THE EFFECT OF VARIETY ON THE REINFORCING VALUE AND AMOUNT OF PHYSICAL ACTIVITY IN CHILDREN, YOUNGER ADULTS, AND OLDER ADULTS

A dissertation submitted to the Kent State University College and Graduate School of Education, Health and Human Services in partial fulfillment of the requirements for the degree of Doctor of Philosophy

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It has been repeatedly demonstrated that increasing the variety of available food and purchasing options reliably increases eating and consumer spending behavior respectively. However, the potential pro-behavioral effect of increasing the variety of exercise equipment options on the amount of exercise individuals perform is very limited. The purpose of this investigation was to compare the amount, enjoyment (liking), and relative reinforcing value (RRV) of resistance training exercise versus a sedentary alternative during a high variety (HV) resistance exercise equipment condition versus a low variety (LV) equipment condition.

During each condition, children (8–12 years), young adults (18–26 years), and older adults (≥ 60 years) had free choice access to both resistance exercise equipment and sedentary activities for a total of 20 minutes. The amount of time allocated to resistance exercise, the total number of repetitions performed, and session liking were measured during each condition. After completing each 20-minute free-choice session, the RRV of exercise versus sedentary activity was assessed by asking participants to perform work, in an operant button pressing computer software task, to earn additional access to either resistance
exercise or sedentary activities. Participants then completed the time earned (maximum of 11 total minutes) for each activity. The amount of work performed and time earned for exercise and sedentary activity during each condition (HV, LV) served as the measures of RRV.

Participants significantly \((p \leq 0.05\) for all) increased: the amount of time allocated for exercise \((14.3 \pm 6.3\) min vs. \(12.1 \pm 6.5\) min\) repetitions performed \((126.4 \pm 71.7\) vs. \(88.0 \pm 48.8\)) and liking \((8.1 \pm 1.5\) cm vs. \(7.1\pm 2.1\) cm) during the HV condition relative to the LV condition. RRV of resistance exercise versus a sedentary alternative was not significantly \((p \geq .09)\) different from the HV to the LV condition in males but was significantly greater in the HV condition in females \((p \ll .05)\). Increasing the variety of resistance training equipment increased the amount and enjoyment of resistance training exercise performed.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>ix</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td><strong>CHAPTER</strong></td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. LITERATURE REVIEW</td>
<td>7</td>
</tr>
<tr>
<td>Epidemiology</td>
<td>8</td>
</tr>
<tr>
<td>Physical Activity Patterns</td>
<td>8</td>
</tr>
<tr>
<td>Risk Factors Diseases</td>
<td>10</td>
</tr>
<tr>
<td>Behavioral Economics</td>
<td>12</td>
</tr>
<tr>
<td>RRV Determination</td>
<td>13</td>
</tr>
<tr>
<td>Relative Reinforcing Value</td>
<td>14</td>
</tr>
<tr>
<td>RRV of Smoking</td>
<td>14</td>
</tr>
<tr>
<td>RRV of Alcohol</td>
<td>15</td>
</tr>
<tr>
<td>RRV of Food</td>
<td>16</td>
</tr>
<tr>
<td>RRV of Physical Activity</td>
<td>19</td>
</tr>
<tr>
<td>Wanting and Liking</td>
<td>21</td>
</tr>
<tr>
<td>Variety</td>
<td>22</td>
</tr>
<tr>
<td>Variety and Food</td>
<td>23</td>
</tr>
<tr>
<td>Variety and Consumer Purchasing</td>
<td>24</td>
</tr>
<tr>
<td>Variety and Physical Activity</td>
<td>24</td>
</tr>
<tr>
<td>Other Factors Influencing Physical Activity Behavior</td>
<td>26</td>
</tr>
<tr>
<td>Sensory-Specific Satiety</td>
<td>28</td>
</tr>
<tr>
<td>Physiological Benefits of Exercise Variety</td>
<td>29</td>
</tr>
<tr>
<td>Purpose</td>
<td>29</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>30</td>
</tr>
<tr>
<td>III. METHODS</td>
<td>31</td>
</tr>
<tr>
<td>Participant Selection</td>
<td>31</td>
</tr>
<tr>
<td>Research Design</td>
<td>31</td>
</tr>
<tr>
<td>Procedures</td>
<td>32</td>
</tr>
<tr>
<td>Visit One</td>
<td>33</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>1. Free choice, condition by gender—Time allocated to weights</td>
<td>49</td>
</tr>
<tr>
<td>2. Free choice, group by gender—Average time allocated to weights</td>
<td>50</td>
</tr>
<tr>
<td>3. Free choice, condition—Time allocated to weights</td>
<td>52</td>
</tr>
<tr>
<td>4. Free choice, group—Average time allocated to weights</td>
<td>53</td>
</tr>
<tr>
<td>5. Free choice, group by gender—Total repetitions</td>
<td>55</td>
</tr>
<tr>
<td>6. Free choice, group—Total repetitions</td>
<td>56</td>
</tr>
<tr>
<td>7. Free choice, gender—Average total repetitions</td>
<td>57</td>
</tr>
<tr>
<td>8. Free choice, condition—Total repetitions</td>
<td>58</td>
</tr>
<tr>
<td>9. Free choice, condition—Total weight lifted</td>
<td>61</td>
</tr>
<tr>
<td>10. Free choice, condition—VAS (liking) scores</td>
<td>63</td>
</tr>
<tr>
<td>11. Free choice, condition—OMNI RPE</td>
<td>64</td>
</tr>
<tr>
<td>12. RRV, group by gender—Time earned for additional weight lifting</td>
<td>66</td>
</tr>
<tr>
<td>13. RRV, condition by gender—Time earned for additional weight lifting</td>
<td>67</td>
</tr>
<tr>
<td>14. RRV, condition—Time earned for additional weight lifting</td>
<td>68</td>
</tr>
<tr>
<td>15. O_{MAX}—Condition by gender</td>
<td>70</td>
</tr>
<tr>
<td>16. O_{MAX}—Condition</td>
<td>71</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Research Design</td>
<td>32</td>
</tr>
<tr>
<td>2. Counterbalancing Orders for High Variety and Low Variety Exercise Conditions</td>
<td>33</td>
</tr>
<tr>
<td>3. Participant Physical Characteristics</td>
<td>46</td>
</tr>
<tr>
<td>4. VAS Scores Resistance Exercises (M ± SD)</td>
<td>47</td>
</tr>
<tr>
<td>5. Free Choice, Condition—Time Allocated to Weights</td>
<td>48</td>
</tr>
<tr>
<td>6. Free Choice, Condition—Total Repetitions</td>
<td>54</td>
</tr>
<tr>
<td>7. Free Choice, Condition—Total Weight Lifted (M ± SD)</td>
<td>60</td>
</tr>
<tr>
<td>8. Free Choice, Condition—VAS (Liking) and Average OMNI RPE</td>
<td>62</td>
</tr>
<tr>
<td>9. RRV, Condition—Time Earned for Additional Weight Lifting</td>
<td>65</td>
</tr>
<tr>
<td>10. $O_{\text{MAX}}$—Condition</td>
<td>69</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

According to the Centers for Disease Control and Prevention (CDC), in the United States, at least 365,000 “preventable” deaths/year (16% of all deaths), second only to deaths caused by smoking, are the result of poor diet and lack of physical activity (Lox, Martin-Ginis, & Petruzzello, 2006; Mokdad, Marks, Stroup, & Gerberding, 2005). The CDC further concluded that “physical inactivity is one of the major underlying causes of premature mortality in the United States” (Cook et al., 1998, p. 1097). Regular physical activity has numerous health benefits for individuals of all ages including improved cardiovascular fitness, weight control, improved self-esteem, reduced risk of cardiovascular disease (Eyre et al., 2004; Haskell et al., 2007; Kruger, Ham, & Sanker, 2008; Lee & Paffenbarger, 2000; US Department of Health and Human Services, 1996), diabetes (Albright et al., 2000; Bakris et al., 2009; US Department of Health and Human Services, 1996), hypertension (Siscovick, LaPorte, & Newman, 1985; US Department of Health and Human Services, 1996), certain types of cancer (Coups, Hay, & Ford, 2008; Coyle, 2008; Hagey & Warren, 2008; Inoue et al., 2008; Miles, 2007; Reigle & Wonders, 2009; US Department of Health and Human Services, 1996), obesity (Desai, Miller, Staples, & Bravender, 2008; Kipping, Jago, & Lawlor, 2008a, 2008b; O’Gorman & Krook, 2008; US Department of Health and Human Services, 1996), and depression (S. L. Hughes, Seymour, Campbell, Whitelaw &
Bazzarre, 2009; Taliaferro, Rienzo, Pigg, Miller, & Dodd, 2009; Taylor, Sallis, & Needle, 1985; US Department of Health and Human Services, 1996). However, the prevalence of overweight and obesity has steadily increased over the past 20 years (CDC, 2006; National Center for Health Statistics, 2007; Nader, Bradley, Houts, McRitchie, & O’Brien, 2008; Ogden, Carroll & Flegal, 2008). Approximately two-thirds of adults in the U.S. are overweight (BMI ≥ 25 – <30) or obese (BMI ≥ 30; National Center for Health Statistics, 2007). Thirty-three percent of children in the U.S. are either at risk for becoming overweight (≥85th – <95th BMI percentile) or are overweight (≥95th BMI percentile; CDC, 2008). These rates suggest that individuals of various ages are likely not participating in adequate amounts of physical activity.

Despite the known benefits of exercise, fewer than 60% of adults participate in regular physical activity, with 25% being considered sedentary (National Center for Health Statistics, 2007). Accelerometer data obtained from the National Health and Nutritional Examination Survey (NHANES) revealed that 58% of children ages 6–11 and 92% of adolescents ages 12–19 do not achieve recommended levels of daily physical activity (National Center for Health Statistics, 2007). The U.S. Department of Health and Human Services recently released the new 2008 Physical Activity Guidelines for Americans for those aged six and older. Recommendations for children, ages 6–17, include 60 minutes or more of moderate to vigorous physical activity (MVPA) daily. Resistance training should be incorporated as well, on at least three days/week (U.S. Department of
Health and Human Services, 2008). For health benefits, adults, ages 18–64, should incorporate 150 minutes of moderate intensity, or 75 minutes of vigorous intensity exercise weekly. Resistance training should be performed on two or more days a week. Individuals ages 65 and older should follow the adult guidelines with the addition of exercises to maintain or improve balance (U.S. Department of Health and Human Services, 2008). These guidelines closely follow guidelines from the American College of Sports Medicine (ACSM)/American Heart Association (AHA) (Haskell et al., 2007; Nelson et al., 2007).

Various factors have been indicated as potential contributors to the decline in physical activity over the years, including technological advances that reduce the need for physical labor. There have also been concomitant increases in working hours and greater production demands placed upon employees leaving less free time for physical activity (Hellerstedt & Jeffery, 1997). Astrand and others (Astrand, 1988; Booth, Gordon, Carlson, & Hamilton, 2000) maintained that the human species evolved adapting to a “hunter-gatherer” lifestyle relying heavily on physical labor for survival. The advent of the industrial revolution lessened the need for physical labor resulting in increased physical inactivity which may a contributing factor to the increase in chronic diseases observed late in the 20th century (Booth et al., 2000).

Results from the third National Health and Nutrition Examination Survey (NHANES III) and the 1990 National Health Interview Survey reveal that physical activity decreases with age (Arriaza Jones et al., 1998; Crespo, Keteyian, Heath,
& Semos, 1996; J. P. Hughes, McDowell, & Brody, 2008). Additionally, there are gender differences in the frequency, intensity, type, and time of activities in which individuals engage (Arriaza Jones et al., 1998; National Center for Health Statistics, 2007; Sallis, 2000; Sallis, Prochaska, & Taylor, 2000). Garnering a better understanding of factors that contribute to the likelihood that individuals of all ages will be physically active may lead to the development of exercise recommendations and/or intervention programs which are more likely to increase the amount of physical activity performed, leading to the promotion of health-related fitness.

The decision to be active or sedentary is primarily influenced by the access to and the reinforcing (motivating) value of the two options. Assuming access is equal, people will typically choose the most reinforcing option (Epstein, Saelens, & O’Brien, 1995; Epstein, Kilanowski, Consalvi, & Paluch, 1999; Epstein, Roemmich, Saad, & Handley, 2004; Saelens & Epstein, 1999; Vara & Epstein, 1993). It has been demonstrated that altering aspects of an individual’s environment may influence their motivation to be physically active. One such environmental manipulation involves increasing the variety of options with which an individual is presented. When food variety is increased, individuals tend to eat more (Myers Ernest & Epstein, 2002; Rowland, Vaughan, Mathes, & Mitra, 2008; Temple, Giacomelli, Roemmich, & Epstein, 2008) and when individuals, after eating a similar food for a period of time, are exposed to a novel food stimulus the reinforcing value of eating increases (Epstein, Saad, et al., 2003;
Research on consumer spending has also demonstrated that increased consumer spending is associated with increased purchasing options (Goldfield & Epstein, 2002; Kahn, 1995; Kahn & Wansink, 2004; Mehta & Chang, 2008; Meiselman, deGraaf, & Lesher, 2000; Raynor & Epstein, 2001; Raynor, Niemeier, & Wing, 2006; Temple, Giacomelli, et al., 2008; Van Trijp, 1994).

Despite the evidence supporting a pro-behavioral effect of variety on eating and spending there is very limited research on the effect of variety of exercise options on exercise behavior (Barkley et al., 2008; Glaros & Janelle, 2001). In one study, adults exhibited greater adherence to physical activity and a greater level of enjoyment when changing aerobic exercise every two weeks versus an unchanging exercise regimen (Glaros & Janelle, 2001). In the other study, children performed a greater amount of exercise and reported greater liking for that exercise when presented with multiple exercise options compared to a single option (Barkley et al., 2008). Despite evidence of declining physical activity across the lifespan (Sallis, 2000; Sherar et al., 2009; Troiano et al., 2008), each of these studies focused only on a single age group; adults (ages 18–35) and children (age 8–12 years) respectively. Furthermore, unlike eating studies (Mehta & Chang, 2008; Meiselman et al., 2000; Raynor & Epstein, 2001; Raynor et al., 2006; Temple, Giacomelli, et al., 2008; Van Trijp, 1994), the effect of altering the variety of exercise options on measures of reinforcement or motivation has not been conducted. Therefore, the purpose of this investigation
was to compare the amount of and relative reinforcing value (RRV) for exercise performed in a high-variety exercise condition versus a low-variety exercise condition in children (age 8–12 years), young adults (age 18–26 years), and older adults (age ≥60 years).

Three primary goals of the present study included: (a) To compare the relative reinforcing value (RRV) of a high-variety exercise condition and a low variety exercise condition versus sedentary alternatives. (b) To assess the impact that increasing the variety of exercise options had on the amount of exercise performed. (c) To assess the impact that increasing the variety of exercise options had on the liking of the exercise. Comparisons were then made between three different age groups of males and females; children aged 8–12, young adults aged 18–26, and older adults ≥ age 60. We hypothesized that the high variety condition would elicit a greater RRV and liking, and individuals would perform more exercise than in the low variety condition. We further hypothesized that there would be no age or gender differences in the amount of work performed or the reinforcing value of variety options.
CHAPTER II
LITERATURE REVIEW

Currently, no published data exists examining the effect of altering the variety of exercise options on the relative reinforcing value (RRV) of exercise versus sedentary behavior. Furthermore, few studies have examined the effect of altering the variety of exercise equipment options on exercise behavior in general (Barkley et al., 2008; Glaros & Janelle, 2001).

Conversely, ample research has assessed the effect of altering the variety of food choices on the consumption and RRV of certain foods (Mehta & Chang, 2008; Meiselman et al., 2000; Raynor & Epstein, 2001; Raynor et al., 2006; Temple, Giacomelli, et al., 2008; Van Trijp, 1994). Consumer spending is affected by altering the variety of purchasing options (Inman, 2001; Kahn, 1995; Kahn & Wansink, 2004; Novak & Mather, 2007; Ratner, Kahn, & Kahneman, 1999). Most research demonstrates that as choices increase, individuals increase their food consumption (Mehta & Chang, 2008; Meiselman et al., 2000; Raynor & Epstein, 2001; Raynor et al., 2006; Temple, Giacomelli, et al., 2008; Van Trijp, 1994) and commodity spending (Inman, 2001; Kahn, 1995; Kahn & Wansink, 2004; Novak & Mather, 2007; Ratner et al., 1999). Although the evidence is very limited, variety appears to similarly affect physical activity behavior (Barkley et al., 2008; Glaros & Janelle, 2001).
Literature relative to the current investigation is summarized in the areas of epidemiology, behavioral economics, hedonics, the potential behavioral effects of manipulating variety, and finally, the physiological benefits of participating in a variety of different types of exercise. This review examined previous research in these areas and demonstrated the need for further study examining the effect that varying exercise equipment may have on exercise behavior in children and adults. The goal of this investigation was not to create new programming recommendations but to evaluate the basic effect of altering the variety of exercise equipment on the amount and RRV of the exercise performed in two conditions: high-variety and low-variety. Furthermore, this effect was examined across and compared between three different age groups: children (ages 8–12), young adults (ages 18–22), and older adults (ages ≥60).

**Epidemiology**

**Physical Activity Patterns**

During leisure time, individuals make the choice between active and sedentary behaviors. Leisure-time physical activities are defined as physical activities participated in by an individual during their free time, engaged in at their discretion (Howley, 2001). Examples of such activities can be, but are not limited to, participation in sports, structured exercise programs, gardening, walking, swimming, skiing, and dancing. Data released by the National Health Interview Survey (NHIS) indicated that 39.4% of adults 18-24 engaged in regular leisure time physical activity whereas only 23.1% of adults aged 65–74 and 17.4% of
adults aged 75 and older engaged in regular leisure time physical activity 
(National Center for Health Statistics, 2007). Accelerometer data obtained from 
the 2003–2004 National Health and Nutritional Examination Survey (NHANES) 
revealed that 42% of children ages 6–11 accumulated the recommended 
(Troiano et al., 2008) >60 minutes of moderate to vigorous physical activity 
(MVPA) on 5–7 days per week, whereas only 8% of 12–15 year olds and 7.6% of 
16–19 year olds met similar physical activity guidelines (Troiano et al., 2008). In 
addition to this NHANES data, multiple independent research projects have 
demonstrated a decline in physical activity with age (Sallis, 2000; Sherar et al., 
2009; Troiano et al, 2008) and an increase in physical activity in males when 
compared to females across all age groups (Azevedo et al., 2007; Beighle, 
Morgan, Le Masurier, & Pangrazi, 2006; DeVries, Hopman-Rock, Bakker, & 
VanMechelen, 2009; Sallis, Prochaska, & Taylor, 2000; Sherar et al., 2009; 
Troiano et al., 2008; Trost et al., 2002). Although the benefits of regular physical 
activity, which include decreased risk of cardiovascular disease, obesity, Type II 
Diabetes and certain types of cancers (Albright et al., 2000; Bakris et al., 2009; 
Booth et al., 2000; Coups et al., 2008; Erikssen, 2001; Friedenreich & Orenstein, 
2002; Miles, 2007; O’Gorman & Krook, 2008; Siscovick et al., 1985), are well 
established and accepted, the number of individuals across all age groups 
meeting the recommended guidelines for physical activity remains low.
Risk Factors Diseases

In 2005, the leading causes of death in the United States were heart disease, cancer, and stroke, closely followed by diabetes and Alzheimer’s disease (National Center for Health Statistics, 2007). Multiple investigations focusing on adults have demonstrated an inverse relationship between participation in physical activity and the incidence of these diseases (Albright et al., 2000; Bakris et al., 2009; Booth et al., 2000; Coups et al., 2008; Erikssen, 2001; Friedenreich & Orenstein, 2002; Kramer, Erickson, & Colcombe, 2006; Lautenschlager et al., 2008; Miles, 2007; O’Gorman & Krook, 2008; Podewils et al., 2005; Roberts et al., 2008; Siscovick et al., 1985). Because of this evidence, physical activity is now recognized as a modifiable risk factor for each of these diseases (Eyre et al., 2004; Haskell et al., 2007; Kruger et al., 2008).

Additionally, obesity, which itself is a risk factor for diabetes, cardiovascular disease, and breast and colon cancers (American Cancer Society, 2008; Coups et al., 2008; Coyle, 2008; Hagey & Warren, 2008; Inoue et al., 2008; Miles, 2007; Reigle & Wonders, 2009), has been repeatedly linked to physical inactivity (Desai et al., 2008; Kipping et al., 2008a, 2008b; O’Gorman & Krook, 2008). Obesity and physical inactivity contribute to an estimated cost of more than $170 billion annually for the diagnosis and treatment of Type II diabetes, cardiovascular disease, and several types of cancers (Finkelstein, Fiebelkorn, & Wang, 2003; Pratt, Macera, & Wang, 2000).
The health problems associated with physical inactivity and obesity are not limited to adults. Physical inactivity has been implicated as contributing to the increasing rates of obesity, metabolic and cardiovascular disease observed in children and adolescents (Dencker & Andersen, 2008; Kipping et al., 2008a, 2008b). Currently, 16.3% of American children ages 2–19 are considered overweight (BMI percentile $\geq 95^{th}$) and 17% are considered at risk for becoming overweight (BMI percentile $\geq 85^{th} - < 95^{th}$; Ogden et al., 2008). From the 1970s to the present, the incidence of obesity in children ages 2 to 5 and 12 to 19 have nearly tripled while the incidence has quadrupled in children ages 6 to 11 (Daniels, Jacobson, McCrindle, Eckel, & McHugh Sanner, 2009). The short-term and chronic adverse consequences of this obesity epidemic are alarming. Risk factors for cardiovascular disease including hypertension, left ventricular hypertrophy, and dyslipidemia have been linked to an increased BMI in children (Daniels, 2006). Insulin resistance and Type II diabetes, once considered a disease of adulthood, are now appearing in children and adolescents (Daniels, 2006). These risk factors and their concomitant link to physical inactivity appear to be predictive of cardiovascular disease mortality and morbidity in later life (Kvaavik, Klepp, Tell, Meyer, & Batty, 2008).

The link between physical inactivity and the risk of developing cardiovascular and metabolic diseases and certain forms of cancer across the lifespan has been clearly demonstrated (American Cancer Society, 2008; Coups et al., 2008; Coyle, 2008; Dencker & Andersen, 2008; Desai et al., 2008; Hagey
& Warren, 2008; Inoue et al., 2008; Kipping et al., 2008a, 2008b; Miles, 2007; O’Gorman & Krook, 2008; Reigle & Wonders, 2009). Despite this evidence, participation in the recommended levels of physical activity across all age groups remains low. Consequently, additional research is needed to understand factors that influence individuals to engage in healthier behaviors.

**Behavioral Economics**

The field of exercise psychology, which combines elements of exercise science and psychology, has emerged to study and apply psychological theories to promoting and maintaining leisure time physical activity (Lox et al., 2006). One theory in the field of exercise psychology, behavioral economics, describes how the time and effort required to participate in one behavior are weighed against the time and effort required to participate in an alternative behavior (Epstein, 1998). The time and effort required to participate in a behavior are often thought of as part of the ‘cost’ of participating in that behavior. The perceived consequences of participation and the motivation or reinforcing value of participating in each option is then factored in with the cost before a decision is made as to which behavior will be chosen. If two options have a similar cost, individuals will choose the more reinforcing option. If cost is different, individuals may work more for the more reinforcing option (Epstein, Bulik, Perkins, Caggiula, & Rodefer, 1991; Epstein, Smith, Vara, & Rodefer, 1991; Epstein & Roemmich, 2001; Epstein, Roemmich, Paluch, & Raynor, 2005; Lox et al., 2006; Murphy, Correia, & Barnett, 2007). One of the goals of this theory is to provide a
framework to identify how choice is influenced by the manipulation of environmental variables that are designed to alter the cost and/or RRV of a behavior (Faith, Rose, Matz, Pietrobelli, & Epstein, 2006). Various studies demonstrate that by manipulating these factors a desired alternate behavior can be obtained (Epstein, Bulik, et al., 1991; Epstein, Smith, et al., 1991; Epstein & Roemmich, 2001; Epstein et al., 2005; Giesen, Havermans, Nederkoorn, Strafaci, & Jansen, 2009; Lox et al., 2006; Murphy et al., 2007; Vara & Epstein, 1993).

**RRV Determination**

Measurement of the strength of the reinforcers can be performed by using a progressive-ratio schedule whereby a variable ratio (VR) or fixed ratio (FR) schedule is introduced and the strength of the reinforcer is determined by how much work is performed to obtain access to that reinforcer (Hursh & Silberberg, 2008). Determination of the RRV of one activity versus another can be accomplished by having an individual work to gain access to the two activities (Epstein & Roemmich, 2001). In a laboratory setting, an individual is asked to perform an operant button-pressing computer task to gain access to one activity or the other (Epstein et al., 1999). The RRV is assessed by how much work the individual is willing to perform to engage in one option versus the alternative. This model has been validated by demonstrating that children, who have a greater RV for physical activity relative to sedentary behaviors, participate in greater amounts of physical activity than children who find sedentary behaviors
relatively more reinforcing than physical activity (Epstein et al., 1999; Epstein & Roemmich, 2001; Epstein, Smith, et al., 1991). To our knowledge, these types of investigations have not been performed on child or adult populations with respect to variety of exercise options.

**Relative Reinforcing Value**

Use of relative reinforcing value has been applied in multiple studies seeking to engage individuals to participate in alternate behaviors. Studies reviewed include the evaluation of RRV of the following behaviors: smoking, alcohol consumption, participation in physical and sedentary activity, and eating. Where it has been assessed, the effect of variety on RRV of these behaviors is highlighted.

**RRV of Smoking**

The RRV task was initially developed to assess smoking behavior. As such this research is outlined first.

For example, Epstein, Bulik, et al. (1991) evaluated the RRV of smoking and analyzed this behavior using food and money as alternative reinforcers, over two separate experiments. In the first experiment, prior to the RRV task, for two days each, participants were either deprived of smoking for a period of time, or had no restriction placed upon smoking. During the RRV computer task, when the required amount of work to gain access to money or smoking was equal, money was chosen over smoking. During the smoke deprivation days, as the reinforcing value task continued, with progressively more work needed to obtain
points for either smoking or money, equal time was allocated for working towards access to both. In the non-deprived condition, participants worked towards significantly more points for money than smoking even as the work required to gain access to money increased. In the second of the experiments, four conditions were counter-balanced: smoke deprivation, food deprivation, deprivation of both, or no deprivation of either smoking or food. In the no food or smoking deprivation condition, smoking appeared to have the greater RRV whereas during the smoking and food deprivation settings, respectively, the RRV of each deprived behavior was greater than the alternate behavior. When access to both food and smoking were decreased, the RRV task demonstrated that initially participants worked more to obtain food. As the amount of work to gain access increased, both smoking and food were equally reinforcing. Finally, when the largest amount of work was required to gain access, the choice was shifted to smoking. The investigators concluded that the RRV of smoking was dependent upon the time deprived from smoking, the amount of work performed to obtain the reinforcer, and if alternative reinforcers were available (Epstein, Bulik, et al., 1991).

**RRV of Alcohol**

Murphy et al. (2007) examined the use of behavioral economic theory in an effort to explain college drinking behavior. The investigators maintained that college student drinking is related to several of the factors outlined in the behavioral economic theory. Specifically, when the “cost” to obtain a commodity
is low, greater consumption results and individuals are more likely to participate in or choose options or behaviors that are more accessible (Epstein, Bulik, et al., 1991; Epstein, Smith, et al., 1991; Epstein & Roemmich, 2001; Epstein et al., 2005; Lox et al., 2006; Murphy et al., 2007). In and around college campuses the cost of alcohol is typically low and readily accessible (Murphy et al., 2007). Additionally, most students have large amounts of leisure time and if more reinforcing options are not as easily accessible or the cost of these alternatives is the same or greater, students will often choose to participate in drinking.

**RRV of Food**

Several studies have evaluated the RRV of food under various conditions. A study was conducted with college aged females examining the RRV of food in food deprived and food restricted conditions (Raynor & Epstein, 2003). During the deprived conditions, no food was presented to participants during the meal session. In the restricted condition, a plate of their highest rated snack food was present during the 15 minute meal session, but participants were not permitted to eat the food. Participants were instructed to study the appearance of the food for questioning after the session. Participants then played a RRV computer game to earn points for their highest rated food or sedentary activity. It was revealed that participants worked more for food when deprived but not when food was restricted, that is, access to food was limited. It was concluded that in a deprived condition the RRV of food is increased and may lead to individuals choosing
eating over other behaviors. However, this may or may not generalize to all types of food.

Other studies investigated the RRV of food when participants of different weight status performed tasks to access food or alternate sedentary activities (Epstein, Temple, et al., 2007; Saelens & Epstein, 1996; Temple, Legierski, Giacomelli, Salvy, & Epstein, 2008). In these studies, obese adults (Epstein, Temple, et al., 2007; Saelens & Epstein, 1996) and overweight children (Temple, Legierski, et al., 2008) performed more work to access food than the non-obese adults and at risk for overweight children. The individuals that chose food over alternative behaviors found food to be highly reinforcing.

Food can be a very powerful reinforcer when compared to available alternatives (Berridge, 1996). A review by Rowland et al. (2008) concluded that three factors, increased access to energy-dense foods, decreased monetary costs to obtain the food, and the variety of options available, are partly responsible for increased obesity in humans. In a study conducted by Goldfield and Epstein (2002) as the cost to gain access to a desired behavior, in this case snack foods, was increased, participants switched to alternative behaviors as substitutes. Another study examined the individual differences in the reinforcing value of snack food in restrained and non-restrained participants (Giesen et al., 2009). The restrained participants worked harder for access to the snack foods leading the investigators to posit that RRV of snack food is larger when access is limited. Therefore, these studies in examining the RRV of food suggest that
alternative reinforcers can compete with food depending on the deprivation state of the individual and constraints placed on access to the food.

An individual's eating behavior may also be related to the environment and/or genetic factors. A study involving a group of 5-year-old twin boys by Faith et al. (2006) demonstrated that the amount of fruit and vegetable intake as well as caloric intake could be manipulated by offering the prize vouchers (contingent reinforcer) for consuming fruits and vegetables over high fat food options. Using a counterbalanced approach, with lunch meals being equal, one of the twins in each set was told that vouchers for prizes could be earned for each fruit or vegetable consumed. The other twin in each set was only told that he would receive a predetermined amount of prize vouchers after the meal. The results indicated that the twins in the contingent reinforcer group had greater consumption of fruits and vegetables (desired behavior) and reduced fat and total caloric (less desirable behavior) intake than the non-contingent reinforced group of twins. Thus, this study suggests that it is possible to change behaviors and induce individuals to exhibit a more desirable behavior, greater consumption of fruits and vegetables, by pairing the desired behavior with an attractive reinforcer, in this case, prize vouchers. This investigation was unique in that by using identical twins as participants, environmental effects were isolated by substantially controlling for genetic factors (Faith et al., 2006).
RRV of Physical Activity

Ways to reinforce reductions in sedentary behavior and/or increases in physical activity in children were explored in numerous studies (Epstein et al., 1995; Epstein & Roemmich, 2001; Epstein et al., 2004; Salvy et al., 2009; Southard & Southard, 2006). When choice and access to sedentary and physical activities are equal, the sedentary behavior is chosen in both overweight and normal weight children (Epstein, Smith, et al., 1991). It has been theorized that participation in physical activity occurs after a series of choices made between being either active or sedentary. Normal and overweight children demonstrate an increase in physical activity when access to sedentary behavior was decreased and access to vigorous physical activity was simultaneously increased. This was accomplished by increasing the amount of work required to gain access to the sedentary behavior, or reinforcing non-engagement in sedentary behavior. However, overweight children relative to their lean counterparts performed more work for more access to the sedentary behavior, independent of the relative cost of sedentary versus vigorous physical activities (Epstein, Smith, et al., 1991). This suggests that overweight children relative to their lean counterparts may require different approaches to prompt increased activity participation.

Another study involving overweight children demonstrated that physical activity could be increased by either reinforcing an increase in physical activity or by reinforcing a reduction in time allocated to one of their two preferred sedentary
activities (Epstein et al., 1995). On non-experimental days, children had equal access to four physical and four sedentary activities. Children on these days devoted more time to sedentary activities. On experimental days, children in each treatment group earned points for reinforcers such as gift certificates for each minute of increased physical activity or decreased preferred sedentary behaviors, respectively. Activity increased in both groups compared to the control condition. Although significantly more physically active than the control group, the reduced sedentary behavior group allocated more time to the less reinforcing sedentary behaviors. By employing reinforcement strategies to increase physical activity behaviors or decrease sedentary behaviors, overweight children may begin allocating more leisure time to physical activity as a substitute for sedentary behaviors. Further research is necessary to determine if this behavior would be observed in lean children as well as the adult population.

The practice of using economic incentives to engage consumers in preventive health behaviors has become more common (Finkelstein, Brown, Brown, & Buchner, 2008). Financial incentives were used as a reinforcer in the promotion of walking among sedentary older adults (Finkelstein et al., 2008). The treatment group logged almost two times more walking hours per week than the control group, leading the authors to conclude that modest financial incentives may be a way of increasing physical activity in previously sedentary older adults (Finkelstein et al., 2008).
These studies suggest that one approach to increasing physical activity may be examining its reinforcing value as an alternative to reinforcing sedentary behaviors. It also indicates that modifications may need to be made in exercise intervention programs for obese individuals as they may be differently motivated relative to lean individuals. Understanding these theories may assist in the development of effective exercise prescriptions for individuals of varying ages, body weight, and levels of motivation.

**Wanting and Liking**

The type of physical activity individuals engage in is likely influenced by additional factors apart from reinforcement. One such factor may be hedonics (liking) of physical activity (Hyman & Malenka, 2001; Robinson & Berridge, 2000; Roemmich et al., 2008). The amount of physical activity engaged in may be predicted by the enjoyment or “liking” (Lox et al., 2006; Wankel, 1993) of the activity (Dishman et al., 2005; Motl et al., 2001).

Differences in neurobiology may partially explain the differences in reinforcing value and liking. The dopamine neurotransmitter system influences the reinforcing or motivational values of such behaviors as eating and the administration of addictive drugs (Berridge, 1996). Conversely, liking or the hedonic pleasure of these behaviors is controlled by the opioid system (Berridge, 1996; Pecina, Smith, & Berridge, 2006). It appears possible to dissociate the concepts “wanting” and “liking” for foods (Finlayson, King, & Blundell, 2007; Finlayson, King, & Blundell, 2008) and drugs (Berridge, Robinson, & Aldridge,
The role of liking in the choice to engage in physical activity (Ekkekakis, Hall, & Petruzzello, 2008; Roemmich et al., 2008) has been studied. An independent association between the RRV and liking of physical activity and the amount of time spent performing moderate to vigorous physical activity (MVPA) has been demonstrated (Roemmich et al., 2008). Furthermore, the greatest performance of MVPA occurs when individuals exhibit both high RRV and liking of physical activity (Roemmich et al., 2008). When comparing a physical activity game (interactive dance) and a corresponding sedentary alternative (video hand controlled dance game), liking was equal between the two, but the dance activity was more motivating, that is, more work was performed to gain access to the activity (Epstein, Beecher, Graf, & Roemmich, 2007).

**Variety**

The concept of altering the variety of available options as a means of increasing a behavior has been studied in several contexts. The manipulation of the variety of options available affects consummatory behaviors when purchasing goods (Kahn & Isen, 1993; McAlister & Pessemier, 1982; Menon & Kahn, 1995; Ratner et al., 1999), determining music choices (Novak & Mather, 2007), and feeding behaviors (Mehta & Chang, 2008; Meiselman et al., 2000; Raynor & Epstein, 2001; Raynor et al., 2006; Temple, Giacomelli, et al., 2008; Van Trijp, 1994). Factors such as age appear to affect variety seeking behavior indicating that older adults choose less variety for future consumption of items such as food and music, whereas when choosing for immediate consumption older adults...
select greater variety and younger adults exhibit less variety-seeking behaviors (Novak & Mather, 2007).

**Variety and Food**

A review of feeding behaviors, obesity and neuroeconomics, a discipline that examines the neural basis of the decision-making process, revealed that food consumption is increased in buffet type restaurants where the cost is fixed and individuals have access to a wide variety of food choices with no restriction on accessibility (Rowland et al., 2008). It has been suggested that a positive association exists between the number of restaurants in a neighborhood and weight status of the surrounding population. Moreover, it appears that the types of restaurants available function as a determinant for weight outcomes. For example, a higher density of fast-food restaurants is positively associated with increased weight (Meiselman et al., 2000). Changing the variety of sensory properties of various foods such as taste, smell, color, and texture may affect feeding behaviors due to the perception of variety (Inman, 2001; Kahn & Wansink, 2004; Rolls, Rowe, & Rolls, 1982; Rolls, Van Duijvenvoorde, & Rolls, 1984; Van Trijp, 1994). Changing the shape of pasta (Rolls et al., 1982), the color of chocolate (Rolls et al., 1982) and jellybeans (Kahn & Wansink, 2004), and the flavor of cream cheese sandwiches (Rolls et al., 1982), although the same food, resulted in enhanced food intake. When presented with a four course meal with different food in each course or the same food in each course, a 60% increase in food consumption was noted in the varied condition (Rolls et
al., 1984). In each of the aforementioned conditions, the introduction of variety appears to increase food consumption.

When repeatedly presented with the same food, habituation, a decreased response to the food stimulus, occurs, resulting in decreased consumption (Swithers & Hall, 1994). The addition of variety results in dishabituation (Myers Ernest & Epstein, 2002; Temple, Giacomelli, et al., 2008) as well as variety being more reinforcing than presentation with the same food (Epstein, Saad, et al., 2003; Epstein & Leddy, 2006; Myers Ernest & Epstein, 2002; Temple, Giacomelli, et al., 2008).

**Variety and Consumer Purchasing**

Variety-seeking behavior is evidenced in many aspects of life. Consumer purchasing of goods and services is influenced by variety (Kahn, 1995; Ratner et al., 1999). The variety of options influences the purchase of such diverse commodities as financial investments, foods, restaurants, vacations, and choice of theme parks (Kahn, 1995; Kemperman, Borgers, Oppewal, & Timmermans, 2000). Interestingly, even in frontier days in early Kentucky, wealthier settlers purchased more goods from a variety of stores (Perkins, 1991).

**Variety and Physical Activity**

Despite the assessments of the RRV of physical activity, and the observation that variety increases the RRV of eating and consumer spending, currently no studies have examined the effect of variety and the RRV of physical activity. Only two studies have directly investigated the effect of variety on levels
of physical activity performed by participants (Barkley et al., 2008; Glaros & Janelle, 2001). The effect of varying resistance training equipment on the amount of physical activity performed by 8–12 year old children was examined when having access to seven pieces of resistance training equipment during the high variety (HV) session or only their single favorite piece of resistance training equipment during the low variety (LV) session (Barkley et al., 2008). It was revealed that, relative to the LV session, participants performed more resistance-training exercise and indicated greater liking scores for the HV session. One of the limitations of this study was that only one piece of equipment was available for the LV session which may have limited the amount of exercise participants could perform in this condition due to fatigue. The study also did not evaluate the RRV of the HV session versus the LV session.

In the second study examining whether varying workouts would increase exercise adherence, participants included sedentary adults, ages 18–35 (Glaros & Janelle, 2001). The study was conducted over an 8-week period during which participants in the varied condition changed their one type of aerobic exercise every two weeks whereas the other group performed the same exercise for the entire study. Although the potential effect of variety on increasing physical activity participation in a single session was not demonstrated here, the study did reveal greater adherence to physical activity and a greater level of enjoyment in the group that changed the aerobic exercise every two weeks.
Other Factors Influencing Physical Activity Behavior

Environmental factors may contribute to increased or decreased physical activity performed by individuals. Access to or availability of recreational resources has been shown to influence participation in physical activity. The presence of public parks in neighborhoods may be contributory to increased physical activity (Baker, Schootman, Kelly, & Barnidge, 2008; Epstein et al., 2006; Grow et al., 2008). Other studies reveal that when a greater variety of physical activity resources such as schools, parks, and commercial facilities (Pate et al., 2008), abundant and varied playground equipment (Farley, Meriwether, Baker, Rice, & Webber, 2008), and multiple recreational activity choices (Bowles, Merom, Chey, Smith, & Bauman, 2007) were accessible, levels of physical activity appear to increase. A study by Gauvin et al. (2008) indicates that in neighborhoods with a greater variety of destinations such as restaurants and stores, middle-aged and older adults increased walking both for pleasure as well as utilitarian purposes. Accessibility to attractive public open spaces was found to be associated with higher levels of walking, sport participation, and other recreational activities (Giles-Corti et al., 2005). When availability and/or accessibility to physical activity resources are decreased, recommended levels of physical activity may not be met (Estabrooks, Lee & Gyurcsik, 2003). On the other hand, in an effort to decrease sedentary behavior, more physical activity was performed when a variety of physical activity options were available as opposed to only one choice (Epstein & Roemmich, 2001). Research
investigating different types of physical activity programs for older adults revealed that multiple-component programs containing classes consisting of a combination of low-impact aerobic exercise, resistance training, and flexibility, exhibited significantly better adherence as well as significantly greater improvements in functional test measurements (S. L. Hughes et al., 2009). These results suggest that variety within an exercise class may be a motivating factor to increase retention rates as well as enjoy the benefits of exercise.

In a study examining older adults and physical activity, Podewils et al. (2005) explored the relationship between the variety of leisure time physical activity and the relative risk of dementia. Findings revealed that there was an inverse relationship between leisure-time energy expenditure and risk of dementia. They also discovered that as the number of physical activities increased, the risk of dementia decreased. They concluded that participation in a greater variety of activities appears to be as or more important in the relative risk of dementia than the frequency, intensity, or duration of the activities.

If physical activity is increased, activities that often accompany sedentary activity such as eating decrease. Being overweight is the result of positive energy balance. Therefore, increasing physical activity while decreasing energy intake will cause a shift with concomitant weight-loss. The outcome may result in decreasing the obesity epidemic in our country. Obesity is considered a risk factor for diseases such as CAD (Dencker & Anderson, 2008; Kipping et al., 2008a, 2008b; National Center for Health Statistics, 2007), diabetes (Bakris et
al., 2009; O’Gorman & Krook, 2008), and certain types of cancers (Coups et al., 2008; Coyle, 2008; Friedenreich, 2001; Friedenreich & Orenstein, 2002; Hagey & Warren, 2008; Inoue et al., 2008; Miles, 2007; Pan & DesMeules, 2009; Reigle & Wonders, 2009). Lifestyle changes including healthier eating and increasing physical activity may ultimately lead to decreases in these diseases as well.

Fifty percent of adults drop out of exercise programs within six months of beginning them (Dishman, 1994; Dishman & Gettman, 1980; Dishman, Washburn, & Schoeller, 2001). Adding variety may decrease boredom thereby increasing enjoyment and adherence to an exercise program (Finkelstein et al., 2008; Glaros & Janelle, 2001).

**Sensory-Specific Satiety**

The basis for variety-seeking behavior has been studied in many different contexts. Kahn (1995) asserted that individuals may seek variety due to satiation/stimulation, external situation, and future preference uncertainty. Individuals will choose less preferred experiences for the sake of variety. One hypothesis is that individuals seek variety when satiated with higher preference choices such as music (Ratner et al., 1999) and food (Epstein, Saad, et al., 2003; Myers Ernest & Epstein, 2002; Temple, Giacomelli, et al., 2008). When a new food or product is introduced, consumption increases. Ratner et al. (1999) concluded that the benefit of variety generalizes to choosing multiple different and not just less-preferred experiences. They further surmise that individuals will choose less preferred choices even when not yet satiated on favored choices.
Age groups appear to demonstrate differences in sensory-specific satiety, being pronounced in adolescents and reduced in the elderly (Rolls & McDermott, 1991). This difference may be due to sensory impairment resulting from aging (Doty et al., 1984). Perhaps if individuals are presented with a variety of exercise options their “consumption” would increase.

**Physiological Benefits of Exercise Variety**

While the effect of altering the variety of exercise options on the RRV of exercise behavior has not been well studied, there is a substantial amount of evidence supporting the physiologic benefits of performing a variety of different physical activities. When the same activities are performed all of the time there is the risk of injury from overuse/repetitive motion (American College of Sports Medicine [ACSM], 2009). Conversely, by performing a variety of new activities the body is challenged in new ways (Vescovi & Fernhall, 2000; Wong et al., 2008). The physiological benefits incorporating variety in resistance training include significant increases in strength and lean body mass, decreases in body fat, and modest increases in cardiovascular capacity and have been demonstrated in both adults (Gettman & Pollock, 1981) and at risk and overweight children (McGuigan, Tatasciore, Newton, & Pettigrew, 2009).

**Purpose**

In conclusion, while the pro-behavioral effects of variety have been well-studied in the context of eating and consumer spending, there is a dearth of information examining the basic effect of altering the variety of exercise
equipment options on the amount and reinforcing value of exercise behavior. Furthermore, there have been no examinations of the potential differential effects manipulation of the variety of exercise equipment has on individuals of different age groups. Therefore, the purpose of this investigation was to examine the effect of altering the variety of resistance-training equipment options on the RRV, liking, effort perception, and the amount of exercise performed by children (ages 8–12), young adults (ages 18–26) and older adults > age 60.

**Hypotheses**

1. Children, young adults, and older adults will perform more repetitions, allocate more time for, and lift more weight during a free-choice high-variety resistance-training equipment exercise condition than a free-choice low-variety alternative session of equal duration.

2. Children, young adults, and older adults will exhibit a greater liking and RRV (earn more time and perform more work during an operant responding computer task) and a lower RPE (rate of perceived exertion) for access to physical activity relative to sedentary alternatives when there is a high variety of exercise equipment options (HV) versus a condition where there is a low variety (LV) of exercise equipment options.

3. There will be no age or gender differences between preferences of the high variety resistance exercise equipment option relative to the low variety resistance exercise equipment option.
CHAPTER III

METHODS

Participant Selection

Participants consisted of three different age groups: children, 8–12 years old, boys ($n = 6$) and girls ($n = 6$); young adults, 18–26 years old, males ($n = 6$) and females ($n = 6$); and older adults, $\geq 60$ years old, males ($n = 6$) and females ($n = 6$). Participants did not have any conditions that were considered contraindications to physical activity including: orthopedic, neuromuscular, metabolic, cardiovascular, or cognitive disorders. Participants were excluded if they were currently participating or had a history of participation with resistance training within the previous six months.

Research Design

The study was a quasi-experimental design which examined the differences in the amount of time earned and/or work performed to participate in either a high variety (HV) or low variety (LV) resistance training exercise condition (Table 1). This is a three age group (child, young adult, older adult) by two gender (male, female) by two condition (HV, LV) mixed design with age and gender serving as between-subjects variables and condition serving as a within-subjects variable. Condition order (HV, LV) was counterbalanced across participants and test days. There were 2 counterbalancing orders with equal numbers of males and females from each age group in each order (Table 2).
Table 1

*Research Design*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>High Variety Time Earned</th>
<th>Low Variety Time Earned</th>
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<tbody>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>6</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Females</td>
<td>6</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Young adults</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>6</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Females</td>
<td>6</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Older adults</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>6</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Females</td>
<td>6</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Procedures**

Participants were recruited from the local community through posted flyers and from a database of individuals that had previously contacted the Applied Physiology Laboratory at Kent State University for separate unrelated studies. A phone script was read to familiarize the potential adult participants (Appendix A) or parents of potential child participants (Appendix B) with the details of the study. If interested in participation, a phone screen was completed to assess height, weight, and medical history (Appendices C & D). If deemed acceptable for the study, participants came to the applied Physiology Laboratory in the School.
Table 2

Counterbalancing Orders for High Variety and Low Variety Exercise Conditions

<table>
<thead>
<tr>
<th>Order</th>
<th>N</th>
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<th>Visit 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 male children</td>
<td>HV</td>
<td>LV</td>
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<tr>
<td></td>
<td>3 female children</td>
<td>HV</td>
<td>LV</td>
</tr>
<tr>
<td></td>
<td>3 young adult males</td>
<td>HV</td>
<td>LV</td>
</tr>
<tr>
<td></td>
<td>3 young adult females</td>
<td>HV</td>
<td>LV</td>
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<tr>
<td></td>
<td>3 older adult males</td>
<td>HV</td>
<td>LV</td>
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<td></td>
<td>3 older adult females</td>
<td>HV</td>
<td>LV</td>
</tr>
<tr>
<td>2</td>
<td>3 male children</td>
<td>LV</td>
<td>HV</td>
</tr>
<tr>
<td></td>
<td>3 female children</td>
<td>LV</td>
<td>HV</td>
</tr>
<tr>
<td></td>
<td>3 young adult males</td>
<td>LV</td>
<td>HV</td>
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<td>LV</td>
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<tr>
<td></td>
<td>3 older adult males</td>
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<td>HV</td>
</tr>
<tr>
<td></td>
<td>3 older adult females</td>
<td>LV</td>
<td>HV</td>
</tr>
</tbody>
</table>

of Exercise Leisure and Sport at Kent State University on three separate occasions.

Visit One

Participants and parents of child participants read and signed informed consent and child participants read and signed assent forms (Appendices E, F, & G, respectively). Adults and children also completed validated questionnaires designed to measure self-efficacy (Appendices H & I; Marcus, Selby, Niaura, &
Rossi, 1992; Motl et al., 2000) and physical activity levels (Appendix J; Godin & Shephard, 1985). Anthropometric measurements (height and weight) were then obtained. Participants were then familiarized to the following Cybex (Medway, MA) resistance training or free weight equipment—Nautilus Bowflex SelectTech BD 552 dumbbells (Vancouver, WA): Upper body exercises: triceps extension, bicep and hammer curls, latissimus dorsi pulldowns, chest press, bench press, and lateral raises. Lower body exercises: leg press, leg extensions, and leg curls. After demonstration of proper lifting technique by trained exercise physiologists, participants performed two sets of 8–10 repetitions on each piece of equipment with a minimum of two minutes of rest between sets. Proper lifting technique was defined as moving the apparatus through a complete range of motion in a controlled fashion while exhaling during the concentric portion of each repetition and inhaling during the eccentric portion. During each of these two practice sets, resistance for the children was set at the lowest possible setting (one plate) for that piece of equipment. For adults, resistance was set at two plates except for the triceps extension and bicep curls. The resistance for each piece of equipment for children was as follows: leg press: 20 lb.; leg extension: 10 lb.; leg curl: 10 lb.; chest press: 12.5 lb.; biceps curl: 12.5 lb.; triceps extension: 12.5 lb.; latissimus dorsi pulldown: 10 lb.; hammer curl: 5 lb.; bench press: 5 lb.; and lateral raise: 5 lb. The resistance for adults was as follows: leg press: 40 lb.; leg extension: 30 lb.; leg curl: 30 lb.; chest press: 25 lb.; biceps curl: 12.5 lb.; triceps extension: 12.5 lb.; latissimus dorsi pulldown: 30 lb.; hammer curl: 7.5 lb.; bench
press: 7.5 lb.; and lateral raise: 7.5 lb. After successfully completing the two sampling sets, participants performed an indirect 1-repetition maximum (1-RM). Participants were given a rest period of five minutes after completing a 1-RM before repeating the process (sampling, and determining 1-RM) on the next piece of equipment until all 10 pieces of equipment were utilized (Appendix K). After obtaining a 1-RM participants completed a 10 cm visual analogue scale (VAS) ranging from “do not like at all” to “like very much” to assess liking or hedonics for that piece of equipment before moving to the next (Appendix L).

Visits Two and Three

During visits two and three, for a period of 20 minutes, participants had the option of performing the resistance exercises in either the HV or LV exercise session. Throughout the HV session, participants had access to all 10 pieces of equipment sampled during visit one, and during the LV exercise session, participants had access to only their favorite upper and lower body exercises as determined via VAS scores from visit 1. Participants also had a choice of age appropriate sedentary activities such as puzzles, crosswords, magazines, and so forth, set up on a table in the exercise room during each session. Resistance for each piece of equipment was set at 70% 1-RM. A trained exercise physiologist (JJH, JEB) was present to ensure that proper lifting technique was utilized throughout each session. Because participants could perform as much or as little resistance training exercise as they chose, the supervisors neither encouraged nor attempted to suppress the amount of resistance training exercise
the participants performed in each session. The number of repetitions and sets was recorded and total amount of weight lifted was calculated using the following equation: weight lifted = weight per repetition * total repetitions. The amount of time out of 20 minutes that participants allocated to the resistance training equipment relative to the sedentary alternatives was recorded via observation with a stopwatch (Appendices M & N). Participants also wore an Actigraph accelerometer to monitor physical activity counts during each session. Finally, at the end of each exercise session, participants completed a VAS scale to determine overall liking for that session (Appendix L) as well as indicating an overall rating of perceived exertion (RPE) for that session (Appendices O & P).

Assessment of RRV of high variety versus low variety exercise was accomplished by asking participants to perform work, in an operant button pressing computer software task, to earn access to either the HV or LV exercise condition or the sedentary alternatives (Appendix Q). Two computers were used, one for either the HV/LV condition, the other for the sedentary alternative. Participants worked to earn a total of 11 minutes of additional access, in one-minute blocks, to the HV or LV conditions, the sedentary alternatives or a proportion of time for one condition and the remaining time for the other. Participants then completed the time earned for each condition. The amount of work performed and time earned for the respective exercise conditions and sedentary time were then compared as the measures of reinforcement.
Participants were reimbursed $30.00 ($10.00/session) with their choice of a gift certificate to ACME Grocery Stores, Giant Eagle Grocery Stores, Gamestop, Target, or Wal-mart.

**Measurements**

**Anthropometrics**

All anthropometric measures were completed by an experienced anthropometrist (JJH, JEB). Weight was assessed to the nearest 0.2 kg using a balance beam scale (Health O Meter, Alsip, IL). Height was assessed to the nearest 1.0 mm using a calibrated stadiometer (Health O Meter, Alsip, IL).

**Body Mass Index (BMI) Calculation**

BMI was calculated using the following formula: Weight in kg/Height in m$^2$.

**One Repetition Maximum (1-RM)**

Although participants were screened for orthopedic, neuromuscular, metabolic, or other limitations that might inhibit their participation in the study, an indirect 1-RM assessment was used with participants for safety reasons. The indirect 1-RM was performed by requiring the participants perform between 2 and 10 repetitions of the given exercise to volitional fatigue. No more than 10 repetitions should be performed at the set weight; if the participant was capable of completing 10 or more repetitions the process was completed with a greater weight after a 1–3 minute rest period. Once the correct weight was determined the following calculation was used to determine the indirect 1-RM (Brzycki, 1993):
Relative Reinforcing Value of High Variety and Low Variety Exercise

The relative reinforcing value (RRV) of high variety and low variety exercise was assessed by evaluating how much work each participant was willing to perform in an operant button-pressing computer task to engage in each option and/or the sedentary alternatives (Appendix Q). Participants had the option to work on either of two computer screens; one screen was associated with earning points towards the HV or LV exercise condition and the other with the sedentary alternative. Participants were told that they could work to earn points for HV or LV exercise condition or the sedentary alternatives and they could switch from working on one screen to the other as often as they wished. Each screen consisted of a series of three different shapes, when the computer mouse button is pushed the shapes changed. The goal was to have the shapes match. When the shapes matched on one screen, a point was earned for the exercise condition associated with that screen. Each point earned was equal to one minute of access to that corresponding exercise condition. The RRV computer task was performed until the participant accumulated a total of 11 points from which they earned 11 minutes of access to physical activity (either high or low variety) and/or the sedentary alternative. The reinforcement schedule for both the high or low variety conditions and the sedentary alternatives was initially set to a fixed ratio (FR) 1 (participants earn one point for every 1 button...
press) for the first point earned. The FR level then increased to 2 and then doubled with each point earned for one task (complete FR schedule: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024). The FR level only increased for a condition if a point was earned for that condition. The schedules for the two condition alternatives were independent in that the FR level for a specific activity pattern did not increase to the next FR level until the participant completed the necessary operant responding to earn a point for that pattern.

For example:

- A participant earns 6 points for high variety exercise progressing through FR 1, FR 2, FR4, FR8, FR16, and FR 32 and then switches to the computer that corresponds to sedentary activity for the final 5 points.

- In order to earn 5 points of sedentary activity at this point the participant will have to progress through FR 1, FR 2, FR4, FR8, and FR16.

Participants were given access to the exercise condition and the sedentary alternative they earned, once they compiled a total of 11 points. Outcome measures included: time earned for each activity, the total number and pattern of responses performed (amount of work) and output maximum ($O_{max}$) for the high relative to the low variety exercise conditions. $O_{max}$ is defined as the maximum amount of responding for one minute of interval and continuous exercise (Bickel, Marsch, & Carroll, 2000). This RRV computer task has been validated in studies where children found physical activity more reinforcing in the laboratory setting,
were more physically active in natural settings (Epstein, Beecher, et al., 2007; Epstein et al., 1999; Epstein, Smith et al., 1991; Vara & Epstein, 1993), and more reinforcing than their least liked sedentary activity (Epstein et al., 2004).

Liking of Physical Activity

Participants rated their liking of each individual piece of resistance training equipment and each of the two exercise sessions (high variety, low variety) using a VAS consisting of a 10 cm line anchored by “do not like at all” on the left side and “like very much” on the right side (Appendix L). The ratings were made immediately after sampling each piece of equipment (visit one) and immediately after the final minute of the high variety and low variety sessions. Utilizing a VAS to assess liking or hedonics as an affective rating of a behavior is considered both reliable and valid (Flint, Raben, Blundell, & Astrup, 2000) and measures of liking directly correlates with physical activity participation (Craig, Goldberg, & Dietz, 1996; DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Motl et al., 2001; Roemmich et al., 2008).

Rating of Perceived Exertion (RPE)

Rating of perceived exertion (RPE) was assessed to determine how tired one’s body felt during exercise. In this study, RPE was monitored at the end of each exercise session. RPE was monitored during all exercise sessions via the OMNI Resistance Exercise scale (Lagally & Robertson, 2006; Robertson et al., 2003; Robertson et al., 2005). Two validated scales were used, one for adults (Lagally & Robertson, 2006; Robertson et al., 2003; Robertson, 2004) and one
for children (Robertson, 2004; Robertson et al., 2005). This rating scale consists of numerical ratings from 0–10 as well as pictures of a child or adult (depending upon the scale being used) lifting weights on a line ascending from the lower left to the upper right side of the drawing (Appendices O & P). Participants were instructed to use the pictures to describe how their body felt when performing the resistance training exercise. If they felt like the picture at the lower left picture which corresponds to “extremely easy,” their effort was number zero. The picture in the upper right corresponds to “extremely hard” with an effort of number 10. If they felt somewhere between extremely easy (0) and extremely hard (10) they gave a number between 0 and 10. Participants were told that there was no right or wrong answer.

**Accelerometer Counts**

Participants wore a validated (Abel et al., 2008; Brown & Werner, 2008; Freedson, Pober, & Janz, 2005; Puyau, Adolph, Vohra, & Butte, 2002; Trost et al., 1998) ActiGraph GT1M accelerometer (ActiGraph, Pensacola, FL) around their waist during HV and LV conditions. This was used to determine the amount of non-resistance training physical activity (walking around the room) in which they participated.

**Resistance Exercise Observation**

During each condition, HV and LV, the number of sets and repetitions performed on each piece of equipment was recorded (Appendices M & N). The total amount of weight lifted on each piece of equipment per session (HV, LV)
was calculated by multiplying the number of repetitions performed by the amount of weight lifted (kg) per repetition and then by the number of sets if multiple sets per piece of equipment were performed. During visits two and three, participants had access to equipment for 20 minutes. They chose to use the equipment the entire time or part of the time. After performing the RRV task, participants then had 11 minutes of access to complete the time earned for each condition, the HV or LV options and the sedentary alternatives. They had access to the option only for the amount of time earned. For example, if 5 minutes were earned for HV option and 6 minutes for the sedentary activity, access to each was only for 5 and 6 minutes, respectively.

**Statistical Analyses**

**Participant Characteristics**

One two-way analysis of variance (ANOVA) was used to examine differences in age, height, weight, and BMI between males and females and across all three age groups (children, young adults, older adults).

**Liking, RPE, Repetitions, Weight Lifted, Weight Lifting Time, O\textsubscript{max}, and Total Time Earned**

Separate three-way ANOVAs with gender (males and females) and age (children, young adults, older adults) as between-subject variables and condition (HV and LV) as within-subject variables was used to determine the differences in the following dependent variables: VAS (liking) scores, OMNI RPE, total number of repetitions performed, total weight lifted (kg), amount of time allocated to
resistance training, $O_{\text{max}}$, and total time for resistance training earned from the RRV computer task.

**A Priori Determinations**

Significance was set at $p < 0.05$. Post hoc analysis, when appropriate, was performed to determine where differences occurred. Post-hoc test included independent and paired samples T-tests and additional two and three-way ANOVAs.
CHAPTER IV

RESULTS

The purpose of this investigation was to determine the effect of altering the variety of resistance training equipment options on the RRV and the amount of resistance training exercise performed by children, young adults, and older adults versus sedentary alternatives. Upon providing written consent or assent (Appendices E, F, & G, respectively), 36 participants completed three visits to the applied Physiology Laboratory in the School of Health Sciences at Kent State University. The trials were counter-balanced, with half of the participants undergoing the HV trial first and half of the participants undergoing the LV trial first. The trials were preceded by anthropometric measurements and familiarization to resistance training equipment and free weight training exercises. During each trial, participants, wearing an accelerometer, were exposed to a 20 minute free-choice exercise and/or sedentary activity period, followed by assessment of RRV of high variety versus low variety exercise. Following the RRV assessment, participants completed the time earned for each condition. Data were collected to assess the number of repetitions, sets, and total amount of weight that was lifted, the amount of time out of 20 minutes allocated to the resistance training equipment relative to the sedentary alternative, physical activity counts, an overall rating of perceived exertion (RPE), a VAS scale to determine overall liking during each session (Appendices L, M, N,
O, & P, respectively). For the RRV computer task, data collected assessed $O_{max}$, total responses performed during the RRV computer task, and total time earned from the RRV computer task.

**Participant Characteristics**

**Physical Characteristics**

Participant characteristics are presented in Table 3. There were significant ($p = .04$ for both) age group by gender interactions for height and weight. Males relative to females exhibited a greater height ($p \leq .03$) in the 18–26 year old and > 60 age group with no difference in height in the 8–12 year old group ($p \geq .94$). In the > 60 age group, males were significantly ($p = .001$) heavier than females with no differences ($p \geq .49$) in weight in either of the other two groups. There were no significant age group by gender interactions for age ($p = .25$) or BMI ($p = .14$).

There were significant ($p < 0.01$ for all) main effects of age group for differences in age, height, weight, and BMI. The > 60 year old age group was significantly older than both the 8–12 year old group and the 18–26 year old group ($p < .001$ for both). The 18–26 year old group was significantly older than the 8–12 year old group ($p < .001$). With respect to height, weight, and BMI, the > 60 year old age group and 18–26 year old groups were not significantly different ($p \geq .73$) from one another but exhibited significantly greater height ($p < .001$ for both), weight ($p < .001$ for both), and BMI ($p < .003$ for both) than the
Table 3

*Participant Physical Characteristics*

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>Age (Years)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>BMI</th>
<th>BMI %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child</td>
<td>MALE</td>
<td>10.3 ± 1.5</td>
<td>139.2 ± 10.3</td>
<td>38.4 ± 12.4</td>
<td>62.7 ± 34.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>10.0 ± 1.1</td>
<td>139.7 ± 7.3</td>
<td>33.6 ± 9.8</td>
<td>45.5 ± 31.6</td>
<td></td>
</tr>
<tr>
<td>Young adult</td>
<td>MALE</td>
<td>22.4 ± 1.7</td>
<td>177.9 ± 7.3*</td>
<td>71.3 ± 24.7</td>
<td>26.0 ± 4.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>21.0 ± 1.3</td>
<td>162.6 ± 4.8</td>
<td>69.5 ± 18.1</td>
<td>26.3 ± 7.2</td>
<td></td>
</tr>
<tr>
<td>Older adult</td>
<td>MALE</td>
<td>72.2 ± 5.4</td>
<td>172.4 ± 8.5</td>
<td>94.8 ± 17.4</td>
<td>32.1 ± 7.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>67.6 ± 5.1</td>
<td>160.7 ± 6.7</td>
<td>61.4 ± 7.2</td>
<td>23.8 ± 3.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>MALE</td>
<td>35.0 ± 27.8</td>
<td>163.2 ± 19.4</td>
<td>68.1 ± 29.7</td>
<td>25.9 ± 7.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>32.9 ± 25.9</td>
<td>154.3 ± 12.3</td>
<td>54.8 ± 19.7</td>
<td>22.4 ± 6.1</td>
<td></td>
</tr>
</tbody>
</table>

8–12 year old group. There were also significant (p ≤ 0.05 for all) main effects of gender for differences in height, weight, and BMI. Males were significantly taller, weighed more, and had greater BMIs than females. There were no additional significant main or interaction effects (p ≥ 0.06).

**Liking Scores of Resistance Exercises**

Mean liking scores for each resistance exercise are presented in Table 4.
Table 4

**VAS Scores Resistance Exercises (M ± SD)**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>M (cm)</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triceps extension</td>
<td>6.7</td>
<td>2.3</td>
<td>36</td>
</tr>
<tr>
<td>Bicep curl</td>
<td>6.1</td>
<td>2.5</td>
<td>36</td>
</tr>
<tr>
<td>Hammer curl</td>
<td>6.5</td>
<td>2.1</td>
<td>36</td>
</tr>
<tr>
<td>Lattisimus dorsi pulldown</td>
<td>7.8</td>
<td>1.9</td>
<td>36</td>
</tr>
<tr>
<td>Chest press</td>
<td>7.2</td>
<td>2.2</td>
<td>36</td>
</tr>
<tr>
<td>Bench press</td>
<td>6.4</td>
<td>2.9</td>
<td>36</td>
</tr>
<tr>
<td>Medial deltoid raise</td>
<td>4.6</td>
<td>2.6</td>
<td>36</td>
</tr>
<tr>
<td>Leg press</td>
<td>8.3</td>
<td>1.6</td>
<td>36</td>
</tr>
<tr>
<td>Leg extension</td>
<td>6.7</td>
<td>2.3</td>
<td>36</td>
</tr>
<tr>
<td>Leg curl</td>
<td>7.0</td>
<td>2.4</td>
<td>36</td>
</tr>
</tbody>
</table>

**Free Choice Conditions**

**Time Allocated**

Table 5 depicts the time allocated to weights in the free choice conditions. Three way ANOVA demonstrates a significant ($p = .008$) condition by gender interaction (Figure 1) for time allocated to weights, with females allocating significantly ($p = .001$) more time in the HV condition than the LV condition with no significant time allocation difference between conditions seen in males ($p = .90$). Additionally, a significant ($p = .004$) group by gender interaction (Figure 2) was
Table 5

*Free Choice, Condition—Time Allocated to Weights*

<table>
<thead>
<tr>
<th>Group</th>
<th>HV (Males)</th>
<th>LV (Males)</th>
<th>HV (Females)</th>
<th>LV (Females)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time weights</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 8–12</td>
<td>17.2 ± 4.7</td>
<td>16.9 ± 4.8</td>
<td>9.3 ± 4.3</td>
<td>4.8 ± 2.8</td>
</tr>
<tr>
<td>Age 18–26</td>
<td>8.5 ± 8.1</td>
<td>10.2 ± 7.4</td>
<td>16.8 ± 5.0</td>
<td>10.1 ± 5.3</td>
</tr>
<tr>
<td>Age ≥ 60</td>
<td>16.9 ± 3.6</td>
<td>15.1 ± 5.5</td>
<td>16.9 ± 5.2</td>
<td>15.4 ± 5.2</td>
</tr>
<tr>
<td>Total</td>
<td>14.2 ± 6.9</td>
<td>14.1 ± 6.3</td>
<td>14.3 ± 5.8</td>
<td>10.1 ± 6.2</td>
</tr>
</tbody>
</table>
Figure 1. Free choice, condition by gender—Time allocated to weights

Mean ± SEM for the condition by gender interaction with females allocating significantly more time to weights ($p < .05$) in the HV condition versus the LV condition with no significant difference in males.
Figure 2. Free choice, group by gender—Average time allocated to weights

Mean ± SEM for the group by gender interaction of average time allocated to weights. Males in the 8–12 year old group allocated on average significantly ($p = .002$) more time to weights than females. There were no other significant ($p \geq .24$) group by gender effects for average time allocated to weights.
also observed with males in the 8–12 year old group allocating more average time to weights (17.1 ± 4.6 min) than the females (7.0 ± 3.5 min), with no significant differences (p ≥ .24) observed between males and females in the other two groups. Figure 3 demonstrates a significant main effect of condition (p = .005) with more time being allocated to weights in the HV condition (14.3 ± 6.3 min) than in the LV condition (12.1 ± 6.5 min). Additionally, a significant (p = .05) main effect of group (Figure 4) was observed with a greater average time being allocated to weights by the ≥ 60 year old group (p = .04) than the 18–26 year old group, with no significant (p ≥ .09) differences between the 8–12 year old group and the 18–26 year old or > 60 year old groups. No other significant (p ≥ .06) main or interaction effects were observed.

**Repetitions Performed**

A three way ANOVA was performed to compare the total number of repetitions performed in the free choice conditions (Table 6). There was a significant (p = .001) group by gender interaction (Figure 5), with males (168.7 ± 58.6) in the 8–12 year old group performing significantly more repetitions than females (63.9 ± 37.7) with no significant (p ≥ .11) gender differences observed in the other two groups. Significant main effects for group (p = .006) and gender (p = .04) were also present (Figures 6 and 7, respectively). The ≥ 60 year old group performed more (p = .002) average repetitions (130.6 ± 33.6) than the 18–26 year old group (74.8 ± 42.8), but not the 8–12 year old group (p = .54). There were no significant (p = .10) differences for average repetitions between the 8–12 year old
Figure 3. Free choice, condition—Time allocated to weights

Mean ± SEM for the main effect of condition time allocated to weights.

Participants allocated significantly ($p = .005$) more time in the high variety condition than the low variety condition.
Figure 4. Free choice, group—Average time allocated to weights

Mean ± SEM for the main effect of group time allocated to weights. Participants in the > 60 year old group allocated significantly \( p = .05 \) more time to weights than the 18–26 year old group. There were no other significant \( p \geq .09 \) differences between groups.
Table 6

*Free Choice, Condition—Total Repetitions*

<table>
<thead>
<tr>
<th>Group</th>
<th>Males (n = 6)</th>
<th>Females (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HV</td>
<td>LV</td>
</tr>
<tr>
<td>Total reps</td>
<td>Age 8–12</td>
<td>201.7 ± 94.0</td>
</tr>
<tr>
<td></td>
<td>Age 18–26</td>
<td>57.8 ± 52.3</td>
</tr>
<tr>
<td></td>
<td>Age &gt; 60</td>
<td>164.0 ± 39.1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>141.2 ± 88.2</td>
</tr>
</tbody>
</table>
Figure 5. Free choice, group by gender—Total repetitions

Mean ± SEM for group by gender interaction effect. Males in the 8–12 year old group performed significantly ($p = .004$) more total repetitions than the females.

There were no other significant ($p \geq .11$) differences between groups.
Figure 6. Free choice, group—Total repetitions

Mean ± SEM for main effect of group. Participants in the > 60 year old group performed significantly ($p = .002$) more repetitions than the 18–26 year old group. There were no other significant ($p \geq .10$) differences between groups.
Figure 7. Free choice, gender—Average total repetitions

Mean ± SEM for main effect of gender. Males performed significantly ($p = .006$) more average total repetitions than females.
Figure 8. Free choice, condition—Total repetitions

Mean ± SEM for main effect of condition. Participants performed significantly ($p \leq .001$) more repetitions in the high variety condition than the low variety condition.
group and the 18–26 year old group. Males (122.1 ± 66.1) performed significantly more (p = .04) repetitions than females (92.4 ± 40.4). There was a significant main effect (Figure 8) for condition (p < .001), with more repetitions performed in the HV condition (126.4 ± 71.7) than in the LV condition (88.0 ± 48.8). No additional significant (p ≥ .20) interaction effects were observed.

**Total Weight Lifted**

Table 7 illustrates the total amount of weight lifted in the free choice conditions. There were no significant (p ≥ .06) main (Figure 9) or interaction effects for differences in weight lifted.

**VAS and OMNI RPE**

Table 8 illustrates the VAS (liking) and effort perception (RPE) data recorded at the conclusion of the HV and LV conditions. There was a significant (p = .009) main effect of condition (Figure 10) for differences in VAS with participants rating the HV condition more favorably (8.1 ± 1.5) than the LV condition (7.1± 2.1). There were no additional significant (p ≥ .08) main or interaction effects for VAS. A significant (p = .01) main effect of group for differences in average RPE was observed with the > 60 year age group demonstrating a higher value (M = 5.5 ± 2.2) than both the 8–12 year old (M = 3.0 ± 1.5) and 18–26 year old (M = 3.5 ± 2.0) groups. No significant (p = .53) differences in average RPE were observed between the 8–12 year old and 18–26
year old groups. There were no additional significant \((p \geq 0.13)\) main (Figure 11) or interaction effects for differences in RPE.

Table 7

*Free Choice, Condition—Total Weight Lifted (M ± SD)*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Group</th>
<th>Gender</th>
<th>N</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV total wt. (lb)</td>
<td>Age 8–12</td>
<td>Male</td>
<td>6</td>
<td>8626.8</td>
<td>8310.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>6</td>
<td>2510.4</td>
<td>1804.9</td>
</tr>
<tr>
<td></td>
<td>Age 18–22</td>
<td>Male</td>
<td>6</td>
<td>5080.0</td>
<td>4908.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>6</td>
<td>6367.9</td>
<td>2913.5</td>
</tr>
<tr>
<td></td>
<td>Age ≥ 60</td>
<td>Male</td>
<td>6</td>
<td>10792.5</td>
<td>4326.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>6</td>
<td>5202.9</td>
<td>1349.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Male</td>
<td>18</td>
<td>8166.4</td>
<td>6227.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>18</td>
<td>4693.8</td>
<td>2598.7</td>
</tr>
<tr>
<td>LV total wt. (lb)</td>
<td>Age 8–12</td>
<td>Male</td>
<td>6</td>
<td>4621.3</td>
<td>3713.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>6</td>
<td>1515.4</td>
<td>1039.8</td>
</tr>
<tr>
<td></td>
<td>Age 18–22</td>
<td>Male</td>
<td>6</td>
<td>5488.3</td>
<td>5269.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>6</td>
<td>6475.4</td>
<td>5278.9</td>
</tr>
<tr>
<td></td>
<td>Age ≥ 60</td>
<td>Male</td>
<td>6</td>
<td>8997.1</td>
<td>3039.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>6</td>
<td>6864.6</td>
<td>2511.0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Male</td>
<td>18</td>
<td>6368.9</td>
<td>4327.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>18</td>
<td>4951.8</td>
<td>4080.1</td>
</tr>
</tbody>
</table>
Figure 9. Free choice, condition—Total weight lifted

Mean ± SEM for main effect of condition. There was no significant ($p = .23$) main effect of condition for total weight lifted between the high and low variety conditions. There were no other significant main or interaction effects ($p \geq .06$).
Table 8

*Free Choice, Condition—VAS (Liking) and Average OMNI RPE*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age Group</th>
<th>Males (n = 6)</th>
<th>Females (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS (cm)*</td>
<td>Age 8–2</td>
<td>8.4 ± 1.5</td>
<td>7.5 ± 1.8</td>
</tr>
<tr>
<td></td>
<td>Age 18–26</td>
<td>7.4 ± 1.8</td>
<td>8.3 ± 1.2</td>
</tr>
<tr>
<td></td>
<td>Age &gt; 60</td>
<td>8.4 ± 0.7</td>
<td>8.7 ± 1.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>8.0 ± 1.4</td>
<td>8.2 ± 1.6</td>
</tr>
<tr>
<td>OMNI RPE**</td>
<td>Age 8–12</td>
<td>2.8 ± 1.2</td>
<td>3.0 ± 1.4</td>
</tr>
<tr>
<td></td>
<td>Age 18–26</td>
<td>3.3 ± 2.9</td>
<td>4.5 ± 2.3</td>
</tr>
<tr>
<td></td>
<td>Age &gt; 60</td>
<td>6.7 ± 0.8</td>
<td>4.8 ± 2.8</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4.2 ± 2.5</td>
<td>4.1 ± 2.3</td>
</tr>
</tbody>
</table>

VAS = Visual analog scale

RPE = Ratings of perceived exertion

* Main effect of condition (p < .05)

** Main effect of group (p < .05)
Figure 10. Free choice, condition—VAS (liking) scores

Mean ± SEM for main effect of condition for liking (VAS) scores in the high versus low variety condition. All participants indicated a significantly ($p = .009$) higher liking score for the high variety versus the low variety condition.
Figure 11. Free choice, condition—OMNI RPE

Mean ± SEM for main effect of condition for OMNI RPE scores in the high versus low variety condition. There were no significant differences in OMNI RPE between conditions ($p = .13$).
Reinforcing Value

Time Earned

Three way ANOVA was performed to determine the amount of time earned for weight training in each condition (Table 9). A significant ($p = .05$) group by gender interaction (Figure 12) was observed, with males ($12.2 \pm 3.8$ min) in the 8–12 year old group earning more time for resistance exercise than females ($4.1 \pm 2.4$ min). No significant ($p \geq .58$) group by gender interactions were observed in the other two groups. Additionally, a significant ($p = .02$) condition by gender interaction (Figure 13) was observed as well, with males ($7.2 \pm 3.0$ min) earning significantly more time in the LV condition than females ($4.4 \pm 2.8$ min) but not in the HV condition ($p = .67$). No additional significant ($p \geq .09$) main (Figure 14) or interaction effects were observed.

Table 9

RRV, Condition—Time Earned for Additional Weight Lifting

<table>
<thead>
<tr>
<th>Group</th>
<th>Males ($n = 6$)</th>
<th>Females ($n = 6$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HV</td>
<td>LV</td>
</tr>
<tr>
<td>Age 8—12</td>
<td>$7.5 \pm 3.3$</td>
<td>$8.3 \pm 3.2$</td>
</tr>
<tr>
<td>Age 18–26</td>
<td>$5.0 \pm 3.8$</td>
<td>$5.3 \pm 2.8$</td>
</tr>
<tr>
<td>Age &gt; 60</td>
<td>$7.2 \pm 2.6$</td>
<td>$7.8 \pm 2.6$</td>
</tr>
<tr>
<td>Total</td>
<td>$6.6 \pm 3.3$</td>
<td>$7.2 \pm 3.0$</td>
</tr>
</tbody>
</table>

$^*$Time in minutes
Figure 12. RRV, group by gender—Time earned for additional weight lifting

Mean ± SEM for group by gender interaction for time earned during the relative reinforcing value task. Males in the 8–12 year old group earned significantly ($p = .001$) more time than the females. There were no other significant group differences in time earned between genders ($p \geq .58$).
<table>
<thead>
<tr>
<th>Condition</th>
<th>Time earned (min)</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>LV</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 13. RRV, condition by gender—Time earned for additional weight lifting

Mean ± SEM for condition by gender interaction for time earned during the relative reinforcing value task. Males earned significantly \( (p = .002) \) more time than the females.
Figure 14. RRV, condition—Time earned for additional weight lifting

Mean ± SEM for main effect of condition for time earned during the relative reinforcing value task in the high versus low variety condition. There were no significant differences in time earned between conditions ($p = .25$).
Three-way ANOVA was performed to determine the $O_{\text{max}}$ in the RRV task (Table 10). A significant condition by gender interaction (Figure 15) was observed ($p = .006$), with males (364.0 ± 481.6) eliciting greater responses in the LV condition than females (31.7 ± 40.2) with no significant ($p = .83$) differences observed in the HV condition. Additionally, females exhibited a significantly higher $O_{\text{max}}$ ($p = .03$) in the HV condition (254.5 ± 389.6) than the LV condition (31.7 ± 40.2). No additional significant ($p \geq .12$) main (Figure 16) or interaction effects were observed.

Table 10

$O_{\text{MAX}}$—Condition

<table>
<thead>
<tr>
<th>Group</th>
<th>Males</th>
<th></th>
<th></th>
<th>Females</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group</td>
<td>HV</td>
<td>LV</td>
<td>HV</td>
<td>LV</td>
</tr>
<tr>
<td>Age 8–12</td>
<td>393.0 ± 497.5</td>
<td>537.3 ± 534.8</td>
<td>9.5 ± 7.6</td>
<td>16.0 ± 14.3</td>
<td></td>
</tr>
<tr>
<td>Age 18–26</td>
<td>187.0 ± 410.7</td>
<td>178.7 ± 414.1</td>
<td>315.3 ± 396.2</td>
<td>48.5 ± 47.2</td>
<td></td>
</tr>
<tr>
<td>Age &gt; 60</td>
<td>274.3 ± 415.3</td>
<td>376.0 ± 503.5</td>
<td>438.7 ± 491.7</td>
<td>30.7 ± 49.2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>284.8 ± 425.0</td>
<td>364.0 ± 481.6</td>
<td>254.5 ± 389.6</td>
<td>31.7 ± 40.2</td>
<td></td>
</tr>
</tbody>
</table>

$O_{\text{MAX}} = \text{Output maximum}$

*Maximum number of responses performed to gain access to a single reinforcer
<table>
<thead>
<tr>
<th>Condition</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>HV Male</td>
<td>0</td>
</tr>
<tr>
<td>HV Female</td>
<td>100</td>
</tr>
<tr>
<td>LV Male</td>
<td>200</td>
</tr>
<tr>
<td>LV Female</td>
<td>300</td>
</tr>
<tr>
<td>HV Male</td>
<td>400</td>
</tr>
<tr>
<td>HV Female</td>
<td>500</td>
</tr>
<tr>
<td>LV Male</td>
<td>600</td>
</tr>
<tr>
<td>LV Female</td>
<td>700</td>
</tr>
</tbody>
</table>

Figure 15. $O_{\text{MAX}}$—Condition by gender

Mean ± SEM for condition by gender interaction. Males elicited greater responses in the low variety condition than did females ($^* p = .006$). Females elicited greater responses in the high variety condition than the low variety condition ($^{**} p = .03$). No significant condition by gender effect in high variety condition ($p = .83$).
Figure 16. $O_{\text{MAX}}$—Condition

Mean ± SEM for main effect of condition. There was no significant main effect of condition for $O_{\text{MAX}}$ ($p = .17$)
CHAPTER V
DISCUSSION

This chapter presents a summary of the current study including conclusions elucidated from the data presented in Chapter IV. A discussion of the implications and recommendations for further research are provided as well. The purpose of this investigation was to compare the amount and RRV of resistance training exercise versus a sedentary alternative during a high variety (HV) resistance exercise equipment condition versus a low variety (LV) equipment condition using a cross-sectional design with males and females from three age groups: children (8–12 years of age), young adults (18–26 years of age), and older adults (> 60 years of age). This was the first study to objectively compare the impact of altering the variety of exercise options on the amount of and RRV of physical activity versus sedentary alternatives performed across these age groups. While initial research performed in this laboratory (Barkley et al., 2008) has been encouraging, it is far from definitive and there remains a dearth of research evaluating the basic effect of altering variety on physical activity. This previous study examined the effect of altering variety on the amount of resistance training physical activity performed in children only. Additionally, exercise options in both the high variety and low variety conditions in the previous study were fewer than what was utilized in the present study with only a single option in the LV condition and no assessment of perceived exertion.
Finally, RRV of resistance exercise versus a sedentary alternative in the HV and LV condition was also not examined in the Barkley et al. (2008) study.

**Hypotheses**

**Hypothesis #1**

*Children, young adults, and older adults will perform more repetitions, allocate more time for, and lift more weight during a free-choice high-variety resistance-training equipment exercise condition than a free-choice low-variety alternative session of equal duration.*

Presently, participants significantly increased the amount of time allocated for exercise and the number of repetitions performed during the HV condition relative to the LV condition. Furthermore, this pattern was observed in all three age groups. These results agree with a previous study performed with 8–12 year old children in our laboratory (Barkley et al., 2008). However, contrary to findings by Barkley, participants in the present study did not lift significantly more weight in the HV condition relative to the LV condition. Although total weight lifted in the HV and LV conditions was not different, the number of repetitions performed represents a better measure of effort. Each repetition represented 70% of maximum effort for each piece of exercise equipment. However, depending upon the lift being performed, the amount of weight required to achieve 70% of maximum effort varied substantially while the percentage of maximum effort remained constant. Therefore, the decision to perform more repetitions
represents an increased motivation to participate in exercise while weight lifted is more representative of individual pieces of equipment used.

The present study has many unique aspects such as the comparison of the effects of variety on exercise performance of three different age groups in one investigation with the concurrent assessment of liking and reinforcing value, independent of perceived exertion. These results have similarities not only to previous work performed in this laboratory but three other studies that have examined variety in exercise in differing age groups and with disparate methodology. Adults participating in an exercise training intervention exhibited greater program adherence when their exercise programs were changed every two weeks relative to adults in a similar program who had invariant programs (Glaros & Janelle, 2001). Older adults also demonstrate increased participation in multi-component exercise programs versus a single component program (S. L. Hughes et al., 2009). During school recess children are more physically active when exercise equipment is present versus the absence of equipment (McKenzie, Hardung, Arrendondo, Baquero, & Elder 2006). Taken together, these previous data along with the current findings make a strong case for the importance of variety of exercise options on physical activity behavior in individuals of differing ages.

**Hypothesis #2**

Children, young adults, and older adults will exhibit a greater liking and RRV (earn more time and perform more work during an operant
responding computer task) and a lower RPE (rate of perceived exertion) for access to physical activity relative to sedentary alternatives when there is a high variety of exercise equipment options (HV) versus a condition where there is a low variety (LV) of exercise equipment options.

The type of physical activity individuals engage in is likely influenced by a number of factors. One such factor may be hedonics (enjoyment/liking) of physical activity (Hyman & Malenka, 2001; Robinson & Berridge, 2000; Roemmich et al., 2008). Another is related to wanting or motivation. Differences in neurobiology may partially explain the differences in reinforcing value and liking. The dopamine neurotransmitter system influences the reinforcing or motivational values of such behaviors as eating and the administration of addictive drugs (Berridge, 1996). Conversely, liking or the hedonic pleasure of these behaviors is controlled by the opioid system (Berridge, 1996; Pecina et al., 2006). It appears possible to dissociate the concepts “wanting” and “liking” for foods (Finlayson et al., 2007; Finlayson et al., 2008) and drugs (Berridge et al., 2009). Epstein, Truesdale, Wojcik, Paluch, and Raynor (2003) suggested that RV of food is a better predictor of consumption than the liking of food. After repeated presentations “liking” for a food may subside, though the RV can increase. The present investigation measured both concepts (“wanting” and “liking”) using RRV assessment and VAS scores respectively.

**Liking.** Children, young adults, and older adults exhibited significantly greater liking scores for the HV condition than the LV condition. As previously
discussed, significantly greater time was allocated and greater repetitions performed in the HV condition as well. This is in agreement with previous research signifying the enjoyment or "liking" (Lox et al., 2006; Wankel, 1993) of an activity (Dishman et al., 2005; Motl et al., 2001) may be indicative of the amount of physical activity in which an individual may participate.

**RRV.** Contrary to liking, RRV of resistance exercise versus a sedentary alternative was not significantly different from the HV to the LV condition. This is surprising as RRV is considered a stronger predictor of behavior than liking (Epstein, Truesdale, et al., 2003) and presently exercise behavior was increased in the HV relative to the LV condition. However, this lack of difference in RRV is likely explained by the design of the present study. All participants completed the RRV task immediately after completing the 20-minute free choice session on each day. It is possible that participants became satiated with the resistance exercise during the free choice portion of the study as they were allowed to participate in as much exercise as they wished for the entire 20-minute session.

With respect to food consumption, satiety is defined as "the feeling of fullness that persists after eating, potentially suppressing further energy intake until hunger returns" (Benelam, 2009, p. 129). Eating behaviors are influenced by numerous factors including increasing variety (Benelam, 2009), which increases consumption. In the current investigation greater variety resulted in increased exercise participation (or "consumption") in the HV free-choice condition than the LV condition. Because individuals in the present study participated in (or
“consumed”) differing amounts of exercise in the free-choice sessions before the RRV task this may have differentially affected their subsequent motivation to accumulate more resistance exercise in the HV and LV conditions. Therefore, future evaluations of the RRV of exercise versus a sedentary alternative in HV and LV conditions should fix the access to exercise and sedentary activities at equal amounts in both conditions before completing the RRV task.

Because there is little evidence evaluating the effect of variety on exercise behavior, the present study attempted to explore possible outcomes. Several models for the free choice section of the study were considered. The model used was chosen to allow participants total free access to their choice of activities for the entire 20-minute period. This free choice session allowed for the examination of actual behavior which may be of greater importance than the assessment of reinforcement via the computer task which is designed to be predictive of behavior. Although RRV was not different, the fact that individuals performed a similar amount of work for additional exercise in the HV and LV conditions after participating in more exercise in the HV condition suggests that if access to exercise prior to the RRV task was constant the amount of work performed for additional exercise may have been greater in the HV condition relative to the LV condition. Because of this finding and the limitation of the present design to properly evaluate RRV, future research specifically designed for the assessment of the RRV of exercise versus a sedentary alternative in HV and LV conditions is recommended.
RPE. One argument that could be made explaining the differences between the greater amount of time allocated to exercise and the greater number of repetitions performed in the HV condition relative to the LV condition is that participants were fatigued in the LV condition due to the limited resistance exercise options. If this were to occur the increased fatigue may have limited the participant’s ability and motivation to perform more exercise in the LV condition. Because fatigue is regularly assessed via RPE (Foster et al., 2001; Gearhart, Lagally, Riechman, Andrews, & Robertson, 2008), the OMNI resistance training RPE (Lagally & Robertson, 2006; Robertson et al., 2003; Robertson et al., 2005) was utilized in the present study. It was hypothesized that if an individual is more fatigued in the LV than the HV condition their RPE would be greater in that condition. However, in the present study there were no significant differences in fatigue assessed via RPE over the two variety conditions. In fact, although not significant, participants indicated a greater average RPE during the HV than the LV condition. These results demonstrate the unlikelihood that fatigue was a major contributor to the increased exercise behavior noted in the HV condition.

Hypothesis #3

There will be no age or gender differences between preferences of the high variety resistance exercise equipment option relative to the low variety resistance exercise equipment option.

Multiple studies (Azevedo et al., 2007; Beighle et al., 2006; DeVries et al., 2009; Sallis et al., 2000; Sherar et al., 2009; Troiano et al., 2008; Trost et al.,
2002) have demonstrated that physical activity levels decrease with age with males more physically active than females. Age appears to affect variety-seeking behavior as evidenced by a decrease observed with aging under certain conditions (Novak & Mather, 2007). Older adults appear to be motivated by less variety when choosing jellybeans and music for consumption at a later time as opposed to younger adults who choose more variety under these conditions (Novak & Mather, 2007). Conversely, when choosing for immediate consumption older adults select greater variety and younger adults less of the aforementioned items (Novak & Mather, 2007). This may be related to differences in mood, with older adults having a greater positive affect than younger adults. This in turn can lead to greater variety seeking (Novak & Mather, 2007). However, in the present investigation we did not note any differential responses of the three age groups over the HV and LV conditions.

**Age differences.** There was a single significant main effect for group with the older adults allocating significantly more time and performing more repetitions than the younger adult group. This is inconsistent with literature asserting that physical activity levels decrease with age (Sallis, 2000; Sherar et al., 2009; Troiano et al., 2008). This result was not expected and it is unclear why it occurred. Age differences may influence variety seeking. Older adults appear to choose more variety for immediate consumption whereas the opposite is observed in younger individuals (Novak & Mather, 2007). As designated in the methods section, participants were excluded from the study if they participated in
regular resistance training within the previous six months. Thus, the argument cannot be made that some individuals may have been advantaged or had a preconceived familiarity and/or liking for resistance exercise. Perhaps the younger adult participants did not find resistance training a motivating physical activity. An additional observation was that the older adult group indicated a significantly higher OMNI RPE than both the younger adults and child participants. This is not surprising given the fact that they performed significantly more work in the free choice conditions.

**Gender differences.** Although we hypothesized no gender differences between preferences in HV condition relative to the LV condition this was not entirely the case. Collectively, females as opposed to males, allocated a significantly greater amount of time to lifting weights in the HV condition than the LV condition. Males allocated almost equal time to lifting weights in both conditions. Time, however may not be the ideal assessment of work performed as participants were free to sit and rest at the machines or walk around the exercise area in either condition. The key dependent variable is the number of repetitions performed which is a better indicator of the amount of work performed. Although not significant, males performed more repetitions than females in both the HV and LV conditions. This is in agreement with multiple research demonstrating males having a higher physical activity participation rate than females (Azevedo et al., 2007; Beighle et al., 2006; DeVries et al., 2009; Sallis et al., 2000; Sherar et al., 2009; Troiano et al., 2008; Trost et al., 2002).
There was also a significant gender by condition interaction for $O_{\text{max}}$ which was due to a significantly greater $O_{\text{max}}$ in the HV condition than in the LV condition in females with no difference in males. This observation in combination with females allocating a significantly greater amount of time to lifting weights in the HV condition may indicate that females do find the variety of resistance exercise options more reinforcing. It is not clear why males did not increase $O_{\text{max}}$ in the HV relative to the LV condition. However, during the RRV task males exhibited a greater $O_{\text{max}}$ than females in the LV condition. The males greater $O_{\text{max}}$ in the LV condition, relative to females, may have limited their ability to significantly increase $O_{\text{max}}$ in the HV condition.

In summary, this investigation is in agreement with previous studies demonstrating that age and gender differences appear to exist in consummatory patterns of individuals (Wansink, Cheney, & Chan, 2003). However, as a whole, the HV condition elicited greater liking, time allocation for weight lifting and work performed compared to the LV condition.

**Study Limitations**

This study was not without limitations. As previously discussed, although RRV was assessed, the design of this study was not ideal for doing so. In previous studies focusing on eating behavior (Epstein, Saad, et al., 2003; Epstein & Leddy, 2006; Myers Ernest & Epstein, 2002; Temple, Giacomelli, et al., 2008), when given more options, participants worked to obtain additional access to the greater variety of options indicating they perceived it as more reinforcing. This
was not observed in the current study. This may be the result of individuals becoming satiated with the resistance exercise resulting from spending significantly more time and performing a significantly greater number of repetitions in the HV condition. In the free choice segment of the study individuals could freely choose between the available exercise options and the sedentary alternatives for the entire 20-minute period. To better evaluate the effect of variety on the RRV of physical activity versus a sedentary alternative, participants would require a fixed duration of access to both the resistance training equipment and sedentary alternatives (i.e., 10 minutes for available resistance exercise options and 10 minutes for the sedentary alternatives) during HV and LV conditions before assessing RRV. It is possible based on the following observations in the current study: increased liking, time allocation, and number of repetitions with no significant RPE differences in the HV condition relative to the LV condition, that this suggested paradigm may result in demonstrating the HV condition to be more reinforcing.

This study was limited to resistance training exercise which was chosen because it is easily accessible for a controlled research study. Other reasons include: easier to manipulate the relative intensity of the equipment, easier to manipulate the variety of the equipment, and easier to monitor as we counted repetitions performed. It would be interesting to see if other exercise modalities yield similar results. Previous research demonstrates that overweight and obese children (Mitchell et al., 2009) and adults (Riebe et al., 2009; Zapka, Lemon,
Magner, & Hale, 2009) appear to be more sedentary. Epstein, Smith, et al. (1991) determined that overweight youths appear to find physical activity less reinforcing than lean children. In the current investigation only two of the child participants were considered at-risk or overweight and only five of the adults obese. As previously discussed weight status can affect physical activity levels. Consequently, future inquiry is warranted to determine if comparable results would be seen with when making comparisons by weight status. Another limitation of the study is the ethnic makeup of the participants. There is evidence of disparity between physical activity levels of various ethnicities (Marshall et al., 2007). The majority of the participants in the current study were Caucasian. Finally, our participants’ ages ranged from 8–81 years of age. Examining the effects on younger children is warranted.

**Conclusions**

In the present study the effect of variety on the amount and RRV of resistance exercise versus sedentary alternatives was compared in males and females across three age groups. This was the first study to examine the effects of variety on physical activity behavior across multiple different age groups. The number of repetitions performed, liking, and RPE during the respective free choice conditions are in support of a pro-physical activity behavior effect of variety. The data demonstrate that in the high variety condition individuals perform more resistance training exercise and exhibit increased enjoyment without identifying significant differences in perceived effort between conditions.
The relevance of these findings includes a potentially greater understanding of how altering the variety of exercise equipment influences individuals of different age groups and genders participation in physical activity. If these effects are present in additional modes of exercise, altering the variety of exercise options may be used as a motivational mechanism to increase physical activity in individuals of differing ages.

**Future Directions**

Based on the findings of the present investigation, the following recommendations are proposed for future research:

1. Replication of the present study will be conducted with participants having fixed access to exercise options and sedentary alternatives in the HV and LV free choice conditions (i.e., 10 minutes for exercise options and 10 minutes for the sedentary alternatives) and then assessing reinforcing value. This design may allow for a more accurate assessment of the effect of variety on the RRV of exercise.

2. Future research could evaluate different exercise modalities such as aerobic and flexibility activities.

3. Future research should examine if variety of exercise options would yield different results between physically active and sedentary individuals.

4. Additional research can also examine if body composition, race, ethnicity, or socio-economic background yield similar results.
APPENDICES
APPENDIX A

ADULT PHONE SCRIPT
The Effect of Variety on the Reinforcing Value and Amount of Physical Activity in Children, Younger Adults, and Older Adults

Hello, this is _____________________ from the Applied Physiology Lab at Kent State University. I am calling because you have previously expressed interest in a study in our laboratory and you indicated your willingness to be contacted for future studies. Would you like to hear about a new study that you may qualify to participate in?

The purpose of this study is to determine how adults aged 18–26 and older than age 60 enjoy exercising with different pieces of exercise equipment. If you decide to participate in this study you will be asked to complete three 30-minute activity sessions. In the first session you will be shown all of the exercise options. We will determine the maximum amount of weight that you can lift for each exercise and then calculate 70% of that amount to be used in sessions two and three. In the second and third sessions you will have access to all 10 pieces of exercise equipment or your favorite upper body and lower body options for 20 minutes. Quiet activities such as reading magazines and playing matching games will be available for you as well. You can choose which you prefer to do for this time period. After the 20-minute exercise session, you will perform a computer matching task to acquire points that will allow you access to your choice of the exercise option, the sedentary activities, or a combination of both for a total of 11 minutes. You can participate in any of the activities you choose for as much time as you choose. You will be allowed to rest whenever you wish
during each session. To record your activity you will be wearing an activity
monitoring belt during each 30-minute session. We will also ask you how you like
each of the sessions. At the end of the study you will receive a $30.00 gift
certificate to your choice of ACME, Giant Eagle, Gamestop, Target, or Wal-mart.

Any information obtained from you, including this phone screen, will be
treated in strict confidence. This phone screen is voluntary and you may stop at
any time. Do you have any questions? Does this sound like something you are
interested in?

*If no.* Thank you for your time.

*If yes.* Great, I have a few questions to ask you to determine if you are
eligible to participate in this study. This will only take a couple of minutes and
you can ask me questions at any time.

1. Answer questions on medical history
2. What times would you be available to participate in this project?
3. Let’s go ahead and set up your appointment times. *(See time sheet)*

If for some reason you are unable to attend a session please try to give as much
advanced notice as possible.
APPENDIX B

PARENT/CHILD PHONE SCRIPT
The Effect of Variety on the Reinforcing Value and Amount of Physical Activity in
Children, Younger Adults, and Older Adults

Hello, this is _____________________ from the Applied Physiology Lab at Kent State University. I am calling because you have previously expressed interest in a study in our laboratory and you indicated your willingness to be contacted for future studies. Would you like to hear about a new study that your child may qualify to participate in?

The purpose of this study is to determine how boys and girls ages 8–12 enjoy exercising with different pieces of exercise equipment. If you decide to participate in this study your child will be asked to complete three 30-minute activity sessions. In the first session your child will be shown all of the exercise options. We will determine the maximum amount of weight that your child can lift for each exercise and then calculate 70% of that amount to be used in sessions two through four. In the second and third sessions your child will have access to all 10 pieces of exercise equipment or their favorite upper body and lower body options for 20 minutes. Quiet activities such as reading magazines and playing matching games will be available for your child as well. Your child will then perform a computer matching task to acquire points that will allow them access to their choice additional time to exercise, the quiet activities or a combination of both for a total of 11 minutes. Your child can participate in any of the activities he/she chooses for as much time as he/she chooses. Your child will be allowed to rest whenever he/she wishes during each 30-minute session. To record
his/her activity your child will be wearing an activity monitoring belt during each 30 minute session. We will also ask your child how he/she liked each of the sessions. At the end of the study your son or daughter will receive a $30.00 gift certificate to their choice of ACME, Giant Eagle, Gamestop, Target or Wal-mart.

Any information obtained from you, including this phone screen, will be treated in strict confidence. This phone screen is voluntary and you may stop at any time. Do you have any questions? Does this sound like something you and your child are interested in?

If no. Thank you for your time.

If yes. Great, I have a few questions to ask you to determine if your child is eligible to participate in this study. This will only take a couple of minutes and you can ask me questions at any time.

1. Answer questions on medical history
2. What times are convenient for you to bring your child in for the study?
3. Let’s go ahead and set up your appointment times. *(See time sheet)*

If for some reason you are unable to attend a session please try to give as much advanced notice as possible.
APPENDIX C

MEDICAL HISTORY (ADULT)—PHONE SCREEN
MEDICAL HISTORY (ADULT)—PHONE SCREEN

Participant #_____________ Date___/___/____

Name_________________________________ Major (if college student) ____________________
Address___________________________________________________________________________
Phone Number____________________________
Age________ DOB_____/_____/_____ Sex m f
Height ________ in Wt ________ lbs
Height ________ cm (inches *2.54) Wt ________ kg (lbs/2.2)
BMI ________ kg/m² Weight percentile____________________

Which ethnic group do you most identify with (circle response):
American Indian or Alaskan Native Asian or Pacific Islander Black, not of Hispanic Origin
Hispanic White, not of Hispanic Origin
Other___________________________

Y/N
____ Has a doctor ever said that your blood pressure was too high or too low?
____ Do you ever have pain in their heart or chest?
____ Do you ever notice extra heart beats, skipped beats or a racing heart?
____ Has a doctor ever said that you have heart trouble, an abnormal electrocardiogram (ECG or EKG), heart attack, or coronary?
____ Do you often have trouble breathing?
____ Have you ever been diagnosed with asthma?
____ Have you ever been diagnosed with diabetes?
____ Do you have any orthopedic limitations to physical activity?
Do you have any other medical conditions that affect your ability to safely participate in physical activity? If yes, explain.

_____________________________________________________________________________
_____________________________________________________________________________

Are you currently taking any medication(s)?

Y  N

If yes, please describe the medication(s)

_____________________________________________________________________________

Are you involved in any club or school sport teams?

Y  N

If yes, what sport(s) and how frequently each week?

Do you have any questions?

Does the participant seem eligible? Y  N

Schedule Appointments:

Date of first appointment: ____________________________

Second: ____________________________

Third: ____________________________
APPENDIX D

MEDICAL HISTORY (CHILD)—PHONE SCREEN
MEDICAL HISTORY (CHILD)—PHONE SCREEN

Participant # _______________ Date ___/___/_____

ChildName_________________________________ Parent____________________________________

Address___________________________________________________________________________

Phone Number______________________________________________________________

Age________ (must be 8—12 y) DOB_____/_____/_____ Sex m f

Height ________in Wt _________lbs

Height ________cm (inches *2.54) Wt_________kg(lbs/2.2) BMI_________kg/m²

Weight percentile_____________________

Which ethnic group do you most identify with (circle response):

<table>
<thead>
<tr>
<th>American Indian or Alaskan Native</th>
<th>Asian or Pacific Islander</th>
<th>Black, not of Hispanic Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic</td>
<td></td>
<td>White, not of Hispanic Origin</td>
</tr>
<tr>
<td>Other______________________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Y/N

<table>
<thead>
<tr>
<th></th>
<th>Has a doctor ever said that your child’s blood pressure was too high or too low?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Does your child ever have pain in their heart or chest?</td>
</tr>
<tr>
<td></td>
<td>Does your child ever notice extra heart beats, skipped beats or a racing heart?</td>
</tr>
<tr>
<td></td>
<td>Has a doctor ever said that your child has heart trouble, an abnormal</td>
</tr>
<tr>
<td></td>
<td>electrocardiogram (ECG or EKG), heart attack, or coronary?</td>
</tr>
<tr>
<td></td>
<td>Does your child often have trouble breathing?</td>
</tr>
<tr>
<td></td>
<td>Has your child ever been diagnosed with asthma?</td>
</tr>
<tr>
<td></td>
<td>Has your child ever been diagnosed with diabetes?</td>
</tr>
<tr>
<td></td>
<td>Does your child have any orthopedic limitations to physical activity?</td>
</tr>
</tbody>
</table>
Does your child have any other medical conditions that affect his/her ability to safely participate in physical activity? If yes, explain.

____________________________________________________________________________________

Is your child currently taking any medication(s)?

Y  N

If yes, please describe the medication(s)

____________________________________________________________________________________

Is your child involved in any club or school sport teams?

Y  N

If yes, what sport(s) and how frequently each week?

____________________________________________________________________________________

Do you have any questions?

Does the participant seem eligible?  Y  N

Schedule Appointments:

Date of first appointment: ____________________________

Second:

______________________________

Third:

______________________________
The Effect of Variety on the Reinforcing Value and Amount of Physical Activity in Children, Younger Adults, and Older Adults

Hello, I want to do a research project on how individuals enjoy exercising with different types of exercise equipment. I would like you to take part in this project. If you decide to do this, you will be asked to come to the exercise physiology laboratory on three occasions for about 45 minutes each time. During the first session, after completing a brief medical history, you will be weighed and your height measured. Next you will be shown 10 different strength training exercises. After a practice session, we will determine the greatest amount of weight you can lift on each particular piece of equipment. You will then let us know how much you like each of the exercises you try. On the second and third session you will have access to either all of the pieces of equipment or your favorite upper and lower body equipment for a period of 20 minutes. During the 20 minutes, you may exercise as much or as little as you wish. You will also have the choice of activities such as magazines, puzzles, games, and books. While exercising, you will wear a strap called an accelerometer which will allow us to measure the amount of activity you perform during your session. We will also ask you how you liked your exercise session and how you feel, i.e., if you’re tired or have any discomfort. After the first 20-minute session you will play a computer matching game where you will be able to earn access to 11 minutes of exercise. Two computers will be set up, one allowing you to earn time for the exercise options from that session, and one to earn time for the sedentary
activities. You will be able to choose all of one or the other or a combination of both. You will then complete the 11 minutes of exercise and/or the sedentary activities that you earned during the computer game.

You may experience some muscle soreness during these activities or the day after you exercise. An exercise physiologist will be present to ensure that you are performing the exercises properly. Medical Assistance or emergency medical treatment by the University Health Center is provided only to currently registered students. Please be advised that for all others, “911” will be called for physical injuries occurring on the Kent State University main campus. You or your medical insurance will be billed for this service. No other medical treatment or financial compensation for injury from participation in this project is available.

Confidentiality will be maintained to the limits of the law. Confidentiality may not be maintained if you indicate that you may do harm to yourself or have done harm to others. All files will be kept in Dr. Jacob Barkley’s applied physiology laboratory in a locked filing cabinet. Your name will not be used during the study; you will be assigned a number that will serve as your identity. If you take part in this project you will receive a $30.00 gift certificate to your choice of one of the following stores: ACME, Giant Eagle, Game Stop, Target, or Wal-Mart. Taking part in this project is entirely up to you, and no one will hold it against you if you decide not to do it. If you do take part, you may stop at any time.
If you want to know more about this research project, please call me, Judith A. Juvancic-Heltzel, at 330*307*8953 or Dr. Jacob Barkley at 330*672*7040. The project has been approved by Kent State University. If you have questions about Kent State University’s rules for research, please call Dr. John West, Acting Vice President of Research, Division of Research and Graduate Studies (Tel. 330.672.2704).

You will get a copy of this consent form.

Sincerely,

Judith A. Juvancic-Heltzel

Graduate Student

Department of ELS

Kent State University

B. CONSENT STATEMENT (S)

1. I agree to take part in this project. I know what I will have to do and that I may stop at any time.

____________________________________________________________________

Signature
Date

____________________________________________________________________

Witness Signature
Date
APPENDIX F

PARENTAL/CHILD INFORMED CONSENT
Hello, I want to do a research project on how individuals enjoy exercising with different types of exercise equipment. I would like your child, __________________, to take part in this project. If you decide to do this, your child will be asked to come to the exercise physiology laboratory on three occasions for about 45 minutes each time. During the first session, after completing a brief medical history, your child’s weight and height will be measured. Next your child will be shown 10 different strength training exercises. After a practice session we will determine the greatest amount of weight your child can lift on each particular piece of equipment. Your child will then let us know how much they like each of the exercises they try. On the second and third session your child will have access to either all of the pieces of equipment or their favorite upper and lower body equipment for a period of 20 minutes. During the 20 minutes, your child may exercise as much or as little as they wish. They will also have the choice of activities such as magazines, puzzles, games and books. While exercising, your child will wear a strap called an accelerometer which will allow us to measure the amount of activity they perform during their session. We will also ask your child how they liked their exercise session and how they feel, i.e. if they are tired or have any discomfort. After the first 20-minute session your child will play a computer matching game where they will be able to earn access to 11 minutes of exercise. Two computers will be set up,
one allowing your child to earn time for the exercise options performed that day, and one to earn time for the sedentary activities. Your child will be able to choose all of one or the other or a combination of both. Your child will then complete the eleven minutes of exercise and/or the sedentary activities that they earned during the computer game.

Your child may experience some muscle soreness during these activities or the day after they exercise. An exercise physiologist will be present to ensure that your child is performing the exercises properly.

Medical Assistance or emergency medical treatment by the University Health Center is only provided to currently registered students. Please be advised that for all others, “911” will be called for physical injuries occurring on the Kent State University main campus. You or your medical insurance will be billed for this service. No other medical treatment or financial compensation for injury from participation in this project is available.

Confidentiality will be maintained to the limits of the law. Confidentiality may not be maintained if you indicate that you may do harm to yourself or have done harm to others. All files will be kept in Dr. Jacob Barkley’s applied physiology laboratory in a locked filing cabinet. Your child’s name will not be used during the study; they will be assigned a number that will serve as their identity. If your child takes part in this project they will receive a $30.00 gift certificate to their choice of one of the following stores: ACME, Giant Eagle, Game Stop, Target, or Wal-Mart. Taking part in this project is entirely up to you.
and no one will hold it against you or your child if you decide not to do it. If your child does take part, he or she may stop at any time.

If you want to know more about this research project, please call me, Judith A. Juvancic-Heltzel, at 330*307*8953 or Dr. Jacob Barkley at 330*672*7040. The project has been approved by Kent State University. If you have questions about Kent State University’s rules for research, please call Dr. John West Acting Vice President of Research, Division of Research and Graduate Studies (Tel. 330.672.2704).

You will get a copy of this consent form.

Sincerely,

Judith A. Juvancic-Heltzel
Graduate Student
Department of ELS
Kent State University

B. CONSENT STATEMENT (S)

1. I agree to have my child to take part in this project. I know what they will have to do and that they may stop at any time.

________________________________________________________
Parent Signature Date

________________________________________________________
Child Signature Date

________________________________________________________
Witness Signature Date
The Effect of Variety on the Reinforcing Value and Amount of Physical Activity in Children, Younger Adults, and Older Adults

Who are we?

My name is Judi Juvancic-Heltzel and I am a doctoral student at Kent State University. Dr. Jacob Barkley is an Assistant Professor at Kent State University and he is helping me finish my research project so I can graduate.

Why are we meeting with you?

We want to tell you about a study that involves children like yourself. We want to see if you would also like to be in this study.

Why are we doing this study?

We are trying to learn more about how you feel and like to exercise with different types of exercises and exercise equipment.

What will happen to you if you are in the study?

You will come to the lab here at Kent State University on three separate days. On the first day, you and one of your parents will learn about the study and you will let us know if you want to be in the study. If you decide to be in the study you will have your height and weight measured. You then will be shown all the exercises and exercise machines and how to do the exercises. You will come back two more times, and every time you come to the lab you will go to the same gym for about 30 minutes. While you are in the gym, you will have to wear a special belt that we give you. This belt tells us how many steps you moved while you were in the gym. Each of the next two times you will be able to do all of the activities...
exercises we show you or just your favorite arm and favorite leg exercises.

When you are in the gym you can do the exercises, sit and color or rest for as much as you want for 20 minutes. You can rest any time you would like. Then you will play a computer matching game where you can earn points to do more exercise, color or rest, or both for an additional 11 minutes. You will be given a $10.00 gift certificate for every visit (for a total of $30.00 if you come for all three visits). You can choose your gift certificate for Giant Eagle, ACME, Gamestop, Target, or Wal-mart.

**What are the good or bad things that may happen?**

You arms and legs may get tired if you are not used to the exercise and your muscles may be sore the day after you exercise. This is normal.

**Do I have to be in the study?**

No you don’t. No one will get angry or upset with you if you don’t want to do this. Just tell us if you don’t want to be in the study. And remember, you can change your mind later if you decide you don’t want to be in the study anymore.

**Do you have any questions?**

You can ask questions at any time. You can ask now. You can ask later. You can talk to me or you can talk to someone else at any time during the study.

Here are the telephone numbers to reach us:

Jake Barkley, PhD, Exercise, Leisure, and Sport, (330) 672-0209.

Kent State Applied Physiology Lab, (330) 672-7040
If you want to be in the study, sign your name on the line below:

Signature of Child: ______________________________  Date: _________

Signature of Parent: ______________________________  Date: _________

Signature of Witness: _____________________________  Date: _________

Signature of PI: ________________________________  Date: _________
APPENDIX H

ADULT EXERCISE SELF-EFFICACY
# ADULT EXERCISE SELF-EFFICACY

Name _______________________________  Participant # _______________________

Date ________________________________

<table>
<thead>
<tr>
<th>How confident are you that you could exercise in each of the following situations?</th>
<th>Not Confident</th>
<th>Slightly Confident</th>
<th>Moderately Confident</th>
<th>Very Confident</th>
<th>Extremely Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>When I am tired</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I am in a bad mood</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>When I feel I do not have time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I am on vacation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When it is raining or snowing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

APPENDIX I

CHILD PHYSICAL ACTIVITY SELF-EFFICACY
# CHILD PHYSICAL ACTIVITY SELF-EFFICACY

Name ___________________________ Participant # ___________________ Date ___________________

Please mark a box that best describes your answer for each question. The rating scale range from 1 (Very Easy/Agree a lot) to 5 (Very Difficult/Disagree a lot). Only one answer for each question.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I can be physically active during my free time on most days.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I can ask my parent or other adult to do physically active things with me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I can be physically active during my free time most days even if I could watch TV or play video games instead.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I can be physically active during my free time on most days even if it is very hot or cold outside.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I can ask my best friend to be physically active with me during my free time on most days.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I can be physically active during my free time on most days even if I have to stay at home.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I have the coordination I need to be physically active during my free time on most days.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I can be physically active during my free time on most days no matter how busy my day is.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX J

GODIN LEISURE-TIME EXERCISE QUESTIONNAIRE
Name _________________________ Participant # ______ Date __________

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

   Times Per Week

(a) STRENuous exercise (Heart beats rapidly)
   (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)
   __________

(b) MODERate exercise (Not exhausteding)
   (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)
   __________

(c) MIld exercise (Minimal effort)
   (e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)
   __________

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


APPENDIX K

DAY ONE EVALUATIONS
DAY ONE EVALUATIONS

Date ___________ Participant # _______________ Evaluator __________________

Date of Birth ________________ Gender (circle) M or F

ANTHROPOMETRY

Weight _______ (kg) Height ____ (cm.) ____ (m) ____ (m²)

BMI (Wt in kg/Ht in m²) __________________

* Sampling on machines—1 plate children, 2 plates adults

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>MACHINE SETTINGS</th>
<th>HIGHEST WEIGHT LIFTED, # OF REPS</th>
<th>ESTIMATED 1 RM</th>
<th>70% 1 RM</th>
<th>VAS SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricep extension</td>
<td>Back _____ Seat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 plate adults)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicep curl</td>
<td>Seat _____</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 plate adults)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer curl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lat pulldown</td>
<td>Thigh pad _____</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest press</td>
<td>Seat _____ Arms _____</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest bench press</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial deltoid raise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg press</td>
<td>Back _____</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg extension</td>
<td>Back _____ Leg pad _____</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg curl</td>
<td>Back _____ Leg pad _____ Thigh stab. _____</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Predicted 1-RM = wt.lifted/1.0278 - .0278 * X  Where X = the # of reps performed

Favorite upper body exercise _______________________________  jjh2/16/09

Favorite Lower body exercise _______________________________
APPENDIX L

LIKING VISUAL ANALOGUE SCALE
LIKING VISUAL ANALOGUE SCALE

Name: ________________________  Participant # _______  Date: ___ / ___ / ___

Equipment: (if day one) ______________________________

Session (if day 2 or 3) circle one           High variety            Low variety

|_____________________________________|

Do not like it at all.  Like it very much.

(Left side)  (Right side)
APPENDIX M

WORKLOAD DOCUMENTATION - HIGH VARIETY
## WORKLOAD DOCUMENTATION - HIGH VARIETY

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Weight Setting 70% 1RM</th>
<th>Machine Settings</th>
<th># of Sets (Mark multiple times comma b/w each set)</th>
<th># of Reps (Mark # of reps/set, comma in between each set of reps)</th>
<th>Time Spent</th>
<th>Total Amount Weight Lifted</th>
<th>Observer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricep extension</td>
<td></td>
<td>Back</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicep curl</td>
<td></td>
<td>Seat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer curl (free weights)</td>
<td></td>
<td>Seat</td>
<td></td>
<td></td>
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<tr>
<td>Lat pulldown</td>
<td></td>
<td>Thigh</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Chest press</td>
<td></td>
<td>Seat</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Chest bench press (free weights)</td>
<td></td>
<td>Arms</td>
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<tr>
<td>Medial deltoid raise (free weights)</td>
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</tr>
<tr>
<td>Leg press</td>
<td></td>
<td>Back</td>
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</tr>
<tr>
<td>Leg extension</td>
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<td>Back</td>
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<tr>
<td>Leg curl</td>
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<td>Back</td>
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<td>Leg</td>
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<td>Thigh</td>
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<td>TOTAL TIME</td>
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<tr>
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</tr>
</tbody>
</table>

LIKING _______________________________    RPE _______________________________
APPENDIX N

WORKLOAD DOCUMENTATION - LOW VARIETY
## WORKLOAD DOCUMENTATION - LOW VARIETY

Participant Number ___________________________  Date ______________

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>WEIGHT SETTING 70% 1RM</th>
<th>MACHINE SETTINGS</th>
<th># OF SETS (Mark multiple times comma b/w each set)</th>
<th># OF REPS (Mark # of reps/set, comma in between each set of reps)</th>
<th>TIME SPENT</th>
<th>TOTAL AMOUNT WEIGHT LIFTED</th>
<th>OBSERVER NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricep extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicep curl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Hammer curl (free weights)</td>
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<td>Lat pulldown</td>
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<td>Chest press</td>
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<td>Seat</td>
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<td>Chest bench press (free weights)</td>
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<td>Medial deltoid raise (free weights)</td>
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<td>Leg press</td>
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<td>Leg extension</td>
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<td>Back</td>
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<td>Leg curl</td>
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<td>Back</td>
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<td>Table activities</td>
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TOTAL TIME

LIKING _______________________________  RPE ___________________________________
APPENDIX O

OMNI RPE WEIGHT TRAINING - ADULT
OMNI Resistance Exercise Scale: Adult

OMNI-RES scale for children.

APPENDIX Q

SCRIPT FOR HIGH VARIETY, LOW VARIETY,

AND THE RRV COMPUTER TASK
SCRIPT FOR HIGH VARIETY, LOW VARIETY
AND THE RRV COMPUTER TASK

Introduction

Welcome to the Kent State Applied Physiology Lab. Before we get started with the exercise demonstrations for today, please complete this paperwork. First, you will sign a Consent Form. The other two forms will let us know your exercise habits and how you feel about exercising. If you have any questions about the forms, please feel free to ask.

Baseline Data

Today we are going to measure your height and your weight. You then will be shown the exercises that you will do on your second and third visits.

Explaining the estimated 1-RM protocol to the subject

We will demonstrate (show you how) how to perform 10 different strength training exercises. You will then perform two sets of 8-10 repetitions on each piece of equipment, resting for a minimum of two minutes between sets. This will be your practice session. Y or N

After a practice session, we will determine the greatest amount of weight you can lift on each particular piece of equipment. Y or N

After you perform each exercise, you will then let us know how much you like each of the exercises you try. Y or N

You will have the participant mark a line on the VAS liking scale immediately after completing each 1-RM. If after completing the estimated 1-RM
for all of the equipment, there are duplicate VAS scores for upper body exercises, you must have them designate their favorite between the duplicates.

If this occurs with the lower body exercises as well, you must have them also designate which is their favorite lower body exercise.

You are done for today. Do you have any questions?

Visits 2 and 3

*NOTE: Order will be counterbalanced, half of the participants will perform low variety session on their second visit and high variety on the third visit, the other half of the participants will perform high variety on the second visit and low variety on the third visit.

Low Variety Session

Today you will have access ONLY to your favorite upper body exercise and your favorite lower body exercise for 20 minutes. You may not use any of the other exercise equipment on this day. Y or N

While exercising, you will wear a strap called an accelerometer which will allow us to measure the amount of activity you perform during your session. Y or N

We will show you how to do the exercises again in case you have forgotten how to do them. Y or N

During the 20 minutes, you may exercise as much or as little as you wish. You may also choose to do any of the table activities. Y or N
If you choose to do the table activities you must sit at the table when doing them.  **Y or N**

You are free to move between the exercises and the table activities if you wish.  **Y or N**

At the end of the 20 minutes, we will also ask you how you liked your exercise session (*VAS liking scale*).  **Y or N**

We will also ask how you feel, i.e. if you’re tired or have any discomfort (*Age appropriate OMNI RPE scale*).  **Y or N**

After the first 20 minute session you will play a computer matching game where you will be able to earn access to 11 minutes of exercise.  **Y or N**

Do you have any questions before we begin?  **Y or N**

If not, let’s begin.  Remember, if you have any questions during this session don’t be afraid to ask.  **Y or N**

*REMEMBER, DO NOT ENGAGE IN ANY UNNECESSARY CONVERSATION WITH THE PARTICIPANT OR THE OTHER INVESTIGATOR THAT IS PRESENT.  ONE INVESTIGATOR WILL SHADOW THE PARTICIPANT AND ANSWER QUESTIONS, CORRECT FORM, ETC.  THE OTHER INVESTIGATOR WILL BE RESPONSIBLE FOR DATA COLLECTION.*

**The Computer Game**

Now I want you to remember how you felt when you were performing the resistance training exercises.  You will now play the computer game where you
will earn time for more exercise or time for the table activities. Remember there will be 2 computers one for the exercise and one for the table activities and you will have to click on the shapes of the computer that has the activity you want to earn more time for. Every time you match the shapes you get a point. Every point you earn will earn you one minute of time for that activity (exercise or table) and the game will go to the next level. For example if you want to earn resistance exercise you would click on this computer or to earn time for the table activities you would click on that computer. You can go back and forth between the 2 computers whenever you want. You will keep clicking and earning time until you have earned a total of 11 minutes. You have to earn 11 total minutes and then you do the exercise activities and/or table activities for the amount of time earned. So make sure you work for the activity you want to do. Y or N

Let me show you.

Start clicking on one machine and switch to the other then go back to the first. Stress how to match the shapes and how the points are earned. Then allow the participant to practice. Y or N

OK now I am going to let you practice. Do you have any questions? If so address them if not begin the practice. Y or N

After the participant completes the practice, inform them how many minutes they earned. Ask them if they understand what they are doing and if they have any questions. If so address them, if not begin.
I will be in the other room watching on a camera, I will talk to you through the speaker. Do not start until I tell you. Let me know if you have any questions.  

OK begin.  **Y or N**

*Tell the participant whenever they earn time for a protocol, so they understand what they are working for and earning.*  **Y or N**

*Once the participant has earned 11 minutes tell them to stop.*  **Y or N**

*Let them know what they will be doing.*  **Y or N**

*Take the participant back to the weight room to perform the earned activities.*  **Y or N**

*If they earn time for both exercise and table activities, they must complete all of the time for one first, before completing time for the second.*  **Y or N**

**High Variety Session**

Today you will have access to all of the exercises you were shown on your first visit for 20 minutes.  **Y or N**

While exercising, you will wear a strap called an accelerometer which will allow us to measure the amount of activity you perform during your session.  **Y or N**

We will show you how to do the exercises again in case you have forgotten how to do them.  **Y or N**

During the 20 minutes, you may exercise as much or as little as you wish.

You may also choose to do any of the table activities.  **Y or N**
If you choose to do the table activities you must sit at the table when doing them.  **Y or N**

You are free to move between the exercise and the table activities if you wish.  **Y or N**

At the end of the 20 minutes, we will also ask you how you liked your exercise session (**VAS likert scale**). **Y or N**

We will also ask how you feel, i.e. if you’re tired or have any discomfort (**Age appropriate OMNI RPE scale**). **Y or N**

After the first 20-minute session you will play a computer matching game where you will be able to earn access to 11 minutes of exercise.  **Y or N**

Do you have any questions before we begin?  **Y or N**

If not, let’s begin. Remember, if you have any questions during this session don’t be afraid to ask.  **Y or N**

**The Computer Game**

Now I want you to remember how you felt when you were performing the resistance training exercises. You will now play the computer game where you will earn time for more exercise or time for the table activities. Remember there will be 2 computers one for the exercise and one for the table activities and you will have to click on the shapes of the computer that has the activity you want to earn more time for. Every time you match the shapes you get a point. Every point you earn will earn you one minute of time for that activity (exercise or table)
and the game will go to the next level. For example if you want to earn resistance exercise you would click on this computer or to earn time for the table activities you would click on that computer. You can go back and forth between the 2 computers whenever you want. You will keep clicking and earning time until you have earned a total of 11 minutes. You have to earn 11 total minutes and then you do the exercise activities and/or table activities for the amount of time earned. So make sure you work for the activity you want to do. Y or N

Let me show you:

Start clicking on one machine and switch to the other then go back to the first. Stress how to match the shapes and how the points are earned. Then allow the participant to practice. Y or N

OK now I am going to let you practice. Do you have any questions? If so address them if not begin the practice. Y or N

After the participant completes the practice, inform them how many minutes they earned. Ask them if they understand what they are doing and if they have any questions. If so address them, if not begin.

I will be in the other room watching on a camera, I will talk to you through the speaker. Do not start until I tell you. Let me know if you have any questions. OK begin. Y or N

Tell the participant whenever they earn time for a protocol, so they understand what they are working for and earning. Y or N

Once the participant has earned 11 minutes tell them to stop. Y or N
Let them know what they will be doing. Y or N

Take the participant back to the weight room to perform the earned activities. Y or N

If they earn time for both exercise and table activities, they must complete all of the time for one first, before completing time for the second. Y or N

*REMEMBER, DO NOT ENGAGE IN ANY UNNECESSARY CONVERSATION WITH THE PARTICIPANT OR THE OTHER INVESTIGATOR THAT IS PRESENT. ONE INVESTIGATOR WILL SHADOW THE PARTICIPANT AND ANSWER QUESTIONS, CORRECT FORM, ETC. THE OTHER INVESTIGATOR WILL BE RESPONSIBLE FOR DATA COLLECTION.
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