ELSEVIER

Psychology of Sport and Exercise 8 (2007) 795–817

Psychology
OF SPORT AND EXERCISE

www.elsevier.com/locate/psychsport

Predicting attitudes and physical activity in an "at-risk" minority youth sample: A test of self-determination theory

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Received 3 June 2006; received in revised form 14 December 2006; accepted 29 December 2006
Available online 24 January 2007

Abstract

Objectives: The present work sought to extend past research by (i) testing a model of motivational processes based on the tenets of self-determination theory (SDT; Deci & Ryan [1991. A motivational approach to self: Integration in personality. In R. Dienstbier (Ed.), *Nebraska symposium on motivation. Vol. 38. Perceptives on motivation* (pp. 237–288). Lincoln, NE: University of Nebraska Press]) in an "at-risk" minority youth sample, (ii) exploring the relationship between motivation and physical activity behavior and attitudes, and (iii) assessing autonomy-support for physical activity from two social agents.
Design: A field cross-sectional design, including an assessment of physical activity over 4 days using pedometers.
Methods: Complete data were obtained from 237 predominantly low socioeconomic Hispanic 5th–8th grade students (M age = 12.11 years; SD = 1.21) from an elementary school located in the southwestern region of the United States of America. Four days of physical activity data, height and weight measurements, and responses to a multi-section inventory were collected. A model of hypothesized relationships among the study variables was examined using structural equation modeling.
Results: The proposed model demonstrated a very good fit to the data [Satorra-Bentler χ^2 (24) = 46.88, $p < .01$; CFI = .94; IFI = .95; SRMR = .052]. Supporting the study hypotheses, the model showed that students who perceived autonomy-support toward physical activity to be promoted by their teachers and their parents experienced greater levels of need satisfaction variables (viz., autonomy, competence, and relatedness). In turn, the satisfaction of these psychological needs positively predicted autonomous

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1469-0292/$ - see front matter
doi:10.1016/j.psychsport.2006.12.006

motivation towards physical activity. Autonomous motivation positively predicted greater levels of (i) physical activity and (ii) positive attitudes towards physical activity. Body Mass Index (BMI) was found to be a negative predictor of physical activity.
Conclusions: Collectively, the results of the present work provide support for SDT and the application of the framework to enhance our understanding of motivational processes as they relate to physical activity within "at-risk" minority youth.

Keywords: Motivation; Self-determination theory; Physical activity; At-risk youth; Minority adolescents; Attitudes; Autonomy-support; BMI

Introduction

Coronary heart disease is the leading cause of death in the United States of America (Anderson & Smith, 2005) with physical inactivity and poor nutrition two of the leading risk factors for the disease. Significant variations exist in physical activity rates, obesity levels, and nutrition awareness among different populations. Specifically, research has shown that differences in obesity and physical activity appear as a function of race, socioeconomic status, and gender (US Department of Health and Human Services (USDHHS), 2000). These differences place children and adolescents from minority and low socioeconomic groups to be "at-risk" for disparities that will impact their health and well-being. Although research has shown that children tend to be more active than adults, many children and adolescents do not attain the recommended minimum levels of physical activity (US Department of Health and Human Services (USDHHS), 1997). Since physical activity patterns established during early childhood tend to track into adulthood, less physically active children tend to remain less active compared to their more active peers (Pate, Baranowski, Dowde, & Trost, 1996).

While physical inactivity is a major health concern across all segments of society, the problem is more noticeable in minority and low socioeconomic youth populations. Between 1986 and 1998, the prevalence of children who were overweight increased by approximately 120% among Hispanic children, compared to an increase of approximately 50% among non-Hispanic White children (Strauss & Pollack, 2001). Approximately 21.8% of Hispanic children and 21.5% of African American children were overweight, compared to 12.3% of White children (Strauss & Pollack, 2001). From a public health perspective, the level of physical inactivity amongst American youth, particularly those of minority and low socioeconomic populations, is a significant source of concern and requires considerable research attention. Accordingly, the present work is designed to further our understanding of the motivational processes underpinning levels of physical activity behavior and attitudes towards physical activity in a "at-risk" primarily Hispanic youth population.

Although it has been recommended that studies are needed to investigate how social factors can better promote physical activity among Hispanic, African American, and low income youth (e.g., Frenn et al., 2005), a paucity of work examining the motivational and psychosocial variables that underpin physical activity behavior and associated attitudes in ethnically diverse youth populations exists. Clearly, an understanding of the motivational processes that affect physical

activity behavior and attitudes would better aid future interventions designed to encourage physical activity in disparate youth populations.

School-based physical education (PE) has been advanced as a context that should encourage children to be physically active, with the view that "active children" become "active adults" (USDHHS, 1997). However, the mere presence of a PE program does not guarantee that the children will be physically active. Although students spend almost half of their waking day at school, only approximately 2% of their time is spent in PE (Fox & Harris, 2003). Furthermore, Simons-Morton, Taylor, Snider, Wei Huang, and Fulton (1994) reported that elementary school children and middle school students spent only 8.6% and 16.1% of their PE class time actually participating in moderate-to-vigorous physical activity. Such figures are substantially lower than the recommended 50% minimum of PE class time that youth should spend engaging in moderate-to-vigorous physical activity (USDHHS, 1997).

Given the state of PE in schools, it would seem particularly important to target outside-school or after-school programming if children are to achieve the recommended levels of physical activity (Corbin & Pangrazi, 2004). Such an objective is further warranted in view of the current climate within many American schools that is represented by the primacy of standardized testing, a focus on "core" academic skills, funding challenges, and the subsequent erosion of PE from many schools' curricula (Centers for Disease Control and Prevention (CDC), 2000). From a public health perspective, the time outside of school represents a tremendous opportunity to increase physical activity levels, particularly in regard to affecting a reduction in sedentary activities such as television watching and computer time (Epstein et al., 1995). Therefore, an assessment of children's physical activity patterns within school and outside of school may provide valuable insight into the factors that affect the totality of their daily physical activity behavior.

When considering viable options for increasing physical activity, it is important to consider that interventions are likely to be most successful when the factors that influence behavior and individual choice are better understood. To this end, an important avenue of research that is receiving increased attention in the literature is examining the motivational processes of children to participate in physical activity settings (cf. Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Ntoumanis, 2005; Reinboth, Duda, & Ntoumanis, 2004; Standage, Gillison, & Treasure, in press). Commensurate with contemporary research in physical activity settings, the present work is guided by the theoretical tenets of self-determination theory (SDT; Deci & Ryan, 1985, 1991; Ryan & Deci, 2000). The present work extends the SDT knowledge-base by exploring a model of motivational processes in an "at-risk" minority youth sample to predict physical activity behavior and physical activity attitudes.

SDT

SDT distinguishes between behaviors that individuals perform freely and those that they pursue for separable contingencies. The theory examines "why" an individual acts (i.e., the degree to which their motivation is more or less self-determined), how various types of motivation lead to different outcomes, and the social conditions that support or undermine optimal functioning and well-being via human psychological needs.

Central to SDT is the proposition that individuals have three basic psychological needs for autonomy (i.e., the need to endorse and be the origin of one's behavior), competence (i.e., the need

to interact effectively within the environment), and relatedness (i.e., the need to feel connected, cared for, and close to others and one's community) (Ryan & Deci, 2002). Whether the three psychological needs are met is proposed to underlie variations in the quality of motivation, well-being, learning, and functioning (Deci & Ryan, 1985, 1991; Ryan & Deci, 2000). Assumed to be innate and universal, these needs are motivating forces that, if satisfied, lead to optimal functioning and well-being (Ryan & Deci, 2002). However, if one or more of the needs are not satisfied, ill-being and poor functioning are hypothesized. Past work in the PE context has shown the three needs to predict self-determined forms of motivation independently (Standage, Duda, & Ntoumanis, 2003, 2006) and when combined as a composite variable (Ntoumanis, 2005; Standage, Duda, & Ntoumanis, 2005). In the current work, we hypothesized that the needs for autonomy, competence, and relatedness would independently predict a composite variable of self-determined motivation (viz., a self-determination index; SDI).

Considering the hypothesis that the three psychological needs serve as nutriments to optimal functioning, understanding the social contexts that facilitate young people's motivation, performance, and well-being by satisfying these needs is an important line of inquiry (e.g., Véronneau, Koestner, & Abela, 2005). According to Deci and Ryan (1987), perceptions of an autonomy-supportive context (i.e., a context that promotes choice and understanding) facilitates self-determined motivation. However, if a social context supports controlling factors (i.e., contexts that limit choice or are coercive) autonomous forms of motivation, learning, well-being, and optimal functioning are undermined (Deci & Ryan, 2000).

Past research in education has shown parental and teacher autonomy-support to have independent effects on autonomy and competence (Vallerand, Fortier, & Guay, 1997). In addition, research in youth sport (e.g., Reinboth et al., 2004) and school PE settings (Standage et al., 2006) has shown that perceptions of autonomy-support from the coach and PE teacher to positively predict the satisfaction of the participants' needs for competence, relatedness, and autonomy. Recognizing that numerous socializing agents exist for children and youth, in the present work we sought to build on past research (e.g., Standage et al., 2006) and examine how perceptions of autonomy-support as provided by parents (or guardians) and the students' teachers affect the satisfaction of the three basic psychological needs. We hypothesized that perceptions of autonomy-support provided by the parents (or guardians) and teachers would positively predict the students' needs for autonomy, competence, and relatedness.

Understanding the differing reasons why people act has been a central theme of SDT research for over three decades (cf. Deci & Ryan, 2002). According to SDT, intrinsic and extrinsic motivation fall along a continuum of self-determination.[1] At the self-determined pole of the continuum is intrinsic motivation that refers to fully regulated behaviors that are performed for the activity's sake with no external contingency (i.e., for the interest and pleasure it provides). In the middle of the continuum reside various forms of extrinsic motivation that vary in their degree of relative autonomy. Ranging from low to high autonomy, these regulations are external regulation, introjected regulation, and identified regulation. External regulation occurs when an

[1]For the purposes of the present study, amotivation, integrated regulation, and the three types of intrinsic motivation (to learn, to accomplish tasks, and to experience sensations) were not individually assessed and will not be discussed further. Integrated reasons are not normally given by students and adolescents; therefore, this type of extrinsic motivation is not normally assessed in this population (Ntoumanis, 2002; Vallerand & Fortier, 1998).

individual engages in a behavior to receive a reward or to avoid punishment. Introjected regulation refers to the incomplete internalization of a regulation that was previously solely external (i.e., the behavior is performed to avoid feelings of guilt or for ego-enhancement) (Ryan & Deci, 2002). Identified regulation occurs when the individual freely chooses to carry out an activity that is not considered to be enjoyable, but is thought of as important.

The type of motivation an individual possesses influences the selection of activities, attitudes toward the activity, the effort and persistence one devotes to those activities, and the affect experienced. Past work has often shown intrinsic motivation and identified regulation to predict positive behavioral, cognitive, and affective outcomes (cf. Vallerand, 2001). Participating in activities that an individual freely chooses to engage in (i.e., intrinsic motivation and identified regulation) are important distinctions in self-determined behavior. SDT would predict that autonomously motivated individuals (individuals possessing intrinsic motivation and identification) would demonstrate a strong interest in the activity, volitionally continue the activity when given a choice, and exhibit a high degree of effort. For example, fostering young peoples' autonomous motivation toward physical activity should result in them choosing to be physically active when they are free from extrinsic reinforcement (Hagger et al., 2005). While the type of motivation underlies *why* an individual engages in an activity, an individual's attitude reflects his/her personal orientation or view towards participating in the activity (Hagger et al., 2005). Research has shown that autonomous motives strongly influence adolescents' attitudes towards physical activity (Hagger, Chatzisarantis, & Biddle, 2002; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Hagger et al., 2005). Consistent with the tenets of SDT, we hypothesized that in the "at-risk" ethnic minority youth sample, participants' attitudes towards physical activity would be positively predicted by their reported level of self-determined motivation.

Measure of physical activity

A number of researchers (e.g., Hagger et al., 2005; Standage et al., 2003) have proposed that future studies investigating physical activity and SDT in youth should adopt more objective measures of physical activity. In the present work, we used pedometers to assess the participants' level of physical activity. Although there are limitations to every physical activity measure, pedometers have demonstrated acceptable accuracy (Bassett et al., 1996), reliability (Tryon, Pinto, & Morrison, 1991) and convergent and discriminative validity in assessing physical activity (Tudor-Locke & Myers, 2001a). High reliability between pedometers and accelerometers in measuring physical activity has also been reported ($r = .80$–$.90$; Basset et al., 2000). It is important to note that the pedometer is not without limitations particularly as it cannot measure intensity or frequency of physical activity (Vincent & Pangrazi, 2002).

Past work from a SDT perspective has not reported the relationship between motivation and pedometer-assessed physical activity. Clearly, understanding the relationship between motivation and physical activity behavior would provide important information for researchers and practitioners interested in increasing physical activity levels, and subsequently affecting child and adolescent health. Past research has shown that self-determined motivation is predictive of positive behavioral outcomes in education (Miserandino, 1996), health care (Williams, McGregor, Zeldman, Freedman, & Deci, 2004), and in physical education (Parish & Treasure, 2003). Based

on SDT and past work, we therefore hypothesized that self-determined motivation would positively predict physical activity.

Age and Body Mass Index (BMI)

Research has shown that adolescents' participation in physical activity decreases as a function of increasing age (Stone, McKenzie, Welk, & Booth, 1998) while ethnic differences exist in regard to youth physical activity (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998). One factor that may be related to adolescents' participation in physical activity is body composition. Hispanic and African American youth have a higher prevalence of overweight than non-Hispanic White youth (Ogden, Flegal, Carroll, & Johnson, 2002) and the greatest prevalence of overweight is amongst Mexican American girls (Ogden et al., 1997). One method of assessing body composition is using BMI which correlates with body adiposity and represents weight levels associated with overall risk of disease and morbidity (World Health Organization, 1995). BMI for children, referred to as BMI-for-age, is gender and age specific (Pietrobelli et al., 1998). Previous research examining BMI and physical activity in young people has shown an inverse relationship between physical activity and BMI (Klesges, Klesges, Eck, & Shelton, 1995). Therefore, examining the aforementioned variables may aid in understanding adolescent physical activity behavior. Based on previous research (Stone et al., 1998), we predicted that age would be inversely associated with physical activity. In addition, we hypothesized that BMI would negatively predict physical activity.

Generalizing SDT to the current sample

According to SDT, the fulfillment of the basic psychological needs of autonomy, competence, and relatedness are salient and central to individuals, despite human diversity such as culture, ethnicity, gender, and age (Ryan, 1995; Ryan et al., 1999). While the manner in which these needs are satisfied by the prevailing social context may hold different meanings in various cultures/samples, the motivational processes remain constant (Ryan & Deci, 2002). Recent research has supported the generalizability tenet advanced by SDT to adolescent academic motivation (Chirkov & Ryan, 2001). In the physical activity setting, Hagger et al. (2005) examined a model of motivational processes towards physical activity based on a number of the SDT tenets (viz., the Trans-Contextual Model; Hagger et al., 2003). Using high school students from Britain, Greece, Poland, and Singapore, Hagger and colleagues found, with the exception of the Polish sample that, perceived autonomy-support from PE teachers had a significant positive effect on autonomous motives for self-reported leisure-time physical activity.

Although there has been a recent increase in empirical support for the theoretical tenets of SDT across cultures, to our knowledge no research has examined the utility of SDT to explain motivational processes towards physical activity in an "at-risk" minority youth sample. Accordingly, this study will contribute to the extant literature by testing whether a model of motivational processes based on SDT is generalizable to an ethnic minority youth population "at-risk" for health disparities.

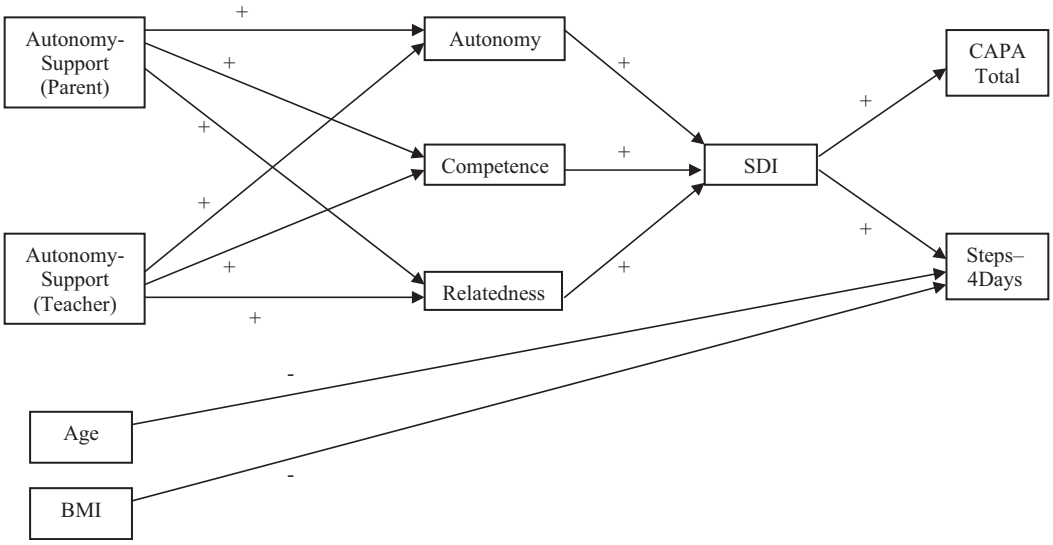

Fig. 1. Hypothesized model of motivational processes.

The present study

The purpose of this study was to examine a model of motivational processes to predict physical activity and attitudes toward physical activity in an "at-risk" minority youth sample. Grounded in SDT, a model encompassing the sequence of motivational processes of "social factors → psychological mediators → types of motivation → consequences" (see Vallerand, 2001 for an overview) was tested (see Fig. 1).[2,3] Specifically, we hypothesized that:

1. Students would experience greater levels of competence, autonomy, and relatedness when autonomy-support toward physical activity was perceived to be promoted by their (i) teachers and/or (ii) parents (or guardians).
2. The satisfaction of the basic psychological needs for competence, autonomy, and relatedness would positively predict self-determined motivation, which would in turn positively predict higher levels of physical activity and positive attitudes toward physical activity.
3. BMI would negatively predict physical activity.
4. Age would negatively predict physical activity.

[2]SDT holds that the psychological processes and constructs embraced by SDT are universal to all cultures, across gender, and throughout developmental periods (Deci & Ryan, 2000; Ryan & Deci, 2000, 2002). Past work in PE (Ntoumanis, 2001; Standage et al., 2005) and education (Vallerand et al., 1997) has supported the gender invariance of motivational models grounded in SDT. As such, for the purpose of this paper we analyzed the data from males and females together.

[3]Based on past work that has shown the basic needs to be associated with each other (e.g., Standage et al., 2003), the error terms of the three needs were allowed to correlate (e.g., Hollembeak & Amorose, 2005).

Method

Participants

Students in the 5th–8th grades ($N = 239$; 119 females, 120 males; ages 9.81–14.41 years; M age = 12.11 years; SD = 1.21 years) from an ethnically diverse school in the southwestern United States participated in this study (Hispanic = 67.3%, African American = 10.1%, White = 9.6%, Native American = 2.4%, Pacific Island/Asian = 2.4%, multiple ethnicities = 8.2%). During the study, 90% and 50% of all students qualified for federally funded free breakfast and lunch programs, respectively. Due to the demographics, the current sample was classified as "at-risk" for health disparities particularly regarding risk factors related to coronary heart disease. Permission to conduct the study was obtained from the school principal, district superintendent, and the institutional review board at a major research university. An informational letter was sent to parents explaining the school curriculum and provided contact information if they had any questions. Students who completed at least 4 days of weekday pedometer monitoring over 8 days of data collection, a multi-section inventory, provided height and weight information, and did not have any medical conditions that limited physical activity were included in the study. Each participant was assigned a numerical code to protect confidentiality and so that the data could be matched without using the participant's name. Additionally, each person who had contact with the students or data related to this study signed a confidentiality statement.

Measures

Body composition: BMI (kg/m^2) was used as the measure of body composition. To permit the calculation of BMI scores, direct height and weight measurements (to the nearest 0.5-inch and lb) were obtained concurrently by using the Healthometer Professional balance scale (model 402S). All height and weight data were transformed to metric equivalents (i.e., kilograms and meters) prior to data analysis.

Physical activity measurement: The Walk4Life 2-Function pedometer (LS 2505) (Walk4Life Inc., Plainfield, Illinois) was used to assess physical activity. The Walk4Life pedometer is a motion sensor device that includes a loss prevention strap, attaches to the child's waistband, and measures vertical movement as step counts and activity time. Four days of monitoring has been shown to be a sufficient length of time to determine habitual activity levels in children (Trost, Pate, Freedson, Sallis, & Taylor, 2000; Vincent & Pangrazi, 2002). The pedometer has been found to be a reliable and valid measure to assess physical activity in both adults and children (Rowe, Mahar, Raedeke, & Lore, 2004; Tudor-Locke & Myers, 2001b). As recommended by previous researchers (Tudor-Locke & Myers, 2001b), the choice of metric for the pedometer data was in the units of steps/day.

Perceived autonomy-support: The participants' perceptions of the autonomy-supportiveness of their environment for physical activity were assessed using a modified version of the Sport Climate Questionnaire (SCQ; Baard, Deci, & Ryan, 2000). Higher scores indicate greater perceived autonomy-support. For the purposes of this study, this questionnaire was adapted to pertain to the participants' perceived autonomy-support from their teachers and parents (or guardians) to be physically active. Therefore, two modified 15-item questionnaires were administered; one referring

to the participant's teachers and a second referring to the participant's parents (or guardians). In addition, the stem "In general…" was added to this questionnaire to reflect the contextual nature of physical activity. An example item from the teacher-specific questionnaire is "My teachers give me choices and options." Responses were indicated on a 5-point Likert-type scale anchored by 1 (strongly disagree) and 5 (strongly agree). The internal consistency for this scale has been shown to be adequate in previous research (Cronbach's $\alpha = .93$; Hagger et al., 2003).

Competence. Competence toward physical activity was assessed using the five item perceived competence subscale of the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989). In the present study, the stem was modified to "In general, how good are you at physical activity?" to reflect the contextual nature of physical activity being assessed. An example item is "I think I am pretty good." Responses were indicated on a 5-point Likert-type scale anchored by 1 (strongly disagree) and 5 (strongly agree). The competence subscale of the IMI has demonstrated acceptable reliability in previous physical activity research involving similar aged youth (Cronbach's $\alpha = .85$, Standage et al., 2003).

Autonomy: Perceived autonomy was measured with five items used by Standage et al. (2003) that were derived from previous research assessing perceptions of autonomy in PE (Ntoumanis, 2001) and various other life domains (Blais, Ballerand, & Lachance, 1990). For the present study, the participants were asked to consider the questions in regard to their daily physical activity. The following short description of physical activity was added so that the participants were clear as to its meaning, "Physical activity means when you play, participate in sports, or any time that you are moving your body." An example item regarding autonomy to engage in physical activity is "I feel that I do it because I want to." This measure has demonstrated acceptable internal consistency in previous research (Cronbach's $\alpha = .81$; Standage et al., 2003).

Relatedness: Relatedness was assessed using the Acceptance subscale of the Need for Relatedness Scale (Richer & Vallerand, 1998), which has been used in previous physical activity research with similar age youth (Standage et al., 2003). The stem was modified to ask participants, "With the other people who care about me I feel…" followed by five items, such as "supported," "valued," and "listened to." The participants responded on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). This measure has demonstrated acceptable internal consistency in previous research (Cronbach's $\alpha = .91$; Standage et al., 2003).

Contextual motivation: Contextual motivation towards physical activity was assessed using an adapted version of the Self-regulation Questionnaire (SRQ; Ryan & Connell, 1989) similar to questionnaires used by Ntoumanis (2005) and Goudas, Biddle, and Fox (1994). Whereas Goudas et al. (1994) and Ntoumanis (2005) adapted the SRQ to pertain to PE, the present study adapted the SRQ to pertain to general physical activity. In the present study, participants responded to 12 items on a 5-point Likert-type scale ranging from 1 (not true at all) to 5 (very true). Each item follows the stem "In general, why are you physically active?" Each subscale contains three items. Example items for each of the subscales are "Because I enjoy it" (intrinsic motivation), "Because it's important for me to do it" (identified regulation), "Because I would feel bad about myself if I didn't do it" (introjected regulation), and "Because it helps me look good to others" (external regulation). The adapted SRQ has been used in various studies in PE with adolescents and has been shown to have a clear factor structure (e.g., Ntoumanis, 2001, 2005). The adapted SRQ has

been shown to have high internal reliabilities with the exception of introjected regulation, which has been reported to yield α coefficients slightly below .70 (e.g., $\alpha = .64$; Ntoumanis, 2001).

Attitude towards physical activity: Participants' attitudes toward physical activity were assessed using the Children's Attraction to Physical Activity scale (CAPA; Brustad, 1993, 1996). This instrument consists of five different scales (liking of games, liking of exercise, liking of physical exertion, peer acceptance, and importance of exercise) that reflects a child's overall attitudes about being active. There are five items per scale and each is assessed using a 4-point structured alternative format. Some minor modifications were made so that items more clearly referred to physical activity. An example of an item from the scale is "For some kids, games and sports is their favorite thing BUT other kids like other things more than games and sports." The child then responds to the item by first deciding which statement more accurately reflects his/her attitudes and then whether the statement is "Really true for me" or "Sort of true for me." This measure has demonstrated acceptable internal consistency in previous research (Cronbach's $\alpha = .70$ to .74; Brustad, 1996). In this study, a composite indicator based on the mean of the five subscales was used to reflect the children's overall attitude toward physical activity. This indicator has been shown to have acceptable internal consistency when used as a unitary construct (Cronbach's $\alpha = .82$; Welk, Wood, & Morss, 2003).

Procedure

Students participated in a 2-week orientation prior to the beginning of data collection in which they were introduced to the pedometers. The children were familiarized with the pedometers during their PE classes before the scheduled monitoring time to reduce reactivity. It was explained that the pedometers must be worn on the waistband or belt, in line with the right knee, and parallel to the ground. All the pedometers were required to be placed on the right side of the body so that the pedometer placement was uniform and correct placement could be quickly verified.

Following this initial orientation, the participants practiced the correct placement of the pedometer and participated in a 30-stride walking test to determine that the pedometers were accurately recording their steps/activity time during their PE classes (see Tudor-Locke & Myers, 2001b for a description of this procedure). Further, because the pedometer must remain in the upright vertical plane of the body (i.e., perpendicular to the floor) to accurately register counts, participants were reminded to check the pedometer position periodically during each day. The teachers and school staff members were trained to immediately confiscate the student's pedometer if the participant was seen misusing or shaking the pedometer and to return the device to a research assistant at the end of the day.

The height and weight of each child was assessed at the school to calculate BMI-for-age prior to the administration of the psychological questionnaires. Psychological questionnaires (demographic information and measures assessing autonomy-support, three basic needs, contextual motivation, and attitude towards physical activity) were administered over 3 school days and took a maximum of 30 min/day to complete. If a student was absent for a portion of this data collection, the questionnaire was administered on the first day of the student's return.

In order to assess the participants' habitual physical activity level, each child wore a sealed pedometer for 8 consecutive school days: 4 successive school days the first week of pedometer data

collection followed by an additional 4 consecutive school days the subsequent week. To maintain confidentiality and to allow the data derived from the pedometer to be matched to the questionnaire responses, each pedometer and participant was assigned a matching numerical code. All pedometers were sealed with a plastic cable tie at the beginning of each day's monitoring period to prevent the participant from resetting the pedometer and to avoid behavior modification as a result of feedback.

During the physical activity data collection period, participants were instructed to wear the unit during all waking hours (i.e., told to re-attach the pedometer each morning before returning to school while getting dressed and to continue with their normal daily activities during the monitoring days). We also informed the participants to only remove the pedometer during bathing, water activities, or sleeping. The participants were instructed that if they shook or misused the pedometer, then teachers, staff members, or other adults would confiscate the pedometer.

Confiscated pedometers were then given to the research assistants, identified as confiscated pedometers, reset to zero steps, and remained in the possession of the researchers until the following day. The confiscated pedometers were not returned to the students until the following day. Therefore, if a participant was seen misusing/shaking the pedometer, then the pedometer was confiscated and the physical activity data for that day was not used in analyses. Because 4 days of physical activity data were required for inclusion in the present study, re-offending participants were excluded from the study analyses.

The pedometer was reset to zero steps following the collection of the participants' physical activity data at school each morning. This process continued for 2 consecutive school weeks. To minimize pedometer loss and in accord with previous research procedures investigating adolescent physical activity using pedometers (i.e., Tudor-Locke et al., 2004; Vincent & Pangrazi, 2002; Vincent, Pangrazi, Raustorp, Tomson, & Cuddihy, 2003), pedometer data in the current study was collected solely during the school week. Previous research has described difficulties in gathering data over the weekend period such as lost pedometers and the inability of being able to differentiate individual daily weekend data using sealed pedometers without investigators visiting the participants' homes to gather daily step counts (Vincent et al., 2003).

Treatment of physical activity data

When reviewing the daily physical activity step counts, abnormal data (3 standard deviations above or below the mean) were investigated to determine if the pedometer was working properly or if the pedometer had been tampered with. In accordance with a procedure used by Rowe and colleagues, all pedometer data below 1000 steps and above 30,000 steps were investigated to determine if the pedometer was working properly or if it had been tampered with (Rowe et al., 2004). In the event that it was determined that a pedometer had not been functioning properly or that it had been tampered with, the daily step counts for that pedometer were eliminated from the analyses. To determine the average number of steps per day for each participant, each day's physical activity was summed together to form a total score. The total score was then divided by the number of days of physical activity data the participant had provided to derive an average steps per day indicator.

Results

Descriptive statistics

Before proceeding to the main analyses, we examined and replaced incomplete values with the mean response provided to similar items (e.g., if competence item 2 was missing, the mean score of items 1, 3, 4, and 5 was used to make mean substitution participant specific). We also explored the data for univariate and multivariate outliers. Two cases were identified as multivariate outliers (extreme scores on the Mahalanobis' distance criterion, $p < .001$) and were eliminated from subsequent analyses. As such, data from 237 participants were retained for analyses.

Table 1 contains the means, standard deviations, and α coefficient (Cronbach, 1951) values for all measures. Previous research has recommended that children ages 6–12 years attain between 12,000 and 15,000 steps (12,000 steps for females; 15,000 steps for males) based upon BMI-referenced steps/day cut points (Tudor-Locke et al., 2004). Participants in the present study failed to achieve the recommended amount of daily physical activity (overall sample $M = 9523$ steps/day, SD = 4211 steps/day; female $M = 7896$ steps/day, SD = 2927 steps/day; male $M = 11{,}136$ steps/day, SD = 4658 steps/day).

The BMI of the overall sample ($M = 21.72$, SD = 4.83) and by sex (boys $M = 21.80$, SD = 5.01; girls $M = 21.64$, SD = 4.66) were examined (see Table 2). Based on the mean participant age (overall sample = 12.11 years, boys = 12.04 years, girls = 12.17 years), the mean BMI values by sex revealed the boys in the present study to be "at-risk" for overweight and the girls approaching "at-risk" for overweight status according to international sex and age-appropriate BMI cut points (boys BMI cut point = 21.22, girls BMI cut point = 21.68) (Cole, Bellizzi, Flegal, & Dietz, 2000). From a public health perspective, the physical activity and body composition statistics for the current sample provide considerable cause for concern.

Because α coefficients can be attenuated by scales with a small number of items, some of our three-item measures failed to reach the conventionally accepted criterion of $\alpha > .70$ (Nunnally, 1978). Such problems have been reported in previous work using constructs indexed by three

Table 1
Means, standard deviations, and Cronbach's α's for all variables

	α	M	SD
Autonomy-support—parents	.90	3.41	.69
Autonomy-support—teacher	.89	4.01	.67
Autonomy	.53	4.04	.65
Competence	.77	3.97	.79
Relatedness	.80	4.05	.76
Intrinsic motivation	.73	4.04	.82
Identified motivation	.63	4.00	.79
Introjected regulation	.56	2.58	.97
External regulation	.54	3.24	1.00
Attraction to physical activity	.79	2.81	.42
Average physical activity (steps/day)	—	9523	4211
BMI	—	21.72	4.83

Table 2
Participant BMI by ethnicity and sex

Ethnicity	Overall		Male		Female	
	M	SD	*M*	SD	*M*	SD
Hispanic	21.49	4.42	21.98	5.15	20.98	3.49
African American	22.37	4.47	24.52	5.68	21.29	3.48
White	23.27	5.28	24.40	5.39	22.13	5.19
Native American	21.33	4.47	19.45	1.21	24.15	7.10
Pacific Island/Asian	27.36	4.83	18.88	2.55	28.94	4.71
Multiple Ethnicities	21.24	4.79	20.22	5.76	22.16	3.85

Table 3
Bivariate correlations among the study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Autonomy-support—parents	—												
2. Autonomy-support—teacher	.33**	—											
3. Autonomy	.25**	.27**	—										
4. Competence	.28**	.25**	.37**	—									
5. Relatedness	.27**	.33**	.30**	.35**	—								
6. Intrinsic motivation	.25**	.37**	.43**	.60**	.44**	—							
7. Identified regulation	.22**	.27**	.24**	.34**	.40**	.48**	—						
8 Introjected regulation	.11	.12	.04	−.10	−.01	.05	.21**	—					
9. External regulation	.05	.14*	.17**	.32**	.24**	.29**	.27**	.44**	—				
10. CAPA total	.10	.18**	.17*	.41**	.19**	.32**	.18**	−.01	.18**	—			
11. Average steps/day (4 days)	.05	.08	.04	.18**	.00	.17**	.02	.03	.15*	.18**	—		
12. Age	−.18**	−.13*	−.09	−.05	−.08	−.09	−.11	−.06	−.02	−.16*	−.07	—	
13. BMI	−.02	−.08	−.03	−.03	−.02	−.08	.01	−.04	−.10	−.16*	−.28**	.19**	—

*$p < .05$, **$p < .01$.

items (e.g., Vallerand et al., 1997). Therefore, two further amendments were made to the measurement scales in the present study. Specifically, an inspection of the item-total scale score correlations revealed that the reverse scored items for autonomy and competence were problematic ($r < .20$). Thus, these items were eliminated from further analysis. Recalculation of Cronbach's α coefficients revealed that the exclusion of these items yielded improvements from $\alpha = .49$ to .53 and from $\alpha = .64$ to .77 for autonomy and competence, respectively. As the α value for the autonomy subscale was below the conventionally used α of $> .70$, results pertaining to this subscale should be interpreted with caution.

The bivariate correlations (Table 3) revealed perceptions of autonomy-support (as provided by parents and teachers) to be positively associated with autonomy, competence, relatedness, intrinsic motivation, identified regulation, and external regulation.

Autonomy, competence, and relatedness were positively associated with intrinsic motivation, identified regulation, and external regulation. Intrinsic motivation, identified regulation, and external regulation were positively correlated with CAPA scores. Intrinsic motivation and external regulation were positively, while BMI was negatively, related to total steps.

As shown in Table 3, the associations among the motivation types deviated from the proposed simplex pattern of associations advanced by SDT (cf. Ryan & Connell, 1989) making it inappropriate to calculate a SDI. In view of the alpha values for external regulation ($\alpha = .54$) and introjected regulation ($\alpha = .56$) we decided to exclude these two scales from the main analyses and proceed with a composite variable labeled *autonomous motivation*. This approach is consistent with past work (e.g., Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Because SDT considers intrinsic motivation to be more self-determined than identified regulation, we retained the first part of the SDI equation to form the composite score autonomous motivation (i.e., 2 × intrinsic motivation subscale + identified regulation). The use of this approach was considered appropriate as it (i) reflects the theoretical distinction between intrinsic motivation and identified regulation (i.e., a relatively autonomous form of extrinsic motivation) and (ii) it is in accord with past work that has applied this weighting to distinguish responses regarding motivational types (e.g., Ntoumanis, 2005; Standage et al., 2006). This composite score was used in the SEM analysis.

Structural equation modeling

Using Version 6.1 of the EQS software (Bentler, 2004), a path analysis was conducted to examine the adequacy of the hypothesized model (Fig. 1). Although it would have been preferable to use a latent modeling approach, due to the relatively small number of participants per estimated parameter, we chose to use the averaged subscale scores in the form of manifest variables. An inspection of the Mardia's normalized multivariate coefficient (normalized coefficient estimate = 6.96) showed the data not to be normally distributed. As such, the data were analyzed using Satorra and Bentler's (1994) scaling correction of the maximum likelihood chi-square (χ^2).

To examine the adequacy of the path model, a two-index presentation strategy as proposed by Hu and Bentler (1999) was used. This approach advances the use of the standardized root mean square residual (SRMR) together with one or more incremental and/or absolute fit indices. In the present work, we used the SRMR, the Comparative Fit Index (CFI), and the Incremental Fit Index (IFI) to assess the adequacy of the proposed model. These indices were chosen as they are less sensitive to distributional assumptions and sample size than comparable indices which tend to over-reject true population models in small samples (e.g., TLI and RMSEA) (Hu & Bentler, 1999). For incremental indices such as the CFI and IFI, values of over .90 are indicative of an acceptable fit, whereas values close to (or above) .95 represent an excellent fit between the model and data (Bentler, 2004; Hu & Bentler, 1999). For SRMR, values of .08 (or lower) represent well-specified models (Hu & Bentler, 1999).

Results of the SEM analysis revealed the model to be a very good fit to the data [Satorra-Bentler χ^2 (23) = 46.58, $p < .01$; CFI = .94; IFI = .94; SRMR = .052]. However, the hypothesized path from age to average number of steps was not significant, and thus was dropped. Subsequently, the model was reassessed and revealed the slightly revised model to fit the data very well [Satorra-Bentler χ^2 (24) = 46.88, $p < .01$; CFI = .94; IFI = .95; SRMR = .052]. The standardized solution is shown in Fig. 2.

R^2 values revealed autonomy-support provided by parents and teachers to predict 8%, 11%, and 14% of the variance in autonomy, competence, and relatedness scores, respectively. Autonomy, competence, and relatedness cumulatively accounted for 45% of the variance in

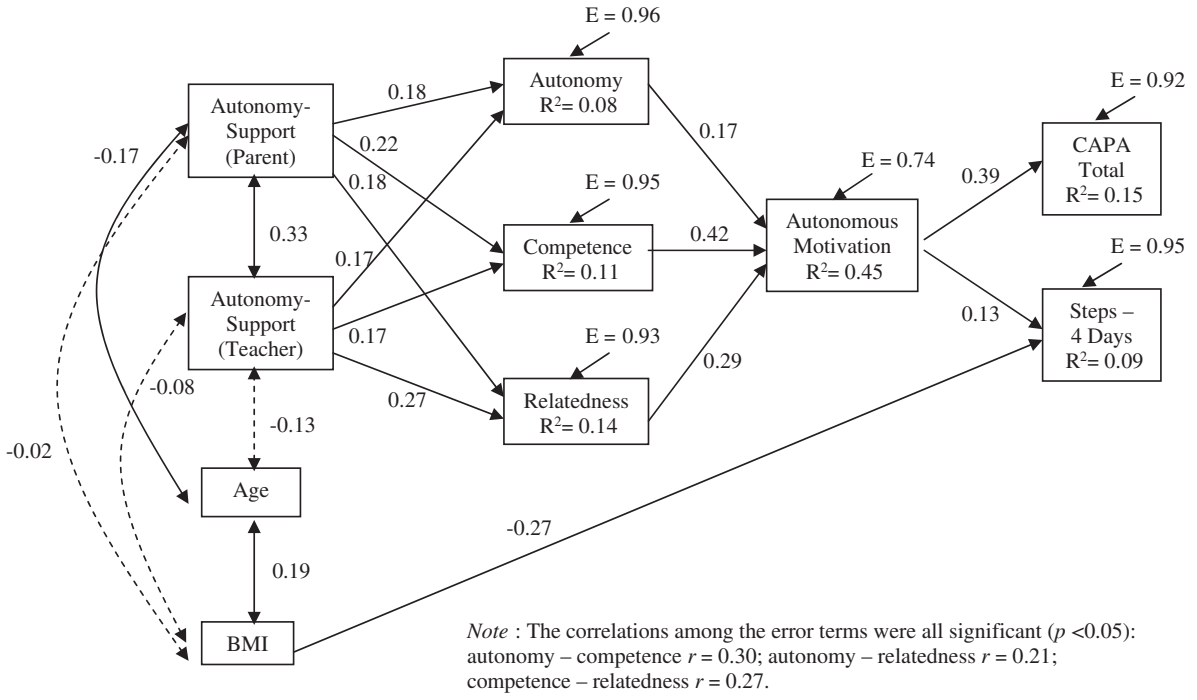

Fig. 2. Standardized solution of the path model.

autonomous motivation scores. Finally, autonomous motivation accounted for 15% in reported CAPA scores and 9% in physical activity, respectively.

To facilitate the interpretation of model effects, the 12 direct paths listed in Table 4 were added to the path model. Standardized total, direct, and indirect effects are shown in Table 4. Indirect effects are consistent with mediation, with a mediating effect being implied if a parameter's indirect effect is significant whereas its direct effect is no longer significant (Hair, Black, Babin, Anderson, & Tatham, 2006). Complete mediation is implied if a significant direct path is reduced to zero when the mediator is added to the model. Partial mediation is assumed when a direct effect remains significant in the presence of a significant indirect effect. To explore the significance of the indirect effects that emerged (i.e., drop from the total to direct effect) we used the bootstrap generated bias-corrected confidence interval approach (Preacher & Hayes, 2004; Shrout & Bolger, 2002).[4] When examining indirect effects, past work has shown the bootstrapping approach (especially when combined with the bias correction) to be superior to the alternative Sobel test with respect to power and Type 1 error rates (MacKinnon, Lockwood, & Williams, 2004). After generating 5000 bootstrap samples, results provided support for partial mediation for autonomy-support (teacher) to autonomous motivation ($\beta = .16$, $p < .001$; Bootstrap 90% CI = .09–.23). As

[4]The indirect effects from autonomy-support (parent) to CAPA total, autonomy to CAPA total, and relatedness to CAPA total were not explored further as the total effects were not significant. Further, and with respect to the latter two indirect paths, these values were small (i.e., less than .08). According to Hair et al. (2006), such effects are seldom of interest and add little to substantive conclusions.

Table 4
Total, direct, and indirect effects of parameter estimates

Parameter	Total effect β	Direct effect β	Indirect effect β
Autonomy support (teacher) → autonomous motivation	.32*	.16*	.16*
Autonomy support (parent) → autonomous motivation	.16*	.00	.16*
Autonomy support (teacher) → steps—4 days	.06	.03	.03
Autonomy support (parent) → steps—4 days	−.02	−.05	.03
Autonomy support (teacher) → CAPA total	.17*	.05	.12*
Autonomy support (parent) → CAPA total	.05	−.05	.10*
Autonomy → steps—4 days	.01	.00	.01
Autonomy → CAPA total	.06	.02	.04*
Competence → steps—4 days	.21*	.18*	.03
Competence → CAPA total	.38*	.29*	.09*
Relatedness → steps—4 days	−.09	−.11	.02
Relatedness → CAPA total	.03	−.03	.06*

Note: *denotes a significant effect (i.e., $z = p < .05$).

the direct path between autonomy-support (teacher) and CAPA total did not reach significance, an intervening effect but not a mediating effect was found ($\beta = .12$, $p < .01$; Bootstrap 90% CI = .06–.18) (i.e., there was no significant path to mediate; see Holmbeck, 1997). Likewise, an intervening effect was found for autonomy-support (parent) to autonomous motivation ($\beta = .16$, $p < .01$; Bootstrap 90% CI = .08–.25). Lastly, partial mediation was supported for the path between competence to CAPA total scores ($\beta = .09$, $p < .01$; Bootstrap 90% CI = .04–.16).

Discussion

The growing physical inactivity and overweight levels of minority youth in the United States represent significant public health challenges, particularly because they represent two of the primary risk factors for coronary heart disease (US Department of Health and Human Services (USDHHS), 2001). With this in mind, the present study examined a model of motivational processes toward physical activity in an "at-risk" youth population. This is the first study, to our knowledge, that has examined a model of motivational processes grounded in SDT to examine factors that predict physical activity in a racially diverse sample "at-risk" for health disparities. The findings of the present study provide support for a model of motivational processes grounded in SDT. Specifically, the model revealed autonomy-support to foster the social conditions for the three basic psychological needs (viz. autonomy, competence, and relatedness) to be met. In turn, all three needs positively influenced autonomous motivation towards physical activity. Autonomous motivation positively predicted physical activity behavior and positive attitudes toward physical activity (see Fig. 2).

The current findings support previous research that has found perceptions of an autonomy-supportive social context to positively meet the needs for autonomy, competence, and relatedness (Ntoumanis, 2005; Standage et al., 2006). Extending previous research, our results endorse the role that numerous social agents have when supporting the physical activity experience of young

"at-risk" ethnic minority individuals. Specifically, participants' autonomy, competence, and relatedness were positively predicted by perceptions of autonomy-support as provided by teachers and parents (Fig. 2). While research has extolled the benefits of autonomy-support provided by PE teachers (e.g., Hagger et al., 2005; Standage et al., 2006), our findings suggest that parental encouragement of physical activity is also important. Within an "at-risk" sample, our findings support past work that has shown parents to be a significant socializing agent in promoting physical activity participation to overweight children (e.g., Tanofsky-Kraff, Hayden-Wade, Cavazos, & Wilfley, 2003).

Although the present work added to the extant literature by examining general "autonomy-support" effects provided by teachers and parents on need satisfaction variables, past work has shown support from mothers and fathers to have differing effects on the motivational responses of adolescents (Niemiec et al., 2006; Soenens & Vansteenkiste, 2005). As such, future work would do well to tease out the unique contributions of mothers and fathers on the motivational responses of children and youth toward physical activity.

Consistent with a central hypothesis of SDT, the basic needs variables of autonomy, competence, and relatedness were found to positively predict autonomous motivation (e.g., Deci & Ryan, 2000). This finding is consistent with recent work examining the tenets of SDT with adolescent samples in sport (Reinboth et al., 2004) and school PE (Ntoumanis, 2005; Standage et al., 2006) contexts. Furthermore, support for a mediating role (teacher autonomy-support) and intervening role (parent autonomy-support) of the need variables in the "social context–motivation" relationship was supported by significant indirect effects. Through the needs, the effect of autonomy-support (teachers) on motivation was partially mediated whereas the need-satisfaction variables served to provide an intervening effect for autonomy-support (parents) on motivation. Given the important role that basic needs play in the "social context–motivation" relationship, future research should further assess "need-supporting" social contexts. Such environments may create the necessary social conditions to promote adaptive engagement in physical activity for all youth, including those "at-risk" for health disparities.

According to SDT, individuals are likely to continue a behavior if they are autonomously motivated (Deci & Ryan, 1985, 1991, 2002). As expected, autonomous motivation positively predicted both physical activity and positive attitudes toward physical activity. Specifically, autonomous motivation accounted for 9% of the variance in physical activity and 15% of the variance in the participants' attitudes toward physical activity. Although accounting for 9% of the variance in physical activity may not initially seem substantial, the potential of being able to increase actual physical activity by further understanding motivational processes is quite noteworthy and encouraging for further research. In addition, we extended past work by assessing physical activity using pedometers. By employing different methods of assessment (i.e., via self-report and pedometer), common method variance was attenuated in the present work.

Rather than using a self-report questionnaire to assess physical activity, the present work added to the extant SDT literature by employing pedometers to assess physical activity. Although self-report methods are often used to assess physical activity in studies linking psychosocial variables with behavior, motion sensors such as pedometers are being more accepted as they have the ability to quantify physical activity. While self-report methods may be influenced by the participant's ability to recall his/her physical activity and may suffer from floor and/or ceiling effects, the monitoring of physical activity with pedometers is not affected by the participant's

ability to recall activities. Such an approach is particularly useful when examining physical activity in children who have been shown to struggle when asked to recall their physical activity patterns (cf. Sallis & Owen, 1999). Although pedometers have their own limitations (e.g., inability to measure frequency and intensity), pedometers are generally easy to administer, unobtrusive, do not rely on the participant's memory, and can be used by individuals with language or literacy difficulties (Tudor-Locke & Myers, 2001b). In a diverse sample of adolescents, pedometers may represent an effective method of assessing physical activity.

In addition to subjective perceptions, the current study supports previous research that revealed an inverse relationship between physical activity and body composition in young people (Klesges et al., 1995; Vincent et al., 2003). Although the current work and past research (e.g., Vincent et al., 2003) have shown negative relationships between physical activity and BMI, the cross-sectional nature of the studies cannot determine the direction of causality between body composition and physical activity. Therefore, although the proposed model is a good fit to the data, it is uncertain as to whether BMI influences physical activity levels or whether physical activity levels influence BMI. In addition, a linear relationship may not be the best link between physical activity and the BMI-for-age curves that represent growing and developing adolescents (Tudor-Locke et al., 2004). Future research should use a longitudinal design to explore and test causal relationships embraced by SDT so that these determinants of physical activity and attitudes towards physical activity can be firmly established. Such work would provide valuable information to aid with intervention efforts.

In the current study, participant age was inversely associated with both parent autonomy-support for physical activity and the child's attraction to physical activity. Previous research has shown that adolescents' participation in physical activity decreases as a function of increasing age (Stone et al., 1998). However, in this sample of "at-risk" minority youth, the amount of physical activity was low overall (i.e., when compared to the BMI-referenced standards of children aged 6–12 years of 12,000 steps/day for females and 15,000 steps/day for males, respectively; cf. Tudor-Locke et al., 2004) and was unrelated to participant age. As such, examining motivational processes to predict and affect physical activity in adolescent minority populations may be especially pressing.

Practical implications

The practical applications arising from this research for parents and practitioners involved in promoting youth physical activity focus on the importance of creating suitable social conditions to encourage "at-risk" youth to choose to be more physically active. The findings of the present study illustrate that both parents and teachers are instrumental in creating an autonomy-supportive environment for youth and fostering their three basic psychological needs of autonomy, competence, and relatedness to promote self-determined motives to be more physically active. Providing more opportunities for youth to safely engage in physical activities with peers, cultivating autonomous motivation, and encouraging them to develop competencies by participating in a variety of physical activities would likely enhance adolescents' attitudes toward physical activity and increase their levels of physical activity. By supporting youth to be more physically active, parents and teachers can positively affect the overall health of "at-risk" youth and potentially decrease the likelihood of these adolescents becoming overweight or developing coronary heart disease later in life.

Conclusion

This study added to the extant SDT literature in a number of ways. These extensions were to (i) test a model of motivational processes with an "at-risk" minority youth sample (ii) assess physical activity using pedometers as opposed to employing a self-report questionnaire, and (iii) assess perceptions of autonomy-support provided by two social agents (viz., parents and teachers). Overall, support was found for a number of the theoretical tenets advanced by SDT. First, results supported the role that autonomy-support as provided by teachers and parents play in facilitating the motivational processes that influence positive subjective perceptions (i.e., attitudes) and physical activity. Second, the findings reinforced, via both direct and indirect effects, SDT's proposition that the three psychological needs of autonomy, competence, and relatedness are key variables to the "social context—motivation" relationship. Third, autonomous motivation was positively linked to physical activity and positive attitudes towards physical activity. In conclusion, the findings of the present work provide support for the propositions of SDT and corroborate the application of the framework to enhance our understanding of motivational processes pertaining to physical activity within minority "at-risk" youth.

Acknowledgments

This study was part of the first author's doctoral dissertation completed at Arizona State University under the guidance of the third author. The study was funded by a grant from the Arizona Department of Health Services, Chronic Disease Program (HP454366-001) awarded to the third author.

References

Andersen, R. E., Crespo, C. J., Bartlett, S. J., Cheskin, L. J., & Pratt, M. (1998). Relationship of physical activity and television watching with body weight and level of fatness among children: Results from the Third National Health and Nutrition Examination Survey. *Journal of the American Medical Association*, *279*, 938–942.

Anderson, R. N., & Smith, B. L. (2005). Deaths: Leading causes for 2002. *National Vital Statistics Reports*, *53*, 1–92.

Baard, P. P., Deci, E. L., & Ryan, R. M. (2000). *Intrinsic need satisfaction as a motivational basis of performance and well-being at work*. Unpublished manuscript, Fordham University.

Bassett, D. R., Ainsworth, B. E., Swartz, A. M., Strath, S. J., O'Brien, W. L., & King, G. A. (2000). Validity of four motion sensors in measuring moderate intensity physical activity. *Medicine and Science in Sports and Exercise*, *32*, S471–S480.

Bassett, D. R., Ainsworth, B. E., Leggett, S. R., Mathien, C. A., Main, J. A., Hunter, D. C., et al. (1996). Accuracy of five electronic pedometers for measuring distance walked. *Medicine and Science in Sports and Exercise*, *28*, 1071–1077.

Bentler, P. M. (2004). *EQS Structural Equations Modeling Software version. 6.1* [*computer software*]. Encino, CA: Multivariate Software Inc.

Blais, M.R., Ballerand, R.J., & Lachance, L. (1990). *L'èchelle des perceptions d' autonomie dans le domaines de vie* [*The perceived autonomy in life domains scale*]. Unpublished manuscript, University of Quebec at Montreal, Montreal, Quebec, Canada.

Brustad, R. J. (1993). Who will go out and play? Parental and psychological influences on children's attraction to physical activity. *Pediatric Exercise Science*, *5*, 210–223.

Brustad, R. J. (1996). Attraction to physical activity in urban schoolchildren: Parental socialization and gender influences. *Research Quarterly for Exercise and Sport*, *67*, 316–323.

Centers for Disease Control and Prevention. (2000). *School health policies and program study*. Washington, DC: Government Printing Office.

Chirkov, V. I., & Ryan, R. M. (2001). Parent and teacher autonomy-support in Russian and US adolescents: Common effects on well-being and academic motivation. *Journal of Cross-Cultural Psychology*, *32*, 618–635.

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *British Medical Journal*, *320*, 1–6.

Corbin, C. B., & Pangrazi, R. P. (2004). *Guidelines for appropriate physical activity for elementary school children: 2003 update*. Reston, VA: NASPE Publications (AAHPHERD National Guidelines).

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*, 296–334.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*, *53*, 1024–1037.

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. Dienstbier (Ed.), *Nebraska symposium on motivation. Vol. 38. Perceptives on motivation* (pp. 237–288). Lincoln, NE: University of Nebraska Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*, 227–268.

Deci, E. L., & Ryan, R. M. (Eds.). (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.

Epstein, L. H., Valoski, A. M., Vara, L. S., McCurley, J., Wisniewski, L., Kalarchian, M. A., et al. (1995). Effects of decreasing sedentary behavior and increasing activity on weight change in obese children. *Health Psychology*, *13*, 373–383.

Fox, K. R., & Harris, J. (2003). Promoting physical activity through schools. In J. McKenna, & C. Riddoch (Eds.), *Perspectives on health and exercise* (pp. 181–202). Basingstoke: Palgrave-Macmillan.

Frenn, M., Malin, S., Villarruel, A. M., Slaikeu, K., McCarthy, S., Freeman, J., et al. (2005). Determinants of physical activity and low-fat diet among low income African American and Hispanic middle school students. *Public Health Nursing*, *22*, 89–97.

Goudas, M., Biddle, S. J. H., & Fox, K. R. (1994). Perceived locus of causality, goal orientations, and perceived competence in school physical education classes. *British Journal of Educational Psychology*, *64*, 453–463.

Hagger, M. S., Chatzisarantis, N. L. D., Barkoukis, V., Wang, C. K. J., & Baranowski, J. (2005). Perceived autonomy support in physical education and leisure-time physical activity: A cross-cultural evaluation of the trans-contextual model. *Journal of Educational Psychology*, *97*, 376–390.

Hagger, M. S., Chatzisarantis, N. L. D., & Biddle, S. J. H. (2002). The influence of autonomous and controlling motives on physical activity intentions within the Theory of Planned Behaviour. *British Journal of Health Psychology*, *7*, 283–297.

Hagger, M. S., Chatzisarantis, N. L. D., Culverhouse, T., & Biddle, S. J. H. (2003). The processes by which perceived autonomy support in physical education promotes leisure-time physical activity intentions and behavior: A trans-contextual model. *Journal of Educational Psychology*, *95*, 784–795.

Hair, J. F., Black, B., Babin, B., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed). Englewood Cliffs, NJ: Prentice-Hall.

Hollembeak, J., & Amorose, A. J. (2005). Perceived coaching behaviors and college athletes' intrinsic motivation: A test of self-determination theory. *Journal of Applied Sport Psychology*, *17*, 20–36.

Holmbeck, G. N. (1997). Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from the child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology*, *65*, 599–610.

Hu, L., & Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*, 1–55.

Klesges, R. C., Klesges, L. M., Eck, L. H., & Shelton, M. L. (1995). A longitudinal analysis of accelerated weight gain in preschool children. *Pediatrics*, *95*, 126–130.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate Behavioral Research*, *39*, 99–128.

McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport*, *60*, 48–58.

Miserandino, M. (1996). Children who do well in school: Individual differences in perceived competence and autonomy of above average children. *Journal of Educational Psychology*, *88*, 203–214.

Niemiec, C. P., Lynch, M. F., Vansteenkiste, M., Bernstein, J., Deci, E. L., & Ryan, R. M. (2006). The antecedents and consequences of autonomous self-regulation for college: A self-determination theory perspective on socialization. *Journal of Adolescence*, *29*, 761–775.

Ntoumanis, N. (2001). A self-determination approach to the understanding of motivation in physical education. *British Journal of Educational Psychology*, *71*, 225–242.

Ntoumanis, N. (2002). Motivational clusters in a sample of British physical education classes. *Psychology of Sport and Exercise*, *3*, 177–194.

Ntoumanis, N. (2005). A prospective study of participation in optional school physical education using a self-determination theory framework. *Journal of Educational Psychology*, *97*, 444–453.

Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.

Ogden, C., Flegal, K., Carroll, M., & Johnson, C. (2002). Prevalence and trends in overweight among US children and adolescents, 1999–2000. *Journal of the American Medical Association*, *288*, 1728–1732.

Ogden, C. L., Troiano, R. P., Briefel, R. R., Kuczmarski, R. J., Flegal, K. M., & Johnson C. L. (1997). Prevalence of overweight among preschool children in the United States, 1971 through 1994. *Pediatrics*, *99*, e1. URL 〈http://www.pediatrics.org/cgi/content/full/99/4/e1〉.

Parish, L. E., & Treasure, D. C. (2003). Physical activity and situational motivation in physical education: Influence of the motivational climate and perceived ability. *Research Quarterly for Exercise and Sport*, *74*, 173–182.

Pate, R. R., Baranowski, T., Dowde, M., & Trost, S. G. (1996). Tracking of physical activity in children. *Medicine and Science in Sports and Exercise*, *28*, 92–96.

Pietrobelli, A., Faith, M. S., Allison, D. B., Gallagher, D., Chiumello, G., & Heymsfield, S. B. (1998). Body mass index as a measure of adiposity among children and adolescents: A validation study. *Journal of Pediatrics*, *132*, 204–210.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, *36*, 717–731.

Reinboth, M., Duda, J. L., & Ntoumanis, N. (2004). Dimensions of coaching behavior, need satisfaction, and the psychological and physical welfare of young athletes. *Motivation and Emotion*, *28*, 297–313.

Richer, S., & Vallerand, R. J. (1998). Construction et validation de l'èchelle du sentiment d' appartenance sociale [Construction and validation of the perceived relatedness scale]. *Revue Européene de Psychologie Appliquée*, *48*, 129–137.

Rowe, D. A., Mahar, M. T., Raedeke, T. D., & Lore, J. (2004). Measuring physical activity in children with pedometers: Reliability, reactivity, and replacement of missing data. *Pediatric Exercise Science*, *16*, 343–354.

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, *63*, 397–427.

Ryan, R. M., Chirkov, V. I., Little, T. D., Sheldon, K. M., Timoshina, E., & Deci, E. L. (1999). The American dream in Russia: Extrinsic aspirations and well-being in two cultures. *Personality and Social Psychology Bulletin*, *25*, 1509–1524.

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, *57*, 749–761.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development and well-being. *American Psychologist*, *55*, 68–78.

Ryan, R. M., & Deci, E. L. (2002). An overview of self-determination theory: An organismic-dialectical perspective. In E. L. Deci, & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). Rochester, NY: University of Rochester Press.

Sallis, J. F., & Owen, N. (1999). *Physical activity & behavioral medicine*. Thousand Oaks, CA: Sage.

Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. In A. von Eye, & C. C. Clogg (Eds.), *Latent variables analysis: Applications for developmental research* (pp. 399–419). Thousand Oaks, CA: Sage.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*, *7*, 422–445.

Simons-Morton, B. G., Taylor, W. C., Snider, S. A., Wei Huang, I., & Fulton, J. E. (1994). Observed levels of elementary and middle school children's physical activity during physical education classes. *Preventive Medicine*, *23*, 437–441.

Soenens, B., & Vansteenkiste, M. (2005). Antecedents and outcomes of self-determination in 3 life domains: The role of parents' and teachers' autonomy support. *Journal of Youth and Adolescence*, *34*, 589–604.

Standage, M., Duda, J. L., & Ntoumanis, N. (2003). A model of contextual motivation in physical education: Using constructs from self-determination and achievement goal theories to predict physical activity intentions. *Journal of Educational Psychology*, *95*, 97–110.

Standage, M., Duda, J. L., & Ntoumanis, N. (2005). A test of self-determination theory in school physical education. *British Journal of Educational Psychology*, *75*, 411–433.

Standage, M., Duda, J. L., & Ntoumanis, N. (2006). Students' motivational processes and their relationship to teacher ratings in school physical education: A self-determination theory approach. *Research Quarterly for Exercise and Sport*, *77*, 100–110.

Standage, M., Gillison, F., & Treasure, D. C. (in press). Self-determination and motivation in physical education. In M.S. Hagger, N.L.D. Chatzisarantis, (Eds.), *Self-determination theory in exercise and sport*. Champaign, IL: Human Kinetics.

Stone, E. J., McKenzie, T. L., Welk, G. J., & Booth, M. L. (1998). Effects of physical activity interventions in youth: A review and synthesis. *American Journal of Preventive Medicine*, *15*, 298–315.

Strauss, R. S., & Pollack, H. H. (2001). Epidemic increase in childhood overweight, 1986–1998. *Journal of the American Medical Association*, *286*, 2845–2848.

Tanofsky-Kraff, M., Hayden-Wade, H., Cavazos, P. A., & Wilfley, D. E. (2003). Treating and preventing pediatric obesity. In R. E. Anderson (Ed.), *Obesity: Etiology, assessment, treatment, and prevention* (pp. 155–175). Champaign, IL: Human Kinetics.

Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (2000). Using objective physical activity measures with youth: How many days of monitoring are needed? *Medicine and Science in Sports and Exercise*, *32*, 426–431.

Tryon, W. W., Pinto, L. P., & Morrison, D. F. (1991). Reliability assessment of pedometer activity measurements. *Journal of Psychopathology and Behavioral Assessment*, *13*, 27–44.

Tudor-Locke, C. E., & Myers, A. M. (2001a). Challenges and opportunities for measuring physical activity in sedentary adults. *Sports Medicine*, *31*, 91–100.

Tudor-Locke, C. E., & Myers, A. M. (2001b). Methodological considerations for researchers and practitioners using pedometers to measure physical (ambulatory) activity. *Research Quarterly for Exercise and Sport*, *72*, 1–12.

Tudor-Locke, C., Pangrazi, R. P., Corbin, C. B., Rutherford, W. J., Vincent, S. D., Raustorp, A., et al. (2004). BMI-referenced standards for recommended pedometer-determined steps/day in children. *Preventive Medicine*, *38*, 857–864.

US Department of Health and Human Services. (1997). *Healthy People 2010: National health promotion and disease prevention objectives*. Washington, DC: Government Printing Office.

US Department of Health and Human Services. (2000). *Healthy People 2010. Understanding and improving health* (2nd ed). Washington, D.C.: Government Printing Office.

US Department of Health and Human Services. (2001). *The Surgeon General's call to action to prevent and decrease overweight and obesity*. Rockville, MD: US Department of Health and Human Services, Public Health Service, Office of the Surgeon General.

Vallerand, R. J. (2001). A hierarchical model of intrinsic and extrinsic motivation in sport and exercise. In G. C. Roberts (Ed.), *Advances in motivation in sport and exercise* (pp. 263–319). Champaign, IL: Human Kinetics.

Vallerand, R. J., & Fortier, M. S. (1998). Measures of intrinsic and extrinsic motivation in sport and physical activity: A review and critique. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 81–101). Morgantown, WV: Fitness Information Technologies.

Vallerand, R. J., Fortier, M. S., & Guay, F. (1997). Self-determination and persistence in a real-life setting: Toward a motivational model of high school dropout. *Journal of Personality and Social Psychology*, *72*, 1161–1176.

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic role of intrinsic goals and autonomy-support. *Journal of Personality and Social Psychology*, *87*, 246–260.

Véronneau, M.-H., Koestner, R. F., & Abela, J. R. Z. (2005). Intrinsic need satisfaction and well-being in children and adolescents: An application of the self-determination theory. *Journal of Social and Clinical Psychology*, *24*, 280–292.

Vincent, S. D., & Pangrazi, R. P. (2002). Does reactivity exist in children when measuring activity levels with pedometers? *Pediatric Exercise Science*, *14*, 56–63.

Vincent, S. D., Pangrazi, R. P., Raustorp, A., Tomson, M. L., & Cuddihy, T. F. (2003). Activity levels and body mass index of children in the United States, Sweden, and Australia. *Medicine and Science in Sports and Exercise*, *35*, 1367–1373.

Welk, G. J., Wood, K., & Morss, G. (2003). Parental influences on physical activity in children: An exploration of potential mechanisms. *Pediatric Exercise Science*, *15*, 19–33.

Williams, G. C., McGregor, H. A., Zeldman, A., Freedman, Z. R., & Deci, E. L. (2004). Testing a self-determination theory process model for promoting glycemic control through diabetes self-management. *Health Psychology*, *23*, 58–66.

World Health Organization. (1995). *Physical status: The use and interpretation of anthropometry*. WHO Technical Report Series. Geneva, Switzerland: World Health Organization.