Western Washington University

Research & Sponsored Programs

Human Subjects Activity Review Form

Investigator: Thomas Zink   Email: zinkt@students.wwu.edu W#: W00986302

Department: Honors Program   Mail Stop: CH 107   Phone: (360) 650-3034

Project Title: Effects of Music on Exercise Recovery

Proposed Start Date: 11/10/2015   Proposed Duration: 1 month

Contact: zinkt@students.wwu.edu

Type of Study: Undergraduate

1. What is your research question, or the specific hypothesis?

This study seeks to determine the effects of music on exercise recovery. It is hypothesized that listening to calm, deactivating music after exercise will result in shortened heartrate and blood pressure recovery times and greater decreases in perceptions of fatigue and pain compared to not listening to music during recovery.

2. What are the potential benefits of the proposed research to the field?

This study will contribute data to an area of music application that is relatively unexplored. Findings will specifically contribute to understandings of the physiological effects of music and will help determine how music effects exercise recovery. Such knowledge is important, as it will allow for informed use of music in exercise situations.

3. What are the potential benefits, if any, of the proposed research to the subjects?

The subjects will be informed of how music effects their own recovery after exercise. They will also have the benefit of learning their resting HR/BP and their 600m run time, both of which are valuable for gauging one's fitness levels.

4. Answer a), then answer either b) or ~~c)~~ as appropriate.
a. Describe how you will identify the subject population, and how you will contact key individuals who will allow you access to that subject population or database.

The subject population is college aged students who will be identified by their presence on Western's campus and enrolment in WWU courses. Professors in contact with the investigator will be contacted for access to students for recruiting purposes.

b. Describe how you will recruit a sample from your subject population, including possible use of compensation, and the number of subjects to be recruited.

Subjects will be asked to participate as volunteers with no compensation. Approximately 10 subjects will be recruited. Recruiting will be done by making a small announcement about the study.

5. Briefly describe the research methodology. Attach copies of all test instruments/questionnaires that will be used. Note: All attachments must be in final form; drafts are unacceptable.

Prior to testing subjects will be asked to sign informed consent forms. Subject information will then be gathered via interview. An example of subject characteristics is provided in Table 1. Subjects will be asked to provide a list of familiar, calming music tracks which will be used to prepare a recovery playlist for the subject using a music streaming application. This will be done by searching the tracks in a prescription music streaming application and saving them to a playlist. If the subject has no music preference, either a classical or popular music playlist will be provided. Calming, familiar music will be used because it has been shown to produce the most significant analgesia and parasympathetic activation (Bergström-Isacsson, 2007; Garza-Villarreal, 2014; Hseih, 2014). Unlike the study by Waterhouse et al. (2010) that used music to motivate subjects to stay active after exercise, this study is aimed at examining physiological effects of music not the psychological effects, so using activating music, as demonstrated in other studies, would be unwarranted. Resting heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP), rating of perceived fatigue (RPF), and rating of perceived pain (RPP) will be taken at this time.

After completing the pre-exercise tests and interview, subjects will be instructed in a dynamic warmup for 5 min which will include light jogging, lunges, and other dynamic movements (Baechle, 2008). The subject will then be asked to run 600m (1.5 laps) around a track as fast as possible. This duration of intense exercise should be proficient to produce considerable fatigue in the subjects (Baechle, 2008). Immediately after the run HR, BP, RPF, and RPP will be assessed, and will continue to be assessed every 2 min for a total recovery time of 16 min. Also following the completion of the run, the subject will either be provided headphones and asked to listen to their respective deactivating music playlist or asked to simply rest, depending on their group. This will be the conclusion of test day 1. After a 24hr rest period, subjects will be guided through the same experimental procedure, however, the group receiving the music treatment will be reversed. This will be test day 2.

Equipment to be used is as follows:

- Automated Heart Rate / Blood Pressure Monitor
- Track
- Stopwatch
- Chairs
- Portable Table
- Track
- RPF/RPP Scale Sheets
- Laptop with Music Streaming Softwear (Rhapsody or Spotify)
- Over-Ear Headphones
- Informed Consent Forms

Copies of Rating of Perceived Fatigue and Rating of Perceived Pain scales are attached.

6. Give specific examples (with literature citations) for the use of your test instruments/questionnaires, or similar ones, in previous similar studies in your field.

Heart Rate (HR) and Blood Pressure (BP): Heart Rate (Desai, 2011; Eliakim, 2010; Savitha, 2010) and Blood Pressure (Desai, 2011; Savitha, 2010) are common parameters used to study exercise recovery in similar studies.

Ratings of Perceived Fatigue and Ratings of Perceived Pain are similar to ratings of perceived exertion used by Savitha and colleagues (2010) and Eliakim et al. (2010). However, because the study is monitoring recovery periods not exercise, using the term fatigue may be more appropriate than exertion. The difference between fatigue and exertion in this case is semantic, with the idea that the slightly different connotation of the word will be easier for subjects to understand and rate. Rating pain on a 1-10 scale is a common practice.

Desai, R. M., Thaker, R. B., Patel, J. R., & Parmar, J. (2015). Effect of music on post-exercise recovery rate in young healthy individuals. *International Journal of Research in Medical Sciences*, *3*(4), 896-898.

Eliakim, M., Bodner, E., Eliakim, A., Nemet, D., & Meckel, Y. (2012). Effect of motivational music on lactate levels during recovery from intense exercise. *The Journal of Strength & Conditioning Research*, *26*(1), 80-86.

Savitha, D., Reddy, N. M., & Rao, C. (2010). Effect of different musical tempo on post-exercise recovery in young adults. *Indian Journal of Physiology and Pharmacology. 54*(1), 32-36.

7. Describe how your study design is appropriate to examine your question or specific hypothesis. Include a description of controls used, if any.

The study is similar to other studies examining the same concept. Exercise is significant to induce stress/fatigue/acidosis without threatening the well-being of the subjects. The distance run, as well as the duration of warm up, music type, and minimum rest period are all controlled.

8. Give specific examples (with literature citations) for the use of your study design, or similar ones, in previous similar studies in your field.

Desai, Thaker, Patel, and Parmar (2015) conducted a study in which subjects were allowed to listen to slow, fast, or no music following a Harvard Step Test, and found that slow music produced the fastest recovery times for pulse rate, systolic blood pressure, and diastolic blood pressure. In this study, music was played from a laptop through headphones, and HR, SBP, and DBP were measured every 1 min during recovery. Desia et al were proceeded by a study conducted by Savitha, Reddy, and Rao (2010) in which they found slow music produced the fastest recovery times as indicated by decreases in heart rate, systolic, blood pressure, and diastolic blood pressure following a run on a treadmill. Music was played through headphones using an iPod and parameters were measured periodically during recovery, every 2 min for blood pressure and heartrate and every 4 min for RPE. Eliakim, Bodner, Eliakim, Nemet, and Meckel (2012) also studied the effect of music on recovery from a treadmill test, although they were testing not the effectiveness of music in aiding relaxation, but as a motivator for active recovery. In doing so they measured heart rate, ratings of perceived exertion, and lactate levels during recovery with and without activating music and found that subjects that were exposed to music had greater decreases in RPE improved lactate clearance, but no significant changes in heart rates, attributing these findings to increased movement after exercise as motivated by the fast music. Parameters were measured every 3 min, and the study used a similar random order construction as is proposed in the study outlined above.

Desai, R. M., Thaker, R. B., Patel, J. R., & Parmar, J. (2015). Effect of music on post-exercise recovery rate in young healthy individuals. *International Journal of Research in Medical Sciences*, *3*(4), 896-898.

Eliakim, M., Bodner, E., Eliakim, A., Nemet, D., & Meckel, Y. (2012). Effect of motivational music on lactate levels during recovery from intense exercise. *The Journal of Strength & Conditioning Research*, *26*(1), 80-86.

Savitha, D., Reddy, N. M., & Rao, C. (2010). Effect of different musical tempo on post-exercise recovery in young adults. *Indian Journal of Physiology and Pharmacology. 54*(1), 32-36.

9. Describe the potential risks to the human subjects involved.

There is inherent risk associated with any type of exercise including risk of fatigue, light-headedness, soreness, and injury including pulled muscles. Subjects may also feel some stigma based on their run times.

10. If the research involves potential risks, describe the safeguards that will be used to minimize such risks.

Because the run is short and intensity is controlled by the subject (i.e. self-paced) risks associated with over-exertion are minimized. Subjects have the freedom to cease exercise at any time, should they start to feel ill, and a Red Cross CPR/First-aid/AED trained evaluator will be on hand. Risks of stigma based on run times are eliminated by keeping individual run times confidential.

11. Describe how you will address privacy and/or confidentiality.

Subject information will be kept strictly confidential by assigning each subject a specific number that will be associated with data, and names will not be associated with the data after testing. Volunteer contact information will only be used to organize test times, assure data is recorded for the correct subject. No contact information or identifying information will be released or presented. Lists correlating subject code number to data will be kept in a secured file separate from the coded data, which will be in its own secured file. Personal results will be distributed following the second run test. All identifying information will be permanently deleted following the study and necessary records (such as data or consent forms) will be kept in password protected, encrypted files.

12. If your research involves the use of schools (pre-kindergarten to university level) or other organizations (e.g., community clubs, companies), please attach a clearance letter from an administrator from your research site indicating that you have been given permission to conduct this research. For pre-kindergarten to grade 12 level Protocol # ___________________ 2 of 3 07/01/05 schools, an administrator (e.g. principal or higher) should issue the permission. For post-secondary level schools the class instructor may grant permission. For Western Washington University, this requirement of a clearance letter is waived if you are recruiting subjects from a scheduled class. If you

are recruiting subjects from a campus group (not a class) at Western Washington University, you are required to obtain a clearance letter from a leader or coordinator of the group.

By working with faculty to recruit test subjects, the clearance letter should be waived.

13. If your research involves the use of schools (pre-kindergarten to university level) or other organizations (e.g., community clubs, companies), and you plan to take still or video pictures as part of your research, please complete a) to d) below:

photos will not be taken

Bibliography

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Moris, D. N., & Linos, D. (2013). Music meets surgery: two sides to the art of “healing”. *Surgical endoscopy*, *27*(3), 719-723.

Nilsson, U., Rawal, N., & Unosson, M. (2003). A comparison of intra-operative or postoperative exposure to music–a controlled trial of the effects on postoperative pain. *Anaesthesia*, *58*(7), 699-703.

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Table 1. Subject Characteristics

	Subject 1	Subject 2
Age	21	22
Sex	M	M
Height (m)	1.7m	1.8m
Weight (kg)	75kg	82kg
Music Background	no	yes, orchestra
Athletic Background	yes, HS soccer	no
Activity Level	3x/w RT, 2x/w AT	3x/w AT
Group	1	2

Informed Consent Form for: Research on the Effects of Music on Exercise Recovery

All participation is voluntary and all decisions to participate as a subject in the study are made at the discretion of the subject. Subjects may stop participation in the study at any time, for any reason. Subjects will be provided a copy of this form for their own records.

Experimental Design: The study is designed to examine the effects of music on exercise recovery. Specifically, it will be looking at differences in reductions in blood pressure, heart rate, ratings of perceived pain, and ratings of perceived exertion after a short run. As a subject, you will be given a short pre-test interview, allowed to warm up sufficiently, and asked to run 600m (1.5 labs around a track) as fast as possible. After the run, you may or may not be provided music to listen to during recovery. During the recovery time their heart rate and blood pressure will be monitored, and you will be asked to rank your feelings of pain and fatigue on a 1-10 scale. You will be asked to repeat the run again on a second day, at which time, if you did not receive music during recovery on the first day, you will be provided music, while if you did receive music on the first day, you will not be provided music on the second day.

Target Population: This study seeks college aged individuals who are 18-30 years of age. Exclusions of elite athletes may be made, as they may not be sufficiently fatigued by the run due to their high fitness levels. Exclusion of people who are beyond 30 years of age will be made because such individuals cannot be reasonably considered college aged.

Benefits: Subjects will be informed of their resting heart rate and blood pressure. Subjects will also get two timed runs from which they can gauge their fitness levels. Additionally, by participating in the study, subjects are helping to increase the general knowledge of music in exercise recovery and pain.

Risks: Participating in this study includes exposure to certain risks due to the physical tests. While investigators have made an effort to minimize these risks, whenever someone engages in exercise, there are certain risks that are unavoidable. Risks of this study include, but are not limited to: shortness of breath; lightheadedness; feelings of fatigue, soreness, and exhaustion; injury such as pulled muscles or sprains.

Confidentiality: You information will be kept confidential and your identity will only be known to investigators. Data will only be disclosed in a confidential manner and will be stored in password protected files.

Consent

My signature below indicates that I am aware of and have a general understanding of the study, both in terms of the data to be collected and the risks involved. By signing, I acknowledge that by volunteering for this study, I believe myself to have a level of fitness necessary to safely complete the run described above. I realize that I must be a legal adult to consent to participate in this study and I certify that I am at least 18 years of age.

By signing this form, I am stating that I am aware of all the risks inherent to the study described above. I am agreeing to participate as a test subject and will allow information relevant to the study, including subject characteristics and test results, to be collected, analyzed and presented along with other research findings. I also realize that my participation is completely voluntary, and that I may leave the study at any time for any reason.

Subject Printed Name __________________________________ Date __________

Subject Signature ___________________________________

Thomas M. Zink

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Education

Bachelor of Science, Kinesiology, Chemistry Minor from Western Washington University (WWU), Bellingham, WA *anticipated* December 2015 Cumulative GPA: 3.99, Science GPA: 4.00

Semester at Sea, sponsored by the University of Virginia, Fall 2014 Voyage, Countries Visited include: The United Kingdom, Russia, Poland, Germany, Belgium, Netherlands, France, Ireland, Portugal, Spain, Italy, Morocco, Brazil, Barbados, and Cuba. Program GPA: 4.00

High School Diploma, Skyview High School (SHS), Vancouver, WA GPA: 4.00

Honors: WWU Honors Program, WWU Presidents List Fall 2011-Spring 2015, SAS Deans List Fall 2014, National Society of Collegiate Scholars, Phi Eta Sigma Honor Society, Nominated to Golden Key and Phi Kappa Phi Honor Societies, Kinesiology Nominee for the Paul Woodring Arts and Sciences Scholarship, Trombone in Western Brass, 3rd Place in Men's Middle-Weight Division at WWU Powerlifting Competition, Eagle Scout

Coursework: Have taken full series in General Chemistry, Organic Chemistry, Biology, Biochemistry, and Physics with further courses in Psychology, Anatomy and Physiology, Functional Anatomy, Exercise Physiology Statistics, Human Growth and Motor Development, Biomechanics, Technical Writing, Metagenomics, Medicinal Chemistry, Nutrition, and Global Infectious Disease.

Technical Aptitude: Experience writing lab reports, research poster presentations, writing literature reviews, and writing technical documents from lab classes, using Microsoft Excel and Publisher, and analyzing metagenomic data. Experience using technical lab equipment includes EMG, Motion Capture Systems, Chromatography, IR & NMR Spectroscopy.

Employment History

Subject Tutor, WWU Tutoring Center 9/13-Present
Tutor students one on one in math, business calculus, statistics, chemistry, organic chemistry, physics, and biology

Camp Counselor, Whatcom Family YMCA Adventure Camp 6/15-8/15
Led small groups of children ages 5-12 in various activities, taught skills clinics in music, firstaid, and sports

Trombonist, The Mount Baker Theatre 9/13
Played trombone in the MBT production of The Producers

Mechanical Laborer, Harder Mechanical Contractors, INC 8/13-9/13
Spotted Lifts, Set Up Caution Tape, Cleaned Site, Fire Watch

Warehouse Worker, Set, LLC 7/11-8/11
Facilitated change of warehouse location, took inventories, organized warehouse, accepted shipments, retrieved items for project managers

Clinical Observation

Shadowed Dr. Roger Sharf, MD, General Practitioner at Associates in Family Medicine 5/15
Observed various examinations and minor procedures in a private practice setting

Shadowed Dr. Leonard Kolodychuk, MD, Orthopedic Surgeon at Peace Health Orthopedic 5/15
Observed orthopedic examinations, post-op check-ups, and injections

Shadowed Dr. Jernberg, Rhumatologist at Virginia Mason Federal Way Medical Center 12/14
Observed patient examination, ultra sound, and injections in rheumatology

Shadowed Dr. Peirce, MD, General Practitioner at Virginia Mason Federal Way Medical Center 12/14
Observed wound debridement, cleaning, and dressing in the Wound Care Center

Shadowed Dr. Elizabeth Jernberg, MD, Rheumatologist at New Horizons Clinic, 7/13
Observed examinations, cortisol injections, and charting

Shadowed Dr. Borus, MD, Orthopedic Surgeon at Legacy Salmon Creek Hospital, 9/12
Observed total knee, partial knee, and total hip surgeries including robot assisted and x-ray guided techniques

Shadowed at Ridgefield Physical Therapy, 8/12-9/12
Observed physical therapists and aids evaluate and treat patients with various modalities including exercises, manipulations, and traction at a small town outpatient clinic

Shadowed at Rebound Orthopedics and Neurosurgery, 7/12
Observed physical therapists and athletic trainers evaluate and treat patients with various modalities and preventative exercises at a hospital clinic

Shadowed at 360 Physical Therapy, 6/12-9/12
Observed physical therapists evaluate and treat patients using various modalities including myofascial release, kinesio-taping, and strain-counter-strain at an out-patient clinic

Experience

Section Leader, WWU Wind Symphony and WWU Orchestra, 9/12-Present
Lead weekly trombone sectionals, make decisions on musical interpretations, represent WWU to visiting trombone students

Volunteer, Maple Alley Inn, Bellingham Washington 7/15-8/15
Helped prepare and serve meals free meals to disadvantaged clients, washed dishes, sanitized kitchen and dinning rooms

Guest Lecturer for Dr. Lancaster's Nutrition Class, Semester at Sea 10/14
Discussed physical activity, physiology, and sport related nutrition

Volunteer, Dar Lamima Orphanage, Casablanca, Morocco through Semester at Sea 10/14
Spoke with children in French, donated athletic equipment, played games

Volunteer, for Salarte, La Esperanza Salt Marsh, Cadiz, Spain through Semester at Sea 10/14
Restored salt march bird habitat, participated in salt mining

Volunteer, Collide Day for Women, 11/12-2/14
Served the provided meal to attendees, bussed tables

Volunteer, Park Royal Nursing Home, 7/13-8/13
Reminisced and with residents, served coffee, played bingo, read news with dementia patients and wheelchair-bound residents

Volunteer, New Horizons Clinic in Carpio, Costa Rica, 7/13
Interviewed locals for clinic health survey, Cleaned, Organized materials, Sorted Medications

Volunteer, Huehue Tanengo, Guatemala through The Inn Ministries, 4/13
Hosted day camps for local children, led worship services, painted several buildings

Volunteer Trombone Teacher, Thomas Jefferson Middle School 11/10-5/11
Taught trombone technique and musical interpretation to 6th graders

High School Volunteering included: Over 200 Boy Scout related service hours, Life Skills Prom, Running Youth Football Games, Aiding Lions Club Events

Extracurricular

WWU Pre-med Club, WWU Weightlifting Club, Wind Symphony, Western Brass, Western Symphony Orchestra, Western Jazz orchestra, Recorded for *Out of Nothing* soundtrack, Trombonist for The WWU production of Benjamin Britten's A Midsummer Night's Dream. Other interests include hiking, windsurfing, and skiing.

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Thomas Zink** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 10/25/2015

Certification Number: 1902010

RPF and RPF Rating Scales

Instructions: The following are scales that will be used to subjective levels of sensations during exercise recovery. You will be to rate your perception of fatigue and perception of pain periodically during the recovery period on 1-10 scales. The investigator will record your response in a separate data table.

Ratings of Perceived Fatigue

Please rate your level of fatigue using the following scale (exhaustion or tiredness).

0	1	2	3	4	5	6	7	8	9	10
Well rested/ Energized					Neutral					Extremely Exhausted

Ratings of Perceived Pain

Please rate your level of pain (including sensations of muscle soreness).

0	1	2	3	4	5	6	7	8	9	10
No Pain										Severe Pain

The following selections have been taken from my formal project proposal. There may be redundancies between the provided selection and answers to questions above. Further, some sections, including example figures and equipment lists have been left off, but may be provided in the questions above.

Project Background

This proposed study is part of a larger Honors Program senior project in which I am examining the medical applications of music, and am focusing on the use of music as an analgesic and recovery aid, in terms of its scope, efficacy, and applicability. As I look toward a career in medicine as a kinesiology student with a substantial music background, this project serves as a bridge my interests influence my future practice. I hope that this specific study that I am proposing will allow me to illustrate some points and give me experience with the type of research that has led to the findings discussed below.

Introduction

Music therapy is not a new concept, although its acceptance by the medical community as a clinical modality is just beginning to grow. This newfound acceptance is the result of recently emerging empirical evidence supporting the efficacy of music in a range of applications. Using music to aid learning, either in recovery from brain damage or to overcome neurological disorders is widely accepted. For instance, music has been used to help patients learn to speak after traumatic brain injury (Schlaug, 2009). Much of these music learning programs are based off the Tomatis method that uses specifically adapted music tracks to stimulate cerebral blood flow and facilitate the formation of new neural pathways (Thompson, 2000). Music therapy is also used regularly to treat anxiety. These applications are easily accepted as nearly everyone has grown up with intimate musical experiences; music's power to affect mood and set a tone are well recognized because it is a part of daily life.

The medical potential of music is not isolated to neuropsychology. Music has also been shown to have profound effects in the medical clinic. In particular, evidence suggests that music used prior to, during, and after surgery reduces patient anxiety, pain, and sedative/analgesic requirements (Ayoub, 2005; Ganigdali 2005; Good, 2001; LePlage, 2001; MacDonald, 2003; Moris 2012, Nilsson, 2003). The physiological basis of the results is currently under investigation, although evidence supports several theories. First, music appears capable of stimulating the parasympathetic nervous system, as exposure to deactivating music (calm, >120BPM) has been shown to cause decreases in BP, HR, and RR; responses that are consistent with parasympathetic activation (Bergstrom-Isacsson, 2007; Chan, 2008, Moris, 2012). It has also been suggested music may activate the dopaminergic systems in the limbic system or opioid release in the periaqueductal grey (Hseih, 2014; Garza-Villarreal, 2014). Further, it has been suggested that music analgesia may function through modulation of pain gaits in the CNS by occupying part of total afferent input capacity, effectively closing down pain pathway transmission (Whitehead-Pleaux, 2007). A placebo effect does not seem to be at play (Hseih, 2014). Regardless of explanation, the potential of music as an adjunct to analgesics in pain management is promising, and could have significant implications in reducing medication costs and drug side effects, as music is both inexpensive and bears no side effects.

Commented [RD1]: FGates?

Music has also been studied in athletic settings. As anyone who has worked out with headphones has realized, listening to music during exercise improves performance and decreases rater-perceived exertion, allowing for longer, more intense workouts. Music can also be used in race settings, such as cycling, where higher tempos are correlated with higher athlete paces (Waterson, 2010). Given the similarities between post-operative, stress, and post-exercise states (increased pain, potentially elevated BP, HR, RR), it is logical to question whether the same recovery effects observed from music in clinical settings may also apply to exercise recover. Few studies have been done to answer this question, although the effects of music do appear to cross over into exercise recovery, likely because the same physiological responses are being elicited, in particular parasympathetic activation. A study by Desai, Thaker, Patel, and Parmer (2015) found that listening to slow music significantly decreased recovery times (return to resting HR and BP) after a 3 min step-test. Another study by Savitha, Reddy, and Rao (2010) also found that slow music aided recovery times, while a study by Eliakim and Colleagues (2010) found that music during recovery enhanced lactate clearance. Due to the relatively limited study of music in exercise recovery, further study is justified to corroborate or disprove results and provide further insight into the analgesic effects of music. Thus, this study, which seeks to examine the effects of music on exercise recovery after a short, high intensity run, is warranted.

Test Population

Subjects will be college-aged students of approximately 21 years of age. Varying musical and athletic backgrounds will be accepted, although elite runners will be excluded from the study on the basis that the exercise may not be strenuous enough to produce fatigue. Approximately 10 subjects will be recruited. Subjects will be split into two groups. Group 1 will listen to music after their first run and will not listen to music after their second run. Group two will do the reverse. Using two groups in such fashion should help eliminate the fatigue from the first run affecting the second.

Test Measures

Heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) will be measured using the combined HR/BP monitor. Ratings of perceived fatigue and ratings of perceived pain will be assessed using 10 point numeric scales (examples provided). Run times will also be recorded, as will time to recovery. The rating of perceived fatigue is similar in concept to ratings of perceived exertion, but has been adapted to be more appropriate for recovery situations, as perceived exertion is intended to gauge how hard and individual is working, not how tired they feel.

Methods

See methods described above in question 5, as they are identical to this section.

Calculations

Mean decreases in HR, SBP, DBP, RPF, and RPP over any time period will can be calculated as follows:

$$[(X_f-X_i)_1+(X_f-X_i)_2+\ldots+(X_f-X_i)_n]/n$$ where X is any of the above measures

Mean values of any measure after specific time intervals will also be assessed.

Time to recovery for specific measures can be assessed if all subjects return to resting levels for that measure within the 15 min time period.

The mean difference in recovery times between music treatment and non-music treatment runs will be calculated as follows:

$$[(T_{recNM} - T_{recM})_1 + (T_{recNM} - T_{recM})_2 + \ldots +(T_{recNM} - T_{recM})_n] / n$$

Statistical analysis of calculations will be performed using ANOVA, which is consistent with other studies (Eliakim, 2012; Savitha, 2010).

Expected Outcomes

The goal of this study is to determine if listening to deactivating music during recovery from exercise can aid recovery. Specifically, recovery will be considered aided by music if greater decreases in HR, BP, RPF, and RPP are observed in the music treatment, or if recovery times are significantly shorter when subjects receive the music treatment. Potential figures will include bar graphs of mean decreases of the various measures, as well as plots of the means of the various measures in the music and non-music treatments over time. Preferred significance will be $p \leq 0.05$. Error bars will represent standard error.