THE EFFECT OF PEER INFLUENCE ON THE AMOUNT OF PHYSICAL ACTIVITY
PERFORMED IN 8-12 YEAR OLD BOYS

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

by

Melissa A. Rittenhouse

December, 2008

© Copyright by Melissa A. Rittenhouse 2008

All Rights Reserved

A dissertation written by

Melissa A Rittenhouse

B.S., University of Dayton, 1999

M.S., Georgia State University, 2001

Ph.D., Kent State University, 2008

Approved by

_____, Co-director, Doctoral
Jacob Barkley, PhD Dissertation Committee

_____, Co-director, Doctoral
Ellen Glickman, PhD Dissertation Committee

_____, Members, Doctoral
Natalie Caine-Bish, PhD, RD Dissertation Committee

Accepted by

_____, Director, School of
Wayne Munson, PhD Exercise Leisure and Sport

_____, Dean College and Graduate
Daniel F. Mahony, PhD School of Education, Health and Human Services

Rittenhouse, Melissa PhD, December 2008

Exercise, Leisure and Sport

THE EFFECT OF PEER INFLUENCE ON THE AMOUNT OF PHYSICAL ACTIVITY
PERFORMED IN 8-12 YEAR OLD BOYS (108pp)

Co-directors of Dissertation: Jacob E. Barkley, PhD and Ellen Glickman, PhD

There are several factors that influence the amount of physical activity children participate in. Recent research utilizing self-reported data demonstrated that both lean and overweight children were more likely to engage in physical activity when with peers (in unorganized setting) compared to when they are alone (Salvy, 2008). The purpose of this study is to determine the amount and intensity of physical activity children perform in a controlled setting, by themselves, with a peer who is of similar weight and with a peer of different weight.

During each of the three conditions, children were fitted with an accelerometer and had access to both physical activities and sedentary activities for a total of 30 minutes. The total number of accelerometer counts, sedentary and physical activity time, liking, and RPE for each condition were recorded and compared across all three conditions.

Two-way ANOVAs demonstrated significant group by treatment interactions for accelerometer counts ($p = 0.008$), sedentary activity time ($p = 0.017$) and liking ($p = 0.009$). Overweight boys accumulated fewer accelerometer counts ($p = 0.001$) and participated in greater amounts of sedentary time ($p = 0.007$) than lean boys in the alone condition with no differences in the with-peer conditions ($p \geq 0.50$). Overweight boys also increased their liking score from the alone condition to the with different weight peer

condition, while liking scores for the lean boys were not significantly altered (8.2 ± 1.9 cm to 7.4 ± 3.2 cm, $p = 0.262$). These results highlight a potentially greater need for peer interaction in the at-risk-for/overweight boys to increase physical activity and liking of that activity.

ACKNOWLEDGMENTS

I would like to thank my advisors (Dr. Barkley and Dr. Glickman) and my committee for their time and help guiding me through the dissertation process and for making me a better researcher. I would like to particularly thank Dr. Barkley for the extra time and effort he put in to ensure my dissertation was complete and for the encouragement he provided along the way. I would also like to thank Susan and the support staff in the graduate school for their check and balancing system to ensure I had everything I needed to proceed to the next step as smoothly as possible.

I would also like to thank the subjects and their parents for their participation, without them this study would not be possible. I would also like to thank my fellow graduate students who helped collect the data and made the process much more enjoyable. I would also like to thank my family and friends for their support during my entire journey through the doctorate program and for their confidence in my abilities.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	iv
LIST OF FIGURES.....	viii
LIST OF TABLES.....	ix
CHAPTER	
I. INTRODUCTION.....	1
II. REVIEW OF LITERATURE.....	7
CHILDREN'S PHYSICAL ACTIVITY PATTERNS.....	7
MOTIVATION/RRV.....	11
LIKING/ENJOYMENT.....	12
VARIETY.....	13
PHYSICAL ENVIRONMENT.....	14
PARENTAL MODELING.....	16
PEER INFLUENCE.....	17
PURPOSE.....	22
SPECIFIC AIM.....	22
RATIONALE FOR SPECIFIC AIM.....	23
HYPOTHESES.....	23
III. RESEARCH DESIGN AND METHODS.....	25
METHODS.....	25
DESIGN.....	26

PROCEDURES.....	27
MEASUREMENTS.....	30
SAMPLE SIZE DETERMINATION.....	35
STATISTICAL ANALYSIS.....	36
IV. RESULTS.....	38
DESCRIPTIVE DATA.....	38
SUBJECT CHARACTERISTICS.....	38
PEER VICTIMIZATION.....	39
SELF EFFICACY.....	40
TOTAL COUNTS.....	40
SEDENTARY ACTIVITY TIME.....	41
LIKING.....	42
RATINGS OF PERCIEVED EXERTION.....	44
FATIGUE.....	45
PHYSICAL ACTIVITY BOUTS.....	45
PERCEPTION OF TIME.....	47
V. DISCUSSION/CONCLUSIONS.....	48
CHANGE COUNTS AND PHYSICAL/SEDENTARY ACTIVITY TIME.....	50
INFLUENCE OF PEER VICTIMIZATION.....	52
DIFFERENCES IN LIKING.....	55
ADDITIONAL FINDINGS.....	56

STUDY LIMITATIONS.....	58
CONCLUSIONS AND FUTURE DIRECTIONS.....	59
APPENDIXES	
A. PHONE SCRIPT	64
B. PHONE SCREEN DATA RECORDING FORM.....	66
C. PARENT CONSENT FORM.....	68
D. CHILD ASSENT FORM	70
E. ACTIVITY RECORDING SHEET	73
F. SELF EFFICACY FOR PHYSICAL ACTIVITY QUESTIONNAIRE	77
G. PEER INFLUENCE QUESTIONNAIRE	79
H. OMNI RPE SCALE.....	85
I. VISUAL ANALOG SCALE- LIKING.....	87
J. VISUAL ANALOG SCALE-FATIGUE.....	89
K. GIFT CERTIFICATE RECIEPT ACKNOWLEDGEMENT	91
L. COMPLETION THANK YOU LETTER	93
REFERENCES.....	95

LIST OF FIGURES

FIGURE		PAGE
1	BMI PERCENTILES PER GROUP.....	39
2	ACCELEROMETER COUNTS.....	41
3	SEDENTARY ACTIVITY TIME.....	42
4	LIKING.....	43
5	OMNI CHILD WALK/RUN RPE.....	44
6	VAS FATIGUE.....	45

LIST OF TABLES

TABLE		PAGE
1	DESIGN FOR GROUP BY TREATMENT INTERACTION.....	27
2	COUTERBALANCING ORDERS.....	27
3	SUBJECT CHARACTERISTICS.....	38
4	AVERAGE MINUTES AT EACH PHYSICAL ACTIVITY OPTION...	46

Chapter I

Introduction

The number of overweight children in the United States has increased by 45 % over the past 11 years (NCHS, 2008). Currently approximately 17.1% of children are classified as at risk for overweight (BMI for age percentile $\geq 85^{\text{th}}$ to $< 95^{\text{th}}$) with an additional 17.7% considered overweight ($\geq 95^{\text{th}}$ BMI Percentile) (Weiss, McCullagh et al. 1998; Ball, Marshall et al. 2005). One of the primary factors believed to influence these increasing rates of childhood overweight is a lack of participation in adequate amounts of physical activity (Weiss, McCullagh et al. 1998; Ball, Marshall et al. 2005). Beside weight maintenance (Eliakim, A., G. Kaven, et al., 2002; Ferguson, M. A., B. Gutin, et al., 1999; Gutin, B., N. Cucuzzo, et al., 1995; Owens, S., B. Gutin, et al., 1999), physical activity has numerous health benefits for children including greater cardiovascular fitness (Baker, Little, & Brownell, 2003; Eliakim, A., G. Kaven, et al.(2002), 2002; Gutin, B., N. Cucuzzo, et al., 1995; van Veldhoven, N. H., A. Vermeer, et al., 2001), bone mineral accrual (De Bourdeaudhuij, Lefevre et al. 2005), increased muscular strength and endurance (Faigenbaum, A. D., W. L. Westcott, et al., 1999), improved blood pressure and lipid profiles (Burke, V., R. A. Milligan, et al., 1998; Elder et al., 1998; Manios, Y. J., Moschandreas, et al., 2002), and improved self-esteem (Strauss, R. S., D. Rodzilsky, et al., 2001).

Despite these well known benefits of physical activity, the number of overweight children continues to increase, suggesting that there is an increase in the number of

children who are not participating in adequate amounts of physical activity. (L. H. Epstein & Goldfield, 1999).

As the rate of overweight children increases, there is a concomitant increase in the number of overweight adults, as 80% of overweight children become overweight or obese adults (Burdette, Whitaker, & Daniels, 2004). Because of these dramatic increases in the proportion of overweight children and their influence on the increases in the proportion of overweight adults it is important to develop a better understanding of the factors that influence physical activity in children in order to develop exercise programs and recommendations that children would be more likely to regularly participate in. This is of particular interest because research has shown that if an individual is physically active during childhood he or she is more likely to remain physically active as an adult (Kelly et al., 2007).

There are several factors that have been shown to be related to the amount of physical activity children participate in including: parental influence (Anderssen & Wold, 1992; Salvy et al., 2008) the physical environment (Kelly et al., 2007), enjoyment or liking of physical activity (Dishman, Motl, Sallis et al., 2005), the relative reinforcing value or motivating value of physical activity relative to sedentary alternatives (L. H. Epstein & Goldfield, 1999; L. H. Epstein, Beecher, Graf, & Roemmich, 2007); and a child's self efficacy for physical activity (Troost, Owen, Bauman, Sallis, & Brown, 2002).

An increasing amount of evidence has outlined an additional factor, peer influence, as one which may have a strong influence on the amount of physical activity

children participate in (Dishman, Motl, Saunders et al., 2005; Goldfield et al., 2007; Hartup, 2005; Salvy, Romero, Paluch, & Epstein, 2007; Salvy et al., 2008).

Peer influence can be both positive and negative. For example, peers eating their fruits and vegetables often influence others to eat their fruits and vegetables (Weber Culln, Karen et al., 2001). However, peers using drugs can also influence others to try drugs (Bickel et al., 1998). In regards to physical activity both lean and overweight children report being more physically active in the presence of a friend in an unstructured setting (outside of school) than when they are alone (Salvy et al., 2008). However, in an organized setting (i.e. school physical education class) overweight children are less likely to be physically active in the presence of their peer (Sallis, J.F., 2001). It has been hypothesized that overweight children face peer rejection in these organized settings and as a result withdraw from the activity (Gray, W.N., 2008; Grotmeter, J.K., 1996; Crick, N.R., 1995). Peer rejection or peer victimization impacts the self-esteem of children and may feed into a cycle of unhealthy practices (i.e. watching television alone), which are comforting to the child because they allow the children to be removed from that rejection and peer victimization (Rukavina & Li, 2008). Such activities include limiting physical activity with groups, such as gym class and not participating in after school sport teams (Rukavina & Li, 2008; Weiss, 2000). In turn, this leads to more sedentary activities such as watching television.

In some cases, this sedentary behavior could also be associated with snacking, which is more accessible while at home watching television than while participating in group activities outside the home (Rukavina & Li, 2008). In addition to having greater

access to snack foods while at home, television watching creates a disinhibition of the cues to terminate eating which allows children to eat greater amounts of food while watching television than they would away from television (Armstrong et al., 1998; Berridge, 1996; L. H. Epstein, Paluch, Consalvi, Riordan, & Scholl, 2002). This could contribute to the problem of caloric intake exceeding caloric expenditure in overweight children.

The apparently environmentally sensitive effects peer influence has on a child's physical activity may be the result of the types of peers children associate with in organized versus unorganized settings (Roemmich, Epstein, Raja, & Yin, 2007; Roemmich, Gurgol, & Epstein, 2004; Salvy et al., 2008). As mentioned previously, children, both lean and at-risk-for/overweight exhibit greater amounts of physical activity in the presence of a peer in an unorganized, free-living setting (Salvy et al., 2008). Conversely, peer influence as it pertains to organized activities such as gym class and participation in team sports appear to negatively influence overweight children's participation in physical activity (Anderssen & Wold, 1992). It has been proposed that in an organized setting where overweight children interact with lean children; those overweight children are often ridiculed, thus reducing their desire to participate in physical activity (De Bourdeaudhuij et al., 2005; Salvy et al., 2008).

Because children tend to befriend peers who are similar to themselves, overweight children are likely to befriend other overweight children thus reducing the ridicule the overweight child has to endure in the relationship (Cairns, R. B., M. C. Leung, L. Buchanan, and B.D. Cairns., 1995). This may increase the overweight child's

willingness to be physically active with a similar peer and could explain why overweight children appear to be more active with peers in an unstructured setting (where peers are likely similar in weight) while avoiding physical activity with peers in an organized setting (where peers are likely different in weight).

The evidence supporting peer influence's potential impact on children's physical activity is intriguing. However, the majority of this current evidence relies on child self report data (Anderssen & Wold, 1992; Bailey et al., 1995; Salvy et al., 2008; Weiss, 2000). Controlled laboratory research examining the potential causal impact peer influence may have on lean and overweight children's physical activity patterns is limited to one study (Salvy, Roemmich et al., 2008). This study demonstrated that both lean and overweight children increased activity in the presence of a friend; but in the presence of an unknown peer the motivation to be physically active and the amount of activity performed only increased for overweight and not lean children. This previous study utilized a cycle ergometer as the only available physical activity option which is likely different from the types of physical activity children typically participate in (Salvy, Roemmich et al., 2008).

The purpose of this study was to determine the amount of physical and sedentary activity lean and at-risk-for/overweight children perform in a controlled setting under three different peer-influence conditions; alone, with a peer who is of similar weight and with a peer of different weight. In each of these conditions, children had access to a wide array of physical activity options which were similar to the types of activities children perform during free-living physical activity (running, jumping, throwing, etc.). This was

the first study to examine the effects of peer influence children of differing weight categories have on one another in a controlled setting using objective measures of physical activity and activities that are similar to those a child is likely to participate in (running, jumping, throwing and other sport activities).

Chapter II

Review of Literature

Children today have many options for extracurricular activities. Some of those options are sedentary and others are physically active. Currently we do not know exactly what causes some children to be physically active and others to be sedentary. Nor is it clear as to why children choose the individual activities that they do. There appears to be many factors involved, some of which include enjoyment, motivation, accessibility, and sense of accomplishment. The literature supports several factors that influence the amount of physical activity children participate in. The factors that have evidence supporting their potential impact include; enjoyment or liking of physical activity, reinforcement/motivation, parental support and modeling, the local physical environment, and peer influence. Children's natural activity patterns as well as each of these factors that influence the amount of activity children participate in are discussed in detail in this section, with an emphasis on peer influence.

Children's Physical Activity Patterns

Children's natural activity is comprised of short bursts of activity followed by rest. At least 95% of a child's daily activity (for children under the age of 12 years old), is comprised of bouts of exercise lasting 15 seconds or less (Bailey et al., 1995; L. H. Epstein, Kilanowski, Consalvi, & Paluch, 1999; Gilliam, T. B., P. S. Freedson, D. L. Geenen, and B. Shahraray., 1981).

Because the overwhelming majority of children's physical activity is accumulated in the form of short bursts suggests that children may be more motivated to engage in brief bouts of activity. According to the Premack principle, activities performed at a high rate are motivating or reinforcing while activities that are performed at a low rate are not motivating or reinforcing (Premack, 1959). Therefore, the Premack principle suggests, for children, physical activity comprised of short bouts would be more reinforcing than physical activity comprised of longer bouts. Reinforcement can be measured as the amount of work a behavior will support (Barkley, 2007; Bickel, 2000; Epstein, 1999; Roemmich, 2008). If someone finds a particular behavior reinforcing they will perform more work to gain access to that behavior than another, less reinforcing behavior (Bickel, 2000). Additional evidence has demonstrated that children are willing to perform more work to gain access to more time for interval rather than continuous exercise programs perhaps because interval training more closely resembles their natural activity pattern (Barkley et al., 2008). Interval training is both reinforcing and well-liked by children, which appears to increase the likelihood of their participation in those activities. However, there are limited physical activity recommendations for children and most do not make mention of a child's natural preference for bouts. One of the most commonly utilized recommendations for children's physical activity is the surgeon general's recommendation to exercise 60 minutes most days of the week and makes no mention of allowing for bouts of activity in children (Services, US Dept Health and Human, 1999).

Conversely, the American College of Sports Medicine (ACSM) recommends 60 minutes of physical activity per day and acknowledges that children are not the same as

adults and typically participate in several bouts of a variety of activities at varying intensities (ACSM, 2006). While the ACSM does make mention of bouts in their recommendations for children the instruction for the duration of these bouts is vague. Since children naturally take part in short, moderate to high intensity bursts of activity and are more suited for these types of activities it may be advisable to clearly state that this pattern of activity is acceptable when making exercise recommendations geared toward children's natural tendencies.

Children's preference for short bouts of activity may be influenced by the fact that they are physiologically different from adults. Children's tendencies for shorter duration activities could be due to the fact that children have smaller muscle mass, lower muscle concentrations of glycolytic enzymes and low glycogen, in addition to greater Phosphocreatine (PCr) resynthesis, providing quicker recovery time and decreased hydrogen ion (H^+) concentrations than adults. Therefore, children are ideally suited to perform repeated bouts of short term high-intensity (above the lactate threshold) exercise for 10-15 seconds but are not ideally suited for long durations at intensities exceeding lactate threshold because their glycolytic systems are not mature yet (Bailey et al., 1995; L. H. Epstein et al., 1999; Gilliam, T. B., P. S. Freedson, D. L. Geenen, and B. Shahraray., 1981).

In addition, one study assessed the reinforcing value of two types of the same physical activity, comparing interval and continuous exercise above and below ventilatory threshold (VT) (Barkley, 2007). They found the total number of responses, which was the measurement of reinforcement, for interval exercise was not different

between above and below VT workloads. Children performed more work for interval than continuous exercise above VT starting at an easier level (Flywheel Resistance (FR) 8). However, when exercising below VT, this was not the case until a later level (FR128). Therefore, it is apparent that children exhibited a preference for interval exercise above VT at a much lower FR level than below VT. The fact remains, however, that children earned more time and performed more work for interval compared to continuous exercise both above and below VT. Therefore, it is unlikely that a child's undeveloped anaerobic muscle metabolism is the only aspect that makes interval more reinforcing than continuous exercise (Barkley, 2007).

While the patterns of physical activity children participate in are fairly well established the factors that influence these natural patterns of activity are numerous and less clearly understood. Multiple research articles offer support for a range of factors that influence children's physical activity patterns including; the physical environment (Cohen et al., 2006; Roemmich et al., 2007; Sallis et al., 2003), motivation or reinforcement of the activity (Roemmich, 2008), liking or enjoyment of the activity (Roemmich, 2008; Salvy, Roemmich et al., 2008; Scanlan, 1992), the variety of activity options (Jacob E. Barkley, 2008), parental modeling (Eccles, 1999; Kalakanis, Goldfield, Paluch, & Epstein, 2001; Weiss, 2000) and peer influence (Faith, Leone, Ayers, Heo, & Pietrobelli, 2002; Salvy et al., 2008; Salvy, Roemmich et al., 2008; Storch et al., 2007).

Each of these factors and how they have been proposed to impact children's physical activity patterns are detailed below.

Motivation/Relative Reinforcing Value

As mentioned earlier, the natural patterns of physical activity may also be due, in part, to differences in the reinforcing value of short bursts or interval exercise compared to continuous exercise (Barkley, 2007). The reinforcing value of an activity can be thought of as an individual's motivation to participate in that activity (Epstein and Roemmich, 2001). Reinforcement represents motivational processes that can increase the likelihood of engaging in a particular behavior and, as mentioned previously, an activity that is engaged in at a high-rate during a free-choice setting is considered to be reinforcing (Roemmich, 2008; Premack, 1959; Premack & Premack, 1997).

Children will engage in greater amounts of the most reinforcing behavior where all choices are equally accessible. If the reinforcing values of the choices are similar, but access to those options are not, individuals will choose the most accessible option (L. H. Epstein & Roemmich, 2001). However, if the reinforcing value is different, individuals may be motivated to work harder to gain access to the more reinforcing behavior (Raynor 1998). As for children, it could be argued the choice to be physically active in short bouts is more reinforcing or more motivating than continuous physical activity, since this is their natural tendency and research has shown that children will work harder to gain access to this type of activity (Roemmich, 2008; Barkley, JE 2007).

Apart from influencing the pattern of physical activity performed, relative reinforcing value (RRV) has also been associated with the amount of physical activity children perform. Children who have a greater reinforcing value of physical activity relative to sedentary behaviors participate in greater amounts of physical activity,

compared to children who find sedentary behaviors relatively more reinforcing than physical activity (L. H. Epstein et al., 1999). Additionally, overweight and obese children, who have a low relative reinforcing value of physical activity, are less willing to work to gain access to physical activity than lean children (L. H. Epstein & Roemmich, 2001).

Understanding the basic parameters of physical activity that are most reinforcing is important so that exercise guidelines can be developed that promote physical activity intensities and durations that children are the most motivated to engage in. To date research has shown short duration activities and liking play a role in the RRV for physical activity (Bailey, 1995; Barkley, 2007; Dishman, 2005). Therefore, recommending short burst activities that children naturally take part in may increase physical activity. In addition, increasing the liking or enjoyment of physical activity, which is a separate construct from RRV, may increase a child's motivation to take part in physical activity (Roemmich, 2008; Scanlan, 1992).

Liking/Enjoyment

In addition to reinforcement, an alternative theory for why people engage in particular patterns of physical activity is the enjoyment/liking of physical activity. Liking or hedonics is controlled by the opioid neurotransmitter system of the brain (Ingram, 2000) and, along with RRV, has been shown to be an independent predictor of physical activity (Roemmich, 2008). Enjoyment of physical activity, which also includes liking (Scanlan 1992), has also been shown to predict the amount of physical activity a child engages in (Dishman, et al. 2005). Researchers have demonstrated positive effects on

physical activity during physical education class when an intervention was implemented to increase enjoyment of physical education class. During this intervention physical activity, enjoyment and self-efficacy all increased (Dishman, Motl, Saunders et al., 2005). These results highlight the potential association between enjoyment of physical activity and the amount of physical activity a person participates in. Roemmich et al. suggests the combination of a high reinforcing value and liking of physical activity is associated with a 33% greater participation in physical activity than if the activity was just reinforcing and not liked and vice versa (Roemmich et al., 2008). It appears then that children who have a high liking and RRV for physical activity are more likely to participate in physical activity. The following sections outline factors that may influence how well-liked and/or reinforcing physical activity is for children.

Variety

Because interval physical activity appears more reinforcing than continuous physical activity, both above and below VT, researchers have suggested that additional factors other than a child's unique muscle physiology likely influence the RRV of interval to continuous exercise. Because interval physical activity offers a wider range of exercise intensity and cadence, the difference in variety offered by the two exercise patterns was purported to be a contributing factor (Barkley, 2007). If this is the case, it is possible that the variety of available physical activity options may play a role in the amount of physical activity a child engages in, in addition to how much they like the activity. There is a substantial amount of evidence demonstrating that increasing variety increases participation in several aspects of a person's life. For example; the number of

available food choices reliably increases food consumption (Berridge, 1996; Epstein, L. H., R. Truesdale, A. Wojcik, R. A. Paluch, and H.A. Raynor., 2003). While less extensively studied in exercise, a recent study demonstrated that with increased variety of resistance-training equipment children performed greater number of repetitions, lifted more weight and reported greater liking for a high variety condition relative to a low variety condition (Barkley et. al., 2008). In addition to this study, others have shown that children were more likely to be physically active if a variety of activities were available and they were able to pick which activities they engaged in (Bailey et al., 1995).

Physical Environment

Behavioral economic theory suggests that children's choice to be sedentary or active partly depends on the ease of access to sedentary and physical activity in an individual's surroundings and the reinforcing value of the sedentary and active choices (Roemmich et al., 2007). Therefore, increased access to reinforcing sedentary behaviors within the home increases time youth allocate for watching television (Raynor, D. A., K. J. Coleman, and L.H. Epstein., 1998; Roemmich, 2008). Thus, youth may be more likely to stay home and be sedentary if watching television or other sedentary activities are more accessible and more reinforcing than physical activity (Roemmich, Gurgol et al. 2004). Conversely, if a child lives in a community with more sidewalks, greater number of parks and more connecting streets this greater access to physical activity may positively impact a child's participation in physical activity. However, while some research has demonstrated a positive correlation with these amenities and physical activity (Roemmich et al., 2007; Cohen et al., 2006; Sallis et al., 2003), there are also

some discrepancies in the literature evaluating the impact of the built environment on physical activity patterns in children. A study comparing overweight and lean children showed little difference between overweight and non-overweight children in relation to a variety of variables focusing on children's surrounding environment including the location and number of televisions; availability of sport and physical activity programs; access to parks, open spaces and footpaths. (Jones, Okely, Gregory, & Cliff, 2008). This study demonstrated that overweight children were less active than their lean counterparts; however, these overweight children had more access to footpaths than lean children. Possibly the accessibility to footpaths is either not motivating, or not as rewarding as staying home. It is also possible that the overweight children did not have a friend or peer to go on the footpaths with them. However, as the children age they may be more likely to enjoy the benefits of a community that accounts for access to physical activity when it is planned as additional research has suggested that as children age they tend to rely more on peers than parents to develop a sense of self (Anderssen & Wold, 1992). Therefore, the sidewalks in the planned community may provide easy access to get to their peers and be more rewarding as the children get older, as research has determined that accessibility to sidewalks in teens and adults increases their physical activity (Raynor, D. A. et. al, 1998). The contradicting results regarding the impact of the built environment on children's physical activity suggest that multiple factors are involved in the process of deciding between sedentary and physical activity for overweight children and while the environment may have an impact it is not the overriding factor (Jones et al., 2008).

Parental Modeling

Parental beliefs, expectations and behaviors in regards to physical activity are significantly associated with children's beliefs regarding and enjoyment and intensity of physical activity (Weiss, McCullagh, Smith, & Berlant, 1998). Parents are important transmitters of information about their child's interest in physical activity through mechanisms of modeling and reinforcement of physical activity behavior (Weiss et al., 1998). Parents who recognize and reinforce their child's interest and participation in physical activity through verbal and nonverbal cues and who model enjoyment of their own physical activity convey the message that physical activity is important and can be fun (Weiss et al., 1998). Children who report having physically active parents who portray a sense of value in physical activity to their children are more likely to engage in physical activity (Weiss, M.R., 1998). In addition, children who have parents who support and reward the children's activity are also more likely to participate in more physical activity (Eccles, 1999; Weiss, 2000). Greater parental enjoyment of and encouragement in physical activity has been associated with higher levels of children's perceived ability and attraction to physical activity (Weiss et al., 1998). Conversely, other research has demonstrated that parent-reported moderate to vigorous activity was not related to the child's participation in moderate to vigorous physical activity, but parent's competency beliefs for their child were significantly related to the child's moderate to vigorous physical activity (Weiss et al., 1998). Overall, parents who are seen as confident about their child's abilities, supportive of physical activity involvement, and experience enjoyment from physical activity themselves are associated with children who

report greater ability perceptions, motivation, frequency, and intensity of physical activity. In addition, children's perceptions of their parents' beliefs and behaviors are more strongly related to their self-evaluations and physical activity behaviors than parent-reported beliefs and behaviors (Weiss et al., 1998).

While the effect parental modeling has on children's physical activity appears to be a significant one, once a child is around six years of age they develop a greater sense of self (Anderssen, 1992) and their relationship with peers may grow increasingly important in determining the amount of physical activity they participate in. Because of this relationship, peer influence is a potentially powerful influencing factor regarding a child's physical activity, especially after the age of 6 years.

Peer Influence

In addition to the factors currently known to have an impact on the amount of physical activity a child participates in, peer influence is emerging as potentially powerful influencing factor. The majority of the limited available data has examined the effect of peer influence on physical activity patterns in children via self report data and by observational analysis. According to self-reported data children, both lean and overweight, participate in more intense physical activity when in the presence of peers or close friends versus alone or with neutral counterparts (Salvy et al., 2008). Interestingly, overweight children reported greater physical activity when in the presence of a peer than did lean children compared to when they were alone. However, overweight children also reported spending more time alone and consequently accumulating less physical activity than their lean counterparts (Salvy et al., 2008). Other researchers have also

demonstrated that children spend more time alone and are less likely than their lean peers to participate in organized activities such as joining a sport team (Faith et al., 2002; Hartup, 2005; Salvy et al., 2008).

The self reported data did not examine organized settings such as sport teams and gym class. Previous research has demonstrated in organized settings overweight children tend to withdraw from physical activity (Storch, 2007). The avoidance of organized, peer-based, physical activities such as physical education class or sports may occur in an effort to avoid peer victimization (Faith et al., 2002). The relationship between overweight status and physical activity may also be mediated by peer rejection, for example overweight children are often picked last for physical activities (Storch et al., 2007). Rejected and victimized children often respond to negative peer treatment by disengaging from the social environment to avoid additional pain (Ladd & Burgess, 1999).

Often there is an obesity bias where individuals negatively judge an overweight child as being “lazy” or “stupid” (Rukavina & Li, 2008). This bias could be explicit, meaning it was purposeful as they tease or call overweight children names. Obesity bias could also be implicit, meaning it wasn’t meant to be harmful but it was judgmental. Regardless of intent, this bias may cause significant damage by reinforcing unhealthy, solitary, sedentary behaviors which, because they are free of bias, serve as a coping mechanism or replace healthy habits. Weight related teasing may exacerbate a negative cycle of inactivity by pushing the child to avoid social activities involving physical activity and choose more sedentary activities (Rukavina & Li, 2008). Peers criticizing a

child's weight often leads to overweight children not enjoying physical activity; this criticism is known as peer victimization (Ferguson, M. A., B. Gutin, et al., 1999; Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007). Overweight peers have exhibited lower self-efficacy for physical activity typically as a result of teasing and this could enhance peer rejection (Crick, 1995, Ladd, 1999). If an overweight child feels as if they are not sufficiently skilled enough for a sport or physical activity, they may be less likely to participate in that sport or activity to their fullest extent, which may lead to other children excluding them from many activities, particularly sporting events where children typically want to choose the most skilled players for their team or group. This appears to be true in organized sports or gym class but may not be the case during leisure time physical activity where less structured play is the norm (Cairney et al., 2005, Salvy et al., 2008).

Self-efficacy is an important aspect to consider when recommending physical activity options to children. Self-efficacy represents beliefs in one's capabilities to complete a task (Motl, Dishman et al. 2005). In organized settings, such as gym class, overweight children are less likely to engage in physical activity. This could be due, in part, to low self-efficacy because overweight children often do not feel they are good enough to compete or participate in these activities (Dishman, Motl, Saunders et al., 2005; Rukavina & Li, 2008). However, weight-related teasing may exacerbate a negative cycle of inactivity, further weight gain and subsequently the child may avoid social physical activity in favor of more sedentary activity (Rukavina & Li, 2008). Studies have demonstrated that low self-efficacy also correlates with lower amounts of physical

activity (Ball, Marshall, & McCargar, 2005; R. W. Motl et al., 2005). It is uncertain if low self-efficacy leads to teasing or if teasing leads to low-self efficacy, but there is some evidence of both (Ball et al., 2005; Rukavina & Li, 2008). This low self-efficacy could be a result of years of teasing or possibly from a specific incident when an overweight child tried to play and was unsuccessful so they attributed it to a lack of ability (Rukavina & Li, 2008). Alternatively, overweight children may not be very secure in themselves or their ability to play, which in-turn leads them to perform poorly (Ball et al., 2005). Even more disturbing is that studies suggest teasing and psychological disturbances can have a lasting effect on psychological adjustment in adulthood (Rukavina & Li, 2008).

Perhaps partly because of this concept of self-efficacy, children tend to befriend peers who are similar to themselves (Cairns et. al, 1995; Hedley et. al., 2004). Therefore, overweight children are likely to become friends with other overweight children. It is likely that if two children are both overweight this relationship may be free of weight-related criticism. This may increase the overweight child's willingness to be physically active with their similar peer and may explain why overweight children report being more active with peers in an unorganized setting, such as after-school leisure-time (Cairns et. al., 1995). In addition to reporting greater overall activity, overweight children have also reported more intense physical activity in the presence of a friend. If, in fact, overweight children are more physically active in the presence of a friend or unknown peer, than physical activity recommendations that promote more interaction with friends would be warranted in an effort to increase enjoyment of physical activity

and minimizing the feelings of low self-efficacy also associated with decreased physical activity.

While peer influence appears to be a potentially significant mediating factor of a child's participation in physical activity, presently only one controlled study utilizing objective methods to assess physical activity has been done to examine how peers influence the amount of physical activity they participate in (Salvy, Roemmich et al., 2008). This laboratory-based study assessed children's motivation to perform work to gain access to cycler ergometer exercise and if that motivation changes due to the presence of a friend or a non-friend peer (Salvy, 2008). Interestingly, while lean and overweight children both responded positively to the presence of a friend only the overweight children performed more work for physical activity and cycled longer with a non-friend peer (Salvy, 2008). In addition to this peer interaction with friends, further research will be needed to demonstrate if self-efficacy or prior peer victimization plays a role in a child's motivation to participate in physical activity, particularly with an unknown peer.

The studies that have examined peer influence's impact on physical activity are still relatively few considering the potential implications this factor may have. Furthermore, the majority of these projects rely on self-report data and only one study (Salvy, Roemmich et al., 2008) examining peer-influence and its effect on physical activity was performed in a controlled environment using a type of physical activity, stationary cycle ergometry, that is likely dissimilar to the types of physical activity children typically participate in. A better understanding of the effect of peer influence on

physical activity could be of great importance when designing physical activity interventions or recommendations for at-risk-for/overweight children.

Purpose

The purpose of this study was to determine the amount of physical and sedentary activity lean and at-risk-for/overweight children perform in a controlled setting under three different peer-influence conditions; alone, with a peer who is of similar weight and with a peer of different weight.

Specific Aim

To determine if the amount and intensity of physical activity children perform differs across the three stages and if measures of peer victimization, self efficacy, liking and perceived exertion are associated with those changes.

Rationale for Specific Aim

Past self-reported data has demonstrated that physical activity increases when a peer is present rather than being alone (Salvy et al., 2008). In addition, research has shown the intensity of physical activity also increases in the presence of a peer verses when children are alone regardless of whether they are at-risk-for or overweight in an unorganized setting (Salvy et al., 2008). However, controlled laboratory research examining the potential causal impact peer influence may have on lean and overweight children's physical activity patterns is limited to one study which demonstrated that the presence of a friend increased youth's physical activity, but the presences of a non-friend peer increased the motivation to be active in overweight children only (Salvy, Roemmich et al., 2008). These results could vary based on setting because the children were not

participating in activities they would have access to on a daily basis and a variety of options were not available to them, which has also been shown to increase physical activity (Barkley, 2008). In addition, children were paired up with a friend or peer because past self-reported data demonstrated that children reported more intense activity in the presence of a friend but not necessarily with unknown children. Further research is needed to determine if children will increase their physical activity when sedentary options are available and to determine if there is a differential response to a peer based on the weight status (overweight or lean) of that peer.

Hypothesis I

The amount and intensity of physical activity will increase in the presence of a peer compared to when participants are alone, regardless of group (lean or at risk for/overweight). Recent self-reported data has shown that regardless of weight children participated in more physical activity when in the presence of a peer than when alone in an unorganized setting (Salvy et al., 2008). However, recent evidence in a controlled environment demonstrate that lean and overweight children increased physical activity in the presence of a friend but only overweight children increase physical activity in the presence of a peer. Therefore, since the present study is also performed under controlled conditions a similar result may occur.

Hypothesis II

When two overweight children are paired together each would be more active than if they were partnered with a lean peer. Overweight children may be less likely to associate another overweight child with peer victimization and may be more comfortable

being active in the presence of that peer compared to a lean peer. Because this is the first study to examine the effect of peer influence on natural physical activity patterns in a controlled setting using one-to-one peer interaction in peers of similar and differing weight status it is unclear if the response of overweight children will be similar to previous self-reported data (Salvy et al., 2008), previously studied group-based activity settings (gym class) (Dishman, Motl, Saunders et al., 2005; Salvy et al., 2008) or the laboratory research where children cycled with a friend in the same room (Salvy, Roemmich et al., 2008). Therefore, it is possible that the response of an overweight child to the presence of a lean child will be different from what has been demonstrated previously.

Chapter III

Methods and Research Design

Methods

Participants. Participants were boys, age 8-12 years who are classified as either lean (<85th BMI percentile) (N=12) or at-risk-for-overweight ($\geq 85^{\text{th}}$ – <95th BMI percentile)/overweight ($\geq 95^{\text{th}}$ BMI percentile) (N=12). The children were recruited from the local community through flyers and through a database of subjects who had previously contacted the Applied Physiology Laboratory at Kent State University to participate in previous, unrelated research projects.

Exclusion Criteria. Participants could not:

- Have any conditions that limit or any contraindications to physical activity
- Have clinical disorders including cardiovascular disease, neuromotor, or cognitive disorders interfering with the exercise testing.
- Be female
- Be younger than 8 years or older than 12 years of age.

Inclusion Criteria. Participants:

- Were male between the ages of 8 to 12 years old.
- Had a body mass index between the 5th and 85th percentile for age and sex for the lean group or a body mass index between the 85th and 100th percentile for the overweight group.

Only males were used for this study because opposite genders may interact differently together than two children of the same gender. In order to perform a mixed gender comparison, five different laboratory visits would be required (alone, with similar-weight peer of the same sex, with different-weight peer of the same sex, with similar-weight peer of a different sex, and with different-weight peer of a different sex). This would result in 120 counterbalancing orders for each gender or a minimum of 240 subjects which would require a greater time frame than is allotted for this proposed study.

The present study focused on boys because there is a higher probability of peer victimization being a factor in boys during physical activity with more boys participating in sporting activities in this age group than girls (Ladd, 1999; Dishman, 2005). In addition, more research has been conducted on peer victimization in boys during physical activity to compare our findings to, and therefore enhances the generalizability of our data to that of others thereby increasing recommendations for at-risk-for/overweight boys (Crick, 1995; Faith, 2002; Gray, 2008; Grotper, 1996).

Design

The study was a two group (lean, at-risk-for/overweight) by three treatment (alone, with similar weight peer, with different weight peer) mixed design with group serving as the between subjects variable and treatment serving as the within subjects variable (Table 1). There are six possible orders and two subjects from each group underwent each possible order for complete counterbalancing ($N = 24$) (Table 2).

Table 1

Design for group by treatment interaction

Group	N	Alone	With similar weight peer	With different weight peer
Normal weight <85 th BMI percentile	12	X	X	X
At risk for/overweight >85 th BMI percentile	12	X	X	X

Table 2

Counterbalancing orders

Order	N	Visit 1	Visit 2	Visit 3
1	2 <85 th BMI 2 >85 th BMI	Alone	Similar weight peer	Different weight peer
2	2 <85 th BMI 2 >85 th BMI	Alone	Different weight peer	Similar weight peer
3	2 <85 th BMI 2 >85 th BMI	Similar weight peer	Different weight peer	Alone
4	2 <85 th BMI 2 >85 th BMI	Similar weight peer	Alone	Different weight peer
5	2 <85 th BMI 2 >85 th BMI	Different weight peer	Similar weight peer	Alone
6	2 <85 th BMI 2 >85 th BMI	Different weight Peer	Alone	Similar weight peer

Procedures

All eligible children, as determined via phone screen (Appendix A&B), reported to the Applied Physiology Laboratory at Kent State University for three separate visits. During the first visit, the parent or legal guardian signed a consent form (Appendix C) and the child signed an assent form (Appendix D). Children were then measured for

height, with a stadiometer (Health O Meter, Chicago) and weight, using a calibrated balance beam scale (Health O Meter, Chicago). In addition, the waist to hip ratio was determined with a tape measure in centimeters. Children also complete validated questionnaires designed to measure peer victimization (Appendix G) (Schwartz, D., J. M. Farver, et al., 2002) and self-efficacy for physical activity (Appendix F) (Motl, R. W., R. K. Dishman, et al., 2000; Patterson et al., 1988); R. W. Motl et al., 2005). Upon completion children were taken into a gymnasium where a trained exercise physiologist demonstrated the physical activity options the children had access to. The activities included; modified hurdles (shorter than standard hurdles), ski jump, jump rope, nerf footballs and frisbees, standing long jump, kicking a soccer ball around cones, and shooting a basketball. The children were then required to demonstrate that they were safely able to do all seven activities. If a child requested additional instruction, it was provided. Once the child sampled all seven activities they verbally acknowledged they knew how to do all of the following sedentary activities; drawing, crossword puzzles, word finds, magazines and perfection®, a matching game. These sedentary options were located at a table with chairs in the same gymnasium as the physical activity options.

After sampling the physical and sedentary activities, children participated in their first of three peer condition trials either alone, with similar weight peer or with a different weight peer, each lasting 30 minutes. Each of these peer condition trials were performed on separate days, and the order of these trials were counterbalanced across groups

(Table 2). After each 30 minute session, the children completed two visual analog scales to assess their liking and fatigue for that session and a pediatric specific RPE scale (OMNI walk/run).

The three peer condition trials are as follows:

1. Physical activity alone – The child participated in any physical and/or sedentary activity they chose for a period of 30 minutes with no other children in the room.
2. Physical activity with a similar-weight peer – Two children of similar-weight (both normal weight or both at-risk-for/overweight) participated in any physical and/or sedentary activity they chose for a period of 30 minutes.
3. Physical activity with a different-weight peer – Two children of different-weight (one normal weight child with one at-risk-for/overweight child) participated in any physical and/or sedentary activity they chose for a period of 30 minutes.

The amount and intensity of the physical activity each child performed was measured via accelerometry (ActiGraph GT1M, Pensacola FL) during each 30-minute condition. The amount of time children allocated for each physical activity station, as well as the total amount of physical and sedentary activity time was recorded (Appendix E). The proportion of the 30-minute time block that children allocated to sedentary and physical activity was recorded via observation using a standard stop watch. Participants were compensated \$10.00 per visit (for a total of \$30.00) in the form of gift certificates to a local store of their choice.

Measurements

Anthropometrics. Height was measured via a stadiometer, and weight was measured with a calibrated balance beam scale (Health O Meter, Chicago). Waist to Hip Ratio was measured in centimeters. The waist was measured at the umbilicus and the hip over the widest portion of the buttocks.

Self-efficacy for physical activity. Self-efficacy measures the confidence a person has in being able to perform a certain behavior. Self-efficacy for physical activity was measured using a validated eight-item questionnaire (Motl, R. W., R. K. Dishman, et al., 2000). Example items on the self-efficacy measure include: “I can be physically active during my free time on most days no matter how busy my day is,” and “I can ask my parent or other adult to do physically active things with me.” The children were asked to mark a box that best answers each question relating to physical activity. The rating scale ranges from 1 (Very Easy/Agree a lot) to 5 (Very Difficult/Disagree a lot). The children were instructed to only mark one answer for each question (Motl, R. W., R. K. Dishman, et al., 2000).

Peer Victimization. The Children Self Experience Questionnaire–Self Report (Grotmeter & Crick, 1996) consists of the three subscales, each consisting of five items. Items were generated on the basis of a peer-nomination measure of aggression developed in prior research (Crick & Grotmeter, 1995; Grotmeter & Crick, 1996). All three subscales measure the frequency of particular experiences (1 Never, 2 Almost *never*, 3 Sometimes, 4 Almost *all the time*, and 5 All *the time*). The Overt Victimization (OVS) subscale assesses the frequency with which other students have harmed or threatened to harm the

students' physical well-being. The Relational subscale (RS) assesses how often students have attempted to harm a student's peer relationships. The Prosocial Receipt scale (PRS) measures how often a student has been the recipient of supportive acts by peers. All 3 subscales are summed for a composite score ranging from 5 to 25. Crick and Grotpeter (1996) initially validated the CSEQ-SR on a sample of 474 third through sixth graders. Validity was also supported through analyses that revealed that rejected children reported more overt victimization than popular or controversial children and more relational victimization than all other status groups (popular, average, neglected, controversial).

Liking of physical activity. Children rated their liking of the sample and actual exercise protocols using visual analog scales (VAS) consisting of a 100 mm line anchored by 'do not like it at all' on the left side and 'like it very much' on the right side. The ratings were made immediately following the final minute of each protocol (Appendix I). There is currently no known data regarding the validity of VAS methods in relation to "liking" however, VAS scores for feelings regarding school and sports correlate with numeric VAS scores with a coefficient of 0.80 and the Likert scales with a coefficient of 0.76 (Roemmich, 2008). Additionally, liking for physical activity has been shown to be an independent predictor of the amount of free living physical activity children participate in (Roemmich, 2007).

Accelerometer counts. In this study the ActiGraph GT1M Monitor (ActiGraph, Pensacola, Florida) was used. The accelerometer was worn at the children's hip, snug against the body. The monitor measures the number of counts or amount of activity. The number of counts per session were recorded and compared among each condition and

each group. The ActiGraph is the most widely used accelerometer in pediatric research and has been shown to be a valid and reliable tool for quantifying physical activity in children and adolescents (Trost, 1998). The ActiGraph was validated by having thirty subjects' aged 10 to 14 performed three 5-min treadmill bouts at three, four and six miles per hour, respectively. While on the treadmill, subjects wore activity monitors on the right and left hips. VO_2 was monitored continuously via indirect open circuit spirometry (Parvo, Sandy Utah). Energy Expenditure (EE) was determined by multiplying the average VO_2 by the caloric equivalent of the mean respiratory exchange ratio. Activity counts from both units (each hip) were strongly correlated with EE ($r = 0.86$ and 0.87 , $P < 0.001$) (Trost, 1998).

Proportion of time performing physical activity. The amount of time each child spent performing each individual physical activity, the total amount of physical activity as well as the amount of time spent performing sedentary activities in each treatment was recorded. This was done via direct observation. The observer recorded the number of minutes each child participated in sedentary activities versus the number of minutes the child participates in physical activity using a standard stop watch. There were always at least two observers present for each condition therefore in conditions where two children were present each observer monitored a separate child.

Rating of perceived exertion (RPE). Rating of perceived exertion (RPE) was assessed at the conclusion of each physical activity session. Subjects were shown the OMNI RPE scale and its use was explained with a standardized set of instructions. Perceived exertion was defined for as "How tired does your body feel during exercise?"

(Utter, A. C., R. J. Robertson, et al., 2002). Ratings were undifferentiated as an estimate of the perceived exertion of the total body. The same written instructions were read to each child to describe the use of the scale. The instructions were taken from the original OMNI RPE scale validation paper (Utter, A. C., R. J. Robertson, et al., 2002). The scale numbers and verbal descriptors in the script for the OMNI scale correspond with the low (1: very, very easy) and high (10: so hard I'm going to stop) anchors of the OMNI scale. Children were then told that there were no 'right or wrong' answers. Finally, children were instructed to think about an exercise intensity that was the same as the pictorial descriptor of the boy running (Utter, A. C., R. J. Robertson, et al., 2002; Yelling, Y., K. L. Lamb, et al., 2002). The OMNI scale includes exertion levels from 1 to 10, verbal cues ranging from "very easy" to "so hard I'm going to stop" which are identical to the validated Children's Effort Rating Table (CERT) scale's verbal descriptors (Williams, J. G., R. Eston, et al., 1994).

The Children's OMNI Scale of Perceived Exertion (category range: 0 to 10) was validated using separate cohorts of female and male, African American and white subjects. Each of the four cohorts contained 20 clinically normal, non-obese children, 8-12 yr of age. A cross-sectional, perceptual estimation paradigm using a single multi-stage cycle ergometer test protocol was used. Oxygen uptake ($\text{VO}_2 \text{ ml} \cdot \text{kg} \cdot \text{min}^{-1}$), heart rate (HR; $\text{beats} \cdot \text{min}^{-1}$) and ratings of perceived exertion for the overall body (RPE-Overall), legs (RPE-Legs), and chest (RPE-Chest) were determined at the end of each continuously administered 3-min power output (PO) (i.e., 25, 50, 75, and 100 W) test stage. First-order correlation and linear regression analyses were performed for each cohort separately and

the total sample using a repeated measures paradigm over the four power outputs. They were significantly correlated to physiological measures of exertion VO_2 and HR; $r = 0.85$ to 0.94 ; $P < 0.01$. Differences between RPE-Overall, RPE-Legs, and RPE-Chest were examined with ANOVA for the repeated measures paradigm. RPE-Legs was higher ($P < 0.01$) than RPE-Chest and RPE-Overall at 25, 50, 75, and 100 W. RPE-Chest did not differ from RPE-Overall at 25 and 50 W but was lower ($P < 0.01$) than RPE-Overall at 75 and 100 W. The psycho-physiological responses provide validity evidence for use of the Children's OMNI Scale over a wide range of dynamic exercise intensities (Robertson, 2000).

Fatigue Scale. A novel 10-cm VAS scale anchored by “not tired at all” and “very very tired” was also utilized to assess fatigue. The scale has not yet been validated and was utilized in conjunction with the previously described, validated OMNI child walk/run RPE scale (see above). This new scale was similar to a previously validated fatigue scale designed for adults (Utter, A. C., R. J. Robertson, et al., 2002). The terminology of the present scale was altered by the author to the more pediatric-appropriate language utilized and the maximum and minimum extremes of the OMNI walk/run child RPE scale (Utter, A. C., R. J. Robertson, et al., 2002).

Perception of Time. When assessing the child's perception of time we compared the alone session to the two peer sessions (similar weight and different weight) by asking the following questions:

- If alone was first: for *visit two* and *three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone was second: for *visit two* ask “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?” For *visit three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone third: during *visit three* ask the following two questions “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?” “Compared to the second time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”

While this methodology was not previously validated, it has good face validity as it was used to determine significant differences between groups and treatments for perception of time. The concept of perception of time is affected by many factors including environment, motivation, resources, emotion, body temperature, fatigue and attention focus (Larson, 2006).

Sample Size Determination

Most work has been done by self-report using participants of mixed gender (Salvy et al., 2008). The present study is the first that we know of to have a controlled

laboratory setting and different weight-specific peer conditions as well as the first to compare the proportion of time allocate to sedentary or physical activity and the intensity of physical activity in children.

As previously stated only males were used for this study because opposite genders may interact differently together than two children of the same gender. In the present study in order to have two subjects per group in each counterbalancing order (alone, with a similar weight peer and with a different weight peer), 24 subjects will be required. The proposed time frame for conducting this study (<four months) does not allow for 48 subjects (the required number if girls were analyzed separately).

In the present study overweight children, compared to their lean counterparts, accumulated a significantly greater number of minutes of sedentary activity (7.7 ± 6.5 min overweight, 1.2 ± 3.7 min lean) and significantly fewer accelerometer counts (90332 ± 38450 counts overweight, 136736 ± 45623 counts lean) when in the alone condition. These differences yielded observed effect sizes of 1.6 and 1.2 for differences in sedentary activity time and physical activity counts respectively. With these effect sizes a sample size of 8 (for sedentary time) and 12 (for activity counts) participants per group or 16 and 24 total participants were needed to achieve a power of 0.8. Therefore our sample size of $N=12$ per group ($N=24$ total) was deemed to be sufficient.

Statistical Analysis

One way analysis of variance (ANOVA) were performed to examine differences in subject characteristics (age, height, weight, BMI percentile, and waist to hip ratio) and in the three subscales of the peer victimization questionnaire (OVS, RS, PRS), and

self-efficacy for physical activity between groups (normal weight, at risk for/overweight). Correlation analyses were performed between the pre-participation questionnaire scores that were different between groups (the OVS and RS subscales from the peer victimization questionnaire) and total accelerometer counts and sedentary time performed in each condition.

Five, two-group (normal weight, at risk for/overweight) by three peer condition (alone, similar weight, different weight) ANOVAs with repeated measures on the second variable were performed to determine differences in accelerometer counts, proportion of time performing sedentary activity, RPE, liking and fatigue scores (from VAS). One, two-group (normal weight, at risk for/overweight) by three peer condition (alone, similar weight, different weight) by seven activity stations (basketball, side jump, long jump, modified hurdles, nerf throws, jump rope and soccer cones) ANOVA with repeated measures on peer condition and activity station was performed to determine differences in the duration of time children allocated to each of the seven different activity stations during each visit. Post hoc analyses for any significant main or interaction effects from ANOVA were performed using independent and paired samples t-tests. Finally, Chi-square analysis were performed to compare the differences in children's perception of time during the with-pre conditions relative to the alone condition. SPSS version 16.0 statistical package was used to complete all statistical calculations. The level of significance was set a priori at $p \leq 0.05$.

Chapter IV

Results

Descriptive Data

Subject physical characteristics are shown in Table 3. The at-risk-for/overweight boys (n = 12 Caucasian) were significantly greater than lean boys (n = 11 Caucasian, 1 African American) for height, weight, BMI percentile and waist to hip ratios ($p \leq 0.04$ for all).

Table 3

Subject Characteristics

	Lean (N=12)	Overweight (N=12)
Age (years)	10.0±1.4	10.8±1.6
Height (cm)*	138.6±9.9	147.6±9.6
Weight (kg)*	33.2±6.2	56.8±17.1
BMI percentile*	54.6±16.6	93.4±6.0
Waist to Hip ratio	0.86±.09	0.97±.15

Significant difference between groups ($p \leq 0.04$).

Figure 1 BMI Percentiles per group. Significant differences between groups for BMI percentile ($p = 0.04$).

Peer Victimization

At-risk-for/overweight children (11.5 ± 3.9 OVS and 11.8 ± 4.7 RS), relative to lean children (7.6 ± 2.6 OVS and 8.2 ± 3.1 RS), reported significantly greater scores for the OVS ($p = 0.009$) and RS ($p = 0.04$) subscales of the peer victimization questionnaire. There were no differences between groups for PRS subscale ($p = 0.69$). Both the OVS ($r = 0.41$) and RS ($r = 0.42$) subscales were positively related ($p \leq 0.05$) to the total sedentary time children accumulated when alone and there was a trend ($p \leq 0.07$) towards a significant negative relationship between the two scales ($r = -0.38$ OVS, $r = -0.36$ RS)

and total accelerometer counts when alone. Neither subscale was significantly related to counts or minutes in any of the with-peer conditions ($p \geq 0.35$).

Self Efficacy

There were no differences ($p = 0.09$) between groups in ratings of self-efficacy for physical activity (15.9 ± 4.8 lean, 15.7 ± 4.5 at-risk-for/overweight).

Total Counts

There was a significant group by treatment condition interaction for accelerometer counts ($p = 0.008$) (Figure 2). This interaction was the result of at-risk-for/overweight boys accumulating significantly fewer accelerometer counts than lean boys in the alone condition ($p = 0.001$), with a lack of difference between groups in the remaining two conditions ($p \geq 0.50$). There were no significant main effects for group or treatment condition ($p \geq 0.25$).

Figure 2 Accelerometer Counts. Significant group x condition interaction ($p = 0.008$).

*Overweight children were less active ($p = 0.001$) than lean when alone and not different ($p \geq 0.50$) in the other conditions.

Sedentary Activity Time

There was a significant group by treatment condition interaction for sedentary activity time ($p = 0.017$) (Figure 3). This interaction was the result of at-risk-for/overweight boys accumulating a greater amount of sedentary activity time than lean boys in the alone condition ($p = 0.007$), with a lack of difference between groups in the remaining two conditions ($p \geq 0.50$). There were no significant main effects for group or condition ($p \geq 0.50$). Physical activity time was not analyzed as the results would represent the remaining time, out of 30 minutes, children had not allocated to sedentary activity time which would yield identical results to the sedentary time ANOVA.

Figure 3 Sedentary Activity Time. Significant group x condition interaction ($p = 0.017$).

*Overweight children were less active ($p = 0.007$) than lean when alone and not different ($p \geq 0.50$) in the other conditions.

Liking

There was a significant group by treatment condition interaction for liking as indicated via VAS ($p = 0.009$) (Figure 4). While lean at-risk-for/overweight children were not different ($p \geq 0.065$) at any condition this interaction was due to the fact that pairing with children of different weight, relative to the alone condition, significantly increased liking for at-risk-for/overweight children ($p = 0.003$) but not lean children ($p = 0.262$). There were no significant main effects for group or treatment condition ($p = 0.262$).

Figure 4 Liking. Significant group x condition interaction ($P = 0.009$). *Pairing with children of different weight, relative to the alone condition, significantly increased liking for overweight ($P = 0.003$) but not lean children ($P = 0.262$).

Rating of Perceived Exertion (RPE)

There are no significant main or interaction effects for group or treatment condition for RPE ($p \geq 0.20$) (Figure 5).

Figure 5 Omni child walk/run RPE. There were no significant main or interaction effects ($p \geq 0.20$).

Fatigue

There are no significant main or interaction effects for treatment condition or group for fatigue ($p \geq 0.11$) (Figure 6).

Figure 5 VAS Fatigue. There were no significant main or interaction effects ($p \geq 0.11$).

Physical activity bouts

The amount of time spent at each of the seven physical activity stations for each group during each trial is shown in table 4. There was a main effect for activity option ($p = 0.001$) but no significant main or interaction effects for group or condition ($p \geq 0.49$). Both lean and overweight children spent significantly more time playing basketball than any other activities in all three conditions ($p = 0.003$). In addition, time spent participating in Nerf[®] football and Frisbee[®] throws was significantly greater than

all activities except playing basketball ($p = 0.001$). Long jump was significantly greater than jumping hurdles or kicking a soccer ball ($p = 0.013$) and jumping hurdles was significantly greater than side jumps ($p = 0.013$). There were no other significant differences between any other physical activities ($p \geq 0.82$).

Table 4

Average minutes at each physical activity option

	Lean (N=12)			Overweight (N=12)		
	Alone	Similar	Different	Alone	Similar	Different
Basketball	14.8±6.84	13.6±10.25	14±8.2	11.64±5.64	12.9±8.8	15.6±6.8
Soccer	1.85±2.82	1.58±2.5	2.13±3.9	1.95±1.39	1.51±1.49	2.10±3.8
Throwing	6.11±5.0	9.38±9.16	6.8±6.4	5.20±5.99	5.91±6.28	3.08±4.4
Hurdles	1.66±1.98	1.08±1.21	2.26±2.8	0.93±1.01	2.50±4.1	2.13±3.8
Long jump	1.31±4.3	0.23±0.4	0.65±1.2	0.31±0.66	0.87±2.0	0.77±1.1
Jump rope	1.91±5.1	1.63±3.2	1.21±1.4	1.54±1.62	1.42±1.63	1.60±2.2
Side jump	0.13±0.26	0.19±0.4	0.28±0.5	0.14±0.17	0.20±0.39	0.15±0.3

There was a main effect of activity ($P = 0.001$). There were no significant main or interaction effects for group or peer condition ($p \geq 0.49$).

Perception of time

Chi-square analysis demonstrated that a significantly greater ($p < 0.001$) number of participants (17 of 24) perceived the time spent during the with-similar peer condition as going by more quickly relative to the alone condition. Despite the fact that it was the most chosen of the three possible answers, there were no significant differences ($p = 0.2$) in the number of participants (12 of 24) who perceived time spent during the with-different weight peer condition as going by more quickly relative to the alone condition.

Chapter V

Discussion and Conclusions

Previous observational research has demonstrated that the amount and intensity of physical activity increases in the presence of a peer compared to when a child is alone in an unorganized setting (Anderssen & Wold, 1992; Bailey et al., 1995; Cairns, R. B., M. C. Leung, L. Buchanan, and B.D. Cairns., 1995; Salvy et al., 2008; Salvy, Roemmich et al., 2008). The pro-physical activity effects of peer influence in an unorganized setting appears to occur regardless children's weight status (lean or at-risk-for/overweight) (Salvy et al., 2008). Conversely, others have demonstrated that overweight children tend to withdraw from physical activity in organized, group based physical activity settings (gym class, sport teams), possibly due to peer victimization or peer rejection (Salvy et al., 2008; Gray et al., 2008; Grotperter & Crick, 1996; Rukavina & Li, 2008). Based upon our review of the literature, there has only been one study examining the effect of the presence of a peer in a controlled setting on the amount of physical activity children perform (Salvy, Roemmich et al., 2008). However, there is no known research that has examined the effect of the presence of similar and different weight peers on the amount of physical activity children perform when they have access to a variety of physical and sedentary activities. Therefore, the purpose of this investigation was to determine the effect of peer influence on the amount of physical activity lean and at-risk-for/overweight boys participate in when exposed to three different peer conditions; alone, with similar weight peer, with different weight peer. This was also the first study to examine the

effect of peer influence on the amount of physical activity, versus sedentary activity, lean and at-risk-for/overweight boys freely chose to participate in using objective measures of physical and sedentary activity in a controlled environment.

Results demonstrated that lean children were significantly more physically active, both in accelerometer counts and time, than at-risk-for/overweight children when in the alone condition. While this difference is not unexpected as free-living levels of physical activity have been shown to be different between lean and overweight children (Salvy et al., 2008; Sallis, J.F., 2001; Rukavina & Li, 2008). The one other controlled laboratory study examining the effect of peer influence on physical activity did not show any differences between lean and overweight children in an alone condition (Salvy, 2008). The difference in physical activity between lean and at-risk-for/overweight children abated once children were placed in with-peer conditions. This was due to a small non-significant increase in accelerometer counts and a significant increase in physical activity time in at-risk-for/overweight children and small non-significant decrease in counts and no change in physical activity time in lean children. Both accelerometer counts and physical activity time were negatively associated with measures of peer victimization, which were greater in the at-risk-for/overweight children, in the alone condition but not the with-peer conditions. Participants perceived the with-similar weight peer condition as taking less time than the alone condition, despite each session lasting an equal amount of time (30 minutes). Finally, at-risk-for/overweight children reported greater liking for the with-different weight peer condition than they did alone while lean children did not alter

their liking of any peer-conditions relative to the alone condition. Each of these findings is discussed in greater detail in the following sections.

Changes in accelerometer counts and physical/sedentary activity time

Our first hypothesis was that the children, regardless of group, would perform more physical activity when with another peer, regardless of peer treatment, than when alone. However, this did not occur. The at-risk-for/overweight boys significantly increased their physical activity time between peer treatments and alone. However, examination of accelerometer counts revealed that there were no significant differences in at-risk-for/overweight children in the alone relative to the with- peer conditions despite an average increase in accelerometer counts with a peer versus being alone. In addition, there were no significant (an average decrease in counts and physical activity time was noted) differences between the alone and peer conditions for the lean children. While the presence of a peer did not significantly increase activity counts our results demonstrate that when alone, the at-risk-for/overweight children had significantly less accelerometer counts and spent significantly more time performing sedentary activity compared to lean boys. These differences were eliminated and at-risk-for/overweight children significantly decreased the amount of time allocated to sedentary activities once they were paired with a peer, regardless of whether that peer was lean or at-risk-for/overweight.

In this study we also hypothesized that the at-risk-for-overweight children would perform more physical activity when paired with a similar (at-risk-for/overweight) child than the other conditions. The rationale for this was based on past research (Cairns, R.

B., M. C. Leung, L. Buchanan, and B.D Cairns., 1995) reporting that children tend to be friends with similar peers and would therefore be more likely to interact with similar peers. However, there were no differences between with-peer conditions for either group in the amount of accelerometer counts accumulated or time allocated to sedentary activities. In both with-peer conditions, relative to the alone condition, there was a non-significant trend for the average accelerometer counts to increase and a significant reduction in sedentary time for the at-risk-for/overweight children. It is possible that at-risk-for/overweight children performed less sedentary activity when paired with another child out of concern for how their peer perceived them. Impression management is discussed later in detail, but understanding this concept may lead to a possible explanation of these results, as the at-risk-for/overweight boys increased their activity possibly to prove to the other participant that they were eager and capable of performing physical activity (Gardner, 1988; Leary et. al., 1996; Keresztes et. al., 2008).

Lean children exhibited a slight, non significant, decrease in accelerometer counts when paired with other children. This is possibly due to increased socializing with the other child in the with-peer conditions and taking turns participating in the various physical activity stations. This interaction between children appeared to take away time for physical activity for lean children while conversely reducing the time at-risk-for/overweight children allocated to sedentary activities which resulted in a slight increase in average counts and a significant increase physical activity time. Because lean children allocated very little time for sedentary activity when alone it would have been difficult for them to increase activity (time or counts) much beyond that condition as they

were active for an average of 29 of 30 minutes and there were no other children to interact with or take turns playing with.

These are important findings as they demonstrate that at-risk-for/overweight children may be less physically active than lean counterparts when they are alone and prior research has demonstrated that at-risk-for overweight children spend more time alone than lean children (Salvy et al., 2008; Sallis, J.F., 2001). This indicates a potentially greater need to provide group activities for at-risk-for/overweight children to encourage participation in greater amounts of physical activity.

The influence of peer victimization

These results also demonstrated a significant difference for peer victimization. At-risk-for/overweight children, relative to lean children, reported significantly greater scores for the OVS and RS subscales of the peer victimization questionnaire. These differences between lean and overweight individuals have previously been demonstrated (Grotmeter, 1996). Both of the significantly different subscales were the negative portions of the questionnaire. The OVS subscale assesses the frequency with which other students have harmed or threatened to harm the students' physical well-being and the RS assesses how often students have attempted to harm a student's peer relationships (Grotmeter, J.K., 1996; Crick, N.R., 1995). While others have demonstrated that at-risk-for/overweight children report experiencing more peer victimization than lean children (Crick, 1995; Grotmeter, 1996) and that victimization may affect physical activity, this was the first study to demonstrate that peer victimization is associated with the at-risk-for/overweight children's decreased physical activity participation when alone.

Both the OVS and RS subscales were positively related to the total sedentary time children accumulated when alone and there was a trend towards a significant negative relationship between the two scales and total accelerometer counts when alone. Neither subscale was significantly related to counts or minutes in any of the with-peer conditions. These results help to explain why overweight children, who spend more time alone (Salvy et al., 2008), may be less active during those times.

Rejected and victimized children often respond to negative peer treatment by disengaging from the social environment to avoid additional victimization (Ladd & Burgess, 1999). While this study did not show disengagement in the peer trials, the study was conducted with one-on-one peer interaction and was closely monitored which likely reduced the chance of peer-victimization in the with-peer conditions. Anecdotally, no overt peer victimization was witnessed during any of the with peer conditions in the present study. It is unclear why the association between peer victimization and physical activity was not significant once children were paired with a peer. It is possible that impression management (Gardner, 1988) plays a role. The concept of impression management refers to the effort of an individual to shape how they are perceived by others (Leary, 1996). In the present setting impression management may have overridden the effect of prior peer victimization as the at-risk-for/overweight boys increased their activity possibly to prove to the other participant that they were eager and capable of performing physical activity.

There is limited research on the concept of impression management as it relates to peer influence in children, however it is possible the competition of another peer

encouraged the children to perform at a higher level verses when they were alone. As seen in sporting events, the participants are willing to work harder to prove themselves; this same type of mentality may occur outside of sports settings with peers as well (Keresztes, Piko, Pluhar, & Page, 2008). Parallels can also be made to research focusing on adults as this is the basis for exercise recommendations that encourage adults to find a workout partner to keep a regular exercise schedule (Deforche & De Bourdeaudhuij, 2000). The rationale for this recommendation is based on the idea that by creating accountability to another person each adult is more likely to participate in physical activity and possibly push each other to work harder. Although further research is necessary these same social interactions appear to take place in children, as present evidence as well as that of others (Salvy et. al, 2008, Cairns et. al., 1995) has demonstrated that physical activity increases in the presence of peers in certain settings. In addition, this appears to be particularly true for the overweight children in this study as they spent significantly less time being sedentary in the presence of a peer. Possibly at-risk-for/overweight children were motivated by the presence of another peer in an effort to favorably manage the impression that other child would have of them. Alternatively, because the other child is lean possibly the at-risk-for/overweight children were even more concerned with how they were perceived and were more active so as to not be stereotyped as “lazy” or “slow”, as research has demonstrated the existence of an obesity bias and overweight children are often negatively judged as being “lazy” (Rukavina & Li, 2008).

When at-risk-for/overweight children were alone they participated less in physical activities and more in sedentary activities relative to lean children. This could have occurred possibly out of habit, because it was more reinforcing or because they are more dependent on a positive peer relationship to encourage physical activity than lean children are. Assuming the at-risk-for/overweight children are spending more time alone or with other at-risk-for/overweight children, as previous research has demonstrated they do (Salvy et al., 2008), it is possible they are not often challenged to participate in physical activity or are less likely to have someone to interact with, therefore, decreasing their activity, even if they enjoy physical activity.

Differences in liking

Hypothesis two suggested that the at-risk-for/overweight children may associate the lean children with other lean children that may have teased them in the past and this may result in a reluctance of the at-risk-for/overweight children to interact with lean children. However, overweight children similarly allocated a greater amount of time for physical activity and exhibited a small increase in accelerometer counts in both peer conditions relative to the alone condition. Additionally, the at-risk-for/overweight group reported greater liking when paired with a different weight peer than when alone. These results are contrary to the hypothesis that partnering with a lean child would decrease the motivation to participate in and the enjoyment of physical activity for the at-risk-for/overweight children. Conversely, when paired with the at-risk-for/overweight children, lean children assigned their lowest VAS score and, while not significant, accumulated the fewest accelerometer counts of the three conditions when paired with

overweight children. The reason for this discrepancy between groups for liking scores is unclear. It is possible that the at-risk-for/overweight children enjoyed playing with lean children more than alone because, relative to lean children, they do not spend as much time playing with other children and when they do those children are likely similar to themselves. Perhaps playing with a lean child in a non-threatening environment was a novel experience for the at-risk-for/overweight child and as such more enjoyable and perhaps more motivating than the other conditions.

Additional findings

Our study also suggests that overweight and lean children perceived the activities as requiring similar effort because neither RPE nor fatigue were not significantly different between groups or over the three different conditions. This is pertinent information and could be relevant to future research, specifically associated with liking and enjoyment of the activities as research has shown when physically active with a peer the perceived exertion rating is lower (Utter, A. C., R. J. Robertson, et al., 2002). Previous research has demonstrated RPE to be a significant predictor of activity preference at high and low exercise intensities in boys and girls (Barkley, 2007). However, the differences in RPE between lean and overweight children for a given amount of physical activity have not been compared. While not significant both the overweight and lean children chose the alone condition as having the greatest RPE.

In addition to RPE and fatigue being similar among groups a significantly greater number of participants perceived the time spent during the similar peer condition as going by more quickly relative to the alone condition. Therefore, when boys were paired

with similar peers they perceived their time spent during that activity session as passing more quickly than the alone condition. However there were no significant differences in the number of participants who perceived time spent during the with-different weight peer condition as going by more quickly relative to the alone condition. While the instrument utilized in the present study has apparent face validity it was the first time this exact scale has been utilized, therefore additional research assessing the validity of this scale is warranted. However if the results from this scale are correct, and it is reasonable to believe they are, the present results indicate a potential need for future research on perception and how that may affect physical activity. One possible outcome may be that if children perceive their time spent performing a physical active or set of activities as proceeding quickly they may allocate more time to that activity.

Additionally we compared the amount of time children allocated to all seven physical activity options over the three activity conditions. There was a main effect for activity but no interaction effects for the amount of time spent at each activity. Both lean and overweight children allocated significantly greater amounts of time for playing basketball than any other activity in all three conditions. In addition, participating in Nerf football and Frisbee throws were significantly greater than all activities except shooting basketball hoops. Possibly this occurred as basketball and throwing Nerf footballs and Frisbees are familiar and easily accessible to these children in an unorganized setting such as at home or in a park. In addition, they can be played alone or with a peer; therefore other factors such as liking and motivation may be greater for these activities than the other activities.

Study Limitations

This study was not without limitations, because girls are typically less active than boys and because rates of overweight are also increasing for girls it would be important to determine if girls respond this paradigm in a fashion that is similar to boys. Should future research seek to examine the effect of peer influence on lean and at-risk-for/overweight girls' physical activity it seems most logical to examine girls separately from boys as children are likely to interact with children who are similar to themselves (Cairns et. al., 1995; Hedley et. al., 2004).

This study was limited to 30 minute sessions, which may have limited the amount of physical activity children could participate in. Especially in lean children who allocated almost all of their time to physical activity in the alone condition which leave little room for increases in physical activity in the with-peer conditions. It would be interesting to determine if children would have been physically active for a longer period of time with peers than alone if no time limit were given. It is possible, based on liking and perception of time results, that children may have continued beyond the 30 minute limit in the with-peer conditions. Overweight children in particular were more active with peers than alone, which could encourage them to participate in physical activity for a longer period of time. In addition, at-risk-for/overweight children reported the greatest liking for the lean with-different weight peer condition which may increase their motivation to participate in more activity if given the opportunity.

It is important to note that at-risk-for overweight children and overweight children may differ from each other despite the fact that to date most research combines these groups

into a single category. To obtain the most accurate information and to make the most appropriate recommendations for physical activity future research evaluating the impact of peer influence on physical activity should be consider separating children into three separate groups; lean, at-risk-for overweight and overweight.

Conclusion and future directions

In conclusion, the present study was the first to demonstrate using objective methods of physical activity assessment that overweight children performed more sedentary activity and accumulated fewer physical activity counts than lean children when given the option between physical and sedentary activities in a controlled laboratory environment where they were alone. These differences in physical activity were not present once children were paired with either an at-risk-for/overweight or lean peer.

This was the first study to demonstrate, using objective methods of physical activity assessment, that overweight children performed more sedentary activity and accumulated fewer physical activity counts than lean children when given the option between physical and sedentary activities in a controlled laboratory environment where they were alone. These differences in physical activity were not present once children were paired with another child, regardless of whether the additional child was at-risk-for/overweight or lean.

This study was also the first to compare liking scores between lean and at-risk-for/overweight children for physical activity. These results demonstrated that pairing with a lean child significantly increased the at-risk-for/overweight children's liking of

that activity relative to the alone condition. Conversely, lean children did not alter their liking over the three conditions. These results were contrary to the hypothesis that at-risk-for/overweight children would not enjoy being paired with lean children as they may associate lean children with peer victimization. Furthermore, previous research has shown children tend to befriend those similar to themselves, and therefore are likely to play with other children similar to themselves (Cairns, et. al., 1995; Salvy et. al., 2008). It is unclear why then, the at-risk-for/overweight children exhibited this greater liking for the different-weight peer condition and this result warrants further investigation.

Another unique aspect of this study was the significant correlation between self-reported peer victimization and objectively measured physical activity in the alone condition. These results agree with previous self-reported data which demonstrated that peer victimization was negatively related to physical activity in the at-risk-for/overweight children (Storch, 2007). Perhaps even more interesting than the relationship between peer victimization and physical activity in the alone condition was the fact that self-reported peer victimization and observed physical activity were subsequently not significantly correlated in either with-peer condition. It appears that peer victimization was a significant factor in predicting physical activity when children are alone but not once a child is paired with a peer. This has potential implications regarding the importance of peer interaction and physical activity especially in at-risk-for/overweight children who report greater victimization and are less active when they are alone. This is the first study to compare objectively measured physical activity from a controlled

laboratory environment to self-reported peer victimization therefore, further exploration of peer victimization and physical activity is warranted.

Future research is necessary to determine if these results are similar among girls and possibly individuals of different ages (adolescents, younger children, adults). It may be beneficial to extend the research to adolescents as the teenage years set the ground work for the amount of physical activity the adolescents will take part in as adults (Keresztes et al., 2008). In addition, a slight variation to this study could be done comparing the amount of time and accelerometer counts the children spend performing physical activity without a time limit. This may help better identify what factors lead children to be more physically active or inhibit them from being active. It may also be worthwhile to explore motivation and liking of common sports and how peer influence affects participation in these sports or sport related activities.

Current evidence suggests the power of friendship may be a key factor when planning interventions especially for overweight children (Salvy et al., 2008; Salvy, Roemmich et al., 2008). Currently the only other study completed in a controlled environment demonstrated that overweight children increased cycle time with friends and non-friend peers (Salvy et. al., 2008). The present investigation also concluded that overweight children performed more physical activity with unknown peers. Therefore, these data suggest that it may be possible that the presence of a peer may be more influential for at-risk-for/overweight children than lean children regardless if that peer is a friend or even similar to themselves. However, further research on peer influence on physical activity as it relates to friendship and non-friend peer relationships is warranted.

Since overweight children often report not having any or fewer friends than lean counterparts (Skar, L., 2008; Gray, W.N., 2008) developing social networks for overweight children may be another factor worth examining to enhance compliance in physical activity interventions.

APPENDEXES

APPENDIX A

PEER INFLUENCE PHONE SCRIPT

APPENDIX A

Peer Influence Phone Script

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 physical activity patterns of boys ages 8-11 years old when they are alone or with another child. If you decide to participate in this study your child will be asked to complete three 30 minute activity sessions. In one session your child will have access to activities in a gym when they are alone and in the other two sessions there will be another child in the room to play with him. In all 3 sessions your child will have access to a variety of physical activity options (running, jumping, and throwing, shooting or kicking a ball) and more sedentary activities such as coloring in coloring books and playing matching games. Your child can participate in any of the activities he chooses for as much time as he chooses. Your child will be allowed to rest whenever he wishes during each 30 minute session. To record his activity your child will be wearing an activity monitoring belt during each 30 minute session. We will also ask him how he liked each of the sessions. At the end of the study your son will receive one \$30.00 gift certificate to a store of their choosing.

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. Is he able to be here 3 x M-Th between 4-9pm? *If not:* what time fits your schedule?
3. Lets go ahead and set up your appointment times.

Since other children will be participating in two of these sessions with your son and it is very important that you keep your appointment times otherwise both participants will have to be rescheduled. If for some reason you are unable to attend a session please try to give as much advanced notice as possible.

APPENDIX B

MEDICAL HISTORY-PHONE SCREEN

APPENDIX B

Medical History – Phone Screen

Subject # _____ Date ____/____/____
Child Name _____ Parent _____
Address _____
Phone Number _____
Age _____ (must be 8 – 12 y) DOB ____/____/____ Sex m
Height _____ in Wt _____ lbs
Height _____ cm (inches *2.54) Wt _____ kg (lbs/2.2) BMI _____ kg/m²
Weight percentile _____

Measurements: Waist _____ Hip _____ Waist to Hip Ratio _____

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

Y/N

_____ Has a doctor ever said that your child's blood pressure was too high or too low?
_____ Does your child ever have pain in their heart or chest?
_____ Does your child ever notice extra heart beats, skipped beats or a racing heart?
_____ Has a doctor ever said that your child has heart trouble, an abnormal electrocardiogram (ECG or EKG), heart attack, or coronary?

_____ Does your child often have trouble breathing?
_____ Has your child ever been diagnosed with asthma?
_____ Has your child ever been diagnosed with diabetes?
_____ Does your child have any orthopedic limitations to physical activity?

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? _____

Does the subject seem eligible? Y N

APPENDIX C
PARENT CONSENT FORM

APPENDIX C

Parent Consent Form

What Types of Physical Activity Do 8-12 Year Old Boys Like To Participate In?

This form is to verify that you understand that this research project is designed to determine physical activity patterns of boys ages 8-11 years old when they are alone or with another child. If you decide to participate in this study your child will be asked to complete three 30 minute activity sessions. In one session your child will have access to activity when they are alone and in the other two sessions there will be another child in the room to play with him. In all 3 sessions your child will have access to a variety of physical activity options (running, jumping, and throwing, shooting or kicking a ball) and coloring in coloring books and playing matching games. Your child can participate in any of the activities he chooses for as much time as he chooses. Your child will be allowed to rest whenever he wishes during each 30 minute session. Finally, your child will be wearing an activity monitoring belt during each 30 minute session.

There is minimal risk of injury with this study. If your child is tired he may rest or if he is injured or ill and wants to leave he is able to do so at any time. In the case of physical injuries "911" will be called. 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. Allowing your child to take part in this study is entirely up to you, and no one can hold it against you if you decide not to let him participate.

To obtain more information about this research study you may contact the Principle Investigators, Melissa Rittenhouse at 440-225-0928 or Dr. Barkley at 330-672-0209. 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, Vice President, Division of Research and Graduate Studies (Tel. 330.672.3012).

You will receive a copy of this consent for my records if your child participates.

I agree to let my child take part in this project. I know what he will have to do and that he can stop at any time.

Signature

Date

APPENDIX D

CHILD CONSENT FORM

APPENDIX D

Child Consent Form

Title of Study: The Effect of Peer Influence on the Amount of Physical Activity Performed in 8-11 Year Old Boys

Who are we?

My name is Melissa Rittenhouse and I am a doctorate 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 like to be in this study too.

Why are we doing this study?

We are doing to see what activities children participate in more.

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

You will come to the lab at KSU on three days. On the first day you and one of your parents will read and sign the informed consent and assent forms. Then you will have your height and weight measured. You will then be allowed to take part in any activity you want in the gym for 30 minutes. You will also be required to wear a belt that we give you. This belt tells us how many steps you moved while you were in the gym. Every time you come for a session you will have access to the same gym floor with the same activities for 30 minutes. You have the option to be physically active, sit and color or rest for as much of the 30-minute period as you choose. You can rest at any time you would like. You will be given \$10.00 per visit (for a total of \$30.00) in the form of gift certificates to a local store you choose.

What are the good or bad things that may happen?

You may get tired if you are moving around more than you are used to.

Do you 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 E

ACTIVITY TRACKING SHEET

APPENDIX E

Activity Tracking Sheets

SESSION I

Participant (last, first name) _____ Accelerometer # _____

Time monitor on: _____ RPE: _____

Visit (circle one): alone w/ similar w/ different

Total Time: Physical Activity _____ Sedentary Activity _____

Physical Activities-Official Time

<i>Shooting Hoops</i>			
<i>Soccer Cones</i>			
<i>Throwing</i>			
<i>Hurdles</i>			
<i>Long Jump</i>			
<i>Jump rope</i>			
<i>Ski Jump</i>			

- If alone was first: for *visit two* and *three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone was second: for *visit two* ask “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
For *visit three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone third: during *visit three* ask the following two questions “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- “Compared to the second time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- Today’s session was (circle one): Faster Slower The same Not applicable

Activity Tracking Sheet

SESSION II

Participant (last, first name) _____ Accelerometer # _____

Time monitor on: _____ RPE: _____

Visit (circle one): alone w/ similar w/ different

Total Time: Physical Activity _____ Sedentary Activity _____

Physical Activities-Official Time

<i>Shooting Hoops</i>			
<i>Soccer Cones</i>			
<i>Throwing</i>			
<i>Hurdles</i>			
<i>Long Jump</i>			
<i>Jump rope</i>			
<i>Ski Jump</i>			

- If alone was first: for *visit two* and *three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone was second: for *visit two* ask “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
For *visit three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone third: during *visit three* ask the following two questions “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- “Compared to the second time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- Today’s session was (circle one): Faster Slower The same Not applicable

Activity Tracking Sheet

SESSION III

Participant (last, first name)_____ Accelerometer # _____

Time monitor on:_____ RPE:_____

Visit (circle one): alone w/ similar w/ different

Total Time: Physical Activity_____ Sedentary Activity_____

Physical Activities-Official Time

<i>Shooting Hoops</i>			
<i>Soccer Cones</i>			
<i>Throwing</i>			
<i>Hurdles</i>			
<i>Long Jump</i>			
<i>Jump rope</i>			
<i>Ski Jump</i>			

- If alone was first: for *visit two* and *three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone was second: for *visit two* ask “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
For *visit three* ask “Compared to the time when you were alone did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- If alone third: during *visit three* ask the following two questions “Compared to the first time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
“Compared to the second time you came in, when you were with another child, did today seem to go by faster, slower or did it feel like it took the same amount of time?”
- Today’s session was (circle one): Faster Slower The same Not applicable

APPENDIX F

CHILD SELF EFFICACY QUESTIONNAIRE

APPENDIX F

Child Self Efficacy Questionnaire

Please mark a box that best describes your answer for each question. The rating scale range from 1 (<i>Very Easy/Agree a lot</i>) to 5 (<i>Very Difficult/Disagree a lot</i>). Only one answer for each question.					
	Very Easy/ Agree a lot				Very difficult/ Disagree a lot
	1	2	3	4	5
1. I can be physically active during my free time on most days.					
2. I can ask my parent or other adult to do physically active things with me.					
3. I can be physically active during my free time most days even if I could watch TV or play video games instead.					
4. I can be physically active during my free time on most days even if it is very hot or cold outside.					
5. I can ask my best friend to be physically active with me during my free time on most days.					
6. I can be physically active during my free time on most days even if I have to stay at home.					
7. I have the coordination I need to be physically active during my free time on most days.					
8. I can be physically active during my free time on most days no matter how busy my day is.					

APPENDIX G

CHILDREN'S SOCIAL EXPERIENCES QUESTIONNAIRE- SELFREPORT

APPENDIX G

Children's Social Experiences Questionnaire – Self Report

The following measure was reported in:

Crick, N.R. & Grotpeter, J.K. (1996). Children's treatment by peers: Victims of relational and overt aggression, Development and Psychopathology, 8, 367-380.

This measure is the Children's Social-Experiences Questionnaire-Self Report and consists of three scales each containing five items. There are no items which need to be recoded.

Subscales

Overt Victimization: Items # 2, 4, 7, 10, 14

Relational Victimization: Items # 3, 6, 9, 11, 13

Recipient of Prosocial Behavior: Items # 1, 5, 8, 12, 15

THINGS THAT HAPPEN TO ME

Name _____

Grade _____

Teacher's Name _____

DIRECTIONS: Here is a list of things that sometimes happen to kids your age at school. How often do they happen to you at school?

EXAMPLE:

A. How often do you eat lunch at school?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

B. How often does your class go outside to play?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

1. How often does another kid give you help when you need it?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

2. How often do you get hit by another kid at school?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

3. How often do other kids leave you out on purpose when it is time to play or do an activity?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

4. How often does another kid yell at you and call you mean names?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

5. How often does another kid try to cheer you up when you feel sad or upset?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

6. How often does a kid who is mad at you try to get back at you by not letting you be in their group anymore?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

7. How often do you get pushed or shoved by another kid at school?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

8. How often does another kid do something that makes you feel happy?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

9. How often does a classmate tell lies about you to make other kids not like you anymore?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

10. How often does another kid kick you or pull your hair?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

11. How often does another kid say they won't like you unless you do what they want you to do?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

12. How often does another kid say something nice to you?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

13. How often does a kid try to keep others from liking you by saying mean things about you?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

14. How often does another kid say they will beat you up if you don't do what they want you to do?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

15. How often do other kids let you know that they care about you?

1 NEVER	2 ALMOST NEVER	3 SOMETIMES	4 ALMOST ALL THE TIME	5 ALL THE TIME
------------	----------------------	----------------	-----------------------------	----------------------

APPENDIX H

OMNI RPE SCALE OF EXERTION

APPENDIX H

OMNI RPE SCALE OF EXERTION

Name _____

Date _____

Session _____

Please use the numbers on this picture to tell us how tired you are. Read all the directions carefully before picking a number.

Look at the boy at the bottom of the hill who is just starting. If you feel like this boy you are not tired at all. You should select a 0 (zero).

Now look at the boy who is barely able to jog to the top of the hill. If you feel like this boy you are very, very tired. You should select number 10.

If you feel somewhere in between not tired at all (0) and very, very tired (10), then pick a number between 1 and 9. Select a number that tells how tired you feel. Remember, there are no right or wrong numbers. Use both the pictures and words to help select the number.

APPENDIX I

LIKING VISUAL ANALOGUE SCALE

APPENDIX I

LIKING VISUAL ANALOGUE SCALE

Name: _____

Date: ____/____/____

Session_____

Do not like it at all.
(Left side)

Like it very much.
(Right side)

APPENDIX J

VISUAL ANALOGUE SCALE- FATIGUE

APPENDIX J

VISUAL ANALOGUE SCALE- FATIGUE

Name: _____

Date: ____/____/____

Session_____

Not tired at all.
(Left side)

So tired I had to stop
(Right side)

APPENDIX K

GIFT CERTIFICATE RECEIPT ACKNOWLEDGEMENT

APPENDIX K

GIFT CERTIFICATE RECEIPT ACKNOWLEDGEMENT

Date: _____

I _____ acknowledge the receipt of gift certificates in the amount of _____ dollars for my child's participation in the Peer Influence Study in the Department of Physical Education at Kent State University.

(Parent's signature and date)

(Witness signature and date)

APPENDIX L
COMPLETION LETTER

APPENDIX L

Completion Letter

July, 2008

Dear Participants:

Thank you for participating in the exercise study at Kent State University. We enjoyed having you! Your participation will help us determine the effect of peer influence on the amount of physical activity 8-12 year old boys. The results from this study, combined with future research will help us develop exercise guidelines for children in this age group, particular when children have free time.

If you would like to be added to Kent State University Department of Physical Education contact list for future studies please email Melissa at mrrittenh@kent.edu. You will not be added if you do not wish to be included on the list. The list will also not be shared with anyone outside the department.

A special thank you to the parents for taking time out of their day to bring the children to the study. Without you this study would not have been possible.

Sincerely,

Melissa Rittenhouse

REFERENCES

REFERENCES

- Anderssen, N., & Wold, B. (1992). Parental and peer influences on leisure-time physical activity in young adolescents. *Res Q Exerc Sport*, 63(4), 341-8.
- Armstrong, C. A., Sallis, J. F., Alcaraz, J. E., Kolody, B., McKenzie, T. L., & Hovell, M. F. (1998). Children's television viewing, body fat, and physical fitness. *Am J Health Promot*, 12(6), 363-8.
- Bailey, R. C., Olson, J., Pepper, S. L., Porszasz, J., Barstow, T. J., & Cooper, D. M. (1995). The level and tempo of children's physical activities: An observational study. *Med Sci Sports Exerc*, 27(7), 1033-41.
- Baker, C. W., Little, T. D., & Brownell, K. D. (2003). Predicting adolescent eating and activity behaviors: The role of social norms and personal agency. *Health Psychol*, 22(2), 189-98.
- Ball, G. D., Marshall, J. D., & McCargar, L. J. (2005). Physical activity, aerobic fitness, self-perception, and dietary intake in at risk of overweight and normal weight children. *Can J Diet Pract Res*, 66(3), 162-9.
- Barkley, J. (2007). Reinforcing value of interval and continuous exercise above and below the ventilatory threshold.

Barkley, J.E.1, James N. Roemmich2 FACSM, Edward J. Ryan1, David Bellar1,

Matthew V. Bliss1 and Melissa A. Rittenhouse. (2008). The effect of increasing the variety of exercise equipment on the physical activity level of children.

Berridge, K. C. (1996). Food reward: Brain substrates of wanting and liking. *Neurosci Biobehav Rev*, 20, 1-25.

Burdette, H. L., Whitaker, R. C., & Daniels, S. R. (2004). Parental report of outdoor playtime as a measure of physical activity in preschool-aged children. *Arch Pediatr Adolesc Med*, 158(4), 353-7.

Burke, V., R. A. Milligan, et al. (1998). A controlled trial of health promotion programs in 11-year-olds using physical activity "enrichment" for higher risk children. *J Pediatr*, 132(5), 840-8.

Cairns, R. B., M. C. Leung, L. Buchanan, and B.D .Cairns. (1995). Friendships and social networks in childhood and adolescence: Fluidity, reliability, and interrelations. *Child Dev.*, 66, 1330-1345.

Cohen, D. A., Ashwood, J. S., Scott, M. M., Overton, A., Evenson, K. R., Staten, L. K., et al. (2006). Public parks and physical activity among adolescent girls. *Pediatrics*, 118(5), e1381-9.

Crick, N. R., & Grotpeter, J. K. (1995). Relational aggression, gender, and social-psychological adjustment. *Child Development*, 66(3), 710-722.

De Bourdeaudhuij, I., Lefevre, J., Deforche, B., Wijndaele, K., Matton, L., & Philippaerts, R. (2005). Physical activity and psychosocial correlates in normal weight and overweight 11 to 19 year olds. *Obes Res*, 13(6), 1097-105.

Deforche, B., & De Bourdeaudhuij, I. (2000). Differences in psychosocial determinants of physical activity in older adults participating in organized versus non-organized activities. *The Journal of Sports Medicine and Physical Fitness*, 40(4), 362-372.

Dishman, R. K., Motl, R. W., Sallis, J. F., Dunn, A. L., Birnbaum, A. S., Welk, G. J., et al. (2005). Self-management strategies mediate self-efficacy and physical activity. *Am J Prev Med*, 29(1), 10-8.

Dishman, R. K., Motl, R. W., Saunders, R., Felton, G., Ward, D. S., Dowda, M., et al. (2005). Enjoyment mediates effects of a school-based physical-activity intervention. *Med Sci Sports Exerc*, 37(3), 478-87.

Eccles, J. (1999). The development of children ages 6 to 14. *Future Child*, 9(2), 30-44.

- Elder, J. P., Broyles, S. L., McKenzie, T. L., Sallis, J. F., Berry, C. C., Davis, T. B., et al. (1998). Direct home observations of the prompting of physical activity in sedentary and active Mexican American children. *J Dev Behav Pediatr*, 19(1), 26-30.
- Eliakim, A., G. Kaven, et al.(2002). (2002). The effect of a combined intervention on body mass index and fitness in obese children and adolescents - a clinical experience. *Eur J Pediatr*, 161(8), 449-54.
- Epstein, L. H., R. Truesdale, A. Wojcik, R. A. Paluch, and H.A. Raynor. (2003). Effects of deprivation on hedonics and reinforcing value of food. *Physiol Behav.*, 78, 221-227.
- Epstein, L. H., Beecher, M. D., Graf, J. L., & Roemmich, J. N. (2007). Choice of interactive dance and bicycle games in overweight and nonoverweight youth. *Ann Behav Med*, 33(2), 124-31.
- Epstein, L. H., & Goldfield, G. S. (1999). Physical activity in the treatment of childhood overweight and obesity: Current evidence and research issues. *Med Sci Sports Exerc*, 31(11 Suppl), S553-9.

- Epstein, L. H., Kilanowski, C. K., Consalvi, A. R., & Paluch, R. A. (1999). Reinforcing value of physical activity as a determinant of child activity level. *Health Psychol*, 18(6), 599-603.
- Epstein, L. H., Paluch, R. A., Consalvi, A., Riordan, K., & Scholl, T. (2002). Effects of manipulating sedentary behavior on physical activity and food intake. *J Pediatr*, 140(3), 334-9.
- Epstein, L. H., & Roemmich, J. N. (2001). Reducing sedentary behavior: Role in modifying physical activity. *Exerc Sport Sci Rev*, 29(3), 103-8.
- Faigenbaum, A. D., W. L. Westcott, et al. (1999). The effects of different resistance training protocols on muscular strength and endurance development in children. *Pediatrics*, 104(1), e5.
- Faith, M. S., Leone, M. A., Ayers, T. S., Heo, M., & Pietrobelli, A. (2002). Weight criticism during physical activity, coping skills, and reported physical activity in children. *Pediatrics*, 110(2 Pt 1), e23.
- Ferguson, M. A., B. Gutin, et al. (1999). Effects of exercise training and its cessation on components of the insulin resistance syndrome in obese children. *Int J Obes Relat Metab Disord*, 23(8), 889-95.

- Gilliam, T. B., P. S. Freedson, D. L. Geenen, and B. Shahraray. (1981). Physical activity patterns determined by heart rate monitoring in 6-7 year-old children. *Med Sci Sports Exerc*, 13, 65-67.
- Goldfield, G. S., Mallory, R., Parker, T., Cunningham, T., Legg, C., Lumb, A., et al. (2007). Effects of modifying physical activity and sedentary behavior on psychosocial adjustment in overweight/obese children. *J Pediatr Psychol*, 32(7), 783-93.
- Gray, W. N., Janicke, D. M., Ingerski, L. M., & Silverstein, J. H. (2008). The impact of peer victimization, parent distress and child depression on barrier formation and physical activity in overweight youth. *Journal of Developmental and Behavioral Pediatrics : JDBP*, 29(1), 26-33.
- Grotpeter, J. K., & Crick, N. R. (1996). Relational aggression, overt aggression, and friendship. *Child Development*, 67(5), 2328-2338.
- Gutin, B., N. Cucuzzo, et al. (1995). Physical training improves body composition of black obese 7- to 11-year-old girls. *Obes Res*, 3(4), 305-12.
- Hartup, W. W. (2005). Peer interaction: What causes what? *J Abnorm Child Psychol*, 33(3), 387-94.

Hay, J. A. (1992). Adequacy in and predilection for physical activity in children. *Clinical Journal of Sport Medicine*, 2, 192-201.

Hedley, A. A., C. L. Ogden, C. L. Johnson, M. D. Carroll, L. R. Curtin, and K.M. Flegal. (2004). Prevalence of overweight and obesity among US children, adolescents, and adults. *JAMA*, 291, 2847-2850.

Horst. (2007). A brief review on correlates of physical activity and sedentariness in youth. *Medicine and Science in Sports and Exercise*, 39(8), 1241-1250; 1241.

Ingram, D. K. (2000). Age-related decline in physical activity: Generalization to nonhumans. *Med Sci Sports Exerc*, 32, 1623-1929.

Jones, R. A., Okely, A. D., Gregory, P., & Cliff, D. P. (2008). Relationships between weight status and child, parent and community characteristics in preschool children. *International Journal of Pediatric Obesity: IJPO: An Official Journal of the International Association for the Study of Obesity*, 1-8.
doi:10.1080/17477160802199984

Kalakanis, L. E., Goldfield, G. S., Paluch, R. A., & Epstein, L. H. (2001). Parental activity as a determinant of activity level and patterns of activity in obese children. *Res Q Exerc Sport*, 72(3), 202-9.

Kelly, L. A., Reilly, J. J., Jackson, D. M., Montgomery, C., Grant, S., & Paton, J. Y.

(2007). Tracking physical activity and sedentary behavior in young children. *Pediatr Exerc Sci*, 19(1), 51-60.

Keresztes, N., Piko, B. F., Pluhar, Z. F., & Page, R. M. (2008). Social influences in sports activity among adolescents. *Journal of the Royal Society of Health*, 128(1), 21-25.

Ladd, G. W., & Burgess, K. B. (1999). Charting the relationship trajectories of aggressive, withdrawn, and aggressive/withdrawn children during early grade school. *Child Development*, 70(4), 910-929.

Larson, Elizabeth (2006). Predicting the Perceived Flow of Time from Qualities of Activity and Depth of Engagement. *Ecological Psychology*, 18(2), 113–130.

Leary, Mark, et. al. (1999). Impression management and health risk. Psychology Press, 182-186.

Manios, Y., J. Moschandreas, et al. (2002). Health and nutrition education in primary schools of Crete: Changes in chronic disease risk factors following a 6-year intervention programme. *Br J Nutr*, 88(3), 315-24.

- Motl, R. W., R. K. Dishman, et al. (2000). Factorial validity and invariance of questionnaires measuring social-cognitive determinants of physical activity among adolescent girls. *Prev Med*, 31(5), 584-94.
- Motl, R. W., Dishman, R. K., Ward, D. S., Saunders, R. P., Dowda, M., Felton, G., et al. (2005). Comparison of barriers self-efficacy and perceived behavioral control for explaining physical activity across 1 year among adolescent girls. *Health Psychol*, 24(1), 106-11.
- Owens, S., B. Gutin, et al. (1999). Effect of physical training on total and visceral fat in obese children. *Med Sci Sports Exerc*, 31(1), 143-8.
- Patterson, T. L., Sallis, J. F., Nader, P. R., Rupp, J. W., McKenzie, T. L., Roppe, B., et al. (1988). Direct observation of physical activity and dietary behaviors in a structured environment: Effects of a family-based health promotion program. *J Behav Med*, 11(5), 447-58.
- Premack, D. Toward empirical behavior laws. I. positive reinforcement. *Psychol Rev*. 66:219-233, 1959.
- Premack, D., & Premack, A. J. (1997). Motor competence as integral to attribution of goal. *Cognition*, 63(2), 235-242.

- Raynor, D. A. et. al. (1998). Effects of proximity on the choice to be physically active or sedentary. *Research Quarterly for Exercise and Sport*, (69), 99-103.
- Raynor, D. A., K. J. Coleman, and L.H. Epstein. (1998). Effects of proximity on the choice to be physically active or sedentary. *Res Q Exerc Sport.*, (69), 99-103.
- Robertson. (2000). Children's OMNI scale of perceived exertion. *Med Sci Sports Exerc*, 32(2), 452-8.
- Roemmich, J. N. (2008). Association of liking and reinforcing value with children's physical activity. *Physiol Behav*, 93, 1011-1018.
- Roemmich, J. N., Epstein, L. H., Raja, S., & Yin, L. (2007). The neighborhood and home environments: Disparate relationships with physical activity and sedentary behaviors in youth. *Ann Behav Med*, 33(1), 29-38.
- Roemmich, J. N., Gurgol, C. M., & Epstein, L. H. (2004). Open-loop feedback increases physical activity of youth. *Med Sci Sports Exerc*, 36(4), 668-73.
- Rukavina, P. B., & Li, W. (2008). School physical activity interventions: Do not forget about obesity bias. *Obes Rev*, 9(1), 67-75.

Sallis, J. F., McKenzie, T. L., Conway, T. L., Elder, J. P., Prochaska, J. J., Brown, M., et

al. (2003). Environmental interventions for eating and physical activity: A

randomized controlled trial in middle schools. *Am J Prev Med*, 24(3), 209-17.

Salmon, J., Booth, M. L., Phongsavan, P., Murphy, N., & Timperio, A. (2007).

Promoting physical activity participation among children and adolescents. *Epidemiol*

Rev, 29, 144-59.

Salvy, S. J., Bowker, J. W., Roemmich, J. N., Romero, N., Kieffer, E., Paluch, R., et al.

(2008). Peer influence on children's physical activity: An experience sampling study.

J Pediatr Psychol, 33(1), 39-49.

Salvy, S. J., Roemmich, J. N., Bowker, J. C., Romero, N. D., Stadler, P. J., & Epstein, L.

H. (2008). Effect of peers and friends on youth physical activity and motivation to be

physically active. *Journal of Pediatric Psychology*, doi:10.1093/jpepsy/jsn071.

Salvy, S. J., Romero, N., Paluch, R., & Epstein, L. H. (2007). Peer influence on pre-

adolescent girls' snack intake: Effects of weight status. *Appetite*, 49(1), 177-82.

Scanlan, T. a. J. S. (1992). The construct of enjoyment in: Motivation in sport and

exercise. *Human Kinetics Publishers*, 119-215.

Schwartz, D., J. M. Farver, et al. (2002). Victimization in South Korean children's peer groups. *30*(2), 113-25.

Services, US Dept Health and Human. (1999). Physical activity and health: A report of the surgeon general.

Skar, L., & Prellwitz, M. (2008). Participation in play activities: A single-case study focusing on a child with obesity experiences. *Scandinavian Journal of Caring Sciences*, *22*(2), 211-219.

Storch, E. A., Milsom, V. A., Debraganza, N., Lewin, A. B., Geffken, G. R., & Silverstein, J. H. (2007). Peer victimization, psychosocial adjustment, and physical activity in overweight and at-risk-for-overweight youth. *Journal of Pediatric Psychology*, *32*(1), 80-89. doi:10.1093/jpepsy/jsj113.

Strauss, R. S., D. Rodzilsky, et al. (2001). Psychosocial correlates of physical activity in healthy children. *Arch Pediatr Adolesc Med*, *155*(8), 897-902.

Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: Review and update. *Med Sci Sports Exerc*, *34*(12), 1996-2001.

Utter, A. C., R. J. Robertson, et al. (2002). Children's OMNI scale of perceived exertion:

Walking/running evaluation. *Med Sci Sports Exerc*, 34(1), 139-44.

Van Veldhoven, N. H., A. Vermeer, et al. (2001). Children with asthma and physical

exercise: Effects of an exercise programme. *Clin Rehabil*, 15(4), 360-70.

Weber Culln, Karen et al. (2001). Children reported family and peer influences on fruit,

juice and vegetable consumption: Reliability and validity measures. *Health Educ*

Research, 16(2), 187-200.

Weiss, M. R. (2000). Motivating kids in physical activity. *President's Counsel on*

Physical Fitness and Sports, Research Digest, 3(11), 1-10.

Weiss, M. R., McCullagh, P., Smith, A. L., & Berlant, A. R. (1998). Observational

learning and the fearful child: Influence of peer models on swimming skill

performance and psychological responses. *Res Q Exerc Sport*, 69(4), 380-94.

Williams, J. G., R. Eston, et al. (1994). CERT: A perceived exertion scale for young

children. *Percept Mot Skills*, 79 (3 PT2), 1451-8.

Yelling, Y., K. L. Lamb, et al. (2002). "Validity of a pictorial perceived exertion scale for

effort estimation and effort production during stepping exercise in adolescent

children. *European Physical Education Review*, 8(2), 157-175.