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Relations between Autonomous Motivation and Leisure-Time Physical Activity Participation: The Mediating Role of Self-Regulation Techniques

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Abstract

This study tested the predictive validity of a multi-theory process model in which the effect of autonomous motivation, from self-determination theory, on physical activity participation is mediated by the adoption of self-regulatory techniques based on control theory. Finnish adolescents (N=411, aged 17-19) completed a prospective survey including validated measures of the predictors and physical activity, at baseline and after one month (N=177). A subsample used an accelerometer to objectively measure physical activity and further validate the physical activity self-report assessment tool (*n*=44). Autonomous motivation statistically significantly predicted action planning, coping planning and self-monitoring. Coping planning and self-monitoring mediated the effect of autonomous motivation on physical activity, although self-monitoring was the most prominent. Controlled motivation had no effect on self-regulation techniques or physical activity. Developing interventions that support autonomous motivation for physical activity may foster increased engagement in self-regulation techniques and positively affect physical activity behavior.

Keywords: intrinsic regulation, action planning, coping planning, self-monitoring, self-regulation strategies.

Introduction

Young people engage in insufficient physical activity for good health (Hallal et al., 2012). In addition, levels of physical activity have often been found to decline from childhood to adolescence and during adolescence (Dumith, Gigante, Domingues, & Kohl, 2011). Children and adolescents are a key group in which to promote an active lifestyle as they need physical activity for healthy development (Biddle, Gorely, & Stensel, 2004). Furthermore, promotion of physical activity in young people is also important for lifelong physical activity given that physical activity levels in adolescence are moderately associated with physical activity in adulthood (Hallal, Victora, Azevedo, & Wells, 2006).

A considerable body of research has sought to identify the psychological constructs associated with health behaviors like physical activity (e.g. Bélanger-Gravel, Godin, & Amireault, 2013; Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003; Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Ng et al., 2012; Webb & Sheeran, 2006). In particular, researchers are interested in identifying the psychological constructs correlated with health behavior that can be changed or manipulated using persuasive communications and behavior-change techniques that target these psychological correlates (Hagger, 2010; Michie, 2008; Michie & West, 2013). Based on the assumption that manipulable psychological constructs are closely related to behavior, evoking a change in such construct will lead to a concomitant, meaningful change in health behavior. Motivation and intentions are constructs that have been shown to significantly predict multiple health behaviors, in the context of a number of social psychological theoretical paradigms (Chatzisarantis et al., 2003; Rich, Brandes, Mullan, & Hagger, 2015). Prominent among these paradigms is self-determination theory (Deci & Ryan, 2000), which has received considerable attention in the literature as an effective means to explain variance in health-related behavior and as a basis for intervention.

It is the focus on the quality of motivation, rather than quantity alone, that sets self-determination theory (Deci & Ryan, 2000) apart from other theories and models. The critical distinction in the theory is the difference between autonomous and controlled forms of motivation. Autonomous motivation is characterized by a sense of choice, volition, and freedom from external pressure. Individuals who are autonomously motivated tend to act for personally-endorsed reasons. Controlled motivation is used to describe acting for external rewards, demands, or coercion. Individuals who are control motivated tend to act for other- or externally-referenced reasons. Within these global categories of motivation, the theory conceptualizes four different types of regulation that vary in their degree of autonomy. *Intrinsic motivation* is the prototypical form of autonomous motivation and reflects engaging in a behavior in the absence of external contingency and for the inherent pleasure and satisfaction derived from the activity. *Identified regulation* is another form of autonomous regulation and reflects acting to obtain self-endorsed goals or outcomes. The goals or outcomes are not strictly intrinsic because they are separable from the behavior itself, but individuals accept the external goals because the outcomes are appreciated or personally valued. *External regulation* is the prototypical form of controlled motivation and reflects acting for externally-referenced reasons such as to avoid punishment or to obtain a reward. The contingency is therefore entirely outside the individual and therefore referenced by others, not the self. *Introjected regulation* is a controlled form of motivational regulation in which external control is partially assimilated, so the behavior is felt as a necessity or a compulsion and may be performed in order to avoid guilt and shame (Deci & Ryan, 2000).

Autonomous forms of motivation have been shown to be significantly related to health behavior engagement while controlled forms are related to desistence and avoidance (Chatzisarantis et al., 2003; Ng et al., 2012; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). This is because autonomous reasons for acting do not depend on external contingencies or cues and are self-regulated rather than other-regulated. Motivation is, therefore, perpetuated by the self and not dependent on prompts or nudges elsewhere. Identified regulation has been associated more strongly to initial or short-term adoption of exercising than any other regulation style (Hagger & Chatzisarantis, 2012; Hagger, Chatzisarantis, & Biddle, 2002), whereas intrinsic motivation has been found to be the strongest predictor of persistent exercise (Deci & Ryan, 2000; Teixeira et al., 2012).

It is important to note that motivation alone does not always lead to engagement in health behavior (Hagger & Chatzisarantis, 2014; Orbell & Sheeran, 1998; Webb & Sheeran, 2006), and the importance of self-regulation mechanisms for turning the motivation into action has also been underlined (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Sniehotta, Schwarzer, Scholz, & Schüz, 2005). Many models and theories in health behavior have identified behavioral enactment as at least a dual-phase process, with separate motivational and implemental phases (Heckhausen & Gollwitzer, 1987; Schwarzer, 2008). In the motivational phase individuals form motives or intentions to engage in a course of action. In the implemental phase individuals engage in volitional processes such as planning to enact the intentions. For instance, action planning which consists of detailed where, when, how, and how often plans, has been found to predict behavioral execution (Bélanger-Gravel et al., 2013; Hagger & Luszczynska, 2013). Coping planning, identifying ways of overcoming specific, foreseeable barriers to maintenance and preventing relapses, is an effective technique for behavior change especially when combined with action planning (Kwasnicka, Presseau, White, & Sniehotta, 2013). A systematic review also has shown the effectiveness of coping planning in increasing physical activity (Carraro & Gaudreau, 2013). Another volitional technique that has been shown to be important in improving behavioral engagement is self-monitoring, that is, keeping a record of specific behaviors (Abraham & Michie, 2008). Self-monitoring has been found to be especially effective for diet and physical activity change, particularly when combined with other self-regulation techniques (Michie et al., 2009). This might be due to the mechanism specified by the control theory (Carver & Scheier, 1982) in which observation of a discrepancy between behavioral goals and actual behavior leads to new action plans and new monitoring until the goal has been achieved.

Considering the importance of both motivational and implemental phases, surprisingly few researchers have investigated the interplay of motivational determinants of action, such as self-determined motivation, and use of self-regulation techniques in predicting physical activity. There is precedent for examining motivational factors alongside implemental factors, and these have found important interactions between the two (e.g. Hagger et al., 2012; Milne, Orbell, & Sheeran, 2002; Prestwich, Lawton, & Conner, 2003). However, few studies have examined this in the context of autonomous forms of motivation from self-determination theory. The limited data in this context has demonstrated that action planning partially mediates the relationship between autonomous motivation and physical activity (Li, Iannotti, Haynie, Perlus, & Simons-Morton, 2014) and the translation of intention into behavior change via planning was facilitated by autonomous motivation (Cao, Lippke, & Liu, 2011). However, no study so far has investigated both planning and self-monitoring behaviors in combination with motivational quality.

The Present Study

The primary purpose of the present research is to investigate whether individuals who are autonomously motivated to engage in leisure-time physical activity behavior are more likely to adopt self-regulatory techniques that will be instrumental in them engaging in the behavior. According to this hypothesis, autonomous motivation facilitates an individual to strategically ‘mobilize’ their self-regulatory resources to bring about the desired autonomous behavior in future. In addition, we also aim to examine the processes behind relations between autonomous motivation and physical activity participation. This is based on the premise that autonomous motivation is converted into action due to the adoption of self-regulatory techniques. In other words, individuals that are autonomously motivated are more likely to persist with behaviors due to their inherent value. But in order to do so, they have to strategically engage in volitional techniques that will assist them in successfully structuring their environment to ensure successful behavioral engagement (e.g., action and coping planning) and behavioral regulation (e.g., self-monitoring). We would therefore expect that the adoption of the techniques explains (i.e., mediates) the effect of autonomous forms of motivation on physical activity behavior.

Methods

Sample and Procedure. Participants were students from eight upper secondary schools: six vocational schools from the largest municipal education and training consortia in Finland, and two geographically matching high schools. The vocational schools represent diverse study fields such as tourism industry, beauty care, catering, metalwork and machinery, while high schools have an academic-focused curriculum. We excluded participants older than 19 years, after which the final recruited sample comprised 411 adolescents (57% girls) with the age range of 17-19 ($M = 17.8$ years, $SD = 0.69$). Participants completed an initial online questionnaire (Time 1; T1) containing self-reports of demographic, psychological (motivational regulations, action and coping planning), and behavioral (physical activity participation) variables during March and April 2013. Forty-three percent of the adolescents ($N = 177$; 63% girls, M age = 17.7, $SD = 0.70$; Attrition rate = 43.07%) completed a follow-up online questionnaire containing self-report measures of self-monitoring and physical activity behavior 3 to 5 weeks later (Time 2; T2). Participants completed survey measures in quiet conditions under teacher supervision. The respondent drop-out rate was mainly due to students’ practical training periods outside of the vocational schools and teachers’ time pressure. Participation in the study was voluntary and all participants gave informed consent prior to data collection. The questionnaire and the study protocol were reviewed by the research ethics committee of the Hospital District of Helsinki and Uusimaa.

Measures

Motivational Regulations from Self-Determination Theory. The Self-Regulation Questionnaire (Ryan & Connell, 1989) adapted for exercise was used to measure motivational regulations at T1. Participants were presented with an initial item 'stem': "There are a variety of reasons why people exercise regularly. Please indicate how true each of these reasons is for why you exercise regularly. I try to exercise on a regular basis…", was followed by 16 items four for each of the self-determination theory motivational regulations: internal regulation (e.g., "…because I enjoy exercising"), identified regulation (e.g., "…because feeling healthier is an important value for me"); introjected regulation (e.g., "…because I feel guilty if I do not exercise regularly"), and external regulation (e.g., "…because others make me do it. In the present study, items from the intrinsic and identified regulation scales were proposed to indicate an autonomous motivation factor, and items from the introjected and external regulation scales were proposed to indicate a controlled motivation factor. The items were averaged summed variables for the purposes of descriptive statistics and drop-out analyses, and as latent variables in the structural equation model. Higher levels on each sub-scale indicate higher levels of that kind of regulation.

Planning. Action planning for leisure-time physical activity was measured at T1 using four items (Sniehotta et al., 2005) (e.g. "I have made a detailed plan regarding when to exercise over the next two weeks"). Coping planning was measured using four items following the common stem "I have made a detailed plan regarding..." (e.g., "…what to do if something interferes with my plans for regular physical activity") with responses given on a scale ranging from 1 to 4 (Sniehotta et al., 2005), with higher numbers indicating more coping plans.

Self-monitoring. Two items assessed self-monitoring at T2 (e.g., "During the last four weeks, I have constantly monitored myself whether I exercise frequently enough") with responses given on a scale ranging from 1 (definitely false) to 7 (definitely true) (Sniehotta et al., 2005).

Leisure-time Physical Activity. Self-reported physical activity during leisure time was assessed at T1 and T2 using a single item from the validated Nord-PAQ measure (Rasmussen et al., 2012): "During the last seven days, on how many days were you physically active so that the activity intensity was moderate or vigorous and you were active at least 30 minutes per one day". Responses were provided on an eight-point scale ranging from 0 to 7 days. To ensure concurrent validity of the self-report measure we measured physical activity objectively using a 3-axis accelerometer (Hookie Meter v2.0, Hookie Technologies Ltd, Espoo, Finland) in a sub-sample (n = 44) of adolescents (Vähä-Ypyä et al., 2015). Activity data were registered as raw data at a 100 Hz sample rate on a 2GB internal flash memory. Accelerometers were worn for seven consecutive days. The correlation coefficient between the accelerometer-measured average daily physical activity (approximately above four METs, representing moderate to vigorous physical activity) and self-reported physical activity (above) was statistically significant (r= .38, p < .02).

Data Analysis

Prior to analysis, missing values were imputed using the multiple imputation features of the IBM SPSS version 23 software, values were imputed for psychological data only and where less than 5% of values were missing, Behavioral data was not imputed. Drop-out analyses were conducted with MANOVA, chi-square tests, and t-tests using SPSS. A structural equation model using a maximum likelihood method was conducted with the

Mplus version 7.31 statistical software (Muthén & Muthén, 2015). All the psychological variables in the model were represented as latent variables indicated by multiple items from their questionnaire measures. Gender, age, and past physical activity behavior at T1 were included as control variables which predicted all other variables in the model. Age, physical activity behavior at T2, and past physical activity behavior, were included as continuous non-latent variables and gender was included as a dichotomous non-latent variable coded as 1 = boys, 2 = girls. The hypothesized relations among the variables in the proposed model are summarized in Figure 1. At the measurement level, construct validity of the latent factors was established using the average variance extracted (AVE) and composite reliability coefficients (ρ) which should exceed .50 and .70, respectively (Diamantopoulos & Siguaw, 2000). Adequacy of the hypothesized model was established using the comparative fit index (CFI) and the Tucker-Lewis Index (TLI) index, with values exceeding .90 typically considered appropriate cutoff values for adequate model fit, and the root mean squared error of approximation (RMSEA) and its 90% confidence intervals (CI_{90}), with a cutoff value equal to or less than .08 and narrow confidence intervals indicative of an adequately-fitting model (Marsh, Hau, & Wen, 2004). Hypothesized mediation effects were tested by calculating indirect effects with bootstrapped standard errors.

Results

Preliminary Analyses

The descriptive statistics are displayed in Table 1. A MANOVA with physical activity and the study psychological variables as multiple dependent variables and study drop-out as the independent variable revealed an overall statistically non-significant multivariate effect, Pillai's Trace = 0.23, $F(5, 390) = 1.87$, $p = .099$. The analysis indicated that participants that did not participate at T2 did not differ on psychological variables or physical activity compared to those that remained in the study. Those that dropped out from the study were older than those who remained in the study (t(409) =-2.57, p = .011) which may be due to a higher number of older students doing practical training outside of school. Differences in gender distribution between the final sample and drop-outs between T1 and T2 did not reach statistical significance ($\chi^2(1) = 3.83$, p = .055). Zero-order intercorrelations, average variance extracted (AVE) and reliability coefficients for study variables are presented in Table 2. We also checked intraclass correlation coefficients (ICC) for study variable scores across schools to check for clustering of data and ensure that scores were not dependent on school membership. The ICC values were not statistically significant for any of the variables (ICC range = .005 to .048) indicating that clustering is negligible.

Structural Equation Model

Prior to evaluating study hypotheses in the structural equation model, we examined the solution estimates to ensure that the psychological constructs were sufficiently well defined. Examination of the factor loadings indicated large factor loadings for the action planning, coping planning, and self-monitoring factors. Furthermore, items from the intrinsic and identified regulation scales of the Self-Regulation Questionnaire loaded on a single autonomous motivation factor as did items from the introjected and external regulation scales to form a controlled motivation factor with AVE values approaching or exceeding the .50 cutoff considered appropriate for adequate construct validity. This justifies our approach to reducing the number of variables in our model consistent with previous research (e.g., Chan & Hagger, 2012; Hagger et al., 2002).

Standardized parameter estimates for the structural relations among the proposed model are given in Figure 2. Overall, the model indicated adequate model fit, CFI = .916, TLI = .902, RMSEA = .062 (CI_{90} upper limit = .072; CI_{90} lower limit = .055). In addition, the model accounted for a statistically significant amount of variance in the key dependent variables measured at T2: self-monitoring (R^2 = .37) and leisure time physical activity (R^2 = .36).

There were statistically significant direct effects of autonomous motivation on action planning (β = .53, $p < .001$) and coping planning (β = .51, $p < .001$), and self-monitoring on physical activity (β = .28, $p = .004$). There was also a statistically significant direct effect of autonomous motivation on self-monitoring (β = .27, $p = .005$). In terms of indirect effects, we found statistically significant overall indirect effect of autonomous motivation on physical activity through the mediated paths in the model (β = .14, $p = .042$), although the most substantive indirect effect was directed through self-monitoring (β = .08, $p = .050$). There was therefore a statistically significant total effect of autonomous motivation on physical activity comprising the direct and indirect effects (β = .22, $p < .001$). We also found a statistically significant indirect effect of autonomous motivation on self-monitoring through coping planning (β = .12, $p = .021$) and a statistically significant total effect comprising the direct and indirect effects (β = .39, $p < .001$).

Discussion

The purpose of the present study was to examine interrelationships between quality of motivation, self-regulatory techniques, and physical activity behavior, and explore the possible mediating role of self-regulatory techniques in the relationship between autonomous motivation and physical activity behavior. Results indicated that young people who were autonomously motivated (i.e., derive enjoyment from exercising or feel that physical activity goals are personally important to them) were more likely to engage in strategic efforts to pursue those behaviors such as planning and monitoring their progress compared with those who exercise for controlled reasons (i.e, to avoid guilt, shame, or judgment). This further sheds light on mechanisms by which autonomous motivation may exert its effect on behaviors.

Importantly, the relationship of autonomous motivation and physical activity was found to be partially mediated by self-regulation techniques, particularly self-monitoring.

This underlines that the reason why autonomous aspirations for exercise translate into physical activity is because individuals are more likely to adopt self-regulatory techniques. Thus, interventions may benefit from fostering autonomous motivation by, for instance, addressing adolescents' using autonomy-supportive rather than controlling language, offering them choices, options and a meaningful rationale for the activities, supporting their confidence in their abilities, accepting and recognizing their efforts, and supporting positive interaction and relatedness with their peers (Hagger et al., 2007). In fact, the climate of trust and personal agency generated by autonomy support may lead adolescents to adopt appropriate and adaptive self-regulation techniques such as coping and planning and self-monitoring. A recent systematic review (Hynynen et al., in press) showed that school-based physical activity interventions for adolescents often include self-regulation techniques, but so far, randomized controlled trials have failed to demonstrate maintenance of behavior change. The current study implies that components enhancing autonomous motivation may be a critical element to add to such interventions in order to enhance long-term effectiveness.

~~The current study implies that components enhancing autonomous motivation may be a critical element to add to such interventions in order to enhance long-term effectiveness.~~ We speculate that the link between autonomous motivation and self-regulatory activities in the current research occurs due to a strategic aligning of self-regulatory techniques to maximize participation in the activity among autonomously-motivated young people. Prominent among these techniques is self-monitoring, that is, engaging proactively in keeping track of their actions relating to their goals. Self-monitoring may act as a means for tracking personal improvement and achievement of challenging goals and this may be a reason for the link between autonomous motivation and self-monitoring. Another such technique is planning, a volitional technique that helps making time for, and initiating, a desired activity (Schwarzer, 2015) – even highly enjoyable activities can be overlooked due to everyday stress and hurry. Planning is therefore consistent with individuals' motives to serve their autonomous goals.

We also tested for the effects of gender on the study variables. We found that boys reported higher levels of physical activity participation, higher extrinsic regulation, and higher levels coping planning. Differences in coping planning might contribute to the gender difference in physical activity observed in other studies (e.g. Dumith et al., 2011). It has been argued that in early adolescence, coping planning would be an especially important self-regulation technique, because young people may be motivated to shield their intentions to engage in counter-normative behaviors against peer pressure, and their self-regulatory capacities to follow a plan may be limited (Araújo-Soares, McIntyre, & Sniehotta, 2009). For example, forming coping plans to deal with potential stigma associated with non-normative behaviors, such as doing physical activity in front of others when others are engaging in more sedentary pastimes, may be an important determinant of the physical activity of young people. It is also possible that other factors indicated by the gender differences, such as gender roles, affect both coping planning and physical activity. Including specific gender roles or gender-role related traits (e.g. Hankonen, Konttinen, & Absetz, 2014) with respect to physical activity as predictors in theoretical models may further elucidate these influences.

Future studies could examine whether the association of autonomous-motivation with planning and self-monitoring can be explained by the nature of self-regulation: skillful use of self-regulation techniques may help individuals to follow their values, succeed in their efforts, and thrive in relationships. Self-directed planning and monitoring of progress can be experienced as autonomy supportive, especially if the plans are achievable, personally relevant, and enjoyable, and lead to continuous accomplishments, verified by self-monitoring. Fostering self-monitoring and planning for physical activity in an autonomy supportive manner would have the potential to reinforce both motivation and behavior.

In addition to measuring use of self-regulatory techniques, future studies could measure also other change strategies that individuals enact to obtain their desired behavior change, such as using prompts to maintain motivation and remind individuals of their plans (Hankonen et al., 2015). This would be especially useful in behavior change interventions where investigating the actual uptake of behavior change techniques represents an important, yet understudied aspect of intervention fidelity (Bellg et al., 2004; Greaves, 2015).

Strengths and Limitations

The strengths of this study were the adoption of constructs from theoretical frameworks that are frequently used to predict leisure-time physical activity (Chatzisarantis et al., 2003; Hagger et al., 2002), using validated measures, and integrating them to test unique hypotheses regarding motivated action. In addition, the study used comprehensive sampling which covered different education levels and professional orientations, thus overcoming the frequent criticism that research is biased due to the preponderance of university or high-school student samples. Limitations of the study include the reliance on self-report measures and the correlational design, which limits the inference of causality. It is important to note that we attempted to address the issue of self-reported behavior by validating our self-reported physical activity measure using an objective measure, an accelerometer, a strength of the current study as this is seldom done in research of this kind. It must, however, be stressed that this was conducted on a relatively small sub-sample. Furthermore, we controlled for past physical activity behavior, an important endeavor in research adopting theoretical models as it accounts for habits and previous decision making. Specifically, the inclusion of past behavior may serve as a proxy for effects of baseline measures of psychological variables as it may reflect unmeasured behaviorally-relevant aspects of previous decision making (Sutton, 1994). Future research may seek to address these limitations by controlling for temporal changes using baseline measures or adopting cross-lagged panel (e.g., Lindwall, Larsman, & Hagger, 2011) and experimental (e.g., Hagger et al., 2012) designs, which may enable better inference of causality. Panel designs may also permit exploration of reciprocal relations among the constructs in the proposed model. Experimental research may shed light on whether particular behavior change interventions or strategies that target autonomous motivation such as autonomy support may also result in the adoption of self-regulatory techniques, as proposed in the current model (Chatzisarantis & Hagger, 2009; Mullan, Todd, Chatzisarantis, & Hagger, 2014). Factorial designs may also allow for the adoption of other techniques that target the self-regulation strategies independent of autonomy support and examine whether these have differential, unique effects on the variables in the current model.

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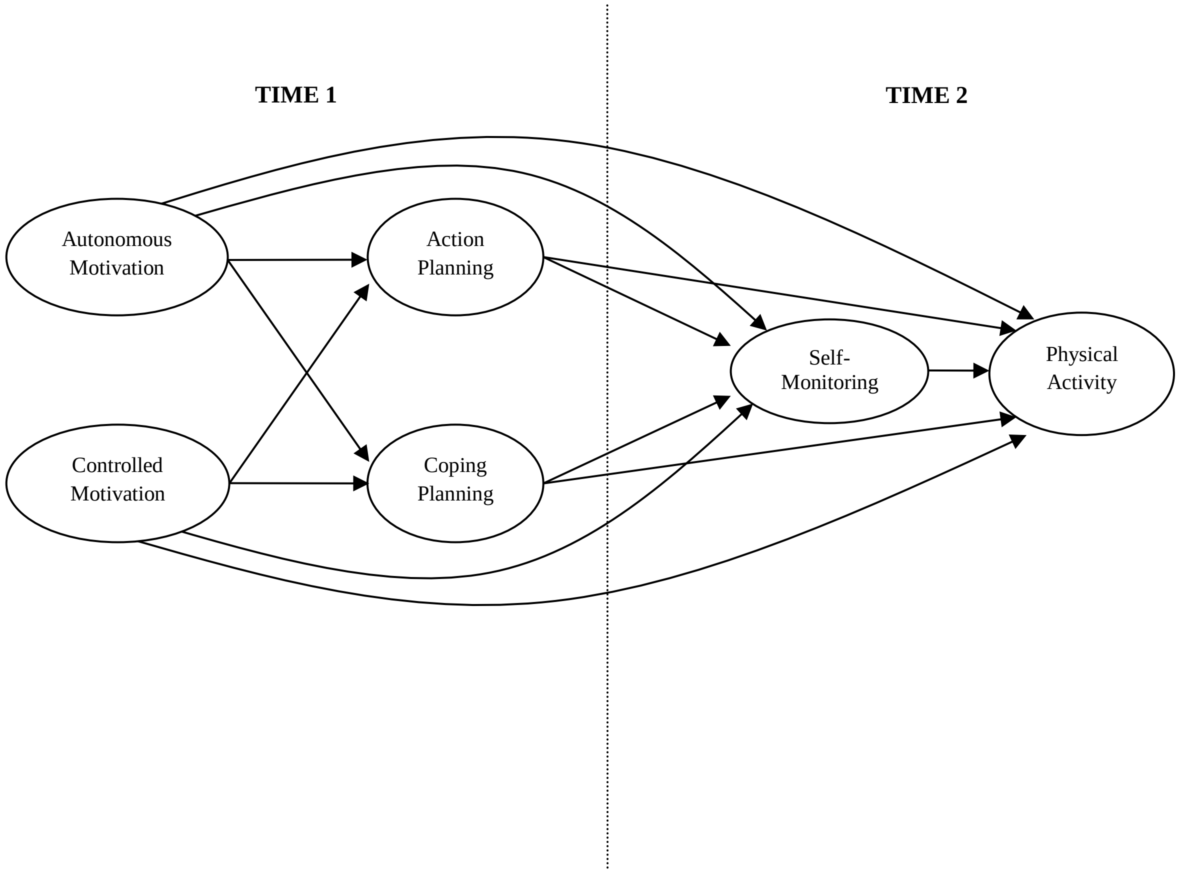

Figure 1. Proposed structural equation model illustrating effects among self-determination theory, planning, self-monitoring, and behavioral variable. Effects of gender, school, and past physical activity behavior as control variables on each variable in the model omitted for clarity.

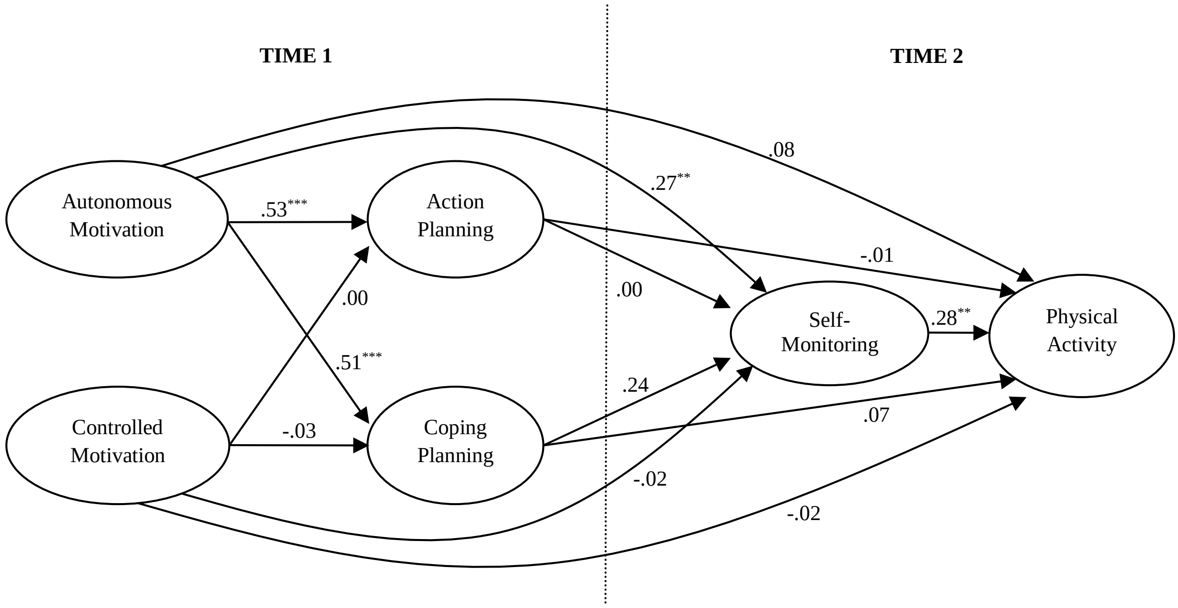

Figure 2. Standardized parameter estimates of a structural equation model of effects among motivation, planning, self-monitoring, leisure-time physical activity, and demographic variables. Statistically significant indirect effects not shown in model: Autonomous motivation → Physical activity (β = .08, p = .050); Autonomous motivation → Self-monitoring (β = .12, p = .021). Effects of gender, school, and past physical activity behavior as control variables on each variable in the model omitted for clarity, paths freely estimated in the model but not depicted in diagram: Gender → Autonomous motivation (β = .05, p = .458); Gender → Controlled motivation (β = -.19, p = .026); Gender → Action planning (β = -.13, p = .025); Gender → Coping planning (β = -.24, p < .001); Gender → Self-monitoring (β = .04, p = .490); Gender → Physical activity (β = -.14, p = .054); School → Autonomous motivation (β = -.02, p = .771); School → Controlled motivation (β = .023, p = .78); School → Action planning (β = -.09, p = .097); School → Coping planning (β = -.10, p = .097); School → Self-monitoring (β = .13, p = .032); School → Physical activity (β = -.02, p = .757); Past physical activity behavior → Autonomous motivation (β = .46, p < .001); Past physical activity behavior → Controlled motivation (β = -.10, p = .307); Past physical activity behavior → Action planning (β = .21, p = .002); Past physical activity behavior → Coping planning (β = .22, p = .004); Past physical activity behavior → Self-monitoring (β = .20, p = .007); Past physical activity behavior → Physical activity (β = .31, p < .001).
* p < .05 ** p < .01 *** p < .001

Table 1

Minimum and Maximum Values, Means, and Standard Deviations of Motivational Regulation Styles, Self-Regulation Techniques and Leisure Time Physical Activity

	Range[a]	Total M (SD)	Boys Mean (SD)	Girls Mean (SD)	*p*[b]
Intrinsic regulation	1-5	3.84 (0.97)	3.86 (0.96)	3.83 (0.98)	.835
Identified regulation	1-5	3.85 (0.96)	3.75 (0.96)	3.91 (0.96)	.272
Introjected regulation	1-5	2.78 (1.09)	2.71 (1.12)	2.83 (1.07)	.490
External regulation	1-5	1.78 (0.85)	1.98 (0.96)	1.65 (0.73)	.011
Autonomous motivation	1-5	3.85 (0.93)	3.80 (0.93)	3.87 (0.93)	.638
Controlled motivation	1-5	2.28 (0.84)	2.34 (0.93)	2.24 (0.78)	.424
Action planning	1-4	2.79 (1.02)	2.93 (0.94)	2.70 (1.06)	.146
Coping planning	1-4	2.52 (0.93)	2.79 (0.82)	2.38 (0.96)	.005
Self-monitoring (Time 2)	1-7	4.35 (1.60) [b]	4.29 (1.62)	4.38 (1.60)	.728
Physical activity (Time 2)	0-7	4.11 (1.77) [b]	4.50 (2.00)	3.90 (1.58)	.030
Past behavior (Physical activity)	0-7	3.94 (1.68)	3.98 (1.63)	3.95 (1.71)	.883

Note. [a]Higher scores indicate stronger agreement with the items; [b]Statistical significance from *t*-test for gender differences. All variables were measured at Time 1 unless otherwise indicated.

Table 2

Zero-Order Intercorrelations and Reliability Coefficients for Study Variables

Variable	AVE	1	2	3	4	5	6	7	8
1. Action planning	.87	(.96)							
2. Coping planning	.73	.83**	(.93)						
3. Autonomous motivation	.56	.62**	.59**	(.92)					
4. Controlled motivation	.29	.01	-.01	.00	(.84)				
5. Self-monitoring (Time 2)	.66	.45**	.48**	.52**	-.05	(.83)			
6. Physical activity (Time 2)	–	.37**	.40**	.38**	-.04	.48**	–		
7. Past behavior (Physical activity)	–	.44**	.45**	.46**	-.01	.45**	.49**	–	
8. Gender[a]	–	-.11	-.21**	.05	-.20	.01	-.15	-.01	–
9. School[b]	–	-.04	-.05	.04	.01	.15*	.06	.13	.02

Note. AVE = Average variance extracted of latent factors. Correlations with psychological constructs are latent factor correlations. Cronbach alpha reliability coefficients displayed on principal diagonal; [a]Dichotomous variable coded as 1 = Boy, 2 = Girl; [b]Dichotomous variable coded as 1 = vocational school, 2 = high school. All variables were measured at Time 1 unless otherwise indicated.

$^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$