Received: 6 March 2020 | Revised: 8 May 2020 | Accepted: 26 May 2020

DOI: 10.1111/jasp.12691

ORIGINAL ARTICLE

Journal of Applied Social Psychology WILEY

Predicting change in middle school students' leisure-time physical activity participation: A prospective test of the trans-contextual model

Juho Polet[1] | Taru Lintunen[1] | Jekaterina Schneider[1] | Martin S. Hagger[1,2]

[1]Faculty of Sport and Health Sciences, University of Jyväskylä, Jyväskylä, Finland

[2]SHARPP Lab, Psychological Sciences, University of California, Merced, Merced, CA, USA

Correspondence
Juho Polet, Faculty of Sport and Health Sciences, University of Jyväskylä, PO Box 35, Jyväskylä, FI 40014, Finland.
Email: juho.j.polet@student.jyu.fi

Funding information
This work was supported by a Finnish Ministry of Education and Culture (Grant No. OKM/62/626/2016). Martin S. Hagger's contribution was supported by a Finland Distinguished Professor (FiDiPro) award no. 1801/31/2015 from Business Finland.

Abstract

We applied the trans-contextual model (TCM) to examine the effects of middle school students' perceived autonomy support from their physical education (PE) teachers on autonomous motivation toward PE in school and, critically, autonomous motivation toward, and actual participation in, leisure-time physical activity (PA). The research adopted a three-wave prospective design enabling the modeling of change in the TCM constructs over time. Middle school students (N = 248) aged from 12 to 16 years reported their perceived autonomy support, autonomous motivation in PE, autonomous motivation toward leisure-time PA, attitudes, subjective norms, perceived behavioral control (PBC), intentions for PA in leisure-time, and leisure-time PA participation. The psychological constructs and leisure-time PA were measured at baseline (T0) and at a first follow-up occasion (T1) 5 weeks later. Another measure of PA was taken at a second follow-up occasion (T2) a further 5 weeks later. A single-indicator structural equation model using residualized change scores revealed that perceived autonomy support predicted autonomous motivation in PE (β = .345), and autonomous motivation in PE predicted autonomous motivation for leisure-time PA (β = .484). Autonomous motivation toward leisure-time PA predicted attitudes (β = .425), subjective norms (β = .264), and PBC (β = .517). Autonomous motivation toward leisure-time PA (β = .376), attitude (β = .231), and subjective norms (β = .185) predicted intentions toward leisure-time PA, and intentions predicted PA (β = .198). Findings extend research on the TCM by demonstrating its efficacy in predicting change in middle school students' autonomous motivation across PE and leisure-time contexts, and accounting for change in intentions toward, and actual participation in, leisure-time PA.

1 | INTRODUCTION

Regular participation in physical activity (PA) in young people is associated with reduced risk of chronic disease risk factors and positive mental health outcomes (Haskell, Blair, & Hill, 2009; Janssen & LeBlanc, 2010; Warburton, Nicol, & Bredin, 2006). In addition, there is evidence that PA in young people tracks into adulthood and may be a gateway to lifelong PA participation (Tammelin et al., 2014).

Despite these benefits, research has shown that young people do not participate in sufficient PA to confer health benefits (Guthold, Stevens, Riley, & Bull, 2020).

Given the insufficient levels of PA observed in young people (e.g., Kokko et al., 2016), development of effective campaigns, and interventions to promote increased PA participation in young people has been identified as a priority (Messing et al., 2019). Researchers in behavioral science and applied psychology have, consequently, adopted psychological theories and models to predict and understand PA participation in young people, with the view of identifying the potential targets for intervention (Hagger, Cameron, Hamilton, Hankonen, & Lintunen, 2020; Hagger, Moyers, McAnally, & McKinley, 2020; Sheeran, Klein, & Rothman, 2017). In addition to identifying these targets, researchers have also been mindful of the key contexts, in which interventions to promote PA will have maximum benefit and reach (Messing et al., 2019). Physical education (PE), for example, has been noted as a potentially viable existing network on which interventionists can capitalize to deliver PA interventions to a broad, and captive audience of young people (Finnish National Board of Education, 2014; Hagger & Chatzisarantis, 2016).

Considering the imperative of identifying factors that determine PA participation and the potential for the school context to intervene and motivate young people to participate in PA in their leisure-time, researchers have sought to identify the factors linked to young people's motivation toward PA both within (Standage, Duda, & Ntoumanis, 2003) and outside of school (Plotnikoff, Costigan, Karunamuni, & Lubans, 2013). Theories of motivation and belief-based decision-making have been identified as important in this regard. Prominent among these is the trans-contextual model (TCM), an integrated model of motivation that outlines the psychological factors that likely influence the children's motivation toward, and actual participation in, PA outside of school (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). The model outlines how the quality of motivation toward PA in school relates to motivation toward, and actual participation in, out-of-school PA. The model has been shown to be effective in identifying the predictors of motivation and PA participation in multiple samples in many countries, and these findings have been supported in a meta-analysis of studies (Hagger & Chatzisarantis, 2016). However, to date, research applying the TCM has not modeled change in its constructs over time. The current study aimed to advance knowledge on the TCM by testing its effectiveness in accounting for change in its constructs over time, particularly the target outcomes of leisure-time autonomous motivation, intentions, and PA behavior.

1.1 | The TCM

The TCM is a multi-theory integrated model that specifies how students' perception of their PE teacher's support for their motivation toward physical activities relates to their in school motivation toward PA and, importantly, their motivation, intentions, and actual PA behavior outside of school in their leisure-time (Hagger et al., 2003). The model draws its hypotheses from three motivational theories: self-determination theory (SDT; Deci & Ryan, 1985), the theory of planned behavior (TPB; Ajzen, 1991), and the hierarchical model of intrinsic and extrinsic motivation (Vallerand & Ratelle, 2002). Next, we outline the predictions of the model derived from the premises of the component theories.

Central to the model is autonomous motivation. Consistent with the predictions of SDT, autonomous motivation reflects engaging in activities and tasks out of a sense of volition, choice, and interest, and to attain self-endorsed goals. Autonomous motivation is important because it has been consistently shown to relate to behavioral persistence in multiple populations, behaviors, and contexts, and in the absence of external contingencies and reinforcement (Hagger et al., 2014; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). It is, therefore, important for fostering self-regulation of behaviors, as individuals who are autonomously motivated are more likely to persist with behaviors without the need for consistent, intensive prompts and interventions. According to the theory, social agents in the environment, such as teachers in school contexts, have the capacity to foster autonomous motivation by displaying autonomy-supportive behaviors. Research in educational contexts has demonstrated that the students of teachers displaying autonomy supportive behaviors in school contexts are more likely to report autonomous motivation and display greater engagement and persistence on tasks (Reeve & Cheon, 2020; Reeve, Jang, Carrell, Jeon, & Barch, 2004). Furthermore, students that perceive their teachers as autonomy supportive are more likely to report autonomous motivation in class (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005). This forms the first premise of the TCM: Students perceiving that their teacher supports their autonomy in their PE classes will report autonomous motivation toward physical activities in class.

A key prediction of the TCM is that students' autonomous motivation toward PA in school will transfer to autonomous motivation toward physical activities outside of school in their leisure-time. This prediction is based on Vallerand and Ratelle's (2002) hierarchical model of intrinsic and extrinsic motivation. The hierarchical model proposes interplay between types of motivation across contexts. The rationale behind this "transfer" of motivation is that individuals who view activities as autonomously motivating in a given context will also seek out further opportunities to experience autonomous motivation in other contexts. The primary drivers behind this process are basic psychological needs. Self-determination theory suggests that satisfaction of three fundamental needs for autonomy, competence, and relatedness is essential for optimal functioning, with the need for autonomy, that is, the need to experience actions as chosen and self-endorsed, the foremost need (Ryan & Deci, 2017). Individuals who experience behaviors as autonomous, are likely to internalize such behaviors as those that satisfy their need for autonomy. Consistent with the hierarchical model, individuals will also be motivated to pursue need-satisfying behaviors elsewhere. This process forms the second premise of the TCM: Students experiencing physical activities in PE as autonomously motivating are more

likely to report autonomous motivation toward PA outside of school in their leisure-time.

Consistent with SDT, individuals experiencing an activity as autonomously motivating are likely to seek out further opportunities to engage in that activity in the future, and will strategically bring their beliefs and intentions toward that activity in line in order to do so (Deci & Ryan, 1985; Hagger et al., 2014). This is because individuals are motivated to seek out behaviors likely to satisfy their psychological needs. The formation of beliefs, therefore, outlines *how* individuals' motives lead to future participation in need-satisfying behavior. In the TCM, this is the process by which autonomous motivation in leisure-time leads to subsequent PA behavior. The TCM utilizes the TPB, a social cognition theory that identifies the belief-based determinants of intentions and behavior, as a means to model these relations (Chan, Zhang, Lee, & Hagger, 2020; Hagger & Chatzisarantis, 2009). The theory suggests that intentions are the most proximal predictor of behavior, a critical relationship in many social cognition theories (Orbell, 2004; Sheeran & Webb, 2016). Intentions are proposed to mediate the effects of three belief-based constructs, attitudes, subjective norms, and perceived behavioral control, on behavior. Research has demonstrated that these beliefs mediate relations between autonomous motivation and leisure-time PA participation (Chan et al., 2020; Hagger & Chatzisarantis, 2009). These findings form the basis of the third premise of the TCM: Autonomous motivation toward leisure-time PA will predict PA participation mediated by attitudes, subjective norms, PBC, and intentions.

Research adopting the TCM has supported its predictions in multiple samples and in different national groups (Chan, Hagger, & Spray, 2011; González-Cutre, Sicilia, Beas-Jiménez, & Hagger, 2014; Hagger & Chatzisarantis, 2016; Hagger, Sultan, Hardcastle, & Chatzisarantis, 2015). Specifically, research has demonstrated that the key premises hold: students' perceived autonomy support predicts their autonomous motivation toward PA in school; students' in school autonomous motivation predicts their autonomous motivation toward PA in leisure-time; autonomous motivation toward leisure-time PA predicts subsequent participation in leisure-time PA mediated by the belief-based constructs and intentions from the TPB. Primary research and meta-analytic findings have indicated small-to-medium sized effects for the direct effects that comprise the three key premises, with a small indirect effect of autonomous motivation on PA participation (Hagger & Chatzisarantis, 2016). In addition, intervention research has also suggested that provision of autonomy support by PE teachers or social agents affects leisure-time PA through the mediation of the model variables (Chatzisarantis & Hagger, 2009; Mavropoulou, Barkoukis, Douka, Alexandris, & Hatzimanouil, 2019; Wallhead, Hagger, & Smith, 2010).

1.2 | Modeling change in the TCM

Despite growing support for the premises of the model, numerous limitations and critiques of the model exist. At the forefront of these critiques has been the "static" approach to test the model (Hagger & Chatzisarantis, 2016). The three-wave prospective design, typically used to test the predictive validity of the model is limited as it does not account for change in the various model components over time. This is problematic because such models do not account for potential changes in both the predictor and predicted variables of the model that occur in the interim between measurements. Such changes may occur for multiple reasons, such as new information becoming available that influences the students' beliefs. For example, the introduction of a new teacher with a different interpersonal approach in PE lessons, the increased availability of opportunities to perform PA, or a series of positive or negative experiences may all change constructs in the model. A means to account for such change is to measure all model variables at each time point, which permits the explicit modeling of change in variables over time. Such an approach accounts for the relative temporal variability or stability in each construct over time, and allows the researcher to evaluate how well changes in antecedent constructs, such as perceived autonomy support and autonomous motivation in PE, predict changes in dependent constructs, such as autonomous motivation, beliefs, intentions, and behavior in leisure-time. Modeling change provides a more stringent test of the predictive validity of the model; if the model is able to account for change in constructs over time, then it will be more relevant to guiding interventions which focus on manipulating model constructs (e.g., perceived autonomy support) in order to affect change in key outcomes (e.g., leisure-time PA intentions and behavior.

1.3 | The present study

The purpose of the present study was to test the predictive validity of the TCM using change scores for each model construct in a sample of middle school students. Previous applications of the TCM have tested the predictive validity of the model using prospective designs, which use absolute values for model constructs to estimate the hypothesized relations among them. However, no previous study has shown whether the key premises of the model hold when it is used to predict change in its constructs over time. We applied a three-wave design to include measures of all model constructs at two data collection occasions separated by a 5-week interval, with a further follow-up measure of leisure-time PA behavior, 5 weeks after the second occasion. This design enabled modeling of change in study constructs using residualized change scores. In terms of specific predictions, we expected to find support for the three premises of the model in our change-score model: (i) changes in students' perceived autonomy support from teachers in PE were proposed to be positively related to changes in autonomous motivation toward PE; (ii) changes in autonomous motivation in PE were proposed to be positively related to changes in autonomous motivation for leisure-time PA outside of school; and (iii) changes in autonomous motivation for leisure-time PA were proposed to be positively related to changes

in intentions toward, and actual participation in, leisure-time PA through changes in the immediate antecedents of intentions from the TPB.

2 | METHOD

2.1 | Participants and design

A convenience sample of middle-school students (*N* = 292) aged from 12 to 16 years was recruited from two schools in the city of Kouvola, Finland. Schools were identified through PE teachers with established links with the University, and approval from the principals of both schools was secured in advance of data collection. The study protocol was approved by the research ethics committee of the University of Jyväskylä. Students' participation in the study was voluntary. Guardians of the eligible students were required to complete informed consent forms prior to participation via letters sent home with the students using an opt-out strategy. The study employed a three-wave prospective correlational design with measures of all TCM variables and PA behavior collected at two initial data collection occasions and a further follow-up comprising a behavioral measure only. Data were collected during regular school lessons and students who did not participate in the study were provided with an alternative writing task. In the first (T0) and second (T1) data collection occasions, separated by 5 weeks, self-report measures of students' perceived autonomy support by teachers, autonomous motivation for PE, autonomous motivation for leisure-time PA, TPB constructs, and self-reported PA were administered. Five weeks after the second data collection occasion, participants self-reported their PA participation for a third time (T2).

2.2 | Measures

Participants completed questionnaires containing previously validated self-report measures of the TCM constructs and self-report measures of behavior. Details of the measures are provided in the next section, and complete study measures are available in Appendix A (Supporting Information).

2.2.1 | Students' perceived autonomy support from their PE teacher

Perceived autonomy support from the students' PE teacher was measured using items from the perceived autonomy support scale for exercise settings (PASSES; Hagger et al., 2007). The scale comprised 12 items (e.g., "I feel that my PE teacher provides me with choices and options to …") with responses provided on 7-point scales (1 = *strongly disagree* and 7 = *strongly agree*). The scale has demonstrated adequate construct validity and reliability statistics in previous research (Hagger et al., 2007, 2009).

2.2.2 | Autonomous motivation toward in school and out-of-school PA

Autonomous motivation toward in school and out-of-school physical activities was measured using items from the perceived locus of causality questionnaire (Ryan & Connell, 1989). Two items measured identified regulation (e.g., "I do PE/PA because it is important to me to do well in PE/PA") and two items measured intrinsic motivation (e.g., "I do PE/PA because it is fun"). Responses were provided on 7-point scales (1 = *not true for me* and 7 = *very true for me*). For each of the PE and out-of-school contexts, a composite autonomous motivation score was computed by averaging scores on the identified regulation and intrinsic motivation items. Measures of autonomous motivation have demonstrated satisfactory construct validity and internal consistency in previous studies (Hagger et al., 2009).

2.2.3 | Theory of planned behavior constructs

Measures of students' attitudes, subjective norms, PBC, and intentions with respect to their future participation in PA were measured using scales developed according to reported guidelines (Ajzen, 2002). Attitudes were measured on three items in response to a common stem: "Participating in PA in the next five weeks will be…" with responses made on 7-point scales (e.g., 1 = *unenjoyable* and 7 = *enjoyable*). Subjective norms (e.g., "Most people who are important to me think I should do active sports and/or vigorous physical activities during my leisure-time in the next five weeks"), PBC (e.g., "I am confident I could do active sports and/or vigorous physical activities during my leisure-time in the next 5 weeks"), and intentions (e.g., "I intend to do active sports and/or vigorous physical activities during my leisure-time in the next five weeks") were measured using two items each with responses provided on 7-point scales (e.g., 1 = *strongly disagree* and 7 = *strongly agree*). Previous research has supported the construct validity and internal consistency of these measures within the TCM (Hagger et al., 2009).

2.2.4 | Physical activity behavior

PA behavior was measured using a modified version of the leisure-time exercise questionnaire (Godin & Shephard, 1985). The measure comprised two items: "In the course of the past five weeks, how often on average, have you participated in vigorous physical activities during your leisure-time for at least 20 min at a time" and "How frequently did you participate in vigorous physical activities during your leisure-time in the course of the past five weeks for at least 20 min at time)" with responses provided on 6-point scales (e.g., 1 = *never* and 6 = *all of the time*). The reference to a 20-min duration was based on American College of Sports Medicine (ACSM) daily guideline levels for vigorous PA. This version of the questionnaire has exhibited adequate inter-item correlations in previous studies (Hagger et al., 2009).

2.3 | Data analysis

Study hypotheses were estimated using single-indicator structural equation models using scale reliabilities to provide estimates of the measurement errors of the latent variables as advocated by Savalei (2019). Models were estimated using the Mplus software version 8.0 (Muthén & Muthén, 2002). Given the number of variables and the complexity of the model, we opted not to use an autoregressive path analytic model. Instead, change in model constructs was estimated using residualized change scores, which is a useful means to control for change while minimizing parameterization (Castro-Schilo & Grimm, 2018). Standardized residualized change scores for psychological constructs were computed by regressing scores for each variable taken at the first follow-up occasion (T1) on its score at the baseline data collection occasion (T0). We also included scores for leisure-time PA taken at T0 as an independent predictor of each psychological construct, which effectively controlled for past behavior. We used the same process to compute residualized change scores for leisure-time PA, but since PA measures were taken on three occasions, T0, T1, and T2, we regressed final PA scores at T2 on PA scores at both T0 and T1. The proportion of missing data for time 1 and time 2 psychological variables was low (M = 0.57%; range 0% to 3.2%), and data were missing completely at random (Little's MCAR test, $\chi^2(26) = 273$, $p = .058$). Missing data for the model components excluding leisure-time PA were imputed using linear interpolation. The residualized change scores were used to indicate latent variables in a structural equation model to test hypothesized predictions of the TCM presented in Figure 1. Latent variables were estimated using change scores as single indicators with McDonald's Omega (ω) reliability coefficient used to estimate fixed values for the error variances of the single-indicator latent variables based on Bollen's (1989) formula. We opted for a single-indicator structural equation model over the more traditional multiple-indicator model because of the difficulty of fitting models comprising constructs indicated by large numbers of items with data, particularly on relatively small sample sizes (Hsiao, Kwok, & Lai, 2018; Savalei, 2019). Model fit was evaluated using multiple goodness-of-fit indices: the model chi-square, the comparative fit index (CFI), the standardized root mean square of the residuals (SRMR), and the root mean error of approximation (RMSEA). A nonsignificant chi-square, a CFI value that approaches or exceeds .95, a SRMR value of less than .08, and a RMSEA value of .05 or less, are indicative of good fit of the model with the data (Hu & Bentler, 1999). Model effects were expressed as standardized parameter estimates. This makes assessment of effect sizes easy because each effect has the same scale ranging from 0 to 1.00. However, because effect sizes for indirect effects are products of one or more direct effects, effect sizes of standardized coefficients should be interpreted differently. Researchers have suggested that indirect effect sizes of .075 or larger are non-trivial in size while effect sizes < .075 are small or trivial in size (Hagger, Koch, Chatzisarantis, & Orbell, 2017; Seaton, Marsh, & Craven, 2010). The data file, Mplus syntax, and output files for the analyses are available online: https://osf.io/py2g7/.

3 | RESULTS

3.1 | Final sample and preliminary analyses

Forty-four participants dropped out of the study due to absences across the three waves of data collection resulting in a final sample size of 248 participants (boys, n = 118, girls, n = 130; M age = 13.63,

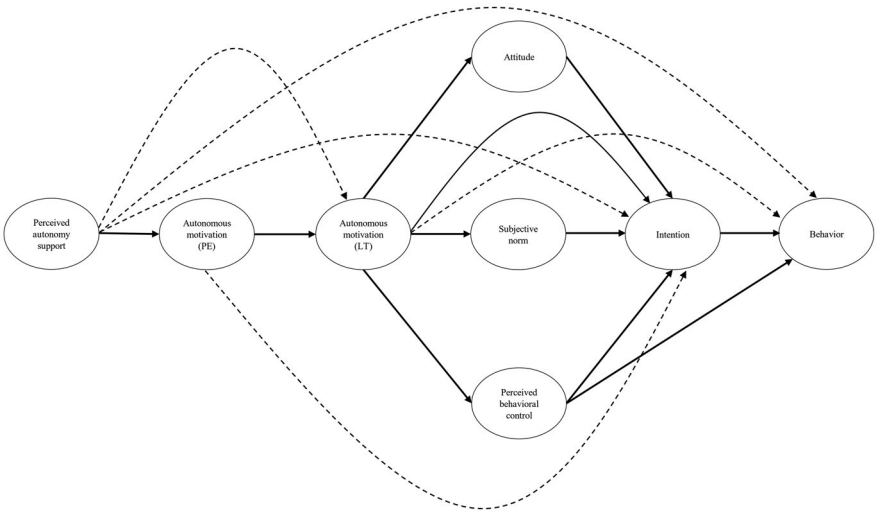

FIGURE 1 The hypothesized trans-contextual model. Broken lines between constructs indicate direct effects proposed to be nonsignificant or unsubstantial. Changes in students' perceived autonomy support from teachers in PE are proposed to be positively related to changes in autonomous motivation toward PE; changes in autonomous motivation in PE are proposed to be positively related to changes in autonomous motivation for leisure-time physical activity outside of school; changes in autonomous motivation for leisure-time physical activity are proposed to be positively related to changes in intentions toward, and actual participation in, subsequent leisure-time physical activity through changes in the immediate antecedents of intentions (i.e., attitude, subjective norm and perceived behavioral control); PE = physical education, LT = leisure-time

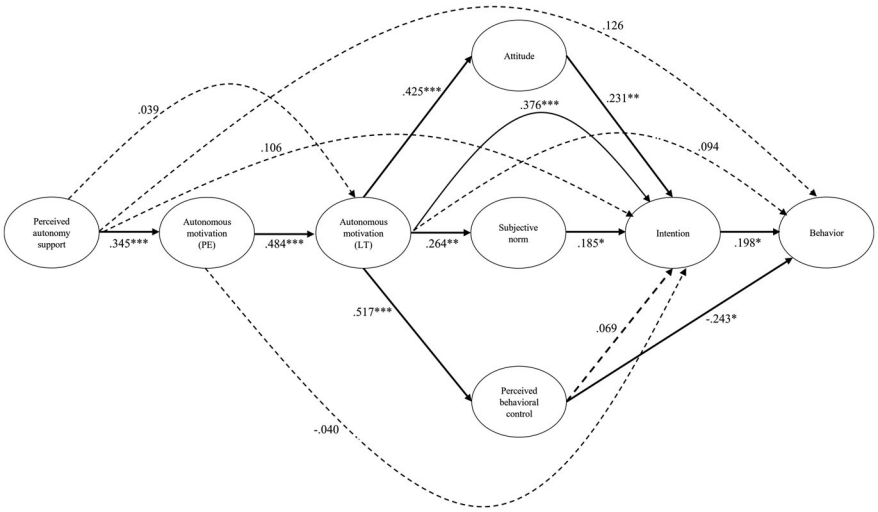

FIGURE 2 Results of the single-indicator structural equation model of the trans-contextual model. Coefficients are standardized parameter estimates. Solid unidirectional arrowed paths represent statistically significant effects among the model variables, broken unidirectional arrowed paths represent nonsignificant effects. Variables depicted are residual change scores for the study variables calculated by regressing variable scores taken at the first follow-up occasion (T1) on scores for the same variable taken on the first data collection occasion (baseline, T0). Physical activity behavior measured at T0 was also included in computing the change score of each variable to control for past behavior. The change score for physical activity was calculated by regressing the physical activity score taken at the second-follow up occasion (T2) on physical activity scores taken at T1 and T0. All parameter estimates of the model and error variances presented in Appendix F. Correlations among study variables omitted for clarity. *p < .05. **p < .01. ***p < .001

SD = 0.92). Attrition analyses indicated that students retained in the study were marginally younger (*M* age = 13.63, *SD* = 0.92) on average than those that dropped out of the study at any stage (*M* age = 14.02, *SD* = 0.73), $t(8) = 3.155$, $p = .002$, $d = .469$. There were no differences between participants that dropped out of the study at any stage and those that were retained in the final analysis on gender distribution, $\chi^2(1) = 1.981$, $p = .159$, Cohen's $w = .082$, psychological variables in the first and second data collection occasions (perceived autonomy support and autonomous forms of motivation in school and leisure-time context, attitudes, subjective norms, PBC, and intention), $F(14, 255) = .884$, $p = .577$; Wilk's $\Lambda = .954$, partial $\eta^2 = .046$, and PA $F(2, 274) = 2.674$, $p = .071$; Wilk's $\Lambda = .981$, partial $\eta^2 = .019$. Descriptive statistics and full correlation matrices among manifest variables prior to residualized change score computation are presented in Appendices B and C (Supporting Information).

3.2 | Model effects

The proposed model exhibited adequate fit with the data according to the adopted goodness-of-fit indices, $\chi^2(9) = 18.543$, $p = .029$; CFI = .967; SRMR = .036; RMSEA = .06590% CI [.020, .108]. Measurement-level parameters from the structural equation model including factor loadings and terms used to fix error variances of each latent variable are presented in Appendix D (Supporting Information), and correlations among latent variables from the structural equation model are presented in Appendix E (Supporting Information). Hypothesized paths among the TCM constructs in the proposed model are summarized in Figure 1. Results of the single-indicator structural equation model of the TCM are presented in Figure 2. Full standardized parameter estimates for model effects including direct, indirect, and total effects are presented in Table 1. Although we did not calculate an a priori statistical power analysis, we conducted a posteriori analysis to check whether the study was sufficiently powered to detect effects. The analysis was based on Satorra and Saris' (1985) recommendations based on effect size and model fit. We first calculated an effect size (δ) for the model based on the proposed restricted model relative to the totally free model based on the goodness-of-fit χ^2 value and final sample size (δ = 18.543/(248–1) = 0.075). We provided an estimate for the reproduced power of the model using this effect size with alpha set at 0.05, degrees of freedom of 9, and the final sample size of 248 implemented using the Webpower function in R (Zhang & Yuan, 2018). The model yielded a power estimate of 0.875, which suggests we had sufficient statistical power to detect effects.

Next, we report parameter estimates for the model-implied direct and indirect effects for the structural equation model. It should be noted that each construct referred to in our description represents change score, but for economy of description we do not prefix each construct with "change in…". Focusing first on direct effects, perceived autonomy support had a statistically significant effect on autonomous motivation in PE ($\beta = .345$, CI_{95} [.213, .478], $p < .001$). There was also a significant trans-contextual effect of autonomous motivation in PE on autonomous motivation in leisure-time ($\beta = .484$, CI_{95} [.335, .614], $p < .001$). Autonomous motivation in leisure-time had a statistically significant effect on attitudes ($\beta = .425$, CI_{95} [.298, .552], $p < .001$), subjective norms ($\beta = .264$, CI_{95} [.109, .419], $p = .001$), and PBC ($\beta = .517$, CI_{95} [.389, .644], $p < .001$). All effects were

TABLE 1 Parameter estimates (β) with 95% confidence intervals for hypothesized effects from the single indicator structural equation model of the trans-contextual model

Independent variable	Dependent variable	Mediator	β	95% CI LL	95% CI UL	*p*
Direct effects						
PAS	Aut. mot. (PE)		.345***	.213	.478	.000
PAS	Aut. mot. (LT)		.039	−.103	.180	.593
PAS	Physical activity		.126	−.016	.269	.082
PAS	Intention		.106	−.025	.237	.111
Aut. mot. (PE)	Aut. mot. (LT)		.484***	.355	.614	.000
Aut. mot. (PE)	Intention		−.040	−.197	.117	.618
Aut. mot. (LT)	Attitude		.425***	.298	.552	.000
Aut. mot. (LT)	Sub. norm		.264**	.109	.419	.001
Aut. mot. (LT)	PBC		.517***	.389	.644	.000
Aut. mot. (LT)	Intention		.376***	.210	.542	.000
Aut.mot. (LT)	Physical activity		.094	−.101	.290	.345
Attitude	Intention		.231**	.080	.383	.003
Sub. norm	Intention		.185*	.014	.355	.034
PBC	Intention		.069	−.139	.277	.514
Intention	Physical activity		.198*	.012	.384	.037
PBC	Physical activity		−.243*	−.437	−.048	.015
Indirect effects						
PAS	Aut. mot. (LT)	Aut. mot. (PE)	.167***	.086	.248	.000
Aut. mot. (LT)	Intention	Attitude	.098**	.028	.168	.006
Aut. mot. (LT)	Intention	Sub. norm	.049	−.004	.101	.069
Aut. mot. (LT)	Intention	PBC	.036	−.072	.143	.514
Aut. mot. (PE)	Intention	Aut. mot. (LT) Attitude	.048*	.011	.084	.011
Aut. mot. (PE)	Intention	Aut. mot. (LT) Sub. norm	.024	−.003	.050	.079
Aut. mot. (PE)	Intention	Aut. mot. (LT) BC	.017	−.035	.070	.516
Aut. mot. (PE)	Physical activity	Aut. mot. (LT) Attitude Intention	.009	−.002	.021	.104
Aut. mot. (PE)	Physical activity	Aut. mot. (LT) Sub. norm Intention	.005	−.002	.011	.171
Aut. mot. (PE)	Physical activity	Aut. mot. (LT) PBC Intention	.003	−.008	.015	.548
Aut.mot (LT)	Physical activity	Intention	.074	−.001	.150	.055
Aut. mot. (LT)	Physical activity	Attitude Intention	.019	−.003	.042	.094
Aut. mot. (LT)	Physical activity	Sub. norm Intention	.010	−.004	.023	.162
Aut. mot. (LT)	Physical activity	PBC Intention	.007	−.016	.030	.546

(Continues)

TABLE 1 (Continued)

Independent variable	Dependent variable	Mediator	β	95% CI LL	95% CI UL	p
Attitude	Physical activity	Intention	.046	−.006	.098	.084
Sub. norm	Physical activity	Intention	.037	−.010	.083	.126
PBC	Physical activity	Intention	.014	−.031	.058	.546
Sums of indirect effects						
Aut. mot. (LT)	Intention	Multiple[a]	.183***	.084	.281	.000
Aut. mot. (LT)	Physical activity	Multiple[a]	−.015	−.146	.117	.825
PAS	Physical activity	Multiple[a]	.035	−.007	.076	.103
Total effects						
PAS	Aut. mot. (LT)	Multiple[b]	.206**	.068	.344	.003
PAS	Intention	Multiple[b]	.207**	.071	.344	.003
PAS	Physical activity	Multiple[b]	.161*	.023	.299	.022
Aut. mot. (LT)	Intention	Multiple[b]	.559***	.428	.690	.000
Aut. mot. (LT)	Physical activity	Multiple[b]	.079	−.064	.233	.279
Correlations						
Attitude ↔ Subjective norm			.114	−.064	.291	.210
Attitude ↔ PBC			.291**	.119	.463	.001
Subjective norm ↔ PBC			.429***	.253	.605	.000

Abbreviations: 95% CI = 95% confidence interval of path coefficient; Aut. mot. (PE) = Autonomous motivation (physical education); Aut. mot. (LT) = Autonomous motivation (leisure-time); PAS = Perceived autonomy support; PBC = Perceived behavioral control; Physical activity = Self-reported participation in leisure-time physical activity; Sub. norm = Subjective norm; β = Standardized parameter estimate.

[a]Mediators for this effect included effects of the predictor on the outcome through multiple mediators.

[b]Mediators for this effect included effects of the predictor on the outcome through multiple mediators along with the direct effect of the predictor variable on the outcome.

*p < .05; **p < .01; ***p < .001.

small-to-medium in size. Attitudes (β = .231, CI_{95} [.080, .383], p = .003) and subjective norms (β = .185, CI_{95} [.014, .355], p = .034) exhibited statistically significant effects on intention with small effect sizes, but there was no effect of PBC on intention and the effect size was small (β = .069, CI_{95} [−.139, .277], p = .514). The hypothesized effect of intention on leisure-time PA was statistically significant with a small effect size (β = .198, CI_{95} [.012, .384], p = .037). The direct effect of perceived autonomy support on intention was not statistically significant and the effect size was small (β = .106, CI_{95} [−.025, .237], p = .111).

Next, we focus on indirect effects in the model. We found a statistically significant indirect effect of perceived autonomy support on autonomous motivation in leisure-time mediated by autonomous motivation in PE (β = .167, CI_{95} [.086, .248], p < .001), with a non-trivial effect size. The indirect effect of autonomous motivation in leisure-time on intention mediated by attitude was statistically significant with a small effect size (β = .098, CI_{95} [.028, .168], p = .006). Indirect effects of autonomous motivation in leisure-time on intention mediated by subjective norm (β = .049, CI_{95} [−.004, .101], p = .069) and PBC (β = .036, CI_{95} [−.072, .143], p = .514) were not statistically significant and the effect sizes were small. The indirect effects of attitudes (β = .046, CI_{95} [−.006, .098], p = .084), subjective norms (β = .037, CI_{95} [−.010, .083], p = .126), and PBC (β = .014, CI_{95} [-.031, .058], p = .546) on PA participation mediated by intention were not statistically significant with small effect sizes. There were statistically significant total effects of perceived autonomy support in PE on intention (β = .207, CI_{95} [.071, .344], p = .003), and PA participation (β = .161, CI_{95} [.023, .299], p = .022), with non-trivial effect sizes.

4 | DISCUSSION

The present study applied the TCM to explain the process by which children's motivation in a school PE context relates to motivation, beliefs, and intentions toward, and actual participation in, leisure-time PA. The model advances previous research applying the model by examining its effectiveness in accounting for change in model constructs over time. The research is expected to provide further formative evidence to inform the development of interventions aimed at promoting leisure-time PA participation delivered in PE context. Current findings provided support for some, but not all, of the key premises of the TCM when accounting for change over time. Specifically, perceived autonomy support predicted autonomous motivation in a PE context directly, and autonomous motivation in a

leisure-time PA context indirectly mediated by autonomous motivation in PE. In addition, we found direct effects of autonomous motivation in leisure-time on attitudes, subjective norms, and PBC. There was also an indirect effect of autonomous motivation in leisure-time on intentions mediated by attitudes, and a direct effect of autonomous motivation in leisure-time on intentions. There were direct effects of intentions and PBC on PA behavior, although the effect of PBC was negative, contrary to predictions. However, we did not find indirect effects of autonomous motivation in leisure-time and the belief-based constructs on PA behavior indirectly mediated by intentions, contrary to predictions. However, we found total effects of perceived autonomy support in leisure-time on PA intentions and behavior through the entire motivational sequence of the TCM.

Current findings support two of the central premises of the TCM: effects of perceived autonomy support on autonomous motivation in PE, and the critical trans-contextual relationship between autonomous motivation in PE and leisure-time PA contexts. Consistent with research testing the model using traditional "static" methods, current findings support these relations when accounting for change over time. Evaluating model effects using the change score model is a more robust test of the TCM and is more faithful to the original proposal of the model as it should be able to account for change in constructs and, in particular, behavior over time. Results provide evidence that students' perceptions that their teachers support their autonomy is related to their autonomous motivation toward the physical activities they do in PE, and also translates to their autonomous motivation toward activities outside of school. These findings have important implications for interventions to promote autonomous motivation among students in both contexts. Research suggests that PE teachers can foster autonomous motivation in PE by displaying key autonomy supportive behaviors (e.g., listening, providing positive feedback, providing choice, providing a clear rationale, assisting setting of autonomous goals), and that such behaviors lead to increased perceptions of autonomy support in students (Cheon, Reeve, & Moon, 2012; Reeve & Cheon, 2020). If such behaviors are effective in changing perceptions of autonomy support, as indicated in the literature, they may lead to changes in school and out-of-school autonomous motivation according to the TCM. While the effects of such interventions need to be empirically verified, these findings may signpost a key strategy that may have utility in promoting positive changes in autonomous motivation and PA across contexts (Ntoumanis et al., 2020).

That changes in autonomous motivation toward PA in leisure-time were also related to the sets of beliefs (attitudes, subjective norms, and PBC) that underpin intentions to participate in PA, also supports a key process in the TCM, as well as previous correlational research demonstrating these relations (Chan et al., 2020). Furthermore, attitudes mediated the effects of autonomous motivation on intentions, as predicted by the model and previous integrative research on the TPB and SDT (Hagger & Chatzisarantis, 2009). Importantly, current findings are consistent with previous research in an adult sample that has also demonstrated that changes in autonomous motivation lead to changes in beliefs and intentions (Jacobs, Hagger, Streukens, De Bourdeaudhuij, & Claes, 2011). What is the value of the inclusion of these beliefs as intermediary constructs between autonomous motivation and intentions? As Deci and Ryan (1985) suggest in their original specification of SDT, individuals holding autonomous motives toward behaviors will likely seek out those behaviors, primarily because they are associated with adaptive, self-referenced outcomes and fulfillment of psychological needs, and, in order to do so, they will strategically align their beliefs and intentions with their motives. The TCM formalizes these proposals and capitalizes on the TPB, a preeminent theory outlining the belief-based determinants of intentions and behavior, as a means to do so. Importantly, current findings provide further evidence to support this process by incorporating change processes. This suggests that these processes hold when accounting for naturally occurring changes in these constructs over time. They also may signpost that changes in autonomous motivation toward PA brought about by contexts that support autonomy may lead to changes in beliefs and intentions. This illustrates one of the additional, often overlooked, advantages of the TCM which is that it provides multiple potential targets for interventions across contexts. For example, significant others like parents and peers may provide support for students' autonomy toward PA in a leisure-time context, and interventions using autonomy support in these groups may be additional means to promote autonomous motivation and intentions toward PA (Teixeira et al., 2020).

However, caution must be exercised when evaluating the effectiveness of the TCM in determining change in PA behavior. Current findings indicate that although intentions toward PA were related to actual participation in PA, the size of the effect was small, much smaller than the effect sizes identified in previous meta-analyses of the TCM (Hagger & Chatzisarantis, 2016) and integrated models of the TPB and SDT (Hagger & Chatzisarantis, 2009). This suggests that intention change may not be very effective in accounting for change in PA participation, and that previous estimates of the size of the intention-behavior relationship based on "static" tests that do not account for change may be inflated, a finding that has been reported elsewhere (Webb & Sheeran, 2006). The small effect size also means that changes in intentions did not transmit effects of changes in beliefs and autonomous motivation to PA behavior. Although the model appears to have efficacy in explaining variance in autonomous motivation and intention change, it seems that it does not account for substantive variance in actual PA change. This raises questions over the effectiveness of the model when it is evaluated taking change into account.

It is important to note that we found a statistically significant small-to-medium sized total effect of perceived autonomy support on PA behavior—this effect comprised the total indirect effect and the direct effect of perceived autonomy support. The direct effect of perceived autonomy support on PA behavior was expected to be zero, and accounted for by the motivational sequence offered by the model. Therefore, although neither the direct nor the indirect effect of perceived autonomy support on behavior was statistically significant, the combined effect was, and was non-trivial in size. There may be a number of reasons for this pattern of effects. One

reason may be limitations in the measures of the TCM constructs. This means that these measures were not sufficient to account for the effect of perceived autonomy support change on PA behavior change. While reliability coefficients of these constructs were reasonable, some researchers have indicated that use of self-report measures reduce the precision of model tests (Fan et al., 2006). Given that all constructs were measured using self-report, such imprecision may have introduced substantive method variance, which may have attenuated relations. Another possibility is that other unmeasured constructs may be responsible for explaining the relationship between perceived autonomy support and PA behavior. For example, the current study did not take into account psychological need satisfaction, another key mediator of perceived autonomy support (Fenner, Straker, Davis, & Hagger, 2013). There is also the possibility that implicit motives that may represent more "automatic" or "non-conscious" effects are important in explaining model relationships (e.g., Hagger, Trost, Keech, Chan, & Hamilton, 2017; Keatley, Clarke, & Hagger, 2012). Nevertheless, the lack of mediation from autonomous motivation raises questions about the proposed process by which perceived autonomy support in PE translates to PA participation in leisure-time.

4.1 | Strengths, limitations, and future directions

Strengths of the current research are the adoption of the TCM, an appropriate integrated model that provides a clear set of predictions on the motivational determinants of PA across contexts, the use of robust, previously validated measures, and the adoption of a three-wave design to account for change in model constructs over time. However, several limitations need to be acknowledged. First, although the TCM includes numerous determinants of PA, the determinants are confined to a relatively narrow set of constructs. For example, the model focused on perceived autonomy support as a determinant of autonomous motivation in PE, and neglected to include student perceptions of other teacher-related behaviors such as controlling behaviors that might have undermined PA participation in school. In addition, the model did not incorporate other environmental factors derived from ecological models of behavior, such as facility availability or neighborhood walkability, which have been shown to be important determinants of PA (e.g., Olson, Ireland, March, Biddle, & Hagger, 2019; Salmon, Hesketh, Arundell, Downing, & Biddle, 2020). Research exploring effects of these additional constructs should be considered in future extensions of the model. Second, while the current data accounted for naturally occurring intra-individual change over time, the data are still correlational. More effective means to explore change would be through manipulation of key model variables experimentally or through interventions, such as an intervention to change autonomy support, and is a key avenue for future research (Chatzisarantis & Hagger, 2009; Hagger, Cameron, et al., 2020). Third, related to the previous point, while the temporal ordering implied directional relations among constructs, causal effects are inferred only by theory and not the data. Again, experimental manipulations are paramount for such inferences. Finally, we also modeled change using two or, in the case of behavior, three time points. Future research should consider adopting multiple measures and assessing change using growth curve models, which has often been cited as the method of choice for effectively modeling change (Rogosa, Brandt, & Zimowski, 1982). However, such analyses involve a large number of parameters, and we had insufficient sample size to estimate such a model. Studies using larger samples and multiple time points are needed for a more fine-grained evaluation of change.

5 | CONCLUSION

The TCM was applied to outline how changes in perceived autonomy support from PE teachers and autonomous motivation in school PE related to changes in autonomous motivation toward PA in a leisure-time context, and changes in beliefs, intentions, and future participation in PA. Although research supported the model in explaining change in autonomous motivation across contexts, including prediction of PA participation and total effects of perceived autonomy support on PA participation, effect sizes were small. Current findings suggest that the TCM does not account for substantial variance in change in PA intentions and behavior. Nevertheless, it should be noted that even small changes in outcomes may translate to substantive changes when translated to the population level.

ACKNOWLEDGMENT

We thank Heidi Pasi-Turpiainen for her assistance in enabling the data collection; Jinyoung Choi, Maiken Hansen, Arto Laukkanen, Stina Seppänen, and Miika Tuominen for their assistance in collecting and processing data. We are also grateful to the the students, teachers, and rectors of the city of Kouvola for supporting the study.

ORCID

Juho Polet https://orcid.org/0000-0002-5305-127X
Taru Lintunen https://orcid.org/0000-0001-5191-2251
Jekaterina Schneider https://orcid.org/0000-0002-6069-4783
Martin S. Hagger https://orcid.org/0000-0002-2685-1546

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2002). *Constructing a TPB questionnaire: Conceptual and methodological considerations*. Retrieved from http://chuang.epage.au.edu.tw/ezfiles/168/1168/attach/20/pta_41176_7688352_57138.pdf

Bollen, K. A. (1989). *Structural equations with latent variables*. New York, NY: Wiley & Sons.

Castro-Schilo, L., & Grimm, K. J. (2018). Using residualized change versus difference scores for longitudinal research. *Journal of Social and Personal Relationships*, *35*, 32–58. https://doi.org/10.1177/0265407517718387

Chan, D. K. C., Hagger, M. S., & Spray, C. (2011). Treatment motivation for rehabilitation after a sport injury: Application of the trans-contextual

model. *Psychology of Sport and Exercise*, *12*, 83–92. https://doi.org/10.1016/j.psychsport.2010.08.005

Chan, D. K. C., Zhang, L., Lee, A. S. Y., & Hagger, M. S. (2020). Reciprocal relations between autonomous motivation from self-determination theory and social cognition constructs from the theory of planned behavior: A cross-lagged panel design in sport injury prevention. *Psychology of Sport and Exercise*, *48*, 101660. https://doi.org/10.1016/j.psychsport.2020.101660

Chatzisarantis, N. L., & Hagger, S. (2009). Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation. *Psychology and Health*, *24*, 29–48. https://doi.org/10.1080/08870440701809533

Cheon, S. H., Reeve, J., & Moon, I. S. (2012). Experimentally based, longitudinally designed, teacher-focused intervention to help physical education teachers be more autonomy supportive toward their students. *Journal of Sport and Exercise Psychology*, *34*, 365–396. https://doi.org/10.1123/jsep.34.3.365

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

Fan, X., Miller, B. C., Park, K., Winward, B. W., Christensen, M., Grotevant, H. D., & Tai, R. H. (2006). An exploratory study about inaccuracy and invalidity in adolescent self-report surveys. *Field Methods*, *18*, 223–244. https://doi.org/10.1177/152822X06289161

Fenner, A. A., Straker, L. M., Davis, M. C., & Hagger, M. S. (2013). Theoretical underpinnings of a need-supportive intervention to address sustained healthy lifestyle changes in overweight and obese adolescents. *Psychology of Sport and Exercise*, *14*, 819–829. https://doi.org/10.1016/j.psychsport.2013.06.005

Finnish National Board of Education. (2014). *National core curriculum for basic education 2014*. Helsinki, Finland: Next Print.

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Sciences*, *10*, 141–146.

González-Cutre, D., Sicilia, A., Beas-Jiménez, M., & Hagger, M. S. (2014). Broadening the trans-contextual model of motivation: A study with Spanish adolescents. *Scandinavian Journal of Medicine & Science in Sports*, *24*, e306–e319. https://doi.org/10.1111/sms.12142

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with 1·6 million participants. *The Lancet Child & Adolescent Health*, *4*, 23–35. https://doi.org/10.1016/S2352-4642(19)30323-2

Hagger, M. S., Cameron, L. D., Hamilton, K., Hankonen, N., & Lintunen, T. (Eds.). (2020). *The handbook of behavior change*. New York, NY: Cambridge University Press. https://doi.org/10.1017/9781108677318

Hagger, M. S., & Chatzisarantis, N. L. (2009). Integrating the theory of planned behaviour and self-determination theory in health behaviour: A meta-analysis. *British Journal of Health Psychology*, *14*, 275–302. https://doi.org/10.1348/135910708X373959

Hagger, M. S., & Chatzisarantis, N. L. (2016). The trans-contextual model of autonomous motivation in education: Conceptual and empirical issues and meta-analysis. *Review of Educational Research*, *86*, 360–407. https://doi.org/10.3102/0034654315585005

Hagger, M. S., Chatzisarantis, N. L., Barkoukis, V., Wang, C., & Baranowski, J. (2005). Perceived autonomy support in physical education and leisure-time physical activity: A cross-cultural evaluation of the trans-contextual model. *Journal of Educational Psychology*, *97*, 376–390. https://doi.org/10.1037/0022-0663.97.3.376

Hagger, M. S., Chatzisarantis, N. L., Culverhouse, T., & Biddle, S. J. (2003). The processes by which perceived autonomy support in physical education promotes leisure-time physical activity intentions and behavior: A trans-contextual model. *Journal of Educational Psychology*, *95*, 784–795. https://doi.org/10.1037/0022-0663.95.4.784

Hagger, M. S., Chatzisarantis, N. L., Hein, V., Pihu, M., Soós, I., & Karsai, I. (2007). The perceived autonomy support scale for exercise settings (PASSES): Development, validity, and cross-cultural invariance in young people. *Psychology of Sport and Exercise*, *8*, 632–653. https://doi.org/10.1016/j.psychsport.2006.09.001

Hagger, M. S., Chatzisarantis, N. L., Hein, V., Soós, I., Karsai, I., Lintunen, T., & Leemans, S. (2009). Teacher, peer and parent autonomy support in physical education and leisure-time physical activity: A trans-contextual model of motivation in four nations. *Psychology and Health*, *24*, 689–711. https://doi.org/10.1080/08870440801956192

Hagger, M. S., Hardcastle, S. J., Chater, A., Mallett, C., Pal, S., & Chatzisarantis, N. (2014). Autonomous and controlled motivational regulations for multiple health-related behaviors: Between-and within-participants analyses. *Health Psychology and Behavioral Medicine: An Open Access Journal*, *2*, 565–601. https://doi.org/10.1080/21642850.2014.912945

Hagger, M. S., Koch, S., Chatzisarantis, N. L., & Orbell, S. (2017). The common sense model of self-regulation: Meta-analysis and test of a process model. *Psychological Bulletin*, *143*, 1117–1154. https://doi.org/10.1037/bul0000118

Hagger, M. S., Moyers, S., McAnally, K., & McKinley, L. E. (2020). Known knowns and known unknowns on behavior change interventions and mechanisms of action. *Health Psychology Review*, *14*, 199–212. https://doi.org/10.1080/17437199.2020.1719184

Hagger, M. S., Sultan, S., Hardcastle, S. J., & Chatzisarantis, N. L. (2015). Perceived autonomy support and autonomous motivation toward mathematics activities in educational and out-of-school contexts is related to mathematics homework behavior and attainment. *Contemporary Educational Psychology*, *41*, 111–123. https://doi.org/10.1016/j.cedpsych.2014.12.002

Hagger, M. S., Trost, N., Keech, J., Chan, D. K. C., & Hamilton, K. (2017). Predicting sugar consumption: Application of an integrated dual-process, dual-phase model. *Appetite*, *116*, 147–156. https://doi.org/10.1016/j.appet.2017.04.032

Haskell, W. L., Blair, S. N., & Hill, J. O. (2009). Physical activity: Health outcomes and importance for public health policy. *Preventive Medicine*, *49*, 280–282. https://doi.org/10.1016/j.ypmed.2009.05.002

Hsiao, Y., Kwok, O., & Lai, M. H. (2018). Evaluation of two methods for modeling measurement errors when testing interaction effects with observed composite scores. *Educational and Psychological Measurement*, *78*, 181–202. https://doi.org/10.1177/0013164416679877

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*, 1–55. https://doi.org/10.1080/10705519909540118

Jacobs, N., Hagger, S., Streukens, S., De Bourdeaudhuij, I., & Claes, N. (2011). Testing an integrated model of the theory of planned behaviour and self-determination theory for different energy balance-related behaviours and intervention intensities. *British Journal of Health Psychology*, *16*, 113–134. https://doi.org/10.1348/135910710X519305

Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, *7*, 40. https://doi.org/10.1186/1479-5868-7-40

Keatley, D. A., Clarke, D. D., & Hagger, M. S. (2012). Investigating the predictive validity of implicit and explicit measures of motivation on condom use, physical activity, and healthy eating. *Psychology and Health*, *27*, 550–569. https://doi.org/10.1080/08870446.2011.605451

Kokko, S., Hämylä, R., Husu, P., Villberg, J., Jussila, A. M., Mehtälä, A., Vasankari, T. (2016). Lasten ja nuorten liikuntakäyttäytyminen Suomessa–LIITU-tutkimuksen tuloksia 2016 [The Physical Activity Behaviours of Children and Adolescents in Finland Results of the LIITU study, 2016]. *Valtion Liikuntaneuvoston Julkaisuja*, *4*. Retrieved from http://www.liikuntaneuvosto.fi/files/438/LIITU_2016.pdf

Mavropoulou, A., Barkoukis, V., Douka, S., Alexandris, K., & Hatzimanouil, D. (2019). The role of autonomy supportive activities on students' motivation and beliefs toward out-of-school activities. *The Journal of Educational Research*, *112*, 223–233. https://doi.org/10.1080/00220671.2018.1503580

Messing, S., Rütten, A., Abu-Omar, K., Ungerer-Röhrich, U., Goodwin, L., Burlacu, I., & Gediga, G. (2019). How can physical activity be promoted among children and adolescents? A systematic review of reviews across settings. *Frontiers in Public Health*, *7*, 55. https://doi.org/10.3389/fpubh.2019.00055

Muthén, L. K. & Muthén, B. O. (2002). *MPLUS (version 8). [computer software]*. Los Angeles, CA: Muthén & Muthén.

Ntoumanis, N., Ng, J. Y. Y., Prestwich, A., Quested, E., Hancox, J. E., Thøgersen-Ntoumani, C., … Williams, G. C. (2020). A meta-analysis of self-determination theory-informed intervention studies in the health domain: Effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review*, 1–31. https://doi.org/10.1080/17437199.2020.1718529

Olson, J. L., Ireland, M. J., March, S., Biddle, S. J. H., & Hagger, M. S. (2019). Physical activity in peri-urban communities: Testing intentional and implicit processes within an ecological framework. *Applied Psychology: Health and Well-Being*., https://doi.org/10.1111/aphw.12182

Orbell, S. (2004). Intention-behaviour relations: A self-regulation perspective. In G. Haddock, & G. R. O. Maio (Eds.), *Contemporary perspectives on the psychology of attitudes* (pp. 145–168). London: Psychology Press.

Plotnikoff, R. C., Costigan, S. A., Karunamuni, N., & Lubans, D. R. (2013). Social cognitive theories used to explain physical activity behavior in adolescents: A systematic review and meta-analysis. *Preventive Medicine*, *56*, 245–253. https://doi.org/10.1016/j.ypmed.2013.01.013

Reeve, J., & Cheon, S. H. (2020). Autonomy supportive interventions. In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen, & T. Lintunen (Eds.), *The handbook of behavior change* (pp. 510–522). Cambridge: Cambridge University Press.

Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion*, *28*, 147–169. https://doi.org/10.1023/B:MOEM.0000032312.95499.6f

Rogosa, D., Brandt, D., & Zimowski, M. (1982). A growth curve approach to the measurement of change. *Psychological Bulletin*, *92*, 726–748. https://doi.org/10.1037/0033-2909.92.3.726

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, *57*, 749–761. https://doi.org/10.1037/0022-3514.57.5.749

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. New York, NY: Guilford Publications.

Salmon, J., Hesketh, K. D., Arundell, L., Downing, K. L., & Biddle, S. J. H. (2020). Changing behavior using ecological models. In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen, & T. Lintunen (Eds.), *The handbook of behavior change* (pp. 237–250). New York, NY: Cambridge University Press. https://doi.org/10.1017/9781086773180.017

Satorra, A., & Saris, W. E. (1985). Power of the likelihood ratio test in covariance structure analysis. *Psychometrika*, *50*, 83–90. https://doi.org/10.1007/bf02294150

Savalei, V. (2019). A comparison of several approaches for controlling measurement error in small samples. *Psychological Methods*, https://doi.org/10.1037/met0000181

Seaton, M., Marsh, H. W., & Craven, R. G. (2010). Big-fish-little-pond effect: Generalizability and moderation—Two sides of the same coin. *American Educational Research Journal*, *47*, 390–433. https://doi.org/10.3102/0002831209350493

Sheeran, P., Klein, W. M., & Rothman, A. J. (2017). Health behavior change: Moving from observation to intervention. *Annual Review of Psychology*, *68*, 573–600. https://doi.org/10.1146/annurev-psych-010416-044007

Sheeran, P., & Webb, T. L. (2016). The intention–behavior gap. *Social and Personality Psychology Compass*, *10*, 503–518. https://doi.org/10.1111/spc3.12265

Standage, M., Duda, J. L., & Ntoumanis, N. (2003). A model of contextual motivation in physical education: Using constructs from self-determination and achievement goal theories to predict physical activity intentions. *Journal of Educational Psychology*, *95*, 97–110. https://doi.org/10.1037/0022-0663.95.1.97

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *9*, 78. https://doi.org/10.1186/1479-5868-9-78

Teixeira, P. J., Marques, M. M., Silva, M. N., Brunet, J., Duda, J., Haerens, L., … Hagger, M. S. (2020). A classification of motivation and behavior change techniques used in self-determination theory-based interventions in health contexts. *Motivation Science*. Advance online publication. https://doi.org/10.1037/mot0000172

Telama, R., Yang, X., Leskinen, E., Kankaanpää, A., Hirvensalo, M., Tammelin, T., … Raitakari, O. T. (2014). Tracking of physical activity from early childhood through youth into adulthood. *Medicine and Science in Sports and Exercise*, *46*, 955–962. https://doi.org/10.1249/MSS.0000000000000181

Vallerand, R. J., & Ratelle, C. (2002). Intrinsic and extrinsic motivation: A hierarchical model. In E. Deci, & R. Ryan (Eds.), *Handbook of self-determination research* (pp. 37–63). Rochester, NY: University of Rochester Press.

Wallhead, T. L., Hagger, S., & Smith, D. T. (2010). Sport education and extracurricular sport participation: An examination using the trans-contextual model of motivation. *Research Quarterly for Exercise and Sport*, *81*, 442–455. https://doi.org/10.1080/02701367.2010.10599705

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal*, *174*, 801–809. https://doi.org/10.1503/cmaj.051351

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, *132*(2), 249–268. https://doi.org/10.1037/0033-2909.132.2.249

Zhang, Z. & Yuan, K.-H. (Eds.) (2018). *Practical statistical power analysis using Webpower and R*. Granger, IN: ISDSA Press.

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the Supporting Information section.

How to cite this article: Polet J, Lintunen T, Schneider J, Hagger MS. Predicting change in middle school students' leisure-time physical activity participation: A prospective test of the trans-contextual model. *J Appl Soc Psychol*. 2020;00:1–12. https://doi.org/10.1111/jasp.12691