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Relationship between Perceived and Actual Exertion and Enjoyment of Exercise in Individuals with Autism

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Relationship between Perceived and Actual Exertion and Enjoyment of Exercise in Individuals with Autism

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Dedication Page

I would like to dedicate my thesis to my family and friends who have supported me throughout my journey. I would not be where I am without your constant support. I would also like to thank my thesis advisor Dr. Moran for allowing me to be a part of Overcoming Barriers during my time at JMU and opening up many doors for me.

Acknowledgments

I would like to acknowledge my undergraduate research assistants who dedicated their time each week for eight week to assist me with data collection. Thank you Jasmin, Emma, Alex, Carder, Kelsey, Molly, and Brianna for all your help this semester with data collection.

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Abstract

Fiscella, N.A., Moran, T.E., Wigglesworth, J.K., and McKay, C.A. Relationship between Perceived and Actual Exertion and Enjoyment of Exercise in Individuals with Autism. **Purpose:** The purpose of this study was to examine the relationship between perceived exertion, actual exertion and enjoyment of exercise in individuals with Autism Spectrum Disorder (ASD). **Methods:** A total of 16 participants (12 males and 4 females) between the ages of 5 and 38 who were diagnosed with ASD participated in the study. The intervention lasted 10 weeks and consisted of participation in one of James Madison University's Overcoming Barriers hour long physical activity programs. Heart rate, perceived exertion, and enjoyment of exercise were measured following three exercises during the program. **Results:** There was no relationship between the three main variables however, a significant relationship, was found between exercise exertion and perceived exertion $r = -0.151$ ($p = 0.66$) and between enjoyment of exercise compared to perceived exertion $r = 0.23$ ($p < 0.05$). **Conclusion:** Consistent with the literature, participants are more likely to participate in exercises they enjoy, in addition we found hunger was related to both perceived exertion as well as with enjoyment of exercise. Further research still needs to be done between hunger and perceived exertion and enjoyment of exercise.

Keywords: AUTISM, PERCEIVED EXERTION, ACTUAL EXERTION, ENJOYMENT, EXERCISE.

Chapter I
Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition affecting 1 in 68 children in the United States making it the most prevalent neurological disorder in youth (Christensen et al., 2016; Prupas & Reid, 2001). ASD is diagnosed by the individual's psychologist or psychiatrist using the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) Diagnostic Criteria (American Psychiatric Association, 2013). Prior to the release of the DSM-V, those diagnosed under the DSM-IV with Asperger's or pervasive developmental disorder not otherwise specified have now been given the diagnosis of ASD. There are five criteria the individual must display to be diagnosed with ASD: (1) persistent deficits in communication/social interaction, (2) restricted or repetitive behaviors, (3) symptoms present early in development, (4) clinically significant impairments in social/occupational behavior and (5) behaviors that cannot be explained by intellectual disability or other delays (Robbins, Pis, Pender, & Kazanis, 2004).

Movement Behaviors Among Individuals with Autism

While defining features of ASD focus on social impairment, individuals with ASD may also exhibit poor motor development which can be categorized as "associated symptoms" (Green et al., 2009; Moore et al., 2009; Strath et al., 2000). Areas of poor motor development include upper and lower body coordination, which affect the individual's ability to perform dexterity related tasks and/or balance, agility and speed related activities (Green et al., 2009; Ming, Brimacombe, & Wagner, 2007; Strath et al., 2000). Studies have also shown that individuals with ASD have displayed deficits in gross and fine motor movements, such as postural control, clumsiness, and reach-to-grasp movement. These motor deficits are present as early as two to three years old and have the potential to

influence future activities based on the development of motor patterns. In the subsequent paragraphs, this manuscript will outline how motor success, as well as motor deficits, can have a positive or negative impact on individual's enjoyment, perceived exertion, and actual exertion during activity.

Enjoyment of Physical Activity

Research indicates the development of motor skills i.e. locomotor, object control, etc. will either positively or negatively affect the individual's perception of competency and, therefore, influence participation, enjoyment, and exertion in any given exercise (Stanish et al., 2015). These perceptions can be tied to the development of their motor skills. In children, fundamental motor skills, i.e. locomotor and object control skills such as running, galloping and skipping, form the foundation for the child's future movement (Obrusnikova & Cavalier, 2011). A study conducted by Stanish et al. (2015) compared enjoyment, barriers, and beliefs about physical activity (PA) among adolescents with and without ASD. Results indicated a higher number of adolescents with ASD perceived certain activities as too hard to learn compared to their typically developing peers (16% vs. 0%), bringing up the question, was their lack of competency negatively influenced by their enjoyment of the activity?

Additionally, when comparing self-efficacy (the idea that the abilities one possesses will influence their overall behavior) and enjoyment prior to, during, and after a bout of PA in typically developing adolescents, attitudes prior to the start of PA positively or negatively influenced enjoyment of the activity (Dishman et al, 2005; Robbins et al., 2004). Subjects in a study conducted by Robbins et al. (2004), were asked to rate their enjoyment during PA using the Physical Activity Enjoyment Scale (PACES) (Robbins et al., 2004).

In particular, Caucasian females and African American males had negative self-efficacy prior to the activity resulting in a lack of enjoyment. It can be theorized negative self-efficacy coupled with poor motor development can lead to an overall dissatisfaction with PA. Another study examining the effect of self-efficacy on enjoyment of exercise conducted by Moore et al. (2009) measured enjoyment of PA in 617 elementary school children. Enjoyment was measured using the revised PACES while PA was measured using The Physical Activity Questionnaire for Older Children. When age was controlled, Caucasians enjoyed PA more than African American children (SE = .06 vs. SE = .04) which support the results from Robbins et al.'s study (2004) (Moore et al., 2009). Just as self-efficacy and perception of competency can influence enjoyment of exercise so can mood.

There is a high prevalence of depression and anxiety among individuals with ASD compared to typically developing individuals, especially among those aged 9 - 14 (Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Matson & Williams, 2014). Previous studies assessed the negative implication and prevalence of depression/anxiety in individuals with ASD finding (1) mood disorders such as anxiety and depression can lead to language and social impairments, stereotypic behaviors and behavioral rigidity (Pine, Guyer, Goldwin, Towbin, & Leibenluft, 2008), (2) extroversion and conscientiousness are lower in individuals with Asperger's (Kanai et al., 2011), (3) of 1390 children, 233 had high functioning ASD and of that, 43 reported depression; 42% of the children had low functioning ASD and depression (Mayes, Calhoun, Murray, Ahuja & Smith, 2011), (4) out of 54 males and females with Asperger's, 50% had recurring episodes of depression over the course of a year while 70% only experienced one episode (Lugnegard, Hallerback, & Gillberg, 2011), (5) out of 95 children diagnosed with ASD, 44% were borderline clinically

depressed and 56% were diagnosed with anxiety (Strong et al., 2012). In individuals with intellectual disabilities and those with diagnosed depression, exercise improved symptoms (Carraro & Gobbi, 2014).

Perceived Exertion Assessment During Physical Activity

Enjoyment of exercise can be influenced by perceived exertion, i.e. one's interpretation on their level of exertion during exercise/physical activity. More specifically, perceived exertion typically describes strains and fatigue of the muscles, cardiovascular and pulmonary systems during exercise (Groslambert & Mahon, 2006).

There are numerous scales available to assess perceived exertion across all ages during exercise (Borg, 1982; Mahon, Gay, & Stolen 1998; Yelling, Lamb, & Swaine, 2002). One commonly used and accepted method of assessing exercise intensity for adults is the Borg's Rating of Perceived Exertion (RPE) which measures perceived exertion by utilizing a range of 6 to 20, with a 6 corresponding to a heart rate of approximately 60 beats·min^{-1} (Borg, 1982; Yelling et al., 2002). This scale includes descriptors such as "very, very light" or 'somewhat hard" to create a more categorical scale and is used across the globe as an easy and effective way to measure intensity. While this scale is appropriate for adults (the population which it was tested on), it is not appropriate for children and adolescents due to their lower level of cognitive development (Groslambert & Mahon, 2006). To correct for this, the Pictorial Children's Effort Rating Table (PCERT) was developed (Lamb & Eston, 1997). The scale replaces descriptors, such as 'hard' and 'light' with stick figures depicting the various stages. Additionally, the PCERT has five fewer responses to select from which makes comprehension easier. According to Lamb and

Eston, (1997) one's ability to comprehend their level of perception is influenced by their experience with exercise.

Yelling et al. (2002) completed a study examining the validity of a pictorial perceived exertion scale (PCERT) on 104 typically developing middle school children who completed developmentally appropriate activities such as relay running, soccer, and netball. For both males and females across age groups (8- 15) the pictorial perceived exertion scale was accurate in matching perceived exertion with actual exertion levels. More specifically, in females, HR across three levels of physical activity were significantly correlated with PCERT scores ($p < .05$, 0.54 – 0.87), whereas with males, there was only significance with the first stage of activity ($p = 0.54$). Furthermore, results showed the younger children had higher heart rates compared to the older children and females had higher heart rates compared to their age-matched males. Other commonly utilized scales for children include Cart and Load Effort Rating Scale and the Children's OMNI Scale of Perceived Exertion both of which were tested using typically developing children.

No studies thus far have examined the effectiveness of these scales in individuals with ASD as they are too complex for these individuals to comprehend. With many of these RPE scales, i.e. PCERT and OMNI, the subject is given a range or a series of pictures and asked to select the number or picture that most represents their level of exertion. Individuals with ASD, when faced with open-ended questions such as selecting how they feel on a scale, may repeat the question verbatim or provide and irrelevant response (Capps, Kehres, and Sigman, 1998). When children with ASD were compared to age-matched children and asked a series of direct and open-ended questions the children with ASD were less likely to respond to an open-ended question than a direct one (Capps, Kehres, & Sigman, 1998).

While these scales (CERT and OMNI) are useful for a specific population (generally because they have been extensively tested and validated with that population) they are not ideal in their current form for the population of interest (individuals with ASD). By reducing the number of responses (a positive of the PCERT) and utilizing closed-ended questions, someone with ASD can better understand and appropriately answer the question.

Actual Exertion During Physical Activity

While RPE and pictorial scales are used to assess perceived exertion, heart rate (HR) is one of the most common ways to assess levels of PA as it is an inexpensive, noninvasive method that provides an index of absolute and relative intensity of the activity being performed (Schmitz et al., 2017; Ueda & Kurokawa, 1991). One study in particular conducted by Strath et al. (2000) examined the relationship between HR and maximal oxygen consumption or (VO_{2max}) during field and lab-based moderate-intensity activities. Sixty-one males and females aged 19 - 74 were given one of seven moderate intensity activities to perform at home and in the lab. Heart rate was measured via Polar HR monitors. Results indicated HR took approximately two to three minutes to increase to a rate representative of the activity being performed. Additionally, HR was shown to be moderately correlated to VO_{2max} (Strath et al., 2000). While a majority of studies have examined the relationship HR has to exertion levels on land, one study by Ueda and Kurokawa was conducted on children aged 10 - 12 in the pool while still finding a linear relationship between HR and VO_{2max} (Ueda et al., 1991). HR is commonly used in lieu of VO_{2max} as they are both effective indicators of intensity with HR being more cost-effective and timely (Hui & Chan, 2006). In studies using both children and adults, HR is nearly always closely related to exercise VO_{2max} allowing the linear relationship between the two

to be used to prescribe exercise for any population using HR to monitor/measure intensity (Hui & Chan, 2006).

Physical Activity Among Individuals With Autism

The physical activity level of individuals with ASD is influenced by many factors and variables. In the aforementioned study conducted by Stanish et al. (2015) barriers to PA were examined for typically developing children as well as children with ASD. The most commonly expressed barriers across individuals with ASD ages 13-21 were being too busy, exercise was not engaging enough, risk of injury, and outside temperature (Stanish et al., 2015). These barriers have been noted as ones that limit individuals with ASD's participation in the recommended 60 minutes per day of moderate to vigorous PA (Stanish et al., 2015). It is well documented that individuals with ASD are more inactive than typically developing children (MacDonald, Esposito, & Ulrich, 2011; Obrusnikova & Cavalier 2011; Pan, 2004). The relationship between barriers and facilitators of after-school PA programs were examined to see if PA patterns were influenced by any of the above barriers, i.e. TV watching, listening to music, disinterested in activity, etc. (Obrusnikova & Cavalier, 2011). Males and females ages 8 - 14 with ASD were recruited for the study. Participants received an accelerometer and questionnaire to fill out regarding time spent being active or inactive following a school day. Top barriers reported were: playing video games (27%), watching TV or listening to music (14%), too tired (14%), and bored with exercise (14%). While these individuals noted they did not have time to partake in PA or sports-related activities, many made time in their schedule after school to sit and play video games or watch TV. Those that did participate in moderate to vigorous PA did so because exercise equipment was readily available.

Time spent sedentary not only presents a barrier but can also negatively influence behaviors. Stereotypic and self-stimulatory behaviors are repetitive behaviors that youths with ASD often display, though the specific behaviors and their severity can vary from child to child (Schmitz et al., 2017). Stereotypic and self-stimulatory behaviors include but are not limited to, repetitive speech, hand flapping, body rocking, agitation when straying from routine, and spinning in circles (Rapp et al., 2004). Aerobic exercise has been shown to be highly effective in reducing stereotypic behaviors in addition to providing other health benefits associated with exercise and increasing learning behavior after exercising (Bahrami et al., 2012). Schmitz et al. (2017) conducted a study on the effects of exercise dose on stereotypical behaviors in children with Autism. Subjects (N = 7) completed low or high-intensity exercise for either 10 or 20 minutes on a treadmill, bike, or elliptical machine. Self-stimulatory behaviors were monitored pre- and post-exercise in a control room. Reductions in self-stimulatory behaviors were observed following shorter duration lower intensity exercise compared to baseline up to an hour post-exercise. However, adverse effects were seen following longer duration and higher intensities.

In a study conducted by Prupas and Reid, (2001) the effects of a single bout of 10-minute moderate intensity walking/jogging compared to three 10-minute walk/jog sessions were examined. Following the intervention, participants returned to the classroom where their stereotypic behaviors were observed for 15-minutes. Between the single frequency session and the multiple frequency sessions, stereotypic behaviors were reduced by a mean of 7.3%. These findings lend themselves to the impact frequency has on reducing stereotypic behaviors over a longer period. Results showed the effectiveness of repeated bouts throughout the day in reducing behaviors at various time points more so than a single

bout. While these bouts of exercise are effective in reducing behaviors, further research needs to be done to explore the activities that individuals with ASD not only enjoy participating in but that also, demonstrate high levels of exertion in order to receive health and wellness benefits.

Purpose of the Study

Therefore, the purpose of this study is to determine if there is a relationship between exercise enjoyment, perceived exertion, and actual exertion levels in individuals with ASD. It was hypothesized that as enjoyment scores for activities increased, both actual and perceived exertion levels would decrease.

Significance

Findings of this study will benefit individuals with ASD as well as the parent's/guardians of individuals with ASD and allow professionals, as well as families, to understand the feelings of individuals with ASD toward physical activity. Additionally, findings will allow the researcher to provide a list of potential activities participants found to be enjoyable while also increasing one's heart rate to a moderate to vigorous level. The results from this study will allow schools and communities to better understand how individuals with ASD perceive exercise and how it relates to their enjoyment and exertion. The findings will be beneficial to educators as well as community-based instructors as our schools and communities attempt to become more inclusive in the programs being offered. As the number of individuals diagnosed with ASD continues to increase along with their likelihood of sedentary behavior and increased risk of obesity, there is a need for effective physical activity programming (MacDonald, Esposito, & Ulrich, 2011).

Chapter II
Methods

Subjects

Thirty-one children and adults aged 5 - 38 years diagnosed with ASD were recruited for the study through James Madison University's Overcoming Barriers program. Of the 30 recruited, 16 were eligible. Written informed consent was obtained from parents/guardians of the participants after obtaining verbal assent from children before beginning the study. Participants 18 and older completed consent for individuals with diminished capacities which presented the information at an appropriate comprehension level (see Appendix A). The research design was approved by the James Madison University's institutional review board. Subjects were recruited using the following selection criteria: males and females, 5 - 40 years of age, an ASD classification based on physician or psychologist/psychiatrist diagnosis using DSM-V criteria, primary diagnosis of ASD with no other diagnosis of an intellectual disability, able to verbally or visually (through picture communication) respond to basic questions on mood and enjoyment of exercise, and be enrolled in at least one physical activity program through Overcoming Barriers.

Research Design

Participants participated in at least one Overcoming Barriers physical activity program i.e. master's aquatics, Saturday aquatics (see Appendix B), fitness, basketball (see Appendix C), I Can Do It, You Can Do It!, and kidnastics. Each program lasted one hour. Participants were asked a series of pre- and post-exercise questions, which took no longer than 10 minutes total. Upon arrival to the program, participants were asked a series of

questions regarding their day and current mood in addition to gathering resting heart rate via radial pulse and pulse oximeters (see Appendix D). Participants were then asked two, two-tiered questions regarding their enjoyment of the exercise and their perceived exertion. Two different brands of pulse oximeter were used FaceLake FL400 (FaceLake, Lake Bluff, IL) and Zacurate Pro Series 500Dl Fingertip Pulse Oximeter (Einstein Associates LLC, Stafford, TX) and calibrated weekly prior to testing participants in order to ensure there was no difference between heart rate readings

Pilot Testing

Prior to the start of data collection, a 10-week pilot study was conducted on five subjects with varying degrees of intellectual disabilities such as Autism and Down Syndrome. This study was used to develop an initial draft of the questionnaire and modify it based on the PACES which was developed and tested on typically developing individuals (More et al., 2009). The PACES was modified from the Children's Understanding of Exercise Scale (CUES) which was tested in a prior pilot study (Moran, 2017). This pilot study began with the CUES going through four rounds of modifications. These modifications were made to correct for readability by the data collector and question comprehension by the participant as the researcher was finding participants were struggling to provide valid and reliable responses giving no rationale for why they selected what they did. The questionnaire used in this study was simplified from the CUES to the point where the participant could comprehend the question while providing a more appropriate answer.

Protocol

Once participants enrolled in an Overcoming Barriers physical activity program of their choosing, they were assigned a research assistant (who were trained by the main researcher) for the duration of the eight weeks. Research protocol was as follows, when participants arrived to program, their assigned research assistant would sit them down and verbally asked them a series of questions regarding mood followed by taking resting heart rate. Questions included, what were you doing prior to arriving to program, if they were hungry or tired, and what their mood was. Depending on the program they enrolled in, the activities performed differed, for example, basketball focused on shooting, passing, and dribbling while freestyle, breaststroke, and backstroke were the foci of swimming. Regardless of the activities performed, all participants were asked the same series of questions at the same time point throughout their program (following the first, third, and fifth activity) (see Appendix B). Once the initial questions were asked and the program began, participants then engaged in the first activity with questions regarding enjoyment of activity (question one on page two of data sheet – see Appendix D) and perceived exertion (questions two) asked after completion of the activity. Post-activity heart rate was also gathered via pulse oximeter using FaceLake FL400 (FaceLake, Lake Bluff, IL) and Zacurate Pro Series 500Dl Fingertip Pulse Oximeter (Einstein Associates LLC, Stafford, TX). The activities the participant engaged in from week to week varied, which allowed the researcher to see the participants reposes across activities and across the same chosen exercise from week to week.

Instruments

Extraneous Variables.

Additional variables collected prior to the start of each program include – mood prior to exercise, what the participant was doing prior to the start of the program, and if they were tired and/or hungry. This information was collected in order to account for any confounding effects they may have on the primary variables of interest.

Actual Exertion.

The accuracy of pulse oximeters was tested by Iryiboz, Powers, Morrow, Ayers, and Landry (1991) in males during treadmill running and cycling. When working at less than 89% of VO_{2max} the pulse oximeters were accurate in measuring heart rate when compared to ear probes. All subjects worked at less than 89% of VO_{2max} during the current study (based on heart rate reserve calculations). When calculating their heart rates, the researcher was able to determine their age-predicted max heart rate. Because resting heart rate and age were gathered age predicted max heart rate was calculated using the Karvonen heart rate reserve equation, it was determined not all subjects worked less than 89% of their calculated target heart rate range (Camarda et al., 2008). Post-activity heart rate was gathered via pulse oximeter using FaceLake FL400 (FaceLake, Lake Bluff, IL) and Zacurate Pro Series 500Dl Fingertip Pulse Oximeter (Einstein Associates LLC, Stafford, TX).

Enjoyment of Exercise.

Participants were asked a two-tiered question regarding enjoyment of exercise. The question asked if they liked or disliked the exercise. The participants were then asked to rate their enjoyment using a 4-part Likert scale (see Appendix D).

Perceived Exertion.

Participants were asked a two-tiered question regarding perceived exertion. Tier one asked if they perceived the exercise as easy or hard. Tier two was a 4-part Likert scale anchored by whether the exercise was perceived as too hard on one end and too easy on the other (see Appendix D).

Statistical Analysis

Descriptive statistics were computed for each variable (actual exertion, perceived exertion, and enjoyment of exercise). There were 258 individual bouts of activity across 16 participants. Each activity and the subsequent data collected was viewed and analyzed as independent data points (as each participant's heart rate, perceived exertion, and enjoyment varied by specific exercise or activity, thus supporting the notion that each should be treated independently). The level significance was tested at $p < 0.05$. Simple linear regression was used to study the relationship between the response variable and the predictor (Chatterjee and Hadi, 2013). Each main variable, perceived exertion, actual exertion, and enjoyment of exercise acted as both the response variable and predictor. There were three individual correlations analyzed; (1) Actual exertion (HR) to perceived exertion (easy/hard); (2) actual exertion (HR) to enjoyment (like/dislike); and (3) perceived

exertion (easy/hard) to enjoyment (like/dislike). Analysis was completed using SPSS 24 statistical software (IBM, 2016).

Chapter III

Manuscript

Relationship between Perceived and Actual Exertion and Enjoyment of Exercise in Individuals with Autism

Abstract:

Fiscella, N.A., Moran, T.E., Wigglesworth, J.K., and McKay, C.A. Relationship between Perceived and Actual Exertion and Enjoyment of Exercise in Individuals with Autism. **Purpose:** The purpose of this study was to examine the relationship between perceived exertion, actual exertion and enjoyment of exercise in individuals with Autism Spectrum Disorder (ASD). **Methods:** A total of 16 participants (12 males and 4 females) between the ages of 5 and 38 who were diagnosed with ASD participated in the study. The intervention lasted 10 weeks and consisted of participation in one of James Madison University's Overcoming Barriers hour long physical activity programs. Heart rate, perceived exertion, and enjoyment of exercise were measured following three exercises during the program. **Results:** There was no relationship between the three main variables however, a significant relationship, was found between exercise exertion and perceived exertion $r = -0.151$ ($p = 0.66$) and between enjoyment of exercise compared to perceived exertion $r = 0.23$ ($p < 0.05$). **Conclusion:** Consistent with the literature, participants are more likely to participate in exercises they enjoy, in addition we found hunger was related to both perceived exertion as well as with enjoyment of exercise. Further research still needs to be done between hunger and perceived exertion and enjoyment of exercise.
Keywords: AUTISM, PERCEIVED EXERTION, ACTUAL EXERTION, ENJOYMENT, EXERCISE.

Introduction

Autism Spectrum Disorder (ASD) is the most common neurological disorder diagnosed by psychologist or psychiatrist using the Diagnostic and Statistical Manual of Mental Disorders 5th Edition, in the U.S. affecting 1 in 68 children (American Psychiatric Association 2013; Christensen et al., 2016; Prupas and Reid, 2001). While defining features of ASD focus on social impairment, individuals with ASD may also exhibit poor motor development (Green et al., 2009; Moore et al., 2009' Strath et al., 2000). These area of poor motor development (present as early as two years old) include poor upper and lower

body coordination which negatively affect the individual's ability to perform dexterity related tasks and/or balance and speed related activities (Green et al, 2009; Ming et al., 2007; Strath et al., 2000). In children, fundamental motor skills, i.e. locomotor and object control form the foundation of the child's future movement (Obrusnikova & Cavalier, 2011). Development of these motor patterns can play a major role in the individuals engagement in activities. Enjoyment, barriers, and beliefs about physical activity (PA) among adolescents with and without ASD was examined by Stanish et al. (2015). Results indicated a higher number of adolescents with ASD perceived certain activities as too hard to learn, bringing up the question, was their lack of competency in the activity negatively influenced by their enjoyment. Furthermore, self-efficacy and enjoyment of exercise were compared in a study by Moore et al. (2009) in 617 elementary school children using the revised Physical Activity Enjoyment Scale (PACES) and The Physical Activity Questionnaire for Older Children. Results showed a negative self-efficacy prior to exercise resulted in a lack of enjoyment.

Just as self-efficacy and perception of competency can influence enjoyment of exercise so can mood. Individuals with ASD are more likely to suffer from depression and anxiety compared to typically developing individuals, especially those aged 9 - 14 (Kim et al., 2000; Matson et al., 2014). Exercise has been shown to improve symptoms associated with anxiety and depression (Carraro and Gobbi, 2014).

There are numerous scales available to assess perceived exertion, i.e. one's interpretation on their level of exertion during exercise/physical activity focusing on fatigue of the muscles, cardiovascular and pulmonary systems (Groslambert and Mahon, 2006). While the Borg's Rating of Perceived Exertion is a commonly utilized method for

assessing intensity it is not appropriate for children or individuals with ASD due to their lower level of cognitive development (Borg, 1982; Yelling et al., 2002; Groslambert and Mahon, 2006). As a result, the Pictorial Children's Effort Rating Table (PCERT) which replaces descriptors with stick figures and has five fewer responses to select from allowing for easier comprehension. While these scales have been tested and validated in typically developing individuals, no study has examined their effectiveness in individuals with ASD. Furthermore, individuals with ASD are less likely to respond to an open ended question than a direct one making it all the more imperative to develop a perceived exertion scale they are able to comprehend and answer (Capps, Kehres, and Sigman, 1998).

RPE and perceived exertion scales are used to assess perceived exertion, heart rate (HR) is one of the most common ways to assess actual levels of PA as it is an inexpensive way of providing absolute and relative intensity (Schmitz et al., 2017; Ueda et al., 1991).

While bouts of exercise are effective in reducing behaviors (Stanish et al., 2015), further research needs to be done to explore the specific activities individuals with ASD not only enjoy participating but allow for high levels of exertion in order to receive health and wellness benefits. Therefore, the purpose of this study is to determine if there is a relationship between exercise enjoyment, perceived exertion, and actual exertion levels in individuals with ASD. It was hypothesized that as enjoyment scores for activities increased, both actual and perceived exertion levels would decrease.

Methods

Subjects

Thirty-one children and adults aged 5 - 38 years diagnosed with ASD were recruited for the study through James Madison University's Overcoming Barriers program. Written

informed consent was obtained from parents/guardians of the participants after obtaining verbal assent from children before beginning the study. Participants 18 and older completed consent for individuals with diminished capacities which presented the information at an appropriate comprehension level (see Appendix A). The research design was approved by the James Madison University's institutional review board. Subjects were recruited using the following selection criteria: males and females, 5 - 40 years of age, an ASD classification based on physician or psychologist/psychiatrist diagnosis using DSM-V criteria, primary diagnosis of ASD with no other diagnosis of an intellectual disability, able to verbally or visually (through picture communication) respond to basic questions on mood and enjoyment of exercise, and be enrolled in at least one physical activity program through Overcoming Barriers.

Research Design

Within Overcoming Barriers in the Spring 2018 semester there were 30 of individuals with a primary diagnosis of ASD with 16 (12 male, 4 female) being eligible for participation. All 16 agreed to participate.

Subjects participated in at least one Overcoming Barriers physical activity program i.e. master’s aquatics, Saturday aquatics, fitness, basketball, I Can Do It! (ICDI), and kidnastics. Each program lasted one hour. Participants were asked a series of pre- and post-exercise questions, which took no longer than 10 minutes total. Upon arrival to the program, participants were asked a series of questions regarding their day and current mood

in addition to gathering resting heart rate via radial pulse and pulse oximeters (see Appendix D). Participants were then asked two, two-tiered questions regarding their enjoyment of the exercise and their perceived exertion. Two different brands of pulse oximeter were used and calibrated weekly prior to testing participants in order to ensure there was no difference between heart rate readings.

Pilot Testing

Prior to the start of data collection, a 10-week pilot study was conducted on five subjects with varying degrees of intellectual disabilities such as Autism and Down Syndrome. This study was used to develop an initial draft of the questionnaire and modify it based on the PACES which was developed and tested on typically developing individuals. The PACES was modified for to the Children's Understanding of Exercise Scale (CUES) which was tested in a prior pilot study. This pilot study began with the CUES going through four rounds of modifications. These modifications were made to correct for readability by the data collector and question comprehension by the participant as the researcher was finding participants were struggling to provide valid and reliable responses giving no rationale for why they selected what they did. The current questionnaire was simplified to the point where the participant could comprehend the question while providing a more appropriate answer.

Protocol

Ten undergraduate research assistants completed a 30-minute training session led by the researcher on administration of the questionnaire and how to monitor heart rate.

Each research assistant was assigned a participant to work with throughout the duration of the study. A typical program had anywhere from six to ten activities throughout the program. For example in the aquatic program began with a warm-up before completing: (1) 300-meter freestyle, (2) treading water three times for 30 seconds, (3) 300-meter backstroke, (4) 300-meter kicking with kickboard, (5) ten streamlines off the wall, (6) 300-meter breaststroke and (7) treading water three times for 30 seconds. Questionnaires were given following the first, third and fifth activity within each program.

Instruments

Extraneous Variables.

Several extraneous variables were collected prior to the start of each program in order to account for any confounding effects they may have had on the primary variables of interest. These extraneous variables included mood prior to exercise, what the participant was doing prior to the start of the program, and if they were tired and/or hungry (see Appendix D).

Actual Exertion.

Post-activity heart rate was gathered via pulse oximeter using FaceLake FL400 (FaceLake, Lake Bluff, IL) and Zacurate Pro Series 500Dl Fingertip Pulse Oximeter (Einstein Associates LLC, Stafford, TX).

Enjoyment of Exercise.

Participants were asked a two-tiered question regarding enjoyment of exercise. The question asked if they liked or disliked the exercise. The participants were then asked to rate their enjoyment using a 4-part Likert scale (see Appendix D).

Perceived Exertion.

Participants were asked a two-tiered question regarding perceived exertion. Tier one asked if they perceived the exercise as easy or hard. Tier two was a 4-part Likert scale anchored by whether the exercise was perceived as too hard on one end and too easy on the other (see Appendix D).

Statistical Analysis

Descriptive statistics were computed for each variable (actual exertion, perceived exertion, and enjoyment of exercise). There were 258 individual bouts of activity across 16 participants. Each activity and the subsequent data collected was viewed and analyzed as independent data points (as each participant's heart rate, perceived exertion, and enjoyment varied by specific exercise or activity, thus supporting the notion that each should be treated independently). The level significance was tested at $p < 0.05$. Simple linear regression was used to study the relationship between the response variable and the predictor (Chatterjee and Hadi, 2013). Each main variable, perceived exertion, actual exertion, and enjoyment of exercise acted as both the response variable and predictor. There were three individual correlations analyzed; (1) Actual exertion (HR) to perceived exertion (easy/hard); (2) actual exertion (HR) to enjoyment (like/dislike); and (3) perceived

exertion (easy/hard) to enjoyment (like/dislike). Analysis was completed using SPSS 24 statistical software (IBM, 2016).

Results

Sixteen participants with a primary diagnosis of ASD (12 males, 4 females) between the ages of 5 and 38 completed the study. A summary of participant characteristics are listed in Table 1. Target heart rate ranges were calculated for 60 – 75% of age-predicted maximal heart rate using the Karvonen heart rate reserve equation (Camarda et al., 2008).

Table 1. Participant Characteristics (N=16)

Age (years)	Gender	Target Heart Rate Range (bpm)	Age-Predicted Max Heart Rate (bpm)
5	Male	157 - 178	215
8	Female	167 – 179	212
9	Male (n=3)	158 – 178	211
10	Male	163 - 180	210
11	Female	163 – 180	209
12	Female	148 – 171	208
15	Male (n=2)	147 – 168	205
18	Male	150 – 169	202
19	Male (n=2)	154 – 171	201
26	Male	152 – 168	194
28	Male	153 – 166	192
38	Female	134 – 172	182

Below are the programs participants could voluntarily enroll in within Overcoming Barriers at the beginning of the semester. The number of activities completed and analyzed within each program varied and are displayed in Table 2. These are the number of activities performed within each program over the course of the study.

Table 2. Program Activity Breakdown

	Aquatics (Saturday and Master's)	Basketball	Fitness	Kidnastics	ICDI
Number of participants	11	3	5	1	1
Number of exercises analyzed	19	11	21	5	3

Several extraneous variables were collected prior to the start of each program in order to determine if there was a relationship between and/or effect on the main variables. These extraneous variables included mood prior to exercise, whether the participant was having a good day, what the participant was doing prior to the start of the program (i.e. eating, watching tv/playing video games, etc.), if the participant was tired and/or hungry coming into the program. A negative significant relationship was found between hunger and perceived exertion as well as with enjoyment of exercise. No significant relationship was found between any other extraneous variable and perceived exertion, actual exertion, and enjoyment of exercise (see Table 3). There were two significant relationships found between extraneous variables themselves. The first significant relationship was between tiredness and hunger, $r = .384$ ($p < .05$), with the second significant relationship being between mood and tiredness, $r = .137$ ($p < .05$).

Table 3. Relationship between Extraneous Variables on Main Variables

Variable	Actual Exertion	Perceived Exertion	Enjoyment of Exercise
Mood Prior to Exercise	0.02	0.037	-0.033
Hunger	-0.032	-.0161*	-0.140*
Tiredness	-0.074	-0.021	-0.046
Having a good day/morning?	0.039	-0.019	0.007

*Significance set at $p < 0.05$

Correlations Between Perceived/Actual Exertion and Enjoyment

When analyzing each activity as an independent data point, the correlation between exercise exertion and enjoyment $r = -0.007$ ($p = 0.63$) no significant relationship was found. A significant relationship however, was found between exercise exertion and perceived exertion $r = -0.151$ ($p = 0.66$) and between enjoyment of exercise compared to perceived exertion $r = 0.23$ ($p < 0.05$) (see Table 4). These results indicate both a between subjects and within subject correlation. For participants with ASD, the easier the activity, (i.e. he or she perceived their exertion level to be low) the more the participant enjoyed the activity. The enjoyment and perceived exertion scores listed in table five are the mean scores across all specific tasks or exercises within an activity.

Table 4. Correlation (*r*) between Main Variables

Relationship between Variables	N (bouts of exercise)	Pearson Correlations
Enjoyment – Perceived Exertion	253	0.230**
Enjoyment – Actual Exertion	250	-0.007
Perceived Exertion – Actual Exertion	251	-0.151*

*Correlation is Significant at 0.05 level
**Correlation is significant at 0.01 level

Table 5. Relationship of Enjoyment of Exercise and Perceived Exertion Across Activities ±SD

Activity	Sample Size (N)	Exercise bouts Examined	Enjoyment (mean score)	Perceived Exertion	Pearson's Correlation (*r*)
Aquatics	11	128	3.24±.729	2.74±.916	0.28**
Basketball	3	44	3.50±.506	2.92±.625	0.18
Fitness	5	63	3.35±.600	2.80±.694	0.21
ICDI	1	3	3.33±.577	3.67±.577	0.50

Note. Mean enjoyment and perceived exertion ratings across activities. All activities had large positive correlations between enjoyment and perceived exertion ratings.

*Correlation is Significant at 0.05 level
**Correlation is significant at 0.01 level

According to our participants in aquatics (N = 11) their mean score was 3.24 meaning they enjoyed the activity and their perceived exertion score was 2.74 indicating participants rated it closer to easy than hard for the 129 bouts of exercise performed. Conversely, the participants in basketball (N = 3) rated the activities between easy and really easy while stating their perceived exertion was a mean score of 2.92 closer to easy than hard in the 45 bouts of exercise performed.

Even though the findings of our study do not support the relationship between actual exertion, perceived exertion, and enjoyment; the findings do suggest a significant relationship between an individual's enjoyment of an activity and their perceived exertion during the activity as well as a negative relationship between their perceived exertion and actual exertion.

Heart Rate

Heart rate was collected at the completion of each activity to determine which activities allowed participants to reach their target heart rate zone during exercise. Table

five displays the heart rate ranges for all programs. Between males and females, males consistently had a higher average heart rate compared to females (116 bpm vs. 101 bpm). While individual exercises were not analyzed in terms of their significance, there were several exercises that allowed the participant to reach their target heart rate zone. The activities of aquatics, basketball, and fitness allowed participants to enter and remain in their target heart rate zone, whereas the activities of kidnastics (i.e. balancing, rolling, and jumping) and ICDI (i.e. kicking and throwing) did not allow participants to enter their target heart rate zone.

Table 6. Heart Rate Ranges for all Programs (Min, Max)

Activity	Heart Rate Range (bpm)	Target Heart Zone
Master's Aquatics	70 – 213	Yes
Saturday Aquatics	67 – 157	Yes
Basketball	81 – 170	Yes
Fitness	70 – 180	Yes
ICDI	120 – 126	No
Kidnastics	88 – 110	No

Specific activities that elicited a heart rate are organized according to individual activities vs. team activities. Master's aquatics included: freestyle (129 bpm - 213 bpm), flutter kick with kickboard (121 bpm - 175 bpm) and backstroke (125 bpm - 135 bpm); Saturday aquatics activities included: submersion (116 bpm - 124 bpm) and flutter kicks with kickboard (130 bpm - 157 bpm); fitness: cycling (129 bpm - 170 bpm), treadmill jogging (120 bpm - 170 bpm), lateral raises (129 bpm - 144 bpm) and lunges (149 bpm - 155 bpm) and the team sport of basketball: dribbling (118 bpm - 132 bpm), passing (125 bpm - 150 bpm), shooting (136 bpm - 162 bpm), running (115 bpm - 127 bpm). Based on our limited sample size, these could be suggested activities that would allow participants with ASD to engage within their target heart rate zone.

Discussion

The purpose of this study was to determine if there was a relationship between exercise enjoyment (i.e. like vs. dislike), perceived exertion (i.e. working hard vs. activity was easy), and actual exertion levels in individuals with ASD. It was hypothesized that as enjoyment scores for activities increased, both actual and perceived exertion levels would decrease. The results of our study were unable to support this hypothesis.

Contrary to our hypothesis, the findings of this study do suggest there is a significant positive relationship between a participant's enjoyment of exercise and their perceived level of exertion. Practically, the greater the level of enjoyment in an activity for participants with ASD, the more likely he or she would be to engage in it. Since aquatics, basketball, and fitness demonstrated the greatest likelihood of getting the participant into the moderate to vigorous range of exercise, it is suggested individuals with ASD engage in these programs to achieve health benefits. This is of high importance since individuals with ASD are more inactive compared to their typically developing peers, with engaging in sedentary behaviors such as watching TV being identified as a major barrier to PA in this population (Stanish et al., 2015; Obrusnikova & Cavalier, 2011).

When compared to Stanish et al. (2015), we found similar results that participants with ASD appear to enjoy individual activities more than team activities. In the present study however, the team sport of basketball was enjoyed by participants. Additionally, Stanish et al. (2015), indicated participants with ASD found physical activities to be hard whereas the findings in the present study were contrary as participants rated the activities to be easy (or closer to easy than hard).

The findings of this study are also in contrast to the results of a study by Raedeke (2007) which examined the relationship between enjoyment and affective responses to exercise in individuals participating in group fitness classes. That study found no significant correlation between enjoyment and perceived exertion. While additional studies have examined the relationship between exercise enjoyment and other psychological factors, such as mood affect, the researchers were unable to find any studies looking at the relationship between enjoyment and physical measures of exertion either in typically developing participants or those with ASD.

A significant negative relationship was found between perceived exertion and actual exertion (see Figure 1, Appendix E). Furthermore, measuring exertion during activities allowed the researcher to determine each participant's level of exercise exertion (low, medium, and high). Additionally, the researcher wanted to determine which activities allowed participants to stay in their target heart zone and thus receive the health benefits from engaging in activity. The relationship between specific exercises (i.e. front crawl vs. backstroke) and the variables of exertion, perceived exertion, and enjoyment were not reported as the sample size was too low (N = 1). Due to the small sample size, a participant's scores during each exercise or task were combined under the name of the activity we were unable to general from that one person and how exerting those two activities were compared to the others. The relationship between a participant's like or dislike of an activity and their perceived level of exertion is for the activity overall and not specific exercises or tasks within the program.

With regard to the relationship between the extraneous variables, mood prior to exercise, whether the participant was having a good day, what the participant was doing

prior to the start of the program (i.e. eating or watching TV/playing video games), if the participant was tired or hungry on the main variables, there were two significant relationships one between hunger and perceived exertion and the second between hunger and enjoyment of exercise. While research has identified sedentary behaviors as a major problem among individuals with ASD, no studies have examined the relationship between hunger and activity levels in this population nor did this study examine the relationship between sedentary behaviors and how it impacted activity, simply it identified the relationship between the two (Obrusnikova & Cavalier, 2011). Even though the current study did not analyze anxiety or depression this study did examine their mood prior to exercise to see the impact it had on engagement and exertion level. While the literature has discussed the prevalence of anxiety and depression in individuals with ASD no studies have examined the relationship between mood and tiredness nor have they discussed the relationship between mood and hunger which was found in this study.

Assumptions, Limitations, Delimitations

During this study, it was assumed the participants were comprehending the questions being asked and were responding with an appropriate answer. Accuracy of measurement instruments and administration of researchers and all assistants were assumed. ASD ranges in severity and may be accompanied by a secondary disability. Because of this, this study cannot be generalized to those with severe ASD or those with any additional disabilities. Furthermore, in this study, there was no distinction between the severity to which ASD affects the individual. An additional limitation of the study was the mode of exercise performed and the exercises selected during each program. As ASD is more prevalent in males than females generally, the population in this study had a higher

proportion of males to females. Further limitations include, the individuals leading the programs each week, environmental changes, consistent group sizes (1:1 to 3:3), and working with a different mentor on occasion. A final limitation is the relationship developed between the mentor and participant as this relationship could have positively or negatively affected their enjoyment in the activity.

Future Directions/Studies

Future studies should use a larger sample size in order to better examine the correlation between variables during specific exercises. Additionally, it is recommended that this be explored further using a formal trial where the subjects are randomly distributed into programs with standardized activities (i.e. participants in the current study were allowed of select the activity of their choosing). This will control for any potential bias from the participant in choosing activities which they are already likely to enjoy more. Future studies should also examine the variety of heart rate monitors available to use to monitor consistent heart rate throughout the program.

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Appendix A
Individuals with Diminished Capacity Consent

INDIVIDUAL WITH DIMINISHED CAPACITY ASSENT FORM (ALL AGES)

IRB # **18-XXAA**

ASSESSMENT OF EXERCISE ENJOYMENT ON EXERTION

Please read to participant who is having difficulty reading or understanding. A parent, teacher or teaching assistant (observer) must be present when communicating to the participant. The observer must initial next to the participant's response to confirm the appropriate YES/NO response and sign his or her name below.

We would like to invite you to take part in this study.

In this study, we will try to learn more about whether you try harder when you are completing an exercise you like. This study will take place during your Overcoming Barriers program(s).

Your parents have been asked and have given their permission for you to take part in this study.

You do not have to be in this study if you do not want to. If you decide not to participate in the study, you will still be able to participate in your program.

PLEASE RESPOND OR POINT – **IS IT OKAY FOR US TO ASK YOU QUESTIONS AND MEASURE YOUR HEART RATE AFTER SPECIFIC ACTIVITIES?**

If you have any questions at any time, please ask one of the researchers.

_____ _____
Name of Individual (printed) Date

_____ _____
Signature of Observer Date

_____ _____
Signature of Investigator Date

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Appendix B

Example Aquatics Program

Topic	Tasks
Warm-up 	• Say Hi to your mentor! • On land Stretching
Submersion 	• Water to nose • Head Tilts • 5 x 5 seconds blowing bubbles • 3 x 10 Bobs
Floating 	• 3 x 10 second lean backs • 3 x 10 second back floating
Treading water 	• 3 x 10 fan arms with mentor • 3 x 10 bicycle kicks with mentor
Tickle-T-Touch 	• 3 x 5 T-T-T arms standing • 3 x 5 T-T-T legs with mentor • 3 Half laps T-T-T
Flutter Kicks 	• Seated on wall 3 x 20 kicks • Holding wall 3 x 20 kicks • 4 half laps with kickboard
Freestyle Arms 	• Duck head taps 5 x 10 taps • Ice cream scoop arms 4 x 10

Appendix C

Example Basketball Program

Stations: 15 min each

1. Shooting (equipment - wipe-board targets, blue hoops, hula hoops)
    a. Aim at various targets against the wall
        i. Try and hit each target **10 times**
    b. Play modified version of HORSE or a word of their choosing with everyone (broken into groups of 4ish) **4 rounds**
2. Footwork/agility
    a. Ladder drill (no basketball) working on agility **x 4**
        i. One foot in each square
        ii. Both feet in squares
        iii. Turn to the side one foot in each square
        iv. Same side two feet in each square
        v. Other side repeat the above 2
    b. Use poly spots as a "target" zig-zag to poly, when they get to the end of the zig-zag one mentor will pass them a ball and they will have to pass it back to them and go back to the start of the line **x 5**
        i. They can run to the spots moving forward or for more of a challenge they can side shuffle
        ii. Progression, each time they get to a poly spot within the zig-zag the mentor passes them the ball and they have to pass the ball back and move on to the next poly spot
        iii. WHILE WAITING IN LINE THEY CAN DRIBBLE OR PASS WITH A PARTNER UNTIL IT'S THEIR TURN TO GO
3. Noodle tag - unfreeze with 5 jumping jacks 10 minutes
4. Ships and sailors - (10 minutes)
    Ships
    Sailors
    5 men eating
    4 men pointing north
    3 men rowing
    Backpack
    Beached whale
5. Relay: dribbling spin around cone 1 time, passing, dribbling spin around cone 3 times, run/jog 5 minutes

Closing: Stretch in a circle, share high of the evening/day

Appendix D

Data Collection Sheet

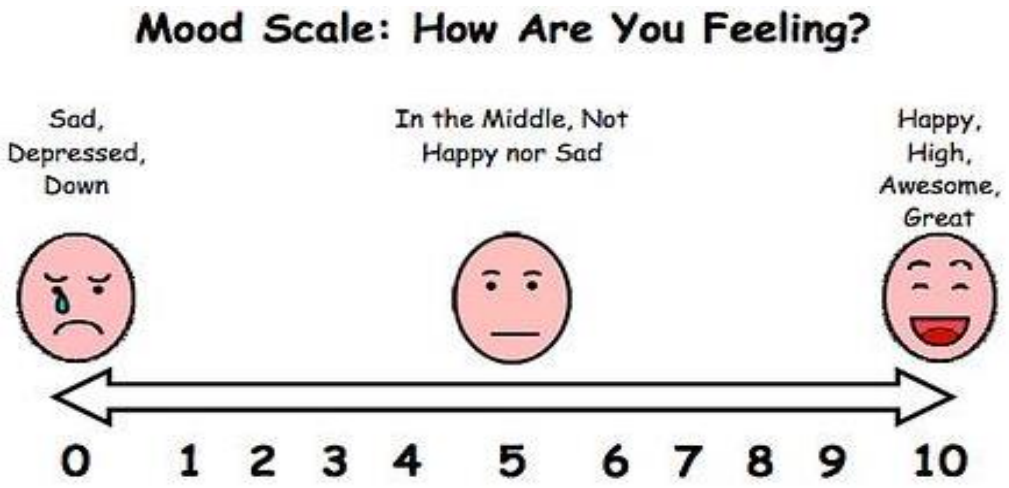
Participants Name: Data Collector: Program/Date:

Questions to ask as soon as participant arrives:

1 What were you doing prior to program?	
2 Are you hungry?	Yes or No
3 Are you tired?	Yes or No
4 Did you have a good day/morning?	Yes or No

Mood

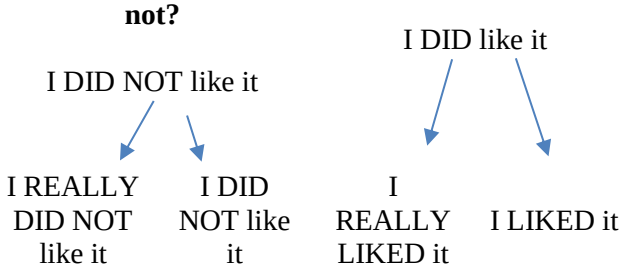
Mood:	**Scaled Number:**



Resting Heart Rate:	**Radial Pulse Heart Rate:**

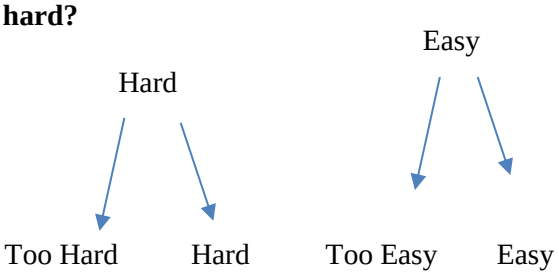
Exercise 1:

1 – Did you like it or not?



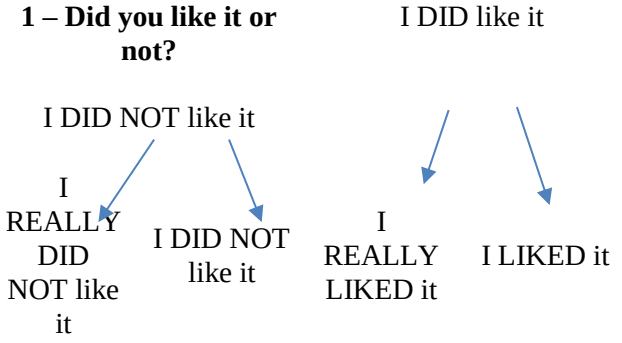
HEART RATE:

2 – Was it easy or hard?



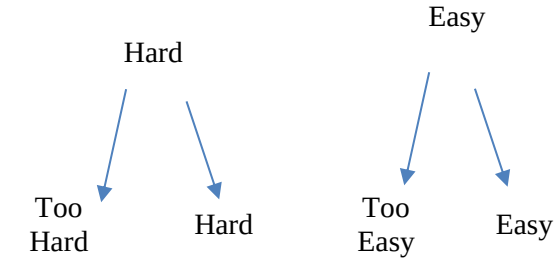
Exercise 3:

1 – Did you like it or not?



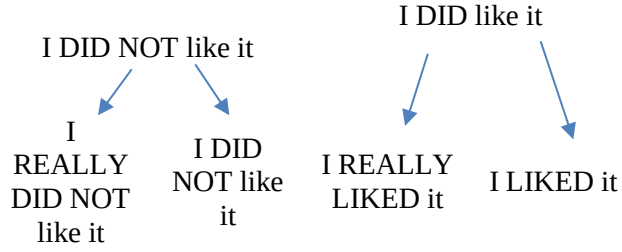
HEART RATE:

2 – Was it easy or hard?



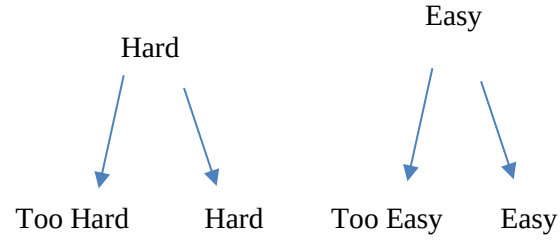
Exercise 5:

1 – Did you like it or not?



HEART RATE:

2 – Was it easy or hard?



Appendix E

Box Plot – Relationship between Heart Rate and Perceived Exertion

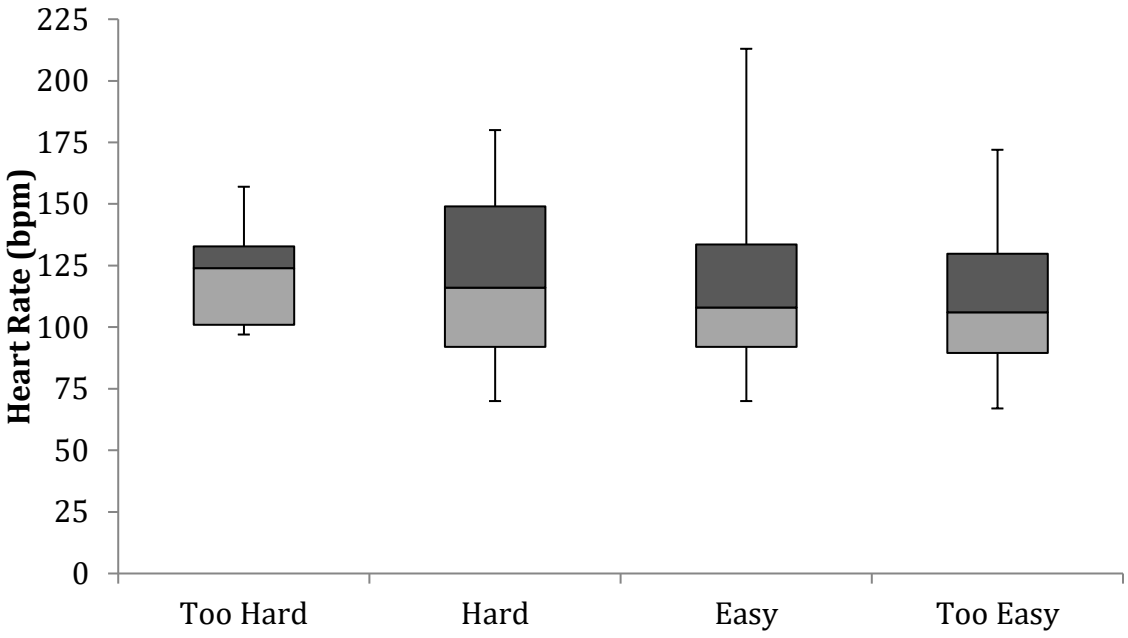


Figure 1. Relationship between Heart Rate and Perceived Exertion.