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Psychological Responses to High-Intensity Interval Training Exercise: A Comparison of Ungraded Running and Graded Walking

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A Comparison of Ungraded Running and Graded Walking

by

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ABSTRACT

This study investigated the effects of ungraded running and graded walking as modalities of HIIT on enjoyment, perceived exertion, and affect. 29 healthy males and females (aged 23.3 ± 5.1) volunteered to participate in the study. Participants completed six visits to the laboratory: the first was a medical screening to ensure safety of the participants. For the second and third visits, participants completed two maximal treadmill exercise tests, one running and one walking. On the fourth visit, the speed needed for the run HIIT (running speed: 6.9 ± 1.2mph) and the grade needed for the walk HIIT (walking speed: 3.3 ± 0.3mph, walking grade: 17.2 ± 3.1%) experimental trials were confirmed. During the last two visits, participants completed both of the two (run HIIT and walk HIIT) randomized and counterbalanced experimental trials. Affective valence was measured at baseline and post-exercise. The single-item Feeling Scale (FS) and the Borg 6-20 RPE scale (both overall exertion and legs-only exertion) were used to measure in-task ratings of affect and exertion. The Physical Activity Enjoyment Scale (PACES) and FS were used to measure post-exercise ratings of enjoyment and affect. Results revealed a main effect for condition for post-exercise enjoyment ($p < 0.001$), with the run HIIT being more enjoyable. A main effect was also found for time for both overall exertion and legs-only exertion ($p < 0.001$ for both interactions), with the walk HIIT producing higher exertion ratings. There was a main effect for condition of legs-only exertion ($p = 0.004$), again walk HIIT produced higher exertion ratings. Lastly, there was a main effect when comparing 20% and 100% of total time in the run HIIT and the walk HIIT conditions, for both overall exertion and legs-only exertion ($p < 0.001$

for all interactions). This shows that exertion increased over time for both conditions. Exertion ratings, both overall and legs-only tended to be highest during the run HIIT condition when compared to the walk HIIT. The opposite was true for affective valence, the ratings were higher in the run HIIT condition than the walk HIIT. In conclusion, the perceptual responses in this study, which represent enjoyment, exertion and affective valence, were generally more favorable during the run HIIT condition. These results support previous findings to suggest that doing a running protocol is a well-tolerated and favorable modality for HIIT exercise.

CHAPTER 1: INTRODUCTION

Rationale

Despite the widespread acceptance that undertaking physical activity is associated with a reduced risk of many diseases, participation in physical activity remains low (Morrow et. al., 2004). According to Healthy People 2020 (2010), 80 percent of adults do not meet the guidelines for both aerobic and muscle strengthening activities. Additionally, Wilson and Brookfield (2009) indicate that 50 percent of people who begin exercise drop out within the first six months. This indicates that people both need to increase their physical activity and need assistance in adhering to the training programs.

Designing more enjoyable training programs could be the next logical step to making the much-needed change toward increasing physical activity and keeping people invested in their programs. Ebben & Brudzynski (2008) conducted a study that investigated college students' motives and barriers towards exercise. Students said that enjoyment is one of the top reasons they exercise. Participants also said that more enjoyable exercise options would lead to an increase in their current amount of exercise and could also inspire non-exercisers to start (Ebben & Brudzynski, 2008). High-intensity interval training (HIIT) has been used in many situations to provide intense effort followed by recovery segments. Aerobic HIIT training most often uses running and cycling to deliver the desired intensities by way of activities such as spin classes and track-based running workouts. Adding other modalities for HIIT training, such as graded walking, may be more enjoyable to some. Therefore, those who want to increase their amount of exercise or even start an exercise training program, can do so with something that they find pleasant.

Problem Statement

Initiating and maintaining an exercise-training program requires motivation, both internally and externally. The more that someone enjoys an exercise or activity, the easier it could be for them to start or stay in the training program. Having options for the modality of the exercise that people do could help individuals find something that they enjoy. There are many studies that explore HIIT training but very few have considered graded walking as a form of high-intensity exercise. This study could potentially add the option to walk at an incline rather than ungraded running or even cycling, which can open up HIIT training to those who don't enjoy running or cycling.

Research Variables

Independent: HIIT method (ungraded) running and (graded) walking

Dependent: Affect, Enjoyment, and RPE

Hypotheses

Hypothesis 1: Compared to ungraded running, graded walking will have a greater post-exercise enjoyment.

Hypothesis 2: Compared to ungraded running, graded walking will result in lower ratings of perceived exertion during exercise.

Hypothesis 3: Compared to ungraded running, graded walking will have a greater in session affect.

Null Hypothesis: There will be no difference between ungraded running and graded walking for any psychological measurements.

Operational Definitions

- Affect: General valenced response of pleasure-displeasure arising without significant thought or cognitive elaboration. (Ekkekakis & Petruzzello, 2000)
- College age: 18-35 years old
- Enjoyment: Emotionally-based construct that involves significant cognition about the totality of the experience and environmental context (Wankel, 1993).
- Interval Training: Alternating periods of relatively intense work interspersed with periods of recovery.
- Rating of Perceived Exertion (RPE): The degree of heaviness or strain experienced in physical work (Borg, 1998).
- Self-paced: Treadmill speed in which the individual chooses a desired pace.

Assumptions

The assumptions of this study were that participants selected an appropriate walking speed, meaning they are at a brisk speed but still able to maintain pace at a high incline, and gave honest and accurate responses to all questions during each trial. We also assumed participants adhered to all instructions and gave the required effort during all trials.

Limitations

Limitations of this study include the sample size and demographics such as age and being relatively healthy. These may limit the generalizability of the results to other age groups and populations. Participants may not have been familiar with the scales and questionnaires that are used during the trials; however, this was addressed during the familiarization trial as well as before each experimental trial began.

Delimitations

A primary delimitation of this study was the age group due to the study being conducted on a college campus and to be able to recruit a larger sample. Also, participants were asked to avoid strenuous exercise 24 hours prior to exercise visits to avoid fatigue or delayed onset muscle soreness symptoms that could have interfered with the exercise experience. Another delimitation is our definition of high-intensity being 85% of VO_{2max}.

Significance

The goal of this research study was to determine the influence of two HIIT modalities, ungraded running and graded walking, on affect, enjoyment and ratings of perceived exertion for both overall and legs only. The study was important to determine whether graded walking can be more enjoyable and have lower exertion scores than ungraded running. Results from this study may allow people who are starting or wanting to continue a HIIT training program, to choose a modality they find most enjoyable, which will increase adherence.

CHAPTER 2: REVIEW OF LITERATURE

Introduction

The purpose of this literature review is to describe the benefits of HIIT and to consider the psychological responses to different types of HIIT sessions. This section represents the body of knowledge relative to where the research stands today. This review evaluates how human behavior towards physical activity has changed over time, what this means for health, and what aspects of HIIT training were important for this study.

Sedentary Behavior

In 2007, 22% of adults in the United States were considered insufficiently active, with men being more likely to meet recommended levels than women (Adabonyan et. al., 2007). It was also reported that more than 135 million persons aged 16 years or older were in the labor force, but 43% of those people were in low activity occupations while only 23% were in high-activity occupations (Current Population Survey, 2002).

This minimal activity could be contributed to a number of factors. In 1950 approximately 10% of households in the United States had a television (Putnam, 1995). By 2005 more than 95% of US households had a least one television, and viewing time had approximately doubled by this time. The average US household increased its TV time by 36 minutes every 10 years since 1950. That ends up being about a 1% increase every year in time spent watching TV (Robinson & Godbey, 1999).

Increases in TV time equates to less time for physical activities, even if people wanted to do them. From 1987 to 2000 there was a growth in sales for sporting goods and bicycle stores but there was an even steeper growth in the sales of television and radio stores (Brownson et. al., 2005). Overall these censuses showed that leisure time physical activity had either been maintained or slightly increased over time, work related activity was declining, activity in the home was declining and sedentary activity was increasing. This trend shows that total physical activity was declining over the aforementioned time period (Taylor, 2003).

Sedentary behavior is a primary contributor to the development of obesity, which is a primary risk factor for cardiovascular and metabolic diseases (Hu, 2003). Obesity has the potential to accelerate other health threatening morbidities including hypertension, hyperlipidemia, metabolic syndrome, type 2 diabetes, cardiovascular disease, musculoskeletal issues and psychological disorders (Reilly et. al., 2003). In 2015 and 2016, the prevalence of obesity was 40% among US adults. In adults aged 20-39 the occurrence was 36%. This number has been increasing since 1999 and Healthy People 2020 is hoping to see this percentage drop to 31% (Hales et. al., 2017).

Time Limitations for Physical Activity

Americans often cite, among numerous other reasons, lack of time as the primary barrier for not adhering to a traditional exercise program (Trost et. al., 2002). The American College of Sports Medicine suggests that adults should accumulate at least 150 minutes of moderate-intensity exercise per week. These recommendations can be met by 30-60 minutes of moderate-intensity exercise (five days per week) or 20-60 minutes of vigorous-intensity exercise (three days per week). The time can also be split up into intermittent sessions throughout the day if one chooses (ACSM, 2017). There have been some studies that show that these intermittent sessions can be equal or even more effective than continuous exercise when it comes to improving risk factors associated with cardiovascular disease (Murphy et. al., 2002; Donnelly et. al., 2000; Coquart et. al., 2008).

Health Outcomes of Physical Activity

Physical activity is important for health. Participating in the recommended amount of physical activity can help decrease fat mass and increase fat-free mass which is associated with a lower risk for all-cause mortality. This physical activity can help decrease the risk for cardiovascular disease, stroke, type 2 diabetes, and some forms of cancer. It can also help lower blood pressure and enhance insulin sensitivity (Garber, et. al., 2011).

Quality of life is an important outcome of physical activity. A study showed improvements in the six-minute walk test and peak oxygen consumption, post-intervention with both HIIT training and moderate intensity continuous training. These were improvements in quality of life for individuals with heart failure (Ulbrich et. al., 2016).

Increases in maximal oxygen uptake, mean Wingate power, insulin sensitivity index and resting fat oxidation rate can be observed with increased physical activity, as well as decreases in systolic blood pressure, resting carbohydrate oxidation, and waist and hip circumferences (Whyte et. al., 2010). Increased muscle oxidative potential and endurance capacity are also outcomes associated with physical activity (Burgomaster et. al., 2005).

There have been debates about whether HIIT training can help with all-around health. And there have been positive explanations that there is a genuine potential for scalable, enjoyable HIIT interventions that contribute substantially to addressing areas of public health priority, including prevention and treatment of Type 2 diabetes and cardiovascular disease (Biddle & Batterham, 2015). But when it comes to individuals with Type 2 diabetes it has been shown that HIIT training can rapidly improve glucose control and induce adaptations in skeletal muscle that are linked to improving metabolic health (Little et. al., 2011).

Graded Walking Versus Ungraded Running

A study done by Stamford (1975) looked at maximal oxygen uptake during walking versus running on a treadmill. The study revealed that the VO_{2max} found from a walking test was about 3 $ml \cdot kg^{-1} \cdot min^{-1}$ less than that from the running test. The researchers also found that VO_{2max} for the walking test was independent of speed, meaning increasing the walking speed did not increase VO_{2max}, but running VO_{2max} is interrelated with speed of running and state of training.

Previous investigations have compared graded walking to ungraded running at a constant perceived exertion and examined the metabolic responses to that exercise. Results demonstrated that during the running portion of the intervention, the participants did not have to change the speed by any significant amount, however during graded walking, the participants had to decrease the incline in order to stay at the moderate-intensity that was asked of them. These results provide evidence that ungraded running and graded walking produce very different cardiovascular and metabolic responses at the same perceived exertion (Kilpatrick et. al., 2009).

Exercise Intensity

How does intensity of exercise affect aerobic capacity? A study was conducted to examine this impact and discovered that higher intensities allow for greater improvements in oxygen consumption during exercise. This is important because HIIT training involves intervals of high intensity and recovery (Gromley et. al., 2008).

HIIT training can be completed at different relative intensities and durations. Wisloff et. al. (2009) found that performing HIIT training at higher intensities and for longer durations can induce a more favorable adaptation in the cardiovascular system. These higher intensities in HIIT were shown to improve the function of the heart's contractile function and the growth of the heart muscle. The researchers also found that with a compromised heart function due to metabolic syndrome or heart failure, these higher intensities can help restore fractional shortening in heart muscle cells which is important for the efficiency of the heart ejecting blood (Wisloff et. al., 2009).

HIIT Versus Continuous Exercise Training

A meta-analysis indicated that both moderate intensity continuous training (60-85% maximum heart rate) and high-intensity interval training (90-95% maximum heart rate) elicit large improvements in VO_{2peak} of healthy, young to middle-aged adults with the effects being greater for the less fit individuals (Milanovic et. al., 2015). However, there have been studies to show that HIIT was more beneficial for improving VO_{2peak} in healthy individuals (Helgerud et. al., 2007; Baekkerud et. al., 2016). Additional studies have shown that these benefits are also seen in heart transplant recipients (Dall et. al., 2014), individuals with the metabolic syndrome (Tjonna et. al., 2008), people with hypertension (Molmen-Hansen et. al., 2012), and obese adults (Schjerve, et. al., 2008). All of these aforementioned studies suggest that HIIT had better improvements in oxygen uptake than continuous moderate exercise.

For healthy older adults, all-extremity HIIT training was shown to improve aerobic fitness, ejection fraction and insulin resistance. These same results were not seen in moderate-intensity continuous training (Hwang et. al., 2016). There have also been results that show an increase in energy expenditure and excess post-exercise oxygen consumption were higher in HIIT training sessions than moderate-intensity continuous training sessions (Schaun et. al., 2017).

Time Commitment and HIIT

A study conducted by Gaesser and Angadi (2011) investigated the health outcomes that can be elicited by HIIT training. Findings indicate that as little as six 20-minute sessions of HIIT training was able to reduce resting pre-prandial blood glucose by 13%, reduce postprandial blood glucose by 30%, increase mitochondrial proteins by 20-70% and increase glucose transporter 4 protein levels by 369%. This shows all the physiological benefits of HIIT training and the time benefits for those who are limited in their time to exercise.

Short-term interval training produces similar muscle and exercise performance adaptations to traditional endurance training. This study found that the two types of training induced an increase in muscle buffering capacity, muscle oxidative capacity and glycogen content. The study results showed that even though interval training requires less time and volume, the results are very similar to that of a more time-consuming exercise-training program (Gibala et. al., 2006).

Psychological Responses to HIIT

Psychological responses to exercise can be just as effective in keeping people physically active as the physiological responses. The positive relationship between affective response and aerobic exercise intensity for moderate intensity continuous training has been demonstrated along with the more negative affective responses of intensities near the anaerobic threshold compared to below the anaerobic threshold (Ekkekakis & Petruzzello, 2011). This information shows that it is important to take these negative affective responses into consideration when creating training programs for individuals, because enjoyment of exercise can be a large contributor to what keeps people adhering to a program.

A study considered the differences in exercise enjoyment on 30-second, 60-seond, 120-second intervals for HIIT and heavy continuous exercise (Martinez et. al., 2015). The results indicated that pleasure and enjoyment were higher during shorter interval trials (30 or 60-second) intervals trials compared to longer interval or heavy continuous exercise (Martinez et. al., 2015).

Kilpatrick, et. al. (2014) found that affective responses to HIIT training can be higher than that of other exercise types, such as prolonged continuous exercise at high intensities, because of the added benefit of the recovery period. This allows for the high intensities to be broken up by bursts of lower-intensity exercise. As it pertains to affective response, the researchers also observed that the most pleasurable interval might be relatively short (60 seconds or less) and or near maximal (approximately 90% of aerobic capacity).

Highest enjoyment responses were reported for HIIT conditions rather than continuous moderate-intensity exercise. This can be relevant for improving adherence to exercise programs (Bartlett et. al., 2011). A systematic review found that most of the comparisons performed presented positive effects for HIIT training, meaning that people appeared to enjoy themselves more with HIIT training than with continuous training. The eight studies used in this review together resulted in a conclusion that HIIT exercise can be a viable approach to achieve positive psychological responses (Oliveira, et. al., 2018).

Conclusion

Previous research has shown that physical activity is crucial for health, but it can be less than enjoyable sometimes. For individuals who don’t usually enjoy exercise, it may be hard to start a program or continue in one that is not considered enjoyable. It is important to consider options when it comes to training programs and modalities in which individuals can be physically active.

High-intensity interval training allows for the desired physiological changes that we want to get from exercise, but also the psychological responses that keep people appreciating the exercise that they are doing. HIIT training includes high-intensity intervals, broken up by recovery intervals. This recovery time is what allows for the body to relax and promotes a better mindset than when performing continuous exercise. HIIT training is also a good program when time is a limitation. HIIT allows for the same physiological changes obtained with continuous training.

This study could help increase the number of modalities and approaches that can be used for HIIT training programing. Graded walking has not been investigated for HIIT training in many studies, and until this study no studies have inspected the psychological responses to graded walking. Graded walking is a potentially great alternative to ungraded runnning, in that it allows individuals who don't enjoy running, have musculoskeletal injuries or have extra weight that makes it difficult for them to run with, to still put in high-intensity work.

CHAPTER 3: METHODS

Participants

For this study, 37 college-aged men and women were recruited. Four participants dropped out prior to completion due to medical or personal reasons. Four participants were dropped from the study due to an equipment malfunction that could not be resolved in a timely manner. Therefore, there was a final sample size of 29 participants. Informed consent was obtained from all who participated in the research study in accordance with University of South Florida Institutional Review Board (IRB) guidelines. Each participant underwent a medical screening and health risk assessment, which was conducted by a licensed medical professional at the Health and Exercise Science laboratory prior to completing the maximal exercise testing or the experimental trials. Individuals were included in the study if they meet the following criteria: age of 18-45 years, body mass index (BMI) of 18-35, designated as low or moderate risk for cardiovascular diseases based on ACSM guidelines. Physical activity status was determined using the American College of Sports Medicine guidelines (ACSM, 2017). Twenty-nine (10 males, 19 females) participants completed this study. Participants had a mean ± standard deviation (SD) age of 23 ± 5 years (range = 18-43). The mean BMI for participants was 25 ± 3 (range = 20.6 – 32.8) and the mean body fat percentage was 27 ± 8 (range = 11 – 43). Participant characteristics with means, standard deviations and ranges are shown in Table 3.1. Maximal oxygen consumption (VO_{2max}) was determined by two multistage, progressive treadmill tests, one running and one walking. The mean VO_{2max} collected during the running maximal exercise testing was 41.1 ± 6.2 ml·kg^{-1}·min^{-1} (range = 30.1 – 56.2). The mean VO_{2max} data collected during the walking maximal exercise testing was 39.3 ± 6.8 ml·kg^{-1}·min^{-1} (range = 27.3 – 56.5). Metabolic testing data with means, standard deviations and ranges are shown in Table 3.2. A successful VO_{2max} test was defined as reaching a peak heart rate of at least 90% of age-predicted maximal heart rate (based on 220-age), a peak rating of perceived exertion of 18 or greater (on a 6-20 scale), and a peak respiratory exchange ratio (RER) of at least 1.15 (Maud & Foster, 1995). For this study, 90% of the participants age-predicted maximum heart rate (mean = 177 ± 4.5, range = 159-182) The number of participants that reached these criteria are shown in Table 3.3.

Instrumentation

Perceived Exertion

Ratings of perceived exertion, for both overall and legs-only exertion, during exercise were measured using the Borg 6 to 20 scale (Borg, 1998). This is a 15-point scale, which ranges from 6 “no exertion at all” to 20 “maximal exertion.” It is widely used in exercise science research as a means to monitor as well as prescribe intensity levels of exercise, it has been validated as a measure of discomfort and exertion (Borg, 1998). It has been found to be an accurate indicator of effort and has a high reliability for intratest and retest measures (Borg, 1998). The Borg scale used during trials is shown in Appendix A.

Enjoyment

The Physical Activity Enjoyment Scale (PACES) was used to measure enjoyment post-exercise. The PACES was developed and validated by Kenzierski and DeCarlo (1991) and is an 18-item, 7-point rating scale that allows participants to rate how they feel at the moment about exercise. Anchors were provided for every item with two contrasting statements in which the participants were asked to indicate the strength of the agreement. The post enjoyment scale used during the trials is shown in Appendix B.

Affect

The Feeling Scale (FS) was used to measure affective valence pre-exercise, during exercise, and post-exercise (Appendix C). This 11-point scale ranges from feeling "very good" at +5 to "very bad" at -5. This scale asked participants to rank the sensation of effort while running or walking on the treadmill as pleasant or unpleasant. The validity of this scale was tested through three experiments, which collectively showed validity in using the scale to measure affective valence during exercise (Hardy & Rejeski, 1989). The affective valence scale used during trials is shown in Appendix C.

Health Screening and Physical Exam

The health screening form covered health history, as well as physical activity level, and alcohol and tobacco use. A representation of this form can be found in Appendix D. The physical exam form was completed by a licensed medical professional and clearly indicated medical clearance level, and can be found in Appendix E.

Equipment

Polar heart rate monitors (Lake Success, NY) were used during all exercise sessions to monitor exercise and resting heart rate. All trials were completed on a Track Master™ TM428CP treadmill (Newton, KS). Oxygen consumption was measured through a MGC CardiO_2 Ultima Series. (St. Paul, MN) Blood pressure was measured by auscultation using a stethoscope and sphygmomanometer. Body fat percentage was estimated through use of an InBody bioelectrical impedance analysis (Cerritos, CA). Height and weight were measured using a Health O' Meter Professional scale (McCook, IL).

Procedures

Screening

The protocols, risks and benefits were read aloud to each individual, and all participants were encouraged to ask any questions or express any concerns prior to signing the informed consent form. After signing the consent form during the first visit, individuals were required to receive clearance from the study's medical professional in order to qualify for the study. Age, height, weight, resting heart rate and blood pressure, and body fat percentage were also recorded during the first visit. Body mass index was calculated using height and weight. All screening information was gathered using a health history questionnaire form. Participants received instructions for metabolic testing, which occurred the following two visits.

Metabolic Testing

The two metabolic testing trials were randomized, one ungraded running and one graded walking. During the metabolic tests, a progressive multistage, protocol was performed on a motorized treadmill. The maximal running test started at 3.5 mph walking speed and 0% grade. Speed increased by 0.5 mph per minute until the participant ended the test at maximum exertion. Grade remained at 0% throughout the protocol except in cases where the participant reached 8.5 mph at which time speed became fixed and grade increased by 2% every minute until exhaustion. The maximal walking test started at a self-selected walking speed (mean of 3.3 mph ± 0.3) and 0% grade. Grade increased by 2% per minute until the participant ended the test at maximum exertion (speed remained constant throughout the protocol except in cases where the participant reached 24% grade at which time the grade became fixed and speed increased by 0.5 mph every minute until exhaustion). Participants were encouraged to perform the test to maximal effort, and the tests were terminated when the participant indicated that they could not perform any longer. Heart rate, blood pressure, ratings of perceived exertion, and expired gases were monitored in accordance with standard exercise testing guidelines (ACSM, 2017). Heart rate and blood pressure were measured pre- and post-test. Ratings of perceived exertion were estimated each minute using the Borg RPE scale (Borg, 1998). Expired gases were collected and analyzed continuously using a metabolic cart. Maximal oxygen consumption was identified as the largest volume of oxygen consumed per minute during the test.

Confirmation and Familiarization Trial

ACSM metabolic equations were used to estimate the speed and grade needed to reach 85% for each participant's highest VO_2 max. The metabolic cart was again used to collect and analyze expired gases continuously during this trial. Each participant warmed-up for three minutes at his or her self-selected walking speed. Speed was then increased until the desired VO_2 needed for the experimental trials was obtained. After the desired VO_2 (85% of highest VO_{2max}) was achieved, there was a small active cool-down period before grade was increased until the desired VO_2 needed for the experimental trials was obtained. Each participant then received an explanation of all scales and questionnaires that were used during the trials. They also received details on how each experimental trial was going to be conducted.

Experimental Trials

Participants were asked to avoid strenuous exercise 24 hours prior to all exercise trials. All exercise trials were separated by at least 24 hours, started at around the same time of day, and completed within three weeks. The two experimental conditions were randomized, counterbalanced, and followed the same protocol.

Each participant was seated for five minutes before resting heart rate and blood pressure was recorded. Each participant completed the pre-exercise assessment of affect (FS). Participants then completed a 3-minute warm-up at the self-selected walking speed and 0% grade, prior to beginning the exercise session. Following the warm-up, the experimental exercise trials commenced and consisted of 20 minutes of exercise alternating between high-intensity at approximately 85% of max capacity (running speed: 6.9 ± 1.2mph, walking grade: 17.2 ± 3.1%) (60 secs) and low intensity activity (60 secs) at the previously self-selected speed (3.3 ± 0.3mph). Participants were asked for their perceived exertion, both overall and legs only, (Borg RPE scale), affect (FS) and enjoyment (EES) after 20, 40, 60, 80, and 100% of the total time had passed, during the high intensity phases of the 20 minutes of exercise. Participants completed a 2-minute cool-down, followed by 10 minutes of seated passive recovery. During the 10 minutes of passive recovery post heartrate and blood pressure was recorded and participants completed the post-exercise assessments of enjoyment (PACES) and affect (FS). There were no gases collected for the experimental trials.

Heart rate was assessed pre-exercise, in-session, and post-exercise through use of a Polar hear rate monitor. Blood pressure was also monitored pre and post-exercise. Rating of perceived exertion was measured using of the Borg RPE scale in-session for both overall and legs only exertion. Enjoyment was measured post-exercise using the Physical Activity Enjoyment Scale (PACES). Affect was measured pre, in session and post-exercise using the Feeling Scale (FS).

To ensure each trial was completed under the same conditions, all trials were completed in a lab setting to eliminate environmental factors such as climate and scenery and each participant completed all their trials around the same time of day. All study staff collecting data during the experimental trials followed the same procedures in interacting with research participants.

Statistical Analysis

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) and was completed in several phases. The first phase included a descriptive analysis of the sample and characteristics. The second phase included a series of 2 (Trials: ungraded running, graded walking) X 5 (Time: 20, 40, 60, 80, and 100% of total time) repeated measures ANOVA for each of the dependent variables. These omnibus tests were followed up with dependent t-tests. Criterion for significance was set at a probability of 0.05. Cohen's d effect size was calculated for individual mean differences (Cohen, 1988).

Table 3.1
Participant Characteristics

	Mean ± SD	Range
Age (y)	23 ± 5	18-43
Height (in)	66 ± 4	59-78
Weight (lbs)	154 ± 30	120.5-259
Body Mass Index	25 ± 3	20.6-32.8
Body Fat (%)	27 ± 8	11-43
Resting Heart Rate (bpm)	70 ± 12	52-108
Systolic Blood Pressure (mmHg)	117 ± 8	106-131
Diastolic Blood Pressure (mmHg)	72 ± 4	64-81

Table 3.2
Maximal Exercise Testing (mean ± SD)

	Running	Walking
Maximal VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	41.1 ± 6.2	39.3 ± 6.8
Maximal HR (bpm)	194 ± 13	192 ± 11
Maximal RPE-O	19.0 ± 1.2	18.9 ± 1.5
Maximal RPE-L	18.8 ± 1.5	19.3 ± 1.4

Maximal RER	1.14 ± 0.1	1.18 ± 0.1

Table 3.3
Participants Meeting Criteria for VO_{2max}

	Running	Walking
HR max (90% age-predicted max or greater)	25	29
Overall RPE (18 or greater)	23	26
Peak RER (1.15 or greater)	23	25

Note: The numbers above indicate how many participants achieved each of the indicators for maximal effort during their two maximal exercise trials.

CHAPTER 4: RESULTS

Enjoyment

When analyzing the post-exercise data, there was a significant difference between conditions ($p < 0.001$, ES = 0.7), with the run HIIT having higher post-exercise enjoyment ratings.

Table 4.1
Enjoyment Post-Exercise

	Mean ± SD	Range
Run HIIT	99 ± 13	74-119
Walk HIIT	90 ± 16	54-118

Exertion

Overall RPE

When analyzing the in-task data, there was no main effect for condition ($p = 0.19$) but there was a significant main effect for time ($p < 0.001$). This indicates that overall RPE was increasing with time, but there was no significant difference between the run HIIT and walk HIIT. Furthermore, the analyses noted no interaction effect for trial by time ($p = 0.93$). Follow up analyses provided by t-tests noted two significant mean differences. There was a significant difference between the running trial at 20% of total time and 100% of total time at the high intensity ($p < 0.001$, ES = 1.5), shown in Figure 4.1. Similarly, there was a significant difference between the walking trial at 20% and 100% of total time at the high intensity ($p < 0.001$, ES =

1.7), shown in Figure 4.1, both indicating that RPE increased over time for each trial. There were no significant differences when comparing high intensities of the running trial to high intensities of the walking trial for any of the five time points (p-values range = 0.12-0.41, ES range = 0.1-0.3).

Table 4.2
Overall Perceived Exertion: Comparing Conditions at High Intensities.

% of total time	20%	40%	60%	80%	100%
Run mean ± SD	10.3 ± 2.0	11.8 ± 2.2	12.6 ± 2.2	13.4 ± 2.6	14.0 ± 2.9
Walk mean ± SD	10.6 ± 2.0	12.1 ± 1.5	13.1 ± 1.6	13.7 ± 2.2	14.3 ± 2.5
p-value	0.24	0.31	0.12	0.41	0.38
ES	0.2	0.2	0.3	0.1	0.1

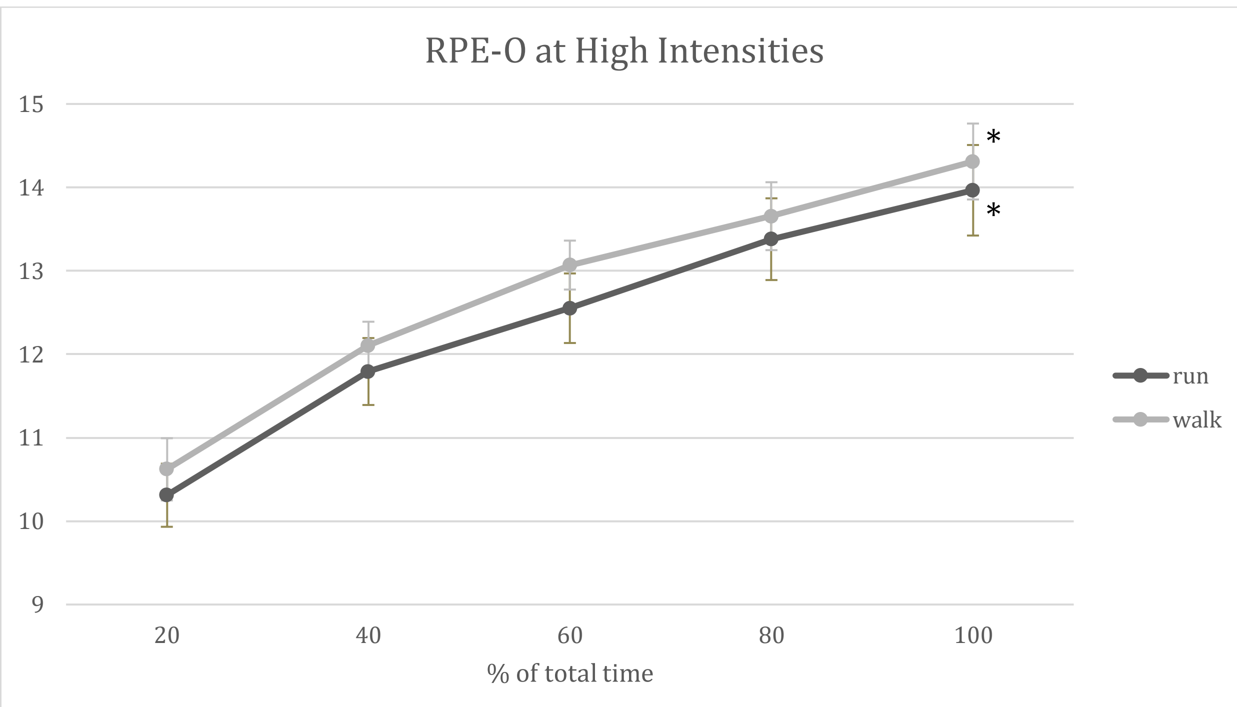

Figure 4.1 Overall Exertion
*denotes significance comparing 20% to 100% of total time for trials separately
#denotes significance comparing same time point in the walk and run trials

Legs Only RPE

When analyzing the in-task data, there was a main effect for both conditions ($p = 0.004$) and time ($p < 0.001$). This indicates that the legs-only RPE was increasing over time and that the walk HIIT had significantly higher legs-only RPE results than the run HIIT. Furthermore, the analyses revealed no interaction effect for trial by time ($p = 0.75$). Follow up analyses provided by t-tests noted many significant mean differences. There was a significant difference within the running trial, comparing 20% of total time and 100% of total time at the high intensity ($p < 0.001$, ES = 1.4), shown in Figure 4.2. Similarly, there was a significant difference between the walking trial at 20% and 100% of total time at the high intensity ($p < 0.001$, ES = 1.4), shown in Figure 4.2, both indicating that RPE increased over time for each trial. There was significant difference when comparing high intensities of the running trial to high intensities of the walking trial at 20% ($p = 0.01$, ES = 0.4), 40% ($p = 0.01$, ES = 0.5), 60% ($p = 0.004$, ES = 0.6), and 80% of total time ($p = 0.01$, ES = 0.4), but at 100% of total time there was only a trend towards significance ($p = 0.05$, ES = 0.9), shown in Table 4.3.

Table 4.3
Legs-only Perceived Exertion: Comparing Conditions at High Intensities.

% of total time	20%	40%	60%	80%	100%
Run mean ± SD	10.1 ± 2.1	11.8 ± 2.2	12.5 ± 2.4	13.3 ± 2.7	13.8 ± 3.1
Walk mean ± SD	11.2 ± 2.7	12.8 ± 1.8	13.9 ± 1.8	14.4 ± 2.5	14.7 ± 2.5
p-value	0.01	0.01	0.004	0.01	0.05
	`				
ES	0.4	0.5	0.6	0.4	0.3

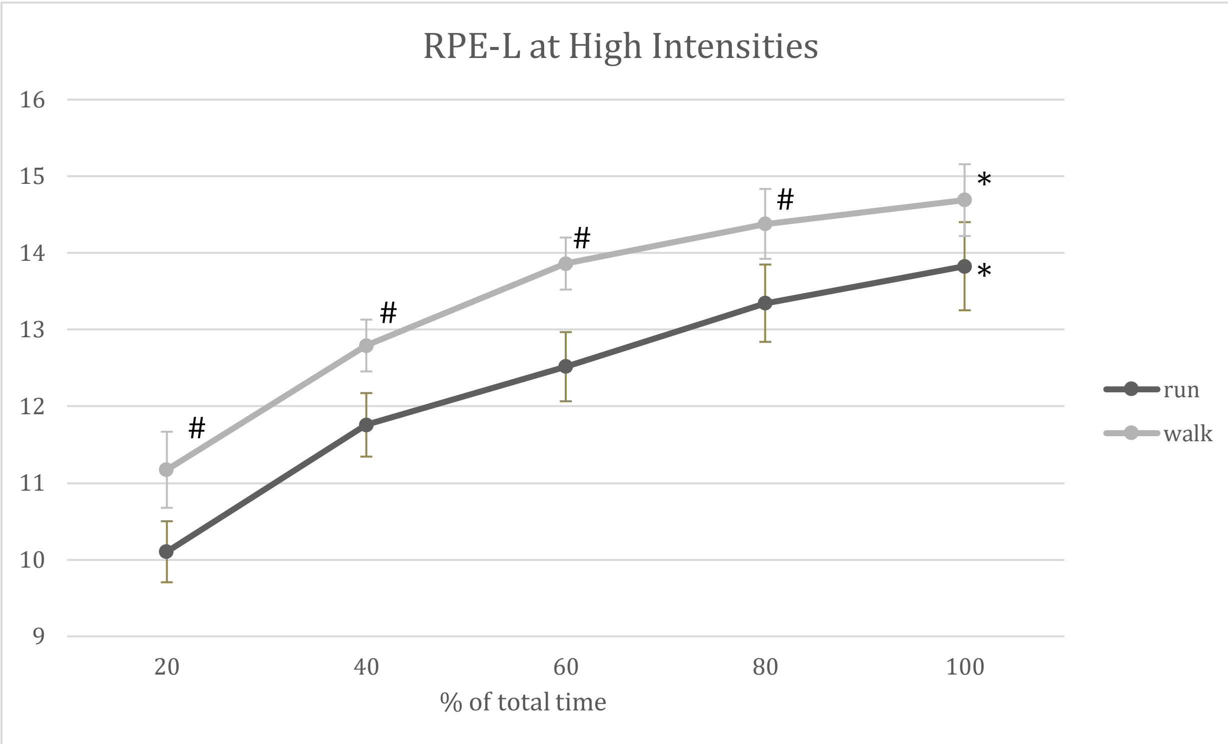

Figure 4.2 Legs-only Exertion

*denotes significance comparing 20% to 100% of total time for trials separately

#denotes significance comparing same time point in the walk and run trials

Affective Valence

When analyzing the in-task data, there was no main effect for condition (p = 0.14) and time (p = 0.19) or interaction effect for trial by time (p = 0.12). This indicates that there were no significant change over time for the FS scores and there was no significant difference between the run HIIT and walk HIIT conditions. There were no significant differences at 20% of total time and 100% of total time at the high intensity for the running trial (p = 0.35, ES = 0.2) or the walking trial (p = 0.16, ES = 0.3). There were no significant differences when comparing high intensities of the running trial to high intensities of the walking trial at any of the times, except a trend towards significance at 80% of total time (p = 0.05, ES = 0.3), shown in Table 4.4.

Table 4.4
Affective Valence: Comparing Conditions at High Intensities.

% of total time	20%	40%	60%	80%	100%
Run mean ± SD	2.5 ± 1.5	2.6 ± 1.5	2.3 ± 1.6	2.5 ± 1.8	2.1 ± 2.2
Walk mean ± SD	2.4 ± 1.6	2.2 ± 1.7	1.9 ± 2.1	1.8 ± 2.5	1.7 ± 2.6
p-value	0.65	0.24	0.17	0.05	0.25
ES	0.1	0.2	0.2	0.3	0.1

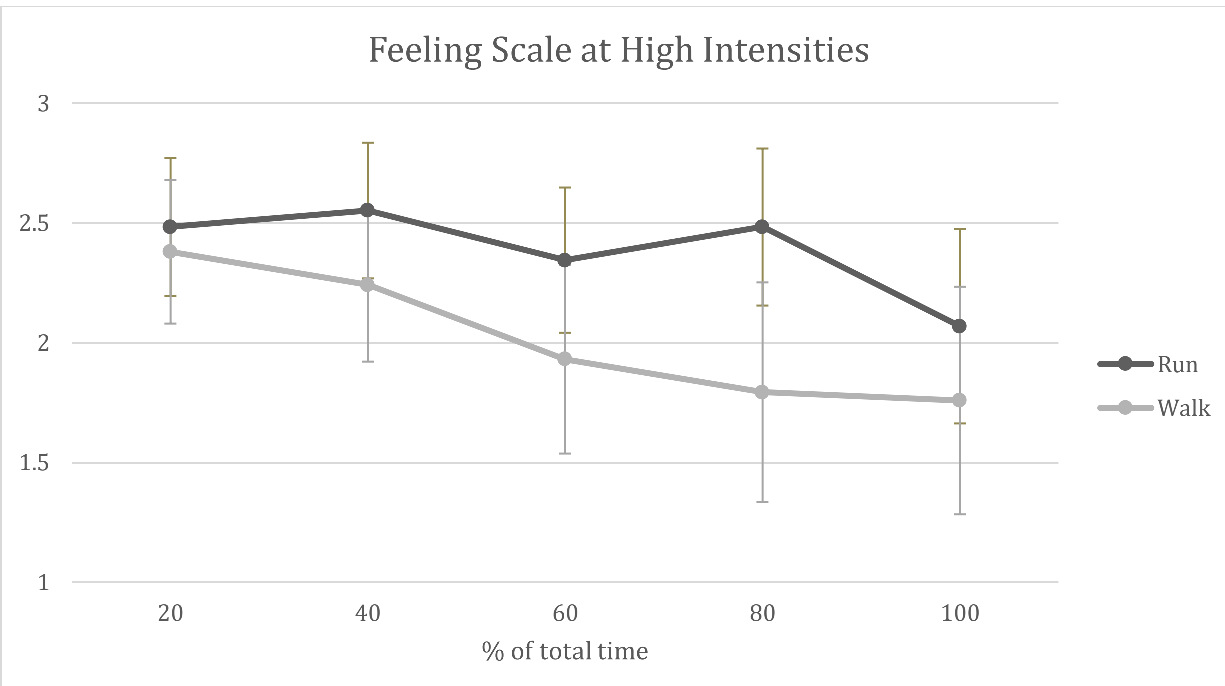

Figure 4.3 Affective Valence
*denotes significance comparing 20% to 100% of total time for trials separately
#denotes significance comparing same time point in the walk and run trials

CHAPTER 5: DISCUSSION

Recent studies have highlighted the positive psychological responses of HIIT exercise. Poon, et. al. (2018) found that both young (aged 18-25) and middle-aged (aged 40-59) healthy, insufficiently active males had more positive affective valence responses to HIIT, done at 100% of VO_{2max}, compared to continuous exercise, done at either 65% of VO_{2max} for the moderate intensity or 80% of VO_{2max} for the vigorous intensity. Williams et. al. (2008) indicated that one-unit increase in a feeling scale score after one session of exercise is associated with an additional 38 minutes of physical activity per week in sedentary individuals. Furthermore, a study done by Bartlett, et. al. (2011) and a systematic review done by Oliveira et. al. (2018) both reported that HIIT training have higher enjoyment responses than that of continuous training. These positive responses are important for adherence to exercise programs (Williams et. al., 2008). The immense amount of research done with HIIT has utilized running on treadmills or cycling misses the variety of other modalities that could be examined. The current study examined the use of two different protocols of HIIT, running and walking, for the purpose of eliciting psychological responses to determine if this new graded walking modality is viable. The hypothesis of this study state that walking HIIT would elicit the most positive experience compared to the run HIIT. The findings of this study provide evidence that suggests a need for further examination of the perceptual responses to this new modality with different populations and intensities.

Enjoyment

Previous research suggests that if an activity is perceived as enjoyable, it is more likely that an individual will engage in the activity more often (Wininger & Pargman, 2003). For post-exercise enjoyment, using the PACES, Oliveira et. al. (2018) found in their systematic review that six of 10 comparisons presented beneficial effects for HIIT involving both normal weight and overweight-to-obese populations. For studies that looked at in-task enjoyment, using the EES, six out of seven comparisons exhibited the same beneficial effects as the PACES, in similar populations (Oliveira et. al., 2018). The findings of this current study showed run HIIT having the higher enjoyment ratings (Table 4.1). These findings support the results in Oliveira et al. (2018) systematic review, which showed that run HIIT is correlated with increased enjoyment compared to other exercise programs, but did not support the hypothesis that the walk HIIT would be considered more enjoyable. Since ungraded running is a more typical modality when using the treadmill, these results could represent inexperience in graded walking in the participant group. Considering that walking HIIT has never been researched, the activity of walking at a high incline for 60-seconds and then coming back down to a flat walk for the subsequent 60-seconds, may have contributed to the lower enjoyment ratings secondary to the change in ankle angle and leg musculature recruitment during the incline walking. This ankle flexion and leg musculature recruitment during the incline walking phase differs from that of the ungraded running phase. Participants may not have been familiar with these differences, possibly contributing to the lower enjoyment ratings. Future studies could attempt to mitigate this difference by familiarizing participants to this graded walking type of exercise, or could use only those who are familiar or trained in this sort of exercise. Doing a study like this in a more mountainous or hilled area of the country might also help ease the differences, especially if this area were to be a city, such as Pittsburg, where individuals do more walking anyway.

It should also be noted that even though differences were noted when comparing conditions in this study, both walk HIIT and run HIIT mean PACES scores were considered the same if not higher than that of previous research (Bartlett et. al. 2011 & Martinez et. al. 2015). Bartlett et. al. (2011) found mean PACES scores, for a run HIIT protocol, at around 90, which was similar to our mean for the walk HIIT and less than for the run HIIT. Martinez et. al. (2015) also saw similar PACES scores with 30-second interval HIIT producing a mean score of 91, 60-second intervals producing a mean score of 98 and 120-second intervals producing mean scores of 83. Looking at the current study again, the PACES score collected were very similar from the 60-second intervals to the run HIIT, but the walk HIIT trials had very similar to the 30-second intervals and even better than the 120-second intervals. These comparisons indicate that even the less enjoyable mode of HIIT from this current study is just as enjoyable as previously researched HIIT protocols.

Exertion

Similar to the results of this study, Poon et. al. (2018) found a significant increase in RPE across the exercise session in all trials. This increase in RPE being higher than that of the moderate-intensity continuous exercise, indicates that the participants were working closer to or above their metabolic threshold (Poon et. al., 2018). These results seem to be expected in that as exercise continues, exertion increases, even with the same high-intensity workload. Curiel-Regueros et. al. (2019) completed a study with Spanish army soldiers and saw an increase in RPE during the operative HIIT exercise, a modality of HIIT that includes different exercises based on military procedures, but did see that the values for RPE were lower than the evaluated metabolic response. The results for this current study showed that both types of exertion continued to increase over time for both the run HIIT and walk HIIT trials (Figures 4.1 and 4.2). They also revealed that the walk HIIT trials have a significantly higher legs-only exertion when compared to the run HIIT (Table 4.3). This would also make sense considering that local, lower-body musculature would be fatigued during the incline walking occurring during the walk HIIT condition. Again, with ungraded running being a more regular mode of locomotion than graded walking, causing an unaccustomedness to graded walking, may account for this difference in the exertion ratings.

Affective Valence

The Dual-Mode Theory was created to help explain the exercise-affect relationship by bridging the mind-focus and body-focus approaches (Ekkekakis, 2009). This theory advocates that two cues, interoceptive (e.g. respiratory or muscular) and cognitive (e.g. self-efficacy), jointly influence affective responses to exercise (Ekkekakis, 2003); and would then suggest that HIIT would elicit more negative affective responses than moderate-intensity continuous exercise, shown in the Poon et. al. (2018) study, because of its reliance on anaerobic metabolism. However, HIIT induced the opposite, with positive affective responses in studies done by both Poon et. al. (2018) and Kilpatrick et. al. (2014). The main explanation for this is that built-in recovery during a HIIT session, which can help to negate the feeling of displeasure during the exercise and in turn helps increase exercise participation and adherence (Ekkekakis, 2003, Hall et. al. 2002). The reduction of boredom and development of accomplishment after an interval in the HIIT session is what helps reduce this displeasure (Poon et. al., 2018). Although this study did not look at HIIT compared to another exercise modality in this study, there were no differences when comparing run HIIT to walk HIIT (Table 4.4). This suggests that both modalities of HIIT are equally pleasurable from start to finish.

It should be noted that the results of this current study showed a mean FS score that never dropped below 1.5 (Figure 4.3), which is important when looking at previous studies that observed more negative affective responses to different HIITs. Martinez et. al. 2015, saw lower affective responses in their 120-second interval group and their continuous exercise group, with a few of their means being below 1.0. Although this study didn't result in any differences in affective valence, we can say that this protocol of HIIT seems to be fairly pleasurable when compared to previously measured HIITs.

These results appear interesting since this study found a difference in enjoyment but not in affective valence. But if we look more closely at the different scales being used for each psychological response, we see that the FS used for affective valence, is proctored as a quick-response type answer, with not a lot of thought or cognition being used to answer. Whereas, the PACES used for enjoyment, is designed for a more thoughtful response to each of the 18- items. This difference in how much thought goes into each answer could help explain why there was a significant difference in the enjoyment results but none for affective valence.

Conclusions

The purpose of this study was to examine the effect of ungraded running and graded walking as modalities of HIIT on the perceptual responses of healthy males and females. The perceptual responses of exertion, both overall and legs-only, enjoyment and affective valence in this study were generally more favorable in the ungraded running HIIT session. Although these results support previous findings to suggest ungraded running HIIT is a very viable and enjoyable activity which may lead to increase in physical activity adherence, it should be noted that graded walking HIIT was shown to be just as pleasurable based on affective valence.

Based on these findings, graded walking as a modality of HIIT should be considered since the same metabolic work is being performed and it is perceived to be just as pleasant. Also, when we compare the results of this study to previous studies, we find that both modes of HIIT evaluated are just as enjoyable if not more enjoyable and more pleasurable. Promoting exercise adherence is important in helping the general population increase their activity level. Exercise adherence increases when the population has positive feelings toward the exercise that they are doing. It is noted that an individual's more positive perception of exercise has a direct influence on their increased participation in that exercise (Silva et. al., 2016). The continued inactivity of the general population is having huge detriments on the health of that population. This additional modality of HIIT may be able to be used in populations who cannot or do not like the other HIIT modalities (e.g. running or cycling). Increasing the possible modalities that can be used to engage in HIIT can only help increase the number of people starting and adhering to exercise because then they have choices as to how they exercise. As discussed, there is a great deal of research related to HIIT in two main modalities, running and cycling, but there is much to be done with this new plausible mode of HIIT. HIIT itself has been shown to be such a great health stimulus, no matter the modality, with beneficial health outcomes including improving vascular parameters in inactive adults (Ramirez-Velez et. al., 2019) and decreasing anthropometric variables, such as body fat percentage, body mass and abdominal visceral fat, in overweight and obese adults (Andreato et. al., 2019). HIIT also shows great exercise and performance enhancements as well, such as the improvements in VO_{2peak} of healthy adults with even greater effects for the less fit individuals from the study conducted by Milanovic et. al. (2015). Machado et. al. (2019) found performance increases in anaerobic capacity with HIIT training even at very low volumes. All of this leading to the importance of physical activity and the practicality of HIIT as the type of physical activity.

The strengths of this study include internal validity, which was sustained through controlling the environment in which the participants completed the trails. All protocols and communication with subjects were equated to confirm that each participant received the same instruction, which helped to ensure internal validity. Also, to ensure this validity, the laboratory remained the same each time the participant visited the laboratory for their trials. Industry standard equipment was used for all baseline measures including body composition, heart rate, blood pressure, and metabolic testing. A strong attribute of the study was the small but well-trained staff, which allowed for testing conditions to be controlled for all subjects and across experimental conditions, regardless of the research staff member leading the session.

The weaknesses of this study include external validity. This study used a sample consisting of relatively healthy adults, which may limit the generalizability of the results across various populations. Physical activity status was not considered when we analyzed the results; therefore, the population we used could have an uneven number of individuals who are considered active versus inactive. This may be something that should be considered in future research in this area. Additionally, in terms of ecological validity, the environment in which the testing conditions were performed was not reflective of "real-world" activities. Participants were required to complete the trials in a laboratory setting, in which they were required to face a white wall with printouts of the variables being measured.

The results of this study offer a groundwork for future research to be done developing the plausibility of graded walking as a modality of HIIT. Future studies may want to look at larger sample sizes and targeted populations (e.g., overweight or obese populations, individuals with joint injuries or illnesses, strictly inactive groups). Considerations for the muscular work being performed during the session and the possibility for health and performance enhancements could be used in future studies as well that look at graded walking HIIT. Future researchers may also consider comparing this new HIIT modality to continuous exercise similar to previous HIIT research. This study represents a beginning and novel attempt to understand the conceivability of using graded walking as a format for HIIT. And although the findings of this study reflect more positive psychological responses to ungraded running HIIT, further investigation is necessary to examine other possible positive attributes of graded walking HIIT.

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APPENDICES

Appendix A: Borg 6-20 Scale

Borg Rating of Perceived Exertion

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

Appendix B: Physical Activity Enjoyment Scale

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

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

Appendix C: Feeling Scale

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

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

Appendix D: Health Status Questionnaire

HEALTH STATUS QUESTIONNAIRE **Aug 2014**

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

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

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

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

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

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

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

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

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

List exercise that has been typical for you over the last 3 months. Include: type (e.g. running, weight training), frequency per week, minutes per session, and intensity (light, moderate, vigorous)	Type	Frequency	Duration	Intensity

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

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

Appendix E: Pre-Participation Physical Exam Form

Pre-Participation Physical Examination

University of South Florida – Health & Exercise Science Lab

Baseline Information

Participant Name		Date of Exam	
Height		Resting HR	
Weight		Resting BP	

Medical Evaluation

	Normal	Abnormal Findings	Initials
General Appearance			
Eyes			
Ears			
Nose			
Throat			
Mouth			
Neck			
Heart			
Pulses			
Thorax			
Lymph Nodes			
Lungs			
Abdomen			
Hernia			
Gastrointestinal			
Genitourinary			
Neck			
Back			
Shoulder			
Arm			
Elbow			
Wrist			
Hand			

Hip			
Thigh			
Knee			
Ankle			
Foot			
Posture			
Flexibility			
Other			

Medical Clearance

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

Name of Medical Evaluator		Date	
Signature of Medical Evaluator			

Appendix F: Informed Consent

USF
UNIVERSITY OF SOUTH FLORIDA

Informed Consent to Participate in Research and Authorization to Collect, Use, and Share your Health Information

Pro# 00036343

You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is called an informed consent form. Please read this information carefully and take your time making your decision. Ask the researcher or study staff to discuss this consent form with you, please ask him/her to explain any words or information you do not clearly understand. We encourage you to talk with your family and friends before you decide to take part in this research study. The nature of the study, risks, inconveniences, discomforts, and other important information about the study are listed below.

Please tell the study doctor or study staff if you are taking part in another research study.

You are being asked to take part in a research study called:

Psychological Responses to High-Intensity Interval Training Exercise: A Comparison of Ungraded Jogging and Graded Walking

The person who is in charge of this research study is *Abby Fleming*. This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge. She is being guided in this research by Dr. Marcus Kilpatrick.

The research will be conducted at University of South Florida-Tampa.

Purpose of the study

The proposed study is to compare the psychological responses of ungraded jogging HIIT to graded walking HIIT performed at the same metabolic work rate. Specifically looking at affect, enjoyment and intention in sticking with an exercise program.

In order to take part in this study you must meet the following criteria.

You must be physically active (according to ACSM guidelines: planned, structured physical activity at least 30 minutes at moderate intensity on at least 3 days a week for at least 3 days a month) or inactive, age of 18-45 years, and labeled as low or medium risk for cardiovascular diseases based on ACSM guidelines.

This study includes the use of a Cardio Ultima Series metabolic cart. It is being used as part of this research study to estimate maximal oxygen consumption to better understand the sample demographics.

Study Procedures: What will happen during this study?

You will be asked to complete a brief health history questionnaire to determine if you are eligible to participate in the study. If you pass the initial screening you will have a pre-exercise medical examination by a licensed medical professional. You will complete 6 sessions, total. The first session will include informed consent, medical screening, and instructions for the following metabolic tests. The second and third session will include the metabolic testing. The fourth session will include the familiarization trial with laboratory environment, equipment, measures, scales, and protocols. Remaining sessions will be experimental trials. For visits 2-6, you need to avoid tiring exercise 24-hours prior to the session, and arrive to the session in proper exercise clothing.

- *Session 1: Informed consent and Medical Screening*

This session is for you to read and sign the informed consent approved by the Institutional Review Board and complete a medical check by a licensed medical professional and other members of the research team. Age, height, weight, resting heart rate and blood pressure, body fat percentage and body mass index will also be recorded during your first visit. All screening information will be gathered using a health history and risk survey previously approved by the IRB. You will receive instructions for the following two visits.

- *Session 2&3: Metabolic Testing*

These two sessions will be counterbalanced.

The running max test will be performed on a motorized treadmill. You will be asked to perform the test to your greatest effort, and the test will end when you say that you cannot perform any longer. The test will start at a self-selected walking speed and 0% grade. Speed will increase by 0.5 mph per minute until you end the test at your greatest effort (grade will remain at 0% throughout the protocol until you reach 9 mph at which time speed will stay the same and the grade will increase until the end). Once you reach your greatest effort we end the test. A 3-minute cool down at the previously self-selected walking speed and no grade will immediately follow the end of the maximal test. We will be monitoring your heart rate, blood pressure, perceived exertion and oxygen intake during the test. Your heart rate will be measured using a Polar heart rate monitor before, during, and after the test. Your blood pressure will be measured before and after the test. You will be asked for your perceived exertion for both overall exertion and legs only exertion at the end of every minute during the test. Both legs will be exerted during these tests. This test will be considered a maximal test if you meet the following criteria: a peak heart rate of at least 90% of age-predicted maximal heart rate (based on 220-age), a peak rating of perceived exertion of 18 or greater (on a 6-20 scale), and a peak respiratory exchange ratio of at least 1.15.

The walking max test will also be performed on a motorized treadmill. The test will start at your self-selected walking speed and 0% grade. Grade will increase by 2% per minute until you end the test at maximum exertion (speed will stay at your selected speed until you reach 25% grade, then the grade will stay the same and speed will increase until exhaustion). The walking max test will follow all the other same steps as the running max test.

- *Session 4: Familiarization Trial*

We will use the ACSM metabolic equations to determine the speed and grade needed to reach 85% of your VO2max. You will warm-up for 3-minutes at your self-selected walking speed. Speed or grade will then be increased until the wanted VO2 is achieved. You will receive explanation of all scales and questionnaires that will be used during the trials. You will also receive details on how each experimental trial will be conducted.

- *Sessions 5-6: Experimental Trials*

You will be seated for 5 minutes before your resting heart rate and blood pressure is taken. You will then complete a 3-minute warm-up before starting the exercise session. Following the warm-up, the experimental exercise trials will be 20-minutes of exercise alternating between high intensity activity (60 secs) and low intensity activity (60 secs) at your self-selected speed. You will complete a 2-minute cool-down, followed by 10 minutes of inactive recovery.

- *Questionnaires/ Measures*

There will be three questionnaires/measures used during the trials. The Borg 6-20 scale will be used to measure your perceived exertion for both overall exertion and legs only exertion; this will be taken during the exercise trials. The Felling Scale will measure affect, and this will be taken pre, during and immediate post-exercise. Enjoyment will be measured pre and immediate post-exercise through the Physical Activity Enjoyment Scale. Enjoyment will also be measured in-session using the Exercise Enjoyment Scale. All assessments during the exercise trials will be taken by asking you to verbalize perceptions while being shown the scale and will be measured at minutes 3&4, 7&8, 11&12, 15&16, and 19&20.

Affect: Affective valence will be measured using the Feeling Scale, a single-item measure scored on an eleven-point scale (from -5: "Very Bad" to +5: "Very Good").

Enjoyment: Enjoyment pre- and post- exercise will be measured using the Physical Activity Enjoyment Scale, an 18-item, 7-point rating scale that you will be asked to rate how they feel at the moment about exercise. Enjoyment during exercise will be measured using the Exercise Enjoyment Scale, a single-item measure scored on a 7-point scale (from 1: "Not at all" to 7: "Extremely").

Perceived Exertion: Perceived exertion for both overall exertion and legs only exertion will be measured using Borg's 6-20 scale, a single-item measure of effort scored on a 15-pt scale (from 6: "No exertion at all" to 20: "Maximal Exertion"). Both legs will be exerted during these tests.

To make sure each trial is completed under the same condition, all trials will be completed in a lab setting to get rid of any environmental factors such as climate or scenery, and you will complete all of your trials around the same time of day.

A study visit is one you will have with the person in charge of the study or study staff. You will need to come for 6 study visits. Most study visits will take about 60 minutes of your time.

Total Number of Participants

About 40 individuals will take part in this study at USF.

You do not have to participate in this research study.

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. Decision to participate or not to participate will not affect your student status (course grade) or job status.

You can decide after signing this informed consent document that you no longer want to take part in this study for any reason at any time. If you decide you want to stop taking part in the study, tell the study staff as soon as you can.

- We will tell you how to stop safely.

Please note, even if you want to stay in the study, there may be reasons we will need to withdraw you from the study. You may be taken out of this study if we find out it is not safe for you to stay in the study or if you are not coming for the study visits when scheduled. We will let you know the reason for withdrawing you from this study.

Benefits

The potential benefits of participating in this research study include: free health assessments.

Risks or Discomfort

There may be unforeseen risks that are associated with participating in this study. Each of the exercise trials will consist of moderate or vigorous exercise, each of which has a variety of associated risks such as dizziness, vomiting, heart attack, and possibly death. However, these risks will be minimized by pre-exercise screening by a licensed medical professional, and monitoring and assessing the participants throughout each minute of exercise. Breach of confidentiality will be minimized by using an ID system for participants, and securing all data and records in one place.

Women who participate in the study will self-report if they are pregnant or planning to get pregnant during the duration of the study. Pregnant women or those planning to get pregnant during the duration of the study, will be excluded from the study. If you do become pregnant during this study, you must inform your study physician immediately.

Compensation

You will receive no payment for completing this study.

Costs

It will not cost you anything to take part in the study.

Conflict of Interest Statement

The research team reports no conflict of interests related to this project.

Privacy and Confidentiality

We will keep your study records private and confidential. Certain people may need to see your study records. Anyone who looks at your records must keep them completely confidential. These individuals include:

- The research team, including the Principal Investigator, study coordinator, research licensed medical professional and all other research staff. Certain government and university people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. This is done to make sure that we are doing the study in the right way. They also need to make sure that we are protecting your rights and your safety.

- Any agency of the federal, state, or local government that regulates this research. This includes the Department of Health and Human Services (DHHS) and the Office for Human Research Protection (OHRP)]
- The USF Institutional Review Board (IRB) and its related staff who has oversight responsibilities for this study, and staff in USF Research Integrity and Compliance.

We may publish what we learn from this study. If we do, we will not include your name. We will not publish anything that would let people know who you are.

What if new information becomes available about the study?

During the course of this study, we may find more information that could be important to you. This includes information that, once learned, might cause you to change your mind about being in this study. We will notify you as soon as possible if such information becomes available.

You can get the answers to your questions, concerns, or complaints.

If you have any questions, concerns or complaints about this study, call Abby Fleming at 410-349-7412. If you have questions about your rights, complaints, or issues as a person taking part in this study, call the USF IRB at (813) 974-5638 or contact by email at RSCH-IRB@usf.edu**.**

Authorization to Use and Disclose Protected Health Information (HIPAA Language)

The federal privacy regulations of the Health Insurance Portability & Accountability Act (HIPAA) protect your identifiable health information. By signing this form, you are permitting the University of South Florida to use your health information for research purposes. You are also allowing us to share your health information with individuals or organizations other than USF who are also involved in the research and listed below.

In addition, the following groups of people may also be able to see your health information and may use that information to conduct this research

- The medical staff that takes care of you and those who are part of this research study;
- Each research site for this study including University of South Florida-Tampa.
- Any laboratories, pharmacies, or others who are part of the approved plan for this study;
- The USF Institutional Review Board (IRB) their related staff who have oversight responsibilities for this study, including staff in USF Research Integrity and Compliance and the USF Health Office of Clinical Research.
- Data Safety Monitoring Boards or others who monitor the data and safety of the study;

Anyone listed above may use consultants in this research study, and may share your information with them. If you have questions about who they are, you should ask the study team. Individuals who receive your health information for this research study may not be required by the HIPAA Privacy Rule to protect it and may share your information with others without your permission. They can only do so if permitted by law. If your information is shared, it may no longer be protected by the HIPAA Privacy Rule.

By signing this form, you are giving your permission to use and/or share your health information as described in this document. As part of this research, USF may collect, use, and share the following information:

- Your research record
- All of your past, current or future medical and other health records held by USF, other health care providers or any other site affiliated with this study as they relate to this research project. This may include, but is not limited to records related to HIV/AIDs, mental health, substance abuse, and/or genetic information.

You can refuse to sign this form. If you do not sign this form you will not be able to take part in this research study. However, your care outside of this study and benefits will not change. Your authorization to use your health information will not expire unless you revoke (withdraw) it in writing. You can revoke this form at any time by sending a letter clearly stating that you wish to withdraw your authorization to use your health information in the research. If you revoke your permission:

- You will no longer be a participant in this research study;
- We will stop collecting new information about you;
- We will use the information collected prior to the revocation of your authorization. This information may already have been used or shared with others, or we may need it to complete and protect the validity of the research; and
- Staff may need to follow-up with you if there is a medical reason to do so.

To revoke this form, please write to:

Principal Investigator
For IRB Study # Pro00036343
4202 E Fowler Ave.
Tampa, FL 33620

While we are conducting the research study, we cannot let you see or copy the research information we have about you. After the research is completed, you have a right to see the information about you, as allowed by USF policies.

Consent to Take Part in Research

And Authorization for the Collection, Use and Disclosure of Health Information

I freely give my consent to take part in this study and authorize the use of my health information as outlined above**.** I understand that by signing this form I am agreeing to take part in research. I have received a signed copy of this form to take with me.

____ ____________
Signature of Person Taking Part in Study Date

____
Printed Name of Person Taking Part in Study

Statement of Person Obtaining Informed Consent and Research Authorization

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I confirm that this research subject speaks the language that was used to explain this research and is receiving an informed consent form in their primary language. This research subject has provided legally effective informed consent.

____ _______________
Signature of Person Obtaining Informed Consent Date

____
Printed Name of Person Obtaining Informed Consent

Appendix G: IRB Approval

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

9/20/2018

Abby Fleming
Educational and Psychological Studies
[redacted]

RE: **Full Board Approval for Initial Review**

IRB#: Pro00036343

Title: Psychological Responses to High-Intensity Interval Training Exercise: A Comparison of Ungraded Jogging and Graded Walking

Study Approval Period: 9/18/2018 to 9/18/2019

Dear Ms. Fleming:

On 9/18/2018, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):

Protocol Document(s):

Psychological Responses to High-Intensity Interval Training Exercise Protocol- Clean

Consent/Assent Document(s)*:

Informed Consent- Clean.pdf

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

The IRB determined that all future reviews of this study qualify for expedited review under category 9 (Continuing review of research, not conducted under an investigational new drug application or investigational device exemption where categories two (2) through eight (8) do not apply but the IRB has determined and documented at a convened meeting that the research involves no greater than minimal risk and no additional risks have been identified).

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

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

Sincerely,

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