



Extending the trans-contextual model in physical education and leisure-time contexts: Examining the role of basic psychological need satisfaction

Vassilis Barkoukis^{1*}, Martin S. Hagger², George Lambropoulos¹
 and Haralambos Tsorbatzoudis¹

¹Aristotle University of Thessaloniki, Greece

²Risk Analysis, Social Processes, and Health Group, School of Psychology,
 University of Nottingham, UK

Background. The trans-contextual model (TCM) is an integrated model of motivation that aims to explain the processes by which agentic support for autonomous motivation in physical education promotes autonomous motivation and physical activity in a leisure-time context. It is proposed that perceived support for autonomous motivation in physical education is related to autonomous motivation in physical education and leisure-time contexts. Furthermore, relations between autonomous motivation and the immediate antecedents of intentions to engage in physical activity behaviour and actual behaviour are hypothesized.

Aims. The purpose of the present study was to incorporate the constructs of basic psychological need satisfaction in the TCM to provide a more comprehensive explanation of motivation and demonstrate the robustness of the findings of previous tests of the model that have not incorporated these constructs.

Sample. Students ($N = 274$) from Greek secondary schools.

Method. Participants completed self-report measures of perceived autonomy support, autonomous motivation, and basic psychological need satisfaction in physical education. Follow-up measures of these variables were taken in a leisure-time context along with measures of attitudes, subjective norms, perceived behavioural control (PBC), and intentions from the theory of planned behaviour 1 week later. Self-reported physical activity behaviour was measured 4 weeks later.

Results. Results supported TCM hypotheses. Basic psychological need satisfaction variables uniquely predicted autonomous motivation in physical education and leisure time as well as the antecedents of intention, namely, attitudes, and PBC. The basic psychological need satisfaction variables also mediated the effects of perceived autonomy support on autonomous motivation in physical education.

*Correspondence should be addressed to Dr Vassilis Barkoukis, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece (e-mail: bark@phed.auth.gr).

Conclusions. Findings support the TCM and provide further information of the mechanisms in the model and integrated theories of motivation in physical education and leisure time.

There is substantial research evidence indicating the importance of physical activity for physical and psychological health and well-being across the life-span (e.g., Biddle & Mutrie, 2007). However, research in Western societies indicates that many children adopt sedentary life-styles. For example, only a very small proportion of boys and girls in Greece participate in moderate or vigorous physical activity in their leisure time (e.g., Manios, Kafatos, & Codrington, 1999). The largest decreases in participation in physical activity occur in the transition from childhood to adolescence (Nelson, Neumark-Stzainer, Hannan, Sirard, & Story, 2006). Interestingly, such decreases often coincide with reductions in adaptive forms of student motivation to participate in school physical education classes (Digelidis & Papaioannou, 1999; Sallis, 2000). Taking into consideration that motivation in school physical education can affect intentions for and actual leisure-time physical activity (Corbin, 2002; Ferrer-Caja & Weiss, 2002; Standage, Duda, & Ntoumanis, 2003), it is important to examine the possible mechanisms through which this is achieved.

The trans-contextual model

The trans-contextual model (TCM) is an integrated theoretical model of motivation incorporating specific aspects of self-determination theory (Deci & Ryan, 1985, 2002), a hierarchical model of intrinsic motivation (Vallerand, 1997, 2007; Vallerand & Ratelle, 2002), and a theory of planned behaviour (TPB; Ajzen, 1985, 1991, 2002) in an attempt to explain the processes by which support for motivation in school physical education lessons affects students' participation in out-of-school leisure physical activity (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Each of the component theories of the model contributes to the understanding of motivation in different contexts, such as physical education and leisure time, in accordance with principles of theoretical integration outlined by Hagger (2009). Self-determination theory (Deci & Ryan, 1985) provides explanations of the environmental and interpersonal states that give rise to behavioural tendencies in given contexts (e.g., autonomy support and motivational regulations), Vallerand and Ratelle's (2002) hierarchical model suggests that there are top-down effects between different levels of generality (e.g., contextual motivation influences intentions at the situational level), and the TPB (Ajzen, 1985) represents the decision-making process towards behavioural engagement at the situational level (i.e., the belief-based components that lead to intentions to engage in future behaviour).

Recent evidence has supported the interplay among these three perspectives. First, Vallerand and Ratelle (2002) argued that (a) social agents can affect the formation of motives in the same context and (b) motivation in one context can influence motives in another similar context, as individuals use information from a context as a source of information when forming motivational orientations in subsequent contexts. Research evidence indicated that an autonomy-supportive environment in physical education lessons would result in the formation of autonomous motives in the same context (Ntoumanis, 2005; Standage *et al.*, 2003; Wilson & Rodgers, 2004). Second, the formation of autonomous motives in physical education lessons could affect autonomous motives in an out-of-school leisure-time physical activity (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger *et al.*, 2003, 2007).

That is, intrinsic motives in physical education could be transferred as intrinsic motives in a social or sport context (i.e., leisure motivation). Third, autonomous motives in a context are assumed to affect motivation to act in specific situations. As a result, they are likely to influence the situation-specific beliefs and judgments that affect future behavioural engagement. These situation-specific judgments are specified explicitly in the TPB. For example, Hagger and Armitage (2004) and Hagger, Chatzisarantis, and Biddle (2002) found that attitudes and perceived behavioural control (PBC) mediated the effect of autonomous motives on behavioural intention and physical activity behaviour.

Based on this research, the premise of the TCM is that autonomy support in an educational context is related to autonomous motivation in this context, which, in turn, is translated into autonomous motivation in a non-educational context. Autonomous motivation in this context is hypothesized to predict behaviour through the influence of the constructs from the TPB. Several studies provided empirical evidence in favour of the TCM and a recent meta-analysis by Hagger and Chatzisarantis (2007) supported the proposed sequence (for a more detailed review on the theoretical underpinnings of TCM, see also Barkoukis & Hagger, 2009; Hagger & Chatzisarantis, 2007; Hagger *et al.*, 2003, 2005).

Basic psychological need satisfaction

Self-determination is a macro-theory of motivation that seeks to explain the 'why questions' of human behaviour. The theory incorporates several subtheories that deal with the role that environments and contexts, interpersonal processes and individual differences, and basic psychological needs play in determining behaviour. The theory postulates that behaviour is a result of the interaction among the individual's environment, the satisfaction of his/her needs, and the formation of motivational regulations. A fundamental element of self-determination theory (Deci & Ryan, 1985, 2002) is that human behaviour is guided by innate psychological needs. In self-determination theory, psychological needs correspond to 'innate psychological nutrients that are essential for ongoing psychological growth, integrity, and well-being' (Deci & Ryan, 2000, p. 229). These needs contribute to human strivings as they provide a substantive basis for the energization (i.e., process) and direction (i.e., content) of human behaviour. That is, the degree to which these psychological needs are satisfied determines the individual's goal pursuits and attainment as well as the regulatory processes adopted (Deci & Ryan, 2000).

In self-determination theory, three innate psychological needs have been identified: needs for autonomy, competence, and relatedness. The need for autonomy corresponds to the desire of individuals to choose their actions and feel that their behaviour is self-endorsed. The need for competence reflects individuals' propensity to feel efficient and effective, and to experience opportunities to experience mastery of their environment. The need for relatedness refers to the desire to feel connected with others, treated with sensitivity, cared for, and supported by significant others (Ryan & La Guardia, 2000; for extensive reviews on psychological needs, see also Deci & Ryan, 2000; Ryan & Deci, 2000). Sheldon, Elliot, Kim, and Kasser (2001) provided evidence that these three needs are fundamental and salient in cross-cultural research examining numerous candidate psychological needs.

According to Vallerand (1997, 2001, 2007), the environment will influence autonomous motivation through the satisfaction of psychological needs.

The satisfaction of psychological needs will result in the formation of autonomous motivation, whereas the neglect or thwarting of them will have an adverse effect on autonomous motivation. Research evidence has consistently supported the mediating role of need satisfaction in the environment–motivation relationship. More specifically, an autonomy-supportive environment is assumed to satisfy needs for autonomy, competence, and relatedness, which in turn fosters autonomous motivation that is associated with positive cognitive, affective, and behavioural consequences from involvement (Vallerand, 1997, 2007; Vallerand & Ratelle, 2002). In the sphere of education, Ntoumanis (2005) and Standage, Duda, and Ntoumanis (2003, 2005) provided evidence that need satisfaction in physical education lessons enhance autonomous motivation that, in turn, was associated with adaptive physical education – related outcomes, such as actual participation, positive affect, task challenge, concentration, and leisure-time physical activity intentions. Furthermore, need satisfaction in an exercise context has been shown to be associated with positive affect and psychological well-being (Wilson, Longley, Muon, Rodgers, & Murray, 2006). On the other hand, a controlling environment that undermines need satisfaction is thought to decrease need satisfaction resulting in decrements of autonomous motivation and, subsequently, in maladaptive outcomes. For example, Sarrazin, Vallerand, Guillet, Pelletier, and Cury (2002) indicated that a controlling coach-initiated environment thwarted the three psychological needs and this, in turn, undermined autonomous motivation and led female handball players to drop out from their sport. In the educational domain, Ntoumanis, Pensgaard, Martin, and Pipe (2004) reached similar conclusions concerning high school students' drop-out from physical education classes.

TCM of motivation and basic psychological need satisfaction

Research evidence has so far indicated that need satisfaction influences motivational regulations and their consequences with respect to activity involvement. The aim of the TCM is to explain the processes that lead to the transfer of autonomous motivation across contexts. Its hypotheses are therefore focused on contextual-level motivational regulations and agentic support for autonomous regulation. The role of psychological needs as formative in the development of autonomous motivational regulations was implied but not formally stated or tested empirically in the original formulation of the TCM (Hagger, Chatzisarantis, & Harris, 2006; Hagger *et al.*, 2003). However, we contend that the satisfaction of basic psychological needs is an important step in developing the TCM and confirming the role that basic needs play in determining autonomous motivational engagement and subsequent behaviour in the model. It can be hypothesized that need satisfaction might mediate the effect of agentic support for autonomy on motivational regulations. An autonomy-supportive environment is likely to satisfy basic psychological needs which, in turn, are likely to foster the development of autonomous motivation. There is limited research examining the effect of need satisfaction on motivation in leisure activities. According to the TCM, adolescents' autonomous motivation in leisure time can be determined by autonomous motivation in physical education. Yet, there is no evidence as to whether need satisfaction has direct effects on the formation of autonomous motivation in leisure time and, subsequently, on the proximal influences on behaviour. Taken together, this evidence suggests that the inclusion of need satisfaction in the TCM might assist in a more comprehensive understanding of the mechanisms behind the effects of perceived autonomy support in an educational context on leisure-time physical activity.

The present study

The TCM examines the effect of perceived autonomy support on autonomous motivation in physical education and leisure time and the latter's influence on the decision-making processes to engage in a behaviour and, subsequently, the actual behaviour itself. However, need satisfaction constitutes an important construct that affects the formation of autonomous motivation, both in physical education and in leisure. In fact, need satisfaction in physical education and out-of-school activities has been shown to use a unique and significant effect on autonomous motivation (Ntoumanis, 2005; Sarrazin *et al.*, 2002). Although the TCM has examined the process by which agentic support for autonomous motivation influences out-of-school physical activity, the role of need satisfaction in this process has not been examined. The aim of the present study was to extend the TCM by examining the direct and mediating role of need satisfaction on autonomous motivational regulations within the TCM. More specifically, the present study investigated the direct and mediating role of need satisfaction in PE on the formation of autonomous motivation in both PE and leisure time, and the effect of leisure-time need satisfaction on autonomous motivation in leisure time and on the decision-making process leading to engagement in leisure-time physical activity.

We formulated 10 hypotheses in the present study based on hypotheses from the TCM and the previous research on the role of that need satisfaction as a precursor to autonomous motivation. Hypotheses 1–3 relate to the proposed mediating role that need satisfaction plays in mediating the effect of perceived autonomy support on autonomous motivation in PE. Autonomy support in PE will have significant direct effects on the need satisfaction variables (Hypothesis 1). The need satisfaction variables will have significant direct effects on autonomous motivation in physical education (Hypothesis 2). We expect a significant correlation between perceived autonomy support and autonomous motivation in physical education as specified in the original TCM and that this relationship will be mediated by the need satisfaction variables (Hypothesis 3). These three hypotheses will extend the model by demonstrating that students who perceive that their PE teacher provides an autonomy-supportive environment will be autonomously motivated in PE. This represents a fundamental process in self-determination theory – that an agentic environment that is perceived as providing practices and opportunities for people to satisfy their psychological needs will lead to autonomous motivation. These hypotheses are depicted in the left-hand side of Figure 1 in the Time 1, physical education context.

Hypotheses 4 and 5 relate to one of the core processes outlined in the TCM, namely, the trans-contextual transfer of motivation from physical education to leisure-time physical activity. An important addition in the present study is the role of autonomous motivation in physical education in mediating any direct effects that need satisfaction have on autonomous motivation in leisure time. This demonstrates that need satisfaction is specific to a particular context. It was hypothesized that autonomous motivation in physical education would have a significant direct effect on autonomous motivation in a leisure-time context (Hypothesis 4). Additionally, it was hypothesized that autonomous motivation in physical education would mediate the effects of need satisfaction in physical education on autonomous motivation in leisure time (Hypothesis 5). This is shown in Figure 1 by the arrows from autonomous motivation and the three needs at Time 1 and autonomous motivation at Time 2.

Hypotheses 6 and 7 represent the effects that autonomous motivation have on the proximal determinants of intention and behaviour from the TPB as hypothesized in the TCM. In the present study, we also specify that the effects of need satisfaction on these constructs will be directed through autonomous motivation. Self-determination theory

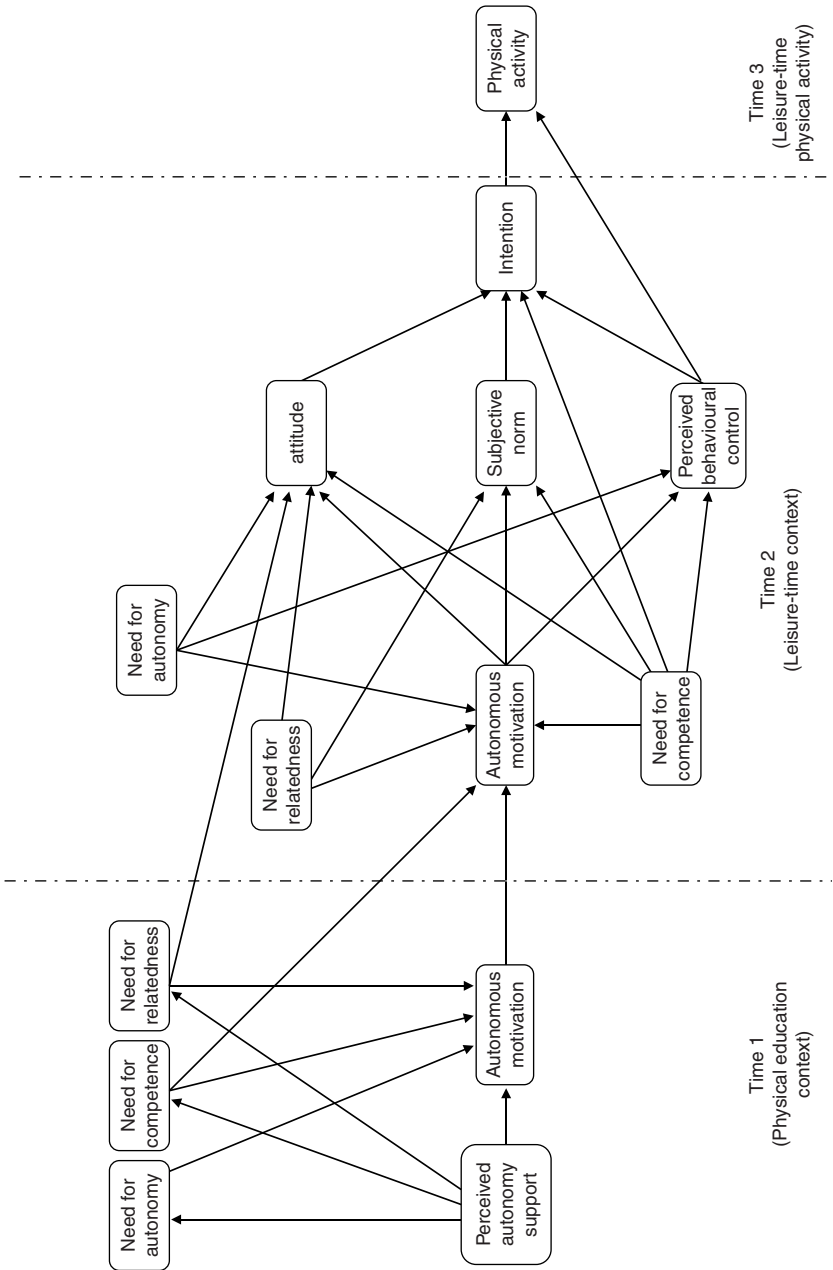


Figure 1. The extended TCM. Note. For clarity, the following parameters have been omitted from the diagram: (1) direct paths from past behaviour on all study variables, (2) error covariances among the attitude, subjective norm, and PBC variables, and (3) covariances among the psychological need construct within and between time points 1 and 2; bold lines illustrate the effects from the proposed motivational sequence that were tested in the model; plain lines indicate theoretically plausible paths set to be free as recommended by LM tests.

and the hierarchical model suggest that global satisfaction of psychological needs will give rise to autonomous motivation at a contextual level which will, in turn, affect cognitive, affective, and behavioural responses at a situational level. In the present study, the situational-level constructs take the form of the variables that give rise to intentional behaviour from the TPB. This mediation effect has been corroborated empirically in a previous study in which need satisfaction affected the TPB variables through the mediation of contextual-level motivation (Hagger *et al.*, 2006). It was expected that need satisfaction in leisure time will have a significant direct effect on autonomous motives in leisure time (Hypothesis 6). It was also hypothesized that autonomous motivation in leisure time would mediate the effects of need satisfaction in leisure time on the situational determinants of behaviour; that is the TPB variables of attitudes, subjective norm, and PBC (Hypothesis 7). The hypotheses are shown in Figure 1 in the central segment (Time 2) as arrows from autonomous motivation and the three psychological need constructs to the attitude, subjective norm, and PBC constructs.

The final set of hypotheses relate to the proximal influences on leisure-time physical activity behaviour. The previous process model (Hypotheses 1-7) indicates that support for autonomous motivation influences autonomous motivation in physical education and leisure-time contexts and form the basis for beliefs and expectations regarding future engagement in leisure-time physical activity. These hypotheses chart the final stages in the process towards actual behaviour. With respect to the prediction of intention, it was assumed that only the TPB variables would have a significant direct effect on intention (Hypothesis 8). With respect to the prediction of behaviour, it was hypothesized that intention and PBC would have a significant effect on participation in leisure-time physical activity and that intention would mediate the effect of the other TPB variables on behaviour (Hypothesis 9). Finally, prior research on TPB has indicated that past behaviour is a significant predictor of current behaviour (Hagger *et al.*, 2002). Yet, the effects of the proposed model were assumed to hold regardless of the effect of past behaviour (Hypothesis 10). These hypotheses are shown in Figure 1 in the segment to the far right as arrows from the attitudes, subjective norm, and PBC constructs at Time 2 to physical activity behaviour at Time 3. The effects of past behaviour are not depicted for clarity.

Method

Participants

Participants ($N = 274$; males = 132, females = 137, unreported = 5; mean age 16.89, $SD = 0.65$) were recruited from three co-educational high schools in Greece. Attrition across the three waves of data collection resulted in a final sample of 170 (males = 84, females = 86; mean age 16.91, $SD = 0.63$). The chi-square analysis revealed no variation in the proportion of males and females among those who dropped out of the study relative to those who remained in the study. An independent samples *t* test revealed no significant difference in age among those who dropped out of the study and participants remaining in the study. These findings suggest that there was no response bias in terms of demographics between recruited participants who dropped out of the study and those that were included in the final analysis.

Research design

The study adopted a three-wave prospective design. In the first wave (Time 1), participants completed self-report measures of perceived autonomy support from

physical education teachers (Hagger *et al.*, 2007), autonomous motivation in a physical education context (Hagger *et al.*, 2003), and need satisfaction (Ntoumanis, 2005). Students were instructed, both in writing and orally, to respond on the basis of their experiences in physical education classes. A second questionnaire containing measures of the components of the TPB (Ajzen, 1985), autonomous motivation in a leisure-time physical activity context (Mullen, Markland, & Ingledew, 1997), need satisfaction (Sheldon *et al.*, 2001), and past behaviour (Hagger *et al.*, 2002) was administered in the second wave, 1 week later (Time 2). At Time 2, students were instructed to report their perceptions regarding their out-of-school physical activity participation. The 1-week interval between Times 1 and 2 was used to minimize the amount of error variance introduced into the data that could be attributed to the use of similar measures, as in previous research (Hagger & Chatzisarantis, 2007). Five weeks later, self-reported physical activity behaviour was measured in the third wave (Time 3) using a self-report measure of physical activity based on the Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985).

Permission from school principals and parental consent was obtained prior to data collection. Students were told that they were participating in a survey on young people and would be asked to complete a battery of questionnaires over a series of weeks. Data were collected in quiet classroom conditions and students were isolated so that they could not discuss responses. Questionnaires were completed anonymously to preserve confidentiality and were matched using a unique code number based on participants' birth date and gender.

Measures¹

Perceived autonomy support

The 12-item perceived autonomy support scale for exercise settings (PASSES) was administered to measure participants' perceived autonomy support from their physical education teachers. This measure has shown construct, discriminant, predictive, and nomological validity with conceptually related constructs (Hagger *et al.*, 2007). An example item from the scale is: 'I feel that my physical education teacher provides me with choices, options, and opportunities to do active sports and/or vigorous exercise'. Responses were recorded on a seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The internal reliability (Cronbach alpha) for the perceived autonomy support scales from physical education teacher was satisfactory ($\alpha = .90$).

Autonomous motivation in physical education²

A modified version of Ryan and Connell's (1989) Perceived Locus of Causality (PLOC) Scale was used to measure autonomous motivation in physical education. The scale measures four types of motivation, each varying in the degree of autonomy. These types of motivation are represented on a continuum ranging from high to low autonomy,

¹ All questionnaire items are available from the first author on request.

² We produced a single measure of autonomous motivation in PE, a relative autonomy index (RAI) in order to reduce the number of constructs in subsequent analyses testing study hypotheses. The RAI was calculated from the PLOC constructs using the procedures outlined by Vallerand (2007). Weights were assigned to each intrinsic motivation (+2), identified regulation (+1), introjected regulation (-1), and extrinsic regulation (-2) items from the PLOC measures for PE and leisure time. Each weighted item was then aggregated to form four indicators of two latent RAI constructs, one in each context. The RAI was used in all subsequent analyses.

known as the PLOC. The types of motivation are: *intrinsic motivation* (e.g., 'I participate in physical education because it is fun'), the prototypical form of autonomous motivation representing behavioural engagement for no external contingency or reinforcement; *identified regulation* (e.g., 'I participate in physical education because I value physical education'), a highly autonomous form of motivation representing motivation to engage in a behaviour because it services goals that are intrinsic and salient to the self; *introjected regulation* (e.g., 'because I will feel ashamed if I do not do physical education'), a less autonomous form of motivation reflecting behavioural engagement due to perceived internal pressures like avoiding shame or guilt or gaining contingent self-worth or pride; and *external regulation* (e.g., 'I participate in physical education because important others want me to do physical education'), the prototypical form of extrinsic motivation, and therefore the least autonomous, reflecting engaging in behaviours due to external reinforcement such as obtaining a reward or avoiding punishment. Two items tapped each motivation type and responses were made on four-point scales ranging from 1 (not true at all) to 4 (very true).

Psychological need satisfaction in physical education

A shortened version of Ntoumanis' (2005) measure of the three need satisfaction constructs from self-determination theory adapted for a physical education context was administered at the first wave of data collection. Items measuring the satisfaction of the needs for self-determination or autonomy (e.g., 'I feel that my choices are based on my true interests and values'), for competence (e.g., 'I feel that I can successfully complete difficult tasks and projects'), and for relatedness (e.g., 'I feel a sense of contact with people who care for me, and whom I care for') were measured by three items each on seven-point Likert-type scales with end-points of *not true at all* (1) and *very true* (7). The internal consistency coefficients for these need satisfaction scales were, $\alpha = .73$, for autonomy, $\alpha = .50$ for competence, and $\alpha = .62$ for relatedness.

Autonomous motivation in leisure time³

Mullen and Markland's (1997) Behavioural Regulations in Exercise Questionnaire was used to measure autonomous motivation in a leisure-time context. Participants were asked 'Why do you participate in active sports and/or vigorous physical activities in your spare time?' followed by four reasons from each motivation style from the PLOC. Items measuring intrinsic motivation (e.g., 'I exercise because it is fun'), identified regulation (e.g., 'I exercise because it is important to make the effort'), introjected regulation (e.g., 'I exercise because I will feel guilty if I do not'), and external regulation (e.g., 'I exercise because others say I should') were assessed on seven-point scales ranging from 1 (not true at all) and 7 (very true). Reliabilities were satisfactory for intrinsic motivation ($\alpha = .75$), identified regulation ($\alpha = .71$), introjected regulation ($\alpha = .71$), and external regulation ($\alpha = .70$).

Psychological need satisfaction in leisure time

A modified version of Sheldon *et al.*'s (2001) measure of need satisfaction from self-determination theory adapted for a leisure-time physical activity context was

³ We also produced a RAI for autonomous motivation in leisure time using the same formula as previously cited.

administered at the second wave of data collection. Items measuring the satisfaction of the needs for autonomy (e.g., 'I feel that my choices are based on my true interests and values'), for competence (e.g., 'I feel that I can successfully complete difficult tasks and projects'), and for relatedness (e.g., 'I feel a sense of contact with people who care for me, and whom I care for') were measured by four items each on seven-point Likert-type scales with end-points of *not true at all* (1) and *very true* (7). Internal consistency coefficients for the autonomy ($\alpha = .80$), competence ($\alpha = .70$), and relatedness ($\alpha = .79$) need satisfaction scales were satisfactory.

Intentions

The measure of intentions comprised three items (e.g., 'I intend to do active sports and/or vigorous physical activities during my leisure-time in the next 5 weeks ...') rated on seven-point scales anchored by 1 (strongly agree) to 7 (strongly disagree). The internal consistency of this scale was satisfactory ($\alpha = .75$).

Attitudes

Attitudes were measured using five seven-point semantic differential scales with the bipolar adjectives: *bad-good*, *harmful-beneficial*, *not enjoyable-enjoyable*, *useful-useless*, and *boring-interesting* in response to the common stem: 'Participating in active sports and/or vigorous physical activities during my leisure-time in the next five weeks is ...' These items achieved satisfactory internal consistency ($\alpha = .89$).

Subjective norms

Subjective norms were measured by four items (e.g., 'People important to me think that I should do active sports and/or vigorous physical activities during my leisure-time in the next 5 weeks') on seven-point scales ranging from 1 (strongly disagree) to 7 (strongly agree). The inter-item correlation for this scale was .25.

Perceived behavioural control

Three items comprised the measure of PBC (e.g., 'I feel in complete control over whether I do active sports and/or vigorous physical activities in my leisure-time in the next 5 weeks') measured on seven-point scales ranging from 1 (no control) to 7 (complete control). The internal consistency of this scale was adequate ($\alpha = .78$).

Physical activity behaviour

Self-reported leisure-time physical activity behaviour was measured at Time 3 using an adapted version of Godin and Shephard's (1985) Leisure-Time Exercise Questionnaire. Participants rated their 5-week behavioural frequency on two items (e.g., 'In the course of the past two weeks, how often have you participated in vigorous physical activities for 20 minutes at a time?') using six-point Likert scales with scale end-points *never* (1) and *every day* (6). A definition of vigorous physical activity was given: 'Vigorous physical activities are activities which make you breathe faster, make your heart beat faster, and make you hot and sweaty'. The inter-item correlation for this measure was .60.

Past behaviour

Past physical activity behaviour was assessed at Time 1 using a single-item: 'In the course of the past six months, how often, on average, have you participated in vigorous physical activities for 20 minutes at a time?' Responses were made on six-point Likert scales with scale end-points *not at all* (1) and *most days per week* (6). This measure has been used in many previous studies to estimate past behavioural frequency (Hagger *et al.*, 2003, 2005).

Translation procedures

Standardized back-translation procedures were used to develop a Greek version of the study measures using three independent bilingual translators (Brislin, 1986). The back-translation procedure was repeated iteratively until the original and back-translated English versions of the questionnaires were virtually identical.

Results

Data analysis

Data were analysed by path analysis using a simultaneous process with the EQS program (Bentler, 2004) and a robust maximum-likelihood estimation method. Averaged composites of the study variables were computed prior to analyses. Goodness of fit of the proposed model with the data was evaluated using multiple recommended indices of good fit: the Sattora–Bentler scales goodness-of-fit chi-square ($S-B\chi^2$), the comparative fit index (CFI), the non-normed fit index (NNFI), and the root mean squared error of approximation (RMSEA). Values approaching .95 for the CFI and NNFI were indicative of an acceptable model. Values of .05 or less for the RMSEA were deemed satisfactory for well-fitting models (Hu & Bentler, 1999). The Lagrange multiplier (LM) test was used to identify paths in the model that would make a significant change in the goodness-of-fit chi-square value if freed.

Path analyses

Descriptive statistics and zero-order correlations among the composite variables used in the analysis are given in Table 1. The hypothesized relationships among the TCM constructs are depicted in Figure 1. In addition to estimating the hypothesized relationships, we controlled for the effect of previous involvement and decision making by including past behaviour as an independent predictor of all model variables as in previous tests of the model (Hagger *et al.*, 2003). The hypothesized model exhibited unacceptable fit with the data ($S-B\chi^2 = 125.63$, $df = 55$, $p < .01$; CFI = .92; NNFI = .85; RMSEA = .09). According to the LM tests freeing direct paths from the need satisfaction constructs in leisure time with the TPB constructs as well as paths from the need for relatedness in physical education to attitudes and from the need for competence to autonomous motivation in leisure time were included in the model as free parameters. These paths were deemed theoretically plausible as they reflect direct effects of these need constructs on the decision-making variables from the TPB and indicate that contextual autonomous motivation does not completely mediate the effect of these distal need constructs on the TPB variables. Including these paths in the analysis produced a model with acceptable fit ($S-B\chi^2 = 49.17$, $df = 45$, $p = .31$; CFI = 1.00; NNFI = .99; RMSEA = .02).

Table 1. Descriptive statistics and intercorrelations among the extended TCM components

Factor	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Past PA	3.51	1.63	–														
2. PA	4.49	1.32	.30	–													
3. Intention	4.32	1.42	.33	.28	–												
4. Attitude	5.64	1.49	.31	.16	.64	–											
5. Subjective norm	4.21	1.56	.08	.07	.34	.24	–										
6. PBC	4.88	1.49	.31	.20	.70	.64	.30	–									
7. Need for autonomy (LT)	3.32	1.09	.15	.17	.18	.17	.02	.30	–								
8. Need for competence (LT)	3.53	0.89	.22	.18	.33	.35	.01	.37	.47	–							
9. Need for relatedness (LT)	3.36	1.11	.20	.21	.11	.09	–.04	.25	.82	.40	–						
10. Autonomous motivation (LT)	5.11	5.23	.08	.02	.26	.40	–.14	.44	.24	.47	.21	–					
11. Need for autonomy (PE)	3.47	0.95	.14	.21	.36	.39	.10	.43	.44	.33	.35	.21	–				
12. Need for competence (PE)	3.52	0.77	.14	.22	.53	.52	.23	.50	.41	.50	.30	.40	.55	–			
13. Need for relatedness (PE)	3.82	0.86	.22	.09	.46	.47	.24	.42	.25	.42	.21	.38	.31	.50	–		
14. Autonomous motivation (PE)	1.54	3.35	.08	.20	.16	.21	–.02	.20	.47	.54	.41	.36	.29	.33	.22	–	
15. PAS (PE)	4.34	1.27	.14	.09	.16	.11	.02	.28	.78	.44	.82	.20	.38	.30	.29	.39	–

Note. PA, physical activity behaviour; Past PA, past physical activity behaviour; PBC, perceived behavioural control; LT, leisure-time context; PE, physical education context; PAS, perceived autonomy support. Correlations > .15 significant at $p < .05$ and correlations > .20 significant at $p < .01$.

Relationships in the model

Standardized path coefficients (beta) for the free parameters in the path analysis are given in Table 2. Overall, the model accounted for 57.9% of the variance in leisure-time physical activity intentions and 12.9% of the variance in physical activity behaviour.

Hypothesis 1: As expected, perceived autonomy support from physical education teachers had significant and direct effects on the need satisfaction variables of autonomy ($\beta = 0.78, p < .01$), competence ($\beta = 0.37, p < .01$), and relatedness ($\beta = 0.82, p < .01$).

Hypothesis 2: In accordance with hypotheses, need satisfaction for autonomy ($\beta = 0.25, p < .01$) and competence ($\beta = 0.41, p < .01$) in physical education had significant direct effects on autonomous motivation in physical education. However, need satisfaction for relatedness did not predict autonomous motivation in physical education.

Hypothesis 3: There was a significant zero-order correlation between perceived autonomy support and autonomous motivation in physical education ($r = .39, p < .01$; see Table 1) as expected. We investigated the hypothesis that the need satisfaction for autonomy and competence mediated the relationship between perceived autonomy support and autonomous motivation in physical education.⁴ Significant intercorrelations among the need satisfaction variables and perceived autonomy support and between the needs satisfaction variables and autonomous motivation in physical education satisfied the primary criteria set out by Baron and Kenny (1986).⁵ To satisfy the final criterion, we re-estimated the model fixing the paths from need satisfaction for autonomy and competence to autonomous motivation in physical education. The path from need satisfaction for relatedness to autonomous motivation in physical education was not freed because it was not significant in the final model. The model indicated that the effect of perceived autonomy support on autonomous motivation in physical education was restored ($\beta = 0.39, p < .01$) which mirrored the correlation between these variables and the value for this path in the Sobel (1982) test for the indirect effect. The separate indirect effects for each of the mediation variables revealed that the indirect effect of perceived autonomy support on autonomous motivation in physical education was mediated by the autonomy need satisfaction (mediated path $\beta = 0.19, p < .01$) and competence need satisfaction (mediated path $\beta = 0.15, p < .01$) variables. This provided confirmation that psychological needs satisfaction for autonomy and competence mediated the effect of perceived autonomy support on autonomous motivation in physical education.

Hypothesis 4: In accordance with the hypothesis, there was a significant direct effect of autonomous motivation in physical education on autonomous motivation in a leisure-time context ($\beta = 0.15, p < .05$).

⁴ We did not investigate the possibility that the psychological need satisfaction for relatedness variable mediated the effect of perceived autonomy support in PE on autonomous motivation in PE because there was no significant effect of relatedness need satisfaction on autonomous motivation.

⁵ In all analyses, testing for significant indirect effects the following criteria proposed by Baron and Kenny (1986) were met: (1) significant correlations between the dependent variable and the independent (predictor) variable(s); (2) significant correlations between the mediator and the independent variable(s); (3) a significant unique effect of the mediator on the dependent variable when it is included alongside the independent variable(s) in a multivariate test of these relationships; and (4) the significant effect of independent variable on the dependent is attenuated or extinguished when the mediator is included as an independent predictor of the dependent variable.

Table 2. Standardized parameter estimates (β) for the path analysis of the extended TCM

Path (hypothesized) ^a	β	Path (hypothesized) ^a	β	Path (modified) ^b	β
Intention → PA	0.22*	AM (LT) → Attitude	0.22**	Competence (LT) → Intention	0.15*
PBC → PA	-0.03	AM (LT) → SN	-0.31**	Competence (LT) → Attitude	0.27**
Past PA → PA	0.22**	AM (LT) → PBC	0.29**	Competence (LT) → SN	0.25**
Attitude → Intention	0.25**	Past PA → Autonomy (LT)	0.13	Competence (LT) → PBC	0.23**
SN → Intention	0.12*	Past PA → Competence (LT)	0.12	Autonomy (LT) → Attitude	0.18**
PBC → Intention	0.40**	Past PA → Relatedness (LT)	0.22**	Autonomy (LT) → PBC	0.22**
Past PA → Intention	0.10	AM (PE) → AM (LT)	0.15*	Relatedness (LT) → Attitude	0.15*
Past PA → Attitude	0.23**	Autonomy (PE) → AM (PE)	0.25**	Relatedness (LT) → SN	0.20**
Past PA → SN	0.02	Competence (PE) → AM (PE)	0.41**	Relatedness (PE) → Attitude	-0.17**
Past PA → PBC	0.22**	Relatedness (PE) → AM (PE)	0.10	Competence (PE) → AM (LT)	0.26**
Autonomy (LT) → AM (LT)	-0.06	PAS (PE) → AM (PE)	-0.07		
Competence (LT) → AM (LT)	0.17*	PAS (PE) → Autonomy (PE)	0.78		
Relatedness (LT) → AM (LT)	0.19*	PAS (PE) → Competence (PE)	0.37		
Past PA → AM (LT)	-0.04	PAS (PE) → Relatedness (PE)	0.82		

Note. PA, physical activity behaviour; Past PA, past physical activity behaviour; PBC, perceived behavioural control; SN, subjective norms; Autonomy, need for autonomy; Competence, need for competence; Relatedness, need for relatedness; LT, leisure-time context; PE, physical education context; AM, autonomous motivation; PAS, perceived autonomy support; * $p < .05$; ** $p < .01$.

^a Paths estimated in the original hypothesized model.

^b Theoretically plausible paths included in the model as a result of the LM test.

Hypothesis 5: It was expected that autonomous motivation in physical education would mediate the effects of need satisfaction in physical education on autonomous motivation in leisure time. There was a significant indirect effect of need satisfaction for competence ($\beta = 0.06, p < .05$) in physical education on autonomous motivation in leisure time mediated by autonomous motivation in physical education. The indirect effect for the autonomy need satisfaction in physical education did not reach significance. Relatedness need satisfaction did not have a significant indirect effect on autonomous motivation in leisure time because there was no significant effect for this variable on autonomous motivation in physical education. However, the LM test from the original model suggested that there was also a significant trans-contextual direct effect of need satisfaction for competence in physical education on autonomous motivation in leisure time ($\beta = 0.26, p < .01$). Therefore, there were both direct and indirect effects of the competence need satisfaction in physical education on autonomous motivation in leisure time (total effect, $\beta = 0.32, p < .01$). Interestingly, and contrary to our hypotheses, the LM test suggested that there was also a significant and negative trans-contextual direct effect of need satisfaction for relatedness in physical education on attitude ($r = -.17, p < .01$). However, this was likely to be a suppressor effect and innocuous given the significant and positive zero-order correlation between these variables ($r = .47, p < .01$), see Table 1.

Hypothesis 6: As hypothesized, need satisfaction for competence ($\beta = 0.17, p < .05$) and relatedness ($\beta = 0.19, p < .05$) in leisure time had significant direct effects on autonomous motivation in leisure time. However, contrary to our expectations, need satisfaction for autonomy in leisure time did not predict autonomous motivation in leisure time.

Hypothesis 7: We also hypothesized that the effect of need satisfaction in leisure time on the TPB variables of attitudes, subjective norm, and PBC would be mediated by autonomous motivation in leisure time. There were significant indirect effects of need satisfaction for relatedness in leisure time on attitude ($\beta = 0.04, p < .05$), subjective norm ($\beta = -0.06, p < .05$), and PBC ($\beta = 0.05, p < .05$). There were no indirect effects for need satisfaction for autonomy and competence. However, there were also significant direct effects as recommended by the LM tests. Specifically, need satisfaction for competence in leisure time had significant direct effects on attitude ($\beta = 0.27, p < .01$), subjective norm ($\beta = 0.25, p < .05$), PBC ($\beta = 0.23, p < .01$), and intention ($\beta = 0.15, p < .05$). Need satisfaction for autonomy in leisure time had significant direct effects on attitude ($\beta = 0.18, p < .01$) and PBC ($\beta = 0.22, p < .01$). Need satisfaction for relatedness in leisure time had significant direct effects on attitude ($\beta = 0.15, p < .05$) and subjective norm ($\beta = 0.20, p < .01$). Therefore, there were both direct and indirect effects of the need satisfaction for relatedness on attitude and subjective norms. This resulted in total effects of need satisfaction for relatedness on attitude (total effect, $\beta = 0.19, p < .01$) and subjective norms (total effect, $\beta = 0.14, p < .05$).

Hypothesis 8: In accordance with hypotheses from the TPB, attitudes ($\beta = 0.25, p < .01$), subjective norms ($\beta = 0.12, p < .05$), and PBC ($\beta = 0.40, p < .01$) were significant predictors of intention. Contrary to hypotheses, there was also a significant direct effect of need satisfaction for competence in leisure time on intention ($\beta = 0.15, p < .05$). There were therefore significant direct and indirect ($\beta = 0.21, p < .01$) effects of this need variable on intentions resulting in a significant total effect (total effect, $\beta = 0.37, p < .01$). There were no other direct psychological predictors on intention.

Hypothesis 9: Behavioural intentions were the sole predictor of leisure-time physical activity as hypothesized ($\beta = 0.22, p < .05$). PBC did not predict behaviour directly. There were no other direct psychological predictors of physical activity behaviour. Intentions completely mediated the effects of attitudes (indirect effect, $\beta = 0.05, p < .05$) and PBC (indirect effect, $\beta = 0.09, p < .01$) on behaviour, but there was no significant indirect effect for subjective norms.

Hypothesis 10: It was expected that the effects of the proposed model would be independent of the effect of past behaviour. We therefore included past behaviour as a significant predictor of all of the leisure-time variables. While past behaviour was a significant predictor of many of the constructs (see Table 2), the majority of the hypothesized relations among the psychological variables and Time 3 physical activity behaviour were significant.

Discussion

Substantial research has indicated that adaptive motivation in physical education can lead to increased leisure-time physical activity participation (Corbin, 2002; Ferrer-Caja & Weiss, 2002). Findings of the path analysis provided support for the extended TCM and suggested that the addition of need satisfaction, as predictor and mediator in the model was a meaningful one. Specifically, need satisfaction predicted autonomous motivation in physical education and leisure time and also served to mediate relations between perceived autonomy support in PE and autonomous motivation in PE and between perceived autonomy support in PE and autonomous motivation in leisure time. Furthermore, the model significantly predicted both intentions to participate in out-of-school physical activity and actual participation in physical activity congruent with previous research using the TCM. Finally, although the relations between the constructs were lower because of controlling for past behaviour, they still remain significant, highlighting that it is the psychological variables rather previous experience that is responsible for explaining variance in the dependent variables in this model, an essential consideration in any motivational model (Ajzen, 2002; Ouellette & Wood, 1998; Sutton, 1994). These findings support the usefulness of TCM, as an integrated theoretical approach, to describe the processes by which physical education environment can affect leisure-time behaviour.

The results of the path analysis of the extended TCM indicated that the effect of perceived autonomy support on autonomous motivation in physical education would be mediated by need satisfaction in that context as hypothesized (Hypothesis 2). Specifically, satisfaction of needs for autonomy and competence mediated the perceived autonomy support–autonomous motivation relationship. This indicates an important mechanism in the model as it explains that the reason why perceived autonomy support is related to autonomous motivation is due to on the satisfaction of these psychological needs. This is corroborated by previous research that has shown that providing autonomy support increases need satisfaction (Deci & Ryan, 2000; Edmunds, Ntoumanis, & Duda, 2007; Ryan & Deci, 2000; Sarrazin *et al.*, 2002; Standage *et al.*, 2003). As a consequence, informants are likely to report elevated levels of autonomous motivation towards physical activity in a physical education context. Future research should seek to confirm this pattern of causation by examining whether autonomy support leads to changes in need satisfaction and results in elevated levels of autonomous motivation using experimental and intervention methods.

Consistent with the TCM (Hagger & Chatzisarantis, 2007; Hagger *et al.*, 2003), autonomous motivation in physical education had a significant effect on autonomous motivation in a leisure-time context. More importantly, autonomous motivation in physical education was found to mediate the effect of need satisfaction on autonomous motivation in a leisure-time context. Specifically, competence need satisfaction had both direct and indirect effects on autonomous motivation in leisure time through autonomous motivation in physical education. These findings support the vital role need satisfaction plays in determining motivation in a leisure-time context. In particular, perceptions of competence seem to be the most important need in this regard. Students who perform well in physical education lessons, and have their needs for competence satisfied, are more likely to form autonomous motives for out-of-school physical activity participation. Hence, providing opportunities to satisfy the need for competence could result in autonomous motives for both participation in physical education and leisure-time physical activity.

With respect to the effect of need satisfaction in leisure time, the results of the path analysis indicated that only satisfaction of needs for competence and relatedness were significant predictors of autonomous motives in leisure time. Contrary to our expectations, satisfaction of need for autonomy was not a significant predictor. These findings are somewhat different from those reported by Grouzet, Vallerand, Thill, and Provencher (2004) who found that needs for autonomy and competence significantly predicted leisure-time activity. Competence was a significant predictor in both studies suggesting the important role perceptions of competence can play in the formation of autonomous motivation. The lack of predictive ability of the satisfaction of need for autonomy might be because the effects of this need are subsumed by the effects of other psychological predictors of autonomous motivation. This is because there was a significant zero-order correlation between autonomy need satisfaction and autonomous motivation in leisure time ($r = .24, p < .01$; Table 1), which suggests that these variables do share variance as expected. However, correlations between autonomy need satisfaction and other predictors of autonomous motivation were also significant and comparatively high, such as the correlation between autonomy need satisfaction and competence need satisfaction ($r = .47, p < .01$; Table 1) and between autonomy need satisfaction and autonomous motivation in physical education ($r = .47, p < .01$; Table 1). We therefore tested alternative models fixing the effects of competence need satisfaction and autonomous motivation on autonomous motivation in leisure time to be zero iteratively. Sure enough, when the effects of these variables were fixed, the effect of autonomy need satisfaction was restored ($\beta = 0.20, p < .01$). Therefore, it seems that the variance shared by autonomous motivation in leisure time and autonomy need satisfaction in leisure time is also shared by competence need satisfaction and autonomous motivation in physical education. This suggests that satisfaction of this need is not independent of other needs, nor is it independent of motivation in other contexts. These are not likely to be methodological artifacts because these variables have previously displayed satisfactory discriminant validity in confirmatory factor analyses (see Hagger *et al.*, 2006; Ntoumanis, 2005). More likely, it is situational motivation in another relevant context and competence need satisfaction that contributes to motivation in leisure time rather than autonomy need satisfaction.

Additionally, we assumed that need satisfaction will also affect the TPB variables through their effect on autonomous motivation in leisure time. The results of the study indicated that there were both direct and indirect effects of the need satisfaction of relatedness on attitude, PBC, and subjective norms. These findings

supported the mediation of the effect of the satisfaction for the need of relatedness on these TPB variables by autonomous motivation in leisure time. These findings resemble those reported by Hagger *et al.* (2006) who suggested that students with high levels of need satisfaction are more likely to report higher levels of autonomous motivation to engage in leisure-time physical activity. As this behaviour is not a spontaneous one, it is assumed that students should form intentions to engage in such an activity. Hence, need satisfaction and the corresponding autonomous motives lead students to form intentions for participating in out-of-school physical activity. That is, when a student satisfies his/her needs for autonomy, relatedness, and competence, he/she is more likely to form autonomous motives for the corresponding behaviour and more likely to have positive attitudes towards the behaviour, and higher levels of PBC and subjective norms.

Importantly, the results of the present study regarding the TPB variables and their effect on leisure-time physical activity were consistent with both theoretical assumptions (Ajzen, 1985, 1991, 2002) and research evidence (Armitage & Conner, 2001; Hagger *et al.*, 2002) suggesting that intention is the most important predictor of actual leisure-time physical activity behaviour. Furthermore, intention mediates the effect of attitudes, PBC, and subjective norms on behaviour. This is important also for the TCM as it confirms of the hypotheses of the component models and supports the integration of the theories. Failure to confirm these hypotheses is grounds for rejection of the integrated model (Hagger & Chatzisarantis, 2007).

Overall, the findings of the present study provided support to the TCM of motivation in educational and extracurricular contexts. Furthermore, the addition of need satisfaction to the model is a meaningful one as need satisfaction in physical education was a significant predictor of autonomous motivation in leisure time and need satisfaction in leisure was significant predictor of situational variables (i.e., the TPB variables) affecting participation in leisure-time physical activity. These findings extend the TCM of motivation by providing alternative channels to explain how autonomy-supportive environments in physical education lessons can affect leisure-time behaviour.

In terms of practical recommendations, the present study indicates that autonomy-supportive behaviours in a physical education may be influential in motivating children's autonomous motivation to engage in physical activity in physical education as well as in a leisure-time context out of school. There is good evidence that adopting autonomy-supportive behaviours in a physical education context increases perceived autonomy support and autonomous motivation in physical education (Chatzisarantis & Hagger, 2009; Chatzisarantis, Hagger, & Smith, 2007; Taylor & Ntoumanis, 2007). The present research demonstrates that such practices administered in an educational setting may also have an effect on motivation in a context outside of physical education, such as leisure time. Therefore, practices such as providing children with choice within physical education with respect to the activities they perform, acknowledgement of conflicts regarding doing physical tasks, providing a rationale, encouraging the setting of personal goals, adopting a questioning and skill-based approach to learning new tasks, encouraging exploratory behaviour, and providing positive, informational feedback are all behaviours that physical education teachers can adopt in order to promote autonomous motivation in children. Reeve and Jang (2006) have devised a system of classifying autonomy-supportive behaviours and their adoption may be an important step in making changes to children's autonomous motivation towards physical education but also their autonomous motivation towards physical activity outside of school and their intentions to perform physical activities in the future.

Conclusions, limitations, and future directions

The present study provided further support for the unique integrated approach adopted in the TCM and extended it further by including need satisfaction constructs. The inclusion of these constructs provided new information in terms of the unique variance accounted for by these need satisfaction constructs in the core components of the TCM, namely, autonomous motivation in physical education and leisure time and the proximal antecedents of intentions, namely, attitudes, subjective norms, and PBC. In addition, the inclusion of these constructs also demonstrated some unique mechanisms in the model, especially the mediation of the effect of perceived autonomy support on autonomous motivation in physical education. This highlights a key process in the model hitherto uncharted by previous research. Finally, these results were found to hold even after controlling for past behavioural engagement, a finding that is important theoretically as well as practically because it means that an intervention to change a psychological variable in the model (e.g., perceived autonomy support) may lead to a change in the variable associated with it (e.g., autonomous motivation, need satisfaction).

There are, of course, limitations of these data and the findings that can be inferred from the reported effects. Principally, these data, like many of the studies in exercise psychology are correlational in nature. While the prospective nature of the study design is advantageous as it is suggestive of a temporal ordering of the purported relationships, the study cannot be used to infer causality insofar as one variable causes a change in another. Recent researchers have criticized the adoption of causal language when making inferences in causal data and the problems associated with skating around the issue by avoiding such causal language at all. In the present study, we adhere to the recommendations of Hagger and Chatzisarantis (2009) by overtly stating that any inferences of causality are made on the basis of theoretical speculation rather than directly based on the data. Furthermore, wherever possible, we have supported any speculative causal links made in the present model by referring to other research adopting the component theories that have provided support for the findings using experimental or intervention methods that are more effective in delineating causal effects. Of course, future research needs to demonstrate that interventions to change the core antecedents variables in the model result in concomitant changes in the consequent variables. While research has demonstrated such effects in the component theories of the model such as self-determination theory (Chatzisarantis & Hagger, 2009) and the TPB (Chatzisarantis & Hagger, 2005), no research, to date, has demonstrated the trans-contextual effects in the model experimentally, i.e., whether changing autonomous motivation in a physical education context (using autonomy-supportive techniques) leads to increased autonomous motivation in leisure time. This would be an important addition to the literature and integrated theoretical approaches to physical activity behaviour.

Other limitations stem from the adoption of a self-report measure of physical activity. We ensured that our measure of physical activity was one that has been adopted previously and shown validity and reliability against methods considered more comprehensive and 'objective' such as accelerometers and heart rate monitors (Godin & Shephard, 1985; Sallis, 1991; Sallis, Buono, Roby, Micale, & Nelson, 1993). However, it may be an important endeavour in future to examine the findings of the present study using more objective measures of behaviour. Such research is already being conducted and recent results have found an identical pattern of effects in the model when physical activity was measured using accelerometers (Wallhead, Hagger, & Smith, in press).

An alternative approach may be to use analogues of physical activity such as changes in levels of fitness or attendance to sports clubs or after-school activities.

A further limitation of the present study was the comparatively low levels of internal consistency exhibited by some of the scales used in the present study. The competence and relatedness need satisfaction in physical education variables from self-determination theory and subjective norm variable from the TPB exhibited alpha values below the .70 cut-off criterion. There is precedence for the low reliabilities of these constructs in previous self-determination theory (Harris & Hagger, 2007) and TPB (Hagger, Chatzisarantis, & Biddle, 2001), therefore these scales may not transfer well across contexts. This lack of reliability must be acknowledged as a limitation and results pertaining to these constructs should be interpreted with caution.

A final limitation is the omission of perceived autonomy support from other sources such as peers and parents. This has been an important recent modification of the TCM demonstrating that autonomous motivation for physical activity in leisure time is also generated from sources other than the physical education teacher (Hagger *et al.*, 2009; Wallhead *et al.*, in press). However, it is important to note that the effects of these additional variables were independent of the effects of perceived autonomy support from physical education teachers. Therefore, the effects of the additional forms of perceived autonomy support are unlikely to interfere with the effects of need satisfaction on autonomous motivation and perceived autonomy support in a physical education context. However, an important future avenue for research may be to include the additional forms of perceived autonomy support. This will be important because it will provide a more holistic view of the processes by which autonomy support and need satisfaction influence autonomous motivation in a leisure-time context. For example, a logical hypothesis that could be tested on the basis of the present research might be whether the effects of perceived autonomy support on autonomous motivation from these other sources are mediated by need satisfaction.

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