PHYSICAL ACTIVITY IN ADOLESCENTS: APPLICATION OF CONSTRUCTS FROM THE TRANSTHEORETICAL MODEL

By

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PHYSICAL ACTIVITY IN ADOLESCENTS: APPLICATION OF CONSTRUCTS FROM THE TRANSTHEORETICAL MODEL

Abstract

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The majority of adolescents do not engage in the recommended amounts of moderate to vigorous physical activity (MVPA). The development of physical activity (PA) interventions should be guided by theoretical foundations in psychosocial constructs that drive PA behavior. The purpose of this study was to evaluate the validity of selected constructs from the Transtheoretical Model and to assess hypothesized group differences in measures of decision balance pros (DB-pros), decisional balance cons (DB-cons) and self-efficacy for PA (SEPA) by stage of change (SOC). To this end, adolescents from middle schools and high schools in Eastern Washington and Northern California completed questionnaires regarding their MVPA behavior, SOC for recommended MVPA, SEPA, DB-pros and DB-cons regarding daily MVPA.

As expected, the younger middle school adolescent population engaged in more MVPA than the older high school adolescent sample. A gender difference in MVPA existed in older adolescent sample only. Females in the younger adolescent sample had higher than previously reported MVPA and engagement in organized sporting activity. The DB-cons scale had poor psychometric properties and was not included in the analysis of variances tests. We found that SEPA and DB-pros differed by SOC. Higher body mass index
percentile was associated with higher \textit{DB-pros} scores in the older adolescent sample only. The portion of the variance in \textit{SEPA} and \textit{DB-pros} explained by \textit{SOC} was small in the younger adolescent sample. Although the portion of the variance in \textit{SEPA} and \textit{DB-pros} explained by \textit{SOC} was larger in the older adolescent sample, the effect size only approached moderate.

Further work is needed to better understand what drives MVPA behavior in both younger and older adolescent populations. Research in this vein will help to inform development of efficacious interventions to increase MVPA in adolescents.
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Chapter One

Introduction

Just a half century ago physical activity was embedded in activities of daily living for American youth. The majority of children were responsible for their own transportation, walking or riding their bikes to and from school and social engagements (McDonald, 2007). Daily recess and physical education class were the norm and allowed United States (U.S.) youth to integrate physical activity (PA) into their school days (Pate et al., 2006). After school, children were more likely to be performing physical chores or involved in free play rather than engaging in sedentary activities like watching television. Today the typical U.S. youth is driven to school, performs no physical chores, does not have daily physical education class, and uses electronic media almost eight hours a day (McDonald, 2007; Pate et al., 2006; Rideout, Foehr & Roberts, 2010).

Given changes in American youth culture, it is therefore not a surprise that despite the well-known health benefits of physical activity, the rates of PA are at record low levels (Centers for Disease Control and Prevention [CDC], 2011). National survey data have shown that by the time children reach early adolescence the majority of youth are not engaged in recommended amounts of daily exercise. Watson and Fulton (2011) found that more than 60% of U.S. youth (ages 6 to 19 years) participated in less than 20 minutes (min) of moderate to vigorous physical activity (MVPA) daily as assessed by accelerometer ($N = 2724$). A cross sectional study of 1,800 U.S. youth found that MVPA declined with age (Troiano et al., 2008). This study found that 42% of children (ages 6 to 11 years) participated in at least 60 min of MVPA daily but only 8% of adolescents (ages 12 to 19 years) participated in at least 60 min of MVPA daily (Troiano et al., 2008). More recent survey data using self-report of PA behavior found that only 15.3% of high school aged youth are engaged in at least 60 min of MVPA daily (Fulton et al., 2011). A
longitudinal study found that the majority of younger children (age 9 years) were engaged in at least 60 min of MVPA daily, but six years later PA participation for these subjects had declined significantly with 69% of adolescents (age 15 years) failing to meet the U.S. Department of Health and Human Services (USDHHS) objective of 60 min of MVPA daily (Nader, Bradley, Houts, McRitchie & O’Brien, 2008). Nader et al. (2008) found that when the participants were 9 years old they engaged in on average 180 min ($SD = 51$ min) of MVPA daily, but by the time they were 15 years old they engaged in only a mean of 35 min of MVPA on weekends ($SD = 30$ min) and 49 min of MVPA on weekdays ($SD = 33$ min). Many of the older adolescents (age = 15 years) in this study engaged in less than 20 min of MVPA daily on weekdays (>20%) and less than 20 min of MVPA daily on weekends (>40%). Nader et al. (2008) found that MVPA declined on average 38 min daily for each additional biological year beyond age 9 years.

National survey data using self-report report and objective measures of PA have revealed that there is a precipitous decline in MPVA during adolescence and that the majority of adolescents do not engage in the recommended amount of MVPA (Nader et al., 2008; Troiano et al., 2008).

Physical activity has been shown to contribute to both physical health and psychological health that translate to a perception of a higher quality of life (Bize, Johnson & Plotnikoff, 2007). The epidemic of childhood obesity has focused attention on PA patterns in youth in the U.S., and PA has been shown to contribute to maintenance of a healthy body mass index (BMI) (McMurray, Harrell, Creighton, Wang & Bangdiwala, 2008), and reduction in adiposity in children who were overweight (Gidding, 2007). Indicators of cardiovascular health in youth, including blood pressure, blood lipids, and insulin sensitivity, have been shown to be healthier in physically active children compared to their sedentary peers (Gidding, 2007; Kelley, Kelley &
Tran, 2003; Leary, et al. 2008; Schmidt, Cleland, Thomson, Dwyer, & Venn, 2008). Physical activity has been associated with positive affect (Pasco et al., 2011), reduction in depressive symptoms (Zoeller, 2007), and higher quality of life in youth (Shoup, Gattshall, Dandamudi & Estabrooks, 2008). Regular PA has been associated with reduced risk of numerous morbidities and increased life span (Kokkinos, 2008). Physical activity on a regular basis offers both physiological and psychological benefits to youth.

In response to the overwhelming evidence regarding the benefits of exercise, numerous expert panels in national and global organizations have established PA guidelines and recommendations. The Academy of Pediatrics published recommendations for physical activity (2006) and later the USDHHS published national physical activity guidelines (USDHHS, 2008). The USDHHS guidelines were endorsed by global and national health organizations (American College of Sports Medicine, 2010; National Association of Pediatric Nurse Practitioners, 2009; World Health Organization [WHO], 2010). The USDHHS guidelines included recommendations for a minimum of 60 min of PA on most days for individuals between the ages of 6 and 17 years (USDHHS, 2008). It is recommended that the PA be sustained for at least 10 min at a time and be composed of MVPA (USDHHS, 2008). Moderate PA is defined as activity that requires 3 to 6 metabolic equivalents (MET). MET is a standardized unit of energy consumption. One MET is equivalent to the energy used at rest. PA at a MET level of 3 to 6 indicates that the amount of energy consumed during the activity is 3 to 6 times that is required at rest, and is often described as activity that requires a moderate amount of effort and noticeable elevation in heart rate (WHO, 2013). Vigorous PA is defined as activity that requires greater than 6 MET and is described as activity that requires a large amount of effort and a significant increase in respiratory rate and heart rate (WHO, 2013). After review of scientific evidence regarding the health benefits of
physical activity, the USDHHS made recommendations regarding engagement in daily MVPA for U.S. youth which included 60 min of MVPA on most days of the week (USDHHS, 2008).

In an effort to better understand how to effectively encourage U.S. youth to engage in daily PA a growing body of research has been devoted to developing and applying theoretical models that attempt to explain mechanisms of PA behavior. An example of one such theoretical model that has been evaluated within the context of physical activity is the Transtheoretical Model (TTM) (Nigg, 2002). In 1983, Prochaska and DiClemente introduced the TTM and proposed that health related behavior was influenced by a number of processes and was dynamic in nature. The TTM incorporates psychosocial constructs that are associated with readiness to change health related behavior. Prochaska and DiClemente (1983) proposed that readiness to change a behavior occurred as a process that progressed through a series of stages. They proposed the Stages of Change (SOC) model, a heuristic device, to describe the stages in the process of behavior change. The stages in the model were defined as follows: 1) pre-contemplative (PC) in which individuals are not thinking of taking action on a behavior in the next six months, 2) contemplative (C) in which individuals are thinking of taking action on a behavior in the next six months, 3) preparatory (P) in which individuals are thinking of taking action in the immediate future, 4) action (A) in which individuals are overtly exhibiting the behavior, and 5) maintenance (M) in which individuals have been engaged in the behavior for at least 6 months (DiClemente, Prochaska, & Gibertini, 1985). Thus, in the first three stages of change, individuals are not engaging in the desired behavior, but there are cognitive processes that are moving them toward readiness to engage. In the last two stages of change, individuals are engaging in the desired behavior. The benefit of applying this model to classify individuals is that the characteristics and perceptions of the individuals at each stage of readiness can be
explored. Exploration of SOC group characteristics may lead to a better understanding of the driving forces that establish and maintain healthy behavior and may be used to develop targeted intervention.

The model of SOC has been applied in the context of PA behavior and has been shown to be a predictor of PA in adults (Marshall & Biddle, 2001). A meta-analysis revealed a large effect size ($d = 0.85$) in the positive association of PA and SOC between the preparatory stages (PC, C, and P) and the action stages (A and M) (Marshall & Biddle, 2001). These authors also found a small effect size ($d = 0.34$) in the difference in PA between individuals in precontemplative and contemplative stages, suggesting that changes in PA behavior occur even at these earlier stages of readiness (Marshall & Biddle, 2001). Evidence to date indicates that the strength of the relationship of SOC and PA is greater when evaluating differences between the action stages (A and M) and preparatory stages (PC, C, and P).

In spite of the findings regarding SOC and adult physical activity, the ability of SOC to distinguish between activity levels in youth is not well established. Two studies in Canada evaluated SOC and PA in high school students and found stage related differences in vigorous PA (Berry, Naylor & Wharf-Higgins, 2005; Nigg & Courneya, 1998). In both studies very few students were classified as precontemplative and this stage was eliminated from analysis. The relatively low prevalence of adolescents in the PC stage was likely due to the definition of the criterion behavior. In the Nigg & Courneya (1998) study, students were asked if they engaged in exercise. Exercise was not defined in regards to intensity, duration or frequency. The Berry et al. (2005) study defined physical activity as occurring for $\geq 15$ min duration on $\geq 3$ days per week. A study in Belgium of 6000 adolescents found that SOC was related to moderate, vigorous and leisure time PA (De Bourdeaudhuij et al., 2005). In this study the SOC questions were not based
on current PA recommendations of 60 min of MVPA and did not include criteria to categorize
the preparatory stage. The relationship of SOC and MVPA has not been evaluated in a U.S.
population of adolescents, using a staging algorithm which is based on current national
recommendations for MVPA.

Progress through the stages of change has been conceptualized as involving a process that
is under one’s control (Prochaska & Velicer, 1997). The theory of decisional balance (DB) is
often applied in conjunction with application of stages of change research to better understand
the volitional process at each SOC. Decisional balance is derived from the theory of conflict
resolution and hypothesizes that behaviors were the result of decisions derived by weighing the
gains (pros) against the losses (cons) of the behavior (Janis & Mann, 1977). Research has shown
that individuals at higher SOC have greater perceived DB-pros and lesser perceived DB-cons for
a variety of health related behaviors evaluated (Prochaska, Velicer, et al., 1994). This
relationship between perceived DB-pros and DB-cons and SOC has been demonstrated in the
context of PA in adult populations (Cox, Stimpson, Poole & Lambur, 2003; Marcus & Owen,
1992; Marcus, Pinto, Simkin, Audrain & Taylor, 1994). Research that evaluates DB among SOC
for PA behavior youth is scant; only two studies were found that evaluated DB within the context
of SOC in youth. Berry et al. (2005) found a significant correlation between DB-pros and DB-
cons with SOC in older adolescents, ages 15 to 17 years. Hausenblas, Nigg, Downs, Fleming &
Connaughton (2002) failed to demonstrate a relationship between DB and SOC in younger
adolescents, grades 6 to 8 (mean (M) age = 12.6 years). Further exploration of stage related
differences in the perceived gains and losses associated with PA in children and adolescents is
needed as it may provide insight into factors that contribute to readiness to change PA behavior
in this population.
The concept of *self-efficacy*, like *DB*, has been used in conjunction with *SOC* to increase understanding of PA behavior. *Self-efficacy* (*SE*) is defined as the belief that one is capable of executing an action (Bandura, 1995). Research has demonstrated that higher *self-efficacy for physical activity* (*SEPA*) predicts engagement in PA in adolescents (Craggs, Corder, Esther, van Sluijs & Griffin, 2011; Lubans, Foster & Biddle, 2008; Dishman et al., 2004; Dowda, Dishman, Pfeiffer, & Pate, 2007; Nahas, Goldfine & Collins, 2003; Springer, Kelder, & Hoelscher, 2006; Van der Horst, Paw, Twisk, & Van Mechelen, 2007). An analytical review article by Marshall and Biddle (2001) found that *SEPA* was related to *SOC* in adult populations, with greater effect size of the relationship at the higher *SOC* categories. A paucity of research exists in evaluating *SEPA* in the context of *SOC* in children and adolescents. Initial studies have found that *SE* to overcome barriers to PA has been shown to be greater at higher *SOC* in preadolescent (Annesi, Faigenbaum & Westcott, 2010) and early adolescent populations (Hausenblas et al., 2002; Nigg & Courneya, 1998).

Understanding the relationship between psychosocial constructs and behavior is a vital first step in developing effective interventions to change behavior. Once the relationship between a behavior and a theoretical construct is established then the construct can be utilized to develop intervention strategies or measure outcomes from interventional studies. *Stages of change* is well established as a predictor of MVPA behavior in adult populations (Marshall & Biddle, 2001), but there is a paucity of research to evaluate the relationship between *SOC* and MVPA in adolescents (Berry et al., 2005; De Bourdeaudhuij et al., 2005; Nigg & Courneya, 1998). *Decisional balance* has been shown to correlate with *SOC* in adults (Cox et al., 2003), but in younger populations the research in this area demonstrates conflicting findings (Berry et al., 2005; Hausenblas et al., 2002). Further exploration of this *DB* construct within the context of MVPA in an adolescent population...
population is needed. SEPA has been shown to be related to SOC in adults (Marshall & Biddle, 2001), and initial work in children and adolescents support this relationship (Annesi et al., 2010; Hausenblas et al., 2002). Since SOC has been shown to be predictive of adolescent behavior, and DB and SE to be related to SOC in a variety of contexts including smoking cessation, condom use, sexual decision making, and injury risk reduction (Grossman, et al., 2008; Hulton, 2001; Kidd, Reed, Weaver, Westneat & Rayens, 2003; Robinson & Vail, 2011), it is anticipated that MVPA will increase at each SOC and that DB and SE will increase at each SOC in adolescent populations.

The proposed study was intended to fill gaps in the literature by exploring the relationships of SOC, DB, SEPA and MVPA among adolescents. Further, characteristics of the groups of adolescents by SOC were explored. The specific aims of the study were to:

1. describe mean age, body mass index and mean number of days per week that 60 min of MVPA was performed by the middle school and high school students recruited to this study.

2. determine if there was a gender difference in SEPA and DB scores across SOC in either the middle school or high school populations.

3. evaluate if BMI percentile was associated with SEPA or DB scores to determine if this variable should be included as a covariate in the analysis.

4. assess the validity of the SOC instrument.

5. describe the participants’ physical activity behavior and SOC in regards to the intention to perform at least 60 min of MVPA on 5 or more days per week.
6. evaluate the validity and reliability of the instruments measuring the *SEPA* and *DB* constructs.

7. describe mean differences in *SEPA* and *DB* in relation to *SOC* in the middle school and in the high school samples.
Chapter 2
Literature Review

The Adolescent Period

Adolescence is a tumultuous developmental period, marked by many changes. Changes occur in the physical, cognitive, and psychosocial domains, leading to profound alterations in growth and development. Physical changes of puberty are ushered in by the onset of production of sex hormones. For the adolescent, the familiar child body form morphs into a novel adult form. The timing of onset of puberty varies from age 9 to 13.5 years, and the complete physical development takes on average 4.5 years (Pinyerd & Zipf, 2005; Santrock, 2011). Given the naturally occurring variance in timing of physical development, the adult physique may be formed as early as age 11 or as late as age 22 years (Pinyerd & Zipf, 2005). Adolescence is a time for cognitive development as well, which is not necessarily in step with physical development. According to Piaget’s cognitive theory, the development of formal operational thinking begins in early adolescence (ages 11 to 12 years) and continues into adulthood. In this stage of cognitive development the young adolescent begins to be able to think abstractly and apply systematic reasoning to problem solving (Piaget, 1977). The ability to predict outcomes of hypothetical decisions increases as adolescents’ understanding of probability develops. Adolescents begin to integrate these new cognitive capacities into their decision-making skills. Experts indicate that by the age of 15 years adolescents have developed adult-like metacognition of the decision-making process, problem-solving, and commitment to a course of action (Mann & Power, 1989); however, experts indicate that younger adolescents (aged 12 to 14 years) are less able to identify risk and benefits of a particular decision, or foresee consequences for alternative actions (Fischhoff, Crowell, & Kipke, 1999).
It is recognized that decisions are also influenced by emotions and social settings (Scott, Reppucci & Woolard, 1995; Steinberg & Cauffman, 1996). Emotional maturation begins in early adolescence and continues through late adolescence, such that gains in self-control and impulse control continue into late adolescence (Reyna, 2012). Thus, for adolescents the capacity to make choices regarding health related behavior become adult-like in that decisions are based on a better understanding of the problem at hand and the anticipated consequences of their actions.

Not only do adolescents experience striking changes in their physical appearance and cognition, but adolescence also marks a time for change in psychosocial development. Erikson’s theory of psychosocial development indicates that adolescence (age 13 to 18 years) is a time period of identity development (Erikson, 1968). Identity development entails forming a self-schemata, or ideas and beliefs that one holds about themselves (Markus, 1977). Developing a self-schema that incorporates health is important because the schema is self-perpetuating. It has been shown that individuals that incorporate physical fitness into their self-schemata in turn exercise on a more frequent basis (Banting, Dimmock & Lay, 2009). A self-definition of being physically active in an adolescent population ($N = 168$, ages 9 to 17 years) has been shown correlate with PA frequency ($r = 0.52$, $p < .001$), selection of PA as a favorite activity ($r = 0.30$, $p < .001$), and indication of a self-definition of being physically active in the future ($r = 0.66$, $p < .001$) (Robbins, Pis, Pender & Kazanis, 2004). Thus it is important to encourage adolescents to incorporate healthy ideals into their self-schemata as this will influence decisions regarding health related behaviors throughout their lifetimes.

Another aspect of psychosocial development for adolescents is the formation of a distinct identity that is separate and apart from their parents (Kroger, 2007). During this process adolescents often shift their primary referent group from family, and establish peer groups for
guidance in social norms (Young & Ferguson, 1979). Thus in adolescence, parental modeling of healthy behavior becomes less salient than peer modeling of behavior (Prochaska, Rodgers & Sallis, 2002). Because adolescents are developing independence from parental influences and begin making decisions regarding their own behaviors, it is imperative to evaluate the psychosocial mediators, variables like DB and SEPA that may account for differences in behavior, in the context of health related behavior in this age group.

**Benefits of Physical Activity**

Numerous health benefits of PA have been recognized. One of those benefits has been shown to be the maintenance of a healthy body mass index (BMI) in youth (McMurray et al., 2008), and reduction in adiposity in children who were overweight (Gidding, 2007). Population based studies of 9 to 10 year-olds ($N = 1292$) (Ekeland et al., 2004), 11 to 12 year-olds ($N = 5500$) (Ness et al., 2007) and 10-14 year-old girls ($N = 1553$) (Cooper, Page, Fox & Misson, 2000), have shown that PA level, measured with accelerometers, was inversely related to measures of adiposity. A longitudinal study of four year-old children ($N = 103$) demonstrated that children with the highest level of PA, as measured by accelerometers, had smaller gains in BMI and skinfold thickness over an 8 year period when compared to their less active peers (Moore et al., 2003). A review of 62 longitudinal studies using adolescent participants found the protective effects of PA on adiposity to be a salient factor in observational, experimental and quasi-experimental studies (Reichert, Baptista, Wells, Carvalho, & Hallal, 2009). Others have demonstrated that low PA and high sedentary activity were associated with higher BMI over a one year period ($N = 10,000$) (Berkey et al., 2000), and a 7 year period ($N = 103$) (Proctor et al., 2003). Evidence to date indicates that a higher level of engagement in PA is associated with lower age related gains in BMI and adiposity.
Physical activity has a positive outcome on cardiovascular health in adolescents. In a study of 5500 children aged 11 to 12 years, an inverse association between systolic blood pressure and measured MVPA was demonstrated (Leary et al., 2008). Data from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) (N = 1170) for 8 to 17 year olds revealed a small inverse dose response curve of measured PA and both systolic blood pressure (SBP) and diastolic blood pressure (DBP) (Mark & Janssen, 2008). Others have found a small (1 to 2 mmHg) reduction in age-related increase in SBP associated with PA (Gidding, 2007). A meta-analysis of 12 randomized-controlled interventional trials (N = 1266) did not find that the PA intervention had a statistically significant impact on SBP or DBP (Kelley et al., 2003). Findings from the 2003-2004 NHANES data indicate that the risk of hypertension was greatly reduced when youth engaged in 30 min of MVPA (odds ratio = .50) and 60 min of MVPA (odds ratio = .38) (Mark & Janssen, 2008). The physiological impact of PA on blood pressure seems to be greater in obese adolescents, because a review of interventional studies have found clinically significant reductions (6 mmHg) in SBP associated with increased fitness level (Torrance, McGuire, Lewanczuk & McGavock, 2007). A study of 3110 adolescents (ages 9 to 19 years) found that total cholesterol (TC) was lower and high-density lipoprotein (HDL-C) was higher in those individuals with higher cardiovascular fitness (estimated VO$_{2\text{max}}$) than in those individuals with lower cardiovascular fitness (Carnethon, Gulati & Greenland, 2005). A meta-analysis of both observational and interventional studies indicated that high-density lipoprotein was higher and triglyceride level was lower in youth who exercised on a regular basis (Kelley & Kelley, 2007).

Physical activity also has a favorable effect on risk of developing non insulin dependent diabetes mellitus. An inverse relationship between fasting insulin and self-report PA level (r = -
0.12, ρ = 0.03) and positive relationship between insulin sensitivity and PA (r = 0.13, ρ = 0.001) was demonstrated in adolescents using the euglycemic clamp technique (Schmidt et al., 2008). In a study of children aged 9 years (N = 301), PA measured by accelerometer was inversely related to risk of metabolic syndrome (MetS). MetS is a cluster of cardiovascular risk factors including altered glucose metabolism, elevated blood pressure, increased waist circumference and dyslipidemia (Brage et al., 2004). In a larger study (N = 4,450) that employed self-report report PA, MetS was more common in adolescents with low activity levels (4.3%) than in those with moderate (3.1%) or high (2.6%) PA levels, but the differences were not statistically significant (Pan & Pratt, 2008). Benefits of PA seem to be additive with early benefits in prevention of age-related increases in adiposity and reduction of cardiovascular risk factors.

**Long Term Benefits of Physical Activity**

Physical activity patterns established in early adolescence may influence behavior in later adolescence and into adulthood. Review studies have identified previous PA to be a consistent predictor of current PA (Sallis, 2000; Trost, Owen, Bauman, Sallis & Brown, 2002). Walters, Barr-Anderson, Wall and Neumark-Sztainer (2009) found that individuals engaged in organized sports at age 15 years (N = 1,708) had higher levels of MVPA at age 20 years. A retrospective study of 486 women found that past sport participation was related to current PA level and was inversely related to BMI (Alfano, Klesges, Murray, Beech & McClanahan, 2002). A longitudinal study of 1563 Finnish youth, conducted from 1980 to 2001, found that Spearman’s rank order coefficients (rho) for PA for the 21-year study period were significant in males (range .33 to .44) and not significant in females (Telama et al., 2005). For shorter tracking intervals, the inter-age correlations of PA level were stronger in both males and females (r = 0.5 to 0.6 for a 3 year interval, r = 0.3 for 12 year interval) (Malina, 2001). In another long term tracking study of 374
Canadian youth (ages 7 to 18 years to ages 29 to 40 years), PA behavior was found to track over a 15-year period but not a 22-year period (Herman, Craig, Gauvin & Katzmarzyk, 2009). In a review of available evidence regarding PA tracking evidence, it was concluded that the strength of longitudinal tracking of PA was moderate, but that the relationship weakened as the time between observations lengthened (Malina, 2001). Overall, current evidence suggests that PA patterns established in childhood and adolescence may contribute to maintenance of this health-related behavior in adulthood.

Physical Activity Trends

The increase in prevalence of obesity in childhood since the 1980s has focused attention on lifestyle factors that may be contributing to this unhealthy trend. To identify potential contributors to the longitudinal trend in increasing body mass index, researchers have turned their attention to changes in PA patterns in U.S. youth. Evaluating to what extent changes in PA may have contributed to the increased body mass index (BMI) of U.S. youth is, however, fraught with methodological limitations. Most of the information evaluating PA trends comes from national surveys, including National Health Interview Survey (NHIS), NHANES and Youth Risk Behavior Surveillance Survey (YRBS). Unfortunately, historical trends antecedent to the early 1990s cannot be obtained as PA questions were not included in national surveys before that time (CDC, 2012). Since that time, the national surveys have included self-report measures of physical activity. Self-report, as a method of assessing PA, has been shown to have only low to moderate correlation with direct measurements of PA, and a pattern of both over- and under-reporting of PA has been found (Prince et al., 2008). Because there is no trend in the inconsistencies of self-report report data, experts indicate that interpretations and extrapolations of the findings should be viewed with caution.
Physical activity is a complex behavior that manifests in many forms, is embedded in activities of daily living, and occurs in different settings. National survey data have failed to capture sufficient information to allow researchers to evaluate PA behavior on a global basis. National survey data often address PA behavior in finite domains. The YRBS contain questions regarding physical education (PE) class, sport team participation and leisure time, but these were not included in the surveys until 2011 (CDC, 2014). The NHIS only evaluated PA during leisure time, and the NHANES evaluated active transportation frequency and PA during leisure time. Physical activity can occur in different settings, including during transportation, at school, at home, and during leisure time, and no single survey addresses PA in all of these settings.

The behavior of PA is complex, as it can occur via different modes, intensities, durations and frequencies, and these PA modifiers affect the health benefits that are derived from PA (Haskell et al., 2007; CDC, 2008). National surveys often have narrow definitions of PA, when posing questions about PA behaviors. The 2013 YRBS asked questions regarding activity “that increased your heart rate and made you breathe hard at least some of the time” and in 2011 the YRBS included questions regarding PA that “made you sweat and breathe hard” for at least 60 min a day. The NHANES posed questions regarding activity type, duration, and frequency to evaluate PA volume (expressed as MET/day or MET/week), but these questions were only posed in limited survey years (CDC, 2014). Since no national survey provides a complete evaluation of PA behavior, available evidence from multiple sources must be collectively evaluated to further our understanding of PA trends among youth (Dollman, Norton & Norton, 2005).

**Physical activity in adolescents’ lives – active transportation.** The milieu of U.S. children has been explored to increase our understanding of current PA patterns. U.S. youth engage in exercise around school-based activities, in organized sports and in leisure time periods.
In the distant past, most children used some form of active transportation to get to and from school. This trend has changed significantly in the past 20 years. Walking is the most prevalent means of active transportation to school and this practice has declined in the past 30 years (Buehler et al., 2011; McDonald, 2007). Survey data have demonstrated that the percent of students who live within one mile and walk to school declined from 85.9% in 1969 (95% Confidence Interval [CI] = 82.3%–89.4%), to 49.9% in 2001 (95% CI = 46.5%–53.4%) (McDonald, 2007). Logistic regression of Department of Transportation survey data indicated that increased travel distance to school may account for almost half of the decline in rates of walking to school seen from 1969 to 2001 (McDonald, 2007). Other studies have found parental concerns about child safety due to potential dangers posed by traffic and crime to be a barrier to active transportation to school (CDC, 2002; CDC, 2008). In 1987, 87% of school-aged children walked or rode their bikes to school, while in 2008 only 18% participated in active transportation to school (Buehler, Pucher, Merom & Bauman, 2011). Active transportation to school has significantly decreased over the past 30 years, with travel distance, heavy traffic and high crime as the most commonly cited parental barriers to promoting this practice (CDC, 2008).

**Physical activity in adolescents’ lives – school recess.** While at school U.S. children are in primarily engaged in PA while at recess, as most states do not require daily physical education class (National Association of Sport and Physical Education, 2012). It has been estimated that children are engaged in vigorous activity 63% of the time during recess, and take about one-quarter of their daily walking steps during lunch and recess breaks (Beighle, Morgan, LeMasurie, & Pangrazi, 2006; McKenzie, Crespo, Baquero, & Elder, 2010). Children, however, are getting less free time for PA during the school day. With increasing pressures for schools to meet state mandated learning benchmarks, the time allotted for recesses has been decreasing nationwide.
(McMurrer, 2008). The most recent report indicates that only 12% of states require elementary schools to provide scheduled recess for their students (National Association for State Boards of Education, 2011). Although recess is offered to most children, one-third of schools offer 20 min or less of recess on most days of the week (Barth, 2008). Despite the known benefits of recess to the health of U.S. youth, most states do not require schools to provide this opportunity for PA, and on average schools have been reducing allotted recess time in the past two decades.

**Physical activity in adolescents’ lives – physical education curriculum.** For older adolescent students, there is no recess time in which free play is engaged. Instead breaks in the academic day are generally occupied by nutrition intake and not physical activity. For these students, PA is performed during scheduled physical education classes. However, daily physical education classes are no longer a standard part of the curriculum. Although the majority of states require physical education in school, YRBS data showed that daily PE participation rates in older adolescent students declined from 42% to 32% over the past 20 years (CDC, 2012). Required physical education curriculum has been shown to vary by grade, the prevalence of daily PE classes for a portion of the academic year decreased from 88% in 8th grade, and 48% in 10th grade, to 20% in 12th grade (O’Malley, Johnston, Delva, & Terry-McElrath, 2009). Others have reported that daily physical education for the full academic year for all grades in the school was offered in only 4% of elementary schools, 8% of middle schools and 2% of high schools (Lee, Burgeson, Fulton & Spain, 2007). Results from the 2001 YRBS indicated that only 51.7% of high school students were even enrolled in a PE class, while 31.2% of students were attending PE class on a daily basis (Grunbaum et al., 2002). YRBS 2011 data indicated that participation in daily PE class decreased throughout the high school years, from 41.3% of 9th grade students to 24.2% of 12th grade students were participating in daily PE (CDC, 2012). A large disparity exists
in daily PE curriculum, with the reported prevalence in daily PE participation ranging from 6.3% to 71.2% (CDC, 2012). P.E. class offers U.S. youth the opportunity to engage in PA during the school day, yet the majority of older youth do not have the opportunity to participate in daily P.E. class. To date, the research shows that prevalence of daily PE class for the full academic year had declined over the course of the past two decades for all ages. Further, that the prevalence of attendance in a daily PE class for the full academic year decreases over the course of adolescence.

**Physical activity in adolescents’ lives – organized sports.** Physical activity during organized sports participation may be an important source of vigorous activity in youth. Evaluation of NHANES data from 1988 to 1994 indicated that greater than 50% of students aged 12 to 16 years participated in organized sport or exercise (Forshee, Anderson & Storey, 2004). The National Council of Youth Sports (2008), a more recent survey, found that there was little change in prevalence of organized sports participation from 1997 to 2008 (63% to 66% in boys and 34% to 37% in girls), but a significance difference in prevalence of sports participation between boys and girls. YRBS data support these findings of relatively stable trends of sports team participation from 1999 to 2011 (55% versus 58%) (CDC, 2012). Prevalence in participation in organized sport has not changed significantly in the past 30 years. A consistent pattern is that boys are more likely to participate in organized sport when compared to girls. Since participation in sports is associated with greater daily MVPA (Sallis, Prochaska, Wendell, Hill & Geraci, 1999), recruiting U.S. youth, to engage in organized sports may off-set losses in opportunity to engage in PA during transportation to school and during recess and P.E. class.

**Physical activity in adolescents’ lives – leisure time activities.** Total expenditure of energy achieved during all of the day’s activity, both at school and during leisure time, may be
an important factor in health, especially in weight control (Powers, & Howley, 1990; McArdel, Katch & Katch, 1991). Age related declines in PA and high rates of sedentary activity among adolescents may be related to changes in the types of leisure time activity in which they are engaged. Advancements in technology have provided children and adolescents new leisure activities that require little energy expenditure to perform. These sedentary options, like playing video games and participating in on-line social networking, may take away time from activities that require more PA (Dietz & Gortmaker, 2001; Sisson, Broyles, Baker & Katzmarzyk, 2010). It is believed that sedentary activities may impact health by different physiological pathways than those influenced by PA (Raynor, Bond, Freedson & Sisson, 2012), and it has been demonstrated that factors that influence sedentary behavior are distinct from those that influence PA behavior in adolescents (Norman, Schmid, Sallis, Calfas & Patrick, 2005). In a study of 50,000 U.S. youth (ages 6 to 17 years old), 50% of youth were found to be watching television greater than two hours a day (Sisson et al., 2010). Viewing television for more than two hours per day has been shown to increase the risk of obesity and of performing less than 20 min of PA daily (Anderson, Economos & Must, 2008; Eisenmann, Bartee, Smith, Welk & Fu, 2008; Hume, Singh, Brug, van Mechelen, & Chinapaw, 2008; Rey-Lopez, Vicente-Rodriguez, Biosc & Moreno, 2008). A meta-analysis of 52 studies ($N = 52,000$) confirmed a small but significant negative association of television viewing and PA, and a small positive association of television viewing and body weight or body adiposity measures in adolescent populations (Marshall, Biddle, Gorely, Cameron & Murdey, 2004). A recent study found that television viewing was the biggest contributor to the four hours of daily sedentary activity reported by adolescent girls ($N = 238$), and was inversely associated with both total min of PA and time spent engaged in MVPA (Bauer, Friend, Graham & Neumark-Sztainer, 2012).
The advancement of electronic media for pocket sized entertainment may also be altering how U.S. youth are filling their leisure time. The Kaiser Foundation recently reported that U.S. youth between the ages of 8 and 18 years (N = 2000), spend an average of seven hours and 38 min daily using entertainment media (Rideout, Foehr & Roberts, 2010). Access to alluring sedentary leisure time activities may be contributing to the downward trend in PA performed during leisure time in U.S. youth (Marshall, Biddle, Gorely, et al., 2004).

**Summary of Evidence**

Ample evidence demonstrates that PA decreases over the adolescent years. By the time children are in high school, only 15% are engaged in the recommended amount of MVPA. Physical activity has been shown to benefit cardiovascular health in adolescence and to help youth maintain a healthy body weight. In the light of the current childhood obesity epidemic, PA may be important behavior in preventing the age-related increase in adiposity in U.S. youth. The behaviors adopted in adolescence influence those in adulthood, and early intervention to encourage PA on a regular basis may help prevent tracking of physical inactivity and obesity from childhood into adulthood. Both obesity and physical inactivity in adulthood are associated with increased morbidity (Mokdad, Marks, Stroup & Gerberding, 2004) and mortality (Flegal, 2005; Peeters et al., 2003). Treatment of obesity related co-morbid conditions are contributing to escalating national health care costs (Congressional Budget Office, 2010; Thorpe, Florence, Howard, & Joski, 2004). It is therefore a public health imperative to better understand the factors that influence PA behavior in adolescence so that effective interventions to promote PA can be created and employed in this at risk population.
Need for a Theoretical Model

When attempting to modify the physical activity behavior of others, it is essential to have a sound theoretical foundation and empirical findings to support interventions. It is important to be able to both anticipate if an intervention will be effective in changing behavior, and how the intervention was able to cause the targeted behavior change. Thus far, authors of review article regarding PA interventions to prevent childhood obesity, indicate that the field has largely failed to design programs and evaluate outcomes using a theoretical foundation (Katz et al., 2005; Zenzen & Kridli, 2009). Underpinning interventional studies with a theoretical foundation is seen as a vital means of advancing our understanding of the problem and finding a solution by designing effective interventions to insufficient PA in adolescents. In light of this understanding, there is need for research to evaluate potential variables that influence change in PA behavior in PA inventions. These variables that influence change are known as mediators. Mediators are hypothesized causal mechanisms through which interventions work to change behavior. Examining the function of theoretical mediators can lead to explanatory mechanisms for change. Investigating mediators facilitates knowledge development in how interventions are efficacious by providing theoretical causal pathways between the intervention and the outcome behavior (Baron & Kenny, 1986). The strength of the relationship between the mediator and the behavior can be influenced by a number of factors. These factors, known as moderators, can amplify or dampen the relationship between the mediator and the behavior. Investigating modifiers allows for a better understanding of how characteristics of subgroups, like age, gender and socioeconomic status (SES) alter the relationship between the intervention and the outcome (Baron & Kenny, 1986).
Potential Moderators of Physical Activity

The body of evidence regarding PA indicates that behavior is modified by a complex matrix of demographic factors. Further examination of these variables is warranted as they may modify the relationship between the mediator variables and PA behavior. Research has established a number of factors that have a predictable relationship with MVPA. One of those factors is age. Research has established that MVPA decreases with age (Fulton et al., 2011; Nader et al., 2008; Troiano et al., 2008). Nader et al. (2008) found that MVPA declined on average 38 min daily for each additional biological year beyond age 9 years. National survey data using self-report report and objective measures of PA have revealed that there is a precipitous decline in MPVA during adolescence and that the majority of adolescents do not engage in the recommended amount of MVPA (Nader et al., 2008; Troiano et al., 2008). Although age has not been evaluated as a modifier of a mediated change in PA behavior, the correlation of age and PA behavior identifies age as a potential modifier of the mechanisms of behavior change in the context of PA.

A consistent trend in the pattern of PA across childhood into adulthood is that females engage in less exercise than males (Fulton et al., 2011; Nader et al., 2008; Troiano et al., 2008). Survey data (N = 11,429) that assessed MVPA by self-report report found a significant gender difference in prevalence of meeting the 60 min MVPA objective in high school students (boys = 21.4% and girls = 8.4%) (Fulton et al., 2011). A study that used accelerometer data to measure PA found that in children (ages 6 to 11 years; N = 597) adherence to recommended amounts of MVPA was lower in girls than in boys (35% versus 48%, respectively; ρ < .05). In this same study, a significant gender difference in rates of adherence to the USDHHS MVPA guideline was found in the adolescent population (N = 1181) (girls = 3% versus boys = 12%; ρ < .05). A
longitudinal study that used accelerometer data to assess MVPA found that boys engaged in more MVPA than girls at age 9 years (boys = 190.8 min/day; girls = 173.3 min/day), at age 12 years (boys = 105.3 min/day; girls = 86 min/day), and at age 15 years (boys = 58.2 min/day; girls = 38.7 min/day). Although this study identified a significant decline in MVPA from childhood to adolescence, there was not a significant difference in rates of decline between the genders (Nader et al., 2008). Research to date has found that females perform less MVPA in childhood and adolescence when compared to age matched males. Because PA behavior is different in girls and boys, it will be important to evaluate if gender difference in the TTM variables of SEPA and DB exist.

The association between PA behavior and body mass index (BMI) has been reported as indeterminate by an early review of the literature (Sallis et al., 2001) and as unrelated to PA behavior in a later review of the literature (van der Horst, et al., 2007). BMI is a relatively insensitive measure of weight status, and this may account for the inconsistency in findings regarding the relationship between BMI and PA. More recent literature has found that BMI percentile, which is derived from BMI divided by ideal BMI (50th percentile for age and gender) to be a more sensitive assessment of weight status (Steele, Daratha, Bindler & Power, 2011). To date, the relationship of BMI percentile and PA behavior has not been evaluated. Further evaluation of BMI ratio and other more established correlates of MVPA are needed to guide intervention development and evaluation by identifying modifiers of the causal mechanisms of behavior change.

Potential Mediators of Physical Activity

A common method for the statistical analysis of mediators as causal pathways of change in PA behavior is mediations analysis. The Baron and Kenny’s (1986) test of mediation consists
of four separate tests. First, it is determined if a statistically significant association between the intervention and the change in PA behavior exists. Then it is determined if there is a statistically significant change in the putative mediator variable association with the intervention. This is known as the action theory test. Next it is determined if a statistically significant association between in the putative mediator and the PA behavior exists. This is known as the conceptual theory test. If these three tests have statistically significant findings, then a fourth test is conducted to evaluate the mediation effect. In this test, it is determined if the relationship between the intervention and PA behavior is substantially reduced when controlling for the hypothesized mediator (Baron & Kenny, 1986). Mediation analysis is used to determine if an intervention is associated with changes in the outcome behavior, with changes in the construct believed to mediate behavior change, and if the change in the mediator construct accounts for a significant portion of the change in the outcome behavior.

Mediator variables are proximal to the behavior change and are identified through theory and confirmed through empirical evidence (Chen, 1990). Numerous theories related to health behavior provide the theoretical basis for potential mediators. These theories include Self-determination Theory (Deci & Ryan, 1985), Theory of Planned Behavior (TPB) (Ajzen, 1991), Social Cognitive Theory (SCT) (Bandura, 1977) and the Transtheoretical Model (TTM) (Prochaska & DiClemente, 1983). An example of how a hypothesized mediator operates as a causal pathway to behavior change is presented for the construct of self-efficacy (SE). SE is the belief in one’s ability to succeed in actions to achieve a desired goal (Bandura, 1995). SE determines whether a behavior will be initiated, how much effort will be expended in changing the behavior, and how long it will be sustained in the face of obstacles (Bandura, 1990). If a PA intervention can successfully alter individuals’ SE it is believed that they will be more
successfully in achieving the desired goal of increasing PA. If it can be established that changes in SEPA account for a meaningful portion of the change in PA behavior, then program developers can focus on devising interventions that work to change this mediator. Many experts call for evaluation of putative mediators of behavior in interventional studies as this will increase understanding of the mechanisms of change and facilitate development of successful behavior change interventions (Lubans et al., 2008; van Stralen et al., 2011; Zenzen & Kridli, 2009).

Literature on mediation analysis of hypothesized mediators of behavior change in the context of PA is sparse. Mediation of PA behavior may be different among adult, children or adolescent populations, but given the paucity of the extant literature, review articles that evaluate the findings in each of these age groups are presented. Rhodes and Pfaeffli (2010) provided a review of experimental PA studies in an adult population. Of the 359 studies initially examined only 22 unique trials met the criteria for inclusion in the review. Of these 22 trials, only 11 studies demonstrated a treatment effect on PA behavior, thus 50% of the studies failed to meet the first step in mediation analysis. Of the remaining 11 studies, all demonstrated a relationship between the intervention and the hypothesized mediator (i.e., action theory test). Only five of the 11 studies reported a conceptual theory test. In all of these five studies a statistically significant relationship between the hypothesized mediator and the PA behavior was demonstrated. Of these five studies that demonstrated a significant treatment effect, action theory test and conceptual theory test, only four were able to demonstrate that the hypothesized mediators actually mediated the change in PA behavior. The review authors indicated that evidence regarding mediation of PA behavior was mixed for constructs from the TTM, was supported in a limited fashion for constructs from the SCT, inconclusive for constructs from the TPB, and not supported for constructs from the Self-determination theory (Rhodes & Pfaeffli, 2010). Lubans, Foster and
Biddle (2008) provided a review of seven interventional studies in an adolescent population (ages 11 to 18 years) that reported results from mediation analysis. These authors indicated that because the seven studies included in the review varied in design and mediator construct evaluated, strong conclusions could not be made. However, the authors did find that self-efficacy, a construct integral to the theories of SCT and TTM, received the most support for mediation of the relationship between the intervention and change in physical activity in an adolescent population. Outcome expectancy and Perceived benefits were assessed in five of the seven studies and were found to be related to PA behavior (i.e. conceptual theory test) in all these studies. However, only one of the five studies was able to demonstrate that change in Outcome Expectancy and Perceived Benefit mediated change in PA (Taymoori & Lubans, 2008). Change in Perceived Barriers to PA was found to be related to the PA intervention (action theory test) and the change in PA behavior (conceptual theory test) but not found to mediate the relationship between the interventions and the change in PA behavior in any of the studies included in the review. Enjoyment of PA was evaluated in a single study and was found to partial mediate change in PA (Dishman et al., 2004). A recent review article that evaluated PA interventions in children (ages 5 to 12 years) found that of the 31 studies included in the review, not one had performed a mediation analysis (Brown, Hume, Pearson & Salmon, 2013). The review authors evaluated the action theory tests performed in these 31 studies and included an effect size to provide a common metric upon which to evaluate the impact of the PA interventions on the hypothesized mediators. The reviewers found that in the 14 studies that evaluated self-efficacy, seven determined that SEPA was related to the intervention. The range of effect sizes were calculated to be from small to moderate (Cohen’s $d > .2$ to $.8$). Intention, a construct from the TPB, was evaluated in five studies and only two studies found that Intention was related to the
intervention. The effect sizes were trivial ($Cohen's \ d \leq .2$) and moderate ($Cohen's \ d \ > .5$ to $.8$) in these two studies. *Outcome expectancy* was evaluated in five studies and two determined that the intervention had a small effect ($Cohen's \ d \ > .2$ to $.5$) on the proposed mediator. Upon review of the extant literature on PA interventions, the authors indicated that the paucity of evidence does not allow for substantive conclusions regarding mediation of PA behavior in children. Each of these review articles, examining PA interventions in adult, adolescent and children populations indicated that there is a need for further research in the area of mediation of PA behavior.

Behavior change is seen as a stepwise process, and a multitude of changes in proximal mediators occur prior to the change in target behavior (Prochaska & DiClemente, 1983). It is change in the proximal mediator variables that move an individual along a continuum from thinking about changing a behavior to achieving behavior change on a consistent long-term basis. Of the theories that predict health related behavior, only the TTM has accounted for this observed stepwise progression of behavior change. TTM integrates *stages of change*, or degrees of readiness to engage in the target behavior, into the model. It is believed that the needs of individuals as they move along the continuum of change may be different at the various stages. A novel study evaluated potential mediators of PA behavior of adults ($N = 220$) who had just completed an interventional program to increase PA and then repeated the mediation analysis after 6 weeks, 6 months and 12 months (Fuchs, Seelig, Gohner, Burton & Brown, 2012). These authors found that some of the hypothesized mediators partially mediated change across all the test periods, but others only mediated change at the onset of adoption of the new PA behavior, or only after the new behavior was maintained. Thus, the efficacy of interventions may depend on how well they are matched to salient stage-matched mediators of the target group.
The Transtheoretical Model

The Transtheoretical Model (TTM) has been used to gain insight into how individuals achieve behavior change, including adoption of a physically active lifestyle. This model has been used as a framework to evaluate and understand the progressive stages individuals move through as they change their behavior (Prochaska & DiClemente, 1983). TTM integrates key constructs from other theories to provide a comprehensive overarching theory of behavior change. The TTM posits two major ideas. The first postulation is that behavior change is seen as a dynamic process that occurs in a sequenced order of stages, known as the stages of change (SOC) (Marcus, Selby, Niauri & Rossi, 1992; Marcus & Owen, 1992). The second postulation is that progression through the stages of change is driven by cognitive and motivational processes. These are the putative mediators of behavior change. The cognitive process includes decisional balance (DB) and motivational factor includes self-efficacy (SE). Both DB and SE are constructs that are hypothesized to be proximal mediators that predict movement towards the distal targeted behavior or relapse. The proximal mediator DB is derived from the conflict resolution theory (Janis & Mann, 1997). Decisional balance reflects the cognitive aspects of decision making. The theory of DB proposes that decisions are made upon cognitive comparisons, in a process of weighing the pros and cons of engaging in a particular behavior (Velicer, DiClemente, Prochaska & Brandenburg, 1985). The process of moving from sequential stages of change involves a relative weighing of the pros and cons with a tipping of the balance toward the perceived benefits of the behavior to achieve positive behavior change. Another of the proximal mediators is known as self-efficacy (SE) and is derived from social cognitive theory (Bandura, 1977). Bandura indicated that SE, or the belief in one’s capacity to institute behavior change, will influence adoption and maintenance of the new behavior (1995). The theory of SE proposes that...
aspirations, motivation, outcome expectation, and perseverance in the face of obstacles are all affected by SE beliefs (Pajares & Urdan, 2006). According to the TTM, SE mediates proximal changes by effecting willingness to initiate a behavior change, by influencing goal setting, and by improving success in overcoming setbacks. Behavior change can occur in both a positive and negative direction. Relapse in behavior, or movement from a higher stage of change to a lower stage of change, can also occur. High SE is thought to be particularly important in preventing relapse of behavior and achievement of the maintenance stage of change (Velicer, DiClemente, Rossi & Prochaska, 1990). By using the TTM to frame our view of behavior change, it would be predicted that change occurs in a series of steps that is driven by weighing the perceived benefits and barriers to adoption of a new behavior and is facilitated by a belief in one’s capacity to adopt and maintain the behavior change.

Although the Transtheoretical Model was developed by examining the cognitive and motivational processes of adults who were attempting to quit smoking, it has been evaluated in the context of many different health related behaviors. The pattern of increasing pros and decreasing cons as SOC increases has been shown in both behaviors where cessation is desired and where adoption is the goal (Prochaska et al., 1994). Self-efficacy has also been shown to be associated with behavior change in variety of contexts including, weight control, contraception use, alcohol cessation and PA behavior (Strecher, DeVellis, Becker & Rosenstock, 1986). It is hypothesized that SE and DB mediate changes in SOC and empirical evidence has supported the theory. In the context of PA behavior, pros, cons and SE have been shown to explain much of the variance in SOC (41%) (Marcus, Eaton, Rossi & Harlow, 1994).
Figure 1. Conceptualization of the Transtheoretical Model

Figure 1. Conceptualization of the Transtheoretical Model. The model predicts that the perceived benefits of a new behavior increases (+) as the SOC advances, the perceived barriers to a new behavior decreases (−) across the SOC, and SEPA increases as SOC increases. The demographic factors like age and gender are predicted to modify the relationship of SEPA and DB with SOC (adapted from Keller & McGowan, 2001).

Detailed discussion of the TTM constructs

Stages of change. The stages of change model is one of the key constructs of TTM. The SOC model represents a central organizing dimension of the TTM. The underlying principle of the SOC is that behavior change is a multidimensional process that occurs through a series of changes. The SOC describes five stages that individuals move through as they seek to adopt and maintain a particular behavior (Prochaska, DiClemente & Norcross, 1992). The SOC indicates
that the first stage is precontemplation (PC). In this stage individuals are not seriously thinking about changing behavior in the next six months. In the next step, contemplation (C), people become aware that they have a problem behavior, are beginning to think about changing that behavior, but have not made a commitment to change. In the third *stage of change*, preparation (P), individuals intend to change a problem behavior. Preparations begin and can entail plan making, goal setting, altering the environment, or small adjustments in the problem behavior. In the fourth *stage of change*, action (A), individuals have successfully altered the problem behavior, but have not maintained the new behavior for longer than six months. In the final *stage of change*, maintenance (M), people have successfully altered the problem behavior for longer than six months. In the maintenance stage, individuals work to prevent relapse of the problem behavior. The *SOC* suggests that behavior change is not an all or nothing phenomenon. *SOC* predicts that behavior is dynamic and made malleable by intention, preparation and action.

*SOC in the context of physical activity.* The *SOC* model has been applied to the behavior of physical activity. Various tools to assess *SOC* in PA have been developed and utilized for the past 20 years (Bulley, Donaghy, Payne & Mutrie, 2007; Marshall & Biddle, 2001; Spencer, Adams, Malone, Roy & Yost, 2006). In each case, the tool follows a template originally proposed by Marcus & Owen (1992) and later modified by Marcus & Simkin (1993) that requires self-evaluation of intention to engage in exercise (for those in precontemplation and contemplation stages) and degree of engagement in the PA (preparation, action and maintenance stages). The general form of the *SOC* tool requires individuals to select one of the following statements that reflect their current PA behavior:

1. I currently do not exercise and I do not intend to start in the next six months (staged as precontemplation).
2. I currently do not exercise but am thinking about starting to exercise within the next six months (staged as contemplation).

3. I currently exercise some, but not regularly (staged as preparation).

4. I currently exercise regularly, but have only begun doing so within the past six months (staged as action).

5. I currently exercise regularly and have done so for longer than six months (staged as maintenance).

Various tools used to assess SOC differ in regards to how the targeted behavior is defined. Marcus et al. (1992) defined regular exercise as a minimum of three sessions of 20 min of vigorous exercise per week. Marshall and Biddle (2001) in their meta-analysis of the extant literature, found that in the studies included in the review, regular exercise was not defined in 31% of the studies, was defined as 15 min on three days per week with no mention of intensity of exercise in 50% of the studies, and as 15 min of MVPA on three days per week in 11% of the studies. Only two of the 68 studies included in the review defined regular exercise as 30 min of MVPA of four to 7 days per week, which was in alignment with the contemporary recommendations for physical activities in adults (Marshall & Biddle, 2001). Characterization of the behavior is important as it appears to influence self-evaluation of the behavior. Marshall and Biddle (2001) found that in studies that provided no criteria to define regular physical activity, a greater proportion of individuals were staged as precontemplation (25%) and a lesser proportion were staged as action (8%) than in the studies that defined regular exercise as 15 min bouts on at least 3 days per week (10% in precontemplation and 12% in action). Others have found that the criterion description, including frequency, duration and intensity of physical activity, have consequences on staging (Reed, Velicer, Prochaska, Rossi, & Marcus, 1997). Because the
criterion description affects self-evaluation of the degree of participation in the target behavior it is important to clearly define the behavior in regards to intensity, duration and frequency.

Stages of change in the context of physical activity - instrument development. Many studies have examined the validity of the SOC for PA tool. Validity of a tool has been evaluated against a criterion measurement in concurrent validity, a related construct for convergent validity, and/or an unrelated construct for divergent validity. Concurrent validity has been explored by evaluating the relationship between SOC and numerous physical fitness and PA measurements in adults. Concurrent validity has been established using self-report report Godin leisure time activity recall (Cardinal, 1995), 7 day recall PA (Cardinal, 1995; Farenwald & Walker, 2003; Marcus & Simkin, 1993), predicted maximum aerobic capacity (VO₂max) (Cardinal, 1995) and measured VO₂max (Cardinal, 1997). Nigg (2005) calculated the specificity and sensitivity of SOC in over 30 studies and found that cumulatively 71% of the participants were correctly classified in the action phases when strenuous activity was the criterion behavior (i.e., sensitivity) and 86% were correctly classified in the preaction stages (i.e. specificity). SOC using a 5-set algorithm has been shown to be a reliable and valid predictor of MVPA.

Convergent validity has been evaluated by examining the relationship between SOC and the psychosocial construct of self-efficacy for PA (SEPA). The TTM posits that SE is related to SOC, and SEPA has been shown to be the consistent predictor of PA in adults (Farenwald & Walker, 2003) and in youth (Sallis, 2000). Research supports the construct validity of SOC, as a significant difference in SEPA among the SOC has been established in both adult and youth populations (Bulley et al., 2007; Marshall & Biddle, 2001; Spencer et al., 2006). The predictive validity of SOC has been evaluated in a review by Marshall & Biddle (2001) that evaluated studies that utilized adult, adolescent, and mixed populations. These authors found that
cumulative data from the studies included in the review (N = 65,000) corroborated epidemiologic evidence regarding the prevalence of inactive individuals (SOC algorithmic method = 30% and epidemiologic evidence = 25%), but overestimated the prevalence of active individuals (SOC algorithmic methods = 50% and epidemiological evidence = 15%). The authors of the review indicated that the discrepancy between the epidemiologic data and the SOC research data may be due to the differences in the definition of the criterion behavior of regular exercise (Marshall & Biddle, 2001). Predictive validity of the SOC construct has also been evaluated using accelerometer data, with significant correlation in adult and student populations (Bulley et al., 2007). The validity of the SOC construct to categorize individuals on exercise behavior has been established, but appears to be dependent on a clearly defined criterion of regular exercise.

*Stages of change in physical activity in adolescent populations.* Much of the research regarding SOC for exercise has been conducted in an adult population, but adolescents have been shown to be able to evaluate their own stages of change. Lee, Nigg, DiClemente and Courneya (2001) conducted a validation study of the stages of change measurement in an adolescent population (M = 15.0 years, SD = 1.2; N = 819). The criterion behavior for the SOC instrument was described as at least three sessions of moderate to strenuous PA for at ≥ 20 min weekly outside of PE class, measured with the Leisure Time Exercise Questionnaire (Godin, Jobin & Bouillon, 1986; Godin & Shephard, 1985). A significant group difference in PA behavior was found among the stages of change groups. Post hoc analysis revealed greater self-report PA in the preparation group compared to the contemplation and precontemplation groups, and greater self-report report PA in the action and maintenance groups compared to the preparation group. These results supported the authors’ hypothesis that there would be a difference in PA behavior
between the adopters of the behavior (action and maintenance groups) and the non-adopters (precontemplation and contemplation groups).

A study in Belgium evaluated SOC for being “sufficiently sporting or physically active” in over 6000 adolescents aged 12 to 18 years and found that SOC was significantly correlated with self-report of sports activity, active transportation and physical education participation ($r = 0.41 – 0.79, \rho < 0.05$) (De Bourdeaudhuij et al., 2005). Post hoc testing revealed the group differences between pre contemplation and all other stages, and the maintenance stage and all other stages to be larger than the other group differences found (De Bourdeaudhuij et al., 2005).

In a Canadian study of 327 adolescents aged 15 – 18 years, who attended a private school, self-report report of strenuous PA was found to be a significant predictor of SOC (Berry et al., 2005). The self-report report of PA asked the number of times per week that participants engaged in at least 15 min of strenuous exercise (“exercise that makes your heart beat rapidly and you sweat”), of moderate exercise (“exercise that is not exhausting”), and of mild exercise (“exercise that requires little effort”). Post hoc testing only identified significant differences in self-report report strenuous PA for one action stage (maintenance) and the two intentional stages (contemplation and preparation). A relationship between SOC and moderate PA or light PA was not found in this study.

The ability of younger African-American children ($N = 206; M$ age $= 9.9$ years, $SD = 1.1$ years) to discriminate SOC was shown in a U.S. study (Annesi et al., 2010). This study found a significant correlation ($\rho < 0.05$) between SOC for regular PA outside of PE class with self-report of voluntary physical activity. The criterion of voluntary PA was defined as ‘the number of days in which at least 20 min of MVPA or exercise (defined as exercise that made you breathe harder than usual) that was voluntarily completed during the previous full week.'
The ability of *SOC* to discriminate the level of voluntary activity was not supported by Hausenblas et al., (2002), who found no significant *SOC* related difference for voluntary PA as measured by the Leisure Time Exercise Questionnaire (Godin et al., 1986) in middle school children. This study did find *SOC* group differences for the one mile walk/run, curl up and push up performance tests. Post hoc analysis indicated group differences between the maintenance stage and the action, preparation and contemplation/precontemplation (collapsed) stages for these objective measures of fitness. The data to date indicates that the *SOC* construct is a valid heuristic device to discriminate between adopters and non adopters of regular PA in an adolescent population.

**Gap in the literature.** To date no literature has reported *SOC* for PA behavior that is in line with current USDHHS recommendations of 60 min of MVPA on most days per week in an adolescent population.

**Decisional Balance.** Analyzing the processes of making health related decisions is an important aspect of understanding current behavior patterns and facilitating behavior change. The TTM incorporates Janis and Mann’s (1977) theory of *DB* to elucidate cognitive factors that influence behavior. Janis and Mann proposed that behavior change is driven by decisions that are based on comparisons of the gains obtained by adopting the behavior with the losses incurred by changing the behavior (1977). *DB* was originally envisioned to be driven by four distinct factors: utilitarian gains and losses for self, utilitarian gains and losses for others, self-approval or disapproval, and approval or disapproval by others (Janis and Mann, 1977). The weighing of the anticipated benefits or gains against the cost or losses in changing behavior was purported to drive behavior (Janis and Mann, 1977).
In 1985, Velicer et al. operationalized the DB concept and created a DB instrument for the behavior of smoking. Principal component analysis for this tool revealed only two distinct factors, not four as postulated by Janis and Mann. Velicer et al. (1985) found that ten of the questions regarding the positive aspects of smoking loaded on one component (labeled DB-pros) and ten of the questions regarding the negative aspects of smoking loaded on the second component (labeled DB-cons). Velicer et al. (1985) created a single factor, DB, by subtracting the total of DB-cons scores from the total of the DB-pros scores. They demonstrated that DB predicted SOC for smoking cessation, and predicted smoking status at six months. Since this time, the DB tool has been tested in adult populations for a variety of health related conditions. Prochaska et al. (1994) evaluated the DB tool in 12 different health related behaviors in adult populations (e.g., sunscreen use, condom use and mammography screening). A consistent pattern emerged in the data among these 12 health behaviors; in the precontemplative group the DB-cons outweighed the DB-pros for changing the behavior, and in the action and maintenance groups the DB-pros outweighed the DB-cons for the targeted behavior. Comparison of the patterns of change in both the DB-pros and the DB-cons across the 12 different health behaviors revealed that in general the DB-pros increased during the intentional SOC (PC, C, P) and the DB-cons decreased during the action SOC (A, M). Although DB was originally conceptualized as a single construct influenced by four distinct factors, empirical evidence indicates that the two factors (DB-pros and DB-cons) and the combined score (DB) change in a predictable fashion across the SOC. The pattern of change in DB-pros and DB-cons suggests that interventions that focus on increasing the DB-pros for a particular behavior may facilitate movement through the preaction SOC, and interventions that focus on decreasing the DB-cons for a particular behavior may facilitate movement through the action SOC.
Decisional Balance in the context of physical activity – instrument development. The concept of decisional balance has been applied to the context of physical activity. Marcus and Owen (1992) developed one of the first instruments to assess the DB-pros and DB-cons of PA. The tool consisted of ten DB-pro items and six DB-con items. Principal component analysis confirmed a two factor solution of the DB construct as proposed by Velicer et al. (1985) (Marcus, Rakowski et al., 1992). Marcus and Owen were able to demonstrate that the reasons for avoidance of PA (DB-cons), the positive perceptions of PA (DB-pros), and the difference between the two measurements (DB) were different among the SOC for adoption of PA in an adult population. Marcus and Owen (1992) used an 11 stage scale, rather than the now commonly accepted five-point scale for assessment of stages of change.

In a later study, the original 16 item DB instrument developed by March and Owen (1992) was altered by rewording and eliminating questions, and then pilot tested in a mixed age population (N = 453; ages 18 – 65 years) (Plotnikoff, Blanchard, Hotz & Rhodes, 2001). Principal component analysis revealed a unidimensional construct, meaning the instrument evaluated a single concept, with two components each with satisfactory internal consistency (DB-pros α = .79; DB-cons α = .71). The two week test–retest reliability of this tool was satisfactory (DB-pros r = .84; DB-cons r = .74) (Plotnikoff et al., 2001). Concurrent validity of the DB tool was established by finding significant positive correlations between the DB-pros subset of questions and SE (Bandura, 1995) (r = 0.21, p < .01) and Behavioral Intention (Ajzen, 1991) (r = 0.27, p < .01) (Plotnikoff et al., 2001). The validation study confirmed that the construct was unidimensional, that the DB-pros and DB-cons of engaging in PA were distinct factors, that there was adequate internal consistency and reliability in the DB tool when it was used in an adult population.
Decisional Balance in an adolescent population. A DB tool was adapted from the Marcus & Owen (1992) 16 item tool and evaluated in an adolescent population (N= 819; grades 9 to 12) (Nigg & Courneya, 1998). Nigg and Courneya (1998) found adequate internal consistency for the DB-pros (α = .92) and DB-cons (α = .81) subsets of the adapted DB tool. The DB-pros and DB-cons scores were all significantly correlated with SOC (DB-pros - r = .29; DB-cons - r = .13; p < .01). More recently a DB instrument was adapted from the Plotnikoff et al. (2001) 10-item tool to be used in a younger adolescent population (N = 878; ages 11 – 15 years) (Roesch et al., 2009). This study found adequate internal consistency for the DB-pros (α = .70) and DB-cons (α = .64) subset of DB scores. Two week test-retest reliability was adequate in the DB-pros (r = 0.86) and DB-cons (r = 0.64) scores. Concurrent reliability of the scales was established by accelerometer measurement of MVPA. The correlation between DB-pros and MVPA was statistically significant in the positive direction, but was weak (r = 0.12, p value not reported). The correlation between the DB-cons and MVPA was statistically significant in the negative direction, but was weak (r = -0.09, p value not reported). The Roesch et al. (2009) study was based in a clinic setting, the instrument was delivered electronically via a computer kiosk in the patient waiting room, and parental support was encouraged in filling out the instrument. Further research is needed to affirm the content validity, concurrent validity and reliability of the DB tool in an adolescent population.

Decisional Balance and Stages of Change in an adult population. According to the TTM, DB should change in a predictable manner with the SOC in the context of PA. Using ANOVA, Plotnikoff et al. (2001) found that DB was different among SOC groups in adults (F (4, 698) = 23.22, p < .01). Post hoc analysis indicates group difference between some of the stages of change but not all. They found the following significant difference in DB scores among the
groups M > A, P, C > PC. These results are support by Cox et al. (2003), who used the Marcus & Owen (1992) 16 item DB tool to examine the relationship between DB and SOC and found significant correlations between SOC and DB (ρ < .0001), DB-pro scores (ρ < .0001), and DB-con scores (ρ < .034). Post hoc analysis revealed the following significant group differences in DB scores among the groups: M > A, P > C, PC (Cox et al., 2003).

Contrary to the findings of others, Marcus et al. (1998) failed to confirm that the 16 item DB instrument predicted SOC in 194 adults. The adults were all placed in the intentional stages of PA (e.g., PC, C, and P) as they were all sedentary, and this may account for the disparity between their findings and others. The evidence to date indicates that DB is lowest in the PC group and highest in the M group. The differences in DB among the SOC groups partially supports Prochaska et al. (1994) findings of predictable trends in DB-pros, DB-cons and DB among the stages of change for PA in adult populations.

Decisional Balance and Stages of Change in an adolescent population. Since adolescence is known to be a developmental period where PA behavior changes, the concept of DB has been employed to evaluate decisional processes in this age group. In a study of private high school students (N = 311) a significant difference in the DB-pros and DB-cons scores among the SOC groups were found (Berry et al., 2005). Post-hoc analysis revealed lower scores for the DB-pros in the PC group than all the other groups (DB-pros - M, A, P, C > PC), and the planning group had higher scores on DB-cons subscale than the maintenance group (DB-cons - P > M). None of the other group differences were statistically significant. The PA behavior of the sample pool may not reflect the PA behavior of the majority of U.S. youth, as the study participants had very low membership in the PC group (N = 6) and high membership in the M group (N = 161).
An earlier study using public high school students (N = 858) also found low PC group membership (2.1%) but were able to demonstrate a greater number of group differences in DB-pros, DB-cons and DB scores among the SOC (Nigg & Courneya, 1998). This study demonstrated significantly higher DB-pro scores in the action groups (A, M) than in the preaction groups (PC, C) and lower DB-pro scores in the precontemplative group than all the other groups (DB-pro - M, A > P, C > PC). The DB-con scores for PA were only greater in the P and C groups when compared to the M group (DB-cons – C, P > M). The low membership in the PC and C groups was deemed a limitation in the study and the loss of statistical power may have made it difficult to achieve statistical cut points for significance.

A more highly powered study with 6,000 adolescents found SOC group differences in DB-pros, DB-cons and DB for PA (De Bourdeaudhuij et al., 2005). However, even with this large sample size, they were not able to establish differences among each of the SOC for the DB-pros, DB-cons, or DB variables. They did find that PC was significantly different than all the other SOC groups, with higher scores on the DB-cons construct and lower scores on the DB-pros construct (DB-pros – M, A, P, C > PC; DB-cons PC > C, P, A, M). There were no significant differences in scores among the P, A, and M groups (DB – M, A, P > C > PC) (De Bourdeaudhuij et al., 2005). The differences in DB-pros, DB-cons and DB had trends similar to those seen in an adult population among the SOC groups. Further work is needed to determine the usefulness of this tool in predicting SOC group membership and to identify group characteristics that can be targeted for PA intervention.

Decisional Balance has been evaluated in a younger population of 6th to 8th graders (N = 387) and no statistical differences in DB-pros, DB-cons or DB were found among the SOC groups (Hausenblas et al., 2002). The authors proposed three possible causes of the outcome: 1)
the study lacked sufficient power to detect groups differences as 88.6% of the sample had classified themselves as either in the active or maintenance *stages of change* in regard to PA; 2) there was limited variability in the DB scores; and 3) the *DB-pros* and *DB-cons* questions were adapted from adult surveys and may not be relevant to PA behavior in an early adolescent population. The DB tool developed for use in an older adolescent population (ages 14 to 18 years) may not be a valid tool to assess the perceived positive and negative aspects of PA in a younger adolescent population (ages 11 to 13 years). Another factor to take into consideration when applying this psychosocial construct to young populations is that weighting *DB-pros* and *DB-cons* of keeping or replacing a behavior requires mature decision-making skills.

Developmental milestones in cognition and psyche that contribute to decisional capacity begin in early adolescence but continue to develop through adulthood. Thus, the capacity for reasoned decisions that affect health behaviors may be highly varied in a young adolescent population.

*Gap in the literature.* Further evaluation of the utility of the DB tool or the construct to evaluate decisional processes in regard to PA behavior is needed in the young population (ages 11 to 13 years). Further research is needed to affirm the content validity, concurrent validity, and long term reliability of the DB tool in an adolescent population (ages 11 to 18 years).

*Self-efficacy.* One of the posits encompassed in the TTM is that health related decisions are mediated by *SE.* *Self-efficacy,* or the belief in one’s capacity to succeed in a particular course of action, was proposed by Bandura (1977, 1995). Bandura purports that *SE* is developed by four different avenues, including successful experiences, role models, reduced psychological and physiological stress, and persuasion by others (Bandura, 1995). Through his research, Bandura concluded that the most effective means to foster *SE* was through successful experiences, especially if obstacles must be overcome for the goal to be attained (1995). *Self-efficacy* is
important in health-related decisions as it determines whether a behavior will be initiated, how much effort will be expended in changing the behavior, and how long it will be sustained in the face of obstacles (Bandura, 1990). *Self-efficacy* is predicted to be an important mediator of health related behavior.

*Self-efficacy for physical activity (SEPA) instrument development.* It is important to evaluate theoretical mediators of behavior, like *SE*, to identify mechanisms that can be targeted to effect change. To determine if a theoretical construct mediates change in a specific behavior, it is important to have a valid and reliable instrument to measure the construct in the context of the specified behavior. Many different instruments to measure *Self-efficacy* for PA (*SEPA*) have been developed. Saunders et al. (1997) developed one of the first tools to evaluate *SEPA* in an adolescent population (*N* = 455; age – 5th grade). Principal component analysis of their 17 item tool with dichotomous responses revealed the following three distinct factors contributed to *SEPA*: 1) *support seeking*, 2) *overcoming barriers to exercise*, 3) *positive alternatives*. The internal consistencies of the *support seeking* and *overcoming barriers to exercise* components were acceptable in the initial testing (*α* = .71 both factors) but poor in the validation testing (*support seeking* *α* = .52; *overcoming barriers to exercise* *α* = .55). The internal consistency of the *positive alternative* component was poor in the initial testing (*α* = .54) and in the validation testing (*α* = .62). The two week test-retest reliabilities were acceptable (*support seeking* *r* = .76; *overcoming barriers to exercise* *r* = .82; *positive alternatives* *r* = .61). Concurrent validity was established as each of these factors had significant correlations with intention to exercise (*support seeking* *r* = .30; *overcoming barriers to exercise* *r* = .39; *positive alternatives* *r* = .29, *ρ* < .001) (Ajzen, 1991). Only the *overcoming barriers to exercise* subscale correlated with the criterion test of previous day PA (*r* = 0.2, *ρ* < .001). The *SEPA* instrument was later modified by
Motl et al. (2000), and tested in a population of Caucasian and African-American adolescent females \( (N = 955, \text{mean age 13.7 years}) \). Confirmatory factor analysis with full information maximum likelihood estimation revealed a single factor composed of eight items to be the most parsimonious and best fitting model \( (X^2 = 39.93, df = 20, RMSEA = 0.031 [90\% CI 0.017–0.045], RNI = 0.98, NNFI = 0.98) \). The final SEPA instrument consisted of eight questions regarding confidence in being physically active when presented with a variety of barriers. The items included a five point response rating from 1 = very easy to 5 = very difficult. The eight item survey loaded onto a single factor, coined as overcoming barrier self-efficacy, and correlated with the criterion measurement of daily min of moderate activity \( (r = 0.31, \rho < .05) \) and vigorous activity \( (r = 0.17, \rho < .05) \) as measured by a 3-day PA recall (3DPAR) (Motl et al., 2000; Motl et al., 2005). Concurrent validity was established in the same adolescent population as SEPA correlated with a related construct of perceived behavioral control (Ajzen, 1991) \( (r = 0.69, \rho < .05 [\text{Motl et al., 2005}]) \). Longitudinal factorial invariance of the single factor eight-item model was established using the baseline data and one-year follow up data from 845 of the original 955 participant cohort. Since these initial efforts to develop and validate a SEPA instrument, others have adapted the SEPA tools and validated them in younger age groups (Annesi et al., 2010), mixed gender samples (Berry et al., 2005; Hausenblas et al., 2002), Hispanic populations (Bartholomew, Loukas, Jowers & Allua, 2005), and populations outside of the U.S. (Callahan, Khalil & Morres, 2010; Neissaar & Radsepp, 2011). Research to date indicates that SEPA scales are unidimensional constructs that are a reliable and valid measure of self-efficacy for physical activity in an adolescent population.

Self-efficacy for physical activity and Stages of Change in an adolescent population.

According to the TTM, greater SEPA would be associated with higher levels of SOC (Prochaska
et al., 1992). The relationship between SEPA and SOC has been evaluated in an adolescent population in the context of physical activity. Berry et al. (2005) evaluated SEPA and SOC for a population of private high school students (N = 327). The SEPA utilized was a tool previously developed by Marcus, Selby et al. (1992) and previously validated in an older adolescent population (Wyse, Mercer, Ashford, Buxton, & Gleeson, 1995). Using ANOVA they identified SOC differences in SEPA (F(4,326) = 22.5, p < .001). Post hoc analysis, using Scheffe to control for type I error, identified significant differences in SEPA scores among the SOC groups as follows: M > A, P, C > PC).

Annesi et al. (2010) evaluated SEPA and SOC for participation in regular exercise (defined as three bouts of at least 20 min of MVPA each week) in a preadolescent population (M = 9.9, SD 1.1 years) of African-American students (N = 206). They adapted a SEPA tool from Marcus et al. (1992) that addressed beliefs regarding overcoming a variety of barriers to engage in PA. Using ANOVA they found SOC group differences in SEPA, with significant difference among many of the stages (F(4, 205) = 8.26, p < .001). Post hoc analysis revealed significant SOC group differences as follows: M > P, C, PC; M, A > PC (p < .05).

Hausenblas et al. (2002) also evaluated the relationship of SEPA and SOC in a young adolescent population (N = 387; Mean age = 12.6 years, SD = 1 years). They used an unique overcoming barriers to exercise scale previously modified from an adult tool by including age-appropriate language and to address leisure time PA only (Nigg and Courneya, 1998). Because there was low PC group membership, the PC and C groups were collapsed. Using ANOVA they identified SOC group differences in SEPA (F(3, 368) = 10.37, p < .001) Post hoc analysis revealed significant SOC group differences as follows: M > A, P, PC/C; A > P (p value was not reported).
In general, research has shown that SEPA is lowest in the precontemplative group that is not ready to engage in the target behavior and greatest in the maintenance stage of readiness. Research has failed to demonstrate difference in SEPA among all the stages of change. The failure to differentiate group difference among all the stages may be due to the low membership in the preaction groups (e.g., PC and C), high variability in SEPA measured, that SEPA is a multidimensional construct that has only been evaluated using unidimensional instruments, or that the relationship between SEPA and SOC is not linear.

**Gap in the Literature.** Further work is needed to evaluate SEPA among the SOC using the current PA standards of 60 min of MVPA on most days of the week as the criterion measure.

**Conclusion.** Research has demonstrated that adolescence is a critical time period to intervene with programs that promote PA, as a precipitous decline in moderate and vigorous activity is seen in this population. Evidence to date has shown that MVPA is associated with numerous health benefits, including control of body adiposity and reduction of risk for a number of morbidities. Longitudinal studies have revealed that habits that build a foundation for a healthy lifestyle track through adolescence (Janz, Dawson, & Mahoney, 2000) and into adulthood (Taylor, Blair Cummings, Wun & Malina, 1996). Thus, it is imperative that the adolescent population be targeted for implementation of interventions that increase PA. Designing effective interventions hinges on the ability to identify and target mediators, like SE and DB, of physical activity. The TTM provides theoretical constructs that have been shown to mediate PA behavior. Paucity of research has evaluated SEPA and DB as salient mediators of PA in an adolescent population. Self-Efficacy has been shown to mediate changes in PA behavior in response to PA interventions (Dishman et al., 2004; Haerens et al., 2006; Taymoori & Lubans, 2008), while DB has not found to be a mediator of PA behavior change in an adolescent
population (Taymoori & Lubans, 2008). Mediation studies, to date, have not evaluated the changes in SE and DB within the context of SOC. Prochaska and Velicer (1997) indicate that cognitive process and motivational characteristics of individuals change as they move along the continuum of SOC, and that the relative importance of these constructs is different at each SOC. It is hypothesized that SE is more important in translating intention into action and is therefore most salient in the transition from planning to action stages. Further, that increased perception of the benefits of the behavior (i.e., DB-pros) is the most salient mediator in moving individuals from the precontemplative to contemplative stages (Prochaska et al., 1994; Prochaska & DiClemente, 1992). Characterization of groups of individuals at every level of SOC in the context of PA is needed to enhance our understanding of the use of these constructs and instruments in an adolescent population.

To date, no study has evaluated PA behavior that is in line with current USDHHS recommendations. We will use the criterion behavior of 60 min of MVPA on most days of the week to evaluate adolescents’ readiness to engage in this level of PA. Further evaluation of the utility of the DB tool or the construct to evaluate decisional processes in regard to PA behavior is needed in the young population (ages 11 to 13 years). And research is needed to affirm the validity of the DB tool in an adolescent population (ages 11 to 18 years). We will test if DB differs across SOC, in both a young and older population of adolescents. Further work is needed to evaluate SEPA among the SOC using the current PA standards of 60 min of MVPA on most days of the week as the criterion measure. To this end, this study will evaluate differences in the theoretical constructs of DB and SEPA across SOC in the context of MVPA in an adolescent population.
Key to Abbreviations

This document contains numerous abbreviations. A list of these abbreviations is included in Table 1.

<table>
<thead>
<tr>
<th>Psychosocial Construct Abbreviations</th>
<th>Statistics Abbreviations</th>
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<tbody>
<tr>
<td><em>DB</em> - decisonal balance</td>
<td><em>α</em> - Cronbach alpha</td>
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<tr>
<td>A - action stage of change</td>
<td><em>ANOVA</em> - analysis of variance</td>
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<tr>
<td><em>DB-cons</em> - perceived costs of physical activity</td>
<td><em>CFA</em> - confirmatory factor analysis</td>
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<td><em>DB-pros</em> - perceived benefits of physical activity</td>
<td><em>Chi square - $X^2$</em></td>
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<tr>
<td>C - contemplative stage of change</td>
<td><em>Cohen's d</em> - effect size</td>
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<tr>
<td>M - maintenance stage of change</td>
<td><em>CFI</em> - comparative fit index</td>
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<tr>
<td>P - planning stage of change</td>
<td><em>CI</em> - Confidence Interval</td>
</tr>
<tr>
<td>PAQ-A - physical activity questionnaire for adolescents</td>
<td><em>df</em> - degrees of freedom</td>
</tr>
<tr>
<td>PAQ-C - physical activity questionnaire for children</td>
<td><em>M</em> - mean</td>
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<tr>
<td>PC - precontempative stage of change</td>
<td><em>MANOVA</em> - multivariate analysis of variance</td>
</tr>
<tr>
<td>SCT - social cognitive theory</td>
<td><em>MANCOVA</em> - multivariate analysis of covaraince</td>
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<tr>
<td><em>SEPA</em> - self-efficacy for physical activity</td>
<td><em>min – minutes</em></td>
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<tr>
<td><em>SOC</em> - stage of change</td>
<td><em>N</em> - sample size</td>
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<tr>
<td>TPB - theory of planned behavior</td>
<td><em>η^2</em> - partial eta squared</td>
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<tr>
<td><strong>Physiological Factor Abbreviations</strong></td>
<td><strong>Other Abbreviations</strong></td>
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<tr>
<td>TTM - Transtheoretical model</td>
<td>National Data Resource Abbreviations</td>
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<tr>
<td><strong>NNFI</strong> - non normed fit index</td>
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<td><strong>Physiological Factor Abbreviations</strong></td>
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<tr>
<td>BMI - body mass index</td>
<td>CDC - Centers for Disease Control and Prevention</td>
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<tr>
<td><strong>ρ</strong> - significance level</td>
<td></td>
</tr>
<tr>
<td>DBP - diastolic blood pressure</td>
<td>MVPA - moderate to vigorous physical activity</td>
</tr>
<tr>
<td><strong>r</strong> – correlation</td>
<td>NHANES - National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>HCL-C - high density lipoprotein</td>
<td>PA - physical activity</td>
</tr>
<tr>
<td><strong>rho</strong> - Spearman’s rank order coefficients</td>
<td>NHIS - National Health Interview Survey</td>
</tr>
<tr>
<td>MET - metabolic equivalents</td>
<td>PE - physical education class</td>
</tr>
<tr>
<td><strong>RNI</strong> - relative non central index</td>
<td>USDHHS - United Stated Department of Health and Human Services</td>
</tr>
<tr>
<td>MetS - metabolic syndrome</td>
<td>YRBS - Youth Risk Behavior Surveillance Survey</td>
</tr>
<tr>
<td>SBP - systolic blood pressure</td>
<td></td>
</tr>
<tr>
<td><strong>SD</strong> - standard deviation</td>
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<tr>
<td>TC - total cholesterol</td>
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<tr>
<td><strong>SRMR</strong> - standardized root mean square residual</td>
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<tr>
<td>VO₂max - maximum aerobic capacity</td>
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<tr>
<td><strong>RMSEA</strong> – root mean square error approximation</td>
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Chapter 3

Methods

Purpose

The purpose of this study was to explore the relationships of the psychosocial constructs of self-efficacy for PA (SEPA), decisional balance (DB) and stages of change (SOC) for readiness to engage in 60 min of moderate to vigorous physical activity (MVPA) on most days of the week in and adolescent population. The specific aims of the study were to:

1. describe mean age, body mass index and mean number of days per week that 60 min of MVPA was performed by the middle school and high school students recruited to this study.
2. determine if there was a gender difference in SEPA and DB scores across SOC in either the middle school or high school populations.
3. evaluate if BMI percentile was associated with SEPA or DB scores to determine if this variable should be included as a covariate in the analysis.
4. assess the validity of the SOC instrument.
5. describe the participants’ physical activity behavior and SOC in regards to the intention to perform at least 60 min of MVPA on 5 or more days per week.
6. evaluate the validity and reliability of the instruments measuring the SEPA and DB constructs.
7. describe mean differences in SEPA and DB in relation to SOC in the middle school and in the high school samples.
Multiple Site Testing

This study combined results from testing two groups of adolescents in distant regions of western U.S. Data from the first group \( (n \sim 80) \) were collected in the Spokane, WA area in the spring of 2013 and 2014. Data from the second group were collected in the Humboldt, CA area in the fall of 2013. While it is recognized that the profile of these two groups may differ, their demographics, physical characteristics and survey responses were analyzed for these differences. The combination of data collected from these two regions allowed for adequate sample size and may increase the generalizability of the results.

Human Subjects Protection

Washington State University (WSU) Institutional Review Board (IRB) approved the study protocols, parent permission and student assent forms and procedures. The students at the Spokane site participated in a larger study that evaluated food preferences, frequency of fruit and vegetable intake, body image, and physical activity. The students at the Humboldt, CA site only participated in the portion of the protocol involving physical activity assessment and beliefs and anthropometric measurements. The rationale underlying this investigation, and the potential risks and perceived benefits were explained to the participants and their guardians. Questions regarding the investigation were answered in person or by telephone or electronic mail conversations. Written permission from the parents and written assent from the participants were obtained prior to data collection and the forms were collected by teachers, school administrators and research team members (see Appendix A for student assent form and Appendix B for parent permission form). Any student volunteering for this study was included.
Recruitment

Recruitment for participation in Spokane, WA study was multi-layered in approach. First, school administrators who indicated an interested in engaging in projects to improve adolescent health were identified. Three districts within the seven school districts that had identified interest were selected to participate in the study. These three districts represented a convenience sampling, as they were selected due to proximity to the WSU and time available to conduct the testing. The districts and schools sites that were selected to participate included the only middle school in the Newport district, both of the middle schools in the Cheney district, and a community high school in the Spokane district. In the Cheney and Newport districts the school districts’ wellness coordinators facilitated recruitment on campus. The principal at the charter school personally advocated for participation in the study. The recruitment technique resulted in inconsistent results. At the Cheney schools, recruitment was so unsuccessful that data collection was canceled. At the Newport district middle school participants were given a certificate for admission to a fitness themed recreation center. Participants seemed very interested in obtaining the token gift, and this incentive may have help the wellness coordinator to recruit student participants. The principal at the charter high school was very effective in recruiting participants. The wellness coordinator in Cheney indicated that there was insufficient time to get parents to return the permission slips, and suggested that the forms be made available on their school web site. The forms were posted, but this strategy did not enhance recruitment efforts. In the Spokane, WA portion of this study, approximately 10% of the eligible participant pool volunteered and participated in the study.

The lessons learned in recruitment techniques in the Spokane, WA study were applied to facilitate recruitment of participants in the Humboldt, CA study. Recruitment for participation in
the Humboldt, CA pool was performed at multiple school sites. Support from a charter high school principal was obtained. The administrator was actively involved in the recruitment process. Support from the physical education teacher was obtained. Data were collected during the school day in the students’ physical education time period. A raffle of token gifts of sweatshirts with school emblems and $10 iTunes gift cards were conducted on several occasions in the weeks prior to data collection to encourage participants to return their paperwork. The testing was done at Academy of the Redwoods located in Eureka, CA.

Participants

**Inclusion criteria.** All students who are attending school in which the study was conducted were eligible to participate in the study. The participants had to be attending a targeted middle school or high school, provide assent, and have parental permission to participate in the study.

**Exclusion criteria.** There were no explicit exclusion criteria for participation in the study. Data were eliminated from analysis for two students who had obvious difficulty comprehending the content of the survey instruments.

Measurements

This study evaluated the relationships among psychosocial constructs of decisional balance (DB), self-efficacy for physical activity (SEPA), and stage of change (SOC). SE, DB and SOC are constructs guided by the Transtheoretical Model (Prochaska & DiClemente, 1983). The constructs selected for these studies were evaluated using surveys completed by each research participant.

The surveys were in paper format and completed on the same day as anthropometric measurements. The testing took place during the school day and was completed in less than 30
The students seemed to be engaged in the process and not distracted or fatigued by the surveys to be completed. The survey instruments were scanned for completeness when they were handed back to the research assistants. When questions were left blank, the omission was brought to the participants’ attention. They were then asked if they would like to answer the question on the survey. PA was evaluated using the Physical Activity Questionnaire for children (PAQ-C) for grades 6 to 8 (Kowalski, Crocker & Donen, 2004) and the Physical Activity Questionnaire for older children (PAQ-A) for grades 9 to 12 (Crocker, Bailey, Faulkner, Kowalski & McGrath, 1997). These survey instruments are included in the appendix (see Appendix C for PAQ-C and Appendix D for PAQ-A.)

**Stages of change.** Participants’ responses were analyzed based on their *stage of change* in the context of physical activity (PA). The SOC survey tool asks participants to reflect on their participation in MVPA. Moderate to vigorous physical activity was defined as activity that increases the heart rate and respiratory rate. This definition of MVPA has been used by others to describe the physiologic response of PA at a 3 to 6 metabolic equivalent of task (MET) level (USDHHS, 2008). Physical activity that requires 3 to 6 METs includes activities such as walking at a 3 to 4.5 miles per hour, dancing, or playing doubles tennis (Ainsworth et al., 2000). The SOC tool provided examples of MVPA including the following activities: running, brisk walking, rollerblading, biking, skateboarding, dancing, swimming, soccer, basketball, football, and surfing. Participants were asked to indicate the number of days per week that they perform a total of 60 min of MVPA. If they respond with four or less days per week, they were directed to the following question: “Do you think that you will start to do 60 min of more of physical activity on five or more days a week in the next 6 months?” The participants were provided the following options to respond: “No, and I do not intend to in the next six months”, “Yes, I intend to start to
in the next six months”, or “Yes I intend to start to in the next 30 days”. If the participants indicate they have no plans to start engaging in this level of PA in the next six months they were classified in Precontemplative stage, if they select that they plan on starting to engage in this level of PA in the next six months they were classified in Contemplative stage, and if they indicated that they plan on starting to engage in the level of PA in the next 30 days they were classified in the preparation stage. If the participants indicate they participate in the criterion behavior on five to seven days per week, they were directed to answer the following question: “How many months have you been doing 60 min of physical activity 5 or more days per week?” The participants were provided the following two options in response to this question: “less than 6 months”, and “more than 6 months”. Those who indicate that have been engaging in the criterion measure of PA for at least six months, were classified in the maintenance stage. Those participants, who indicate they had been engaging in 60 min of MVPA on greater than five days per week for less than six months, were classified in the action stage. The stages of change (SOC) tool that was administered to the participants can be found in the appendix (Appendix E – SOC Instrument).

The SOC instrument that was used in this study is novel regarding how the criterion behavior, physical activity, is defined. Current USDHHS recommendations, of greater than five days a week of at least 60 min of MVPA, was used to define the physical activity. Other SOC tools, which differ in how the criterion behavior is defined, have been used in adolescent populations and have been found to have acceptable test-retest reliability in a preadolescent population \( r = 0.77 \) (Anneis et al., 2010) and older adolescent population \( r = 0.79 \) (Nigg & Courneya, 1998). Concurrent validity of SOC instruments have been established using a variety of measures including self-report report leisure time activity (Cardinal, 1995; De Bourdeaudhuij
et al., 2005; Lee et al., 2001) and physical fitness measures (Annesi et al., 2010). Previous studies have found inadequate sample size in some of the SOC groups and found it necessary to collapse some of the groups (e.g., most commonly the precontemplative and contemplative groups were collapsed). As anticipated the PC and C stages were collapsed and the A and M stages were collapsed for data analysis.

**Decisional balance.** Participants were asked to complete a questionnaire regarding the positive and negative aspects of PA (see Appendix F - DB Instrument). The instrument was originally developed by Marcus, Rakowski et al. (1992) for use in adults and later adapted by Roesch et al. (2009) for use in an adolescent population. The tool consists of five questions regarding the **pros** of PA (DB-pros) and five questions regarding the **cons** of PA (DB-cons). The tool requires that the participants indicate how important each statement is to their decisions to be physically active. Participants rated the importance of each statement using a five point Likert scale with response choices of “not at all important”, “slightly important”, “moderately important”, “very important”, and “extremely important”. The DB-pros and DB-cons questions have been previously demonstrated to have adequate internal consistency (DB-pros $\alpha = 0.86$, DB-cons $\alpha = 0.77$), and acceptable concurrent validity using a 7-day PAR (DB-pros $r = 0.12$, DB-cons $r = -0.09$) (Roesch et al., 2009).

**Self-efficacy for physical activity.** Self-Efficacy for PA was evaluated using an eight item tool originally designed by Motl et al. (2000) and later adapted by Steele et al., (2011). The modified instrument that was used in this study, like the Motl et al. (2000) tool, asks the participant to evaluate their capability to engage in PA given eight different scenarios (Appendix G - SEPA Instrument). For instance, one of the questions is as follows: “I can ask my parent or other adult to do activity things with me”. Participants were instructed to select one of five Likert
type responses that indicate if they “disagree a lot”, “somewhat disagree”, “neither agree or disagree”, “somewhat disagree”, or “agree a lot” with the stem question. The internal consistency of the adapted tool has previously been demonstrated to be high ($\alpha = 0.86$) (Steele, Bindler, Power & Daratha, 2008). Convergent validity with perceived behavioral control ($r = 0.69$) and concurrent validity with moderate and vigorous PA determined by 3-day defined (PAR) ($r = 0.34, r = 0.17$, respectively) has been previously established (Motl et al., 2000; Motl et al., 2005). They also found acceptable test-retest reliability ($r = 0.61$).

**Anthropometric data.** Anthropometric measurements in Spokane, WA were performed by undergraduate nursing and exercise physiology students from local universities. The students were provided a training session prior to the start of the data collection each day. Similarly, anthropometric measurements in California were taken by trained personnel. These personnel were students recruited from the nursing program at College of Redwoods. The measurements were taken by personnel who are of the same gender as the participant. A training session was held to instruct the student research assistants in the protocol for measuring height, weight, and waist circumference. The assessment technique of the student research assistants was randomly checked by the researcher herself. Participants were asked to remove heavy jackets, shoes and hair adornments that may interfere with the anthropometric measurements. Participants’ privacy was guarded by providing a screen that prevents other students from observing the anthropometric assessments. Body weight was assessed using a portable digital scale. Participants were asked to step onto the digital scale. The electronic display was positioned so that only the research personnel and the participant could view the readout. Weight was recorded in kilograms to two decimal places. Height was assessed using a portable stadiometer. Participants were asked to step onto the stadiometer facing forward with the back of their head,
their back, and their heels against the vertical backboard. The participant’s head was placed so that the horizontal line form the ear canal to the lower border of the eye orbit is parallel to the floor and perpendicular to the vertical backboard. The stadiometer head piece was lowered to rest on the top of the participant’s head. The participant was asked to take a deep breath and hold this position. The stadiometer head piece was pressed onto the top of the participant’s head with sufficient force to compress the hair. The height was recorded in centimeters to one decimal place. Waist circumference just above the iliac crest of the hip was measured with a plastic tape. For this measurement the research personnel asked the participant to pull up clothing around the waist and hold their arms across their body. The trained personnel stood on the participant’s right and palpated the hip area to locate the iliac crest of the pelvis. The measuring tape was placed around the waist just above the right and left iliac crest, ensuring that the tape was in a horizontal plane parallel to the floor. The tension on the tape was firm but great enough to compress the skin. The measurement was recorded in centimeters to one decimal point at the end of a normal expiration. The protocol for these anthropometric measurements has been previously used in the National Health and Nutrition Examination Survey (CDC, 2007). The data from the anthropometric measurements was recorded on the instrument as seen in the appendix (Appendix H – Anthropometric Measurements).

**Weight status.** Weight status was calculated as BMI percentile. BMI was calculated using measured weight in kilograms divided by the square of height in meters. The LMS method was used to determine BMI percentile stratified by age and gender (Cole, Bellizzi, Flegal & Dietz, 2000). Weight status, including underweight, healthy, overweight, or obese was determined using the guidelines provided by the CDC (CDC, 2011).
**Participation in organized physical activity.** Participation in organized sports was assessed by asking a single question. The question was as follows, “Do you currently play on a sports team or go to lessons where you do PA (e.g., competitive teams, karate lessons, or dance class)?”

**Physical activity behavior.** The Physical Activity Questionnaire for children (PAQ-C) and for older children (PAQ-A) was used to provide a general measure of physical activity (see Appendices C for PAQ-C and D for PAQ-A). The PAQ instruments were a self-report recall of MVPA in the past 7 days. The instrument provided a description of MVPA as, “sports or dance that make you sweat or make your legs feel tired, or games that make you breath hard.” The PAQ instruments query about MVPA during recess, lunch and leisure time. This PAQ tools have been shown to have good test-retest reliability ($r = 0.75$ to $0.82$), internal consistency ($\alpha = 0.79$ to $0.89$), and acceptable correlation with accelerometer data ($r = 0.39$, $\rho < 0.05$) (Kowalski et al., 2004). The PAQ instruments provide a quantitative evaluation of PA using an instrument that is easy to administer, requires a minimal amount of time to complete, and is low in cost.

**Data Analysis Plan**

**Combining data.** It was the intent to combine the data collected from the Spokane, WA schools and the Humboldt, CA school. Since the primary objective of the study is to evaluate differences in $DB$ and $SEPA$ by $SOC$ grouping, multivariate analysis of variance was used to evaluate if the outcome variables differed by school when $SOC$ was taken into consideration.

**Screening data.** Data collected were screened for univariate outlier values and multivariate outlier values. Frequency distributions were examined for categorical variables. The distribution of each continuous variable was examined. Data points for $SEPA$, $DB$-Pros, and $DB$-
cons beyond three standard deviations from the respective means were evaluated for data recording accuracy. All data entry errors were corrected.

**Missing data screening.** Analysis of missing values was performed to determine if a pattern existed in the missing data. When missing data could not be rectified by reviewing the original paper survey instruments, then a missing data code was entered for analysis. SPSS version 22 was used to determine if the missing data were missing completely at random. SPSS version 22 was used to impute missing data utilizing the Expectation-Maximization algorithm method with the data was deemed to be missing completely at random (Dempster, Laird & Rubin, 1977). For bivariate correlation and multivariate analysis tests, the imputed data was used. In the confirmatory factor analysis (CFA), M plus provided multiple imputation of missing data using Bayesian analysis (Muthen & Muthen, 2012).

**Statistical Assumption Testing.** Since most parametric statistical procedures have a common assumption that the data being analyzed display a normal distribution, normality for the outcome variables was assessed using Shapiro-Wilk test. If this assumption was violated, skewness and kurtosis values were examined. Using these values as a guide, transformation of the data was attempted. When transformation failed to achieve a non significant Shapiro-Wilk test, and normality could not be achieved, then nonparametric data analytical techniques were used to evaluate the outcome variables. The plan for data analysis is presented below and was specific for each of the study aims.

**Aim #1- Describe mean age, body mass index and mean number of days per week that 60 min of MVPA was performed by the middle school and high school students recruited to this study.** For this first aim, descriptive statistics was utilized to determine the frequency distribution and percent of the population for gender, number of days per week 60
minutes of PA is performed, and weight classification (CDC, 2002). Means and standard deviations were reported for the continuous variables of age and age and gender-specific BMI percentile, and MVPA behavior.

Aim #2- Determine if there was a gender difference in outcome variables across SOC in either the middle school or high school populations. The second aim of this study was to determine if there was a gender difference in the outcome variables across SOC in either the middle school or high school populations. For data that had equality of covariance, analysis of variance (ANOVA) was performed using fixed factors of gender and SOC. For data that violated the assumption of equality of covariance, Kruskal-Wallis was used to evaluate gender differences in the outcome variables.

Aim #3- Evaluate if BMI percentile was associated with SEPA or DB scores to determine if this variable should be included as a covariate in the analysis. To determine if BMI percentile would be included in the analysis of covariance, a correlation analysis between BMI percentile and the outcome variables was conducted. Correlation strength greater than 0.1, that was statistically significant, was required for inclusion as a covariate in the subsequent analysis of variance tests (Stevens, 2001).

Aim #4- Assess the validity of the SOC instrument. To evaluate the construct validity of the SOC instrument, a second self-report survey regarding physical activity behavior was administered in a subset of middle school. Physical activity behavior, as determined by the Physical Activity Questionnaire (PAQ), and differences in PAQ by SOC levels using the Kruskal-Wallis test of ranks was evaluated.

Aim #5- Describe the participants’ physical activity behavior and SOC in regards to the intention to perform at least 60 min of MVPA on 5 or more days per week. The fifth aim
of this study was to describe the SOC of the study population. The SOC questionnaire used in the current study was developed to address the readiness to engage in 60 min of MVPA on most days of the week. The questionnaire required respondents to first select their current number of days per week that they engage in 60 min of MVPA, and then to answer a question regarding their readiness to change this behavior. Descriptive statistics were used to calculate the mean days per week that 60 min of MVPA is performed, and the percent of the population that met or exceeded this level of recommended amount of MVPA. Data were reported separately for gender and grade level.

**Aim #6- Evaluate the validity and reliability of the instruments measuring the SEPA and DB constructs.** The sixth aim was to evaluate the validity and reliability of the instruments measuring the SEPA and DB constructs. To this end, confirmatory factor analysis (CFA) was used to evaluate model fit. SPSS was used to determine correlations coefficients between the constructs and other variables to calculate Cronbach’s α or Spearman rho. Cronbach’s α or Spearman rho was employed to assess internal consistency of the instruments. Validity of the instruments was assessed by correlating the values of SEPA with DB values and by correlating PAQ with the SEPA and the DB findings.

**Aim #7- Describe mean differences in SEPA and DB in relation to SOC in the middle school and in the high school samples.** A multivariate analysis of variance was performed to investigate differences in the outcome variables by SOC groups in the middle school and high school samples separately. BMI percentile was included as a covariate only when it could be demonstrated that this factor had sufficient association strength ($r > 0.1$). Preliminary assumption testing was conducted to check for normality, linearity, and multivariate outliers, homogeneity of variance, and multicollinearity, using Kolmogrov Smirnov, scatter plots,
Mahalanobis distance, Levene’s Test and variance inflation factor test (Mertler & Vannatta, 2010). The outcome variable data was not normally distributed, but MANOVA is relatively robust to violations of this assumption when there are at least 20 cases in each cell (Tabachnick & Fidell, 2001). When the multivariate normality testing revealed violations of the assumption of multivariate outliers, two separate analyses were performed, one which retained multivariate outliers, and one which removed multivariate outliers (Portney & Watkins, 2009). When Levene’s Test revealed the assumption of equality of error variance was violated, a more conservative alpha level was selected. Variance inflation factor was less than 5 in the MANOVA tests, indicating no multicolinearity existed between the outcome variables. Estimated marginal means were used compared to evaluate main and interaction effects of the outcome variables and the covariates. When a difference among the SOC groups was found, then post-hoc comparisons using Tukey’s HSD, Duncan and Scheffe were used. Partial eta squared was calculated to determine the meaningfulness of the result (Portney et al., 2009).

**Power Analysis**

A priori power analysis cannot be done directly when MANCOVA is planned (Cohen, 1988). Instead repeat post-hoc power analyses are performed by adjusting the sample size and degrees of freedom to arrive at the a priori power value selected. For MANOVA the Pillai-Bartlett’s V criterion, rather than lambda, is used as the multivariate test statistic (Faul, Erdfelder, Lang & Buchner, 2007). The variables used to detect power include the following:

\[ p = \text{the number of dependent variables}, \]
\[ n_h = \text{the number of predictors for the effect to be tested}, \]
\[ s_h = \min(p, n_h), \]
\[ N = \text{total number of subjects summed across all groups}, \]
$k = \text{number of groups in the design,}$

$df_1 = p \times n_h \text{ (numerator degrees of freedom),}$

$df_2 = s_h \times (N-k-p+s_h)$

$f^2 = \text{multivariate effect size}$

Multivariate effect size ($f^2$) can be calculated from $\eta^2$, $V_h$ (Pillai-Bartlett’s $V$ in underlying populations) and $s_h$. (GPOWER Tutorial). For two dependent variables and five groups (PC, C, P, A, M), an expected moderate effect size, a type I error ($\alpha$) of .05, and a target power of .8 there must be 56 individuals in each of the five groups ($N = 280$) (Guildford & Frunchter, 1978).

For two dependent variables and three groups (PC/C, P, A/M), an expected moderate effect size, $\alpha$ of .5, and a target power of .8 there must be 44 individuals in each of the three groups ($N = 132$) (Guildford & Frunchter, 1978). Given this is an exploratory study, the historical difficulties in recruiting school students to participate in studies, and past research that has failed to established differences in $DB$ and $SOC$ across all the stages, it was expected that the data from the participants in this study to be combined to form three groups (i.e., PC/C, P, A/M). Thus, a minimum sample size of 132 students, 44 individuals in each of the three $SOC$ groups was determined to be the target sample size.
Chapter 4

Results

The purpose of this study was to fill gaps in the literature by exploring hypothesized differences in Self-efficacy for physical activity (SEPA) and Decisional Balance (DB) by Stages of Change (SOC) in the context of physical activity among middle school and high school students. The specific aims of the study were to:

1. describe mean age, body mass index and mean number of days per week that 60 min of MVPA was performed by the middle school and high school students recruited to this study.
2. determine if there was a gender difference in SEPA and DB scores across SOC in either the middle school or high school populations.
3. evaluate if BMI percentile was associated with SEPA or DB scores to determine if this variable should be included as a covariate in the analysis.
4. assess the validity of the SOC instrument.
5. describe the participants’ physical activity behavior and SOC in regards to the intention to perform at least 60 min of MVPA on 5 or more days per week.
6. evaluate the validity and reliability of the instruments measuring the SEPA and DB constructs.
7. describe mean differences in SEPA and DB in relation to SOC in the middle school and in the high school samples.
Multiple Site Testing

This study tested several groups of adolescents in Eastern Washington and Northwestern California. Data from the first collection period included 73 middle school students from two different schools, one located in Cheney and the other in Newport. The middle school in Cheney provided instruction for 6th through 8th grade students and the middle school in Newport provided instruction for 5th through 8th grade students. The student body was primarily Caucasian in both the schools (Cheney - 79% and Newport - 88%) (Spokane Public Schools (SPS), 2014). District data revealed eligibility for the free or reduced lunch program was 52% for the Cheney middle school and 63% for the Newport middle school (SPS, 2014). Both middle schools had intramural programs for a multitude of sports for the 6th through 8th graders. Data from the first collection period also included 85 high school students from a single high school in Eastern Washington. This high school was located in Spokane, WA and had an enrollment size of 280. The high school provided instruction for 9th through 12th grade. The student population was 67% Caucasian and 69% were eligible for the free or reduced lunch program (SPS, 2014). This school had limited intramural sport program, offering basketball for girls only. Data from the second collection period included 22 high school students recruited from a single high school in Northwestern, California in October of 2013. The school in Northwestern, California provided instruction for 9th through 12th grade. The student population was 70% Caucasian (Fortuna Union High School District (FUHSD), 2014). The enrollment at this school was 280 and 44% were qualified for the free or reduced lunch program (FUHSD, 2014). The only intramural sport offered at this high school was co-ed basketball. Data from the third collection period included 34 middle school students and 49 high school students each recruited from the same middle schools in the and high school in Eastern Washington. To determine if the data collected at the
multiple school sites and dates were substantively different in the outcome variables. MANOVA was performed using fixed factors of school site and SOC in the high school sample. The MANOVA test revealed a non significant omnibus test (Pillai’s trace = (8, 264) = 0.795, \( \rho = 0.6 \)). The middle school data violated the assumption of equality of variance and differences in outcome variables were assessed using the nonparametric test, Kruskal-Wallis. This analysis was revealed no statistically significant difference in the two outcome variables evaluated (SEPA \( - X^2 (2) = 0.218, \rho = 0.9 \); DB-pros \( - X^2 (2) = 2.029, \rho = 0.6 \)). Since the analyses revealed no significant school by SOC interaction for the outcome variables, the data from the various middle school students were combined and data from the various high school students were combined for subsequent analysis.

**Prescreening Data**

**Outlier screening.** Data collected were screened for univariate outlier values and multivariate outlier values. Frequency distributions were examined for categorical variables. The distribution of each continuous variable was examined. Data points for SEPA, DB-pros, and DB-cons beyond three standard deviations from the respective means were evaluated for data recording accuracy. In the high school population there were no data points outside three standard deviations from the mean on the outcome variables. There were four outlying data points in the middle school sample, and these cases were further evaluated. Data entry accuracy was validated and the scores were determined by the investigator to be within range of possibility. In two of the cases, the participants selected responses on the survey at the extreme end of the Likert scale for all the surveys completed. In the other two cases, the participants selected a variety of Likert responses on the survey, but did have DB-cons scores that were much higher than the mean. These individuals also had lower self-report physical activity. Since the
statistical analysis employed in this study to evaluate group differences in the outcome measures, analysis of variance, is sensitive to outliers, the analysis was run both with and without univariate and multivariate outliers included in the data set (Portney & Watkins, 2009).

**Missing data screening.** Analysis of missing values was performed to determine if a pattern existed in the missing data. Of the 147 collected surveys in the middle school sample, eight participants (5.4%) had incomplete SOC questionnaires, four participants (2.7%) had incomplete DB questionnaires, and four participants (2.7%) had incomplete SEPA questionnaires. Of the 156 collected surveys in the high school sample, seven participants (4.5%) had incomplete SOC questionnaires, six participants (3.8%) had incomplete DB questionnaires, and four participants (2.8%) had incomplete SEPA instruments. The patterns seen in the missing data were that the entire SEPA survey was not filled out in most of the missing SEPA data cases, and the most frequent missing data was in the SOC questionnaire. The SEPA was on the backside of the DB questionnaire, and many of the participants overlooked the survey. The investigator observed this error during data collection, and it was often rectified during the data collection session as the survey instruments were screened for completeness prior to the participant completing the sessions. Further, the investigator observed during data collection that the students asked the most questions about how to fill out the SOC survey when compared to the other surveys. Students often indicated the days per week they exercise, but failed to indicate if they intended to change this behavior, or how long the physical activity pattern existed. Eighteen percent of the participant’s parents did not fill out the demographics sheet, including questions required to derive the Hollingshead index. The Hollingshead index survey was eliminated after the first round of data collection as it was perceived to be a barrier to participant recruitment and
not essential to achieving the study aims. When missing data could not be rectified by reviewing the original paper survey instruments, then a missing data code was entered for analysis.

SPSS version 22 was used to determine if the missing data were missing completely at random. In the high school sample, the missing SEPA and DB survey data were deemed not to be missing completely at random by Little’s Missing Completely At Random (MCAR) test (SEPA items = $X^2(18) = 39.34$, $\rho = 0.003$; DB items $\rho < .0001$). In the high school sample, cases with missing SOC, SEPA or DB data were eliminated from analysis. In the middle school sample, the missing SEPA and DB data were deemed to be missing completely at random by the Little’s (MCAR) test (SEPA items = $X^2(14) = 18.446$, $\rho = 0.19$; DB items $X^2(18) = 36.342$, $\rho = 0.67$). For the middle school sample, SPSS version 22 was used to impute missing data utilizing the Expectation-Maximization algorithm method (Dempster, Laird, and Rubin, 1977). For bivariate correlation and multivariate analysis tests the imputed data was used. For the multivariate analysis, cases were excluded from analysis if the grouping data was missing (i.e., SOC).

**Statistical assumption testing.** Since most parametric statistical procedures have a common assumption that the data being analyzed has a normal distribution, normality for the outcome variables was assessed. In the middle school sample, the outcome variables were not normally distributed. The DB-cons scores were skewed to the left (skewness = 1.388 ± 0.21) and peaked (kurtosis = 2.163 ± 0.41), leading to a non normal distribution (Shapiro-Wilk Statistic = 0.823 (137), $\rho < 0.001$). Transforming the DB-cons using an inverse function or a log10 function did not yield a normally distributed dataset. The DB-pros scores were skewed to the right (skewness = -0.988 ± 0.21) and peaked (kurtosis = 1.013 ± 0.41), leading to a non normal distribution (Shapiro-Wilk Statistic = 0.923 (137), $\rho < 0.001$). Transforming the DB-pros data using a reflection and inverse function or a reflection and log10 function did not produce
normally distributed data. The SEPA scores were skewed to the right (skewness = -1.149 ± 0.21 and peaked (kurtosis = 1.503 ± 0.42), leading to a non normal distribution (Shapiro-Wilk Statistic = 0.909 (134), ρ < 0.001). Transforming the SEPA data using a reflection and inverse function or a reflection and log10 function did not produce normally distributed data. Since this assumption of normality was violated, nonparametric data analytical techniques were used to evaluate the outcome variables in the middle school sample.

In the high school sample the outcome variables were not normally distributed. The DB-cons scores were skewed to the left (skewness = 1.416 ± 0.21 and peaked (kurtosis = 2.216 ± 0.42), leading to a non normal distribution (Shapiro-Wilk Statistic = 0.818 (131), ρ < 0.001). Transforming the DB-cons using an inverse function or a log10 function did not yield a normally distributed dataset. The DB-pros scores were skewed to the right (skewness = -1.040 ± 0.21 and peaked (kurtosis = 1.170 ± 0.42), leading to a non normal distribution (Shapiro-Wilk Statistic = 0.917 (131), ρ < 0.001). Transforming the DB-pros data using a reflection and inverse function or a reflection and log10 function did not produce normally distributed data. The SEPA scores were skewed to the right (skewness = -1.164 ± 0.21 and peaked (kurtosis = 1.524 ± 0.42), leading to a non normal distribution (Shapiro-Wilk Statistic = 0.907 (131), ρ < 0.001). Transforming the SEPA data using a reflection and inverse function or a reflection and log10 function did not yield a normally distributed dataset. Since this assumption of normality was violated, nonparametric data analytical techniques were used to evaluate the outcome variables in the high school sample.

**Data Analysis Results for Each Aim**

**Aim #1- Describe mean age, body mass index and mean number of days per week that 60 min of MVPA was performed by the middle school and high school students**
recruited to this study. The first aim of this study was to describe mean age, body mass index and mean number of days per week that 60 min of MVPA was performed by the middle school and high school students recruited to the study.

The middle school sample was 39% male and 45% female and 17% had missing gender data. The mean age of the middle school participants was 13.2 years ($SD = 0.9$ years). The mean BMI was $20.8 \text{ kg/m}^2$ ($SD \pm 4.8 \text{ kg/m}^2$). The mean BMI percentile was $64.0 \text{ (SD} \pm 28.0)$. Weight categories following CDC guidelines were determined for the sample. Ten percent of middle school students were classified as obese, 13.7% were classified as overweight, 54.7% were classified as recommended weight, and 2.9% were classified as underweight. The mean days per week that 60 min of MVPA was performed was 4.5 ($SD \pm 1.4$ days/week). The high school population was 36% male and 56% female and 9% had missing gender data. The mean age of the high school participants was 16.8 years ($SD = 1.4$ years). The mean BMI was $25.4 \text{ kg/m}^2$ ($SD \pm 7.0 \text{ kg/m}^2$). Weight categories, following CDC guidelines, were determined for the sample. Twenty-four percent of the high school students were classified as obese, 18.1% were classified as overweight, 45.6% were classified as recommended weight, and 2.0% were classified as underweight. The mean days per week that 60 min of MVPA was performed was 3.4 ($SD = 1.8$ days/week).

Descriptive differences were observed (Table 2). The Mann-Whitney Independent Samples test was used to evaluate differences in descriptive variables as the data were not normally distributed. The mean BMI was significantly lower in the middle school sample than the high school sample ($t (262.863) = -6.52$, $p < 0.001$). The self-report of number of days per week that 60 min of MVPA was performed higher in the middle school population than the high
school sample ($t (278.595) = 5.852, \rho < 0.001$). BMI and age were not different between the genders in either the middle school or the high school samples. The self-report MVPA was lower in females when compared to males in the high school sample only ($t (133) = 2.181, \rho = 0.03$).

Table 2
*Descriptive Variables for Middle School and High School Samples*

<table>
<thead>
<tr>
<th></th>
<th>Males (Mean ± SD)</th>
<th>Females (Mean ± SD)</th>
<th>Total (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Middle School (N = 139)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>13.2 ± .9</td>
<td>13.2 ± .9</td>
<td>13.2 ± .9</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>20.2 ± 4.0</td>
<td>21.5 ± 4.7</td>
<td>20.8 ± 4.8</td>
</tr>
<tr>
<td>MVPA (days/week)</td>
<td>4.4 ± 1.5</td>
<td>4.6 ± 1.4</td>
<td>4.5 ± 1.4</td>
</tr>
<tr>
<td><strong>High School (N = 158)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>16.8 ± 1.4</td>
<td>16.8 ± 1.4</td>
<td>16.8 ± 1.4§</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.7 ± 6.8</td>
<td>25.3 ± 6.8</td>
<td>25.4 ± 7.0§</td>
</tr>
<tr>
<td>MVPA (days/week)</td>
<td>3.8 ± 1.9</td>
<td>3.1 ± 1.7*</td>
<td>3.5 ± 1.7§</td>
</tr>
</tbody>
</table>

*significantly different than males at $\rho < 0.05$

§significantly different than the middle school sample at $\rho < 0.001$

**Aim #2- Determine if there was a gender difference in SEPA and DB scores across SOC in either the middle school or high school populations.** The second aim of this study was to determine if there was a gender difference in the outcome variables across SOC in either the middle school or high school populations. Analysis of variance (ANOVA) was performed using
fixed factors of gender and SOC. Although the outcome variables were not normally distributed,
ANOVA is reasonably robust of violations of this assumption (Gravetter & Wallnau, 2000).
ANOVA was completed for the middle school and high school samples separately. Levene’s test
was used to assess homoscedasticity and was not significant (i.e. \( \rho > 0.05 \)), indicating equality of
variance between the gender-based groups, in the high school sample. In the middle school
sample, Levene’s test was significant (\( \rho < 0.001 \)) for the analysis of gender differences in SEPA
among the SOC groups. To examine if a gender difference in SEPA existed in the middle school
sample, Kruskall-Wallis test was used. The analyses revealed no significant gender by SOC
interaction for DB-pros (\( F = .291, \rho = .71 \)) or gender difference in SEPA (\( X^2 (1) = 0.017, \rho = .90 \))
in the middle school sample. There was no significant gender by SOC interaction for DB-pros or
SEPA in the high school sample (\( F = .247, \rho = .78 \) and \( F = .465. \rho = .63 \), for SEPA and DB-pros
respectively). Thus, with no gender differences observed, data from the males and females were
combined in both the middle school and high school samples.

**Aim #3- Evaluate if BMI percentile was associated with SEPA or DB scores to
determine if this variable should be included as a covariate in the analysis.** The third aim of
the study was to evaluate if BMI percentile was associated with SEPA or DB scores. Previous
evidence indicates that a negative relationship exists between BMI percentile and SEPA (Steele
et al., 2011). To be included in the MANCOVA, a variable should have a significant relationship
with the outcome variables (Mertler & Vanatta, 2010). To determine if BMI percentile would be
included in the analysis of covariance, a correlation analysis between BMI percentile and the
outcome variables was conducted. BMI percentile did not have a significantly strong association
with the outcome variables in the middle school sample to be included as a covariate (DB-pros –
\( r = -0.06, \rho = .27 \); SEPA – \( r = -0.006, \rho = .48 \)). BMI percentile was significantly correlated with
one outcome variable, $DB$-pros, in the high school sample ($r = 0.21, p < 0.001$). BMI percentile, therefore, was included as a covariate in the analysis of variance in the high school sample to determine if $SOC$ differences existed in mean scores for the outcome variables.

**Aim #4- Assess the validity of the $SOC$.** To evaluate the construct validity of the $SOC$ instrument, a second self-report survey regarding physical activity behavior was administered in a subset of middle school ($N = 41$) and high school ($N = 77$) students. Physical activity behavior, as determined by the Physical Activity Questionnaire (PAQ), was shown to be different by $SOC$ levels using the Kruskal-Wallis test of ranks in the high school sample ($X^2 (2) = 16.456, p < 0.001$), but not in the middle school sample ($X^2 (2) = .644, p = .73$). The results of the Kruskal-Wallis Rank Test are presented in Table 3.

<table>
<thead>
<tr>
<th>Table 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Activity Question (PAQ) by Stage of Change (SOC)</strong></td>
</tr>
<tr>
<td><strong>Middle School Sample</strong></td>
</tr>
<tr>
<td><strong>SOC</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>PC/C ($N = 13$)</td>
</tr>
<tr>
<td>P ($N = 6$)</td>
</tr>
<tr>
<td>A/M ($N = 22$)</td>
</tr>
<tr>
<td>#PAQ was not significantly different by $SOC$ level using Kruskal-Wallis Test of ranks ($X^2 (2) = 0.64, p = .72$)</td>
</tr>
<tr>
<td><strong>High School Sample</strong></td>
</tr>
<tr>
<td><strong>SOC</strong></td>
</tr>
</tbody>
</table>
Aim #5- Describe the participants’ physical activity behavior and SOC in regards to the intention to perform at least 60 min of MVPA on 5 or more days per week. The fifth aim of this study was to describe the SOC of the study population. The SOC questionnaire used in the current study was developed to address the readiness to engage in 60 min of MVPA on most days of the week. The questionnaire required respondents to first select their current number of days per week that they engage in 60 min of MVPA. In the middle school group 58% of the group indicated that they engaged in five or more days a week of recommended amounts of physical activity ($M = 4.5$ days/week, $SD = 1.4$ days/week). In the high school group, 33% of the group indicated that they engaged in recommended amounts of physical activity ($M = 3.5$ days/week, $SD = 1.8$ days per week). In the SOC questionnaire, if the participants indicated zero to four days per week, then the survey instructions directed them to select their intention to alter this behavior. Individuals who indicated they engaged in less than 5 days of recommended PA and did not intend to change this behavior in the next six months, were placed in the pre-contemplative (‘PC’) SOC [middle school $N = 7$ (5%), high school $N = 26$ (17%)]. Individuals who indicated they engage in less than five or more days of recommended PA but intend to change this behavior in the next 6 months, were placed in the contemplative (‘C’) SOC [middle

<table>
<thead>
<tr>
<th></th>
<th>(Mean ± SD)</th>
<th>Kruskal-Wallis Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC/C ($N = 41$)</td>
<td>1.7 ± .1</td>
<td>29</td>
</tr>
<tr>
<td>P ($N = 19$)</td>
<td>2.2 ± .2</td>
<td>47</td>
</tr>
<tr>
<td>A/M ($N = 17$)</td>
<td>2.6 ± .2</td>
<td>55</td>
</tr>
</tbody>
</table>

$\$ PAQ was significantly different by SOC levels using the Kruskal-Wallis test of ranks ($X^2 (2) = 16.456, \rho < 0.001$)
school \(N = 27\) (19\%), high school \(N = 44\) (30\%)). Individuals who would be classified as PC and C were combined into a single group, hereafter referred to PC/C, due to the small sample size available for subsequent analyses. Study participants that indicated that they engaged in less than 5 days of recommended PA, but intended to change this behavior in the next 30 days, were placed in the preparation (‘P’) SOC [middle school \(N = 24\) (17\%), high school \(N = 30\) (20\%)]. Individuals who indicated they engaged in five or more days of recommended PA, and had done so for less than 6 months, were placed in the action (‘A’) SOC [middle school \(N = 22\) (16\%), high school \(N = 17\) (11\%)]. Finally, individuals who indicated they engage in five or more days of recommended amount of PA, and had done so for more than 6 months, were placed in the maintenance (‘M’) SOC [middle school \(N = 59\) (42\%), high school \(N = 32\) (22\%)]. Individuals who were classified as A and M phases were combined into a single group, hereafter referred to A/M. Table 4 demonstrates the data from the SOC instrument.

Table 4

<table>
<thead>
<tr>
<th>Stage of Change (SOC) for the Middle School and the High School Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>PC ((N = 7))</td>
</tr>
<tr>
<td>C ((N = 27))</td>
</tr>
<tr>
<td>P ((N = 24))</td>
</tr>
<tr>
<td>M ((N = 59))</td>
</tr>
</tbody>
</table>
Middle school sample was ranked higher than the high school sample on SOC ($X^2 (1) = 19.60$, Asymp significance < 0.001)

Aim #6- Evaluate the validity and reliability of the instruments measuring the SEPA and DB constructs. The sixth aim was to evaluate the validity and reliability of the instruments measuring the SEPA and DB constructs. To this end, confirmatory factor analysis (CFA) was used to evaluate construct validity, and Cronbach’s $\alpha$ or Spearman $\rho$ was employed to assess internal consistency of the instruments. Validity of the instruments was assessed by correlating the values of SEPA with DB values and by correlating PAQ with the SOC, SEPA and the DB findings.

Decisional balance. The construct of decisional balance was adapted from an instrument used in an adult population (Roesch et al., 2009). Janis and Mann indicated in their theory of decisional balance two opposing forces drive health related behavior (1977). The two components include the perceived positive aspects of engaging in a specific behavior ($pros$) and the perceived negative aspects of engaging in a specific behavior ($cons$). The DB concept has been operationalized in survey instruments as a single construct, composed of the two components, $DB-pros$ and $DB-cons$ (Prochaska et al., 1994). In DB surveys, DB is computed as if it is a multidimensional test, composed of the two correlated attributes, $DB-pros$ and $DB-cons$. A single DB score is calculated by subtracting the sum of the T scores for the $DB-cons$ responses from the sum of the T scores of the $DB-pros$ responses. The psychometric properties of the DB scale have not been evaluated and reported in an adolescent population. Thus, validity and reliability of this survey was evaluated prior to proceeding to the planned analysis of mean differences in SEPA and DB by SOC. The items in the DB instrument can be found in Table 5.
Table 5

*Items for the Decisional Balance Instrument*

<table>
<thead>
<tr>
<th>Items Regarding the Benefits of Physical Activity (<em>DB-pros</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item 1</strong></td>
</tr>
<tr>
<td><strong>Item 2</strong></td>
</tr>
<tr>
<td><strong>Item 3</strong></td>
</tr>
<tr>
<td><strong>Item 4</strong></td>
</tr>
<tr>
<td><strong>Item 5</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Items Regarding the Costs of Physical Activity (<em>DB-cons</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item 1</strong></td>
</tr>
<tr>
<td><strong>Item 2</strong></td>
</tr>
<tr>
<td><strong>Item 3</strong></td>
</tr>
<tr>
<td><strong>Item 4</strong></td>
</tr>
<tr>
<td><strong>Item 5</strong></td>
</tr>
</tbody>
</table>

*Confirmatory factor analysis for the DB instrument in the middle school sample.* The ten items in the *DB* scale were subjected to confirmatory factor analysis (CFA). CFA with Geomin oblique rotation using Mplus version 7.2 (Muthen & Muthen, 2012) was performed. Maximum likelihood parameter estimates with standard errors and chi-test statistics were used as they are robust to non normality (Muthen & Muthen, 2012). A number of tests that evaluate model fit were conducted. The chi square test indicated that the theoretical and expected values were
different ($X^2 (34) = 62.572, \rho = 0.002$). Since the chi square test is affected by the size of the correlation in the model and sample size, additional fit indices were conducted. Tucker Lewis Index (TLI) and the Comparative Fit Index (CFI) tests, which assess the fit of the theoretical model when compared to the null model, were evaluated. Acceptable model fit values for both TLI and CFI are close to 0.95 (Hu & Bentler, 2009). For the two factor model, TLI was 0.849 CFI was 0.886. Root Mean Square Error of Approximation (RMSEA) an absolute measure of fit was evaluated. RMSEA values of 0.08, 0.05 and 0.01 have been suggested as cutoffs for mediocre, good, and excellent fitting models (MacCallum, Browne & Sugawara (1996). RMSEA for the two factor model was 0.076. Standardized root mean square residual (SRMR), another measure of absolute model fit, was also evaluated. SRMR values below 0.08 are considered a good fit (Hu & Bentler, 1999). The two factor model had a SRMR value of 0.059. The model fit statistics indicate that the two factor model for DB in the middle school sample had mediocre fit.

The CFA analysis was repeated for the DB-pros portion of the DB instrument. The pros portion of the instrument had good fit indices ($X^2 (5) = 9.505, \rho = .09; \text{RMSEA} = 0.078; \text{CFI} = 0.969, \text{TLI} = 0.937; \text{SRMR} = 0.033$). These indices reveal there was a good fit of the DB-pros data to a single factor model.

Assessing convergent validity. For the DB instrument with both the DB-pros and DB-cons subscale, nine of the ten items had significant loading factors on one of the two factors. The items on the DB-pros scale had substantial factor loadings on the DB-pros component (range = 0.623 to 0.833). This finding indicates that the DB-pros survey items were correlated with adequate strength with the DB-pros component and demonstrated good convergent validity. For the DB-cons component of the DB instrument, item 4 had very poor loading (0.164), indicating poor association of this item with the DB-cons component. The remaining DB-cons instrument
items had moderate loading (i.e., 0.405 to 0.833) on the DB-cons component, thus these items demonstrated adequate convergent validity. Table 6 shows the completely standardized loadings for the two-factor model.

Assessing reliability of DB instrument in the middle school sample. The internal consistency of the DB scale was evaluated using Cronbach’s α. The test revealed adequate internal consistency of the DB-pros scale (α = 0.81). The internal consistency of the DB-cons scale in the middle school sample was also evaluated using Cronbach’s α. The test revealed poor internal consistency for the DB-cons scale (α = 0.54). Elimination of item 4 on the DB-cons scale resulted in only a marginal improvement in internal consistency (Cronbach’s α = 0.60) short of the recommended minimum Cronbach’s alpha level of 0.70 (Nunnally & Bernstein, 1994).

<table>
<thead>
<tr>
<th>Table 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor Loading for Decisional Balance (DB) Survey in the Middle School Sample</strong></td>
</tr>
<tr>
<td>Instrument Item</td>
</tr>
<tr>
<td>Help me stay fit</td>
</tr>
<tr>
<td>Parents would be happy</td>
</tr>
<tr>
<td>I would feel better about myself</td>
</tr>
<tr>
<td>I would have fun with friends</td>
</tr>
<tr>
<td>I would have more energy</td>
</tr>
<tr>
<td>I would feel embarrassed</td>
</tr>
<tr>
<td>There is too much to learn</td>
</tr>
<tr>
<td>Need to much Parental support</td>
</tr>
</tbody>
</table>
Assessing correlation between dimensions of the DB instrument in the middle school sample. Spearman’s rank order correlation was used to evaluate the relationship between the two dimensions, DB-pros and DB-cons of the DB instrument. The test revealed little shared variance between the DB-pros and DB-cons scores (rho = -0.11, p = .50). Visual inspection of the scatter plot of these two variables confirms there appears to be no relationship between the two components of DB-pros and DB-cons. The results of these analyses support the use of the DB-pros and DB-cons as separate scales (Watson, Clark & Tellegen, 1988).

Assessing validity of the DB instrument in the middle school sample. Evaluation of validity of the DB-pros and DB-cons scales, using PAQ as a criterion measure of physical activity, revealed a statistically significant relationship between DB-pros and PAQ (rho = 0.46, p = 0.006), but not between DB-cons and PAQ (rho = -0.24, p = 0.11).

The construct validity of the DB-pros and DB-cons scales was evaluated by comparing these variables with SEPA. From the TTM, it would be predicted that the DB-pros scale would have a positive relationship with SEPA, and the DB-cons scale would have a negative relationship with SEPA. A significant positive relationship between DB-pros and SEPA was found (rho = 0.49, p < 0.001) and a significant negative relationship between DB-cons and SEPA was found (rho = -0.30, p < 0.001).

Summary of the performance of the DB instrument in the middle school sample. These findings indicate that in the middle school sample the DB-pros subscale had adequate internal
consistency, construct validity and convergent validity to be used in the planned analysis of variance. The DB-pros and DB-cons scales addressed unique constructs with little shared variance. The validity of the DB-cons scale could not be established and it had poor internal consistency. Because of the poor psychometric properties, the DB-cons scale was eliminated from the planned subsequent analysis.

**Confirmatory factor analysis for the DB instrument in the high school sample.** The ten items in the DB scale were subjected to CFA with Geomin oblique rotation using Mplus version 7.2 (Muthen & Muthen, 2012). Maximum likelihood parameter estimates with standard errors and chi-test statistics were used as they are robust to non normality (Muthen & Muthen, 2012). The two-factor model had poor fit indices ($X^2 (34) = 94.203$, $p < 0.001$, CFI = 0.782; TLI = 0.712; RMSEA = 0.107; SRMR = 0.084). The model fit statistics indicate that the two factor model for DB in the high school sample had poor fit.

The CFA analysis was repeated for the DB-pros portion of the DB instrument. The DB-pros portion of the instrument had marginal fit indices ($X^2 (5) = 17.014$, $p = .005$; RMSEA = 0.124; CFI = 0.922, TLI = 0.845; SRMR = 0.046). These fit indices reveal a mediocre to poor fit of the DB-pros data to a single factor model.

**Assessing convergent validity of DB instrument in the high school sample.** For the DB instrument, nine of the ten items had moderate to strong loading factors. The item that addressed taking time away from friends had weak factor loading (-0.301, $p < 0.05$). The items on the DB-pros scale had factor loadings in the range of 0.465 to 0.846. The DB-cons items had factor loadings ranging from 0.301 to 0.629. This finding indicates that the DB-pros had adequate convergent validity. For the DB-cons component of the DB instrument, four of the five items had
adequate convergent validity. Table 7 shows the completely standardized loadings for the two-factor model.

Assessing reliability of DB instrument in the high school sample. The internal consistency of the DB-pros and DB-cons scales was evaluated using Cronbach’s α. The test revealed poor internal consistency for the DB-cons scale (α = 0.52). If item 5 was removed from the analysis, internal consistency was improved (α = 0.61). The DB-pros scale had adequate internal consistency (α = 0.74).

<table>
<thead>
<tr>
<th>Instrument Item</th>
<th>DB-Pros Standardized Loading</th>
<th>DB-Cons Standardized Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help me stay fit</td>
<td>0.747*</td>
<td></td>
</tr>
<tr>
<td>Parents would be happy</td>
<td>0.465*</td>
<td></td>
</tr>
<tr>
<td>I would feel better about myself</td>
<td>0.846*</td>
<td></td>
</tr>
<tr>
<td>I would have fun with friends</td>
<td>0.558*</td>
<td></td>
</tr>
<tr>
<td>I would have more energy</td>
<td>0.679*</td>
<td></td>
</tr>
<tr>
<td>I would feel embarrassed</td>
<td></td>
<td>0.508*</td>
</tr>
<tr>
<td>There is too much to learn</td>
<td></td>
<td>0.629*</td>
</tr>
<tr>
<td>Need to much Parental support</td>
<td></td>
<td>0.445*</td>
</tr>
<tr>
<td>I don’t like how it makes me feel</td>
<td></td>
<td>0.624*</td>
</tr>
<tr>
<td>Too much time away from friends</td>
<td></td>
<td>0.301*</td>
</tr>
</tbody>
</table>

* = ρ < 0.05
Assessing correlation between dimensions of the DB instrument in the high school sample. Spearman rank order correlation was used to evaluate the relationship between the two factors, DB-pros and DB-cons. The analysis revealed that these variables had little shared variance \((\rho = -0.05, \rho = .28)\). The results of these analyses support the use of the DB-pros and DB-cons as separate scales (Watson et al., 1988).

Assessing validity of the DB instrument in the high school sample. Validity of the DB-pros and DB-cons scales was evaluated using PAQ as the criterion measure of PA. Bivariate correlation demonstrated a statistically significant association between DB-pros and PAQ \((\rho = 0.28, \rho = 0.02)\), but failed to demonstrate a statistically significant association between DB-cons and PAQ \((\rho = -0.16, \rho = .11)\).

The construct validity was evaluated by comparing the DB-pros and DB-cons variables with SEPA. From the TTM it would be predicted that the DB-pros variable would be associated in positive fashion with SEPA, and DB-cons would have an inverse relationship with SEPA. A significant positive relationship between DB-pros and SEPA was found \((r = 0.49, \rho < 0.001)\), and a significant negative relationship between DB-cons and SEPA was found \((\rho = -0.45, \rho < 0.001)\).

Summary of the performance of the DB instrument in the high school sample. These findings indicate that in the high school sample the DB-pros subscale had adequate internal consistency, construct validity and convergent validity to be used in the planned MANCOVA. The DB-pros and DB-cons scales addressed unique constructs. The validity of the DB-cons scale could not be established and was eliminated from subsequent analysis.

Self-efficacy for physical activity. The SEPA instrument was devised to assess a single dimension of a multi-dimension concept of SE. The SEPA tool assesses barrier SE, evaluating the
participants’ belief that he/she can overcome barriers to physical activity. The items in the SEPA survey can be found in Table 8.

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

Dimensionality of the SEPA instrument in the middle school sample. The eight items in the SEPA scale were subjected to CFA with Geomin oblique rotation using Mplus version 7.2 (Muthen & Muthen, 2012). Maximum likelihood parameter estimates with standard errors and chi-test statistics that are robust to non normality (Muthen & Muthen, 2012). All eight items had significant loading factors on the single factor. Table 9 shows the completely standardized loadings for the one-factor model with all eight items. A number of tests that evaluate model fit were conducted. The chi square test indicated that the theoretical and expected values were different ($X^2 (20) = 34.023, p = 0.03$). Since the chi square test is affected by the size of the correlation in the model and sample size additional fit indices were conducted. Tucker Lewis Index (TLI) and the Comparative Fit Index (CFI) tests, which assess the fit of the theoretical
model when compared to the null model, were evaluated. Acceptable model fit values for both TLI and CFI are close to 0.95 (Hu & Bentler, 2009). For the one factor model, TLI was 0.941 and CFI was 0.958. Root Mean Square Error of Approximation (RMSEA) an absolute measure of fit was evaluated. RMSEA values of 0.08, 0.05 and 0.01 have been suggested as cutoffs for mediocre, good, and excellent fitting models (MacCallum et al., 1996). RMSEA for the single factor model was 0.070. Standardized root mean square residual (SRMR), another measure of absolute model fit, was also evaluated. SRMR values below 0.08 are considered a good fit (Hu & Bentler, 1999). The single factor model had a SRMR value of 0.046. The model fit statistics indicate that the single factor model for SEPA in the middle school sample had adequate fit.

Table 9

Component Matrix for the Self-Efficacy for Physical Activity (SEPA) Survey in the Middle School Sample

<table>
<thead>
<tr>
<th>Item</th>
<th>Item Content</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Free time</td>
<td>0.767*</td>
</tr>
<tr>
<td>Item 2</td>
<td>Parent</td>
<td>0.601*</td>
</tr>
<tr>
<td>Item 3</td>
<td>TV or play video games</td>
<td>0.662*</td>
</tr>
<tr>
<td>Item 4</td>
<td>Weather</td>
<td>0.683*</td>
</tr>
<tr>
<td>Item 5</td>
<td>Friends</td>
<td>0.642*</td>
</tr>
<tr>
<td>Item 6</td>
<td>At home</td>
<td>0.746*</td>
</tr>
<tr>
<td>Item 7</td>
<td>Physical ability</td>
<td>0.539*</td>
</tr>
<tr>
<td>Item 8</td>
<td>Busy</td>
<td>0.733*</td>
</tr>
</tbody>
</table>

* = ρ < .05
Assessing reliability of SEPA in the middle school sample. The internal consistency of the SEPA scale was evaluated using Cronbach’s $\alpha$. The test revealed adequate internal consistency ($\alpha = 0.87$).

Assessing validity of the SEPA instrument in the middle school sample. Evaluation of validity of the SEPA scale using PAQ as the criterion measure of PA revealed a statistically significant positive relationship between SEPA and PAQ ($r = 0.54, \rho = 0.01$).

Summary of the performance of the SEPA instrument in the middle school sample. CFA revealed adequate fit of the single factor model for the SEPA instrument. All eight items had significant loading factors on the single factor. The tests revealed the SEPA instrument had adequate reliability and validity. The psychometric properties of the SEPA instrument were sufficient to include SEPA in the subsequent analysis in the middle school sample.

Dimensionality of the SEPA instrument in the high school sample. The eight items in the SEPA scale were subjected to CFA with Geomin oblique rotation using Mplus version 7.2 (Muthen & Muthen, 2012). Maximum likelihood parameter estimates with standard errors and chi-test statistics that are robust to non normality (Muthen & Muthen, 2012). All eight items had significant loading factors on the single factor. Table 10 shows the completely standardized loadings for the one-factor model with all eight items. A number of tests that evaluate model fit were conducted. The chi square test indicated that the theoretical and expected values were not different ($X^2 (20) = 24.007, \rho = 0.2$). Acceptable model fit values for both TLI and CFI were found (TLI = 0.981; CFI = 0.986). RMSEA was 0.036, indicating good model fit. SRMR was below 0.08 (SRMR = 0.036) indicating good fit of the data to a single factor model. The model fit statistics indicate that the single factor model for SEPA in the high school sample had adequate fit.
Table 10

Component Matrix for the Self-Efficacy for Physical Activity Survey in the High School Sample

<table>
<thead>
<tr>
<th>Item</th>
<th>Item Content</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Free time</td>
<td>0.736*</td>
</tr>
<tr>
<td>Item 2</td>
<td>Parent</td>
<td>0.353*</td>
</tr>
<tr>
<td>Item 3</td>
<td>TV or play video games</td>
<td>0.630*</td>
</tr>
<tr>
<td>Item 4</td>
<td>Weather</td>
<td>0.728*</td>
</tr>
<tr>
<td>Item 5</td>
<td>Friends</td>
<td>0.532*</td>
</tr>
<tr>
<td>Item 6</td>
<td>At home</td>
<td>0.594*</td>
</tr>
<tr>
<td>Item 7</td>
<td>Physical ability</td>
<td>0.665*</td>
</tr>
<tr>
<td>Item 8</td>
<td>Busy</td>
<td>0.763*</td>
</tr>
</tbody>
</table>

* = ρ < 0.05

Assessing reliability of the SEPA instrument in the high school sample. The internal consistency of the SEPA instrument was evaluated using Cronbach’s α. The test revealed adequate internal consistency of the SEPA scale (α = 0.83).

Assessing validity of the SEPA instrument in the high school sample. Evaluation of validity of the SEPA scale using PAQ as the criterion measure of PA revealed a statistically significant positive relationship between SEPA and PAQ (r = 0.58, ρ < 0.001).

Summary of the performance of the SEPA instrument in the high school sample. CFA confirmed adequate model fit for a one factor model. The test revealed adequate internal consistency and good external validity. The psychometric properties of the SEPA instrument were sufficient to include it in the planned multivariate analysis.
Aim # 7- Describe mean differences in SEPA and DB in relation to SOC in the middle school and in the high school samples. A multivariate analysis of variance was performed to investigate differences in SEPA and DB-pros among groups formed by the three SOC (i.e., PC/C, P and A/M). The outcome variables used were SEPA and DB-pros, and the group variable used was SOC. Since BMI percentile was associated with DB-pros in the high school sample it was included in the multivariate analysis as a covariate.

Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance, and multicolinearity. The outcome variable data was not normally distributed, but MANOVA is relatively robust to violations of this assumption when there are at least 20 cases in each cell (Tabachnick & Fidell, 2001). Multivariate normality testing revealed violations of the assumptions of multivariate outliers in the middle school sample only. A small portion of the cases (2.3%) in both the middle school had Mahalanobis distances that were greater than the critical chi-square value of 13.82 (Tabachnik & Fidell, 1996). Since MANOVA is sensitive to multivariate outliers, the analysis was run without these cases. Levene’s Test revealed the assumption of equality of error variance was violated for the outcome variable of SEPA in both the middle school sample and the high school sample and for the outcome variable DB-pros in the high school sample. As recommended Tabachnick and Fidell (2001), a more conservative alpha level of 0.01 was selected.

Differences in SEPA and DB-pros for the middle school sample. The mean values of self-reported scores for DB-pros and SEPA by SOC can be found in Table 1. IBM SPSS version 22 was used to perform multivariate analysis (MANOVA) for the outcome variables of DB-pros and SEPA. For the middle school group, the omnibus test was statistically significant [Pillai’s
Trace (4,260) = 0.079, $\rho = 0.03$. There was a statistically significant difference in $DB$-$pros$ among the $SOC$ groups [$F (2,777) = 26.925$, $\rho < 0.001$, $\eta^2 = 0.065$]. Post hoc testing using Tukey’s HSD, Duncan and Bonferroni formulas all found consistent statistical difference in $DB$-$pros$ between the PC/C and the A/M groups ($\rho < 0.001$), and the P and the A/M groups ($\rho < 0.001$). There was a statistically significant difference in $SEPA$ among the $SOC$ groups [$F (2,777) = 27.102$, $\rho < 0.001$, $\eta^2 = 0.065$]. Post hoc testing using Tukey’s HSD, Duncan and Bonferroni all found consistent statistical difference between in $SEPA$ between the PC/C and the A/M groups ($\rho < 0.001$). The difference in $SEPA$ between the P group and the A/M group failed to reached the adjusted alpha level of 0.0125 in all of the post hoc tests (Scheffe test - $\rho = 0.02$).

$DB$-$pros$ and $SEPA$ were different between the precontemplative/contemplative $SOC$ category and the action/maintenance $SOC$ category. Neither $DB$-$pros$ nor $SEPA$ were different between the PC/C group and the P. The outcome variable of $DB$-$pros$ was different between the preparation $SOC$ group and the action/maintenance $SOC$ group. The difference in SEPA between the preparation $SOC$ group and the action/maintenance $SOC$ group failed to reach the alpha level of 0.0125 in all post hoc tests. In conclusion, the MANOVA found differences in the outcome variables between some, but not all of the $SOC$ groups.

<table>
<thead>
<tr>
<th>$SOC$ Group</th>
<th>$SEPA$ Mean ± SD</th>
<th>$DB$-$pros$ Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC/C ($N = 32$)</td>
<td>29.4 ± 7.4§</td>
<td>18.3 ± 4.3*</td>
</tr>
<tr>
<td>P ($N = 23$)</td>
<td>31.6 ± 4.3</td>
<td>18.6 ± 3.6*</td>
</tr>
</tbody>
</table>

*Note: * indicates a statistically significant difference at the 0.0125 level.
PC/C = precontemplative and contemplative; P = preparation; A/M = action and maintenance

* significantly different than A/M group (ρ < 0.025)
§ significantly different than A/M group (ρ < 0.01)

**Differences in SEPA and DB-pros for the high school sample.** IBM SPSS version 22 was used to perform multivariate analysis (MANOVA) for the outcome variables of DB-pros and SEPA. The mean values of self-reported scores for DB-pros and SEPA by SOC can be found in Table 12. For the high school group, the omnibus test was statistically significant [Pillai’s Trace (4.244) = 0.291, ρ < 0.001]. MANCOVA revealed a significant difference among SOC groups for DB-pros [F (2,752) = 28.659, ρ < 0.001, η² = 0.110]. When the covariate of BMI percentile was included, the difference in DB-pros across SOC persisted, and the effect size increased (η² = 0.162). Post hoc testing using Tukey’s HSD, Duncan and Scheffe found a statistical difference between the means of SEPA for PC/C and both P and A/M groups. MANCOVA revealed a significant difference among SOC groups for SEPA [F (2,752) = 120.579, ρ < 0.001, (η² = 0.243)]. The covariate of BMI percentile had little impact of effect size (η² = 0.244). Post hoc testing using Tukey’s HSD, Duncan and Scheffe all found a statistical difference between the means of SEPA for PC/C and both P and A/M groups. Post hoc testing also revealed a difference between the means of DB-pros for PC/C and A/M groups only. The means scores for SEPA and DB-pros can be found in Table 12.
<table>
<thead>
<tr>
<th>SOC Group</th>
<th>SEPA Mean ± SD</th>
<th>DB-pros Mean ±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC/C (N = 64)</td>
<td>24.1 ± 6.7§#</td>
<td>16.6 ± 4.3§</td>
</tr>
<tr>
<td>P (N = 29)</td>
<td>30.9 ± 4.7§</td>
<td>20.8 ± 2.8§</td>
</tr>
<tr>
<td>A/M (N = 48)</td>
<td>31.1 ± 6.1</td>
<td>17.8 ± 4.5</td>
</tr>
<tr>
<td>Total = 141</td>
<td>27.9 ± 7.0</td>
<td>17.9 ± 4.4</td>
</tr>
</tbody>
</table>

§ significantly different than A/M group (p < 0.01)
# significantly different than P group (p < 0.01)

**Summary**

In the middle school and high school populations the SEPA instrument and DB-pros subscale of the DB instrument had adequate psychometric properties to be included in the planned MANOVA. Mean DB-pros scores were higher in the A/M group than the PC/C and P groups. However, the portion of the variance in DB-pros attributed to SOC was small, as seen in the low partial eta squared value ($\eta^2 = 0.065$). There was no mean difference in DB-pros scores between the PC/C and P group. There was a significant difference in mean SEPA scores among the SOC groups, but the partial eta squared was small ($\eta^2 = 0.065$). Post hoc testing revealed group mean difference in SPEA between the PC/C and A/M groups only.
In the high school group significant mean differences in $DB$-$pros$ and $SEPA$ scores were observed among the $SOC$ groups. The amount of variance in $DB$-$pros$ explained by $SOC$ was small ($\eta^2 = 0.110$), and improved when BMI percentile was included as a covariate ($\eta^2 = 0.162$). Post hoc tests revealed a statistically significant mean difference in $DB$-$pros$ scores between the A/M group and both the P and PC/C groups. There was a significant mean difference in $SEPA$ scores among $SOC$ groups, with a partial eta square approaching moderate effect ($\eta^2 = 0.243$). For the $SEPA$ outcome variable, post hoc testing revealed group mean differences between the PC/C and A/M groups and between the PC/C and P groups.
Chapter 5

Discussion

The Transtheoretical Model (TTM) has been used to gain insight into how individuals achieve behavior change, including adoption of a physically active lifestyle. This model has been used as a framework to evaluate and understand the progressive stages individuals move through as they adopt a new behavior or change an existing behavior (Prochaska & DiClemente, 1983). TTM integrates key constructs from other theories to provide a comprehensive overarching theory of behavior change. Behavior change is seen as fluid process driven by cognitive and motivational factors (Janis & Mann, 1997; Marcus, Selby et al., 1992; Marcus & Owen, 1992). Cognitive processes include decisional balance (DB) and motivational factors include self-efficacy (SE). Both DB and SE are constructs that are hypothesized to be proximal mediators that predict movement towards a distal targeted behavior (Bandura, 1977; Pajares & Urdan, 2006; Velicer et al., 1985). By using the TTM to frame the goal of behavior change, it is predicted that change occurs in a series of steps that is driven by weighing the perceived benefits and barriers to adoption of a new behavior and is facilitated by a belief in one’s capacity to adopt and maintain the behavior change.

The purpose of this study was to explore the relationships of the psychosocial constructs of self-efficacy for physical activity (SEPA), decisional balance (DB) and stages of change (SOC) for readiness to engage in 60 min of moderate to vigorous physical activity (MVPA) on most days of the week in younger and older adolescent populations.

Differences in SEPA and DB for the Middle School Sample

A step in mediation analysis, the conceptual theory test, involves establishing that a significant relationship between the putative mediator and the behavior exists. In the context of
PA, SEPA and the perceived benefits (pros) and perceived barriers (cons) have been shown to have a positive association with physical activity in a younger adolescent population (Sallis, 2000). These studies have not evaluated the relationships of SEPA and DB within the framework of SOC. Theoretically, the effect of SEPA and DB on PA behavior varies by SOC (Prochaska & DiClemente, 1983). A paucity of research exists that evaluates the relationship of SEPA and DB with PA in an adolescent population within the SOC framework. Initial studies have found that SEPA was greater at higher SOC in preadolescent (Annesi et al., 2010) and early adolescent populations (Hausenblas et al., 2002). Further, a 12-week interventional study, found that changes in SEPA significantly mediated changes in PA behavior in preadolescent African American girls (Annesi et al., 2010). The single study that evaluated DB within the SOC framework in a young adolescent population found that DB, DB-pros subscale and DB-cons subscale, did not differ by SOC (Hausenblas et al., 2002). No studies were found that have evaluated DB as a mediator for change in PA behavior change in a young adolescent population.

Our study sought to evaluate the relationship of SEPA, DB-pros, DB-cons and PA in a young adolescent population (i.e., middle school aged). In our study, the DB-cons subscale in the DB instrument had poor psychometric performance in the middle school sample and was eliminated from the planned multivariate analysis. For the middle school sample, there was a statistically significant difference among SOC for SEPA and DB-pros. Post hoc testing found a statistical difference of the means between the PC/C group and the A/M group for SEPA and DB-pros, and a difference in DB-pros between the P and A/M group. Using a different SEPA instrument in a middle school population (N = 357) than was used in this study, Hausenblas et al. (2002) found a similar effect size for SEPA differences among SOC groups (w² = .07). Hausenblas et al. (2002), identified a statistically significant difference in SEPA between the M
group and all other SOC groups, and between the A group and the P group (i.e., PC/C, P, A < M and P < A). In our study, we had a small sample size in the P group, and there may have been insufficient power to identify differences between the P (N = 23) and either the A/M group (N = 77) or the PC/C group (N = 32). SEPA did not differ between individuals who have been engaged in recommended MVPA for less than 6 months (Action SOC) and individuals who have been engaged in recommended MVPA for greater than 6 months (Maintenance SOC). SEPA also did not differ among the stages of change that address readiness to change physical activity behavior (PC, C and P). Thus, as seen in other studies, SEPA was different between some but not all of the SOC groups.

The information obtained from the DB instrument was not as rich as that found in the SEPA instrument. The DB-cons subscale was eliminated from analysis due to its poor psychometric properties. Hausenblaus et al. (2002) utilized a different DB balance scale (Nigg & Courneya, 1998) in a middle school population (N = 387) and did not find a statistically significant difference in DB-cons ($F(3,363) = 4.18, \rho = .006$) or DB-pros ($F(3,363) = 1.58, \rho > .05$). These data indicate that the perceived DB-pros and DB-cons of PA, as measured by two different DB scales, were not different among middle school adolescents with varying SOC. This may mean that PA behavior in the young adolescent is not driven by cognitive factors, that young adolescents do not consciously weigh the benefits and costs of action prior to engaging in the behavior. Given the poor psychometric performance of the DB instrument used in this study, conclusion regarding cognitive factors that influence PA behavior in an adolescent population cannot be drawn. Further work is needed to develop a DB instrument that reflects adolescents’ beliefs about the benefits and costs of engaging in MVPA. Exploration of the processes that
drive PA behavior in the young adolescent is needed to elucidate potential mediators of change in PA behavior.

It is of some concern that the DB tools employed in Hausenblas et al. (2002) and this study may not have content validity. The psychosocial constructs of DB were developed and tested initially in adult populations. The DB instruments used in physical activity research in an adolescent population have been adapted from these adult tools originally developed to assess smoking behavior. The items in the adapted tools may not include the perceived benefits (i.e., DB-pros) or perceived costs and barriers (i.e., DB-cons) to physical activity as seen from the young adolescents’ perspective. To date, no study has elicited middle school students’ beliefs about MVPA using DB as a framework for the interview.

Although studies have not evaluated beliefs regarding physical activity using DB as a guide, there is relevant information that can be garnered from past research in adolescent populations. A review study of physical activity studies in adolescent populations identified that perceived competence, intention, depression (inverse), sensation seeking, parental support, support from others, physically active sibling, and opportunities to exercise were consistently shown to be associated with PA (Sallis, Prochaska & Taylor, 2000). Several of the variables, including mood, sibling interaction, and opportunity are not addressed in the DB tool utilized in this study. Robbins et al. (2010) interviewed boys aged 11 to 13 years (N = 40) and identified several beliefs about the benefits of PA that are not found on the DB instrument used in this study, including having an average body weight, making them happy, taking out aggression, building confidence, being popular, and getting girls’ attention (Robbins et al., 2010). Humbert et al. (2006) conducted mixed gender focus groups and found that middle school adolescents believe that PA programs should have the following qualities: being fun, making the participants
feel competent, fostering new friendships, having adult involvement, being organized, being close by and being affordable. These aforementioned studies have revealed several perceptions regarding the benefits, or DB-pros, associated with PA that are not addressed in the DB instrument and if included in a new tool, could improve the instruments psychometric properties. No research to date has directly explored young adolescents’ perceptions regarding the negative aspects of PA (i.e., DB-cons). Several factors identified in research assessing the barriers to exercise could be conceived as DB-cons. Many of these factors are not addressed in the DB instrument and could improve the performance of the DB-cons scale in predicting PA behavior if they were included. The potential DB-cons identified include exercise is hard work, physical activity takes too much time, and physical activity programs cost too much money (Humbert et al., 2006; Robbins et al., 2010). Further exploration of young adolescents’ beliefs regarding the benefits and losses associated with physical activity is necessary to improve the content validity of the DB instrument.

**Differences in SEPA, DB-pros and DB-cons for the High School Sample**

As was the case in the middle school sample, the DB-cons subscale in the DB instrument had poor psychometric performance in the high school sample and was subsequently eliminated from the planned multivariate analysis.

To allow comparison to previous research, SOC group difference in the psychometric constructs were evaluated using analysis of variance. Since the DB-pros and SEPA variables were correlated, multivariate analysis was conducted. Gender and BMI percentile were evaluated as potential covariates. BMI percentile was included in the analysis of variance as a covariate (MANCOVA) as BMI percentile had an association with DB-pros. The MANCOVA revealed a statistically significant difference in SEPA ($\eta^2 = 0.244$) and DB-pros ($\eta^2 = 0.110$) by SOC level.
These findings are supported by Nigg & Courney (1998) who found DB-pros and SEPA differed by SOC in older adolescents (N = 858). Nigg & Courney (1998) found greater effect sizes than was seen in this study, as a medium effect size for DB-pros ($w^2 = .11$) and a large effect size for SEPA ($w^2 = 0.24$) were found. Several studies have used a different DB tools (Marcus, Rakowski et al., 1992) than was used in this study, and have found that DB-cons scores differed by SOC (Berry et al., 2005; Nigg & Courneya, 1998). In this study, post hoc testing found a statistical difference between the means of SEPA for the PC/C group and both the P and A/M groups (PC/C < P, PC/C < A/M). Others have found SOC group differences in SEPA between PC and all other stages and between P and A/M stages (Berry et al., 2005; Nigg & Courneya, 1998). Post hoc testing in this study also revealed a difference in DB-pros between the PC/C group and the A/M group and between the P and A/M group (PC/C < A/M, P < A/M). Others have found a difference between PC and C groups but not between C and P group (Berry et al., 2005 & Nigg & Courneya, 1998). In this study, we did not find a difference in DB-pros between the PC/C and P. The apparent discrepancy in our findings may be due to the fact that we combined individuals from the PC and C groups into a single category. Since SEPA has consistently been shown to differ by SOC and to have a larger effect size it may be the more promising mediator variable, when compared to DB, in future PA research.

Responses on the SEPA instrument and the DB-pros scale from the DB instrument were evaluated separately in the PC group (N = 23) to determine if there were specific item responses that were unique to this group. Answers for the individual scale items, for both the SEPA or DB-pros instruments, were not uniquely different in the PC group when compared to the entire sample. These results indicate that PA interventions will have to target perceived barriers and
benefits to PA in a multitude of domains to help older adolescents in the PC stage to change their MVPA behavior.

**Demographics and Anthropometric Measurements**

**Middle school.** The mean age of the middle school sample was 13.2 years. The age of this sample is comparable to other studies that evaluated the TMM construct in a middle school population (Hausenblaus et al., 2002). The mean BMI of the middle school sample was 20.7 kg/m² (SD ± 4.4 kg/m²). This mean BMI is comparable to other research studies evaluating SEPA and/or DB in a middle school population (Steele, Burns & Whitaker, 2013). Thirteen percent of the group was obese and 17.6 percent were overweight. National survey data indicate a greater prevalence of obesity in adolescents, aged 12 to 19 years (18.2%) than seen in this study (Ogden, Carroll, Kit & Flegal, 2012). Considerable geographic variation exists in prevalence of obesity (Levi et al., 2013). Since the middle school population was recruited from Washington State, weight categorization demographics at the state level were sought. A national study that reported weight category data by state of children aged 10 to 17 years, found that in Washington 11% of the children were obese and 18.4% were overweight (National Survey of Children’s Health (NCSH), 2007). Data from Washington State Department of Health indicates that 10% of 8th grade students are obese and 14% are overweight (Washington State Department of Health (DOH), 2012). The study sample of middle school students was slightly higher in obesity and overweight prevalence than reported by other state agencies. The disparity findings may be due to how data were collected. In this study both height and weight were measured by trained health workers and in both the NSCH and Washington DOH data were obtained via self-report. BMI calculated from self-report data has been shown to be lower than when BMI is calculated from direct measured height and weight (Gorber and Tremblay, 2010). The
discrepancies in self-report data include both under-reporting weight and over-reporting height and have been shown to underestimate prevalence of obesity by 3% (Gorber & Tremblay, 2010). The higher BMI and greater prevalence of obesity and overweight in the study population than in survey is most likely due to measurement not due to a true difference in BMI.

**High school.** The mean age of the high school sample was 16.8 years (SD ± 1.4 years). The age of this sample is comparable to other studies that evaluated the TMM construct in a high school population (Nigg & Courney, 1998; Berry et al. 2005). The mean BMI of the middle school sample was 25.6 kg/m² (SD ± 7.1 kg/m²). No other study evaluating *SEPA* and *DB* across *SOC* in an older adolescent population has reported BMI or weight category. Based on the CDC percentile curves (Kucamarski et al., 2000), 26% of the group was categorized as obese and 21.5% was categorized as overweight. The prevalence of obesity in this sample of high school students was higher than previously reported in national data (Ogden, Carroll, Kit & Flegal, 2012). Since state related differences in rates of obesity and overweight have been demonstrated, data at the state level was also compared to our findings. Since the sample pool was recruited from both Washington and California state schools, data from these two states were obtained. In the Spokane, WA data collection, the anthropometric data revealed that 29% of the sample were classified as obese and 19% of the sample were classified as overweight. Self-report data collected by the Washington State Department of Health indicated that the prevalence of obesity was 10% and the prevalence of overweight was 13% in 10th and 12th grade adolescents (Washington State DOH, 2012). The difference in the measured BMI of the study group and the predicted BMI from survey data cannot be reconciled with expected differences in self-report and measured data. This large of a difference in prevalence of both obesity and overweight,
likely represents a true difference in BMI of the study population compared to the population at large in WA.

In the Humboldt, CA data collection, the anthropometric data revealed that 18% of the sample was categorized as obese and 23% was categorized as overweight. A national study that reported weight categorization of children (10 to 17 years) by state found that in California 15.5% of children were obese and 15.0% were overweight. Research to date has documented that weight categorization data not only varies by state, but also by region within a state (CDC, 2012). To determine if the stratification of the weight categorization from Humboldt, CA data collection was representative of regional high school students, regional data regarding weight categorization were sought. The California Center for Public Health Advocacy evaluated weight categorization in Humboldt County and found that 14.1% of 9th graders were obese and 26.9% of 9th graders were overweight (California Center for Public Health Advocacy, 2006). The prevalence of obesity seen in our sample from the Humboldt, California data collection were slightly higher than the findings of State data from the National Survey of Children’s Health study (18.2% versus 15.5%) and the findings of regional data from the California Center for Public Health Advocacy (18.2% versus 14.1%). The data from this study had slightly higher rates of overweight than that reported in Humboldt, CA by the California Center for Public Health Advocacy data (22.7% versus 26.9%). The higher BMI in the Humboldt data collection sample, when compared BMI from regional data, may be attributed to the difference in avenues of assessing the anthropometric measurements.

Comparison of middle school and high school descriptive variables. The high school sample had greater BMI than the middle school population. CDC growth charts demonstrate that height and weight, and therefore BMI, is expected to be higher in older adolescents than younger
adolescents (Cole et al., 2000). The rates of obesity and overweight were higher in the high school sample than the middle school sample (obesity rates - 26% and 13%, respectively and overweight rates – 21.5% and 17.6%, respectively). Cross-sectional data reveals that rate of obesity is stable from the 8th to 12th grade (Washington State DOH, 2012). The high school population is higher in rates of obesity and overweight than the population at large.

**Physical Activity Behavior**

**Middle school.** The USDHHS has recommended a minimum of 60 min of MVPA on most days of the week for individuals between the ages of 6 and 17 years (USDHHS, 2008). In this study, the mean number of days that at least 60 min of MVPA was performed each week for girls was 4.6 days per week (SD ± 0.2) and for boys was 4.5 days/week (SD ± 0.2 days). Fifty-six percent of the middle school boys and 67% of the middle school girls indicated that they performed 60 min or more of MVPA on five or more days per week. A national survey, YRBS, used the same self-report evaluation of MVPA as this study. The YRBS results were reported by state, and the results demonstrate that the percent of the middle school population surveyed that met current MVPA recommendations varied by state and gender (CDC, 2012). The YRBS survey found that the range of prevalence of middle school students engaging in recommended amounts of MVAP in the states sampled was 50% to 70% for boys and 44% to 60% for girls (CDC, 2012). Girls sampled in the YRBS survey were less likely to be engaged in recommended MVPA when compared to boys in most states surveyed (CDC, 2012). The results in the current study differ from the YRBS study in two ways. First, our data indicated a greater percent of the girls engaged in recommended MVPA when compared to the percent of the boys that engaged in recommended MVPA (67% versus 57%). Second, the prevalence of girls performing recommended amount of MVPA in this study was higher than that the prevalence reported in any
of the states included in the YRBS study (CDC, 2012). Social bias may account for the greater prevalence in this study, as the school districts have instituted policy and programs to combat childhood obesity. Both schools had wellness coordinators who worked to promote PA in the student body. In addition, the middle school in Newport, WA has received a $700,000 grant to promote physical education. Thus, the difference may be due to the programmatic changes in the district that have led to greater prevalence of organized sports activity and higher levels of engagement in MVPA. A review study found that engagement in organized sports lead to higher levels of engagement in PA (Nelson et al., 2011).

In this study, 79% of the middle school girls and 72% of the middle school boys indicated they were engaged in an organized sports activity. The prevalence of participation in sports activity was higher in our sample, than has been previously reported. A national survey conducted by the Minnesota Amateur Sports Commission found that 66% of boys and only 52% of school aged youth (age 5 – 18 years) participated in an organized sports activity outside of school (1990). Others have found a gender difference in organized activity requiring physical activity. A study by the National Council of Youth Sports reported that of the participants in the organized sports survey found that only 34% were female and 66% percent were male (2008). The prevalence of organized sports was higher in the girls in our sample than in the boys. Participation in organized physical activity in leisure time may account for the greater MVPA in the girls in this study.

**High school.** Physical activity was evaluated by self-report by two measures in this study. One instrument required participants to simply select the number of days per week they engaged in 60 or more min. The other instrument, the PAQ, required self-report of physical activity in various domains, including during PE class, after school, in the evenings and on the
weekends (Kowalski et al., 2004). The mean number of days that at least 60 min of MVPA was performed each week was 3.6 days/week ($SD \pm 1.9$ days) for the high school males and 3.1 days/week ($SD \pm 1.7$ days). In the high school students, 46.7% of the males and 21.5% of the females indicated that they performed 60 min or more of MVPA on five or more days per week. The YRBS national survey ($N = 15,048$) found similar prevalence for meeting MVPA recommendation in male high school students (prevalence = 49.5%, $S.E. = 1.0\%$), but the YRBS results found a much higher prevalence of female high school students meeting this recommendation than was found in this study (prevalence = 38.5% versus 21.5%, respectively).

The influence of organized sports on daily MVPA may have also accounted for the lower than expected MVPA in the high school group of students. Only 29% of these students indicated that they participated in organized physical activity outside of PE class. Unlike the middle school study sample, a higher percent of the boys than the girls indicated that they were presently engaged in an organized sporting activity (girls = 22% and boys = 36%). The YRBS survey of 2011, found that 57.1% of high school females and 65.6% of high school males indicated that they engaged in at least one sports team in the past year (CDC, 2012). The YRBS question regarding organized sport activity is temporally different than was posed in this study. YRBS asks about behavior over the past 12 months and the question in this study asked about present behavior. The YRBS casts a wider net than this study, as it captures student athletes that may only participate in a single sporting activity that is conducted in a particular season. The lower MVPA in the high school girls in this study when compared to national survey data may be due to the fact that neither of the high schools from which the study sample was recruited offered school sports.
Comparison of middle school and high school physical activity. The self-report of number of days per week that 60 min of MVPA performed was higher in the middle school population than the high school sample ($t (312) = 6.968, p < .001$). This finding of greater MVPA in younger when compared to older adolescents is well supported by others (Fulton et al., 2011; Nader, et al., 2008; Sallis, 2000; Toriano et al., 2008).

Stage of Change

The stage of change questionnaire used was developed to address the readiness to engage in 60 min of MVPA on most days of the week. The survey had two components. The first question determined whether the participant was actively engaged in recommended MVPA. If the participant indicated that they engaged in 60 min of MVPA on five or more days per week, then the second question determined if this behavior has been established for less than 6 months or more than 6 months. If the participant indicated that they engaged in less than recommended amount of MVPA, then the next question determined their readiness to change that behavior.

SOC in the middle school population. The majority of the middle school sample indicated that they were engaged in a minimum of 60 min of MVPA on 5 or more days per week (58.4%). The majority of the middle school sample was placed in either the Maintenance SOC (41.7%) or the Action SOC (16.7%). The minority of the middle school sample indicated that they were not engaged in 60 min of MVPA on more than five days per week (41.6%). A small minority of the middle school students were placed in the Precontemplative SOC (5.3%), and placement in the remaining stages of Contemplation, Preparation were roughly equivalent (C= 18.9%, P = 17.4%). The distribution of middle school students into the SOC categories in this study was quantitatively different than seen by Hausenblas et al. (2002). Hausenblas et al. (2002) found 87% of the middle school students were either placed in the A or M stage of change. The
SOC instrument used by Hausenblas et al. (2002) defined PA as 20 min of MVPA on three to 5 days per week, and the instrument used in this study defined PA as ≥ 60 min of MVPA on five or more days per week. It is not unexpected that apportionment of our samples differed, with A and M stage membership reduced in our sample when compared to Hausenblas et al. (2002). In our study, 92% of the sample indicated that they engaged recommended amount of MVPA on three or more days per week, which is not substantially different from the 87% who indicated that they engaged in at least 20 min of MVPA on three or more days per week in Hausenblas et al. (2002).

Despite the difference in definition of the criterion PA behavior, the distribution of the middle school students into the various stages of change in this study was similar to that seen by others (De Bourdeaudhuij et al., 2005; Hasenblaus et al., 2002). We found the most prevalent SOC was M (41.7%) and the least prevalent SOC was PC (5.3%). A Finnish study of 12 – 13 year olds (N = 1623) found that a minority of students were not engage in “sufficient sports or physical activity” and did not intend to change their behavior (PC = 7.6%), and the majority had been engaged in sufficient sports or PA for longer than 6 months (M = 59.5%) (De Bourdeaudhuij et al., 2005). We found that distribution in the stages was roughly equivalent among the C, P an A stages (C= 18.9%, P = 17.4%, A = 16.7%). De Bourdeaudhuij et al. (2005) also found that the percent of young adolescents were roughly equivalent among C, P and A stages (C= 10.2%, P = 11.2%, A = 11.6%). These findings suggest that the majority of middle school population were engaged in recommended amounts of MVPA. Of those middle school students not engaged in sufficient MVPA, only a small minority were not thinking about changing their behavior. This suggests that efforts to encourage MVPA in middle school students would appeal to a larger portion of the population if the program focused on enabling students
who are seeking to change (i.e., C or P) or recently changed their PA behavior (A), rather than
focusing on the small minority of young adolescents who are not seeking to change their
behavior change (i.e., PC).

To evaluate the validity of the SOC instrument, a second self-report survey regarding
physical activity behavior was administered in a subset of the middle school study population (N = 43). Physical activity behavior, as determined by the PAQ, was not correlated with SOC and
was not shown to be different by SOC levels using the Kruskal-Wallis test of ranks. Hausenblas et al. (2002) had similar findings, as they were also not able to demonstrated differences in self-report moderate PA using the Leisure Time Exercise Questionnaire (LTEQ) in a middle school population [F (3,373) = 1.22, ρ > .05]. Hausenblas et al. (2002) did, however, find promising results for SOC related differences in self-report strenuous PA using the LTEQ, but failed to
reach the Bonferroni adjusted significance level of ρ < .004 [F (3,375) 4.03, ρ = .008]. These
findings suggest that middle school student may be better able to recall vigorous bouts of PA, as
they are more memorable within the context of a relatively active lifestyle.

It was expected that the PA behavior would be different between the PC/C groups and the
A/M groups. Individuals who engaged in recommended levels of MVPA were placed in the A
group if they started this behavior less than 6 months ago, and were placed in the M group if they
had been engaged this behavior greater than 6 months ago. Individuals who did not engage in the
criterion level of MVPA were placed in groups based on their readiness to make a change in the
behavior, not on their actual behavior. It may be that the younger adolescent can accurately recall
their current PA behavior, but may have difficulty determining if or when they plan on changing
their behavior. Perhaps the roughly equivalent distribution of C, P, and A SOC groups seen in
other middle school population studies reflects a random selection of one of these stages by the participants (De Bourdeaudhuij et al., 2005; Hausenblas et al., 2002).

**High school.** Only 34% of the high school students indicated that they participated in recommended amount of MVPA of \( \geq 60 \) min on five or more days per week. Two-thirds of these individuals indicated that they had been performing this level of PA for 6 months or more, and were placed in the Maintenance SOC \((N = 31)\). One-third of these individuals indicated that this behavior was established less than 6 months ago and were placed in the Action SOC \((N = 17)\). The majority of the high school sample indicated that they were not engaged in a minimum of 60 min of MVPA on five or more days per week (66%). A portion of these students indicated that they were planning on changing their current PA behavior. If the students indicated that they were intending to engage in the recommended amount of MVPA in the next 30 days they were placed in the Preparation SOC \((N = 29)\). If students indicated that they were intending to engage in recommended amount of MVPA in the next 6 months they were placed in the Contemplative SOC \((N = 41)\). A minority of the high school students were not engaged in recommended amounts of MVAP and did not intend on changing their behavior and were placed in the Precontemplative SOC \((N = 23)\).

Other studies that evaluated SOC in a high school aged population have found different stage distribution of the study population than was found here. Berry et al. (2005) evaluated SOC in 15 to 17 year olds \((N = 327)\) who attended a private boarding high school and found a low group membership in the PC stage (1.6%) and large group membership in the A and M stages (57%). Nigg et al. (1998) also found a low group association for the PC stage (2.1%) and a high prevalence of engagement in the criterion level of PA (65%) in community high schools \((N = 1406)\). In these studies, the criterion level of PA was different than as described in our study.
Berry et al. (2005) described the criterion behavior as 15 to 60 min of MVPA on 3 to 5 days per week, and Nigg et al. (1998) defined the criterion PA behavior as an average of ≥ 20 – 30 min of vigorous activity on three occasions per week. The quantity of MVPA used to define the criterion level PA for these studies may account for the lower group membership in PC and higher group membership in A/M stages than was seen in this study. In this study, current recommendations for MVPA was used to define the criterion PA behavior, which included longer duration of MVPA (≥ 60 min) and greater frequency of MVPA (≥ 5 days per week). It is not unexpected that fewer high school students indicated they were engaged in the greater degree of MVPA in our study when compared to other studies. In this study 63% of the study population indicated that they engaged in MVPA on three or more days per week. This level of PA has been reported by others (Berry et al., 2005; Nigg et al., 1998). As recommended duration and frequency of MVPA have increased, fewer adolescents are engaging in target levels of MVPA. Further, a greater percent of older adolescents have indicated that they are not contemplating changes to their current PA behavior when the criterion description of PA behavior is ≥ 60 min on ≥ 5 days per week, than when the criterion description of PA behavior is ≥ 20 – 30 min of vigorous activity on three occasions per week.

To evaluate the validity of the SOC instrument, a second self-report survey regarding physical activity behavior was administered in a subset of the high school students (N = 82). Physical activity behavior, as determined by the PAQ, was shown to be different by SOC. Others have also found that self-report levels of vigorous PA differed by SOC in a mixed age adolescent population (De Bourdeaudhuij et al., 2005) and a high school aged population (Berry et al., 2005). These results provide support that the SOC instrument is a valid assessment of MVPA behavior in a high school aged population.
**Middle school versus high school.** A larger percent of the middle school sample than the high school sample were engaged in recommended amounts of MVPA. This finding is in agreement with national survey studies that have found a downward trend in MVPA over the course of adolescence (Fulton et al., 2011; Nader, et al., 2008; Toriano et al., 2008). A higher percent of the middle school sample was place in the action and maintenance SOC when compared to the high school sample, due to the age-related difference in prevalence of engaging in recommended MVPA. Both the high school and middle school samples had a higher prevalence of individuals in the PC SOC than seen in other studies (De Bourdeaudhuij et al., 2005; Berry et al., 2005, Hausenblaus et al., 2002; Nigg et al., 1998). This is likely due to the greater duration and frequency in the criterion PA behavior used in this study, when compared to the criterion PA behavior description used in the other studies.

**Self-Efficacy for Physical Activity**

*Self-efficacy* is important in health-related decisions as it determines whether a behavior will be initiated, how much effort will be expended in changing the behavior, and how long it will be sustained in the face of obstacles (Bandura, 1990). Through decades of research on *self-efficacy* Bandura concluded that the most effective means to foster *SE* was through successful experiences, especially if obstacles must be overcome for the goal to be attained (1995). To evaluate SE for overcoming barriers in the context of PA several instruments have been developed. The self-efficacy for physical activity (SEPA) instrument, used in this study, has been previously tested in a middle school population, but not in a high school population (Steele et al., 2013).

**Middle school.** The psychometric properties of the SEPA instrument were evaluated by conducting CFA using Mplus and determining correlations using SPSS. The instrument had
good internal reliability ($\alpha = .87$). Steel et al. (2013) also found that the SEPA had adequate internal reliability ($\alpha = .81$). The SEPA scores correlated with PAQ ($r = 0.4$, $\rho = .01$) and DB-pros ($r = 0.4$, $\rho < .0005$) and number of days of PA activity ($r = 0.4$, $\rho = .01$). This provides evidence of the validity of the SEPA instrument. All eight items had strong factor loadings (ranging from 0.64 to 0.79), providing evidence of convergent validity. In Steele et al. (2013) study, one item regarding the adolescents’ ability to engage an adult in PA was excluded from analysis as it had poor loading ($r = 0.3$, $\rho < .01$). Our group mean for this item was 3.78 ($SD \pm .1$) and Steele et al. (2013) found a group mean of 3.49 ($SD \pm 1.22$). The barrier efficacy pertaining parental support was lower ($\rho \approx 0.03$) in the Steele et al. (2012) group than in the middle school group in this study. Recall that the middle school students in this study had a higher prevalence of participation in organized sporting activity. Given the age of the participants, it is anticipated that a parent would provide transportation to those activities. Perhaps in this group, the students felt that they could engage an adult in physical activity because they were already receiving support for their organized sports activity.

**High School.** The psychometric properties of the SEPA instrument were evaluated by conducting CFA using Mplus and determining correlations using SPSS. The instrument had good internal reliability ($\alpha = .87$). Steel et al. (2013) also found that the SEPA had adequate internal reliability ($\alpha = .81$). The SEPA was correlated with PAQ ($r = 0.40$, $\rho = .01$) and DB-pros ($r = 0.40$, $\rho < .005$) and days of PA activity ($r = 0.40$, $\rho = .01$). This provides evidence of the validity of the SEPA instrument. Seven items had substantial factor loadings (ranging from 0.580 to 0.797), providing evidence of convergent validity. A single item, regarding the ability to engage an adult in PA, has marginal factor loading (0.391). Steele et al. (2013) found poor loading of this item in a middle school aged population. In the high school study population,
most who were of driving age, may not perceive parental engagement in PA as a potential barrier to their engagement in recommended levels of MVPA. The SEPA instrument was shown to have good internal reliability and convergent validity in an older adolescent population.

**Middle school versus high school.** SEPA was higher in the middle school sample than the high school sample ($t = 4.824, \rho < .005$). Since a larger portion of the middle school population was engaged in regular MVPA when compared to the high school population, and SEPA was correlated with PA, it was not unexpected that SEPA was higher in this group. SEPA was not different between these groups when accounting for SOC.

**Decisional Balance**

The process by which adolescents make health related decisions is an important aspect of understanding current behavior patterns and facilitating behavior change. In this study we utilized the construct of *Decisional Balance* to evaluate factors that may influence physical behavior in adolescents. *DB* was originally envisioned to be driven by four distinct factors: utilitarian gains and losses for self, utilitarian gains and losses for others, self-approval or disapproval, and approval or disapproval by others (Janis & Mann, 1977). To date, *DB* surveys that have been devised for numerous health related behavior, have found only two factors. These two factors in the *DB* construct are called the *DB-pros* and *DB-cons* (Prochaska et al., 1994). Paucity of research exists that has been devoted to evaluating the *DB* construct in the context of PA in an adolescent population. The psychometric properties of this scale have not been reported. Thus, one of the aims of this study was to evaluate this psychosocial construct in a younger adolescent and an older adolescent population.

**Middle school.** CFA was used to evaluate the fit of the *DB* data to a two-factor model. CFA found this model had in poor fit indices. The *DB-cons* sub scale had poor psychometric
properties and was eliminated from further analysis. CFA was used to evaluate the fit indices of the DB-pros subscale. The DB-pros subscale was found to have good fit. The DB-pros subscale had adequate internal consistency, construct validity and convergent validity to be used in the planned analysis of variance. Hausenblaus et al. (2002) found similar psychometric properties of a different DB instrument. They found that the DB instrument addressed two factors, DB-pros and DB-cons with little shared variance between the factors ($r = 0.23$). In our study, the DB-cons portion of the DB instrument had poor internal consistency and was not found to be related to PA as measured by the PAQ or associated with DB-pros. Hausenblaus found moderately strong loading factors for their six item DB-cons scale (0.39 to 0.64), but internal consistency was not reported. Due to poor performance of the DB-cons portion of the DB scale in our study, DB and DB-cons were eliminated from the planned analysis of variance. Further work is needed to develop a DB-cons subscale that has improved psychometric properties in a young adolescent population. Given the present evidence, it is uncertain if the theoretical construct does not apply to this age, or if the instrument fails to represent the latent construct of perceived DB-cons to PA in a young adolescent population.

High school. CFA was used to evaluate the fit of the DB data to a two-factor model in a high school population. Most of the instrument items had substantial loading factors. The CFA, however, revealed poor fit indices for a two-factor model. The DB-pros also had good internal reliability and substantial factor loadings. The DB-cons subscale had poor internal reliability and low to adequate factor loads. Due to poor performance of the DB-cons portion of the DB scale, DB and DB-cons were eliminated from analysis. CFA was repeated using the DB-pros subscale data alone. The single factor model had good fit indices. As we found, Prochaska et al. (1994) previously reported that DB instruments for a variety of health related behavior were composed
of two latent constructs, \textit{DB-pros} and \textit{DB-cons}. In this study the \textit{DB-pros} and \textit{DB-cons} scales were not related to each other. The \textit{DB-pros} scores had a significant but weak positive correlation with PAQ. Others have demonstrated a weak correlation of \textit{DB-pros} with self-report measures of moderate or strenuous exercise (Berry et al., 2005; Nigg et al., 2002). The \textit{DB-pros} scores were correlated with the \textit{SEPA} scores. Nigg et al. (1998) also found that \textit{DB-pros} scores were related to \textit{SEPA} scores ($r = 0.45$, $p < .01$). The psychometric findings indicate that the \textit{DB-pros} subscale had adequate internal consistency, construct validity and convergent validity to be used in the planned analysis of variance. As was found in the middle school sample, further work is needed to develop a \textit{DB-cons} subscale that has improved psychometric properties in an older adolescent population.

\textbf{Gender Differences}

Because others have reported gender differences in psychosocial constructs in the context of PA, one of the aims of this study was to determine if there was a gender difference in the outcome variables (\textit{SEPA, DB-pros}) across \textit{SOC} in either the middle school or high school populations (Sallis et al., 2000). ANOVA was performed using fixed factors of gender and \textit{SOC}. This analysis was completed for the middle school and high school samples separately. The analysis revealed no significant gender by \textit{SOC} interaction for the outcome variables of \textit{SEPA} or \textit{DB-pros} in the middle school sample or in the high school sample. This finding from our analysis indicates that gender does not appear to modify the relationship between these constructs.

\textbf{Conclusions}

Previous research has shown that engagement in MVPA progressively declines throughout adolescence (Fulton et al., 2011; Nader et al., 2008; Troiano et al., 2008). As
expected, we found the prevalence of engagement in recommended MVPA was lower in the older adolescents than the younger adolescents. Sports participation has been promoted as a means to facilitate engagement in MVPA. In this study, engagement in organized sports was high as expected in male middle school students, but much higher than expected in the female middle school students. A greater prevalence of middle school students were engaged in recommended amounts of MVPA then was seen by others. This observation provides anecdotal evidence to support the promotion of organized physical activity to facilitate engagement in MVPA. Previous studies have found that males engage in more PA than females (Fulton et al., 2011; Nader et al., 2008; Troiano et al., 2008). The higher than expected engagement in organized physical activity in the middle school girls may account for the lack of gender difference in PA in this sample. We found that the high school students were less likely to be engaged in an organized sporting activity when compared to the middle school students or when compared to national survey data (National Council of Youth Sports, 2008). This may be unique to the sample population, as the high students were drawn from community schools that did not offer team sports.

In an effort to better understand how to effectively encourage U.S. youth to engage in daily PA a growing body of research has been devoted to developing and applying theoretical models that attempt to explain mechanisms of PA behavior. To this end, this study utilized a cross-sectional design to evaluate TTM constructs, SEPA and DB, in a younger and an older adolescent population. The DB-cons portion of the DB instrument had poor psychometric properties it was dropped from analysis. Further work is needed to explore the adolescents’ beliefs about the cons of MVPA. The SEPA and DB-pros portion of the DB instrument had adequate psychometric properties. SEPA was different by SOC in both the middle school and
high school populations. The portion of variance in SOC explained by SEPA or DB-pros was negligible in the middle school sample. This finding indicates that the constructs, as measured by the instruments used in this study, do not account for differences in PA behavior in the younger adolescent. Further work in exploring these constructs in a younger adolescent population is needed. In the high school sample, a greater portion of variance in SOC was explained by SEPA. This finding indicates that SEPA should be explored further as a potential mediator of MVPA behavior in an older adolescent population. The DB-pros portion of the DB instrument was different by SOC. The constructs of DB-pros or SEPA across SOC did not differ by gender. This provides evidence that gender may not modify the relationship between SOC and SEPA or DB-pros. BMI percentile correlated with DB-pros score in the high school population. As BMI percentile increased, the perceived benefit of PA increased. It was included in the MANCOVA and was found to increase explained variance in SOC by DB-pros from 11% to 16%. BMI percentile was shown to be a variable that may be important to consider in future mediation-moderation studies. A summary of the study findings can be found in Table 13.

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<th>Table 13</th>
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<tr>
<td><strong>Summary of Study Findings</strong></td>
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<tr>
<td>1. DB-cons subscale had poor psychometric properties</td>
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<td>2. DB-pros subscale had adequate psychometric properties</td>
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<td>3. SEPA had adequate psychometric properties</td>
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<td>4. MVPA higher in younger adolescents than in older adolescents</td>
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<td>5. Organized sports activities were higher than expected in middle school sample</td>
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<td>6. Higher BMI percentile was associated with higher perceived benefits of PA</td>
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7. *DB-pros* accounted for little of the variance in MVPA behavior
8. *SEPA* accounted for a larger portion of the variance in MVPA behavior
9. No gender differences existed in *SEPA* or *DB-pros* if *SOC* was taken into account

**Health Care and Nursing Implications**

Physical activity has been shown to contribute to both physical health and psychological health (Janssen & LeBlanc, 2010; Kelley & Kelley, 2007; Leary et al., 2008; Mark & Janssen, 2008). PA is an important factor in the treatment and prevention of many chronic medical conditions including diabetes mellitus, hypertension, and depression. PA is also seen as a means to combat the epidemic in obesity seen in American youth, as PA plays a role in maintenance of a healthy body mass index (BMI) (McMurray et al., 2008), and reduction in adiposity in children who were overweight (Gidding, 2007). Despite the well-known benefits of PA, many adolescents are not engaging in recommended amounts of MVPA.

Health care providers are in a unique position to evaluate personal health indices and PA behavior in youth. Despite this opportunity, many health care providers fail to assess PA behavior or to provide guidance on recommended levels of PA during office visits (Abramson, Stein, Schaufele, Frates & Rogan, 2000). This missed opportunity is not related to lack of knowledge or desire on the part of the provider to provide health counseling, but due to time constraints during visits. Health care providers indicate that a barrier to PA counseling in a clinic setting is the lack of practical tools to assess physical activity behavior (Eakin, Smith & Bauman, 2005). PA is a complex behavior that includes mode, duration, frequency and intensity. Since direct measurement of PA requires an external device, is expensive, and is time consuming, there is a need to validate a simple tool to assess PA behavior that can be used during an office visit.
The *SOC* instrument has promise in its use as a proxy measure for MVPA in an adolescent population. The instrument can be administered in a few minutes and provides information about the number of days per week recommended MVPA is being performed. It also provides insight into the adolescent’s readiness to engage in recommended MVPA.

When attempting to modify the behavior of others, by prescribing physical activity, it is essential to have an understanding of the patient’s perspective. Devising a PA intervention that is congruent with the person’s values, beliefs, and preferences will enhance behavior change success rates (Bodenheimer, Wagner & Grumback, 2002). The *SOC* instrument provides information regarding readiness to engage in PA. In addition, the psychometric tools used in this study, *SEPA* and *DB*, provide a means to explore clients’ beliefs and can expose potential barriers to adoption of a PA intervention.

PA interventions should have a sound theoretical foundation and empirical findings to support their efficacy. To date, PA interventions have had limited success in promoting long term changes in PA behavior (Katz et al., 2005; Zenzen, & Kridli, 2009). One common criticism of PA interventions is that PA interventions for youth have not been grounded in theory. Development of successful PA interventions for adolescents will take the efforts of a multidisciplinary team. Adolescents’ beliefs regarding PA need to be queried. Social scientists need to develop instrument that more accurately estimate adolescents’ beliefs and are easy to administer in a clinic setting. Exercise scientists need to devise physical activity programs that are acceptable to an adolescent population. The efficacy of these programs need to evaluated using reliable and valid instruments. Clinicians need to provide input on the practicality of the instruments to assess PA behavior and beliefs, and the efficacy of PA interventions in an ambulatory setting.
Although a multidisciplinary team approach to further efforts to promote PA in adolescents is needed, nurses, nurse practitioners and nurse scientists have a central role in facilitating healthy behavior in U.S. youth. Nurses are in a position to assess PA behavior and the health risks associated with a sedentary lifestyle in adolescents. Nurses provide health counseling to youth and their care providers during healthcare visits. Nurses play a pivotal role in ensuring that tools to assess PA behavior and PA beliefs are meaningful. Nurses prescribe PA interventions and monitor the efficacy for the individual. Thus, the role of nurse in addressing the national health issue of insufficient MVPA is central and vital.

**Limitations and Future Directions**

Several limitations should be considered when evaluating the results of this study. No direct measure of physical activity was performed. Future research that evaluates these TTM constructs and PA should include an objective measurement of MVPA. A convenience sample was recruited for this study. The sample population was largely Caucasian and non-Hispanic, and the lack of diversity calls for caution when extrapolating these findings to other ethnic and racial groups. Middle school-aged children were recruited from 3 school districts; 2 rural school districts with overall low socio-economic status and one more affluent school district in a suburban location. High school-aged students were recruited from two school districts; one community school in a rural location and one community school in an urban core. While attempts were made to recruit a variety of early adolescent and older adolescent populations, further work to evaluate the psychometric properties of the SEPA and DB instruments in specific groups, would help establish invariance of these constructs. The DB-cons portion of the DB scale had poor psychometric properties in this study. Further work is needed to establish a valid and reliable DB-cons survey. Interviews with adolescents to reveal salient cons to MVPA would be
beneficial in the development of a new DB-\textit{cons} scale. This study utilized a cross-sectional design to evaluate differences in PA behavior and TTM constructs between a younger and an older adolescent population. Longitudinal studies that evaluate change over time would provide a better understanding of change within individuals as they progress through adolescence. This study had a low group membership for the PC group, and may indicate that we had a biased sample. Those adolescents who are not engaged in recommended MVPA and are not contemplating change, represent an at risk group and were under represented in this study. Future work that focuses on adolescents who are not engaged in recommended MVPA and are not considering changing this behavior is imperative. This is because health habits that are established in early adolescence are likely to continue through adolescence and into adulthood (Janz et al., 2000; Taylor, Blair, Cummings, Wun, & Malina, 1996). Thus, the sedentary adolescent is more likely to become the sedentary adult. Sedentary adolescents lose out on the health benefits attributable to PA during their youth, and have increased risk of developing obesity. Research that evaluates the health related beliefs that influence PA behavior in these individuals is needed to help target PA interventions to the unique needs of this group. Changing health related behavior in an adolescent population could benefit individuals for a life-time.

\textbf{Summary}

The middle school sample had higher than expected participation in organized sporting activity and engagement in recommended MVPA. Increasing opportunity to engage in organized physical activities may be an important intervention to counter the decline in MVPA engagement during adolescence. No gender differences in \textit{SEPA} or \textit{DB-pros} were found when accounting for \textit{SOC}. Evaluation of the performance of the instruments in gender specific population is needed. The subscale of \textit{DB-cons} had poor psychometric properties. Further work is needed to develop
instruments that provide a valid and reliable measure of \textit{DB-cons} in both the younger and older adolescent population. \textit{SEPA} provided promising results as a potential mediator of MVPA in an older adolescent population.
References


Centers for Disease Control and Prevention. (2008). Kids walk to school: Then and now-


Cox, R. H., Stimpson, T. S., Poole, K. P., & Lambur, M. T. (2003). Physical Activity


Appendices
Appendix A

Student Assent From

**Study Title:** Evaluation of Physical Activity in Adolescents

**Researchers:** Katherine Schoenfield (PhD student)  
Kenn Daratha PhD (WSU Faculty)

WSU College of Nursing  
(707) 409-9786, k.schoenfield@email.wsu.edu

My name is Katherine Schoenfield. I am a nurse practitioner in your community and a doctoral student at Washington State University. I am inviting you to take part in a research study about physical activity. Your parent(s) know we are talking with you about the study, but it is up to you to decide if you want to be in the study. This form will tell you about the study to help you decide whether or not you want to take part in it.

**What is this study about?**

In this study, we want to learn about the physical activity of kids your age, the thoughts and beliefs about physical activity, how much physical activity is performed and what types of physical activity performed.

**What am I being asked to do?**

If you decide to be in the study we will ask you to participate in testing at your school during one class period. During the testing we will weigh you, measure your height, and measure your waist. This will be done so no other students can see you. Finally, we will ask you to fill out some short survey forms. We expect the testing will take about 30 min. We will also ask your school to share your physical activity scores from the FITNESSGRAM®.

**What are the benefits to me for taking part in the study?**

By participating in this study, you may become more aware of the choices you make about physical activity. Your participation in this study will help us understand how to encourage kids to be more active. For completing this form and returning it to your school, you will also get a token gift.

**Can anything bad happen if I am in this study?**

We do not think anything bad will happen to you by being in the study, but some kids might become embarrassed by being weighed, having their waist measured, or answering some of the questions. Others might become bored while answering the questions or filling out surveys. There is no right or wrong answers and you can stop at any time. Everything you do and say will be private.
Who will know that I am in the study?

We won’t tell anybody that you are in this study and everything you tell us will not be shared. Your parents know that you took part in the study, but we won’t tell them anything you said. When we tell other people about what we learned in the study, we won’t include your name or that of anyone else who took part in the study.

Do I have to be in the study?

No, you don’t have to be in the study. The choice is up to you. No one will get angry or upset if you don’t want to do this. And you can change your mind anytime if you decide you don’t want to be in the study anymore.

What if I have questions?

If you have questions at any time, you can ask us and you can talk to your parent about the study. If you would like, we can give you a copy of this form to keep. If you want to ask us questions about the study, call or email:

Name: Katherine Schoenfield  
Phone: (707) 407-9786  
Email: k.schoenfield@email.wsu.edu

The Washington State University Institutional Review Board has reviewed this study to make sure that the rights and safety of people who take part in the study are protected. If you have questions about your rights in the study, or you are unhappy about something that happens to you in the study, you can contact them at (509) 335-3668 or irb@wsu.edu.

IF YOU WANT TO BE IN THE STUDY, SIGN AND PRINT YOUR NAME ON THE LINE BELOW:

_______________________________________  __________________
Sign your name            Date

_______________________________________
Print your name

_______________________________________  __________________
Witness Signature            Name in Print
Appendix B

Parental Permission Form

Dear Parent/Guardian:

You are being asked to allow your child to take part in a research study, conducted by Katherine Schoenfield who is a doctoral student at Washington State University (WSU).

This research study seeks to assess the physical activity practices and thoughts and beliefs about physical activity in adolescents in Humboldt County. We are conducting this research study in your child’s school in fall of 2013. If you provide permission and your child indicates a willingness to participate, we will assess your child during school hours on a scheduled date this spring. During this assessment we will measure your child’s height, weight and waist circumference. We will ask your child to complete some short survey questions related to physical activity. We will also ask the school to provide us with your child’s physical fitness test results. You may request the full study protocol by contacting your school, the study researcher at WSU.

In order for your child to participate we are asking for you to review and complete the following:

- Parent Permission Form
- Demographic Form

Further, your child will need to indicate their willingness to participate in this study:

- Student Assent Form

If you have any questions please do not hesitate to contact us. Thank you for considering the participation of your child in this important study.

Katherine Schoenfield
Study Researcher
(707) 407-9786
k.schoenfield@email.wsu.edu
Appendix C –

Physical Activity Questionnaire – C

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:

1. There are no right and wrong answers — this is not a test.
2. 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.)

<table>
<thead>
<tr>
<th>Activity</th>
<th>No</th>
<th>1-2</th>
<th>3-4</th>
<th>5-6</th>
<th>7 times or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skipping</td>
<td></td>
<td>☐</td>
<td></td>
<td></td>
<td>☐</td>
</tr>
<tr>
<td>Rowing/canoeing</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>In-line skating</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Tag</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Walking for exercise</td>
<td></td>
<td>☐</td>
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<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Bicycling</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Jogging or running</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Aerobics</td>
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<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Swimming</td>
<td></td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Baseball, softball</td>
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<td>☐</td>
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<tr>
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<td>☐</td>
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<tr>
<td>Football</td>
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<tr>
<td>Badminton</td>
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<td>☐</td>
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<tr>
<td>Skateboarding</td>
<td></td>
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<tr>
<td>Soccer</td>
<td></td>
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<tr>
<td>Street hockey</td>
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<tr>
<td>Volleyball</td>
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<tr>
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<tr>
<td>Cross-country skiing</td>
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<td>☐</td>
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</tr>
</tbody>
</table>

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 do most of the time at recess? (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, 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 ....................... □

5. 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 .......... □
6. 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 ........... □

7. 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 last week ...................... □
2 or 3 times last week .............. □
4 or 5 last week ...................... □
6 or more times last week .......... □

8. 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.

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

B. 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) .......... □

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

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

E. I very often (7 or more times last week) did physical things in my free time ..... □
9. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

<table>
<thead>
<tr>
<th>Day</th>
<th>None</th>
<th>Little bit</th>
<th>Medium</th>
<th>Often</th>
<th>Very often</th>
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<td>Sunday</td>
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</table>

10. 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 –

Physical Activity Questionnaire – A

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:

1. There are no right and wrong answers — this is not a test.
2. 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.)

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<tr>
<td>Skipping</td>
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<td>Rowing/canoeing</td>
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<td>In-line skating</td>
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<td>Tag</td>
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<td>Walking for exercise</td>
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<td>Aerobics</td>
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<td>Swimming</td>
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<td>Baseball, softball</td>
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<td>Dance</td>
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<td>Football</td>
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<td>Badminton</td>
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<td>Skateboarding</td>
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<td>Soccer</td>
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<td>Street hockey</td>
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<td>Volleyball</td>
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<td>Floor hockey</td>
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<td>Basketball</td>
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<tr>
<td>Ice skating</td>
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<tr>
<td>Cross-country skiing</td>
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<tr>
<td>Ice hockey/ringette</td>
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<tr>
<td>Other</td>
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</tbody>
</table>
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 last week ......................... □
   2 or 3 times last week ................. □
   4 or 5 last week ........................ □
   6 or more times last week .......... □

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.

   A. All or most of my free time was spent doing things that involve little physical effort .......................................................... □
   B. 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) .......... □
   C. I often (3 — 4 times last week) did physical things in my free time ............... □
   D. I quite often (5 — 6 times last week) did physical things in my free time ...... □
   E. 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.

   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 E

Stages of Change Instrument

**Physical activity** is any activity that increases your heart rate and makes you get out of breath some of the time.

**Physical activity** can be done in sports, playing with friends, or walking to school. Some examples of physical activity are running, brisk walking, rollerblading, biking, skateboarding, dancing, swimming, soccer, basketball, football, & surfing.

PA1. In a typical week, how many days do you do physical activity for 60 min or more? ________

0 – 7 days

PA2. If you answered 5-7 days in PA1 go to the next question. If you answered 0 – 4 days PA1, do you think that you will start to doing 60 min or more of physical activity 5 or more days a week in the next 6 months? Circle the best answer for you.

| No, and I do not intend to in the next six months | Yes, I intend to start to in the next six months | Yes, I intend to start in the next 30 days |

PA3. If you answered 5-7 days per week in PA1, how many months have you been doing 60 min or physical activity 5 or more days per week? circle the best answer for you

| Less than 6 months | More than 6 months |
Appendix F

Decisional Balance Tool

The following statements are beliefs about physical activity. Please rate HOW IMPORTANT each statement is to your decision to do physical activity.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA4.I would feel embarrassed if people saw me doing physical activity</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA5.Physical activity would help me stay fit</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA6.My parents would be happy if I did physical activity</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA7.There is too much I would have to learn to do physical activity</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA8.I would feel better about myself if I did physical activity</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA9.I would need too much help from my parents to do physical activity</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA10.I do not like the way physical activity and exercise make me feel</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA11.I would have fun doing physical activity or doing sports with my friends</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA12.I would have more energy if I did physical activity</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
<tr>
<td>PA13.Physical activity takes time away from being with my friends</td>
<td>Not Important</td>
<td>Slightly Important</td>
<td>Moderately Important</td>
<td>Very Important</td>
<td>Extremely Important</td>
</tr>
</tbody>
</table>

PA22. Do you currently play on a sports team or go to lessons where you do physical activity (competitive teams, karate lessons, or dance class, etc.)? __________ yes/no
**Appendix G**

**Self-Efficacy for Exercise**

Please indicate how much you agree or disagree with this statement about activity.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA14. I can be active during my free time on most days.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
<tr>
<td>PA15. I can ask my parent or other adult to do activity things with me.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
<tr>
<td>PA16. I can be active during my free time on most days even if I could watch TV or play video games instead.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
<tr>
<td>PA17. I can be active during my free time on most days even if it is very hot or cold outside.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
<tr>
<td>PA18. I can ask my best friend to be active with me during my free time on most days.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
<tr>
<td>PA19. I can be active during my free time on most days even if I have to stay at home.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
<tr>
<td>PA20. I have the coordination I need to be active during my free time on most days.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
<tr>
<td>PA21. I can be active during my free time on most days no matter how busy my day is.</td>
<td>Disagree a lot</td>
<td>Somewhat disagree</td>
<td>Neither agree nor disagree</td>
<td>Somewhat agree</td>
<td>Agree a lot</td>
</tr>
</tbody>
</table>
Appendix H

Demographics Sheet

Demographic Sheet (Completed by Parent/Guardian)

Today’s Date ________ Study ID (to be assigned during assessment) _________

What is your relationship to this student (please check and/or circle)?

☐ Biological Mother ☐ Biological Father
☐ Step Mother ☐ Step Father
☐ Foster Mother ☐ Foster Father
☐ Grandmother ☐ Grandfather
☐ Guardian
☐ Other _______________

Gender of Student

☐ Male ☐ Female

Student’s Date of Birth ________________________________

Do you consider your youth to be Hispanic/Latino?

☐ Yes ☐ No

Race/ethnicity of your youth (indicate all that apply)

☐ American Indian or Alaskan Native _______________ Tribe(s) _______________
☐ Asian
☐ Black/African American
☐ White
☐ Other _______________

Does your student participate in the school free and reduced food program?

☐ Yes ☐ No

Please complete the following section based on the caregiver(s) in the child’s primary residence (i.e. where does the child live most of the time. For example, biological mother and biological father, step mother and step father, biological mother and step father, biological father and step mother, or foster parents. If the child is cared for by a single caregiver (e.g. single parent) you may include information for that caregiver only.

Information about Caregiver 1 Information about Caregiver 2

What is this person’s relationship to this student _______________________

(please check and/or circle)? "What is this person’s relationship to this student _______________________

☐ Biological Mother ☐ Biological Father ☐ Biological Mother ☐ Biological Father
☐ Step Mother ☐ Step Father ☐ Step Mother ☐ Step Father
☐ Foster Mother ☐ Foster Father ☐ Foster Mother ☐ Foster Father
☐ Grandmother ☐ Grandfather ☐ Grandmother ☐ Grandfather
☐ Guardian ☐ Other _______________ ☐ Guardian ☐ Other _______________

Contact information if there is anything that needs to be clarified? _______________________


Appendix I

Anthropometric Measurements

ID ___________________ Date ___________ School Site ____________________

Weight (kg to 2 decimal places) __________

Height (cm to 1 decimal place) __________

Waist Circumference (cm to 1 decimal place) __________ __________ __________