Effects of a School-based Intervention on Motivation for Out-of-school Physical Activity Participation

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Abstract

Purpose: We tested effects of an autonomy-supportive intervention in physical education (PE) on high-school students' autonomous motivation in PE, and their autonomous motivation, intentions, and physical activity (PA) behavior in a leisure-time guided by the trans-contextual model.

Method: PE classes in two schools were assigned to receive either an autonomy-supportive intervention and or a control intervention via random allocation by school. The PE teacher of the school assigned to the autonomy-supportive intervention was trained to provide autonomy support while the PE teacher of the school assigned to the control intervention received no training. Students (*N*=256) in all classes completed measures of perceived teacher autonomy support, autonomous motivation in PE and leisure-time, and beliefs, intentions, and PA in leisure-time before and immediately after the intervention.

Results: Results revealed direct effects of the autonomy-supportive intervention on changes in perceived autonomy support. However, there were no direct intervention effects on change in intentions and PA behavior. The intervention also had indirect effects on changes in autonomous motivation in PE and leisure time. Additionally, change in perceived autonomy support had direct effects on change in autonomous motivation in PE, and indirect effects on change in leisure-time autonomous motivation. Changes in autonomous motivation in leisure-time had direct effects on changes in beliefs and indirect effects on changes in intentions and PA behavior through changes in beliefs.

Conclusion: The study provides valuable information on the effect of autonomous supportive climate on students' beliefs toward PA in PE lessons and in their leisure time outside of school.

Keywords: trans-contextual model, self-determination theory, theory of planned behavior, self-regulation.

Evidence suggests that physical inactivity has deleterious effects on the physical and mental health in young people and contributes to increased risk of chronic disease. For example, low levels of physical activity has been associated with overweight and obesity and higher risk for cardiovascular disease in school-aged children (Carson et al., 2016; Kurdaningsih, Sudargo, & Lusmilasari, 2017). Furthermore, low levels of physical activity has been shown to be related to depressive symptoms, psychological distress, low self-esteem, hyperactivity and attention problems, anti-social behavior, and impaired psychological well-being and perceived quality of life (Carson et al., 2016; Hoare, Milton, Foster, & Allender, 2016; Suchert, Hanewinkel, & Isensee, 2015). In contrast, regular participation in physical activity in young people is associated with reduced risk of illness, and positive mental health outcomes (Biddle, Ciaccioni, Thomas, & Vergeer, 2019; Ekelund et al., 2009). These benefits notwithstanding, there is consistent evidence that children and adolescents in many nations do not participate in sufficient physical activity confer these health benefits and reduce disease risk. Governments and health departments have therefore produced guidelines and recommendations on the appropriate levels of physical activity for good health in young people, and developed strategy documents and interventions to promote physical activity (Breda et al., 2018).

Physical education (PE) stands as a useful existing network that can be utilized to deliver interventions aimed at fostering regular participation in physical activity in children and adolescents (Cooper et al., 2016). This has led researchers to explore potential strategies on how to promote increased physical activity in PE students, an endeavor that necessitates an understanding of how contextual factors in PE can foster students motivation toward physical activty. One perspective has been to study how the behaviors displayed by social agents (e.g., teachers, parents, peers) in social contexts can promote motivation and behavior toward activities in class. With respect to PE lessons, an autonomy-supportive environment has been shown to result in adaptive responses in students related to the lesson itself such as vitality, enjoyment, effort, and reduced anxiety (Liukkonen, Barkoukis, Watt, & Jaakkola, 2010; Mouratidis, Vansteenkiste, Sideridis, & Lens, 2011). However, less attention has been focused on the role of school PE in promoting students' out-of-school participation in physical activity, an important priority for PE teachers, health educators, and curriculum developers (Klein & Hardmann, 2007).

There is, however, growing evidence that an autonomy-supportive environment in PE may promote out-of-school physical activity (Hagger & Chatzisarantis, 2016; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Specifically, research has focused on identifying how promoting students' motivation toward activities in PE may also affect their motivation toward, and actual participation in, physical activity outside of school. The trans-contextual model (TCM; Hagger et al., 2003) was developed for this purpose, and aims to describe the process by which support for autonomous motivation in school influences students' participation in related activities outside school. The model integrates core constructs and processes from self-determination theory (Deci & Ryan, 1985, 2002), the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997, 2007; Vallerand & Ratelle, 2002), and theory of planned behavior (Ajzen, 1985, 1991, 2002). Self-determination theory (Deci & Ryan, 1985) specifies how the social environment (i.e., motivational climate) in educational settings relates to motivation and, importantly persistence on tasks (see Hagger, Hardcastle, Chater, Mallett, Pal, & Chatzisarantis, 2014). Vallerand's (1997, 2007) hierarchical model describes the process by which motivation is transferred between different contexts. The theory of planned behavior (Ajzen, 1985) outlines the decision making process by which individuals' beliefs and intentions with respect to particular behaviors lead to future behavioral participation. According to the model, an autonomy-supportive environment in school PE will foster students' autonomous motivation in PE which, in turn, will be transferred into autonomous motivation for out-of-school physical activity participation. Autonomous motivation for physical activity participation will influence actual behavior, through the belief-based constructs from the theory of planned behavior (i.e., attitudes, perceived behavioral control, subjective norms and intentions; Chan, Zhang, Lee, & Hagger, 2020; Hagger et al., 2003).

The key premises of the model have received substantial empirical support in school PE and leisure-time physical activity (Barkoukis & Hagger, 2009, 2013; Hagger et al., 2003; González-Cutre et al., 2014a; González-Cutre, Sicilia, Beas-Jimenez, & Hagger, 2014b; Moreno-Murcia, Hernandez, Pedreno, & Neipp, 2017; Ntovolis, Barkoukis, Michelinakis, & Tsorbatzoudis, 2015; Shen, McCaughtry, & Martin, 2007, 2008). In addition, the cross-cultural invariance and replicability of the TCM in countries with notable cultural differences has been supported (Hagger et al., 2005; Hagger et al., 2009). Furthermore, evidence confirmed the utility of the model beyond PE; in science (Hagger & Hamilton, 2018), mathematics (Hagger, Sultan, Hardcastle, & Chatzisarantis, 2015; Hagger et al., 2016), and for after school learning (Chan, et al., 2015). Research has also supported the predictions of the model beyond school PE, supporting the generalizability of its predictions (e.g., Chan et al., 2011, 2015; Hagger et al., 2016). A recent meta-analysis of studies applying the model in PE contexts also provides converging evidence supporting model predictions (Hagger & Chatzisarantis, 2016).

One of the key propositions of the TCM is that students' autonomous motivation will transfer across contexts and affect physical activity participation outside of school. It stands to reason, that fostering autonomous motivation in PE may be effective in promoting autonomous motivation toward, and actual participation in, physical activities in leisure time. PE may therefore serve as an opportune environment to administer interventions that target change in autonomous motivation that may have ramification beyond school. Research has demonstrated that social agents such as teachers can be effective in promoting greater autonomous motivation through the display of autonomy-supportive behaviors and autonomy-supportive interpersonal communications with students in lessons.

Prior research has consistently supported the positive effect of autonomy supportive environments on students' adaptive responses with respect to in- and out-of school cognition, affect, and behavior (Chatzisarantis, Hagger, & Brickell, 2008; Hagger & Chatzisarantis, 2016; Hastie, Rudisill and Wadsworth, 2013; Su & Reeve, 2011). Hence, in order to achieve positive outcomes from participation in PE lessons emphasis should be placed in the adoption of an autonomy supportive motivational climate. Such a climate adopts the students' perspective, allows students to express their thoughts and feelings, and promotes students' self-regulation (Reeve, 2009). In an autonomy-supportive motivational climate, teachers nurture students' inner motivational resources (e.g., interests, preferences, psychological needs), provide explanatory rationales (e.g., articulate the sometimes hidden usefulness underlying a teacher's request), rely on noncontrolling language (e.g., informational communications that help students diagnose and solve their motivational problems), display patience to allow students the time they need for self-paced learning to occur (e.g., allow time for students to work in their own way), acknowledge and accept students' expressions of negative affect (e.g., treat students' complaints as valid reactions to imposed demands and structures), and engender students' sense of choice over their behavior (Reeve, 2009, 2016; Reeve & Jang, 2006; Teixeira et al., 2020). Experimental studies in educational contexts have confirmed the positive effect of an autonomy supportive climate on students' responses (Su & Reeve, 2011). Furthermore, several intervention studies have demonstrated that programs that train teachers to be more autonomy supportive lead to greater use of autonomy-supportive strategies in the classroom (Cheon, Reeve, & Moon, 2012; McLachlan & Hagger, 2010), and adaptive educational outcomes in students including higher levels of autonomous motivation, need satisfaction, future intentions classroom engagement, and skill development (Cheon et al., 2012; Mandigo, Holt, Anderson, & Shepard, 2008; Murcia, Lacarcel, & Alvarez, 2010; Perlman, 2010; Tessier, Sarrazin, & Ntoumanis, 2010).

These studies provide initial evidence for the benefits of autonomy-supportive teaching environments in PE. Consistent with this research, the TCM has been suggested as a basis for PE-based interventions (Hagger & Chatzisarantis, 2016). However, to date, structured interventions using autonomy-supportive teaching strategies in high school PE to promote physical activity outside of school are scarce. Furthermore, with some notable exceptions (e.g., Cheon et al., 2012) all the above mentioned interventions measured outcomes solely in the school context, whereas there is a lack of evidence on the effects of a school-based interventions on motivation and behavior changes outside school. Furthermore, drawing from the TCM, there is relatively little evidence examining the processes by which school-based autonomy supportive interventions based on self-determination theory relate to physical activity participation outside of school. In particular, there is a dearth of studies examining theory-based motivational and social cognition mediators of the effects of such interventions on leisure-time physical activity in young people. The present study applied the TCM to addess this evidence gap by investigating the effect of an autonomy-supportive school-based intervention on high school students' motivation and beliefs toward, and actual participation in, leisure-time physical activity. Specifically, the study aims to advance knowledge by demonstrating the processes by which an intervention promoting use of autonomy-supportive behaviors in PE teachers relates to out-of-school physical activity behavior in high school students. To date, research on the TCM has been largely confined to correlational, longitudinal and prospective studies, with virtually no data on whether model effects are supported when key constructs, namely perceived autonomy support, and autonomous motivation in PE, are changed through intervention. The current research will, therefore, provide evidence that the key constructs of the model can be changed through intervention, and mediate effects of the intervention on students' out-of-school physical activity participation. In doing so, it may signpost a potentially effective strategy by which PE teachers can support autonomous motivation toward in-school and out-of-school physical activity, which may be useful to promote ongoing physical activity particiption in high school students.

The Present Study

The purpose of the present study was to test the efficacy of a school-based intervention to promote autonomous motivation towards in-class and out-of-school physical activity on key motivational and behavioral variables for physical activity in a leisure-time context based on the motivational sequence specified in the trans-contextual model. We expected the autonomy-supportive intervention to account for changes in psychological variables across baseline prior to the intervention and at follow-up post intervention. We also expected the intervention to account for changes in leisure-time physical activity behavior at follow-up while controlling for baseline leisure-time physical activity behavior. Overall, we therefore expected changes in the psychological variables specified in the trans-contextual model to mediate the effects of the autonomy-supportive intervention in PE on changes in physical activity intentions and behavior in a leisure-time context. As a consequence, we propose that the intervention effects are modelled as predictors of change in key constructs of the trans-contextual model. Model constructs should, therefore, serve to mediate effects of an autonomy-supportive intervention on participation in leisure-time physical activity.

In terms of specific hypotheses, we expected the intervention to affect students' leisure-time physical activity behavior mediated by changes in the variables specified in motivational sequence of the trans-contextual model. Specifically, we expected the intervention to have effects on changes in perceived autonomy support in PE, and, through this variable, affect changes in autonomous motivation in PE. In addition, we expected trans-contextual effects of changes in autonomous motivation in PE to changes in autonomous motivation in leisure time, consistent with the core hypothesis of the model. We also expected changes in autonomous motivation to impact changes in leisure-time physical activity intentions and actual leisure-time physical activity behavior through the belief-based social cognitive constructs from the theory of planned behavior. Specifically, we expected changes in autonomous motivation in leisure time to be related to changes in intentions via changes in attitudes and perceived behavioral control, and that changes in intentions would predict physical activity behavior. Overall, therefore, we expected statistically significant indirect effects of the intervention and perceived autonomy support in PE on physical activity behavior via the sequence in the model. We expected these proposed effects to hold while controlling for demographic variables (gender, age) and past leisure-time physical activity behavior measured at baseline.

Method

Sample and Procedure

The study conformed to Aristotle University of Thessaloniki[University identity masked for peer review] Code of Ethics in Research. Two hundred eighty-one junior high school students took part in the present study. Of those two hundred fifty-six provided valid data in both measurement points (*M* age = 13.46; *SD* = .82, males = 120, females = 129, unreported = 7). The remaining students did not complete the questionnaires in one of the measurement points due to absence from the school the data collection days. Students were recruited from two typical co-educational high schools in an urban city in Northern Greece. Both schools were located in the same educational region and the students were of similar socio-demographic background. Students completed a battery of questionnaires on two measurement occasions; before and immediately after the completion of the intervention. The autonomy-supportive training lasted 10 weeks; two lessons per week. In each measurement occasion, a two-wave prospective design, similar to the one typically used in TCM research, was employed. In the first wave of data collection, students completed the measures pertaining to the TPB variables, motivational regulations in leisure-time, and past behavior. In the second wave of data collection, conducted three weeks after the first wave, measures of perceived autonomy support, motivational regulations in PE, and self-reported physical activity behavior were administered. Before questionnaire administration permission from school principals and parents was obtained. Parents received a pre-print form describing the purpose of the study; parents who did not wish their child to complete the questionnaire or take part in the intervention should sign the form and return it to school. No signed forms were returned. Students were informed that they will participate in a survey on students' beliefs about the PE lessons. They were not informed about participation in an intervention study in order to minimize potential Hawthorne-type effects (i.e., modification of behavior as a result of the awareness of being observed; McCarney et al., 2007). The questionnaires were completed in quiet classroom conditions supervised by a trained research associate and without the presence of their PE teacher. Students were informed that the questionnaire was anonymous and were reassured of the confidentiality of their responses and that they would be used solely for research purposes. Students were matched across waves and measurement points based on their class, gender and date of birth. The study was carried out the spring semester of the 2014-2015 academic season. The timeline of the study design and data collection is presented in Figure 1.

Measures

A battery of measures was used to assess perceived autonomy support, motivational regulations in PE and in leisure-time, and students' social cognition towards leisure-time physical activity. All scales have been used previously with Greek students and demonstrated adequate psychometric properties.

Perceived autonomy support. Students' perceptions of teacher-initiated support were measured with Perceived Autonomy Support Scale for Exercise Settings (PASSES; Hagger et al. 2007). The PASSES comprises 12 items representing respective autonomy supportive behaviors during PE classes (example item 'I feel that my PE teacher provides me with choices, options, and opportunities to do active sports and/or vigorous exercise'). Hagger et al. (2007) provided evidence on the validity of the scale and Barkoukis and Hagger (2013) used this scale with Greek high school students. Students responded on a 7-point scales ranging from 1 ('strongly disagree') to 7 ('strongly agree'). The scale demonstrated adequate internal consistency.

Motivational regulations in PE. The PE version of Perceived Locus of Causality Scale (Ryan & Connell, 1989) was used to assess students' motivational regulations in PE. The scale includes four motivational regulations, two autonomous: intrinsic motivation (e.g. "…it is fun") and identified regulation (e.g. "…I value PE"), and two controlled: introjected regulation (e.g. "…I will feel ashamed if I do not do PE"), and external regulation (e.g. '…important others want me to do PE"). Participants responded to the stem question 'I participate in PE because…' on a 4-point Likert scale ranging from 1 ('not true at all') to 4 ('very true').

Motivational regulations in leisure-time. Students' motivational regulations in leisure time physical activity were assessed with the Behavioral Regulations in Exercise Questionnaire (Mullen

Markland, & Ingledew, 1997). Participants responded to the stem question ‘Why do you participate in active sports and/or vigorous physical activities in your leisure time?’ followed by 15 items measuring four motivational regulations; intrinsic motivation (e.g. ‘…because it is fun’), identified regulation (e.g. ‘…because it is important to make the effort’), introjected regulation (e.g. ‘…because I will feel guilty if I do not’), and external regulation (e.g. ‘…because others say I should’). Responses were anchored on a 7-point Likert scale ranging from 1 (‘not true at all’) to 7 (‘very true’). In order to reduce the number of constructs in subsequent analyses and develop more parsimonious model a relative autonomy index (RAI) was calculated for both the PE and LTPA measures of motivation based on Vallerand’s (2007) recommendations (i.e., 2 x intrinsic motivation + identified regulation - introjected regulation – 2 x external regulation). The RAI was used in all subsequent analyses.

Theory of Planned Behavior variables. The TPB variables in the present study were assessed based on the recommendations of Ajzen (2002) and previous research with the TCM (e.g., Barkoukis & Hagger, 2013). The measure of attitudes included five semantic differential scales with the bipolar adjectives: bad–good, harmful–beneficial, not enjoyable–enjoyable, useful–useless and boring–interesting. Students responded to the stem question: ‘Participating in active sports and/or vigorous physical activities during my leisure-time in the next five weeks is…’ and responses were coded on a 7-point scale. Subjective norms were assessed with two 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’) with students recording their responses on a 7-point scale ranging from 1 (‘strongly disagree’) to 7 (‘strongly agree’). PBC was measured with three items (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”) with responses anchored on a 7-point Likert scale ranging from 1 (‘no control’) to 7 (‘complete control’). Intentions were assessed with 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 disagree”) to 7 (“strongly agree”).

Physical activity behavior. Godin and Shephard's (1985) Leisure-Time Exercise Questionnaire was used to measure students' self-reported leisure-time physical activity participation. The following definition of vigorous physical activity was provided to students: "Vigorous physical activities are activities which make your heart beat faster, breathe faster, and hot and sweaty". Participants then were asked to record their 5-week physical activity participation during their leisure-time on two items (e.g., "In the course of the past five weeks, how often have you participated in vigorous physical activities for 20 minutes at a time?") using six-point Likert scales ranging from 1 ('never') to 6 ('everyday').

Past behavior. A single-item used in past TCM research (Barkoukis & Hagger, 2013; Hagger et al. 2003) was used to measure participants' past physical activity behavior (i.e., '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?'). Participants recorded their physical activity participation on a 6-point Likert scale ranging from 1 ('not at all') to 6 ('most days per week').

Intervention Design

Two schools were randomly assigned to receive the autonomy-support intervention or control intervention. The school assigned to receive the autonomy-supportive intervention comprised five classes of students (total *n* = 131; 63 males and 61 females, 7 students did not report their gender; *M* age = 13.26 years, SD = .84). The school assigned to receive the control intervention also comprised five classes (total *n* = 125 students; 57 males and 68 females, *M* age = 13.65 years, SD = .76). The PE teacher in the school assigned to receive the autonomy-supportive intervention (male, 43 years old, 14 years of experience in secondary education) attended a series of 3 seminars lasting 1.5 hours each over a period of 2 weeks. The first session included a description of key concepts from self-determination theory and their interplay in establishing an adaptive social environment that will result in students adopting adaptive behaviors in the school context (e.g., relations between autonomy supportive climate and intrinsic motivation). The second session included instruction on how to adopt strategies that promote autonomy in students (e.g., providing choice, adopting active listening, encouraging student-generated questions, allowing students to work independently, providing a meaningful rationale, providing informational feedback, offering hints, responding to student-generated questions). The third session included instruction on strategies on how to avoid fostering a controlling climate (e.g., avoiding use of controlling language (e.g., “should”, “must” and “got to”, avoiding giving solutions verbatim, avoiding use of directives and commands) (see Reeve & Jang, 2006; Teixeira et al., 2020). All three sessions were interactive emphasizing discussion of examples from everyday life, demonstrating how to promote interaction with students during lessons, and discussing solutions to existing or anticipated situations during the implementation of the intervention (e.g., number of choices, types of choices in each subject). The PE teacher of the school assigned to receive in the autonomy-supportive intervention was then instructed to apply this training to his regular PE lessons for a period of 10 weeks. For example, during the warm-up phase, the PE teacher offered students choice with respect to the type of warm-up activity or was allowed students to do their own stretching exercises. In addition, the PE teacher was explaining the content of the lesson, providing rationales for the selected activities. In the main part of the lesson, practice and inclusion teaching styles were endorsed allowing students to work at their own pace. Furthermore, on several occasions, students were asked to choose among similar drills to perform, or chose the order of the drills to be performed. Also, depending on the content of the lesson, goal setting was fostered. At the end of the lesson a few minutes were devoted to asking questions to students about their experiences in the lesson (see Table 1 for example strategies). The PE teacher of the school assigned to receive the control intervention (male, 45 years old, 17 years of experience in secondary education) was told that his school was selected to participate in a study investigating the short term effects of PE lessons on students’ beliefs about the lesson and received no training on self-determination or promotion of autonomy supportive climate. The PE teacher was asked to teach their normal PE lessons for a period of 10 weeks. An informal discussion with the PE teacher after the completion of the second measurement point revealed that he did not change his teaching approach. Lesson content in both schools was guided by the national curriculum for PE (see Tsorbatzoudis, Grouios, Barkoukis & Alexandris, 2007). Both teachers taught the same sport activities (i.e., basketball, football, track and field), and Greek traditional dances, but the order of the subjects or the specific dances taught and the time devoted to each activity, was slightly different depending on the school facilities, weather, and other conditions.

Data Analysis

Descriptive statistics and reliability analyses were computed using the *psych* package (Revelle, 2018) in R. We tested hypotheses of our proposed model by path analysis conducted using the *lavaan* package (Rosseel, 2012) in R using a maximum likelihood estimation method[1]. We also estimated bootstrapped standard errors with 1000 replications, consistent with recommendations (Hayes, 2018). Missing data was imputed using the full-information maximum likelihood method (FIML)[2]. As more than 95% of cases were retained across the baseline and follow-up time points of the intervention, attrition analyses were redundant. All the psychological and behavioral variables in the model were represented as change variables. The change variables were computed as residualized change scores derived from the regression of the follow-up measure of the variable on its baseline value. The hypothesized relations among the variables in the proposed model are summarized in Figure 2. The pattern of proposed effects followed hypotheses derived from the trans-contextual model. The effects of the intervention were tested by predicting leisure-time physical activity at follow-up, the primary dependent variable, changes in intention, and changes in perceived autonomy support by a dichotomous intervention variable coded as 1 = control intervention and 2 = autonomy-supportive intervention. Gender, age, and leisure-time physical activity behavior at baseline were included as control variables which predicted all other variables in the model. Age and baseline physical activity behavior, were included as continuous control variables and gender was included as a dichotomous control variable.

[1]Data files, analysis scripts, and output from the data analysis including reliability, statistical power, and path analyses are available online: https://osf.io/b4t9c
[2]Path analyses were conducted without FIML imputation, patterns of effects were unchanged, full results are available online: https://osf.io/b4t9c

Adequacy of the hypothesized model was established using the goodness-of-fit chi-square, the comparative fit index (CFI), with values exceeding .95 typically considered appropriate cutoff values for adequate model fit, the standardized root mean squared residuals with a cutoff value of 0.500 taken as indicating a well-fitting model, and the root mean squared error of approximation (RMSEA) and its 90% confidence intervals (CI_{90}) with a cutoff value equal to or less than .08 and narrow confidence intervals indicative of an adequately-fitting model (Marsh, Hau, & Wen, 2004). Hypothesized mediation effects were tested by calculating indirect effects with bootstrapped standard errors.

Results

Descriptive statistics, reliability coefficients[3], and zero-order correlation coefficients among study variables are reported in Table 2. Reliability coefficients revealed acceptable reliabilities for all constructs at each time point. Exceptions were the autonomous motivation in PE (relative autonomy index) scale at baseline and follow-up and the subjective norm scale at baseline. Standardized parameter estimates for the path analysis among the proposed model constructs are presented in Figure 3. Overall, the model exhibited adequate fit with the data ($\chi^2(18) = 44.390$, $p = .001$; CFI = .956; SRMSR = .045; RMSEA = .078, RMSEA CI_{90} upper limit = .049, RMSEA CI_{90} lower limit = .107). In addition, the model accounted for a statistically significant amount of variance in the key dependent variables: follow-up leisure-time physical activity ($R^2 = .451$), changes in intentions ($R^2 = .439$), and changes in perceived autonomy support ($R^2 = .210$). In addition, a posteriori statistical power analysis for the final model was conducted to ensure the final model had the requisite power. Our analysis was based on MacCallum, Browne, and Sugawara's (1996) method based on the RMSEA and implemented using the *Webpower* tool (Zhang & Yuan, 2018). Based on input parameters recommended for a conservative estimate ($N = 271$, *H1* RMSEA = .078, *H0* RMSEA = .000, df = 18, $p = .001$), the reproduced statistical power was .851.

[3]Where possible Omega reliability coefficients (Revelle & Zinbarg, 2008) were computed. For two-item scales, the Spearman-Brown inter-item correlation was computed. For the relative autonomy index in leisure time at baseline, the Omega reliability calculation did not converge due a non-positive definite matrix, so the standard Cronbach alpha is reported.

Results revealed no statistically significant effects of the intervention on follow-up leisure-time physical activity (β = .049, *p* = .329) and changes in intentions (β = -.024, *p* = .637). Unsurprisingly, there was a significant large-sized effect of the intervention on changes in perceived autonomy support (β = .466, *p* < .001). There were statistically significant direct effects of changes in perceived autonomy support on changes in autonomous motivation in PE (β = .188, *p* = .002) and changes in autonomous motivation in leisure time (β = .117, *p* = .044), with small effect sizes. There was also a statistically significant direct effect of changes in autonomous motivation in leisure time on changes in PBC (β = .318, *p* = .025) as hypothesized with a small-to-medium effect size. Contrary to hypotheses, a we found a statistically significant negative direct effect of changes in autonomous motivation in leisure time on changes in subjective norms (β = -.386, *p* < .001) with a small-to-medium effect size. Changes in intentions were predicted by changes in PBC (β = .610, *p* < .001) with a medium-to-large effect size, as hypothesized. But there was not effect of changes in attitudes (β = .039, *p* = .489) or subjective norms (β = .106, *p* = .069) on intentions, contrary to hypotheses. Changes in intentions predicted participation in leisure time physical activity (β = .559, *p* < .001) with a medium-to-large effect size.

In terms of indirect effects, we found statistically significant indirect effects of the intervention on changes in autonomous motivation in PE via changes in perceived autonomy support (β = .087, *p* = .003) with a small effect size. We also found statistically significant indirect effects of the intervention on changes in autonomous motivation in leisure time via changes in perceived autonomy support and changes in autonomous motivation in PE (β = .038, *p* = .005) with a small effect size. There was also an indirect effect of the intervention on autonomous motivation in leisure time via changes in perceived autonomy support alone which fell marginally short of the conventional level for statistical significance (β = .055, *p* = .052), again, with small effect sizes. Together these resulted in a small, statistically significant total indirect effect of the intervention on changes in autonomous motivation in leisure time (β = .093, *p* = .004). There were, however, no indirect effects of the intervention on changes in intention or physical activity behavior. We also found a statistically significant indirect effect of changes in perceived autonomy support in PE on changes in autonomous motivation in leisure time through changes in autonomous motivation in PE (β = .082, *p* = .004) with a small effect size, consistent with hypotheses. There was also a statistically significant indirect effect of changes in autonomous motivation in leisure-time on changes in intentions through changes in perceived behavioral control (β = .194, *p* = .036), with a small-to-medium effect size, as predicted, but not through attitudes and subjective norms leading us to reject these hypotheses. There was a statistically significant indirect effect of changes in perceived behavioral control (β = .342, p < .001) with a small-to-medium effect size via changes in intentions on leisure time physical activity as hypothesized, but not for attitudes or subjective norms, leading us to reject this hypothesis. There was also a statistically significant indirect effects of changes in autonomous motivation in leisure-time on leisure time physical activity via changes in perceived behavioral control and intentions (β = .109, *p* = .048) with a small effect size.

Discussion

The purpose of the present study was to test the effectiveness of a school-based intervention to promote an autonomy-supportive motivational climate in PE in promoting intentions toward, and actual participation in, leisure-time physical activity behavior outside of school. The study was guided by the trans-contextual model which identified the psychological processes by which the intervention was expected exert its effects on out-of-school leisure-time physical activity intentions and behavior. In the study, students in classes in two schools received either an autonomy-supportive intervention or a control intervention with random assignment at the school level. The PE teacher of the school assigned to receive the autonomy-supportive intervention received a three-seminar interactive program providing them with training to promote autonomy support to students in PE lessons. The teacher in the school assigned to receive the control intervention did not receive the training program. The intervention lasted 10 weeks. During the intervention, each teacher taught their normal PE lessons concurrent to the training. Results indicated that students in the school allocated to receive the autonomy-supportive intervention reported significantly greater levels of perceived autonomy support and, indirectly, autonomous motivation in PE, and autonomous motivation outside of school at post-intervention follow-up. However, there were no direct effects of the intervention on students' intentions to engage in physical activity, and actual physical activity behavior. There were statistically significant effects on perceived autonomy support on autonomous motivation in PE and leisure time, and on intentions to be physically active through autonomous motivation and perceived behavioral control, but these variables did not transmit the effects of the intervention on actual physical activity participation.

Current results have important ramifications for the trans-contextual model as a model of prediction and a model that guides intervention. As a model of prediction, current results support many of the premises of the model. That is, the major premises of the model are supported i.e. perceived autonomy support from teachers in PE contexts predicted students' autonomous motivation in PE, autonomous motivation toward engaging in physical activity in leisure time, and students' intentions to engage in leisure-time physical activity. Results are, therefore, largely consistent with previous prospective tests of the model (Barkoukis & Hagger, 2013; Hagger et al., 2003, 2005; 2009), along with review (Barkoukis & Hagger, 2012; Hagger & Chatzisarantis, 2012) and meta-analytic (Hagger & Chatzisarantis, 2016) evidence supporting the major premises of the model, including the indirect effects across contexts, which are central to the model. PE teachers are encouraged to use autonomy supportive practices such as providing rationales, allowing students to work on their own pace, providing opportunities for interaction with the students and being responsive to their question, avoiding use of controlling language (e.g., "should", "must" and "got to"), avoiding giving solutions verbatim, avoiding use of directives and commands, and avoiding asking controlling questions (see Reeve, 2016; Reeve & Jang, 2006). As our study showed, these practices can increase students' perceptions of an autonomy supportive motivational climate and influence, therefore, their beliefs towards PE lesson and leisure-time physical activity.

However, as a model that guides intervention to change motivation, intentions, and actual participation in physical activity behavior outside of school, current findings only support the effectiveness of model in promoting change in perceived autonomy support and autonomous motivation, but not intentions and physical activity behavior outside of school. Given the consistency and strength of the trans-contextual effects found in previous research of perceived autonomy support and autonomous motivation in a PE context on autonomous motivation, intentions, and actual physical activity engagement in a leisure-time context, it stands to reason that an intervention that evokes change in the constructs in PE may lead to trans-contextual effects on motivation and behavior outside of school. The current intervention was specifically designed to change the key PE variables that have been shown to relate to out-of-school behavior using an intervention that promotes an autonomy-supportive motivational climate, and compare effects with an appropriate “no training” comparison (c.f., Cheon et al., 2012; Reeve & Jang, 2006). While the autonomy-supportive intervention was effective in promoting greater perceived autonomy support and autonomous motivation, consistent with previous research on autonomy-supportive climates (e.g., Cheon et al., 2012), and in changing autonomous motivation in an out-of-school leisure-time physical activity context, the effects were relatively weak and were not transmitted to intentions to engage in, and actual participation in, subsequent leisure-time physical activity behavior. This is inconsistent with a previous intervention deriving its hypotheses from the trans-contextual model, which showed significant effects of a school-based intervention on leisure-time physical activity behavior through the mediators proposed in the model (Chatzisarantis & Hagger, 2009).

Possible reasons why the current intervention had little effect may be that the changes made to the practice of the teacher may have been insufficiently strong to lead to changes in out-of-school physical activity, despite changes in out-of-school autonomous motivation. In other words, the intervention effects were not sufficiently powerful to have an effect on physical activity behavior in leisure time, an activity that is distal to PE. Instead, physical activity likely to be subject to more proximal factors that influence behavioral engagement including motivational and social cognition constructs like perceived autonomy support for physical activity outside of school from parents and peers, attitudes and beliefs toward physical activity, and self-efficacy and socio-ecological factors like access to facilities and opportunities to act (e.g., González-Cutre et al., 2014b; Olson, Ireland, March, Biddle, & Hagger, 2019). Another possible reason is that the changes in PE teacher's practice were perhaps modest or not maintained in the current intervention relative to others. This may have been because teacher's training was relatively brief and of low intensiveness relative to previous interventions. For example, Chatzisarantis and Hagger's autonomy-support training program involved training of teachers for a total of 3 days training with 3-hour sessions and over a period of 5 weeks, similar to other autonomy-support interventions (e.g., Cheon et al., 2012; Polet et al., 2019). In contrast, the current intervention was less intense with a total of 4.5 hours training over a period of a week. The intensiveness and duration of training is likely to be a moderator of the effectiveness of autonomy supportive interventions, particularly the strength of the effects and the likelihood that it will pervade into other contexts. Based on meta-analytic evidence that minimal autonomy support interventions with brief training experience are the least effective in changing autonomous motivation and behavior (Su & Reeve, 2011), there is strong advocacy that autonomy-support interventions to change the behavior of social agents creating motivational climates in educational settings involves multiple exposures over a period of six weeks with reinforcement and feedback on autonomy supportive techniques (Cheon et al., 2012). The relatively brief nature of the teachers' training, therefore, may explain the lack of effects on actual behavior across contexts in the current study.

Strengths, Limitations, and Proposals for Future Research

The current study has numerous strengths including: targeting an important research question, namely, whether fostering students' autonomous motivation in PE will lead to physical activity motivation and behavior outside of school in a leisure time context; the adoption of an appropriate integrated multi-theory model to guide the development of the intervention and map the processes by which the intervention exerts effects across PE and leisure-time contexts; the recruitment of a large sample of students and recruiting PE teachers willing to make changes to their interpersonal style and motivational climate in lessons; the use of previously-validated techniques to foster autonomy-supportive styles in teachers; the use of an intervention design with autonomy-support and control intervention conditions with random allocation by school; and the use of validated measures of psychological mediators of intervention effects and path analytic models using residualized change scores that enabled a test of mediation effects of the model specified a priori while incorporating change across time of measurement.

There are, or course, limitations that must be acknowledged. The primary limitation is the relatively brief, minimal nature of the teacher training relative to other intervention programs adopted in previous studies (e.g., Chatzisarantis & Hagger, 2009; Cheon et al., 2012), an issue to which we alluded to in our previous discussion. A further limitation is the adoption of a self-report measure of physical activity behavior. Although our measure has demonstrated statistically significant correlations against more objective measures of physical activity in previous studies, there is still considerable potential for response bias introducing substantive measurement error into the current analysis. We also did not account for the potential of clustering of students within classes within the two schools. While there is potential for there to be higher likelihood of similar responding to measures within-classes rather than between classes, the current study was underpowered to estimate a multilevel model that tested within-class variation alongside between-class variation. However, given that the number of classes was small (n = 5) and all classes were taught by the same teacher, we expect that the within-class variability component would have been relatively modest. However, conducting an autonomy-support intervention that enables analyses that account for within-participants effects would be an important avenue for future research. It is also important to note that not all scales for the measures used in the current study exhibited acceptable reliability. Specifically, the autonomous motivation in PE scale at baseline and follow-up and the subjective norm scale at baseline were below acceptable cutoff values. While the current path analytic models aimed to correct for error in prediction, there was some measurement error associated with these constructs as a full latent variable model was not able to be estimated. Current findings should therefore be interpreted with the compromised reliability in mind, which has the potential to inflate or suppress model relations involving these constructs. A final limitation is that we did not provide a formal evaluation of the extent to which the PE teacher receiving the autonomy-supportive training and the teacher that received no training differed in the autonomy-supportive behaviors they adopted in their lessons before and after the intervention. This means that a formal evaluation of the fidelity of the intervention, i.e. whether participating teachers had actually followed the protocol and resulted in actual changes in their behavior could not be conducted. This would make the current study much stronger by providing evidence that the intervention led to changes in key behaviors expected to foster autonomous motivation in students. Future research needs to adopt autonomy supportive training programs of extended duration to promote strong effects, use validated, objective measures of leisure-time physical activity such as accelerometers, and include formal tests of intervention fidelity such as observation of teachers' behavior during lessons for key autonomy-supportive behaviors.

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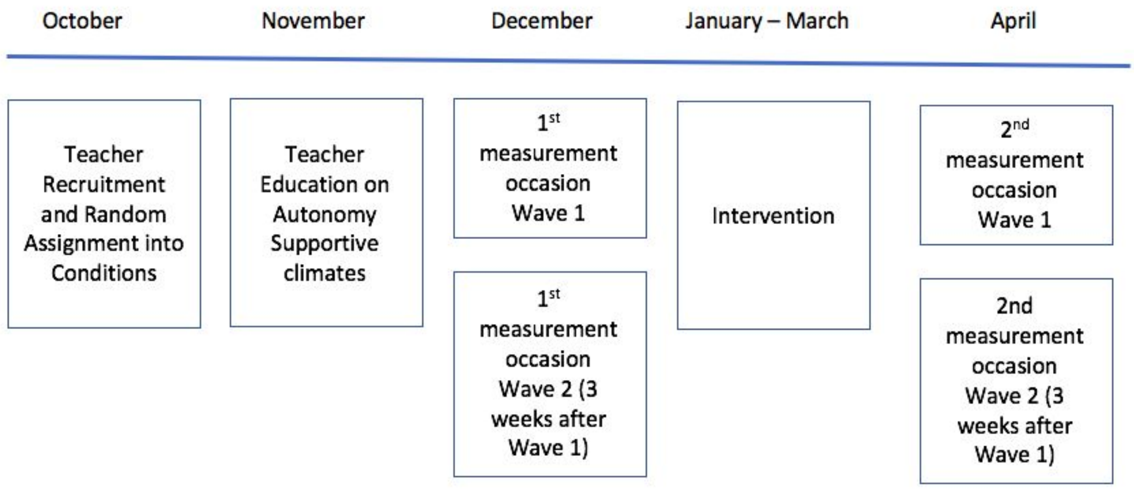

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732 *Figure 1*. Timeline of the study design and data collection.

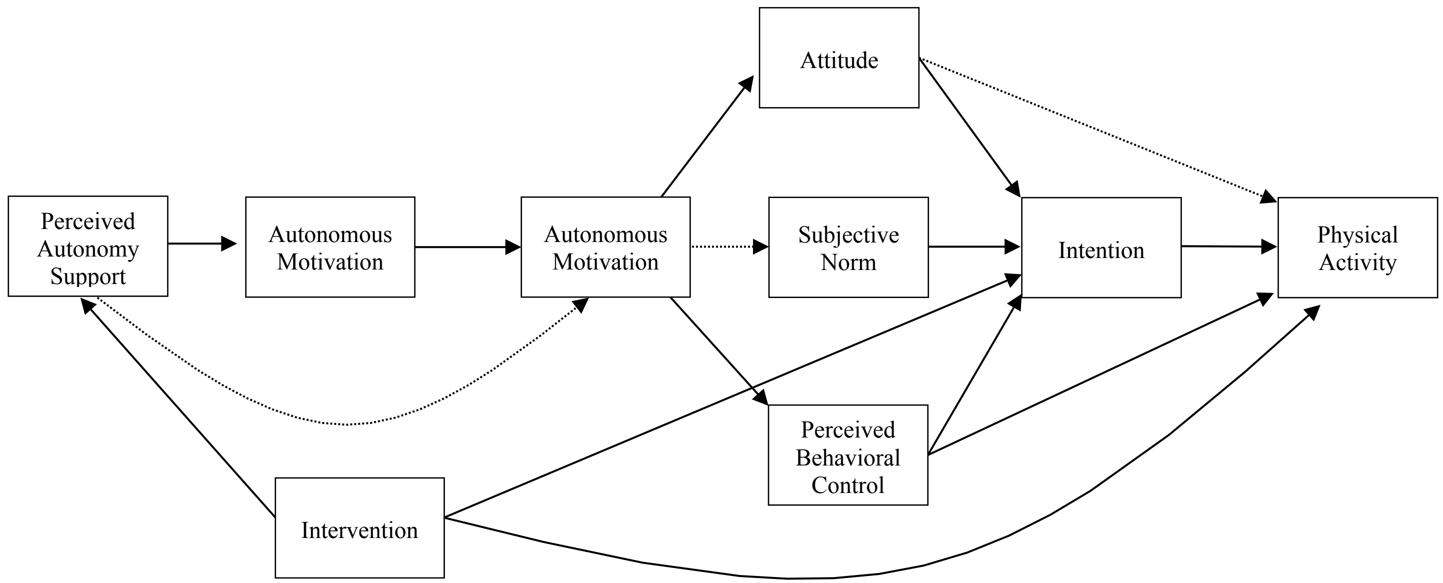
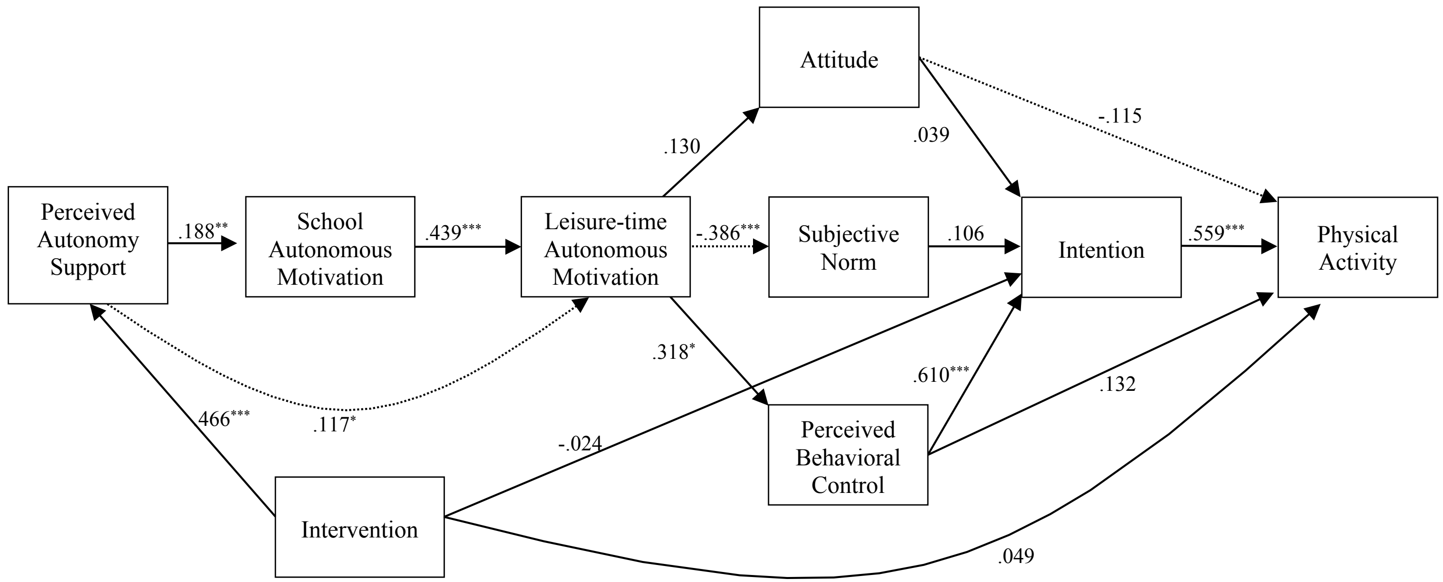


Figure 2. Proposed model illustrating effects of the trans-contextual model intervention on leisure-time physical activity and model constructs. Effects of gender, age, and past physical activity behavior as control variables on each variable in the model omitted for clarity.


Attitude
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Perceived
Autonomy
Support
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School
Autonomous
Motivation
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Leisure-time
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Motivation
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Subjective
Norm
.106
Intention
.559***
Physical
Activity
.318*
.610***
.132
466***
.117*
-.024
Perceived
Behavioral
Control
Intervention
.049

Figure 3. Standardized parameter estimates of effects in the path analytic model of the trans-contextual model intervention effects. Psychological variables (intention, attitude, subjective norm, perceived behavioral control, autonomous motivation in leisure time and school contexts, and perceived autonomy support) are residualized change scores derived from the regression of each variable at follow-up on itself at baseline. Statistically significant specific indirect effects not shown in model: Intervention→Perceived autonomy support→Autonomous motivation in PE (β = .087, *p* = .003); Intervention→Perceived autonomy support→Autonomous motivation in leisure time (β = .077, *p* = .004); Perceived autonomy support→Autonomous motivation in PE→Autonomous motivation in leisure time (β = .082, p = .004); Autonomous motivation in leisure time→Perceived behavioral control→Intention (β = .194, *p* = .036); Perceived behavioral control→Intention→Physical activity behavior (β = .342, *p* < .001); Autonomous motivation in leisure time→Perceived behavioral control→Intention→Physical activity behavior (β = .109, *p* = .048);. Statistically significant total effects: Perceived autonomy support→Autonomous motivation in leisure time (β = .199, *p* = .004); Intervention→Autonomous motivation in leisure time (β = .093, *p* = .004); Perceived behavioral control→Physical activity behavior (β = .474, *p* < .001). Effects of gender, age, and past physical activity behavior as control variables on each variable in the model omitted for clarity, paths freely estimated in the model but not depicted in diagram: Gender→Perceived autonomy support (β = .022, *p* = .712); Gender→Autonomous motivation in PE (β = .185, *p* = .005); Gender→Autonomous motivation in leisure time (β = .013, *p* = .838); Gender→Attitude (β = -.003, *p* = .968); Gender→Subjective norms (β = -.153, *p* = .021); Gender→Perceived behavioral control (β = -.131, *p* = .052); Gender→Intention (β = .005, *p* = .929); Gender→Physical activity (β = -.070, *p* = .171); Age→Perceived autonomy support (β = .166, *p* = .013); Age→Autonomous motivation in PE (β = .082, *p* =.174); Age→Autonomous motivation in leisure time (β = .080, *p* =.157); Age→Attitude (β = -.048, *p* =.534); Age→Subjective norms (β = -.081, *p* =.188); Age→Perceived behavioral control (β = -.055, *p* = .469); Age→Intention (β = .005, *p* = .929); Age→Physical activity (β = .058, *p* = 222); Past physical activity behavior→Perceived autonomy support (β = -.003, *p* =.962); Past physical activity behavior→Autonomous motivation in PE (β = .052, *p* =.450); Past physical activity behavior→Autonomous motivation in leisure time (β = -.008, *p* =.885); Past physical activity behavior→Attitude (β = .023, *p* =.767); Past physical activity behavior→Subjective norms (β = .098, *p* =.098); Past physical activity behavior→Perceived behavioral control (β = .027, *p* =.700); Past physical activity behavior→Intention (β = .053, *p* = .300); Past physical activity behavior→Physical activity (β = .122, *p* = .018).
**p* < .05 ***p* < .01 ****p* < .001

Table 1

Example Content of Autonomy-Supportive Strategies

Theme and focus	Example content
Student motivation and autonomy support	Offering choices to students on various aspects of the lesson. Allowing students work determine the pace of the lesson. Providing rationale for the structure of the lessons and the choice of exercises.
Developing social interactions	Opportunities for students to work in small groups. Opportunities for students to work in multiple groups. Reciprocal teaching style.
Recognition and praise	Recognition to all students. Recognition of motor performance as well as effort and interest towards the lesson.
Developing a sense of competence	Emphasis on personal development. Opportunities for students to work on their own pace. Goal setting. Inclusion teaching style.
Avoiding control: Maintaining autonomy support	Avoiding exhibiting solutions/answers, monopolizing learning materials, uttering solutions/answers, setting deadlines, uttering directives/commands, asking controlling questions, emphasizing students' obligations, using judgmental language and criticizing the students

Table 2

Zero-Order Intercorrelations and Reliability Coefficients for Study Variables

Variable	ω[a]	*M*[b]	*SD*[b]	1	2	3	4	5	6	7	8	9	10	11	12
1. Perceived autonomy support	.931	4.691	1.056	–											
	.931	5.268	0.915												
2. Autonomous motivation (PE)	.583[c]	2.016	2.413	.179**	–										
	.508[c]	2.052	2.417												
3. Autonomous motivation (LT)	.830[d]	7.538	4.642	.235**	.484***	–									
	.900	6.947	5.111												
4. Attitude	.878	4.803	0.966	.165*	.126	.175	–								
	.867	4.908	0.873												
5. Subjective norm	.484[c]	4.020	1.517	.161**	-.087	-.379***	.129*	–							
	.699[c]	4.048	1.720												
6. Perceived behavioral control	.802	5.381	1.238	.447***	.208**	.236**	.331***	.241***	–						
	.823	5.475	1.235												
7. Intention	.809	4.720	1.463	.269***	.214*	.221**	.238***	.244***	.658***	–					
	.812	4.762	1.435												
8. Physical activity behavior	–	3.996	1.431	.132*	.277***	.173*	.116	.215***	.487***	.642***	–				
9. Past physical activity behavior	–	4.025	1.414	.000	.055	.019	.034	.097	.070	.089	.197**	–			
10. Gender[e]	–	–	–	-.032	.173*	.157*	.015	-.224***	-.046	-.031	-.113	-.103	–		
11. Age	–	13.432	0.825	.048	.080	.049	-.012	.081	-.018	.034	.050	-.041	-.120	–	
12. Intervention[f]	–	–	–	.437***	.191**	.176**	.091	-.105	.196*	.073	.126	.116	-.038	-.204***	–

Note. PE = Physical education; LT = Leisure-time physical activity. Correlations among psychological constructs are for residualized change scores derived from the regression of the construct at post intervention follow-up on its baseline score. [a]Revelle's (2019) Omega (ω) reliability coefficient, upper values are for scales at baseline and lower values are for post-intervention follow-up; [b]Descriptive statistics are for averaged scales at each time point, upper values are for scales at baseline and lower values are for post-intervention follow-up; [c]Two item scale so reliability is Spearman-Brown inter-item correlation; [d]Matrix for calculation of ω reliability coefficient was not positive definite, so Cronbach alpha reliability coefficient reported; [e]Dichotomous variable coded as 1 = Boy, 2 = Girl; [f]Dichotomous variable coded as 1 = autonomy-support training, 2 = "no training" control. $^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$