ORIGINAL RESEARCH

Journal of Sport & Exercise Psychology, 2011, 33, 175-197
© 2011 Human Kinetics, Inc.

Predicting Objectively Assessed Physical Activity From the Content and Regulation of Exercise Goals: Evidence for a Mediational Model

Simon J. Sebire,[1] Martyn Standage,[1] and Maarten Vansteenkiste[2]

[1]University of Bath and [2]Ghent University

Grounded in self-determination theory (Deci & Ryan, 2000), the purpose of this work was to examine effects of the content and motivation of adults' exercise goals on objectively assessed moderate-to-vigorous physical activity (MVPA). After reporting the content and motivation of their exercise goals, 101 adult participants (M_{age} = 38.79 years; *SD* = 11.5) wore an ActiGraph (GT1M) accelerometer for seven days. Accelerometer data were analyzed to provide estimates of engagement in MVPA and bouts of physical activity. Goal content did not directly predict behavioral engagement; however, mediation analysis revealed that goal content predicted behavior via autonomous exercise motivation. Specifically, intrinsic versus extrinsic goals for exercise had a positive indirect effect on average daily MVPA, average daily MVPA accumulated in 10-min bouts and the number of days on which participants performed 30 or more minutes of MVPA through autonomous motivation. These results support a motivational sequence in which intrinsic versus extrinsic exercise goals influence physical activity behavior because such goals are associated with more autonomous forms of exercise motivation.

Keywords: self-determination theory, exercise goals, motivation, accelerometer

Owing to epidemic levels of physical inactivity, overweight and obesity (World Health Organization, 2002) and the comorbidities associated with such factors (Hardman & Stensel, 2003), it is recommended that adults perform five 30-min bouts of moderate-to-vigorous physical activity (MVPA) per week accumulated in bouts of activity at least 10 min in duration (Physical Activity Guidelines Advisory Committee, 2008). As such, understanding motivation for physical activity behavior, including exercise, is a priority.[1] A conceptual framework frequently used to study motivation for health-enhancing behaviors such as physical activity

Simon J. Sebire is now with the Centre for Exercise, Nutrition & Health Sciences, University of Bristol, Bristol, U.K. Martyn Standage is with the Department of Health, University of Bath, Bath, U.K. Maarten Vansteenkiste is with the Department of Psychology, University of Ghent, Ghent, Belgium.

is self-determination theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2007; Ryan, Patrick, Deci, & Williams, 2008).

The goals that individuals pursue are important when studying motivation using SDT. Austin and Vancouver (1996) define goals as "internal representations of desired states, where states are broadly construed as outcomes, events or processes" (p. 338), and within SDT both the *content* and the *behavioral regulation* of goals are important considerations. Goal content refers to the "what" of motivation, or a person's specific aspiration (e.g., to be healthier), whereas behavioral regulation refers to the "why" of motivation, or a person's reasoning behind their goal (e.g., because a physician has told them to exercise) (Deci & Ryan, 2000). The purpose of the current study was to investigate the prediction of objectively assessed MVPA behavior from the "what" and the "why" of exercise goal pursuit.

Goal Content and Motivational Regulations

Self-determination theory is based on organismic (i.e., humans are hypothesized to be growth oriented) and dialectic (i.e., growth occurs via environmental interactions) foundations (Deci & Ryan, 2000). Central to this perspective is the proposal of three psychological needs that are purported to underlie optimal human growth, effective functioning and adaptive environmental interactions, namely, autonomy, competence and relatedness. Autonomy is the need to be the origin of one's behavior, competence is the need to interact effectively with and to master one's environment and relatedness refers to the need to feel a sense of mutual connectedness in one's social surroundings (Deci & Ryan, 2000). Deci and Ryan (2000) contend that where goal pursuit (through its content and motivation) facilitates need satisfaction, adaptive cognitive, affective and behavioral outcomes will occur.

Within the broader SDT framework, goal contents theory (GCT; Ryan, Williams, Patrick, & Deci, 2009; Vansteenkiste et al., 2010) holds that goals can be defined as *intrinsic* (i.e., are inwardly focused on self-development and conducive to the satisfying of psychological needs) or *extrinsic* (i.e., are outwardly focused, related to self-evaluative concerns and unsatisfying of psychological needs) (Deci & Ryan, 2000; Vansteenkiste, Lens, & Deci, 2006). Research from this perspective has shown that where intrinsic aspirations (e.g., community contribution, physical fitness or social affiliation) are more central to people's lives than extrinsic aspirations (e.g., wealth, fame or appearance) they experience greater psychological well-being, less depression and anxiety, and reduced physical symptoms (see Kasser, 2002; Kasser, Cohn, Kanner, & Ryan, 2007 and Vansteenkiste, Soenens, & Duriez, 2008, for reviews). Conversely, extrinsic, relative to intrinsic goal endorsement is negatively associated with well-being (Sheldon, Ryan, Deci, & Kasser, 2004) and positively associated with body image concerns (Thøgersen-Ntoumani, Ntoumanis, & Nikitaras, 2010), antisocial attitudes (Duriez, Vansteenkiste, Soenens, & De Witte, 2007; McHoskey, 1999) and behaviors (Sheldon & McGregor, 2000). In addition, positive associations between relative intrinsic life aspirations and health outcomes such as tobacco abstinence and number of days not smoking (Niemiec, Ryan, Deci & Williams, 2009) and between relative extrinsic aspirations and multiple health risk behaviors (Williams, Cox, Hedberg & Deci, 2000) have been reported.

Research examining goal contents from an SDT perspective has recently been extended to the exercise domain (Sebire, Standage, & Vansteenkiste, 2008; see

Standage & Ryan, in press, for a review). In line with GCT, Sebire, Standage, and Vansteenkiste (2009) identified that the pursuit of intrinsic (i.e., health management, skill development and social affiliation) relative to extrinsic (i.e., image and social recognition) exercise goals was positively associated with psychological need satisfaction in exercise, physical self-worth, psychological well-being, and self-reported exercise behavior and negatively associated with exercise-based anxiety. These observations support previous findings delineating positive associations between intrinsic (e.g., health) and extrinsic (e.g., image) exercise goals with adaptive and maladaptive psychological outcomes respectively (e.g., Crawford & Eklund, 1994; Maltby & Day 2001).

In the present work we aimed to build upon previous research (e.g., Sebire, Standage, & Vansteenkiste, 2008; 2009) by (a) focusing on the prediction of behavioral outcomes (i.e., objectively assessed bouts of MVPA) and (b) by exploring in more detail the motivational dynamics between goal content and motivational regulation.

With regards to motivational regulation, in SDT, motivation is classified as autonomous or controlled based on the degree to which a goal is pursued with a sense of self-determination (Deci & Ryan, 2000). Autonomous motivation comprises *intrinsic motivation* and *identified regulation*.[2] Intrinsic motivation stems from the inherent satisfaction, interest or challenge of participation in an activity, whereas identified regulation derives from a sense of value and personal endorsement of an activity. Controlled motivation reflects less self-determined reasons for goal pursuit and is underpinned by *introjected regulation* in which motivation stems from self-imposed sanctions such as guilt, shame or pride and *external regulation* where behaviors are enacted to comply with external demands or to obtain externally based rewards. When an individual's actions are underpinned by autonomous versus controlled motivation it is hypothesized that they will experience adaptive psychological functioning and greater behavioral performance and persistence (Deci & Ryan, 2000). Consistent with this hypothesis, studies of adults' motivation in the exercise domain, have largely identified positive associations between autonomous motivation toward exercise and self-reported exercise (Edmunds, Ntoumanis, & Duda, 2006; Wilson, Rodgers, Blanchard, & Gessell, 2003; Wilson, Rodgers, Fraser, & Murray, 2004) and objectively assessed (Standage, Sebire, & Loney, 2008) bouts of MVPA.

Despite representing theoretically distinct constructs, goal content and motivational regulation tend to covary as they share associations with psychological need satisfaction (Deci & Ryan, 2000). Evidence from previous studies in the exercise domain supports this assertion, identifying an average bivariate correlation between the two concepts of $r = .44$ (Sebire, Standage, & Vansteenkiste, 2008; 2009). Although correlated, the average correlation between goal content and motivational regulation is not indicative of redundancy and it is hypothesized that scores on these two sets of variables predict independent variance or have independent effects (e.g., the initial association between goal content as a predictor and an outcome remains significant after entering motivational regulation as a predictor) on outcomes such as well-being (Deci & Ryan, 2000; Sheldon et al., 2004). This hypothesis has been challenged by some researchers (e.g., Carver & Baird, 1998; Srivastava, Locke, & Bartol, 2001) who contend that the observed associations between relative intrinsic goal content and well-being (e.g., Kasser & Ryan, 1996) are due to autonomous and

controlled motivation which underlie the pursuit of intrinsic and extrinsic goals, respectively. However, studies of the constructs at the general life level (Sheldon et al., 2004) and in exercise (Sebire et al., 2009) have provided support for their independent effects on cognitive and affective outcomes (e.g., psychological well-being, physical self-worth and exercise-based anxiety), although other researchers (Gardarsdottir, Dittmar, & Aspinall, 2009; Srivastava et al., 2001), using measures that are not directly grounded in SDT, failed to provide support for the independent effects of goal contents.

Goal Content, Behavioral Regulation and the Prediction of Exercise Behavior

Although the independent effects of goal content and motivation on cognitive and affective outcomes has been reasonably supported (Sebire et al., 2009; Sheldon et al., 2004), similar findings have not been observed when testing behavioral indices in the physical activity domain. Indeed, work across a number of life domains using experimental and cross-sectional research designs has yielded equivocal findings.

For example, Vansteenkiste, Simons, Lens, Sheldon, and Deci (2004) experimentally manipulated goals for learning tae-bo exercises in a student sample in terms of attaining intrinsic (e.g., physical health) and extrinsic (e.g., appearing attractive to others) outcomes. Participants who received the intrinsic versus extrinsic goal framing manipulation performed better on tests related to tae-bo performance, persisted longer in free-choice tae-bo activities and displayed greater autonomous motivation. Mediation analysis revealed that test performance was independently predicted by the intrinsic goal content and autonomous motivation; however, the effect of the intrinsic goal content manipulation on behavioral persistence was mediated by autonomous motivation.

In a cross-sectional study of adolescent British schoolchildren, Gillison, Standage and Skevington (2006) found individual differences in exercise goal content to have weak direct effects on self-reported leisure-time exercise, as well as indirect effects via exercise motivational regulation. Recent work in large samples of British adults (e.g., Ingledew & Markland, 2008; Sebire et al. 2009) has, however, found that goal content no longer yielded an independent association with self-reported exercise behavior once motivation was taken into account. Sebire et al. (2009) suggested that it could be the case that one's behavioral motivation, relative to exercise goal content, may be more proximal to behavioral engagement as these motivations are more present-oriented. In contrast, the cognitive foci on the content of one's exercise goals (e.g., the promise of social recognition or the ideal appearance) may be rather distal as goals are typically future-oriented, thereby being situated at mid- to even long-term distance from one's current behavior. As a result, the chance that goal content predicts recently enacted and/or proximal behavioral engagement above and beyond the reasons by which one is motivated to act are considerably reduced. In line with previous work (Gillison et al., 2006; Ingledew & Markland, 2008), we suggest that intrinsic and extrinsic goal content precedes the motivational regulation of that goal: a focus on intrinsic, relative to extrinsic, goals would be conducive to physical activity because one would derive more enjoyment and pleasure from the activity (autonomous motivation) and feel less pressured to do it (controlled motivation).

Taken collectively, the findings of extant work examining whether the effect of exercise goal content on exercise behavior occur above and beyond or via exercise behavioral motivation (e.g., Vansteenkiste, Simons, Lens et al. 2004; Gillison et al., 2006; Ingledew & Markland, 2008; Sebire et al., 2009) paint an unclear picture. However, apart from the evidence from the Vansteenkiste, Simons, Lens, et al. (2004) study, evidence of the independent effects of goal content and motivational regulations on physical activity behavior is derived from studies that used cross-sectional study design. Further, only two of these studies (i.e., Ingledew & Markland, 2008; Sebire et al., 2009) were conducted among adult populations. In addition, although the predictive effects of autonomous and controlled motivation on physical activity have been assessed using objectively measured behavior (e.g., Standage et al., 2008), studies of the relationship between goal content and physical activity have relied on behavioral self-reports, with the exception of the experimental goal framing studies by Vansteenkiste and colleagues (Vansteenkiste, Simons, Lens, et al., 2004; Vansteenkiste, Simons, Soenens, & Lens, 2004). However, in these experimental investigations, participants' voluntary engagement in single exercise sessions rather than their daily engagement was assessed. As such, further studies in adult populations using robust and daily behavioral assessments are warranted.

Self-report assessments of activity behavior are cost and time effective but are vulnerable to error from factors such as social desirability and recall biases (see Dale, Welk, & Matthews, 2002 for a review of physical activity assessment). Accelerometers are small electronic motion sensors that objectively detect bodily acceleration, which can be used to quantify physical activity. Using accelerometers in a field that relies on questionnaire inventories for the measurement of most cognitive constructs may reduce common method variance: a source of systematic error where observed relationships between variables may be artificially inflated by the similarity of measurement methods (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). In addition, accelerometers eliminate issues pertaining to activity recall biases and accelerometer data can be used to more accurately quantify physical activity duration, activity in continuous bouts that may reflect purposeful exercise and the meeting of public health recommendations at an individual level (Loney, Standage, Thompson, Sebire, & Cumming, in press). Knowing whether theoretical constructs such as goal content and motivation predict meaningful behavioral engagement, such as the meeting of public health recommendations is important for psychologists and health practitioners alike.

The Present Research

To summarize, the purpose of the present work was to examine the prediction of MVPA and continuous bouts of MVPA by the content and motivation of exercise goals in an adult sample. Extending previous work, accelerometers were used to quantify meaningful behavioral engagement (i.e., that recommended for health).

Method

Participants

Participants were volunteers from southwest England. Participants were eligible for inclusion if they (a) were aged 18–65 years, (b) reported performing at least one exercise session per week on average (to ensure the relevance of questions pertaining to exercise motivation), (c) were not a solely water-based exerciser (e.g., a swimmer) and (d) were free from conditions that restrict physical activity.

The study protocol was completed by 107 participants (racial identity; White = 99%, Asian = 1%). Owing to device malfunction, behavioral data were incomplete (i.e., <5 valid days of data) for six participants. The final sample comprised 101 individuals (33 men, 68 women; M_{age} = 38.79 years; *SD* = 11.50, age range = 21.39–63.39 years). Of the participants, 61.7% were university employees, 21.5% members of the public, and 16.8% postgraduate students. Of the university employees, 54.5% worked in administration, 18.3% teaching, 13.6% research and 13.6% technical employees. Secondary-level and tertiary-level education were reported by 91.1% and 8.9% of participants, respectively.

The average body mass index (BMI) of the sample (M = 24.33 kg/m^2; *SD* = 3.52; range = 19.17–37.89 kg/m^2) resided near the upper threshold of the "normal" range and average waist circumference (WC) values (males: M = 85.76 cm; *SD* = 10.80, females: M = 76.03 cm; *SD* = 8.56) were within gender-appropriate "low risk" ranges (see American College of Sports Medicine, 2006).

Procedure

Following institutional ethical approval, participants were recruited by an advertisement on a university Web page and posters located around a university campus. The protocol of the study followed a three time-point design, which lasted 16 days. At Time 1, participants were given information about the study, asked to provide informed consent and demographics, and responses to exercise goal content and motivation self-report measures were obtained. Seven days later (Time 2) participants' anthropomorphic measurements (height, weight and WC) were taken. Participants were given an ActiGraph GT1M accelerometer (ActiGraph, LLC, Pensacola, FL) to wear for the next seven days and a daily physical activity log to complete. Eight days after Time 2, participants returned the accelerometer and activity log and were debriefed as to the purpose of the study (Time 3).

Measures

Exercise Goal Content. The goal content for exercise questionnaire (GCEQ; Sebire, Standage, & Vansteenkiste, 2008) was used to assess the importance participants placed on intrinsic exercise goals for health management, skill development and social affiliation and extrinsic goals for image and social recognition. The GCEQ consists of 20 items (four per goal subscale) which are rated on a 7-point Likert scale ranging from 1 (*not at all important*) to 7 (*extremely important*). Previous research showed that scores derived from the GCEQ are internally consistent and display construct validity, temporal stability and gender invariance (Sebire, Standage, & Vansteenkiste, 2008; 2009). In the current study,

internal consistency of the five subscales was as follows; health management (α = .82), skill development (α = .89), social affiliation (α = .84), image (α = .89) and social recognition (α = .89). In line with the SDT literature (Deci & Ryan, 2000) and previous work (Sebire et al., 2009; Sheldon et al., 2004) a relative intrinsic goal variable was calculated by subtracting the average of scores on extrinsic goal items (α = .87) from the average of scores on intrinsic goal items (α = .85).

Exercise Motivation. Participants completed Mullan, Markland and Ingledew's (1997) 15-item behavioral regulations in exercise questionnaire (BREQ). The BREQ assesses intrinsic motivation and identified, introjected and external exercise-based motivational regulations. Participants respond to the stem "why do you exercise?" and rated each item on a 5-point Likert scale ranging from 0 (*not true for me*) to 4 (*very true for me*). In the current study the internal consistency of the BREQ subscales was as follows: intrinsic motivation (α = .92), identified regulation (α = .82), introjected regulation (α = .82) and external regulation (α = .77). Bivariate correlations between the subscales conformed to a simplex pattern (Guttman, 1954). As such, and aligned with past work (Koestner, Otis, Powers, Pelletier, & Gagnon, 2008; Ntoumanis & Standage, 2009) scores on intrinsic motivation and identified regulation were averaged to form an autonomous motivation variable (α = .88) and introjected regulation and external regulation scores were averaged to form a controlled motivation variable (α = .66).

Physical Activity. Participants wore an ActiGraph GT1M accelerometer (ActiGraph, LLC, Pensacola, FL). The GT1M is a small (3.8 × 3.7 × 1.8 cm) biaxial accelerometer that detects time-varying acceleration (approximate range = 0.05–2.0 *g*) in the vertical plane 30 times per second. These measurements are then summed to provide a number of "counts" over a user-defined epoch (e.g., 60 s). Previous research supports the reliability (Brage, Brage, Wedderkopp, & Froberg, 2003) and validity (Plasqui & Westerterp, 2007) of scores derived from the Actigraph unit.

Accelerometers were secured to a nylon belt and worn tightly around participants' waists with the accelerometer positioned on the midaxillary line of the right hip (Trost, McIver, & Pate, 2005). Participants were instructed verbally and via standardized written instructions to start wearing the accelerometer on waking each day, to wear it throughout the day and to remove it on going to bed at night. Participants also removed the accelerometer during participation in water sports, showering and bathing. To address potential reactivity to wearing the accelerometer, participants were instructed that it was measuring the time of day they moved and care was taken not to divulge its true purpose (i.e., to measure level of physical activity). In addition, participants wore the accelerometer for the remainder of the day of their Time 2 appointment; however, Actigraphs were programmed to start from 00:01 the following morning. Accelerometer data were collected in 60-s epochs for seven consecutive days.

During the behavioral monitoring, participants completed a daily log of the major activities (both active and inactive) they performed. Participants recorded a description, the duration and perceived intensity (i.e., light, moderate or vigorous) of the activities in addition to times and details of activities performed when they did not wear the monitor during waking hours (e.g., for showering or swimming).

Data Analysis

Accelerometer Data. Accelerometer data were downloaded to a PC and imported to a Microsoft Access database for analysis. The number of "valid days" of data for each participant was defined using the 70/80 rule (Catellier et al., 2005) combined with activity log data (Trost et al., 2005). The 70/80 rule indicated that a valid weekday and weekend day should consist of 732 min and 664 min of recorded data respectively. Data were screened using a Microsoft Access macro that ignored periods in the data file at which the accelerometer count was zero for ≥31 continuous minutes, which may indicate that the accelerometer was not being worn. There is no recommended threshold of continuous zero counts for adult samples. Owing to the age and sedentary occupations of the participants in the current study, additional analyses were conducted to determine a feasible length of continuous zeros of accelerometer data ≥20 min that occur when participants reported wearing the accelerometer in the activity log. Data from 20 randomly sampled participants (5 males, 15 females, M_{age} = 41.19 years, SD = 10.36; M_{BMI} = 23.51 kg/m^2, SD = 1.87) were analyzed. The average length of continuous zero sequences ≥20 min was 31.35 min. Valid days were classified in a two-step process. In Step 1, weekday and weekend day minutes per day (using the 70/80 rule while ignoring sequences of ≥31 zero counts) were analyzed. If a day was valid according to these criteria, no further analysis was required. In Step 2 (i.e., where total minutes/day was less than the 70/80 rule criteria), activity log data and graphical accelerometer data were screened to identify whether the day was invalid due to nonwear, or valid but reflective of a largely sedentary day. A total of 83 additional days were classified as valid at Step 2. It is suggested that 3–6 days of accelerometer data can provide reliable estimates of physical activity (Trost et al. 2005). To balance sample size and data quality, participants with ≥5 valid days of accelerometer data were included in the final sample. Data were screened to quantify participation in MVPA and bouts of MVPA. The threshold for moderate intensity activity (i.e., ≥3 metabolic equivalents[3]) was set at ≥1952 counts·min^{-1} (Freedson, Melanson, & Sirard, 1998).[4] In line with public health physical activity recommendations (Physical Activity Guidelines Advisory Committee, 2008) behavioral variables were quantified to reflect (a) average minutes of MVPA per day, (b) average minutes of MVPA in bouts ≥10 min per day and (c) number of days during monitoring on which ≥30 min of MVPA was accumulated in bouts of ≥10 min. We reasoned that the variable comprising continuous bouts of MVPA were more reflective of purposeful exercise behavior.

In line with recommendations (Pettee, Storti, Ainsworth, & Kriska, 2009), the variable reflecting average minutes per day of MVPA was adjusted to account for moderate-to-vigorous activities that are not accurately quantified by the accelerometer (e.g., swimming, cycling, rowing and resistance exercise). Data (i.e., mode, duration and intensity) for activities reported in participants' activity log as moderate or vigorous were compared with Ainsworth's compendium of physical activities (Ainsworth et al., 2000) to confirm that the intensity was of a MET level considered to be at least moderate. Visual inspection of graphical accelerometer data was conducted to ensure that this activity was not measured by the Actigraph and thus counted twice. A range of activities were reported in the activity logs including walking (e.g., for exercise, transport, shopping, exercising pets and office

based), structured exercise (e.g., walking, running, cycling, swimming and exercise classes), organized sports (e.g., racket sports, football, hockey, rugby and golf) and domestic activities (e.g., DIY, gardening and cleaning).

Preliminary Statistical Analyses. Mean replacement was used to replace missing values ($n = 2$) and standardized skewness and kurtosis values were analyzed to determine normality. The variables representing autonomous motivation, average daily time spent in MVPA, adjusted average daily time spent in MVPA, and average time spent in MVPA in bouts ≥10 min per day displayed non-normality. These variables were transformed according to the nature of their individual distributions (Tabachnick & Fidell, 2007). A reflect and square root transformation was applied to autonomous motivation scores. For interpretation purposes this variable was re-reflected following analysis (Tabachnick & Fidell, 2007). A square-root transformation was applied to each of the behavioral variables.[5] Finally, analysis of residuals for assumptions pertaining to regression analyses (i.e., linearity, homoscedasticity and independence and normality of residuals) revealed no particular problems. Bivariate correlations were used to assess associations between variables and *t* tests were employed to test mean differences between variables and within variables between males and females.

Primary Statistical Analyses. A single-step multiple mediation model (Preacher & Hayes, 2008b) was hypothesized and tested (Figure 1). A series of hierarchical linear regression analyses were used to establish the value of the c, a_1, a_2, b_1, b_2 and c' paths while controlling for participant gender, age and BMI/WC. When calculating the values of the b_1 and b_2 paths, the effect of the other mediator on the dependent variable was controlled (Preacher & Hayes, 2008a). Mediation of the effect of relative intrinsic goal content on physical activity via motivation was tested using the macro developed by Preacher and Hayes (2008a). This is an add-on program that users can download (http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html) and execute using SPSS, which allows advanced mediation analyses to be conducted, such as the nonparametric testing of multiple mediator models while controlling for covariates. Indirect effects of relative intrinsic goal content on physical activity (i.e., the product of a_1b_1 and a_2b_2) were analyzed to establish mediation. As the product of ab is normally distributed only in large samples, it is recommended that bootstrapping (see Efron & Tibshirani, 1993; MacKinnon, 2007, for an overview specific to mediation analysis) is used to construct confidence intervals around a point estimate of the indirect effect (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2008a). Briefly, bootstrapping is a resampling method in which statistics (in this case the mediated effect) are calculated in multiple samples generated from the original sample. When applied to mediation models, estimates from the multiple bootstrap samples are used to produce a distribution of the mediated effect from which confidence intervals can be obtained (MacKinnon, 2007). In the present work, we used bootstrapping to construct bias-corrected and accelerated 95% confidence intervals (BCa 95% CI) of the indirect effect. Five thousand bootstrapped samples with replacement and of the same size as the original sample were requested (Preacher & Hayes, 2008a).

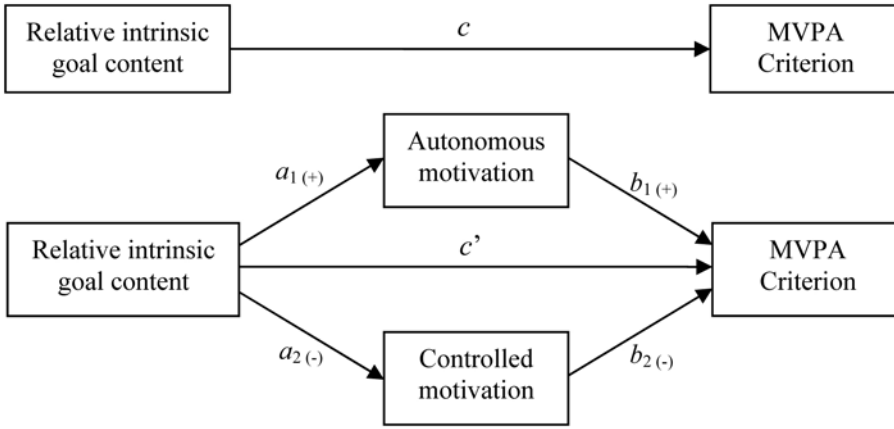


Figure 1 — Hypothesized multiple mediation model. *Note*. Symbols in parentheses indicate the hypothesized direction of effects.

Results

Seven valid days of accelerometer data were collected for 82 participants, 15 participants provided six valid days and 4 participants provided five valid days. On average, a valid day consisted of 834 min (13.90 hr) of data. Bivariate correlations between the serial number of the ActiGraph worn with each behavioral variable (Trost et al., 2005) revealed that interinstrument variability did not account for variance in accelerometer-derived scores (i.e., all correlations were very small and nonsignificant); therefore, ActiGraph unit was not specified as a covariate.

Preliminary Results

Table 1 presents the mean scores, standard deviations, range values and bivariate correlations between the study variables. On average, the participants rated intrinsic exercise goals (M = 4.14, SD = 0.89) as more important than extrinsic exercise goals (M = 3.49, SD = 1.09) and endorsed autonomous motivation (M = 3.31, SD = 0.65) more strongly than controlled motivation (M = 1.02, SD = 0.60). According to the unadjusted MVPA variable, participants completed approximately 59 min of MVPA per day. Adjustment of this value with data from the activity logs increased average daily MVPA participation to approximately 68 min. The average minutes of unadjusted MVPA (M = 58.85, SD = 25.80) was significantly less than the average minutes of activity-log-adjusted MVPA (M = 68.07, SD = 30.81) $t(100) = -6.86$, $p < .01$, (Hedges's $g = -.32$). As such, both variables were included in further analyses. Despite accumulating about an hour of MVPA daily, on average, participants achieved approximately 25 min of MVPA in bouts ≥10 min and achieved the guidelines of a daily accumulation of 30 min of MVPA accumulated in bouts of ≥10 min on 2.56 days. T-tests revealed that females spent less time than males in MVPA (M = 55.41 min, SD = 26.28 & M = 65.94 min, SD = 23.60 respectively) $t(99) = -1.96$, $p < .05$ (Hedges's $g = -.41$) and diary-corrected MVPA (M = 61.68 min, SD = 27.97 and M = 81.24 min, SD = 32.61 respectively) $t(99) = -3.12$, $p < .01$, (Hedges's $g = -.66$).

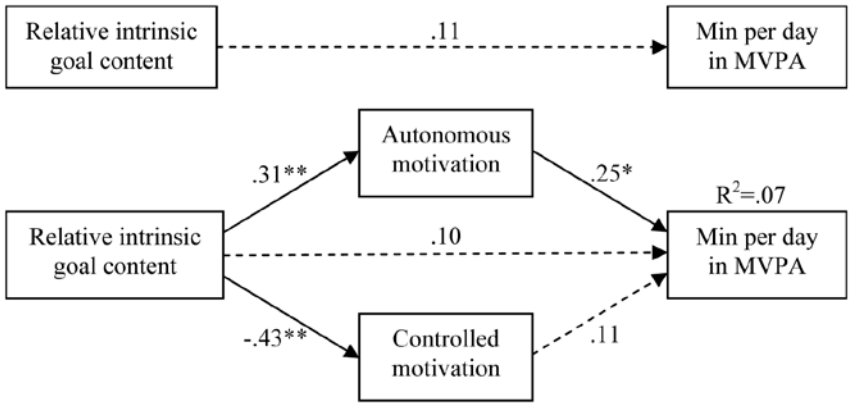
Table 1 Descriptive Statistics and Bivariate Correlations Among Study Variables

Variable	*M* (*SD*)	Range	1	2	3	4	5	6	7	8	9
1 Age	38.79 (11.50)	23.39 to 63.39	—								
2 BMI/WC criteria	—	—	.19*	—							
3 Relative intrinsic goals	.65 (1.28)	−3.17 to 4.33	.07	−.04	—						
4 Autonomous motivation	3.31 (.65)	1.50 to 4.00	.01	−.18	.32**	—					
5 Controlled motivation	1.02 (.60)	.00 to 2.67	−.17	.07	−.44**	.03	—				
6 Average daily time in MVPA (min)	58.85 (25.80)	15.43 to 143.14	.10	.06	−.09	.25*	−.12	—			
7 Adjusted daily time in MVPA (min)	68.07 (30.81)	16.67 to 160.67	.20*	.05	−.07	.21*	−.15	.91**	—		
8 Average daily time in MVPA in bouts >10 min (min)	25.43 (22.24)	.00 to 116.43	.08	−.22*	−.09	.26*	−.07	.82**	.75**	—	
9 Number of days meeting ACSM/AHA guidelines	2.56 (2.05)	.00 to 7.00	−.07	−.22*	−.10	.28*	−.07	.74**	.65**	.90**	—

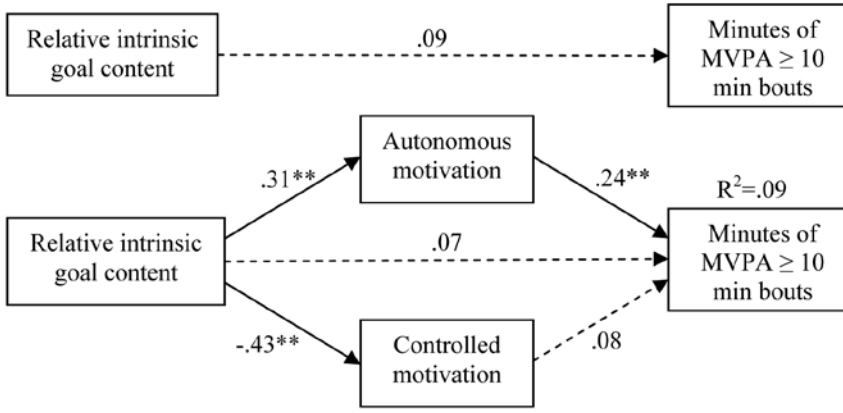
Note. MVPA = moderate-to-vigorous physical activity. BMI/WC = body mass index/waist circumference. ACSM/AHA = American College of Sports Medicine/American Heart Association. * $p < .05$, ** $p < .01$.

Bivariate correlations revealed that participant age was positively correlated with adjusted daily MVPA participation. Risk stratification based on BMI/WC (Zhu et al., 2004) measures correlated negatively with MVPA accumulated in bouts ≥10 min and number of days on which participants met the ACSM/AHA physical activity recommendations. Owing to these relationships, participant age, gender and BMI/WC risk stratification were entered as covariates in further analyses.

With regards to the motivational variables, relative intrinsic goal content was correlated in the expected directions with autonomous and controlled motivation and was uncorrelated with the behavioral variables. Autonomous motivation dis-



Model A: Average time per day in MVPA



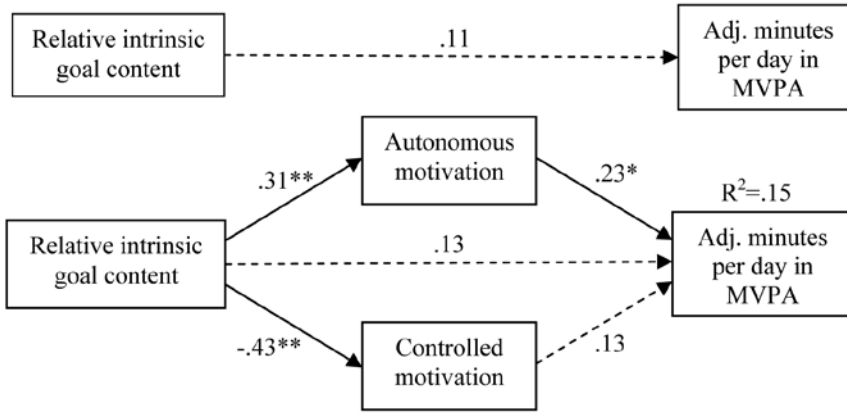
Model C: Total time in MVPA in bouts ≥ 10 minutes

Figure 2 — Models showing effects of goal content on MVPA criterion via autonomous and controlled motivation. *Note*. Values are standardized estimates. The *b* paths (as in Figure 1) are estimated controlling for the other mediator. Dashed lines represent nonsignificant estimates. * $p < .05$, ** $p < .01$. The ACSM/AHA guidelines are for 30 min of MVPA accumulated in bouts of ≥10 min.

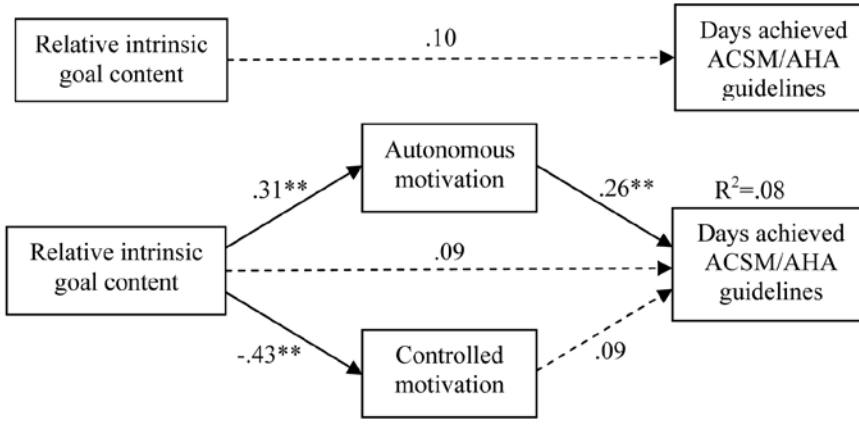
played positive correlations, whereas controlled motivation was uncorrelated with all behavioral variables.

Primary Results

Models A to D in Figure 2 display the results of the regression analyses. In all models there was no direct relationship between relative intrinsic goal content and the behavioral variable. Relative intrinsic goal content was positively associated with autonomous motivation and negatively associated with controlled motivation.



Model B: Adjusted average time per day in MVPA



Model D: Number of days achieved ACSM/AHA guidelines

Figure 2, *continued.*

Autonomous motivation was positively associated with each of the behavioral variables indicating its possible mediating role, whereas controlled motivation was unrelated to the behavioral variables suggesting that it could not be a mediator.

Although a significant *c* path, that is, the direct association between goal content and behavior, was not identified, it is recommended that this is not a requirement of mediation (MacKinnon, 2007; Shrout & Bolger, 2002). Failing to find a significant direct association between an independent and dependent variable may be due to the variables being too distal from one another to be meaningfully related (Shrout & Bolger, 2002). Given their distal relationship, it is likely that the effects of the predictor (e.g., goal content) on the outcome variable (e.g., physical activity behavior) is transmitted through a mediator which is located more proximally to both the independent and dependent variables (e.g., motivation) and bridges the gap between them. In this situation, it is recommended that analysis continue without an initial direct effect.

Table 2 presents the total and specific indirect effects transmitted through autonomous and controlled motivation and their BCa 95% CIs. In each model, the total indirect effects were nonsignificant suggesting that the two proposed mediators did not transmit the effect of goal content to behavior. However, it is possible for the specific indirect effects to be significant, when the total indirect effect is nonsignificant, indicating mediation (Preacher & Hayes, 2008b; Shrout & Bolger, 2002). This was true of the present data as significant specific indirect effects indicated that (controlling for controlled motivation) autonomous motivation mediated the effect of relative intrinsic goal content on each behavioral dependent variable (i.e., the BCa 95% CI of the indirect effect did not include zero). Pairwise contrasts of the specific indirect effects indicated that the mediated effect via autonomous motivation differed significantly from the mediated effect via controlled motivation.

The findings of a nonsignificant total indirect effect despite a significant indirect effect being observed via autonomous motivation may be indicative of inconsistent mediation (MacKinnon, Fairchild, & Fritz, 2007) and suppression (Preacher & Hayes, 2008b). Multiple mediation models are described as inconsistent where indirect effects have opposing signs. In the present data, the positive specific indirect effect through autonomous motivation may have been cancelled out by the negative (albeit nonsignificant) specific indirect effect through controlled motivation. In this case autonomous motivation acted as a mediator whereas controlled motivation acted as a suppressor (Preacher & Hayes, 2008b).[6] In summary, our analysis of direct and mediated (indirect) effects revealed evidence for a meditational model. An indirect effect was observed in which the association between relative intrinsic goal content and behavior was transmitted through autonomous motivation. Goal content was not directly associated with any of the behavioral variables.

Discussion

The purpose of the present work was to advance the existing literature pertaining to the prediction of MVPA and bouts of MVPA in adults from the content and motivation of their exercise goal pursuit. This was achieved through the use of theoretically aligned measures of goal content and motivation (i.e., the GCEQ and BREQ, respectively) combined with the objective assessment of physical activity (i.e., ActiGraph accelerometry).

Table 2 Unstandardized Indirect Effects of Relative Intrinsic Goal Content on MVPA Criterion Through Autonomous and Controlled Motivation

		BCa 95% Confidence Interval	
	Point estimate	Lower	Upper
Model A: Average minutes per day in MVPA			
Total indirect effect	.036	–.216	.258
Autonomous motivation (a_1b_1)	.119	.030	.252
Controlled motivation (a_2b_2)	–.083	–.295	.061
Contrast (a_1b_1) vs. (a_2b_2)	.202	.052	.397
Model B: Adjusted average minutes per day in MVPA			
Total indirect effect	–.027	–.206	.146
Autonomous motivation (a_1b_1)	.086	.012	.188
Controlled motivation (a_2b_2)	–.113	–.274	.001
Contrast (a_1b_1) vs. (a_2b_2)	.199	.076	.373
Model C: Average minutes in MVPA in bouts ≥ 10 min			
Total indirect effect	.009	–.174	.171
Autonomous motivation (a_1b_1)	.095	.018	.213
Controlled motivation (a_2b_2)	–.087	–.244	.030
Contrast (a_1b_1) vs. (a_2b_2)	.181	.043	.351
Model D: Number of days on which ACSM/AHA guidelines were achieved			
Total indirect effect	.033	–.217	.244
Autonomous motivation (a_1b_1)	.116	.024	.250
Controlled motivation (a_2b_2)	–.083	–.288	.046
Contrast (a_1b_1) vs. (a_2b_2)	.199	.063	.390

Note. BCa = Bias corrected and accelerated. MVPA = moderate-to-vigorous physical activity. ACSM/AHA guidelines are for 30 min of MVPA accumulated in bouts of ≥ 10 min.

Our preliminary analysis did not reveal a bivariate correlation between relative intrinsic goal content and MVPA or bouts of MVPA. This finding stands in contrast to those of Ingledew and Markland (2008) and Sebire et al. (2009), who identified small but significant associations between (a) health and fitness goals and self-reported exercise behavior and (b) relative intrinsic goals and self-reported exercise, respectively. Aligned with the tenets of SDT, and supporting past work using subjective (e.g., Edmunds et al., 2006; Wilson et al., 2004) and objective (e.g., Standage et al., 2008) behavioral measures, we observed a positive relationship between autonomous motivation and MVPA and MVPA bouts. These findings

provide support for the adaptive behavioral effects of being autonomous in one's motivation for exercise. The relationship between controlled motivational regulation and behavior was consistently nonsignificant across the entire behavioral criterion. The low internal consistency reliability coefficient of controlled motivation replicates previous findings (Standage et al., 2008) and may partially explain the observed lack of association between controlled motivation and physical activity.[7]

In line with previous findings (e.g., Kasser & Ryan 1993; Wilson et al., 2004), participants endorsed intrinsic goals and autonomous motivational regulations more strongly than extrinsic goals and controlled motivational regulations. This is encouraging given the aforementioned evidence for the adaptive correlates of intrinsic goals and autonomous self-regulation. Greater endorsement of these constructs could reflect the inherent trajectory toward growth posited in SDT (Deci & Ryan, 2000) or alternatively socially desirable responding given the more positive nature of intrinsic goals and autonomous motivational regulations. Researchers may want to develop implicit measures (i.e., tapping goal endorsement or motivation which is not under conscious guidance or control) to examine whether intrinsic goals and autonomous motivation are also highly endorsed at the implicit level and to investigate whether these implicit measures can account for independent variance in physical activity above and beyond the self-reported constructs.

Effects of "What" and "Why" on Physical Activity

Within SDT, it is hypothesized that goal content and motivation are associated processes that can have distinct impact on outcomes (Deci & Ryan, 2000; Sheldon et al., 2004). In the current study goal content and motivational regulations were moderately correlated. Mediation analysis showed that after controlling for participants' age, gender and BMI/WC, goal content had a positive indirect effect on the behavioral outcomes through autonomous motivation. We observed no direct independent effect of goal content on behavior. These findings support observations made previously (e.g., Ingledew & Markland, 2008; Sebire et al., 2009) of a motivational sequence, in which intrinsic goal content engenders autonomous motivation that then positively predicts MVPA and bouts of MVPA.

A direct effect of goal content on behavior was not supported in our analyses of physical activity outcomes. A critical interpretation of this finding might suggest that goal-content does not play an important role in predicting physical activity or that no evidence was obtained for GCT. However, the observation that goal contents influences behavior only through the motivational types they engender does not reduce the study of goal contents to a meaningless endeavor. Indeed, building on the theoretical and empirical contributions of Kasser and Ryan (1993, 1996) coupled with the accumulating evidence supporting the consideration of goal content in numerous life domains, the current findings add support to the recent addition of GCT as a fifth mini-theory within SDT (Ryan et al., 2009). That is, that the specific content of goals is worthy of consideration, in the present case due to the impact that people's exercise goals appear to have on their motivational regulations. This perspective aligns with the notion that exercise goals are more future oriented and distally related to people's current behavior than their more present-oriented motivational regulations. The concept of basic need satisfaction within SDT allows researchers to study goals from a quality, not just quantity, perspective as not all

pursued or contextually promoted goals are equally conducive to need satisfaction. Practically, many people have a specific goal in mind when starting to exercise and, hence, it is interesting to gain insight in the processes (e.g., need satisfaction and motivational regulations) that different goal contents engender.

The Role of Goal Content in Practice

Understanding the pathways through which a person's goals may influence their behavior or cognitive-affective experiences is important because such pathways may represent avenues for intervention with individuals seeking to change their behavior. The results of our analyses suggest that the content of an exerciser's goals may give a practitioner insight into their likely motivation, which will predict their activity behavior. However, and while past work supports moderate relations between goal content and motivation (Sheldon et al., 2004; Sebire, Standage, & Vansteenkiste, 2008; 2009), practitioners should remember that it is theoretically possible that an individual could pursue intrinsic goals with controlled motivation and extrinsic goals with autonomous motivation (Sheldon et al., 2004). A central objective of SDT-based interventions is to encourage the internalization of externally prescribed motivation to more personally valued and self-endorsed motivation, so that they become self-emanating and autonomously enacted (cf. Ryan et al., 2008). The present findings suggest that the content of an exerciser's goals might be an important consideration if practitioners are to optimize the internalization process.

Limitations and Future Directions

As the majority of the participants in this study were White and well educated, the associations explored in this work should also be examined in more racially and educationally diverse samples. Although at least five days of accelerometer data were collected from 101 participants in the current study, the results of this work should be examined using larger samples. This said, while large samples would be advantageous, the greater precision in measurement when using objective behavioral assessment tools may go some way to overcome concerns related to having sufficient power to detect relationships in moderate sized samples such as ours.

A limitation is that physical activity was assessed over a single seven-day period only rather than on multiple occasions and therefore the analysis is cross-sectional. Previous SDT-based research suggests that longitudinal studies of goals, motivation and behavior in the physical domain may be important to capture the dynamic nature of motivation (cf. Standage & Ryan, in press). For example, Vansteenkiste, Simons, Soenens et al. (2004) found that extrinsic goal framing was associated with greater short-term but not continued behavioral persistence relative to a no-goal control group but that the type of persistence displayed by individuals in the extrinsic goal framing condition was not authentic in nature. This poor quality exercise engagement presumably contributed to its lack of persistence over time. Given the associations between goal content and motivation identified in the current study, future longitudinal research using objective assessment of exercise behavior would do well to explore the temporal dynamics of both of these motivational constructs on behavioral engagement. Future longitudinal studies would also do well to attend to the cognitive-affective quality, in addition to the quantity of people's

physical activity / exercise behavior. It would be useful to extend the findings of Sebire et al. (2009) to determine whether over time the quality (i.e., flexible vs. rigid engagement, anxiety, and social comparison processes; see Vansteenkiste, et al., 2008) rather than the quantity of physical activity / exercise engagement is predicted by one's exercise goals and motivation.

In the present work only one part of the more complex theoretical model posited in SDT was considered. Although this study adds to a number of strands of evidence that together begin to support the larger theoretical framework pertaining to goal content it is important that future work strives to test the complete model. In SDT one's level of psychological need satisfaction is proposed to lead to the pursuit of goals with different content as well as be a function of one's goal content. Accordingly, it would be insightful to examine theoretically proposed causal structures leading from social-contextual factors (e.g., autonomy support) through psychological need satisfaction to relative intrinsic/extrinsic goal content and motivation types and subsequently to the consequences of such goal pursuits. The incorporation of cognitive-attentional mediational mechanisms proposed in previous work (e.g., Sebire, Standage, Gillison, & Vansteenkiste, 2008; Vansteenkiste, Soenens, & Lens, 2007) within these models would be particularly insightful. Further, although we examined goal content as a predictor of motivational regulations, it is possible that effects are reciprocal and that motivational regulations could lead to the pursuit of certain goals.

The objective assessment of behavior in the current study provided a number of advancements over the use of self-report methods. However, the treatment of accelerometer data is based on a number of assumptions and is vulnerable to some limitations. For example, when considering bouts of MVPA of ≥10 min, our software only allowed the extraction of bouts with no interruptions. It is likely, however, that prolonged exercise is intermittent (e.g., waiting to cross a busy road while jogging) and that ignoring these instances underestimates total MVPA performed in bouts and therefore more purposeful exercise. Future work could, aligned with the recommendations of Ward, Evenson, Vaughn, Rodgers, and Troiano (2005), employ software that allows detection of activity bouts while allowing minor interruptions.

Biaxial accelerometry is likely to be most accurate in measuring ambulatory activities such as walking and running (Dale et al., 2002). As such, the intensity of participating in other activities such as weight lifting or cycling will not be measured or underestimated. In the current study, we sought to address this limitation by triangulating the accelerometer data with concurrently collected activity log data; however, the use of more advanced technology may address this issue further. For example, Standage et al. (2008) have recently used the Actiheart device (Cambridge Neurotechnology Ltd), which bases the prediction of energy expenditure on concurrently assessed acceleration and heart rate data. Such methodologies account for activities that induce a high heart rate without significant vertical acceleration (e.g., cycling, rowing, weight lifting). Despite the intuitive appeal of such methods, as pointed out by Dale et al. (2002) when weighing up the use of accelerometry or combined accelerometry and heart rate devices, researchers should consider issues such as the device cost, participant burden and the component of behavior that they are seeking to measure. A related limitation is that although we quantified continuous bouts (≥10 min) of MVPA to attempt to reflect more purposeful exercise behavior it is possible that these variables also capture some continuous activity

which is not driven by one's exercise cognitions (e.g., transport or employment related). As the goal content and motivation questionnaires used in the current study pertained to exercise behaviors there may be some mismatch between the motivation constructs and certain behaviors measured. As this would also seemingly attenuate the specified associations, future research using objectively assessed behavior may explore this issue through the simultaneous assessment of motivation and goals for exercise *and* physical activity.

Conclusion

In line with the sequential motivational model proposed by Ingledew and Markland (2008) and supported by Sebire et al. (2009), the current study identified that relative intrinsic goal content was positively associated with autonomous motivation, which in turn positively predicted objectively assessed MVPA, bouts of MVPA and the meeting of public health physical activity recommendations. Building on previous findings that have shown relative intrinsic goal content to predict cognitive-affective outcomes in exercise (Sebire, Standage, & Vansteenkiste, 2008; Sebire et al., 2009), the results of the current study suggest that the content of exercisers' goals is an important consideration when exploring optimal motivation for exercise behavior.

Notes

1. The term *physical activity* encompasses all movement produced by skeletal muscles that confers energy expenditure above rest (Caspersen, Powell, & Christenson, 1985). Exercise is a subcomponent of physical activity that is more "planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of fitness is an objective" (Caspersen et al., 1985, p. 128). In the present research we used the term *physical activity* to refer to the behavior captured by the accelerometer that will encompass exercise behavior. The MVPA measured in bouts of ≥10 min may be more reflective of purposeful exercise and less incidental physical activity.

2. Integrated regulation, the most autonomous form of extrinsic motivation is also posited as part of the self-determination continuum representing where identifications have been assessed and aligned with one's values, goals and needs (Deci & Ryan, 2000). The measure of motivation (viz., BREQ; Mullan et al., 1997) employed in this study does not include a scale to assess this construct and so it is not considered further in this article.

3. The quantity 1 metabolic equivalent (MET) is equal to resting energy expenditure (≈ 3.5 mL O_2 $kg^{-1} \cdot min^{-1}$).

4. The software used to analyze the accelerometer data produced output in blocks of 200 counts (i.e., 0–199, 200–299) and time spent in MVPA was extracted from the block closest to the threshold derived by Freedson et al. (1998) (i.e., ≥2000 counts·min^{-1}).

5. Analyses using the nontransformed data yielded an identical pattern of findings.

6. The mediation analyses were replicated using individual intrinsic and extrinsic goal content scores as predictor variables (Results available from first author on request). Similar to the present findings in each model, intrinsic goal content displayed specific positive indirect effect on the behavioral outcome via autonomous motivation. Regression analyses indicated that extrinsic goal content was unrelated to autonomous motivation (which was then significantly related to the behavioral outcomes) and positively related to controlled motivation (which was unrelated to the behavioral outcomes). As such, for extrinsic goals, mediation was not possible and these

analyses were not pursued further. These analyses suggest that the effects observed of relative intrinsic goal content on behavior were carried by intrinsic rather than extrinsic goal scores.

7. Given the low reliability of the combined controlled motivation score, we analyzed a mediation model specifying individual introjected and external motivational regulation scores as mediators between relative intrinsic goal content and behavior. In the model specifying average daily time in MVPA as the behavioral outcome, relative intrinsic goal content was significantly negatively related to both introjected ($\beta = -.38$, $p < .001$) and external motivation ($\beta = -.07$, $p < .05$). Introjected motivation ($\beta = .25$, $p < .05$) and external motivation ($\beta = -.15$, $p > .05$) were not associated with behavior. These results were consistent across the three other behavioral outcomes.

References

Ainsworth, B.E., Haskell, W.L., Whitt, M.C., Irwin, M.L., Swartz, A.M., Strath, S.J., et al. (2000). Compendium of Physical Activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise, 32,* S498–S516.

American College of Sports Medicine. (2006). *ACSM's guidelines for exercise testing and prescription* (7th ed.). Baltimore, MD: Lippincott Williams & Wilkins.

Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process, and content. *Psychological Bulletin, 120,* 338–375.

Brage, S., Brage, N., Wedderkopp, N., & Froberg, K. (2003). Reliability and validity of the Computer and Science Applications accelerometer in a mechanical setting. *Measurement in Physical Education and Exercise Science, 7,* 101–119.

Carver, C.S., & Baird, E. (1998). The American dream revisited: Is it what you want or why you want it that matters? *Psychological Science, 9,* 289–292.

Caspersen, C.J., Powell, K.E., & Christenson, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100,* 126–131.

Catellier, D.J., Hannan, P.J., Murray, D.M., Addy, C.L., Conway, T.L., Yang, S., et al. (2005). Imputation of missing data when measuring physical activity by accelerometry. *Medicine and Science in Sports and Exercise, 37,* S555–S562.

Crawford, S., & Eklund, R.C. (1994). Social physique anxiety, reasons for exercise, and attitudes toward exercise settings. *Journal of Sport & Exercise Psychology, 16,* 70–82.

Dale, D., Welk, G.J., & Matthews, C.E. (2002). Methods for assessing physical activity and challenges for research. In G.J. Welk (Ed.), *Physical activity assessments for health-related research* (pp. 19–34). Champaign, IL: Human Kinetics.

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.

Duriez, B., Vansteenkiste, M., Soenens, B., & De Witte, H. (2007). The social costs of extrinsic relative to intrinsic goal pursuits: Their relation with social dominance and racial and ethnic prejudice. *Journal of Personality, 75,* 757–782.

Edmunds, J., Ntoumanis, N., & Duda, J.L. (2006). A test of self-determination theory in the exercise domain. *Journal of Applied Social Psychology, 36,* 2240–2265.

Efron, B., & Tibshirani, R. (1993). *An introduction to the bootstrap*. New York: Chapman and Hall.

Freedson, P.S., Melanson, E., & Sirard, J. (1998). Calibration of the Computer Science and Applications, Inc. accelerometer. *Medicine and Science in Sports and Exercise, 30,* 777–781.

Gardarsdottir, R.B., Dittmar, H., & Aspinall, C. (2009). It's not the money, it's the quest for a happier life: The role of happiness and success motives in the link between financial goals and subjective well-being. *Journal of Social and Clinical Psychology, 28,* 1100–1127.

Gillison, F., Standage, M., & Skevington, S.M. (2006). Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behaviour: A self-determination theory approach. *Health Education Research, 21,* 836–847.

Guttman, L. (1954). A new approach to factor analysis: The radex. In P. Lazarfel (Ed.), *Mathematical thinking in the social sciences* (pp. 258–348). NY: Free Press of Glencoe.

Hardman, A.E., & Stensel, D.J. (2003). *Physical activity and health: The evidence explained*. London: Routledge.

Ingledew, D.K., & Markland, D. (2008). The role of motives in exercise participation. *Psychology & Health, 23,* 807–828.

Kasser, T. (2002). *The high price of materialism*. Cambridge, MA: MIT Press.

Kasser, T., Cohn, S., Kanner, A.D., & Ryan, R.M. (2007). Some costs of American corporate capitalism: A psychological exploration of value and goal conflicts. *Psychological Inquiry, 18,* 1–22.

Kasser, T., & Ryan, R.M. (1993). A dark side of the American dream: Correlates of financial success as a central life aspiration. *Journal of Personality and Social Psychology, 65,* 410–422.

Kasser, T., & Ryan, R.M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin, 22,* 280–287.

Koestner, R., Otis, N., Powers, T.A., Pelletier, L., & Gagnon, H. (2008). Autonomous motivation, controlled motivation, and goal progress. *Journal of Personality, 76,* 1201–1229.

Loney, T., Standage, M., Thompson, D., Sebire, S.J., & Cumming, S.P. (2011).Self-report vs. objectively assessed physical activity: Which is right for public health? *Journal of Physical Activity and Health. 8,* 62–70.

MacKinnon, D.P. (2007). *Introduction to mediation analysis*. NY: Lawrence Erlbaum Associates.

MacKinnon, D.P., Fairchild, A.J., & Fritz, M.S. (2007). Mediation analysis. *Annual Review of Psychology, 58,* 593–614.

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.

Maltby, J., & Day, L. (2001). The relationship between exercise motives and psychological well-being. *The Journal of Psychology, 135,* 651–660.

McHoskey, J.W. (1999). Machiavellianism, intrinsic versus extrinsic goals, and social interest: A self-determination theory analysis. *Motivation and Emotion, 23,* 267–283.

Mullan, E., Markland, D., & Ingledew, D.K. (1997). A graded conceptualisation of self-determination in the regulation of exercise behaviour: Development of a measure using confirmatory factor analysis. *Personality and Individual Differences, 23,* 745–752.

Niemiec, C.P., Ryan, R.M., Deci, E.L., & Williams, G.C. (2009). Aspiring to physical health: The role of aspirations for physical health in facilitating long-term tobacco abstinence. *Patient Education and Counseling, 74,* 250–257.

Ntoumanis, N., & Standage, M. (2009). Morality in sport: A self-determination theory perspective. *Journal of Applied Sport Psychology, 21,* 365–380.

Pettee, K.K., Storti, K.L., Ainsworth, B.E., & Kriska, A.M. (2009). Measurement of physical activity and inactivity in epidemiologic studies. In I.M. Lee (Ed.), *Epidemiological methods in physical activity studies* (pp. 15–33). Oxford: Oxford University Press.

Physical Activity Guidelines Advisory Committee. (2008). *Physical Activity Guidelines Advisory Committee Report*. Washington, DC: U.S. Department of Health and Human Services.

Plasqui, G., & Westerterp, K.R. (2007). Physical activity assessment with accelerometers: An evaluation against doubly labeled water. *Obesity (Silver Spring, Md.), 15,* 2371–2379.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., & Podsakoff, N.P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *The Journal of Applied Psychology, 88,* 879–903.

Preacher, K.J., & Hayes, A.F. (2008a). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40,* 879–891.

Preacher, K.J., & Hayes, A.F. (2008b). Contemporary approaches to assessing mediation in communication research. In A.F. Hayes, M.D. Slater, & L.B. Snyder (Eds.), *The Sage sourcebook of advanced data analysis methods in communications research* (pp. 13–54). Thousand Oaks, CA: Sage.

Ryan, R.M., & Deci, E.L. (2007). Active human nature: Self-determination theory and the promotion and maintenance of sport, exercise and health. In M.S. Hagger & N.L.D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 1–19). Champaign, IL: Human Kinetics.

Ryan, R.M., Patrick, H., Deci, E.L., & Williams, G.C. (2008). Facilitating health behavior change and its maintenance: Interventions based on Self-Determination Theory. *The European Health Psychologist, 10,* 2–5.

Ryan, R.M., Williams, G.C., Patrick, H., & Deci, E.L. (2009). Self-determination theory and physical activity: The dynamics of motivation in development and wellness. *Hellenic Journal of Psychology, 6,* 107–124.

Sebire, S.J., Standage, M., Gillison, F., & Vansteenkiste, M. (2008). *"Coveting thy neighbor's legs": Qualitative analysis of the experiences of exercisers pursuing relative intrinsic and extrinsic goals*. Poster session at the Conference of the British Psychological Association Division of Sport and Exercise Psychology: London.

Sebire, S.J., Standage, M., & Vansteenkiste, M. (2008). Development and validation of the Goal Content for Exercise Questionnaire. *Journal of Sport & Exercise Psychology, 30,* 353–377.

Sebire, S.J., Standage, M., & Vansteenkiste, M. (2009). Examining intrinsic versus extrinsic exercise goals: Cognitive, affective, and behavioral outcomes. *Journal of Sport & Exercise Psychology, 31,* 189–210.

Sheldon, K.M., & McGregor, H.A. (2000). Extrinsic value orientation and "The tragedy of the commons". *Journal of Personality, 68,* 383–411.

Sheldon, K.M., Ryan, R.M., Deci, E.L., & Kasser, T. (2004). The independent effects of goal contents and motives on well-being: It's both what you pursue and why you pursue it. *Personality and Social Psychology Bulletin, 30,* 475–486.

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

Srivastava, A., Locke, E.A., & Bartol, K.M. (2001). Money and subjective well-being: It's not the money, it's the motives. *Journal of Personality and Social Psychology, 80,* 959–971.

Standage, M., & Ryan, R.M. Self-determination theory and exercise motivation: Facilitating self-regulatory processes to support and maintain health and well-being (in press). In G.C. Roberts & D.C. Treasure (Eds.), *Motivation in sport and exercise* (Vol. 3). Champaign, IL: Human Kinetics.

Standage, M., Sebire, S.J., & Loney, T. (2008). Does exercise motivation predict engagement in objectively-assessed bouts of moderate-intensity exercise behavior? A self-determination theory perspective. *Journal of Sport & Exercise Psychology, 30,* 337–352.

Tabachnick, B.G., & Fidell, L.S. (2007). *Using multivariate statistics* (5th ed.). USA: Pearson Education.

Thøgersen-Ntoumani, C., Ntoumanis, N., & Nikitaras, N. (2010). Unhealthy weight control behaviours in adolescent girls: A process model based on self-determination theory. *Psychology & Health, 25,* 535–550.

Trost, S.G., McIver, K.L., & Pate, R.R. (2005). Conducting accelerometer-based activity assessments in field-based research. *Medicine and Science in Sports and Exercise, 37,* S531–S543.

Vansteenkiste, M., Lens, W., & Deci, E.L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist, 41,* 19–31.

Vansteenkiste, M., Niemiec, C., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions. In T. Urdan & S. Karabenick (Eds.). *Advances in motivation and achievement, vol. 16: The decade ahead.* UK: Emerald Publishing.

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

Vansteenkiste, M., Simons, J., Soenens, B., & Lens, W. (2004). How to become a persevering exerciser? The importance of providing a clear, future intrinsic goal in an autonomy-supportive manner. *Journal of Sport & Exercise Psychology, 26,* 232–249.

Vansteenkiste, M., Soenens, B., & Duriez, B. (2008). Presenting a positive alternative to materialistic strivings and the thin-ideal: Understanding the effects of extrinsic relative to intrinsic goal pursuits. In S.J. Lopez (Ed.), *Positive psychology: Exploring the best in people* (Vol. 4, pp. 57–86). Westport, CT: Greenwood Publishing Company.

Vansteenkiste, M., Soenens, B., & Lens, W. (2007). Intrinsic versus extrinsic goal promotion in exercise and sport: Understanding the differential impacts on performance and persistence. In M.S. Hagger & N.L.D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 167–180). Champaign, IL: Human Kinetics.

Ward, D.S., Evenson, K.R., Vaughn, A., Rodgers, A.B., & Troiano, R.P. (2005). Accelerometer use in physical activity: Best practices and research recommendations. *Medicine and Science in Sports and Exercise, 37,* S582–S588.

Williams, G.C., Cox, E.M., Hedberg, V.A., & Deci, E.L. (2000). Extrinsic life goals and health-risk behaviors in adolescents. *Journal of Applied Social Psychology, 30,* 1756–1771.

Wilson, P.M., Rodgers, W.M., Blanchard, C.M., & Gessell, J. (2003). The relationship between psychological needs, self-determined motivation, exercise attitudes, and physical fitness. *Journal of Applied Social Psychology, 33,* 2373–2392.

Wilson, P.M., Rodgers, W.M., Fraser, S.N., & Murray, T.C. (2004). Relationships between exercise regulations and motivational consequences in university students. *Research Quarterly for Exercise and Sport, 75,* 81–91.

World Health Organization. (2002). *The world health report 2002. Reducing risks, promoting healthy life*. Geneva: World Health Organization.

Zhu, S., Heshka, S., Wang, Z., Shen, W., Allison, D.B., Ross, R., et al. (2004). Combination of BMI and waist circumference for identifying cardiovascular risk factors in whites. *Obesity Research, 12,* 633–645.

Manuscript submitted: March 15, 2010
Revision accepted: November 11, 2010