EVALUATING THE MEBACTIVE-YOUTH AS A MEASURE OF MENTAL TOUGHNESS

A Thesis Presented

by

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ABSTRACT

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The obesity epidemic in youth is increasing at an alarming rate, in part, due to the decreasing levels of physical activity within the youth population. In order to understand this growing epidemic different variables have been examined as potentially having an influence on youth physical activity levels. One variable that has never been examined as a correlate of physical activity is mental toughness. Mental toughness is a psychological trait characterized by determination, resiliency, and the ability to stay in control, remain focused, and perform optimally regardless of the circumstances. In order to evaluate this trait the MeBActive-Youth was developed. The purpose of this study was to first, evaluate the psychometric properties of the newly developed MeBActive-Youth, a measure for mental toughness for physical activity in youth and secondly, to assess the relationship of mental toughness, social support and self-efficacy to physical activity with the use of the Social Cognitive Theory (SCT). It was hypothesized that the MeBActive-Youth will be a psychometrically sound measure as assessed with the Rasch Rating Scale Model (RRSM) of mental toughness and will also have good construct validity by being positively correlated with social support, self-efficacy and PA. Participants (N = 106) completed a demographic survey, the MeBActive-Youth, Social Support and Exercise Survey (SSES), Physical Activity Self-Efficacy Scale (PASES), and Physical Activity Questionnaire for Adolescents

(PAQ-A). The RRSM showed that the MeBActive-Youth had appropriate items for the sample and measured mental toughness appropriately. The items had a range of 0.53 – -0.64 logits. All but four of the items had a fit statistic within the acceptable range of 0.5 – 1.5, but only one item had a much higher statistic (infit = 1.68 logits). The items had a separation index of 2.38, therefore only distinguishing high or low mentally tough participants. Although the four response options were all utilized appropriately, it may be beneficial to reduce them to three. There was a significant positive correlation between MeBActive-Youth and physical activity ($\rho = .52$, $p \leq .01$) and PASES ($\rho = .30$, $p \leq .01$). The correlation between social support from friends and family and MeBActive-Youth was not significant ($\rho = .12$, $p \geq .05$; $\rho = .17$, $p \geq .05$). There was a positive significant correlation between, physical activity and familial and friend social support ($\rho = .47$, $p \leq .01$; $\rho = .27$ $p \leq .05$), PASES ($\rho = .34$, $p \leq .01$) and mental toughness. The MeBActive-Youth is a valid and reliable instrument yet can be improved with slight changes. This study showed that there is a strong positive correlation between mental toughness, self-efficacy and physical activity. Positive correlations were also found between physical activity and all the measured variables.

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CHAPTER 1

INRODUCTION

The United States population is currently facing an obesity epidemic. This epidemic has become an issue that not only affects adults but also impacts children and adolescents (Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995). Currently approximately 21% of children are overweight or obese in the United States (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). This epidemic, in part may be due to the decreasing levels of physical activity within this population. According to the 2003-2004 NHANES data only 42% of 6-11 year olds and 8% of 12-15 year olds are currently meeting the recommendations for physical activity (Troianoet al., 2008). Therefore, it is important to have a better understanding of why children are not meeting physical activity recommendations.

Many variables may impact physical activity behavior in youth, thus it is important that research in this area is grounded in theory. Social Cognitive Theory (SCT) is a theoretical framework that could help to improve our understanding of the low levels of physical activity behavior in youth. SCT looks at how person factors (e.g., cognitive characteristics, biological characteristics), environment factors (e.g., social influences, built environment), and behavior factors (e.g. physical activity, diet) interact with one other (Bandura, 1986). This is better known as reciprocal determinism, which is the idea that the person, their behavior and the environment constantly and simultaneously influence each other. Therefore, by examining variables associated with person and environment factors, we should be better able to understand behavior. For example, reviews of the physical activity literature in youth indicate that self-efficacy (person factor) and social support

(environmental factor) are both positive correlates of physical activity (Sallis, Prochaska, & Taylor, 2000; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007). There are many variables that fall under these three factors of SCT that could potentially influence physical activity behavior. One variable that has never been examined in relation to youth physical activity and is associated with self-efficacy and social support is mental toughness (Middleton et al., 2004).

Mental toughness has been defined as the ability to remain determined, focused, in control and confident (Jones, Hanton, & Connaughton, 2007). Mental toughness research has primarily focused on successful athletic performance (Connaughton, Wadey, Hanton, & Jones, 2008; Gould, Dieffenbach, & Moffatt, 2002). Because of its close relationship to optimal performance, it is important to properly measure mental toughness.

Two recently developed questionnaires, the Mental, Emotional, and Bodily Toughness Inventory (MeBTough) and the Mental, Emotional and Bodily Toughness Inventory–Youth version (MeBTough-Y) have been tested and validated as measures of mental toughness for sport performance (Mack & Ragan, 2008; Mack, Ragan, Sweet, Dompier & Dompier (in review)).

Recent interest in the potential relationship between mental toughness and the physical activity behavior of adults resulted in the development and testing of a modified version of the MeBTough, the Mental, Emotional, and Bodily Toughness Inventory for Physical Activity (MeBActive) (Ragan et al, in review), that assesses mental toughness for physical activity in adults. To date, mental toughness for physical activity has not been examined in youth.

The Mental, Emotional and Bodily Toughness Inventory for Physical Activity in Youth (MeBActive-Youth) is a recently developed questionnaire for assessing mental toughness for physical activity in youth ages 9-15. The items of the MeBActive-Youth are based on the MeBActive adult version and are consistent with the reading level of the MeBTough-Y. The MeBActive-Youth has yet to be tested in a youth population.

1.1 Purpose

The purpose of this study is to evaluate and calibrate the newly develop MeBActive-Youth questionnaire using the Rasch Rating Scale Model. A series of analyses and output will be used for this evaluation including: 1) optimization categorization, 2) model data fit, 3) item difficulty, location and spread, 4) Wright Item-Person Map, and 5) person ability estimates. Additionally this study will examine initial evidence of construct validity of the MeBActive-Youth by conducting correlational analyses among the self-efficacy, social support, physical activity, and MeBActive-Youth data.

1.2 Hypotheses

Hypothesis 1: The MeBActive-Youth will be a psychometrically sound measure of mental toughness for physical activity in youth. The MeBActive-Youth will be evaluated and calibrated using the Rasch Rating Scale Model. A series of analyses and output will be used for this evaluation including: 1) optimization categorization, 2) model data fit, 3) item difficulty, location and spread, 4) Wright Item-Person Map, and 5) ability estimates.

Hypothesis 2: The MeBActive-Youth will have good construct validity as demonstrated by it being positively correlated with measures of self-efficacy, social support and physical activity. Correlational analyses among the self-efficacy, social support, physical activity, and MeBActive-Youth data will be conducted to examine the construct validity of the MeBActive-Youth.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction: The Growing Obesity Epidemic

The United States is currently facing an obesity epidemic. The obesity epidemic has become an issue that not only affects adults but also impacts children and adolescents (Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995). Since the 1960's, obesity has increased by approximately 22% (CDC 2010). This is concerning because obesity has been shown to lead to an increase risk in cardiovascular disease and also Type II Diabetes Mellitus in not only adults, but also in children (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007; Pate & Sirard, 2000; Steinbeck, 2001). Ogden and colleagues (2010) examined the prevalence of high body mass index (BMI) in children between 1999 and 2008. The BMI is a reliable measure for body fatness for most children and teens. In youth BMI is age- and sex- specific and is often referred to as BMI-for-age (CDC, 2009). It is derived by taking a person's weight in kilograms divided by height in meters squared. Once the BMI is calculated in youth, it is plotted on the CDC BMI-for-age chart and a percentile ranking is obtained. For youth, less than the 5^{th} percentile is considered underweight, 5^{th}-85^{th} percentile is healthy weight, 85^{th}-95^{th} percentile is overweight and equal to or greater than the 95^{th} percentile is considered obese (CDC). Ogden et al. (2010) found that 11.9% of children and adolescents (ages 2-19) were above the 97^{th} percentile (no official classification but is considered very obese) of the BMI-for-age growth charts, 16.9% were above the 95^{th} percentile (obese) and 31.7% were at or above the 85^{th} percentile (overweight).

More than three-quarters of overweight children and adolescents become obese adults, ensuring the presence of this health problem in the future (Serdula, Ivery, Coates, Freedman,

Williamson, & Byers, 1993; US Department of Health and Human Services 2010). This high prevalence of overweight in youth is likely to continue, if not increase (Troiano & Flegal, 1998). There is evidence of an inverse relationship between weight status and physical activity (PA) levels in youth (Reichert, Meneze, Wlees, Dumith, & Hallal, 2009). One potential method to curve the growing obesity epidemic is to increase physcial activity (PA) levels in youth (Gordon-Larsen, McMurray, & Popkin, 1999). However, physical activity is a complicated behavior to measure and understand. By increasing our understanding of physical activity we can begin to appropriately focus efforts aimed at slowing down the increasing number of overweight and obese youth.

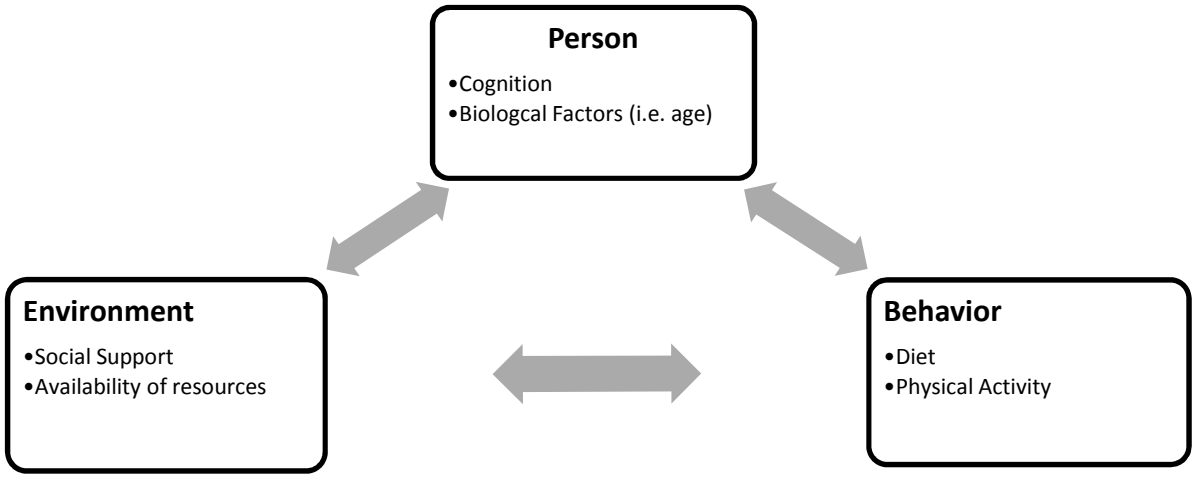
2.2 Social Cognitive Theory (SCT)

The relationship between youth and their lack of engagement in physical activity is not fully understood. One way this can be clarified is by using Social Cognitive Theory (SCT) (Bandura, 1986). SCT is used to understand the relationship between people, their environment and behavior. This theory suggests that a majority of behaviors are learned through social interactions and that the cognition in these settings and behaviors can help clarify their action, motivation and emotion (Buckworth & Dishman, 2002).

A person's behavior both influences and is influenced characteristics of the person and the environment in which they live. This person, behavior and environment interaction is referred to as reciprocal determinism (Figure 1). Reciprocal determinism is the idea that behavior, personal factors and the environment all influence and operate as interconnected determinants of each other (Bandura, 1978; Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). Because of this cyclical relationship, if a characteristic of the person, environment or behavior is to change, the

overall situation changes and the behavior, environment and/or person may be altered (Baronowski, Perry, & Parcel, 2002).

Figure 1 – Reciprocal Determinism



SCT provides a comprehensive framework for understanding health-related behaviors and how to change them (Baranowski, Perry, & Parcel, 2002). Some of the primary concepts of the person include: biological factors (age, health status), skills (the ability to perform the desired behavior), self-efficacy (the confidence to perform a desired behavior), and perceived barriers (what a person thinks is keeping them from being active) (Baranowskiet al., 2003). The environment refers to factors that can affect a person's behavior but that are physically external to the person (Baronowski et al., 2002). Important environmental variables are: availability (whether the equipment is present for use), social support (whether a child has direct or indirect support from their parent/peers to participate in a sport or activity, if they have a ride to/from the park) and access (whether there are sidewalks or public transportation in the area) (Hearn et al., 1998). Behavior can

be depicted as a dynamic area; it depends on aspects of the environment and the person which influence each other simultaneously (Baronowski et al., 2002).

There is substantial research in the literature examining the application of SCT to behaviors associated with overweight and obesity (e.g., diet and physical activity). SCT and reciprocal determinism suggest that the person, behavior, and environment interact, thus SCT provides an ideal framework for examining the relationship of variables, i.e., correlates, associated with physical activity behavior. For example, if a young (person factor) child wants to be physically active (behavioral factor), in order to get to the local park, they may need to get a ride from their parent (environmental factor). If they are not able to get a ride then that in turn affects their ability to be physically active. By using SCT and the idea of reciprocal determinism, we can begin to gain a better understanding how aspects of the person and environment impact each other and more importantly engagement in physical activity.

2.3 Physical Activity

2.3.1 Definition and Recommendations

PA has traditionally been defined as "any bodily movement produced by skeletal muscles that result in energy expenditure" (Casperson, Powell, & Christenson, 1985). The increase in the obesity epidemic, particularly during adolescents has been attributed in part to decreases in the physical activity levels and increases in the sedentary behavior of children and adolescents (Gordon-Larsen et al., 2000). In order to avoid the numerous health problems related to obesity, physical activity could serve as a primary preventative behavior (Lee, Blair, & Jackson, 1999; Pate, et al., 1995).

2.3.1.1 Physical Activity Levels in Children and Adolescents

According to the Physical Activity Guidelines for Americans it is recommended that children and adolescents aged 6–17 years should accumulate one or more hours of vigorous physical activity per day for at least 3 days a week (Pate, Yancey, & Kraus, 2009). This activity should be mostly aerobic but also include muscle-strengthening and bone-strengthening activities. Despite the known health benefits of being physically active, 23.1% of all adolescents who completed a national survey (Youth Risk Behavior Surveillance System) do not meet these recommendations (CDC 2010). These data also showed that a majority of children and adolescence reported no participation in moderate or vigorous physical activity (MVPA) within the past week. Troiano et al. (1998) examined the trends of physical activity in children and adolescence from 1971-1994 and found that the prevalence of overweight in children ages 6-17 was approximately 10.6%. There is clear evidence to show that children are more physically active during childhood compared to adulthood and their engagement in physical activity tends to decrease as they age (Sallis et al., 2000).

In a study completed by Kahn et al. (2008) longitudinal trends of physical activity in adolescents were assessed. Participants included 12,812 boys and girls, 10-18 years old, with mean hours of physical activity ranging from 7.3-11.6 for boys and 8.0-11.2 for girls. Using accelerated longitudinal analysis the study showed a quadratic trend in the engagement of physical activity. The levels of physical activity increased until the age of 13 where it began to decrease (Kahn et al., 2008). Data from NHANES 2003-2004 also showed a similar trend with about 42% of children (ages 6-11) throughout the U.S. (N= 597: 309 males and 288 females) meeting the recommendation of accumulating at least an hour of physical activity on most of the days; yet when compared to adolescents (ages 12-19) the levels of physical activity drop from 49% to 12% for adolescent boys and 3% for girls (Troiano et al., 2008). They also found that in the participants who wore

accelerometers for the 7 day period, the overall prevalence of those meeting the national physical activity recommendations in adolescents was 6-8% but only 5% in adults (Troiano et al., 2008). This decrease in prevalence indicates that altering physical activity behavior at a young age is important because research has shown that health-related behaviors such as being physically active or inactive during childhood and adolescents are eventually carried over into adulthood (Salsberry & Reagan, 2005; Anderssen & Wold, 1992; Hohepa, 2007).

2.3.2 Correlates of Physical Activity in Youth

Substantial research has examined variables that are associated with physical activity behavior in adults and youth and this research is often grounded in SCT. Many variables have been studied to examine if they are associated with physical activity and exercise behavior. These variables can be categorized as person factors (decision-making skills, self-efficacy, gender, education, income, self-motivation or perception of barriers) and environmental factors (social interactions, climate, and access to facilities or environmental characteristics) (Buckworth & Dishman, 2002).

Many correlates such as, perceived competence and attitude have been found to be indeterminate of physical activity in children and adolescents (Sallis et al., 2000), yet intention to be physically active, parental physical activity and time spent outdoors were positively related, while perceived barriers were more consistently negatively related to physical activity levels in children (Sallis et al., 2000). In adolescent populations Sallis et al. (2000) found percieved competance, intention to be active and support from 'significant others' to be positively associated with levels of PA. Factors such as, barriers to being physically active and peer modeling were found to be unrelated to levels of physical activity in adolescence (Sallis et al., 2000).

Multiple factors can be associated with the decline in physical activity levels during youth such as, social factors (e.g. academic pressure, increase in responsibilities) and biological factors (e.g. age, changes in hormonal balance) (Sallis, 2000). Kahn et al. (2008) found that body mass index, athletic and social self-esteem, personal attitudes about body shape and fitness and perceived peer attitudes were all associated with physical activity levels at baseline, but that age was the only variable associated with the decline of physical activity levels across the two years of the study.

Research has shown that there are many correlates of physical activity in youth, yet some have been correlated to physical activity more consistently across studies than others (Allender, 2006). It has been shown that youth were more likely to participate in physical activity when they enjoyed it. It increased their self-esteem and they were supported by their parents (Allender, 2006). Two commonly examined correlates of physical activity are social support and self-efficacy (King, 1994).

2.3.2.1 Social Support and Physical Activity

Similar to adults, a child's social environment can greatly impact their choices and subsequent behavior. Social influences can be defined as a pressure that people perceive from others to perform a behavior (Ajzen, 1991). Social influences, such as support from parents and peers have been shown to greatly influence the levels of physical activity in pre-adolescent and adolescent children (Duncan et al., 2005). Social support has been categorized as either being provided from a child's peers or parents and being direct or indirect (Beets et al., 2006). Direct support is described as assistance to an individual in creating or providing opportunities to be active (i.e. providing transportation to and from sporting events or physically participating in activities together), whereas indirect support would be better described as encouragement to perform activities and praise

associated with the performance (i.e. cheering at the sidelines). One type of support that has been shown to be significantly related to levels of physical activity on children is the direct emotional support a child gets from their parents, siblings, and friends watching them engage in physical activity resulting in higher levels of physical activity (Duncan et al., 2005).

Peer influence to be physically active has been shown to increase during adolescents (Kahn et al., 2008), but parental influence is also present at this time and both continue to influence a child throughout their adolescence (Eccles, 1992). Changes in parental and peer social support and their influence on physical activity levels of 9 to 15 year old adolescent girls in two year increments were examined and showed that although girls tend to become more inactive as they enter adolescence, parental support and modeling parent behavior can help lessen this decline (Krahnstoever Davison, 2009). It has also been shown that among adolescents, peers exert a considerable amount of influence over the activity level of one another (Beets et al., 2006). Among 365 5^{th} – 8^{th} graders, peer support and praise was shown to influence self-perceptions, and affect the activity levels of both boys and girls in this age group more than parental influence. Overall, boys reported higher levels of social support than girls but regardless this study showed that peer support may be advantageous in improving physical activity levels in youth (Beets et al., 2006).

Overall, social support is important to examine because it is the interactions with parents and peers that provide youth the support to be active. The amount of support that is received has different impacts on the level of physical activity a child engages in depending on: who is providing the support (mom, dad, peers) the characteristics of the participant (gender, age, body weight etc.) and what was provided (direct/indirect support) (Beets et al., 2006), but for a substantial portion of the population (regardless of age or gender) the amount of physical activity they participate in can be

determined by the enjoyment and the development and maintenance of social support networks (Allender, 2006).

2.3.2.2 Self-Efficacy and Physical Activity

Self-efficacy is one's belief that they will be successful in performing a desired behavior, given their unique ability (Lox, Martin Ginis, & Petruzzello, 2006). Self-efficacy is a primary variable from the person aspect of the SCT (Baranowski et al., 2003). Therefore, based on recipricol determinism it should exibit a bidirectional relationship with physical activity (McAuley & Blissmer, 2000). Recently, Fisher et al. (2010) found that in 279 children, self-efficacy was significantly correlated with time spent in moderate-vigorous physical activity (MVPA) and that youth with higher levels of self-efficacy were more active. Gender differences have been seen in sixth-grade students and self-efficacy levels (Trost, Pate, Ward, Saunders, & Riner, 1999) yet when looking at self-efficacy as a correlate in interventions 4th- and 5th-grade boys and girls with high self-efficacy for physical activity resulted in less of a decline in physical activity levels one-year into an intervention (Barnett, O'Loughlin, & Paradis, 2002). Self-efficacy has been consistently examined as a determinant of physical activity in youth and has been reported as being associated with greater positive well-being (McAuley & Blissmer, 2000).

2.4 Mental Toughness

2.4.1 Definition

Mental toughness is a psychological skill that is often described by using words such as, "grit", "determination" and "belief" (Moran, 2004; Sheard, 2010) or perseverance and conviction towards some goal or behavior despite pressure or adversity (Middleton et al., 2004; Jones, Hanton,

& Connaughton, 2007). Mental toughness is a unidimensional construct that focuses on three areas: mental, physical and emotional toughness (Mack & Ragan, 2008). From these three areas nine components can be delineated: 1) Being Well-Prepared, 2) Acting Tough, 3) Creating an Optimal Performance State, 4) Accessing Empowering Emotions, 5) Coping, 6) Emotional Flexibility, 7) Emotional Responsiveness, 8) Emotional Strength, and 9) Emotional Resiliency (Loehr, 1994).

2.4.1.1 Physical Toughness

Two components that fall under the physical aspect of mental toughness are being well prepared and acting tough. Being well prepared is the ability of being ready to push one-self and expand one's capacities while also maintaining a balance of stress and recovery, both in training and life (Loehr, 1994). Acting tough is the ability to display confidence, energy, determination, focus and positive fight regardless of the circumstances (Loehr, 1994). This involves learning how to control fear by looking and acting the way you want to feel which will in turn improve one's courage, confidence and decisiveness when stressed.

2.4.1.2 Mental Toughness

The mental aspect of toughness is the ability to create an optimal performance state, to access empowering emotions and to cope (Loehr, 1994). Creating an optimal performance state is the ability to be at the ideal state of physiological and psychological arousal for peak performance, ready and eager to compete (Loehr, 1994). It involves knowing how to get one's mind and body in the zone that is best for oneself and the ability to find the right physical, mental and emotional arousal levels in stressful situations. Empowering Emotions is the ability to consistently trigger the correct

internal emotional climate for competitive success (Loehr, 1994). Empowering emotions are those usually associated with challenge, drive, confidence, determination, energy, and persistence. It is the ability to activate a positive, can-do attitude. Coping is the ability to handle stress and adversity (e.g., a mistake, failure, and crisis) (Loehr, 1994). It is being able to change from a negative to a positive emotional state. This is critical because people often make an instant appraisal of a potentially stressful situation. Being able to diffuse the stress response and utilize skills to complete the task is only possible if a person has the resources needed for coping with the situation.

2.4.1.3 Emotional Toughness

The emotional aspect of toughness encompasses flexibility, responsiveness, strength and resiliency (Loehr, 1994). Emotional flexibility is the ability to absorb unexpected emotional twists while remaining balanced and open to evaluation (Loehr, 1994). Emotional flexibility is important because it allows an individual to be fluid and resourceful in an emotional crisis, which greatly enhances the ability to withstand stress and continue to function. Being able to summon positive emotions helps strengthen and individual's behaviors and reactions. Emotional responsiveness is the ability to remain emotionally connected and engaged under pressure. It is being totally involved and consumed in the moment (Loehr, 1994). Responsive individuals are composed, committed and full of life. This ability to respond emotionally is important because the way someone feels directly affects the way they think and act. Being able to control and use emotions can help to change behaviors and reactions in a positive way. Emotional strength is the ability to resist negative emotions under pressure and to sustain a powerful fighting spirit against all odds (Loehr, 1994). It is the ability to emotionally fight to the finish regardless of how bleak the outcome might appear. This

ability to remain emotionally strong is crucial because of the close link between our emotions, thoughts and behaviors. Maintaining positive emotions will in turn help one act and think more positively regardless of the pressure or situation. Emotional resiliency is the ability to take a punch emotionally and to bounce back quickly (Loehr, 1994). This involves being able to regroup following disappointments, mistakes and missed opportunities.

2.4.2 Mental Toughness in Athletes

The nine components of mental toughness have been recognized by athletes as being essential components of optimal performance. In a study by Middleton et al. (2004), 33 elite sport performers (mean age =37.7, SD ±13.4) from a variety of sport teams (i.e. track and field, basketball, rowing, rugby, cycling, water polo, polo, archery, hockey, mountain climbing, baseball, cricket, triathlon etc.) were individually interviewed and researchers found that almost all the participants identified key components of mental toughness in their interviews when describing their reason for succeeding (Middleton et al., 2004). Very similar results were also found by Jones et al. (2007) who organized focus groups and individual interviews with Olympic athletes and coaches. After these focus groups and interviews 30 attributes clustered into 4 separate dimensions of mental toughness were identified as defined by Jones, all of which were linked to outstanding performances in their sport (Jones, Hanton, & Connaughton, 2007). By excelling at all 9 aspects of mental toughness a person is able to perform at the highest level of their ability whether that is in sport, academics or physical activity.

2.4.2.1 Mental Toughness Research in Sports

Mental toughness has primarily been examined in sport and business environments. When looking at the domain of sport, mental toughness is known to be the most important mental or physical asset to an athlete (Goldberg, 1998). There is considerable evidence within sport research which shows that desirable psychological attributes contribute significantly to superior sport performance (Greenleaf, Gould, & Dieffenbach, 2001; Jackson, Dover, & Mayochi, 1998; Aidman & Schofield, 2004), supporting the idea that characteristics of mental toughness are associated with high levels of performance and success (Marchant et al., 2009; Sheard, 2010). When examining elite Australian rugby players (N=49) before an international competition, Sheard (2009) found that superior mental toughness and hardiness when compared to their competition, eventually led to successful sport performance and winning the tournament. Similar results were found by Crust and Clough (2005) who showed a significant relationship between overall mental toughness and the amount of time, or how successfully participants (41 male undergraduate sport and exercise science students) were able to hold a dumbbell (1.5% of their body weight) with a straight arm at a 90 degree angle in front of them.

2.4.3 Measurement of Mental Toughness

Mental toughness is an important psychological skill required for performing well (Goldberg, 1998; Jones et al., 2007). Therefore an appropriate measure to encompass the concept of mental toughness is necessary since previous attempts to measure this construct have been problematic due to a lack of a sound measure (Middleton et al., 2004). In 1986, Loehr developed the Psychological Performance Inventory (PPI) (Loehr, 1986) one of the first instruments to include specific cognitive-behavioral and self-evaluation dimensions. But despite its ongoing influence on research and

practice, minmal evaluation has been done on the psychometric properties of the PPI. Jones et al (2007) also developed a sport-specific attitudinal measure call the Sports Performance Inventory (SPI). This survey yields 6 interpretable factors: competitiveness, team orientation, emotional control, positive attitude, safety consciousness and mental toughness. Though the subscales were reliable (approximately 0.79), and the mental toughness items shared similar features to those created by Loehr, no further published psychometric data is available for the SPI. The Mental Toughness Inventory is another questionnaire which includes 65-items encompassing 12 different components of mental toughness (Middleton et al., 2004). This questionnaire was tested on 479 elite student athletes from which a series of confirmatory factor analyses was completed (Middleton et al., 2004). Though this questionnaire was developed from a sound theoretical base and has been evaluated through a construct validation framework, very few details about the scale are available. This questionnaire was only validated in a sample of high school athletes with a mean age of 14 and more testing is needed in order to determine its predictive validity.

2.4.3.1 Mental, Emotional and Bodily Toughness (MeBTough)

In 2008, a measure of mental toughness was developed called the Mental, Emotional and Bodily Toughness (MeBTough) Questionnaire (Mack & Ragan, 2008). This questionnaire was based on Loehr's definition of mental toughness which described mental toughness as being able to perform consistently toward the upper range of one's ability regardless of competitive circumstances (Loehr, 1994). Using the 9 components of mental toughness presented by Loehr, 93 potential items were created (9-12 items for each component) from which 45 finalized items were chosen (5 representing each component). These 45 questions were chosen based on previous research (Jackson

& Marsh, 1996) and to make the questionnaire brief. Items targeted components of mental toughness such as coping '*Under the pressure of competition, I think constructively and positively*' or emotional resiliency '*I respond to crisis and pressure with a sense of challenge and determination*' and were answered on a 7-point scale (1= Almost Never, 4= Sometimes, 7= Almost Always). Participants also rated their perceived toughness on a scale from 1-20. To check the validity and reliability of this new measure, 261 athletes from a college setting (5% first year, 23% second year, 43% third year, 29% fourth year) completed the questionnaire.

Unlike the other available mental toughness questionnaires that were developed and evaluated using Classical Test Theory (CTT), the MeBTough was developed using Modern Measurement Theory, specifically the Rasch Rating Scale Model (Rasch, 1980). CTT has well-known limitations including item and sample dependence, ordinal data, and fixed precision across all scores (Bond & Fox, 2001). All psychometrics (reliability and validity) are dependent on the set of items administered and the group of participants completing the measure. Another limitation is that item (difficulty) and person (ability) statistics are put on different scales (Bond & Fox, 2001). CTT also is limited because potentially misleading statistics (such as Chronbach's alpha which is an indicator of homogeneity of items) are used to make evaluation and construction decisions.

The Rasch Model considers the person ability (i.e. the magnitude of the trait being measured) and the item difficulty to be meaningful. The model states that there is a probability between the person and the item of a correct answer. This probability is the difference between the person's ability and the items difficulty. This model is not sample- or item- dependent and is considered to be stable across the samples tested at different times, which is beneficial for comparisons across numerous studies (Zhu, Timm, Ainsworth, 2001).

The Rating Scale Model (RSM) is an extension of the Rasch Model (Rasch, 1960) and converts the ordinal data collected to interval data, with meaningful distance between items. This allows test developers the ability to evaluate the measurement capabilities of the instrument and to create and add items to the instrument if necessary. The first step of the Rasch Rating Scale Model (Wright & Masters, 1982) includes optimal categorization in order to determine how many categories should be used to ensure that all the response options are used. Once the appropriate categorization is determined the model data fit is assessed using infit and outfit statistics. The next step is to look at item difficulty, spread and location and to then visually inspect the results with the Wright Item-Person map. The last step in the Rasch Rating Scale Model is to look at the participant's parameters or their ability estimates.

After the participants completed the MeBTough, the Rasch Rating Scale Model showed that 43 of the items appropriately measured the levels of mental toughness in the athletes (Mack & Ragan, 2008). After the optimization categorization, the 7-point scale was reduced to a 4-point scale (1 = Almost Never, 4 = Almost Always) to ensure appropriate results. After further analyses, differential item functioning showed that 2 questions functioned differently between genders and were therefore dropped from the questionnaire. Based on these results and further testing in additional samples of athletes (Ragan and Mack, unpublished data) the current version of the MeBTough (Ragan & Mack 2010) has 41 items that use the 4-point Likert respons scale.

2.4.3.2 MeBTough - Youth

Though the MeBTough is a valid and reliable measure of mental toughness for adults, a more appropriate instrument was needed in order to measure mental toughness for sport among youth. The MeBTough-Youth (MeBTough-Y) was developed for just this reason (Ragan et al., in review).

The MeBTough–Y was developed to be easily understood by children between the ages of 9-15. Items from each of the nine components of mental toughness contained in the adult version of the MeBTough were evaluated in order to develop the youth version. Based on this premise; an initial pool of 39 items were developed, and then subjected to a Flesch-Kincaid reading level analysis (Kincaid, Fishburne, Rogers, & Chissom, 1975). Flesch–Kincaid grade levels are calculated by a mathematical formula using the average number of syllables per word and words per sentence. If the question was at or below a 4th grade level then they were included in the questionnaire. Items above this level were either modified or discarded until 3 content-valid questions remained for each of Loehr's nine components, resulting in a total of 27 items. Sport psychologists assessed the items in order to ensure that the meaning of each item was consistent with the items in the MeBTough. Reading specialists also assessed the items to ensure they were at an appropriate reading level. The questionnaire included items such as, '*I stay calm when things go good or bad during a game*' (original MeBTough question: '*I remain calm and collected when experiencing the wild emotional swings of competition'*) or '*I like being challenged and having to fight hard*' (original MeBTough question: '*I respond to crisis and pressure with a sense of challenge and determination*'). The MeBTough-Y questionnaire was then administered to 198 youth soccer players (n = 112 females, n = 86 males) taking part in a 3-day recreational league soccer tournament (Ragan et al, in review). By using the Rasch Rating Model, as used in the original MeBTough, 26 of the 27 items were shown to have acceptable fit statistics.

2.4.4 Mental Toughness and Physical Activity

Currently there is no available literature that has examined the construct of mental toughness in the physical activity domain. However, numerous studies have examined variables that are

consistent with the nine components of mental toughness. Much of this research has focused around resiliency and related variables (Burton, Pakenham, & Brown, 2010; Cleland, Bail, Salmon, Timperio, & Crawford, 2010),

In a study conducted by Burton et al. (2010) positive emotions, cognitive flexibility, social support, life meaning and active coping were evaluated as part of a resilience enhancement program in order to determine whether or not these characteristics impacted one's well-being. They found that there was a significant improvement between baseline and post intervention scores on measures of mastery of skills ($p \leq 0.001$), positive emotions ($p \leq 0.002$), personal growth ($p \leq 0.004$), mindfulness ($p \leq 0.004$), acceptance ($p \leq 0.012$), stress ($p \leq 0.013$), self-acceptance ($p \leq 0.016$) and valued living ($p \leq 0.022$) which are characteristics of mental toughness (Burton, Pakenham, & Brown, 2010). By enhancing these characteristics people improved their well-being which can also be applied to increasing physical activity levels. In 2010, 291 women with low educational status provided survey data on their leisure time PA (need to put reference in here if this is referring to a different study than the Burton study above). After looking at potential personal (enjoyment and self-efficacy; barriers; intentions; guilt and priorities; occupational physical activity; television viewing), social (support from family/friends; social participation; sport/recreation club membership) and environmental (aesthetics; safety; local access; footpaths; interesting walks; busy roads to cross; heavy traffic) correlates of resilience to physical activity it was found that personal aspects had the strongest association to meet the recommended levels of leisure time PA (Cleland et al., 2010). These personal aspects of resiliency are also components of mental toughness which could potentially also help increase levels of PA. Similar to what has been seen in adults, it has also been shown that there is an important relationship between a higher self-determined motivation in

youth and perceived enjoyment, effort, and physical activity behaviors (Beets, 2006; Sánchez-López et al., 2009).

2.4.4.1 Measuring Mental Toughness for Physical Activity (MeBActive)

Recently, an instrument has been developed to measure levels of mental toughness for physical activity. The MeBActive (Mack & Ragan, in review) is based off of the MeBTough and uses Loehr's components of mental toughness (Loehr, 1994) and the same framework as the MeBTough (Mack & Ragan, 2008) to better understand this idea of mental toughness as it pertains to physical activity. In order to make the questionnaire more appropriate for physical activity behavior 17 of the original 43 items of the MeBTough were altered to be able to discriminate between the ideas of mental toughness for sport compared to that for PA. The altered questions included things such as '*Under pressure, negative emotional states are hard for me to change*' (original MeBTough question: '*Under the pressure of competition, negative emotional states are hard for me to change*') or '*It's hard for me to trigger the right internal emotional climate for maximum success*' (original MeBTough question: '*It's hard for me to trigger the right internal emotional climate for maximum competitive success*'). A total of 202 participants (males n = 111; females n = 89 mean age = 21.4 ±3.5 years) recruited from university physical education classes participated in the study to check the validity and reliability of the questionnaire. The Rasch Rating Model was used again because this model worked very well for MeBTough and the MeBActive is a modified version of the MeBTough. The only difference between these questionnaires was the focus domain (i.e. sports or physical activity); the mental toughness construct was maintained. The results showed that 41 out of the 43 items had acceptable fit.

2.4.4.2 MeBActive-Youth

Recently, a youth version of the MeBActive, the MeBActive-Youth has been developed. Similar to the development of the MeBTough-Y, the MeBActive-Youth consists of 27 items (3 from each subscale as described by Loehr) and aims to determine levels of mental toughness in youth as it pertains to physical activity. This questionnaire was developed by comparing the items in the MeBTough to the MeBActive in order to better understand how the language of each item was altered to pertain to physical activity rather than sport. Then the MeBTough was compared to the MeBTough-Y in order to determine which items from each of the nine components were altered and used in the youth version. The corresponding questions from the MeBActive were then altered to create the MeBActive-Youth. These new items were discussed and altered as deemed necessary by a panel of youth sport and reading specialists. The new items included things like '*I can keep fighting when things get tough*' (original MeBTough question: '*I can sustain a powerful fighting spirit against almost impossible odds*') and '*When pressured, I hide my feelings*' (original MeBTough question: '*As the battle rages, I sometimes become withdrawn and emotionally disconnected*'). This questionnaire's validity and reliability has yet to be examined, thus one of the aims of this study is to establish the validity and reliability of the MeBActive-Youth. Because these items are very similar to the MeBTough, MeBTough–Y and the MeBActive, it is expected that the construct of mental toughness for physical activity as evaluated through the items in the MeBActive–Y will have good fit to the Rasch Rating Scale model.

2.5 Summary

The growing obesity epidemic and the health risks associated with obesity, further emphasize the importance of fully understanding why engagement in physical activity declines as children age. SCT provides a framework for examining variables (personal, environmental, and behavioral factors) associated with physical activity behavior. Self-efficacy and social support have both been identified as positive correlates of physical activity in youth; specifically higher levels of self-efficacy and social support are associated with more physical activity behavior (Duncan et al., 2005; Baronowski et al., 2003). One variable that has never been examined as a possible correlate of physical activity is mental toughness. Research indicates that mental toughness has strong positive relationships with performance in several domains (e.g., sport and business). It is possible that mental toughness for physical activity is associated with physical activity performance, particularly higher levels of PA. Determining if a relationship exists between mental toughness and physical activity is important because mental toughness is an easily modifiable variable that could be targeted in interventions aimed at increasing physical activity in youth.

Recent advances have been made in the development of psychometrically sound instruments capable of assessing mental toughness. Ragan and colleagues have developed a series of mental toughness questionnaires that assess mental toughness for sport in adults (MeBTough) and youth (MeBTough-Y), as well as a questionnaire that assesses mental toughness for physical activity in adults (MeBActive). The recently developed MeBActive-Youth is a modified version of the MeBActive developed for 9-15 year old children. This questionnaire has not yet been tested in a youth sample.

2.6 Specific Aims and Hypotheses

The purpose of this study is to evaluate the MeBActive-Youth as a measure of mental toughness for physical activity in youth. It is hypothesized that the MeBActive-Youth will be a psychometrically sound measure of mental toughness in physical activity in youth. Therefore the first aim of this study will be to evaluate and calibrate this instrument by using the Rasch Rating scale Model. A series of analyses and output will be used for this evaluation including: 1) optimization categorization, 2) model data fit, 3) item difficulty, location and spread, 4) Wright Item-Person Map, and 5) ability estimates.

The second aim of this study will be to examine initial evidence of construct validity of the MeBActive-Youth. Because we would expect self-efficacy and social support to be associated to mental toughness correlational analyses among these variables, physical activity, and MeBActive-Youth data will be conducted to examine the construct validity of the MeBActive-Youth. It is hypothesized that the MeBActive-Youth will have good construct validity. This will be established by the MeBActive-Youth establishing a positive correlation with measures of self-efficacy, social support and physical activity.

CHAPTER 3

RESEARCH DESIGN AND METHODS

3.1 Participants

Sample Size and Power Estimate: For a one parameter Rasch Rating Scale Model a heterogeneous sample size of 50 is needed (Wright, 1996).

Participant Inclusion/Exclusion Criteria: All participants had a written informed consent signed by their parent/guardian, and completed an assent form in order to participate in the study (Appendix A). Participants were excluded if they had any disability that prevented them from being physically active (unable to participate in routine physical activity in school, require oxygen supplementation for exertion, have developmental or physical disability preventing them from being physically active) or if they or their guardians could not speak English.

Recruitment: Support for this study was received from St. Stephen's Armenian Elementary School (Watertown, MA) with approximately 75 students (Appendix B). Additional recruitment was completed through study fliers being posted throughout the Amherst area, local libraries, camps and after-school programs in Amherst, MA. Participants, or parents, who showed interest, were contacted via phone or in person by research staff for screening and in order to answer any questions the participant and/or their parent/guardian had about the research study. A total of 106 participants (males and females, 9-15 years old) of any background or ethnicity were enrolled in this study.

3.2 Instruments

3.2.1 Demographics

Information about each participant's age, gender, class level, race/ethnicity, number of siblings, and the number and type of family members (parents, grandparents, aunt, uncle etc.) with which they live with was collected (Appendix C). Estimated height and weight of each participant was also collected from parent/guardian.

3.2.2 Mental Toughness for Physical Activity

The MeBActive-Youth is a recently developed questionnaire that measures mental toughness for engaging in physical activity in children. It includes 27 items that encompass the 9 components of mental toughness by having items which ask about topics such as, '*Being active is sometimes too hard for me*' or '*I like how I feel when I am active*'. All the questions are ranked on a 4-point Likert scale ranging from 'almost never' to 'almost always'.

3.2.3 Social Support for Exercise/Physical Activity

Social Support was measured using the Social Support and Exercise Survey (Sallis, Grossman, Pinski, & Nader, 1987). This survey consists of 12 items pertaining to the participant's encouragement to be physically active (Appendix C). Some of the items ask things like '*Gave me helpful reminders to exercise ('Are you going to exercise tonight?')*' or '*Planned for exercise on recreational outings*' The participants were asked to rank the support they receive from their parent/guardian and also their peers on a 6-point Likert scale

ranging from ‘none’ to ‘very often’ and ‘does not apply’. Scores were determined by summing questions 11-16 and 20-23 with and answer of ‘8’ (‘does not apply’) rescored to ‘1’. Scores were summed individually for parents and peers. This questionnaire has been found to be valid and reliable with a Crohnbach’s alpha of 0.85 (Sallis, Grossman, Pinski, & Nader, 1987).

3.2.4 Self-Efficacy for Exercise/Physical Activity

Self-efficacy has been reported as an important predictor of physical activity in children and adolescents (Wenthe, Janz, & Levy, 2009). The Physical Activity Self-efficacy Scale (PASES) is a validated measure for self-efficacy pertaining to physical activity in children (Saunders, Pate, & Felton, 1997) (Appendix C). This 8-item questionnaire asks participants to rank their ability to exercise on their own and maintain their physical activity regimen on their own. Answers range from 0 (‘No’) to 2 (‘Yes’) and values of 1 (‘I don’t know’). The Physical Activity Self-Efficacy Scale was found to be valid and reliable with a Crohnbach’s alpha coefficient ranging from 0.61 to 0.83 in a Caucasian sample and from 0.50 to 0.80 for a Hispanic sample (Bartholomew & Loukas, 2006).

3.2.5 Physical Activity

The Physical Activity Questionnaire for Adolescents, (PAQ-A) is a self-administered, 7-day recall questionnaire. It has been validated against objectively measured physical activity (r = 0.33) (Kowalski, Crocker, & Faulkner, 1997) (Appendix C). The 9-item questionnaire asks participants what their activity levels were throughout the day (‘*In the last 7 days, what did you do most of the time at during lunch?*’) with answers ranging from ‘Sat

down (talking, reading, doing schoolwork)' to 'Ran and played hard most of the time'. It also asks how often the participant is active at different times of the day ('*In the last 7 days, on how many days right after school, did you do sports, dance or play games in which you were very active?*') and provides a range of answers from 'none' to '6 or 7 times last week'. The summary physical activity score was derived from the nine items.

3.3 Procedure

3.3.1 Consent/Assent

As participants were recruited, they completed the Assent form and their parent/guardian completed the Consent form (Appendix A). These forms provided participants and their parents with details about what is required for participating in the study. These forms were sent home with students or were completed with students and their parents at pick-up time. Once informed consent and assent was obtained from both the participant and their parent/guardian the questionnaires were completed.

3.3.2 Data Collection Platform

The NIH Patient-Reported Outcomes Measurement Information System (PROMIS) was used to collect study data. PROMIS is accessed through the Assessment Center (http://www.assessmentcenter.net/) and participants completed the questionnaires either online through the NIH secure website or on laptop computers that had use offline version of PROMIS. PROMIS is a NIH blueprint initiative designed to provide an easily accessible

platform for data collection in clinical and research settings. The Assessment Center has a battery of PROMIS health outcome measures that can be used or it allows researchers to upload their own questionnaires. A website for this study was developed using PROMIS and any data collected online from this study was stored on secure NIH servers until it was downloaded as an excel file for data analysis. The Assessment Center also offers an offline version of PROMIS which was downloaded onto laptops for data collection. The final study website with questionnaires was completed and launched after IRB approval had been obtained. Once a study is launched by the Assessment Center it is not possible to make any changes to it, thus a beta-version of the study website was created first, launched, and tested for problems.

3.3.3 Data Collection

Questionnaires were completed by all participants and these data were collected using either the online or offline version of PROMIS or paper copies of the questionnaires. Researchers collected data in schools and during after school and other community based programs. Data was collected using computer labs when available (i.e. school and after school programs), otherwise data collection laptops and paper copies of the questionnaires were used. Although it was expected that the majority of participants in the study would be familiar with the basic skills for using a computer (i.e., using the mouse and keyboard) researchers asked participants about computer experience and provided directions on using the mouse and keyboard when necessary. Participants who completed the offline version of the questionnaires were given the laptop with the study questionnaires ready to be completed.

All participants were given a login and password when they started the online questionnaire. In the event that a participant needed to stop and take a break, he/she was able to exit the program and then login at another time using the password provided.

3.4 Analyses

3.4.1 Data Processing

All online data were downloaded from the Assessment Center website once per week into Excel. Similarly, data were downloaded and transferred from the data collection laptops on a weekly basis. Also data from the paper copies were entered and double-checked by research staff weekly. The three excel files were compiled into a master excel data file. These data were imported into the statistical programs required for the descriptive statistics and the Rasch analyses.

3.4.2 Descriptive Statistics

Descriptive statistics (e.g., means, standard deviations, data distributions, etc.) for the demographic and outcome variables (self-efficacy, physical activity, social support) were analyzed. All analyses were done in SPSS 18.0.

3.4.3 Rasch Rating Scale Model Analysis

The Rasch Rating Scale Model (Wright & Masters, 1982) was chosen for the evaluation and calibration of this new instrument because of the clinical utility and simplicity (Andrich, 1987; Wright & Masters, 1982). The Rasch calibration is not sample- or item-dependent and thus should be stable among the items of the instrument and across samples tested at different times, which is beneficial for comparisons across studies (Zhu et al., 2001). The Rasch Rating Scale model states that the probability of a person getting an item correct is based on the person's ability and the difficulty of the item. This probability can be expressed as:

$$\Pr(x_{ni} = 1 | \theta_n \delta_i) =$$

Where θ_n represents the ability of person n and δ_i represents the difficulty of the item i (Rasch, 1980). Because we consider mental toughness to be an ordinal variable the Rasch Model can be further extended to employ the use of the Rating Scale Model (RSM). The RSM allows analysis of ratings in two or more ordered categories (Wright & Masters, 1982) by converting ordinal data to interval data with meaningful distance between items. The RSM can be expressed as the following:

$$\log_e\left(P_{nij}/P_{ni(j-1)}\right) = B_n - D_i - F_j$$

This specifies the probability, that person n with an ability is observed in category j of a rating scale applied to item i of difficulty as opposed to the probability of being

observed in category (j – 1). For example, in our measures j could be 'Always' then (j – 1) would be 'Sometimes'. This is considered the Rasch Andrich Threshold which is the point where the probability of selecting j or (j – 1) is equal.

3.4.4 Evaluating Psychometric Properties

The Rasch RSM as it relates to the MeBActive-Youth focuses on five questions designed to evaluate the quality of an instrument and its ability to define the construct of interest:

1. Have we succeeded in defining a discernible line of increasing intensity?
2. Is item placement along this line reasonable?
3. Do the items work together to define a single variable?
4. Have we succeeded in separating persons along the line defined by the items?
5. How valid is each person's measure?

(Wright & Masters, 1982, pp 90-91)

The first three questions help evaluate the capability of the items in the instrument to work together and define the variable of interest. The last two questions address the extent to which the participants are separated along the same line and the validity of their individual measures.

To determine where both the items and participants are located on the continuum, and if this placement is reasonable, we refer to the logit scale. The logit scale is an interval scale where the intervals between the locations on the variable map have a uniform meaning or

value (Bond & Fox, 2001). This scale theoretically ranges from - ∞ to ∞ logits and mirrors the underlying latent construct, mental toughness, where - ∞ represents the lowest level of mental toughness and ∞ represents the highest level of mental toughness. To ensure that the items and participants are sufficiently separated along the logit scale we refer to what is called the reliability of separation. This coefficient represents the ratio of the true score variance to the observed score variance (Wright & Masters, 1982) and provides a measure of the distance between each 'element' of the facet, or variable of interest. It is represented as follows:

$$R = \frac{SD^2 - MSE}{SD^2}$$

Where SD^2 is the observed variance of the element difficulty for a facet and MSE is the mean square calibration of error for each element within the facet. Larger differences between the elements within a facet will yield a higher reliability of separation coefficient. Therefore the item separation index is defined as:

$$G_i = \frac{SA_i}{SE_i}$$

Where SA_i is the adjusted standard deviation and SE_i is the root mean square calibration error. The separation index indicates how well items are spread along the measurement scale, and the separation reliability is an index representing the extent to which the items would have the same order on the measurement scale if given to a different sample.

A higher separation index means there is a larger spread of items and separation reliability closer to 1 would indicate a high degree of confidence that the items difficulties would be in the same order in another sample (Fisher, 1992).

To ensure that the items and the participants fit the Rasch Rating Scale model, the fit statistics (infit/outfit) are evaluated. These statistics measure how far the person or item performance from the uni-dimensional variable that is being assessed. The fit statistics indicate whether or not the assumption of uni-dimensionality holds up empirically.

Outfit statistics (u_i) are useful for diagnosing misfit items to the measurement model and can be defined as the following:

$$u_i = \frac{\sum_{n=1}^{N} z_{ni}^2}{N}$$

An outfit statistic should fall within the range of 0.5 – 1.5, a statistic that it greater than 1.5 may indicate inconsistent responses from the participants, or items. Outfit mean square statistics greater than 2.0 indicate a large amount of unexplained variance, thus providing more misinformation than information. The one major disadvantage of the outfit statistic is that it is greatly impacted by outliers e.g. only one or two participants giving a surprising response to one or two items. Similar to outfit statistics infit mean square statistics (v_i) differ only because they are weighted and less influenced by outliers. An acceptable range for infit statistics is the same as outfit, which is 0.8 – 1.2. The infit statistic is calculated as follows:

$$v_i = \frac{\sum_{n-1}^{N} W_{ni} z_{ni}^2}{\sum_{n-1}^{N} w_{ni}}$$

Although, there are guidelines as to what is considered acceptable from the results from the Rasch Rating Scale Model, it is difficult to set a single uniform standard (Wilson, 2005). A better approach is to consider each application of the instrument individually and develop standards based on the context (Wilson, 2005). The FACETS program will be used for all Rasch analyses (Linacre, 2007).

3.4.5 Rating Scale Utility

Once the analysis of the five components for the evaluation of the instrument is completed, Linacre's 8 steps of response utilization are used to investigate whether the response categories are cooperating to produce observations on which a valid measure can be produced (Linacre, 1999).

1. Each category should have at least ten observations. When the number of observations is too low, then the calibration is not precisely estimated and potentially unstable.
2. There should be a regular observation distribution. Irregularity in observation frequency across the categories may signal atypical category usage. A uniform distribution of observations with a single peak is optimal for step calibration.

3. The average measures, or logits should increase monotonically up the rating scale, otherwise the meaning of the rating scale is uncertain for that data set, and consequently any derived measures are doubtful.
4. The outfit statistic for each category should be less than 2.0. If it is over 2.0 then that category has more unexplained noise than explained noise and therefore indicating misinformation.
5. Step calibrations advance – when looking at the response options, each of them should peak sequentially to ensure that each category of the scale is the most likely to be chosen at some point in the measure.
6. Ratings imply measures and measures imply ratings – a single observation implies an equivalent underlying measure and from an underlying measure the expected behavior can be inferred. Do the responses given correspond with that which was expected?
7. Make sure that the difference between each response option is at least one logit. If it is less than one logit then the response options are not clearly deciphering the response of the participants and the response options should be redefined to either have a wider meaning or by combining the categories.
8. Make sure that the difference between each response option is less than 5 logits. If this distance is greater than 5 logits the response options represent a wide range of performance creating a 'dead zone' and therefore losing the precision of the measurement.

3.4.6 Construct Validity Evidence

Initial validity will be established by examining the relationship between the MeBActive-Youth, the Social Support and Exercise Survey (social support), the Exercise Confidence Survey (self-efficacy) and the Physical Activity Questionnaire for Adolescents (physical activity) using Spearman's Rank Correlation Coefficient (Spearman's rho). Significance level was set at $p = 0.05$.

CHAPTER 4

RESULTS

Table 1 shows the demographic characteristics of the 106 participants. The number of participants that completed each question is provided in parentheses after each demographic variable as indicated by (n= #). Participants were between the ages of 8-15 with a mean age 11 ± 1.8 years. There were fewer 8, 12 and 15 year olds, comprising 7.6, 8.6 and 8.6 percent of the sample, respectively, as compared to the 9, 10, 11, 13 and 14 years olds which comprised of 18.1, 15.2, 13.3, 16.2, 12.4 percent, respectively. A majority of the participants were of White/Caucasian background, there was also a large percentage (21%) of participants self-identifying as 'others'. This could potentially have been due to some participants not understanding the ethnicity classifications provided. From the total sample of 106 only 8 participants were an only child. Approximately 45% of the participants did not have a sister whereas; approximately 30% did not have a brother. Approximately 56% of the data was collected using paper and pencil and 44% was collected through the online platform.

Table 2 shows the descriptive statistics of the measures (MeBActive-Youth, Social Support for Exercise Survey [SSES], Physical Activity Self-Efficacy Scale [PASES] and Physical Activity Questionnaire [PAQ-A]) used for this study. All the measures were normally distributed, with skewness and kurtosis falling within an acceptable range of ±2 and ±5 (Kendall & Stuart, 1958) respectively.

Table 1: Participant (N=106) Demographic Data

Demographic Variable	n	%
Sex (n = 106)		
Male	59	55.7
Female	47	44.3
Age (n = 105)		
8	8	7.6
9	19	18.1
10	16	15.2
11	14	13.3
12	9	8.6
13	17	16.2
14	13	12.4
15	9	8.6
Born in the US (n = 106)		
Yes	103	97.2
No	3	2.8
Ethnicity (n = 106)		
White/Caucasian	74	69.8
Black/African American	1	0.9
Hispanic/Latino	8	7.5
Multiracial	2	1.9
Other	21	19.8
Brothers (n = 103)		
0	32	31.1
1	42	40.8
2	19	18.4
3	8	7.8
4	2	1.9
Sisters (n = 102)		
0	46	45.1
1	42	41.2
2	7	6.9
3	5	4.9
4	1	.98
5	1	.98
Form Of Testing		
Computer Administered	47	44.3
Paper and Pencil	59	55.7

Table 2: Descriptive Statistics for all Measures

Measure	N	Mean	SD	Range	Skewness	Kurtosis
MeBActive-Youth	106	.35	.56	3.22	.18	.46
Friend SS	106	24.10	12.51	64	1.51	3.01
Family SS	106	26.87	10.78	60	.78	1.44
Self-Efficacy	85	1.81	.23	1.13	-.90	.22
PAQ Summary	72	2.87	.68	3.26	-.27	.28

Note: SS = Social Support; PAQ = Physical Activity Questionnaire

4.1 Hypothesis #1

It was hypothesized that the MeBActive-Youth would be a psychometrically sound measure of mental toughness for physical activity in youth. The Rasch Rating Scale Model was used to evaluate this newly developed instrument. A series of analyses and output were used for this evaluation including: 1) optimization categorization, 2) model data fit, 3) item difficulty, location and spread, 4) Wright Item-Person Map, and 5) ability estimates.

4.1.1 Optimization Categorization

Figure 2 shows that all four response options are the most often used at some point within the MeBActive-Youth; this is depicted by the clear curves. By all the response options having a clear peak, this suggests that the number of response options is enough so that participants were able to make a clear decision on each item and that there was not any confusion between the response options.

Figure 2: Probability curves for the 4-category scale (optimization categorization)

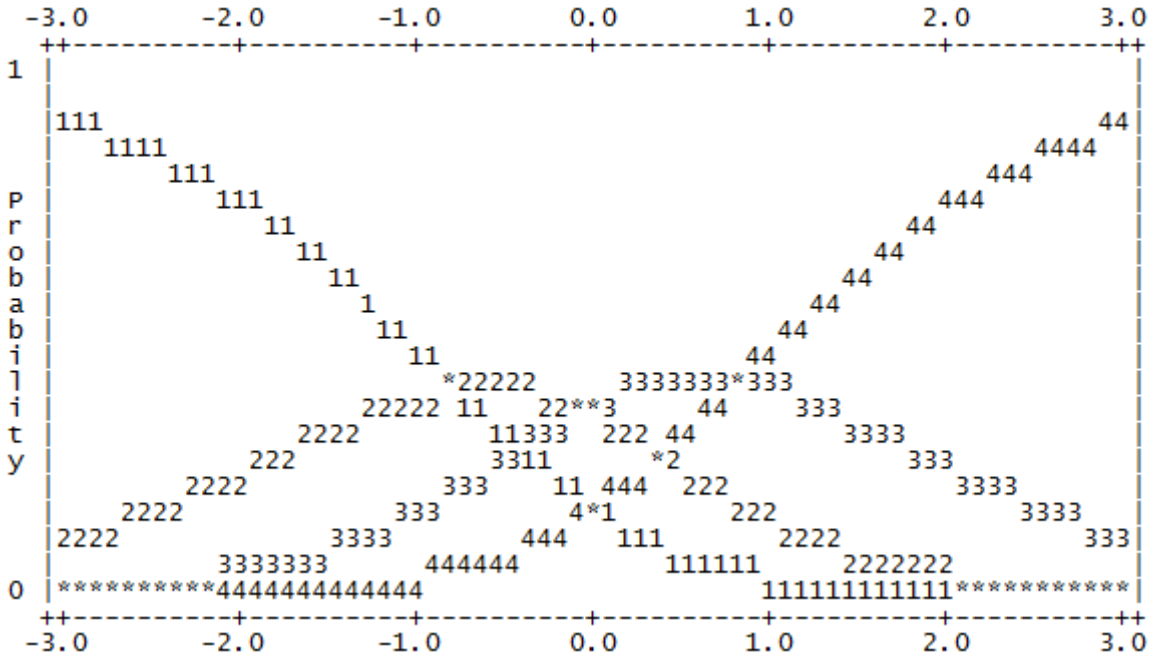


Table 3 shows that overall, the rating scale worked well. The category thresholds increased in order as expected with optimization of the response options. The average logit measure per response option did not all increase in order. The second response option had a lower average than the first therefore the utilization of the first and second response options or the second and third response options should be examined further to determine if they should be combined in order to enhance the measurement ability of the MeBActive-Youth.

Table 3: Summary of Rating Scale Steps for 4 Weighted Categories

Category Score	Counts Used	Average Measure*	Outfit Mean Square Residuals	Category Threshold
1	243	.19	1.6	
2	582	.14**	.7	-.76
3	989	.62	.8	-.08
4	982	1.08	1.0	.84

*Average measure is the mean of logit measures in each category
** The average measure does not increase incrementally

Because the response options were not used optimally, the residuals (Table 4) were examined. Residuals result from the difference between the actual response given by the participant and the expected response according to the Rasch Rating Scale Model. By examining the residuals we may be able to begin understanding why these particular participants were confused. All the residuals resulted from participants answering 1 ('Never') when they were expected to answer with a 4 ('Always'). Three out of the seven residuals were reverse scored items. In order to compare items or combine items, certain items are reverse scored for consistency. By doing so, the highest and lowest numerical values are substituted for each other, the next highest and next lowest values are substituted for each other, and so on. Reverse scored items state the opposite of the other items in the instrument (e.g. '*I like being challenged and having to work hard*' vs. '*It is hard for me to believe in myself when competing'*) and therefore by answering 'always' the participant is actually exhibiting less of the characteristic being measured by the item. There were seven unexpected responses given by four different participants. These residuals could have resulted from the participants not understanding the item and not necessarily because of the response options.

Table 4: Descriptive Information of the Residuals

Participant	Gender	Item	Score	Expected Score
102	M	10. Fully recovered before events	1	4
44	M	21. Trigger optimal performance state	1	4
		23. Negative emotions hard to change	1	4
63	F	4. Allow negative emotions/feelings	1	4
		20. Can handle mistakes/failures	1	4
96	M	11. Emotional setbacks are difficult	1	4
		16. I display confidence/energy	1	4

4.1.2 Item Difficulty

To address both the item fit and person fit (consistency), we refer to the fit statistics. Outfit statistics are useful for diagnosing misfit items to the measurement model. Similar to outfit statistics, infit mean square statistics differ only because they are weighted and less influenced by outliers. Table 5 shows the item data fit statistics. The items of the MeBActive-Youth ranged from 0.53 logits (most difficult) to -0.64 logits (least difficult) with a mean of .00 ± 0.31. The item '*When nervous, I can act tough'* had the highest difficulty (0.53 logits), whereas '*Physical activity is sometimes too hard for me*' had the lowest logit (-0.64 logits). Overall, 23 of the 27 items had a fit statistic within the acceptable range (mean infit mean square = 1.0 ± 0.5 and mean outfit mean square = 1.0 ± 0.5). Four items were slightly above this range and therefore, not very concerning. However there was one item '*When pressured, I hide my feelings*' (infit = 1.68 logits, outfit = 1.90 logits) that had fit statistics well above the accepted range of 0.5 – 1.5, meaning that it was a very difficult item for the sample, yet given the high levels of mental toughness within the sample it was not too concerning.

The separation index of the items was 2.38, which indicates there are 2 distinct groups (easy and difficult) of questions. This study also showed an item reliability to be 0.84 indicating that the items are consistently measuring a single construct throughout the instrument appropriately.

Table 5: Statistical Properties for the 27 MeBActive-Youth Items by Difficulty

Item	Calibration Log	SE Logit	Infit Mean Square Residuals	Outfit Mean Square Residuals
Ability to act tough	.53	.11	1.26	1.25
Understand my ideal state	.52	.11	1.54	1.58
Become withdrawn emotionally	.41	.11	1.68	1.90
Willing to risk losing	.35	.11	1.04	1.13
Emotional strength under pressure	.33	.11	.77	.77
Change from negative to positive	.26	.11	.98	1.08
Emotional shifts don't bother me	.18	.12	.71	.70
Ability to cope	.17	.12	.95	1.04
Sustain powerful fighting spirit	.16	.12	.71	.71
I can handle tough events	.14	.12	.69	.70
Keep fighting good fight	.12	.12	.92	.90
Fully recovered before events	.08	.12	1.02	1.38
Ability to bounce back quickly	.04	.12	.69	.68
Physically project determination	.04	.12	.79	.74
Negative emotions hard to change	.02	.12	1.44	1.63
Trigger optimal performance state	-.04	.12	.92	1.00
Sense of challenge/determination	-.07	.12	.66	.64
Can handle mistakes/failures	-.10	.12	.72	.82
Allow negative emotions/feelings	-.16	.12	1.45	1.56
I display confidence/energy	-.17	.12	.85	.92
Love heat of battle	-.25	.12	.65	.64
Emotional setbacks are difficult	-.25	.12	1.16	1.24
Competitive circumstances affect me	-.34	.13	1.40	1.34
I get too tired to continue being active	-.35	.13	1.10	1.15
Tolerance for physical stress	-.41	.13	.90	.93
I like how I feel when I am active	-.58	.14	.88	.84
Physical demands exceed my capacity	-.64	.14	1.34	1.25
Mean	.00	.12	1.01	1.06
SD	.30	.01	.30	.34

4.1.3 Person Ability

The participants ability ranged from -1.10 – 2.12 logits with a mean of 0.35 (SD = 0.56). The participant separation index is 2.04, which means that the MeBActive-Youth is able to discern between two groups (mentally tough or not mentally tough) of participants. For the persons on the scale there was a reliability statistic of 0.81, which is also acceptable. This ensures that the items of the MeBActive-Youth measure the person's ability consistently throughout the instrument and should therefore show similar results when administered to another similar sample.

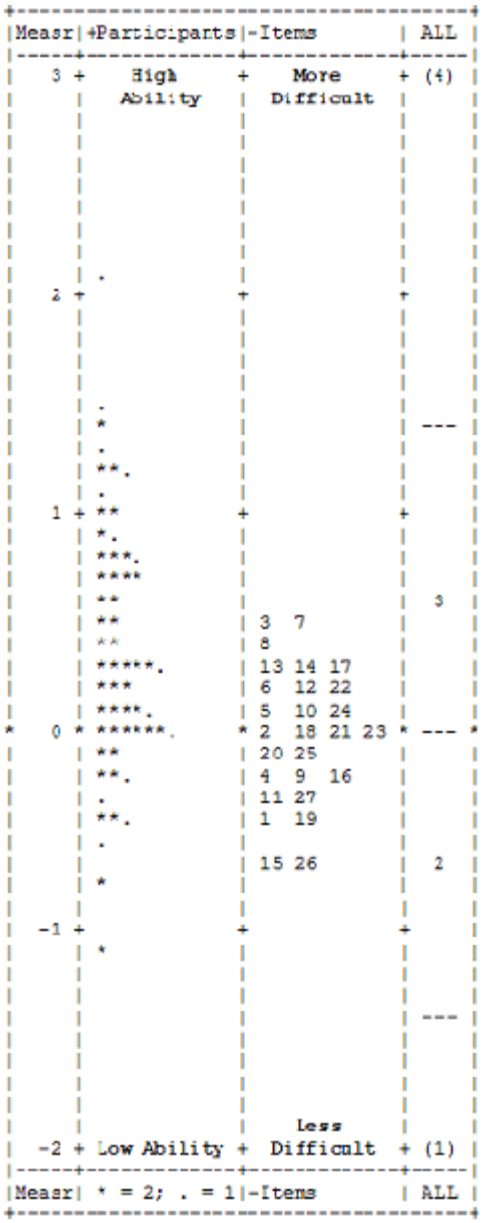
As the Wright-Item Person map shows (Figure 3) the MeBActive-Youth has a good range of participant ability levels. The items between -1 and 1 logit are clustered at the same levels and therefore do not help discriminate between many levels of mental toughness. A larger spread in the items would have been optimal to be able to distinguish between multiple levels of mental toughness of the participants.

4.1.4 Conditional Standard Error of the Mean

The item difficulty and person ability were calculated with the conditional standard error of the mean (CSEM). The CSEM depicts the precision of the instrument as a specific ability level (θ) of the sample. In order to ensure better measurement and less error in the instrument a lower CSEM is desired. The CSEM for the items were small with little variability in the 27 items (ranging from 0.11 – 0.14). When looking at the ability estimates, the CSEM provides valuable information about how precise the instrument is. Relatively equal precision across a large ability range is desired. A lower CSEM results in a more

precise measurement. In this study the CSEMs of the person ability estimates were fairly consistent across the ability range (0.21 – 0.46 logits). The standard error of the items was very small ranging from 0.11 – 0.14 with a mean of 0.12. This low standard error signifies that the items are able to measure the mental toughness levels in the participants with the same precision throughout the instrument.

Figure 3: Wright item-person map displaying the location and distribution of people and items



4.2 Hypothesis #2

It was hypothesized that the MeBActive-Youth, which measures mental toughness for physical activity will have construct validity as demonstrated by it being positively correlated with measures of self-efficacy, social support and physical activity. Using the Social Cognitive Theory as the framework for this study, it was predicted that there will be positive correlations between these variables, providing further evidence that the MeBActive-Youth is measuring mental toughness. Correlational analyses among the self-efficacy, social support, physical activity, and MeBActive-Youth scores were conducted to examine the construct validity of the MeBActive-Youth.

Spearman rho correlations (see Table 6) were computed to examine associations between the MeBActive-Youth, self-efficacy, social support and physical activity. For absolute values of ρ obtained from these correlations, Cohen's criteria sets thresholds at ρ = 0.10-0.29 as small, ρ = 0.30-0.49 as medium and $\rho \geq 0.50$ as a large correlation (Cohen, 1992). There was a significant positive correlation between mental toughness and physical activity (ρ = .52, p = 0.00) and mental toughness and self-efficacy (ρ = 0.30, p = 0.006). The correlations between overall social support both from friends and family with mental toughness was not significant (ρ = 0.12, p = 0.217; ρ = 0.17, p = 0.09). There was a positive significant correlation between, physical activity and all the examined variables; familial and friend social support (ρ = 0.47, p = 0.00; ρ = 0.27 p = 0.022), self-efficacy (ρ = 0.34, p = 0.009) and mental toughness (Table 6).

Table 6: Spearman rho correlations (ρ) among the variables

Measures	1	2	3	4	5
1. MeBA-Y Total (N=106)	----				
2. Friend SS (N=102)	.12	----			
3. Family SS (N=102)	.17	.70**	----		
4. Total SE (N=85)	.30**	.29**	.26**	----	
5. PAQ Summary (N=72)	.52**	.27**	.47**	.34*	----

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Note: SS = Social Support, SE = Self-Efficacy

CHAPTER 5

DISCUSSION

The obesity epidemic in youth is increasing at an alarming rate, in part, due to the decreasing levels of physical activity within the youth population. An important step in understanding physical activity behavior in youth is the identification of variables associated with it. One psychosocial variable that has not been studied in relation to physical activity in youth is mental toughness, Mental toughness, the ability to remain determined, focused, in control and confident under all circumstances (Jones et al., 2007), is a personal characteristic associated with optimal sport performance. It is possible that mental toughness is also associated with physical activity behavior. Psychometrically sound assessments of mental toughness for sport among adults (MeBTough) and youth (MeBTough-Youth) has led to the recent development and testing of a measure of mental toughness for physical activity in adults (MeBActive). The purpose of this study was to evaluate and calibrate a newly developed measure of mental toughness for physical activity in youth (MeBActive-Youth) using the Rasch Rating Scale Model and to examine the construct validity of the measure. This discussion section will address and interpret the results of this study and discuss their importance. Limitations, future directions and implications will also be included.

5.1 Evaluation of the MeBActive-Youth

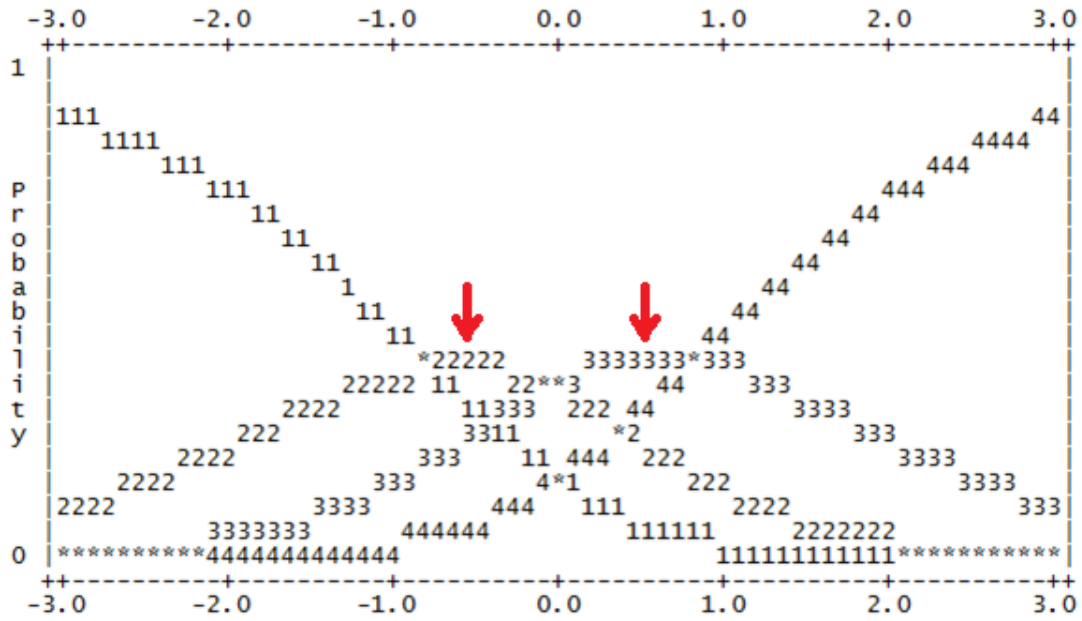
The first hypothesis of this study was that the newly developed MeBActive-Youth would have good psychometric properties when evaluated using the Rasch Rating Scale

Model. The Rasch Rating Scale Model was chosen for the evaluation of the MeBActive – Youth for its simplicity and clinical utility. Rasch calibration is neither item- nor sample-dependent and thus is stable among the items of the instrument and across samples tested at different times (Zhu et al., 2001). This analysis evaluates any measure by examining the optimization categorization, the model data fit, item difficulty location and spread, the Wright-Item Person map, and the ability estimates. Through these steps the first hypothesis of this study was partially supported by the evaluation of the MeBactive-Youth through the use of the Rasch Rating Scale Model.

5.1.1 Response Option Utilization

The probability curves seen in Figure 4 show the likelihood that a response option was used most often at one point in time. All the response options (1 = Never, 2 = Sometimes, 3 = Often, 4 = Always) have a clear peak indicating that all the response options are used appropriately throughout the MeBActive-Youth. Although they all have a clear curve, the peaks for response options two and three are a lot lower than that of response options one and four. This means that these response options are not used as often as the first and fourth, therefore all the response options were examined further through Linacre's 8 steps of response option utilization.

Figure 4: Probability curves for the 4-category scale (optimization categorization)



By using Linacre's 8 steps, we can interpret the results of the response option utilization, the response options meet the first requirement of being used at least 10 times within the sample. The outfit statistics are all under 2, which is within acceptable range. The average measures do not increase in order with response option two (Average Measure = 0.14) being less than response option one (Average Measure = 0.19). This suggests that the second response option should be combined either with the first or the third response option. When looking at the step difficulty, we see that all the response options differ by at least one as specified by Linacre, except for the step between two and three further suggesting that perhaps these response options should be combined.

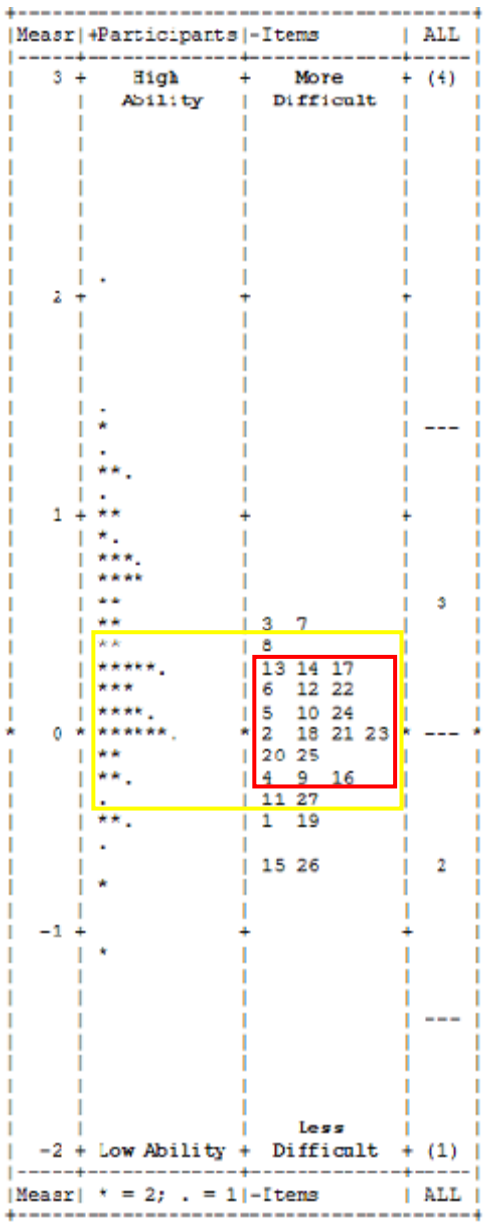
5.1.2 Item Difficulty and Person Fit

The item fit and the person fit was visually inspected through the Wright-Item Person map (Figure 5) which shows that a majority of the participants and items are centered around the average (zero) of the logit scale (as shown by the yellow box). This overlap of participants and items is important because it shows that the ability of the participants and the difficulty of the items were appropriately matched. There were two participants that were one standard deviation below the average which could mean that either the participants are not mentally tough or that these two participants had difficulty understanding items in the instrument. In addition to the two participants below the average of our sample, eleven participants ranked more than one standard deviation above the average indicating that these participants were very mentally tough as compared to the rest of the sample.

The items of the MeBActive-Youth fit the Rasch Rating Scale Model well. All the items were considered to be acceptable except for one ('*When pressured, I hide my feelings*') which was a bit high for the item difficulty range yet is marginally acceptable given the high levels of mental toughness within the sample. Besides that one item, the most difficult item was '*I know how nervous I should be when I compete*' and the least difficult item was '*I love to challenge myself*'. As seen in Figure 5, many of the items in the MeBActive-Youth tend to measure the same level of mental toughness as highlighted by the red box. Based on the infit/outfit statistics, it would be beneficial to alter some of these highlighted items to make them more difficult. This will enhance the overall measurement properties of the instrument for its intended population. Instead of adding more items which will lengthen the instrument it would be better to examine the items that are already in the MeBActive-Youth. For example, item number 23 ('*It's hard for me to change bad emotions when challenged'*)

measures mental toughness at the same level as items 21, 18 and 2 and therefore, does not evaluate a level of mental toughness that isn't already addressed by the MeBActive-Youth. By altering 3-4 items from the instrument, higher levels of mental toughness can be distinguished by the MeBActive-Youth.

Figure 5: Wright Item-Person Map displaying the location and distribution of people and items



5.1.3 Residuals

The data from this study resulted in seven residual items. Residuals result from a participant responding to an item with an answer that is different than expected by the Rasch Rating Scale Model. These residuals resulted from four participants (three had unexpected scores on 2 items and one had an unexpected score on one item) who all responded with 'never' when according to the model it was expected for them to respond with 'always'. Although the number of residuals was not concerning, it was important to examine them further.

All of the residuals resulted from different items which were within the acceptable reading level (maximum reading level = 4.7) for our sample, ranging from 0.8 – 3.9 logits. From the seven residuals only one item ('*I get enough rest before big events*') had a higher calculated reading grade level (Flesh-Kincaid Reading Level = 3.9) than the participant's actual grade level (Grade level = 2). The responses given were the complete opposite of what was the model predicted. Three of the items were reverse scored items which state the opposite of the other items on the instrument. By answering 'always' the participant is actually exhibiting less of the concept. This could have potentially caused the participants to give an unexpected answer. Because all but one item were at an appropriate reading level for the intended population it does not seem that confusion was due to the language of these items but, may have resulted from the participant being distracted or lack of attention.

5.1.4 Validity of the MeBActive-Youth

By examining the model data fit we see that the MeBActive-Youth fits the Rasch Rating Scale Model. The person ability and item difficulty both fit within the guidelines established by the model and therefore work together to define a single variable, in this case, mental toughness. This supports the idea that mental toughness is indeed a uni-dimensional construct. Because the data fits the model and is defining a single construct, we can conclude that the measure is valid.

In order to further support the validity of the instrument we examined the separation index. This allows us to determine if we have succeeded in separating the participants through the items of the instrument and also ensures that the items are defining a single variable.

When evaluating calibration of the items the separation index was 2.38, which indicates there are 2 distinct groups (easy and difficult) of items. Although this is a helpful distinction, these two groups of items do not help us evaluate all of the mental toughness levels within our sample. Like any attribute, mental toughness can be classified into more than just high or low. By increasing the number of questions at a higher difficulty than the current questions or by making some of the existing questions more difficult the MeBActive-Youth will have a wider range of measurement ability. This will result in a larger separation index which will help distinguish more levels of mental toughness through the items, such as, very mentally tough, mentally tough, somewhat mentally tough, not very mentally tough, not mentally tough at all.

When looking at the participant data, we see that the separation index is lower than the item index at 2.04, which means that the MeBActive-Youth was able to classify the participants into two levels of mental toughness (mentally tough or not mentally tough). This index could be due to the fact that we do not have enough items to actually discern between the participants mental toughness levels or that because of the low separation index the items did not cover a large enough spectrum to determine more than two levels of mental toughness.

5.1.5 Reliability

The results of this study showed the item reliability to be 0.84. This means that the items of the MeBActive-Youth are consistently measuring a single construct throughout the instrument appropriately. For the persons on the scale there was a reliability statistic of 0.81, which is also acceptable. This ensures that the items of the MeBActive-Youth measure the person's ability consistently throughout the instrument and should therefore show similar results when administered to another similar sample. Because the development of the MeBActive-Youth was based on content experts and previous measures of mental toughness for sport, there is no doubt that it is measuring mental toughness. To further support that the MeBActive-Youth is specifically measuring mental toughness for physical activity in youth the construct validity of the instrument should be examined.

5.1.6 Summary

By using the Rasch Rating Scale Model to evaluate the measurement properties of the MeBActive-Youth it can be concluded that the instrument is psychometrically sound, but has room for improvement. Although it is a valid and reliable instrument, the items can be improved in order to distinguish between the higher levels of mental toughness within youth. Also, some of the items should be made more difficult in order to discriminate between more than two levels of mental toughness. The response options worked well, but because the second response option did not increase monotonically with the other options, it may be beneficial to collapse the four response options to three in order to improve the utilization of the different responses. This was the first study to use and assess the measurement properties of the MeBActive-Youth questionnaire and the results suggest that there is still room for improving this instrument.

5.2 Construct Validity of the MeBActive-Youth

To further ensure that the MeBActive-Youth is measuring the intended underlying construct, mental toughness, it is critical to test for its construct validity. Construct validity is the degree to which an instrument measures an unobserved theorized construct, in this case, mental toughness. Based on the Social Cognitive Theory (SCT) a person, their environment and the resulting behavior are related and influence each other. Therefore based on the SCT and the variables measured in this study, the second hypothesis of this study was that the MeBActive-Youth which measures mental toughness (person) would be positively correlated

with measures of physical activity (behavior), and two commonly examined correlates of PA, social support (environment) and self-efficacy (person).

It was expected that there would be a strong positive correlation between mental toughness and physical activity behavior. The MeBActive-Youth is an instrument that measures mental toughness for physical activity in youth so it is a very closely related construct to physical activity behavior. Based on the SCT we expected a strong correlation between mental toughness and self-efficacy because they both fall under the person aspect of the model. Also, based on this theory past research has shown that both social support (environment variable) and self-efficacy (person variable) are associated with physical activity levels (King, 1994).

5.2.1 Physical Activity & Mental Toughness

There was a positive correlation between mental toughness and physical activity (ρ = 0.52, $p \leq 01$). This means that higher levels of mental toughness in youth are associated with higher levels of physical activity. This finding was not surprising because the MeBActive-Youth is an instrument that focuses on mental toughness for physical activity. Although mental toughness and physical activity in youth has never been examined, the results from this study are similar to past research that has examined variables similar to the three aspects (physical, mental and emotional) of mental toughness such as resiliency, self-determined motivation and intentions.

It has been shown that there is an important relationship between higher self-determined motivation (a characteristic consistent with the mental aspect of mental

toughness) in youth and physical activity behavior (Beets 2006, Sanchez-Lopez et al., 2009). Sanchez-Lopez et al (2009) examined 1073 children, ages 11-13 and found that on average youth who were more active on a daily basis had significantly higher scores on the resilience, and achievement dimensions of the Child Health and Illness Profile – Child Edition (CHIP-CE) as compared to their inactive counterparts. Consequently, the more active children had less perception of limitations in daily activities and felt more self-confident.

After examining 291 women with low educational status Cleland et al. (2010) found that personal aspects of their lives such as, enjoyment, self-efficacy, barriers and intentions (correlates of mental toughness) had the strongest association to people meeting the recommended levels of leisure time PA. These personal correlates of resiliency are also components of mental toughness which could potentially also help increase levels of PA. It has also been shown that by increasing resiliency (a variable consistent with the emotional aspect of mental toughness) physical activity levels can be increased (Cleland et al., 2010). This current study is the first to relate the idea of mental toughness to physical activity in youth and also the first to establish a relationship between mental toughness and physical activity in youth.

Because this was a cross-sectional study, the relationship between physical activity and mental toughness can be determined but causality cannot. The particular focus of this study was to determine if there was a relationship between mental toughness and physical activity and identifying mental toughness as a possible modifiable correlate of physical activity. If a longitudinal study was conducted then the idea of reverse causality between mental toughness and physical activity can be examined. This idea of reverse causality is consistent with reciprocal determinism because it is expected that by increasing either of

these variables, an increase in the other would occur based on the known positive correlation between these two constructs.

5.2.2 Social Support & Mental Toughness

In this study, it was hypothesized that the more social support a child receives to be physically active from their friends and family the more mental toughness they will exhibit for physical activity.

There were significant positive correlations between both friend and familial social support and physical activity ($\rho = .27$, $p \leq .05$; $\rho = .47$, $p \leq .01$). Past research on social support has shown that, physical activity participation in youth is motivated by the development and maintenance of social support networks (Allender et al 2006). More specifically the support from 'significant others' is positively associated with physical activity (Sallis et al., 2000; Duncan et al., 2005) and youth are more likely to participate in physical activity when they were supported by their parents (Allender et al., 2006). This relationship between parental social support and physical activity was also found to be significant in this study ($\rho = .27$, $p \leq .05$). After examining 372 youth, Duncan et al. (2005) found that friends who supported and watched their friends be physically active was positively and significantly related to PA. Although the sample size of this study was not as large, similar results were found in this study with friend social support trending towards a significant correlation with PA. Both parent and friend social support were significantly correlated with physical activity further supporting the idea that having a complete social support network is important for engagement in PA.

The correlations between both friends and family support with mental toughness were not significant. Therefore, the level of mental toughness in the sample was not impacted by the social support they receive from their family and/or friends. This could potentially be due to the measure (Social Support and Exercise Survey (SSES)) used to evaluate the participants' social support.

The directions and the items in the SSES were difficult for participants to understand therefore the results from the SSES may not be accurate. There was confusion about the directions to the SSES, which had a reading level of 8.1, as compared to the average reading level of the MeBActive-Youth of 2.4. Also, leading to some of the confusion was the format of the SSES, which asked participants to first answer 13 items about the social support they received from their parents and then respond to the same 13 items about their friends. Many of the younger participants did not fully understand the 6-point Likert scale at first and simply put check marks next to the items. After clarification from research assistants, the participants were then able to answer the items appropriately. Also, items from the instrument such as '*My family planned for exercise on recreational outings*' (FKRL = 10.0) were very difficult to understand for the participants who were 13 years old and younger. Many of them did not know what the word recreational meant and therefore had difficulty answering the question.

5.2.3 Self-Efficacy & Mental Toughness

This study showed that there is a positive correlation between a child's mental toughness, self-efficacy for physical activity, social support, and their physical activity.

Mental toughness and self-efficacy fall under the 'person' factor of the Social Cognitive Theory therefore the correlation between these variables is not surprising. They are both traits that include the child's belief that they will be successful during their daily life or while being physically active. The child's ability to believe in themself was addressed by items such as '*I have the skills I need to be physically active*' (PASES), '*I can handle tough events*' (MeBActive-Youth) and their ability to overcome barriers was addressed by items such as, '*I can be physically active even if I could watch TV/play video games*' (PASES) and '*I can keep going after I make mistakes*' (MeBActive-Youth).

Based on the reciprocal determinism of the SCT, self-efficacy and mental toughness, both person characteristics, should have a bidirectional relationship with physical activity (McAuley & Blissmer, 2000). Given the strong positive correlation of self-efficacy and mental toughness with physical activity ($\rho = .34$, $p \leq .01$; $\rho = .52$, $p \leq .01$, respectively), this relationship becomes clearer. Fisher et al (2010) examined 279 children and found that self-efficacy was significantly correlated with time spent in MVPA and that those with higher levels of self-efficacy are more active.

Based on the correlation results there is an appropriate amount of evidence to further support the construct validity of the MeBActive-Youth. There was a strong positive correlation between mental toughness, as measured by the MeBActive-Youth and PA. This was not too surprising since the MeBActive-Youth measures mental toughness specifically for PA. Also, there was a positive correlation between self-efficacy and the MeBActive-Youth which both fall under the person aspect of the Social Cognitive Theory. The correlation between mental toughness and social support was not found to be significant but

this does not mean either variable should be disregarded as potentially impacting overall physical activity levels in youth.

5.3 Limitations

There are some limitations and sources of error in this study that should be noted. First, the sample size was not as large as originally intended, yet was well over the reasonable size of 50 participants for Rasch (Wright, 1996). The current sample size of 106 participants was large enough to complete the Rasch analysis and properly examine the measurement qualities of the MeBActive-Youth.

Another issue which may have affected the results of this study was the amount of time it took participants to complete the five questionnaires. This ranged from 15 minutes for the 13-15 year olds to approximately 35 minutes for the 8-10 year olds. A majority of the participants complained that the packet was too long, some rushed to complete the questionnaires and others simply gave up. This resulted in some questionnaires being completed more often than others, for example the MeBActive-Youth was completed first (N=106) then the Physical Activity and Self-Efficacy Scale (N= 85), followed by the Social Support and Exercise survey (N= 102), followed by the Physical Activity Questionnaire for Adolescents (N= 72).

For the participants who completed the paper version of the study (n = 59), the format of some of the questionnaires was intimidating. This included the long list of activities and their corresponding responses at the beginning of the PAQ-A, and the directions and response options for the SSES. Both questionnaires had directions that were well above the

reading level of the sample (PAQ-A = 7.8, SSES = 10.0). Also, due to the number of questionnaires, participants were more likely to skip certain pages from the study packet such as the SSES or the first page of the PAQ-A, therefore resulting in missing data.

When present, parents were consistently urged by the research staff to allow their children to complete the questionnaires independently, yet there were a few instances where the parent was persistent and continued to help their child. In some cases participants chose to complete the questionnaires at home and return the study packet the next day, therefore it is difficult to know whether or not there was any parental influence on the answers given. This possible interference by the parent could have led to results that were biased.

5.4 Future Directions

5.4.1 Cross-Sectional Research

Because this is the initial evaluation of the MeBActive-Youth, it will be necessary to do further research in order to assess the measurement properties of this newly developed questionnaire and its relationship to physical activity. Based on the need of more difficult questions and changes to the response options and altered version of the MeBActive-Youth would be evaluated in a similar study. This study has provided enough information about the MeBActive-Youth, to conclude that it is measuring mental toughness for physical activity in youth. Therefore, future studies including the MeBActive-Youth will not necessarily need to collect information on the participant's social support or self-efficacy if the researchers are not interested in those variables.

Besides the alterations to the MeBActive-Youth, another change that can be implicated to improve data collection in the future is the use of another measure of physical activity. It may be beneficial to use a shorter measure where the formatting is not as intimidating for the participants as the PAQ-A. The subjective measure of physical activity used in this study, the PAQ-A, was sometimes skipped by the younger participants because of its length and format. Perhaps utilizing an interview/recall with the participant would be beneficial in collecting the most complete data subjectively. By collecting an objective measure, such as accelerometers, a more accurate measurement of the participants' engagement in physical activity may be obtained. By having a more accurate measure of physical activity we can be more confident that our results reflect the true activity levels of the participant which is important in order to make an appropriate conclusion from our results.

5.4.2 Development of Mental Toughness Intervention for Youth

Even though this study had a smaller sample size than originally intended, it is still important to take into consideration the relationships between the factors that were examined. Our results showed that there are relationships between the person (self-efficacy and mental toughness), environment (social support) and behavior (physical activity) as predicted by the Social Cognitive Theory. Through this theory we know that if one component is altered, another is impacted. Therefore, mental toughness, which is a modifiable variable, can now be used as a target variable for interventions aimed at increasing physical activity in youth. Based on reciprocal determinism, it is true that physical activity is also a modifiable variable

and reverse causality suggests that increasing physical activity would increase mental toughness. However, the focus of this study and future research is aimed at decreasing the obesity epidemic in youth and increasing physical activity behavior, therefore the variable targeted by an intervention would be mental toughness. With the knowledge of the relationships between the variables that were studied an appropriate intervention can be created for youth in order to increase their physical activity.

The intervention would be based off of the mental toughness training that has been initially successful in athlete populations. This 6-week Mental Toughness Training Program, developed by Measuremental, LLC (2010) is based on the framework used to create the family of mental toughness instruments that the MeBActive-Youth was created from. This program is unique because it provides a personalized training program based on the person's overall score. Based on this score, a complex statistical model predicts how they should have performed on each of the nine components of the instrument. The actual scores on the nine components are then compared with the expected scores to identify strengths and weaknesses. Then a personalized training program with weekly exercise is developed based on the overall mental toughness score, primary strength, and primary weakness. The intervention created from the MeBActive-Youth results would be very similar and would work towards improving the components where the child has weaknesses.

Research has already been conducted on adult athletes who used this training program and results showed that after completing the training program overall mental toughness levels increased resulting in improved sport performance (Measuremental L.L.C.) Similar to these results we would expect that by increasing the components of mental toughness in the child, it would be possible to also increase the physical activity levels of the child.

5.5 Implications of the Research

The results from this study can be applied to present day research in two ways. First, the Rasch model can be used for proper development and evaluation of self-report measures. As seen in this study, this model allows researchers to assess the response options, range of item difficulty and appropriateness of the items for the intended population of the instrument. This model can be applied to any instrument, new or old, regardless of the topic of interest and can enhance the overall measurement properties by examining the response option utilization, infit/outfit statistics, Item difficulty location and spread and the ability estimates. By examining every component of the instrument, especially the ability estimates we can ensure that the instruments used in research are appropriately measuring the topic of interest.

The second implication of these results is the development of the MeBActive-Youth as the first instrument that measures mental toughness for physical activity in youth. Although the evaluation showed that the MeBActive-Youth has room for some improvements, this new instrument was able to demonstrate that mental toughness is indeed associated with known correlates of physical activity in youth. The MeBActive-Youth can be used as a tool for future research of mental toughness for physical activity in youth. The development and evaluation of the MeBActive-Youth can also serve as a guideline for the development of new measures of mental toughness for other aspects of life, such as academic performance or job acquisition.

The third implication of this study is the establishment of mental toughness as a modifiable variable that, in the future, might be targeted for physical activity interventions in youth. By using the MeBActive-Youth, researchers can not only measure, but also evaluate

the levels of each of the nine components of mental toughness have on youth physical activity levels. Using this information, researchers can enhance mental toughness and in turn, increase physical activity levels in youth.

By ensuring the proper measurement of mental toughness for physical activity in youth, we can begin to understand why children may not be physically active. The MeBActive-Youth is the first instrument to not only measure mental toughness for physical activity in youth, but also establish that it is an important variable which impacts and influences youth PA. By using data from the MeBActive-Youth, personalized programs for youth can be designed to enhance not only their mental toughness, but also their physical activity levels. By doing so, the process of slowing down the growing obesity epidemic can take place.

5.6 Conclusion

Overall, this study showed that the MeBActive-Youth is a valid and reliable instrument to measure mental toughness for physical activity in youth. Although valid and reliable it can be improved by combining response options and adding more items to decipher between more than two levels of mental toughness. This study also established construct validity of the measure as demonstrated by the strong positive correlations between mental toughness, self-efficacy and physical activity. These results suggest that mental toughness for physical activity in youth is a new, modifiable variable of physical activity in youth. The relationship between mental toughness and physical activity may provide insight into youth engagement in physical activity which hasn't been accounted for in the past. With

the use of the MeBActive-Youth, mental toughness for physical activity in youth can be measured and implemented in future research.

APPENDICES

APPENDIX A

CONSENT DOCUMENTS

I. Informed Consent Document

II. Assent Document

I. Informed Consent Document

MeBActive – YOUTH STUDY

University of Massachusetts Amherst - Department of Kinesiology

Physical Activity and Behavior Lab

INFORMED CONSENT DOCUMENT

Your written informed consent is required before your child can participate in this project. By signing this consent form you are indicating that you willingly agree to have your child participate in this project. The details of this study are as follows:

PURPOSE OF RESEARCH PROJECT

Your child is invited to participate in a research study designed to examine how social support, mental toughness, and self-efficacy (one's belief in their ability to complete a specific task) might influence the physical activity levels of youth. This will be measured through the completion four simple surveys. We hope to gain a better understanding on how mental toughness, self-efficacy, and social support to be physically active might influence the physical activity levels of youth.

Eligibility

To participate in this study, your child must be between the ages of 9 and 15, in good physical health (no diagnosed cardiovascular, pulmonary, metabolic, joint, or chronic diseases) and willing to comply with the study conditions included in the project procedures described below.

Your child's participation in this study is entirely voluntary. Your decision whether or not to have your child participate in this study will not affect your relationship with the University of Massachusetts or your child's school, and will not affect your child's grades or

relationship with his/her school. If you wish to have your child participate in this study, you must sign this form. If you decide to have your child participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice to you or your child. If you decide to terminate your child's participation in this study, you should notify one of the research staff collecting data.

PROJECT PROCEDURES

If you choose to have your child participate:

> They will complete an assent form after which they will simply be asked to fill out the four short questionnaires and some demographic information (age, grade in school, etc.) which will take approximately an hour. This will be completed either during school hours or at after school programs.

DURATION OF STUDY INVOLVEMENT

You will only be responsible for completing this document in order for your child to participate in this study. You will also be asked to provide written information about the height and weight of your child at that end of this consent form. After you and your child complete the informed consent and assent documents, your child will be asked to complete a few questionnaires that will take approximately an hour.

WITHDRAWAL FROM STUDY

If you first agree to have your child participate and then you change your mind, you are free to withdraw your consent and discontinue your child's participation at any time. Your decision will not affect your relationship with University Massachusetts or your child's school, and will not affect your child's grades or relationship with his/her school.

POTENTIAL BENEFITS

There will be no direct benefit to your child for participating in this study. Your child may enjoy completing the questions and will be given a study pencil for completing all the questionnaires.

CONFIDENTIALITY

The information obtained from this study will be treated as privileged and confidential. It will not be released except upon your written consent. You and your child's right to privacy will be maintained in any future analysis and presentation of the data. Your child will be assigned a numerical ID number at the beginning of the study and all individual data will be identified by ID number only. Your child's name and ID number will be recorded at the beginning of the study and this information will be placed in a file cabinet that will be locked and only accessible to study investigators. Data collected on computers will be stored in a secure database maintained by the National Institutes of Health.

REQUEST FOR ADDITIONAL INFORMATION

You and your child are encouraged to ask questions about the study. The investigators will attempt to answer all your questions to the best of their knowledge. The investigators fully intend to conduct the study with you and your child's best interest, safety, and comfort in mind.

Everyone conducting this research study has read the Assurance of Compliance with OHRP Regulations for Protection of Human Research Subjects and has completed and passed the human subject training course required by UMass Amherst.

The Human Subjects Review Committee of the School of Public Health and Health Sciences at University of Massachusetts Amherst has approved this study. If you have any concerns about your rights as a participant in this study you may contact the Human Research Protection Office via email (humansubjects@ora.umass.edu); telephone (413-545-3428); or mail (Office of Research Affairs, 108 Research Administration Building, University of Massachusetts, 70 Butterfield Terrace, Amherst, MA 01003-9242).

PARTICIPATION STATEMENT OF VOLUNTARY CONSENT

I have had the chance to ask any questions I have about this study and my questions have been answered. I have read the information in this consent form and I voluntarily agree to have my child participate in the study. There are two copies of this form. I will keep one copy and return the other to the researchers.

_____
Parent/legal guardian Name (Print)

_____
Parent/legal guardian Signature Date

_____
Child's Name (Print)

BASIC INFORMATION ABOUT YOUR CHILD:

Please fill out this information to the best of your knowledge.

Child's Height _____ feet _____inches

Child's Weight _____ pounds

FOR QUESTIONS ABOUT THIS STUDY, CONTACT:

Erin Snook, PhD
University of Massachusetts Amherst
Department of Kinesiology
Totman Building, Room 130A
30 Eastman Lane
Amherst, MA 01003-9258
(413) 545-6438
esnook@kin.umass.edu

Manneh Ghazarians
University of Massachusetts Amherst
Department of Kinesiology

Totman Building, Room 126A
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II. Assent Document

MeBActive – YOUTH STUDY

University of Massachusetts Amherst - Department of Kinesiology

Physical Activity and Behavior Lab

ASSENT FORM

Researchers: Erin Snook Ph.D., Manneh Ghazarians B.S.

We are doing a research study about how much physical activity you do. We also want to know what influences you to be more or less active. A research study is a way to learn more about people. If you decide that you want to be a part of this study, you will be asked to fill out some surveys on a computer.

There are some things that you should know about this study. We want you to answer the surveys honestly and as best you can. There are no right or wrong answers for the questions. Not everyone who is in the study will benefit. A benefit means that something good happened to you. The information we will get from this study will help us better understand why children choose to be active.

When we are done with the study, we will write a report about what we learned. This report will not include your name.

You do not have to be in the study if you do not want to be. If you want to stop after we begin, that is okay. Being in the study will not affect your grade in school. If you finish the study you will be given a study pencil.

If you want to be in this study, please sign your name.

I, _____, want to be in this research study.

PRINT YOUR NAME

_____ _____

SIGN HERE DATE

APPENDIX B

LETTER OF SUPPORT

I. St. Stephen's Armenian Elementary School

I. St. Stephen's Armenian Elementary School

ST. STEPHEN'S ARMENIAN ELEMENTARY SCHOOL
47 Nichols Ave. Watertown, MA 02472
Tel (617) 926-6979 Elementary School
(617) 923-0501 Preschool
http://www.ssaes.org
E-mail:school@ssaes.org

December 1, 2010

Manneh Ghazarians
Department of Kinesiology
University of Massachusetts – Amherst
131B Totman Building
30 Eastman Ln.
Amherst MA, 01003

Dear Ms. Ghazarians,

Your proposed research project (MeBActive – Youth Study) in determining the validity and reliability of a newly developed mental toughness questionnaire sounds very interesting. It is true that the components of mental toughness can help us better understand the levels of physical activity engagement in our students, which is a very important aspect for each child as they grow up. It will also be beneficial for our students to see and learn about how scientific research is conducted.

When this study has the appropriate internal review board approval, St. Stephen's Armenian Elementary School will be happy to provide information about your study to our students. Specifically you will be able to send home fliers and to set up a table during after school hours at our facility in order to enhance your recruitment efforts. Good luck with your proposal and we hope to hear from you soon.

Sincerely,
Houry Boyamian

Houry Boyamian, M.Ed.
Principal

APPENDIX C

STUDY INTRUMENTS

I. Demographics Survey

II. Social Support and Exercise Survey

III. Physical Activity Self-Efficacy Scale (PASES)

IV. Physical Activity Questionnaire for Adolescents (PAQ-A)

I. Demographics Survey

Demographic Survey

Age: _____ Gender (circle one): Male Female

Grade Level (check one box):

- ○ 3rd
- ○ 4th
- ○ 5th
- ○ 6th
- ○ 7th
- ○ 8th

Were you born in the United States? (Circle one) Yes No

How would you classify your race/ethnic background (check all that apply):

- ○ American Indian/ Alaskan Native
- ○ Asian/Pacific Islander
- ○ Black/African American
- ○ Caucasian/White
- ○ Hispanic/Latino
- ○ Indigenous or Aboriginal
- ○ Multiracial
- ○ Other

Which of the following family members live with you in your house (check all that apply)

- ○ Father
- ○ Mother
- ○ Step-Mother
- ○ Step-Father
- ○ Grandmother

- ○ Grandfather
- ○ Aunt
- ○ Uncle

How many brothers do you have?

- ○ None
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ More than 5

How many sisters do you have?

- ○ None
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ More than 5

II. Social Support and Exercise Survey

SOCIAL SUPPORT AND EXERCISE SURVEY

Below is a list of things people might do or say to someone who is trying to exercise regularly. If you are not trying to exercise, then some of the questions may not apply to you, but please read and give an answer to every question.

Please rate each question *twice*. Under *family*, rate how often anyone living in your household has said or done what is described during the last three months. Under *friends,* rate how often your friends, acquaintances, or coworkers have said or done what is described during the last three months.

Please write *one* number from the following rating scale in each space:

none	rarely	a few times	often	very often	does not apply
1	2	3	4	5	8

During the past three months, my family (or members of my household) or friends:

		Family	Friends
11.	Exercised with me.	11.	11.
12.	Offered to exercise with me.	12.	12.
13.	Gave me helpful reminders to exercise ("Are you going to exercise tonight?").	13.	13.
14.	Gave me encouragement. to stick with my exercise program.	14.	14.
15.	Changed their schedule so we could exercise together.	15.	15.
16.	Discussed exercise with me.	16.	16.
17.	Complained about the time I spend exercising.	17.	17.
18.	Criticized me or made fun of me for exercising.	18.	18.
19.	Gave me rewards for exercising (bought me something or gave me something I like).	19.	19.
20.	Planned for exercise on recreational outings.	20.	20.
21.	Helped plan activities around my exercise.	21.	21.
22.	Asked me for ideas on how *they* can get more exercise.	22.	22.
23.	Talked about how much they like to exercise.	23.	23.

III. Physical Activity Self-Efficacy Scale

Physical Activity Self-Efficacy Scale

	No	Yes	Not Sure
1. I can be physically active most days after school	0	2	1
2. I can ask my parent/other adult to do physically active things with me	0	2	1
3. I can be physically active even if I could watch TV/play video games	0	2	1
4. I can be physically active even if it is very hot or cold outside	0	2	1
5. I can be physically active even if I have to stay at home	0	2	1
6. I have the skills I need to be physically active	0	2	1
7. I can be physically active no matter how busy my day is	0	2	1
8. I can ask my best friend to be physically active with me	0	2	1

IV. PAQ-A

Physical Activity Questionnaire (High School)

Name:_____ Age:_____

Sex: M_____ F_____ Grade:_____

Teacher:_____

We are trying to find out about your level of physical activity from ***the last 7 days*** (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

3. There are no right and wrong answers — this is not a test.
4. Please answer all the questions as honestly and accurately as you can — this is very important.

---

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping	❍	❍	❍	❍	❍
Rowing/canoeing	❍	❍	❍	❍	❍
In-line skating	❍	❍	❍	❍	❍
Tag	❍	❍	❍	❍	❍
Walking for exercise	❍	❍	❍	❍	❍
Bicycling	❍	❍	❍	❍	❍
Jogging or running	❍	❍	❍	❍	❍
Aerobics	❍	❍	❍	❍	❍
Swimming	❍	❍	❍	❍	❍
Baseball, softball	❍	❍	❍	❍	❍
Dance	❍	❍	❍	❍	❍
Football	❍	❍	❍	❍	❍
Badminton	❍	❍	❍	❍	❍
Skateboarding	❍	❍	❍	❍	❍
Soccer	❍	❍	❍	❍	❍
Street hockey	❍	❍	❍	❍	❍
Volleyball	❍	❍	❍	❍	❍
Floor hockey	❍	❍	❍	❍	❍
Basketball	❍	❍	❍	❍	❍
Ice skating	❍	❍	❍	❍	❍
Cross-country skiing	❍	❍	❍	❍	❍
Ice hockey/ringette	❍	❍	❍	❍	❍
Other:					
_____	❍	❍	❍	❍	❍
_____	❍	❍	❍	❍	❍

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

- I don't do PE ❍
- Hardly ever ❍
- Sometimes ❍
- Quite often ❍
- Always ❍

3. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

- Sat down (talking, reading, doing schoolwork) ❍
- Stood around or walked around ❍
- Ran or played a little bit ❍
- Ran around and played quite a bit ❍
- Ran and played hard most of the time ❍

4. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

- None ❍
- 1 time last week ❍
- 2 or 3 times last week ❍
- 4 times last week ❍
- 5 times last week ❍

5. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

- None ❍
- 1 time last week ❍
- 2 or 3 times last week ❍
- 4 or 5 last week ❍
- 6 or 7 times last week ❍

6. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

- None ❍
- 1 time ❍
- 2 — 3 times ❍
- 4 — 5 times ❍
- 6 or more times ❍

7. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

F. All or most of my free time was spent doing things that involve little physical effort ❍

G. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics) ❍

H. I often (3 — 4 times last week) did physical things in my free time ❍

I. I quite often (5 — 6 times last week) did physical things in my free time ❍

J. I very often (7 or more times last week) did physical things in my free time ❍

8. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday	❍	❍	❍	❍	❍
Tuesday	❍	❍	❍	❍	❍
Wednesday	❍	❍	❍	❍	❍
Thursday	❍	❍	❍	❍	❍
Friday	❍	❍	❍	❍	❍
Saturday	❍	❍	❍	❍	❍
Sunday	❍	❍	❍	❍	❍

9. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes ❍
No ❍

If Yes, what prevented you? _____

APPENDIX D

NIH PROMIS ASSESSMENT CENTER INFORMATION

I. What is the NIH PROMIS Assessment Center?

II. What do items look like through the Assessment Center?

III. Assessment Center Data Security

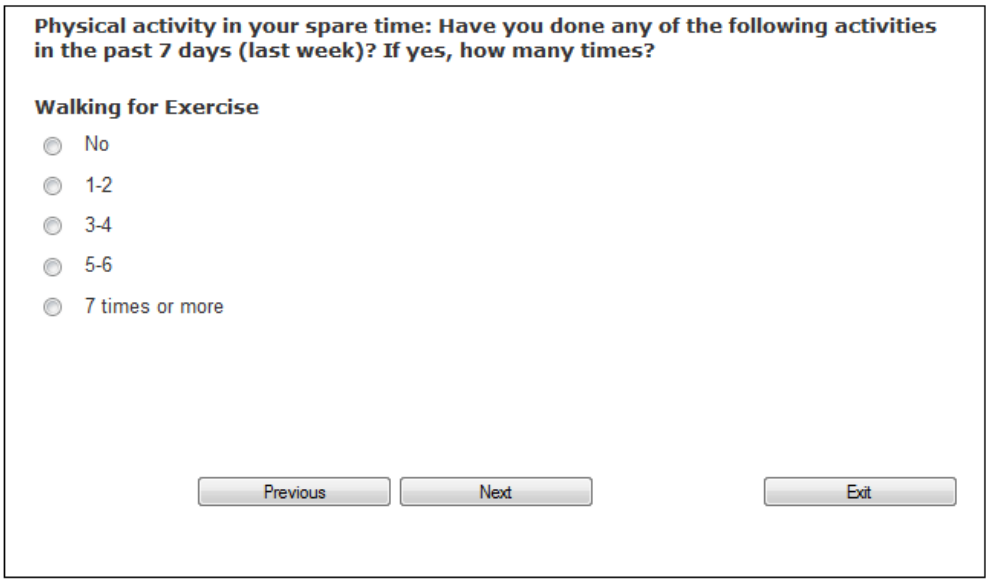
I. What is the NIH PROMIS Assessment Center?

The Assessment Center is a free, online research management tool. It allows researchers to create study-specific websites for capturing participant data securely. Studies can include measures within the Assessment Center library, as well as custom instruments created or entered by the researcher. PROMIS instruments (short forms, CATs, profiles) are a central feature of the instrument library within Assessment Center. Any PROMIS measure can be downloaded for administration on paper or be included in an online study. Detailed statistical information and development history about PROMIS items and instruments is available for review.

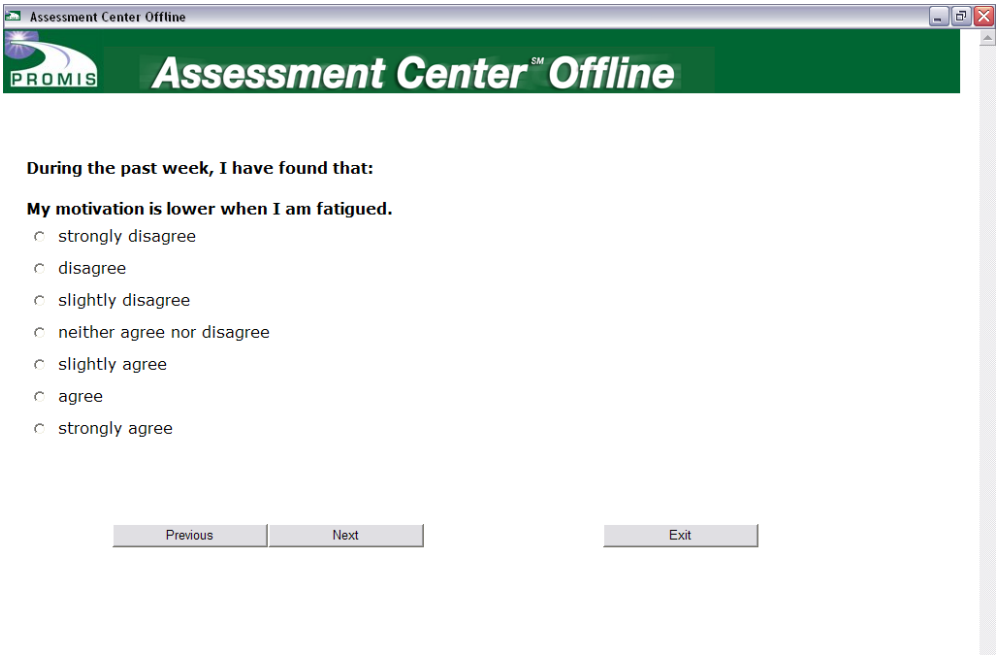
Assessment Center enables customization of item or instruments (e.g., format, randomization, skip patterns), real-time scoring of CATs, storage of protected health information in a separate, secure database, automated accrual reports, real-time data export, graphing of individual PROMIS CAT or Profile scores, and ability to capture endorsement of online consent forms among many other features.

II. What do items look like through the Assessment Center?

The following shows how an item is presented to participants using the online platform of PROMIS.



The following shows how an item is presented to participants using the offline platform of PROMIS. (Note: this is an example from a previously launched Study)



III. Assessment Center Data Security

The importance for confidentiality of the participant's protected health information (PHI) is recognized by PROMIS. PHI is collected and transferred only where necessary. Where possible, participants are identified only by generic ID's. For data files that need to be transferred electronically, the information is encrypted prior to transport. The internet server and associated database server are housed on dedicated machines housed at the secure facilities of the Level2 Data Center. These are physically protected from intrusion as well as natural disasters. The secure facilities are protected electronically by hardware and software firewalls, intrusion detection software, anti-virus scans, and 24x7 monitoring by onsite professionals. All of Level2's data centers are completely fitted with redundancy for precision HVAC, power and fire detection/suppression systems.

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