 and 1500 meter races, was known to listen to soulful ballads during her warmups.

Karageorghis et al. (2008) found that music affects both emotional and psychological states. Haluk et al. (2009) also found that the lyrics of a song or the association to it make an impact on the person's emotions. When prepping for

competition, certain athletes are known to listen to music that has an upbeat tempo. Karageorghis et al. (2007) reported that music decreases fatigue and increases arousal, motor coordination/synchronization, and relaxation. Eliakim et al. (2007) noted that when an athlete needs to perform power type movements, fast and arousing music would be appropriate. However, the same type of music could be detrimental if the tasks require concentration and coordination. Thakur et al. (2013) found that fast tempo and strong rhythmic music is stimulating and increases arousal, which helps the athlete focus on the task at hand and block out distractions.

Chtourou et al. (2012) noted that music has been shown to reduce the levels of perceived exertion and enhance motor coordination in short-term maximal exercises. Haluk et al. (2009) showed that music helped their subjects deal more effectively with exercises that elicit pain, discomfort and fatigue. For the athlete to compete at their optimal level they will in some cases enter an altered state which has been termed “flow” this is the point at which time appears to speed up or slow down and the athlete’s body and mind functions as one unit Karageorghis et al. (2007). This is a point of great motivation; music has shown to help individuals achieve this state, and being motivated can often be a pivotal point between success and failure. Thakur et al. (2013) noted that music can cause dissociation, where the participant will focus on the music rather than internal body cues. This may change the focus from fatigue and pain to the music. This will in turn help the athlete achieve “flow” which will help them immerse into the activity and reduce negative self-judgements. Athletes have used music for many years to achieve this motivational state. In such state athletes can overcome fatigue and pain for a longer period of time and produce a greater work output.

Haluk et al.(2009) found that music could influence a person's psychological state, even helping them overcome mental and emotional fatigue, thus enhancing physical and athletic performance. Music has been shown to help a person push through pain and fatigue, allowing them to become self-absorbed (Karageorghis et al., 2007). Thus, music can be used as a distraction to help the athlete overcome the hurdles of pain and fatigue. Music has elements to it that each individual person gravitates towards as described Karageorghis et al. (2007). These are elements that may help motivate the athlete:

1. *Rhythm response*: relates to how people react to music rhythm – most notably tempo which is the speed of music in beats per minute.
2. *Musicality*: concerns the pitch-related elements of music such as harmony and melody.
3. *Cultural impact*: has to do with the pervasiveness of music within society.
4. *Association*: pertains to extra-musical association that a piece may conjure (e.g., Survivor's Eye of the Tiger and boxing).

Of the four elements mentioned, rhythm seems to play an important role in the psychological effect of exercise. Priest et al. (2004) found that a consistent rhythm of popular music stimulates the ergotropic center in the brain, stimulating the work capacity of the central nervous system and thus increasing work output. Not only does tempo have an effect, musical association may play a role in athletic performance. Haluk et al. (2009) compared the effect of music tempo (fast music >140bpm, slow music <140bpm) to control (no music) on anaerobic performance via a Wingate test. The study consisted of 20 (14 males, 6 females) physically active college students. Music was selected from the Turkish top 10 chart to insure participant familiarity. Significant differences were

reported between slow music to no music, fast music to no music, but there was no significant difference between fast music to slow music in Peak Power, Minimum Power, Mean Power, and Fatigue Index. (Haluk et al., 2009).

During warmups, competitive athletes who participate in primarily anaerobic events such as wrestling, football, sprinting, and power-lifting often listen to music. It is impractical (and often against the rules) for them to listen to music during the actual event.

Listening to music during warmups has been a key aspect to sport for many years. It is now easier than ever to listen to music while warming-up for a sporting event since the introduction of devices such as MP3 players, iPods, and smart phones. Properly selected music has shown to be an ergogenic aid to gaining an advantage over an opponent (Brooks et al., 2010).

Bishop et al. (2007) noted how musical selection causes varying ranges of emotional responses, which are either utilitarian or aesthetic. Utilitarian emotions are high-intensity emergency reactions. They also parallel primary emotions which are emotions that arise from the fight of flight stimulus. Aesthetic emotions are weaker emotions which may only create goose bumps or moist eye. Bishop et al. (2007) interviewed 14 junior tennis players and found varying responses as to why they chose the type of music they listened to. The athletes chose music that would emotionally stimulate them. During the interview process they were asked to list five emotional states in which they felt would be the most important for success in tennis. The participants were also asked to list any music that feel or think about those emotions. They also noted that emotional states change dramatically during the week before a competition. It was

often noted that the reasoning for the type of music listened to was to improve the athlete's mood. The control of the type of music that an athlete listens to before a competition and during a pre-performance warmup may have a significant impact on their performance.

Listening to music before an athletic event seems to have both a physiological and psychological impact on performance. The Rating of Perceived Exertion (RPE) scale was developed to quantify how an individual perceives physical exertion by taking their subjective feelings and putting them into objective findings using a number scale of 6 - 20 (6 being the lowest with no exertion and 20 being maximal exertion) (Borg, 1982). Another tool that has been developed is the Subjective Exercise Experiences Scale (SEES; Appendix H), which is divided into three subscales: Positive Well-Being, Psychological Distress, and Fatigue. There are 12 adjectives describing feelings (great, awful, drained, positive, crummy, exhausted, strong, discouraged, fatigued, terrific, miserable, and tired); each adjective is rated 1 – 7, with 1 being low and 7 being high. These tools have been combined with the Wingate Anaerobic Performance test (Bar-Or, 1987).in a laboratory setting in an attempt to measure how listening to music before an athletic event may impact an athlete's performance.

The primary purpose of this study was to determine whether different music conditions would affect performance on the Wingate anaerobic test We hypothesized that a pre-selected music condition would result in a significantly higher peak power, mean power, RPE, and fatigue index as compared to self-selected and white noise conditions. Concerning the Subjective Exercise Experience Scale, we hypothesized that Positive Well-Being and Psychological Distress would be significantly lower and fatigue would

be significantly higher in pre-selected music condition as compared to self-selected music and white noise.

METHODS

Subjects

Sixteen recreationally active individuals (8 males; 8 females) recruited from the WMU campus as well as off campus participated in this study. Table 1 shows descriptive demographics of the participants. The study was approved by the Human Subjects Institutional Review Board at Western Michigan University. All participants provided informed consent and completed both the AHA/ACSM Health Fitness Facility Pre-participation Screening Questionnaire (Pescatello et al., 2014) and the Lower Leg Injury Questionnaire (Pi-Sunyer et al, 1998) before being accepted into the study (please see appendices A, B & C).

The Lower Body Questionnaire (Appendix C) was administered to ensure the safety of the participants to perform maximal effort during testing. Participation was limited to those classified as low risk for cardiovascular disease according to the American College of Sports Medicine (please see Appendix B). Men and women ages 18 to 45 years with no lower body musculoskeletal injuries within the past 6 months or any other issue that would prevent them from riding on a bike and exerting maximal effort and no cardiovascular, respiratory, or metabolic diseases were recruited for participation.

Table 1*Descriptive Statistics*

Variable	Total (N=16)	Male (n=8)	Female (n=8)
Age (yr.)	23.6 \pm 4.8	23.4 \pm 6.6	23.8 \pm 2.4
Body Mass (kg.)	72.3 \pm 12.2	75.4 \pm 14.5	69.2 \pm 9.4
Height (cm.)	170.4 \pm 7.9	173.5 \pm 8.8	167.3 \pm 5.9
BMI (kg/m ²)	24.8 \pm 3.2	24.8 \pm 3.3	24.8 \pm 3.3

Note: Mean \pm Standard Deviation

Study Design

Each participant attended four sessions: an informational meeting and three exercise testing sessions. All meetings were conducted at Western Michigan University's Human Performance Research Laboratory and are described below.

Informational Meeting

An informational meeting was arranged to allow the potential participants an opportunity to understand the study. The participants were made aware of the time commitment and reminded that participation was voluntary. Participants were given the opportunity to ask questions. The study was verbally explained; the informed consent document was provided for them to read. If they agreed to participate, the informed consent document was signed and the AHA/ACSM Health Fitness Facility Pre-Participation Screening and the Lower Leg Injury Questionnaires were.

The participants were asked to list their five favorite songs and rated each using the Brunel Music Rating Inventory (Karageorghis, Terry, & Lane, 1999) (Appendix G). The top three rated songs were selected for the self-selected trial; these songs were, put on Spotify™, is an online music app that used to create different stations and playlists. Table 2 shows the tempo for each subject's chosen songs.

Table 2

Self-selected Music

Subject	Song 1 BPM	Song 2 BPM	Song 3 BPM	Average BPM
1	120	115	96	110.3
2	127	128	145	133.3
3	93	80	75	82.7
4	102	134	200	145.3
5	167	140	75	127.3
6	92	91	82	88.3
7	110	75	130	105.0
8	171	91	140	134.0
9	129	138	152	139.7
10	157	98	145	133.3
11	96	126	90	104.0

Table 2 - continued

12	128	75	90	97.7
13	99	122	125	115.3
14	132	135	130	132.3
15	93	130	110	111.0
16	145	150	171	155.3

Note: BPM (Beats Per Minute), BPM was taken from songbpm.com

The following songs were selected for the pre-selected music condition (Lose Yourself by Eminem 171bpm, Eye of The Tiger by Survivor 109bpm, and Thunderstruck by AC/DC 134bpm). These songs were selected from Get Pumped! Your Top 25 Workout Songs (2015), and were a mixture of genres (Rock, Heavy Metal, and Rap).

Measures

Rating of Perceived Exertion (RPE)

The RPE scale was developed to quantify how people perceive physical exertion by taking their subjective feelings and putting them into objective findings using a number scale of 6 - 20 (6 being the lowest with no exertion and 20 being maximal exertion) (Borg, 1982). Rejeski (1985) found that a person's response to exercise is impacted by external psychological and internal physiological cues. The first 30 seconds of exercise are dominated by local cues, which come from three different pathways; afferent stimulation from muscular receptors, innervation from the central motor cortex, and peripheral muscular stimulation (Rejeski, 1985). Intensity of the exercise stimulus

might influence the contributions of psychological and physiological input to self-reports of exertion (Rejeski, 1985). Since it has been noted that levels of exertion can be influenced by external stimuli such as music. It has been shown that music affects RPE at low intensity exercise, but not for high intensity exercise (Yamashita, Iwai, Akimoto, Sugawara, & Kono, 2006).

Subjective Exercise Experience Scale (SEES)

In order to combine the outcomes of both physiological stress and psychological stress, McAuley et al. (1994) created the Subjective Exercise Experiences Scale (SEES; Appendix H), which is divided into three subscales: Positive Well-Being, Psychological Distress, and Fatigue. There are 12 adjectives describing feelings (great, awful, drained, positive, crummy, exhausted, strong, discouraged, fatigued, terrific, miserable, and tired); each adjective is rated 1 – 7, with 1 being low and 7 being high. There is a high correlation between physiological stress and psychological stress (Yamashita et al., 2006); by using this assessment it helps researchers conceptualize both positive and negative psychological effects under exercise conditions (McAuley et al., 1994).

Exercise Testing Sessions

The participants warmed up on a MonarkTM 818E cycle ergometer for 10 minutes listening to either pre-selected music, self-selected music, or white noise. All conditions were randomized.

The participants had an opportunity to practice on the equipment and ask any questions. Once comfortable with the equipment, the researcher adjusted the seat both

vertically and horizontally so when one pedal of the bike was at the top of the pedal crank their knee should be flexed at approximately 90 degrees, while the other leg is almost fully extended. Participants were supplied with Logitech™ G430 headphones by the researcher; the headphones were cleaned and sanitized after each use. The participants placed them over their ears and had control of the music volume, at this point they either listened to music they had selected, music selected by the researcher, or white noise. The conditions were randomized, Condition 1: self-selected music (SS), Condition 2: pre-selected music (PS), and Condition 3: white noise (WN). The order of conditions was randomly assigned to subjects (123, 231, 312, 132, 321, 213). The independent variable in the study was the type of music (SS, PS and WN). The dependent variables were the WAT power variables, RPE and the SEES variables.

The subjects begin the warmup by pedaling at $50 \text{ Rev} \cdot \text{min}^{-1}$ for 10 minutes with a light resistance of one kilogram, on a Monark™ 818E cycle ergometer. Once 10 minutes had lapsed, the headphones were removed. Participants were asked to move to the Wingate testing bike (Monark™ 894E peak bike) to simulate a warmup area and the actual sporting event. The participants were asked to pedal as fast and as hard as possible against a resistance of 7.5% of their body mass in kilograms. Once the participants had reached 120 rpms, the weight was released. The participants were verbally encouraged to keep pedaling as fast as they could for 30 seconds. The weight was lifted and the subjects were asked to continue pedaling at a comfortable slow pace for a cool down. The participants were shown the RPE scale immediately after the weight was lifted. Immediately following the Wingate Test, the participants were asked to point at a number that corresponded to how they felt at that moment. The cool-down period was a minimum

of 10 minutes and a maximum of 30 minutes. During the cool down period the participants were asked to complete the SEES.

The participants were asked to stay in the lab for at least 15 minutes from the completion of the cool down so that the researcher could monitor their recovery. Once the first session was completed the researcher scheduled the participants for the other two trials. The remaining two trials were conducted in the same manner as previously described.

STATISTICS

All statistical analyses were calculated using IBM SPSS v. 20. (SPSS Inc., Chicago, IL). The significance level was set *a priori* at $p \leq 0.05$. Repeated measures ANOVAs were used. If there was a significant main effect, then T-tests with boneferroni adjustment were used for post hoc analysis.

RESULTS

Power Variables

Absolute power variables measured in Watts (W). Relative power variables measured in Watts per kilogram of body mass (W/kg). There was no significant effect of self-selected music (SS), pre-selected music (PS), or white noise (WN) on Peak Power (PP), Relative Peak Power (RPP), Mean Power (MP), Relative Mean Power (RMP), and Fatigue index (FI) at the $p < .05$ level for the three conditions; PP [$F(2, 14) = .550$, $p = .589$], RPP [$F(2, 14) = .847$, $p = .450$], MP [$F(2, 14) = .170$, $p = .846$], RMP [$F(2, 14) = .273$,

$p=.765$], FI [$F(2,14) = 1.803$, $p=.201$]. (See Table 3.) for Wingate anaerobic test variables.

Table 3

Power Output

Variable	Pre-selected Music	Self-selected Music	White Noise
Peak Power (W)	679.4 \pm 227.6	652.4 \pm 174.6	667.2 \pm 220.4
Relative Peak Power (W/kg)	9.5 \pm 2.7	9.0 \pm 1.9	9.3 \pm 2.8
Mean Power (W)	455.3 \pm 123.2	458.4 \pm 100.0	462.6 \pm 124.5
Relative Mean Power (W/kg)	6.3 \pm 1.5	6.3 \pm 1.0	6.4 \pm 1.5
Fatigue Index (%)	54.9 \pm 7.9	54.7 \pm 16.5	59.9 \pm 18.4

Note: Mean \pm Standard Deviation

Psychological Factors

There was no significant effect of self-selected music (SS), pre-selected music (PS), or white noise (WN) on positive well-being (PWB), psychological distress (PD), and fatigue (FAT) at the $p<.05$ level for the three conditions; PWB [$F(2,14) = 1.787$, $p=.204$], PD [$F(2,14) = .709$, $p=.509$], FAT [$F(2,14) = .410$, $p=.671$] (see Table 4) for SEES variables.

Table 4*SEES*

Variable	Self-selected Music	Pre-selected Music	White Noise
Positive Well-Being	20.4 \pm 3.4	20.6 \pm 4.2	19.0 \pm 3.6
Psychological Distress	7.8 \pm 3.7	7.2 \pm 2.9	8.5 \pm 6.0
Fatigue	15.3 \pm 4.7	15.6 \pm 5.5	16.5 \pm 5.3

Note: Mean \pm Standard Deviation

Rating of Perceived Exertion

There were no differences between any of the conditions. Self-selected Music: 14.6 \pm 2.6, Pre-Selected Music: 14.6 \pm 2.7, White Noise: 15.0 \pm 2.8. There was no significant effect of self-selected music (SS), pre-selected music (PS), or white noise (WN) on RPE at the $p < .05$ level for the three conditions; [$F(2,14) = .522$, $p = .605$].

DISCUSSION

This study compared two different music conditions and white noise during a 10-minute warmup: self-selected music, pre-selected music, and white noise. The primary purpose of this study was to determine whether or not different music conditions would affect performance on the Wingate anaerobic test. We also sought to explore the effect of music on psychological variables. To the author's knowledge this is the first study to

compare pre-selected music, self-selected music, and white noise during the warmup before a Wingate anaerobic test.

We hypothesized that a pre-selected music condition would result in a significantly higher peak power, mean power, RPE, and fatigue index as compared to self-selected and white noise conditions. Concerning the Subjective Exercise Experience Scale, we hypothesized that Positive Well-Being and Psychological Distress would be significantly lower and fatigue would be significantly higher in pre-selected music condition as compared to self-selected music and white noise.

Pre-selected music was selected based on familiarity from the Get Pumped! Your Top 25 Workout Songs. (2015), and were a mixture of genres. As compared to the self-selected condition the pre-selected music was controlled and played for every individual. The tempo of the music was comparably high as compared to the self-selected music. Concerning the Subjective Exercise Experience Scale, we hypothesized that Positive Well-Being and Psychological Distress would be significantly lower and fatigue would be significantly higher in pre-selected music condition as compared to the self-selected and white noise conditions. Music tends to help stabilize emotions and improve one's mood (Bishop, 2007), which would reflect in a person having a higher PWB and lower PD. FAT would be higher because the individual would be psyched up and would perform at a higher intensity.

The intent of this study was to replicate an anaerobic sporting event in a laboratory setting; this was done by using two different cycle ergometers. The participants first warmed up on the Monark 818ETM for 10 minutes listening to either pre-selected music, self-selected music, or white noise through headphones. Once the

warmup period was over they moved to the Monark 894ETM peak bike where the testing was conducted. The current study used a protocol similar to Eliakim et al. (2007) in which 24 adolescent volleyball players (12 males and 12 females) were enlisted. They used an isolated room for warmups in which the subjects pedaled for 10 minutes at 60 rpms with a light load of one kilogram. There were two conditions: music and no music. The music condition was played only during the warmup, through speakers in the room, and the music tempo was 140bpm. The pre-selected music condition in the current study was not a consistent tempo, the BPM for the three songs were 171, 109, and 134; the average for the pre-selected music was 138bpm. Eliakim et al. (2007) showed that peak power was significantly higher with the music condition ($p < .05$), 7.5% of body mass was used for resistance on the testing bike. The primary difference between the current study and Eliakim et al. (2007) is that they did not give any encouragement during testing. It is unclear at what rpm the weight was dropped as for the current study the weight was dropped at 120 rpms.

The current study did not find any differences between conditions in peak power. There are several possibilities as to why the current study did not see any significance. It is possible that there was some decay from the point of transferring from one bike to another and if the subject had achieved a state of “flow” the stopping of one activity and moving to another may have taken them out of that state. It is possible that the tempo of the music may not have been high enough to see significance. This is shown with Eye of the Tiger by Survivor, which is at 109bpm and is not considered fast tempo music. It is possible that the reasoning for no significance in the self-selected is that several of the songs were <120bpm which are considered slow to moderate tempo (See Table 2). The

results of the current study have shown the importance of musical selection based on the event that an athlete is performing in. The music selection used in this study did not improve performance.

We did not specifically focus on tempo when we selected the music for the pre-selected condition. This study took into consideration the four factors set forth by Karageorghis et al. (2007) rhythm response, musicality, cultural impact, and association. When the music was selected it was important to cross different genres. We chose music that was on the top of the charts for workout music. This was an attempt to use music with which the participants would be familiar and would potentially have a greater response than the self-selected or white noise conditions.

When an athlete selects their music for warmups or cool downs it is important for them to select music appropriate for their sport. Through the guidance of a coach who understands how music can affect performance pre-selection of music can affect the outcome of an event, it seems that tempo is one of the key factors for performance. Using the Brunel Music Rating Inventory (BMRI) for the self-selected music condition was a means to find the best suited songs for each individual. This scale was developed by Karageorghis et al. (1999) to assist athletes in selecting music. In order to help each participant, select music that was best suited for them they chose five of their favorite songs then rated those songs using the BMRI, we then used the top three rated songs for the self-selected condition. This is in contrast to Brooks et al. (2010) who used the BMRI post-test to rate the quality of the music selected. The current study also encouraged all of the subjects during the testing phase; Brooks et al. (2010) only encouraged individuals during the music condition. This could be why they discovered a significant difference

between music and no music conditions in the variables of peak power, average power, and anaerobic power. We found no significant differences when encouraging the participants during testing.

In the current study, white noise was used as a control condition rather than the lack of music. This was similar to Karageorghis et al. (1996) in which a hand dynamometer was used to measure grip strength. They used three conditions; fast tempo music (134 bpm), slow tempo (90 bpm), and white noise. Grip strength was measured in (kg force) and significantly higher in the fast tempo condition 43.94 ± 14.47 than the slow tempo condition 41.97 ± 14.41 or the white noise 43.06 ± 14.35 . Grip strength was significantly lower in the slow tempo condition when compared to white noise. The results from the study could be linked to the cultural background of the music. The selection was taken from the Top 10 British Music Chart during the previous six months. The present study was able to produce similar results in that PP for white noise was higher but not statistically significant than that of self-selected music (see table 3). This could have significant implications showing that this study was able to produce the same response with white noise as it did with two different music conditions. Which suggests that the music and the white noise are distractors and help the exerciser take their attention off of the task.

It has been shown that the time of day can effect an athlete's performance (Chtourou et al., 2012). In the present study, time of day was kept consistent for each individual participant. As Chtourou et al. (2012) demonstrated, that time of day effected peak power and mean power. Two tests were in the morning between 7:00 am – 9:00 am and in the evening between 5:00 pm – 7:00 pm. There was an increase in core body

temperature that could result in connective tissue being able to extend easier and an increase in the conduction velocity of action potentials. Some of the participants in the current study tested in the morning, some tested early afternoon, and some tested in the evening. It is possible that if we tested the subjects in the evening we may have shown a significant difference in peak power and mean power.

RPE is an objective tool used to quantify subjective feelings. Our findings were lower than expected due to a variation of different factors. It is plausible that the resistance was not set high enough to show a significance in any of the conditions. There may also have been significant differences and/or higher RPE values in the three conditions if the participants were asked specifically about their lower body lower body instead of their overall feelings of exertion. Values were lower for RPE than expected in each condition; self-selected music 14.6 ± 2.6 , pre-selected music 14.6 ± 2.7 , and white noise 15.0 ± 2.8 . We found no significant differences in RPE between any of the conditions ($p = .605$). Chtourou et al. (2012) reported RPE values post Wingate test without music at 7:00 am (16.25 ± 1.76), at 5:00pm (16.33 ± 1.67), with music at 7:00am (17.42 ± 1.56), and at 5:00pm (17.58 ± 1.38); Chtourou et al. (2012) also used 8.7% of the participant's body mass and a rolling start of 60 rpms for their Wingate test. Eliakim et al, (2007) used a drop weight of 7.5% for males and 7.0% for females; it is unclear at what rpm the weight was dropped. They found RPE values after Wingate testing of females without music (18.2 ± 0.5), with music (18.1 ± 0.5), males without music (18.5 ± 0.3), and with music (18.5 ± 0.4). Jarraya et al. (2012) reported RPE values of (16.2 ± 2.0) and (17.4 ± 1.4). They used 8.7% of the participant's body mass for the weight basket and had a rolling start at 60 rpm. The current study used 7.5% of the subject's body mass and the

weight basket dropped at 120 rpms. It is also possible that the drop rpm was set too high and may have caused lower RPE results.

SEES is one way to assess the subjects' mood state post-test. We did not find any significant differences in the three SEES variables between conditions PWB ($p=.204$), PD ($p=.509$), and FAT ($p=.671$). However, the two music conditions did show a slightly higher PWB as compared to the white noise. PD and FAT were slightly lower in the music conditions as compared to the white noise. The present study is aligned with McAuley et al. (1994) in that with all three conditions, PWB was higher than PD. A possible reason for PWB being higher than PD maybe that the participant had more intrinsic motivation to complete. McAuley et al. (1994) noted that exercise had a significant impact on psychological responses and that PWB was significantly high and PD was low. They also showed that FAT was high as well, they suggest several reasons as to why FAT was elevated; conditioning levels, length of participation, and exercise environment. Their conclusion was, it is possible to be fatigued and be positive about the exercise experience.

CONCLUSION

In conclusion, the data from this study showed that there were no significant differences between pre-selected music, self-selected music, and white noise in peak power, mean power, and fatigue index. There were also no differences among the SEES variables or RPE. There seems to be many mechanisms that may influence performance on a Wingate anaerobic test from both a psychological and physiological aspect. Music and anaerobic performance have been understudied and the results seemed to be mixed

depending on the mechanism that is used for testing. Our current findings show that listening to music prior to a bout of anaerobic exercise was not beneficial to performance.

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APPENDIX A: Informed Consent Document

Western Michigan University Human Performance and Health Education

Principal Investigator: Nicholas Hanson Ph.D.

Student Investigator: Russell P. Fox

Co-Investigator: Timothy J. Michael Ph.D.

Co-Investigator: Carol Weideman Ph.D.

You have been invited to participate in a research project titled "*Effect of Listening to Music During Warmup on Wingate Anaerobic Test Performance*." This consent document will explain the purpose of this research project and will go over all of the time commitments, the procedures used in the study, and the risks and benefits of participating in this research project. Please read this consent form carefully and completely and please ask any questions if you need more clarification.

What are we trying to find out in this study?

This study is looking at whether or not listening to music prior to an athletic event will significantly affect a person's performance.

Who can participate in this study?

The inclusionary criteria for the participants are: men and women between the ages of 18 and 45 who have not had any hip, knee or ankle injuries in the past six months, with no diagnosis of cardiovascular, metabolic, or respiratory disease and scored low risk on the AHA/ACSM Health Fitness Facility Pre-participation Screening Questionnaire. The exclusionary criteria include all of the following:

- Men and women who are less than 18 years of age or greater than 45 years of age.
- Anyone who has had hip, knee, or ankle injuries in the last six months.
- Any person who has been diagnosed with cardiovascular, metabolic, or respiratory disease.
- If the person scored moderate or high risk on the AHA/ACSM Health Fitness Facility Pre-participation Screening Questionnaire.

Where will this study take place?

Human Performance Research Laboratory at the Western Michigan University Student Recreation Center.

What is the time commitment for participating in this study?

There will be four sessions. The first session will be an informational session to gather demographics and verbally explain the informed consent which will take approximately 30 minutes. There will then be three exercise sessions which will take around 30 minutes each. Each session needs to be separated by 48 hours or more. The total time commitment for each participant will be 120 minutes (2 hours).

What will you be asked to do if you choose to participate in this study?

When you enter the lab you will have an opportunity to practice on the equipment prior to testing and ask any questions that you may have. Once you are comfortable with the equipment the researcher will adjust the seat so as needed. You will be supplied with earbuds by the researcher; the earbuds will be cleaned and sanitized after each use. You will place them in your ears, at this point you will either listen to music you have selected, music selected by the researcher, or white noise. You will then be asked to pedal at 50 RPM for 10 minutes with a light resistance. Once the 10 minutes have elapsed, the ear buds will be removed. You will be asked to pedal as fast and as hard as you can. A weight equal to 7.5% of your body mass in kilograms will be set and released onto the flywheel of the bike once you have reached top speed, and you will be encouraged to keep pedaling against this harder resistance as hard as you can for 30 seconds. Once the 30 seconds has elapsed, the weight will be lifted and you will be asked to continue pedaling at a comfortable slow pace for a cool down; at the same time you will be shown the Borg Rating of Perceived Exertion (RPE) scale. The RPE scale is a numerical scale with verbal descriptors from 6 – 20 (6 being “no exertion at all” and 20 “maximal exertion”). You will be asked to point at a number that corresponds to how you feel at that moment; the researcher will then record the number you pointed to. The cool-down period will be a minimum of 10 minutes. Once the cool down is completed you will be asked to complete the Subjective Exercise Experiences Scale (SEES). You will need to stay in the lab for at least 15 minutes from the completion of the cool down so that the researcher can monitor your recovery. Once the first session is complete the researcher will schedule you for the other two trials.

Condition 1. You will warmup on a Monark Cycle Ergometer while listening to your favorite music in which you had pre-selected.

Condition 2. You will warmup on a Monark Cycle Ergometer while listening to music selected by the investigator.

Condition 3. You will warmup on a Monark Cycle Ergometer while listening to white noise.

What information is being measured during the study?

Peak Anaerobic Power (the maximum amount of power you can produce), Mean Anaerobic Power (your average power), Fatigue Index (FI), RPE, and the SEES (with subscales including Positive Well-Being, Psychological Distress, and Fatigue).

What are the risks of participating in this study and how will these risks be minimized?

Risks will be minimized initially by having you complete pre-exercise screening questionnaires so as to assure that you are classified as low risk according to the American College of Sports Medicine. Exercise of this intensity can elicit feelings of nausea potentially leading to vomiting. To minimize these symptoms, you will be required to follow all pre-test instructions on timing of meals and warmup procedures. Additionally, you will be required to complete the cool down procedures as well. In the event of dizziness that may accompany such exercise a mat will be placed alongside the cycle ergometer to let you lie down to further recover in a supine position. Other potential risks to you are as follows: muscle cramping, muscle soreness. You will possibly experience muscle soreness following the test. To help mediate some of the symptoms you will have a cool down period post-test of a minimum of 10 minutes. You will also be asked to stay in the lab for a minimum of 10 minutes after the cool down is completed to be monitored. You will be asked to refrain from eating a heavy meal two hours prior to the test to help alleviate any potential gastrointestinal discomfort. It should be noted in case of a rare incident of cardiac problems all researchers are CPR with AED certified and an AED device is located just outside the lab door.

What are the benefits of participating in this study?

This information may show whether or not music is overall beneficial for warmups prior to an anaerobic athletic event.

Are there any costs associated with participating in this study?

If you are not a student or faculty of Western Michigan University you will be responsible for paying for your own parking. You are responsible for paying for your own gasoline expenses as well. If you do not drive and need to take public transportation and are not a student or faculty of Western Michigan University you will be responsible for paying for your own transportation.

Is there any compensation for participating in this study?

You will not be compensated for this study.

Who will have access to the information collected during this study?

Only the researchers will have access to any of the information. Information will be coded to maintain anonymity of the participants.

What if you want to stop participating in this study?

You can choose to stop participating in the study at anytime for any reason. You will not suffer any prejudice or penalty by your decision to stop your participation. You will experience NO consequences either academically or personally if you choose to withdraw from this study. The investigator can also decide to stop your participation in the study without your consent.

Should you have any questions prior to or during the study, you can contact the primary investigator, Nicholas Hanson Ph.D. at 269-387-2670 or nicholas.hanson@wmich.edu. You may also contact the Chair, Human Subjects Institutional Review Board at 269-387-8293 or the Vice President for Research at 269-387-8298 if questions arise during the course of the study.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate in this study if the stamped date is older than one year.

I have read this informed consent document. The risks and benefits have been explained to me. I agree to take part in this study.

Please Print Your Name

Participant's signature

Date

APPENDIX B: AHA/ACSM Health Fitness Facility Pre-Participation Screening Questionnaire

Assess your health status by marking all *true* statements

History

You have had:

- ☐ a heart attack
- ☐ heart surgery
- ☐ cardiac catheterization
- ☐ coronary angioplasty (PTCA)
- ☐ pacemaker/implantable cardiac defibrillator/rhythm disturbance
- ☐ heart valve disease
- ☐ heart failure
- ☐ heart transplantation
- ☐ congenital heart disease

*If you marked any of these statements in this section, consult your physician or other appropriate health care provider before engaging in exercise. You may need to use a facility with a **medically qualified staff**.*

Symptoms

- ☐ You experience chest discomfort with exertion
- ☐ You experience unreasonable breathlessness
- ☐ You experience dizziness, fainting, or blackouts
- ☐ You experience ankle swelling
- ☐ You experience unpleasant awareness of a forceful or rapid heart rate
- ☐ You take heart medications

Other health issues

- ☐ You have diabetes
- ☐ You have asthma or other lung disease
- ☐ You have burning or cramping sensation in your lower legs when walking short distance
- ☐ You have musculoskeletal problems that limit your physical activity
- ☐ You have concerns about the safety of exercise
- ☐ You take prescription medications
- ☐ You are pregnant

Cardiovascular risk factors

- ☐ You are a man ≥ 45 yr
- ☐ You are a woman ≥ 55 yr
- ☐ You smoke or quit smoking within the previous 6 mo
- ☐ Your blood pressure is $\geq 140/90$ mm Hg
- ☐ You do not know your blood pressure
- ☐ You take blood pressure medication
- ☐ Your blood cholesterol level is ≥ 200 mg \cdot dL⁻¹
- ☐ You do not know your cholesterol level
- ☐ You have a close blood relative who had a heart attack or heart surgery before age 55 (father or brother) or age 65 (mother or sister)
- ☐ You are physically inactive (i.e., you get <30 min of physical activity on at least 3 d per week)
- ☐ You have a body mass index ≥ 30 kg \cdot m⁻²
- ☐ You have prediabetes
- ☐ You do not know if you have prediabetes

*If you marked two or more of the statements in this section you should consult your physician or other appropriate health care as part of good medical care and progress gradually with your exercise program. You might benefit from using a facility with a **professionally qualified exercise staff**^a to guide your exercise program.*

☐ None of the above

You should be able to exercise safely without consulting your physician or other appropriate health care provider in a self-guide program or almost any facility that meets your exercise program needs.

^aProfessionally qualified exercise staff refers to appropriately trained individuals who possess academic training, practical and clinical knowledge, skills, and abilities commensurate with the credentials defined in Appendix D.

FIGURE 2.2. AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire. Individuals with multiple CVD risk factors (see Table 2.2) should be encouraged to consult with their physician prior to initiating a vigorous intensity exercise program as part of good medical care and should progress gradually with their exercise program of any exercise intensity. ACSM, American College of Sports Medicine; AHA, American Heart Association; CVD, cardiovascular disease, PTCA, percutaneous transluminal coronary angioplasty. Modified from (4).

APPENDIX C: Basic Information Sheet With Lower Limb Injury Questionnaire

Name: _____ Age: _____ Date of Birth: _____ Sex:

M___ F___

Email address: _____

Check which one applies to you:

How often do you exercise?

_____ 0 days per week

_____ 1 – 2 days per week

_____ 3 – 5 days per week

_____ 5 – 7 days per week

How many minutes per session do you exercise?

_____ 15 – 30 minutes

_____ 30 – 45 minutes

_____ 45 – 60 minutes

_____ > 60 minutes

List your five most favorite songs with the artist/group (order does not matter).

Song	Artist/Group
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

Lower Limb Injury Questionnaire

___ Yes ___ No Have you had any lower leg injuries in the last 6 months? (Explain below)

___ Yes ___ No If you answered yes to the question above, is the injury currently limiting your physical activity

___ Yes ___ No Have you experienced any pain, numbness, or tingling in the lower leg after exercise?

Explain:

APPENDIX D: Data Collection Sheet 1 – Self-selected Music

Participant ID #: _____

Date: _____

Age: _____

Birth Date: _____

Height cm: _____

Mass kg: _____

*Conditions	Fatigue Index	Peak Power (Watts)	Relative Peak Power (Watts)	Mean Anaerobic Power (Watts)	Relative Mean Anaerobic Power (Watts)	Subjective Exercise Experience Scale. (S.E.E.S.)	Rating of Perceived Exertion (R.P.E.) (6 - 20)	Brunel Rating Scale		
								Song 1	Song 2	Song 3
Condition 1										

*Note: two of the three trials will have a Brunel rating as one trial will be with white noise.

APPENDIX E: Data Collection Sheet 2 – Pre-selected Music

Participant ID #: _____

Date: _____

Age: _____

Birth Date: _____

Height cm: _____

Mass kg: _____

*Conditions	Fatigue Index	Peak Power (Watts)	Relative Peak Power (Watts)	Mean Anaerobic Power (Watts)	Relative Mean Anaerobic Power (Watts)	Subjective Exercise Experience Scale (S.E.E.S.)	Rating of Perceived Exertion (R.P.E.) (6 - 20)	Brunel Rating Scale		
								Song 1	Song 2	Song 3
Condition 1										

*Note: two of the three trials will have a Brunel rating as one trial will be with white noise.

APPENDIX F: Data Collection Sheet 3 – White Noise

Participant ID #: _____

Date: _____

Age: _____

Birth Date: _____

Height cm: _____

Mass kg: _____

*Conditions	Fatigue Index	Peak Power (Watts)	Relative Peak Power (Watts)	Mean Anaerobic Power (Watts)	Relative Mean Anaerobic Power (Watts)	Subjective Exercise Experience Scale. (S.E.E.S.)	Rating of Perceived Exertion (R.P.E.) (6 - 20)	Brunel Rating Scale		
								Song 1	Song 2	Song 3
Condition 1										

*Note: two of the three trials will have a Brunel rating as one trial will be with white noise.

APPENDIX G: Brunel Music Rating Inventory

The Brunel Music Rating Inventory

	<i>Not at all Motivating</i>					<i>Extremely Motivating</i>				
Familiarity	1	2	3	4	5	6	7	8	9	10
Tempo (beat)	1	2	3	4	5	6	7	8	9	10
Rhythm	1	2	3	4	5	6	7	8	9	10
Lyrics related to physical activity	1	2	3	4	5	6	7	8	9	10
Association of music and sport	1	2	3	4	5	6	7	8	9	10
Chart success	1	2	3	4	5	6	7	8	9	10
Association of music with film or video	1	2	3	4	5	6	7	8	9	10
The artist(s)	1	2	3	4	5	6	7	8	9	10
Harmony	1	2	3	4	5	6	7	8	9	10
Melody	1	2	3	4	5	6	7	8	9	10
Stimulative qualities of music	1	2	3	4	5	6	7	8	9	10
Danceability	1	2	3	4	5	6	7	8	9	10
Date of release	1	2	3	4	5	6	7	8	9	10

Directions: Rate the piece of music you have just heard by indicating the extent each of the items below contributes to its motivational qualities. "Motivational qualities" refer to the extent to which the music inspires or stimulates physical activity. Rate each item on a scale from 1 (not at all motivating) to 10 (extremely motivating).

APPENDIX H: Subject Exercise Experience Scale (SEES)

Subjective Exercise Experience Scale

HOW DO YOU FEEL RIGHT NOW?

Circle the number that reflects how you feel at this particular moment.

	1	2	3	4	5	6	7
not at all ----- moderately ----- very much so							
Great:	1	2	3	4	5	6	7
Awful:	1	2	3	4	5	6	7
Drained:	1	2	3	4	5	6	7
Positive:	1	2	3	4	5	6	7
Crummy:	1	2	3	4	5	6	7
Exhausted:	1	2	3	4	5	6	7
Strong:	1	2	3	4	5	6	7
Discouraged:	1	2	3	4	5	6	7
Fatigued:	1	2	3	4	5	6	7
Terrific:	1	2	3	4	5	6	7
Miserable:	1	2	3	4	5	6	7
Tired:	1	2	3	4	5	6	7

Subjective Exercise Experiences Scale:

PWB = 1 + 4 + 7 + 10

PD = 2 + 5 + 8 + 11

FAT = 3 + 6 + 9 + 12

McAuley, E., & Courneya, K. (1994). The Subjective Exercise Experiences Scale (SEES): Development and preliminary validation. *Journal of Sport & Exercise Psychology*, 16, 163-177.

APPENDIX I: Verbal Advertisement for Subject Recruitment

Hi, my name is Russell Fox and I am a student investigator in a study looking at whether or not listening to music during a warmup before a competitive event enhances performance. I am looking for 28 volunteers to participate in riding a cycle ergometer at maximum effort for 30 seconds on three different occasions.

The volunteers will conduct a maximum effort test on a cycle ergometer. One test you will listen to your favorite songs for 10 minutes prior to the test and then go into the test. On another occasion it will be pre-selected music. There will be a control where you will listen to white noise prior to testing. By participating you will learn if listening to music prior to an event affects your performance. There will also be one informational meeting in which demographic information will be gathered.

Eligible participants include men and women between the ages of 18 and 45 who have not had any hip, knee or ankle injuries in the past six months, with no diagnosis of cardiovascular, metabolic, or respiratory disease and scored low risk on the AHA/ACSM Health Fitness Facility Pre-participation Screening Questionnaire. By participating you will be donating two to three hours of your time.

If you are interested please contact me via email: russell.p.fox@wmich.edu.

APPENDIX J: Flyer for Subject Recruitment



I Want You To Participate In my Research Study

Are you interested in knowing if
if music enhances your exercise
performance?

This is taking place at The
Human Performance Research
Laboratory at the Student
Recreation Center.

To be eligible you must meet
the following criteria:

You must be between the ages
18 - 45

No cardiovascular, respiratory, or
metabolic disease.

No hip, knee, ankle, or any other
lower extremity injury in the past
6 months.

Ability to ride a stationary bike
safely.

If you are interested in participating
in my study and would like more
information contact Russell Fox,
student investigator by email.

russell.p.fox@wmich.edu

<http://www.njskagparty.org/2014/07/17/stars-and-stripes-ride-information/>

APPENDIX K: HSIRB Approval Letter

WESTERN MICHIGAN UNIVERSITY



Human Subjects Institutional Review Board

Date: February 23, 2016

To: Nicholas Hanson, Principal Investigator
Russel Fox, Student Investigator for thesis
Timothy Michael, Co-Principal Investigator
Carol Weideman, Co-Principal Investigator

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 16-01-12

This letter will serve as confirmation that your research project titled "Effects of Listening to Music during Warmup on Wingate Anaerobic Test Performance" has been **approved** under the **expedited** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., ***you must request a post approval change to enroll subjects beyond the number stated in your application under "Number of subjects you want to complete the study."*** Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination:

February 22, 2017

1903 W. Michigan Ave., Kalamazoo, MI 49008-5456

PHONE: (269) 387-8293 FAX: (269) 387-8276

CAMPUS SITE: 251 W. Walwood Hall