Motivational Pathways to Leisure-Time Physical Activity Participation in Urban Physical Education: A Cluster-Randomized Trial

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Purpose: Grounded in the trans-contextual model of motivation framework, this cluster-randomized trial examined the effectiveness of an autonomy supportive physical education (PE) instruction on student motivation and physical activity (PA).

Method: The study comprised six middle schools and 408 students ($M_{age} = 12.29$), with primary outcomes of students’ autonomous motivation in PE and exercise, PA intention, and self-report PA. Results: The path analysis showed that the intervention had a weak positive effect ($\gamma = .11$) on students’ perception of autonomy ($R^2 = .51$), which in turn had a moderate positive effect ($\beta = .29$) on autonomous motivation in PE ($R^2 = .51$). Students’ perception of autonomy during PE had a positive effect ($\beta = .63$) on their autonomous exercise motivation ($R^2 = .44$) and autonomous exercise motivation had a positive effect ($\beta = .37$) on PA intentions ($R^2 = .34$). Autonomous exercise motivation was an indirect link transferring PE autonomy to PA intentions and participation. Conclusion: The study provides evidence on how motivational experiences in PE transfer to out-of-school PA.

Keywords: autonomous motivation, intention, trans-contextual model

One of the key questions in human behavior is how social environment can facilitate individuals’ behavior change. Especially important questions pertain to the physical activity (PA) context, in which the most effective teaching practices to foster participant exercise motivation and long-lasting exercise adherence are yet to be determined (Hagger, & Chatzisarantis, 2016). Literature has highlighted the role of autonomy support, which is a set of intentional strategies to support individuals’ participation due to inherent interest instead of external control, in facilitating individuals’ participation motivation (Deci & Ryan, 1985; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Recent studies in physical education (PE) have shown that when teachers implement autonomy supportive teaching practices, it fosters a positive impact on several PE-related outcomes, such as students’ perceptions of autonomy, skill development, and in-class PA (Cheon, Reeve, & Moon, 2012; Lonsdale et al., 2013). Similarly, early evidence gained in a few experimental studies has indicated that autonomy supportive PE instruction can have a positive “carry over” effect on transferring positive PE autonomy experiences into future PA intentions and leisure-time PA (Chatzisarantis & Hagger, 2009; Cheon et al., 2012).

High poverty urban public schools, in which more than 75 percent of the students are eligible for free or reduced-price lunch, continue to be a challenging environment for students and teachers alike (McFarland et al., 2017). High poverty school students in densely populated inner cities tend to show lower effort, persistence, and academic achievement compared to students in more affluent public schools or private schools (McFarland et al., 2017). Similarly, high poverty urban schools employ more novice teachers and experience higher teacher turnover rate compared to suburban public schools (Gagnon & Mattingly, 2012). These challenges have shown to lead to a weak academic learning climate and a lack of motivation toward different school subjects (Boyd & Shouse, 1997; Kenny, Walsh-Blair, Blustein, Bempechat, & Seltzer, 2010). In the PE context, research has shown that urban school PE teachers can face instructional challenges, such as insufficient instructional resources, implementing culturally relevant pedagogy, and dealing with community violence (McCaughtry, Barnard, Martin, Shen, & Kulinna, 2006). In addition, research has...
shown that urban PE teachers are more likely to be exposed to confrontational and verbally disrespectful teacher-student interactions, which places challenges upon teachers’ instructional strategies (James & Collier, 2011).

This study employed the trans-contextual model of motivation (TCM) framework with three specific propositions guiding this inquiry (Hagger et al., 2003; Hagger & Chatzisarantis, 2016). The TCM framework is an integration of theories supporting self-determination theory (SDT; Deci & Ryan, 1985), the hierarchical model of intrinsic and extrinsic motivation (HMIEM; Vallerand, 2007), and the theory of planned behavior (TPB; Ajzen, 1991). Proposition 1 is drawn from the SDT (Deci & Ryan, 1985, 2000) with the hypothesis that perceived support for autonomous motivation from social agents (e.g., teachers) toward school-based PA (e.g., PE in school) will predict autonomous motivation toward similar activities (e.g., physical activities) within the educational context. Autonomous motivation refers to individuals engaging in PA due to inherent interests and types of extrinsic motivation that are valued while controlling motivation refers to individuals engaging in PA due to external contingencies such as grade or coercive teacher instruction. SDT postulates that autonomous (self-determined) motivation varies based on people’s locus of control (i.e., the extent to which people believe they can control events affecting them). Locus of control is assumed to range from intrinsic to external motivation through three dimensions of external regulations (integrated, identified, and introjected) (Deci & Ryan, 1985). In addition to autonomous and controlling motivation, SDT postulates that human behaviors can be totally non-motivational (i.e., amotivational). It is hypothesized that intrinsic and more intrinsic forms of extrinsic regulations (integrated and identified) contribute to autonomous perception, whereas introjected regulation, external motivation, and amotivation contribute to controlling (Deci & Ryan, 1985).

HMIEM (Vallerand, 2007) proposes that motivation can operate at three levels of generality: global, contextual, and situational. At the contextual level, the model proposes interplay between autonomous forms of motivation across different contexts. Therefore, Proposition 2 postulates that adaptive outcomes derived from autonomous activity in one context are associated with increased propensity to experience autonomy toward similar activities in other contexts. Therefore, a PE student may actively seek to further engage in PA which would foster autonomous motivation in the out-of-school context.

Finally, TPB (Ajzen, 1991) is a social cognitive theory explaining human intentional behavior. A major construct of this theory is intention to behave, considered a motivational concept, and is conceptualized as the most proximal antecedent of the actual behavior. Behavioral intentions represent the level of planning and effort an individual is willing to accomplish in order to perform future behaviors, and is the product of a combined function of personal attitudes, subjective norms, and perceived behavioral control. TPB is the foundation of the Proposition 3, claiming that autonomous motivation toward physical activities (out-of-school context) predicts future intention to engage in physical activities as well as actual PA behavior engagement.

Central to the TCM is the hypothesis that an autonomy supportive social environment (e.g., autonomy support of PE teachers) has a positive impact on students’ perception of autonomy support and autonomous motivation in PE contexts (SDT premise: Proposition 1), which will lead to increased autonomous exercise motivation in out-of-school context (HMIEM premise: Proposition 2). It is further proposed that autonomous motivation facilitates individuals’ willingness to form intentions to participate in PA in the extramural contexts (TPB premise: Proposition 3). This is important because the TCM can provide a framework to help understand the effectiveness of autonomy supportive teaching practices and PE motivation in relation to the objectives of out-of-school PA participation.

The central propositions of the TCM model have received empirical support across multiple studies, particularly those conducted in PE and leisure-time (out-of-school) contexts and in studies focusing on habitual PA (see Hagger & Chatzisarantis, 2016). Previous studies have found significant relationships between perceived autonomy support and autonomous motivation in PE (Proposition 1; e.g., Hagger et al., 2003, 2009), between autonomous motivation in PE and PA (Proposition 2; e.g., Barkoukis, Hagger, LAMBROPOULOS, & Torbatzoudis, 2010; Hagger et al., 2003), between autonomous motivation and intention toward PA (Proposition 3; Barkoukis et al., 2010; Hagger et al., 2003, 2009), and between PA intention and PA engagement (Proposition 3; Barkoukis et al., 2010; Hagger et al., 2003, 2009).

To date, few experimental studies have been conducted to test the TCM in PE/PA context (Chatzisarantis & Hagger, 2009; González-Cutre et al., 2014; Lonsdale et al., 2013). Focusing on the SDT premise, the randomized controlled trial by Lonsdale et al. (2013) comparing motivational instructional practices (i.e., explaining relevance, providing choice, and free choice) to the traditional PE practices in five Australian middle schools showed providing choices and giving students a possibility to select their own content (free choice) to be the most successful instructional strategies. A five-week intervention study in England showed that the students who were taught in an autonomy supportive instructional setting reported stronger intentions to exercise and participated more frequently in physical activities than students in the control “PE-as-usual” condition (Chatzisarantis & Hagger, 2009). Autonomous motivation and intentions mediated the effects of the intervention on self-report PA explaining 64% of the variation in out-of-school PA participation. Finally, González-Cutre et al. (2014) conducted a five-week intervention study with Spanish elementary school students. The results showed increases in teacher autonomy support, identified regulation in PE, and integrated and identified regulation in leisure time PA.

Although previous studies have shown the TCM framework to be useful in understanding student motivation, two important questions have yet to be answered. First, a recent meta-analysis showed robust evidence for the proposed TCM propositions, but the evidence is derived mainly through correlational evidence, not through experimental studies that can establish causal relationships (Hagger & Chatzisarantis, 2016). Second, it needs to be recognized that there has been significant variation in terms of the size of the effects across the studies (Hagger & Chatzisarantis, 2016). This heterogeneity indicates the likelihood that other extraneous variables exist, such as demographics and context, which can affect the TCM hypothesized relationships in the model. Thus, grounded in the TCM, the aim of this study was to examine the effectiveness of autonomy supportive PE instruction on urban middle school students’ PE motivation, exercise motivation along with PA intentions and total PA. Specifically, the study aimed to examine the motivational pathways through which autonomy supportive PE instruction impacts selected student outcomes. This study is one of the first examinations to test the TCM specifically in urban schools setting, and thus will increase our understanding about the utility of the TCM in understanding the motivational process among urban adolescents. The following hypotheses were tested (see Figure 1):
**H1a:** Autonomy supportive teaching practices will have a positive effect on students’ autonomous PE motivation via their perception of autonomy support in PE (Chatzisarantis & Hagger, 2009; Cheon et al., 2012; Hagger et al., 2009). An alternative hypothesis (H1b) was tested, in which the intervention has a direct effect on both students’ perception of autonomy support and autonomous motivation in PE (Chatzisarantis & Hagger, 2009).

**H2:** Students’ autonomous motivation during PE classes will have a positive impact on their PA intentions through autonomous motivation in exercise (Chatzisarantis & Hagger, 2009; Hagger et al., 2003, 2009).

**H3a:** Students’ intentions to participate in PA will mediate the relationship between individuals’ autonomous exercise motivation and actual PA participation (Chatzisarantis & Hagger, 2009; Hagger et al., 2003, 2009). Based on previous findings, an alternative hypothesis (H3b) was estimated assuming that there may be a direct relationship between autonomous exercise motivation and PA (Hagger et al., 2009).

**Method**

**Study Design**

This study was a cluster-randomized controlled (randomization was per schools not per individuals), non-blinded (treatments were not masked from the teachers or students), and parallel-group (study with two different treatments; Spieth et al., 2016) experiment with three data collection phases. The length of the intervention was eight weeks, and the data were collected one week prior to the beginning of the intervention (baseline; T1), during week four of the intervention (T2), and one week after the intervention (T3). Data collection approval from the Institutional Review Board of the University of Memphis and the local School Office of Planning and Accountability were obtained.

**Participants**

The final sample was comprised of 408 middle school students (216 females, 192 males; $M_{age} = 12.29, SD = .99$), 19 PE classes, and 8 PE teachers (4 females, 4 males) in the mid-south United States. Student participant allocation was 198 (100 females, 98 males) students in three experimental group schools and 210 (108 females, 102 males) in three control group schools. Of the total 493 students approached, 449 (91%) submitted their informed assent and parent consent forms, and of these 449 students 41 were omitted from the study due to incomplete data.

A total of eight PE teachers volunteered to provide the instruction in this study, four female and four male. Each signed a letter of informed consent. All of the PE teachers were experienced and tenured teachers in the school district (experiment school teachers: $M_{age} = 46.75$ years, $M_{teaching experience} = 17.25$ years; control school teachers: $M_{age} = 36.33$ years, $M_{teaching experience} = 9.67$ years).

Schools, PE teachers, and students were recruited based on their affiliation to the local school district (261 K-12 schools and 150,000 students; 86% African-American, 8% Caucasian, 4% Hispanic, and 2% other; 80% enrolled in a free or reduced lunch program). A simple cluster sampling analysis strategy (Campbell, Elbourne, & Altman, 2004) comprising all middle schools in the county was employed. After contacting 15 schools, six schools meeting the eligibility criteria (inner city location; African-American student majority) were recruited.

**Sample Size**

Sample size was calculated using GPower 3.1 with two-sided significance level of .05 and a desired power of 80% resulting in the sample size recommendation of 158. To account for the data clustering, 158 was adjusted by design effect (Kish, 1965) of $1 + (m − 1) \times ICC$, where $m$ is the sample size of each cluster (70 students per school) and ICC is an intraclass coefficient. ICCs were determined based on the findings of Yli-Pipari (2011), who found school level ICC of autonomous motivation to be an average .02. The final correcting equation was used: $1 + (70 − 1) \times .02 = 2.38$. Thus, the total minimum sample was $2.38 \times 158 = 377$.

**Randomization**

Although the treatment was delivered at the teacher level, to avoid data contamination, randomization was carried out at the school level with allocation ratio 1:1 selecting three schools to both experiment and control conditions. To ensure that both the experimental and control groups matched in terms of the key determinants, schools were matched based on the following criteria in the order in which they appear: school’s size (one large and two mid-size schools in both conditions), minority student enrollment (two schools with more than 75% of minority students and one school with between 50 to 75% of minority students in both conditions).

**Intervention Program**

Participation in the autonomy supportive teacher intervention program (professional development) constituted the independent variable of the study. The professional development for the experiment and control groups was completed simultaneously in two parts (each part lasting for three hours). The first professional development session for both groups was conducted one week prior to the beginning of the intervention. The second professional
development training was conducted for the experimental group teachers three weeks after the first professional development session, and for the control group teachers two months after the completion of the intervention. The first experimental group workshop began with introductory activities followed by a PowerPoint presentation to introduce teachers to the intervention objectives together with the theoretical foundation of the autonomy supportive teaching practices. Teachers were instructed to: nurture students’ intrinsic motivation, rely on informational language, provide explanatory rationales, and positively process negative student affect (Cheon et al., 2012). Next, several real-life cases on urban PE were presented to the teachers, and teachers were provided with opportunities for individual and group work when working on the challenging teaching and learning scenarios. The experimental group teacher workshop was concluded with a group discussion on potential obstacles that a teacher may face in every day urban PE.

The first workshop for the control group teachers started with introductory activities followed by a PowerPoint presentation to help teachers with the assessment issues that have been a hot topic in the state. Next, teachers were provided a possibility to talk and reflect about the issues pertaining to their everyday work. The control group workshop focused on the curriculum and assessment issues only and not on any teaching practices that would compromise the treatment effect. This is important because control condition teachers should receive similar exposure (but different treatment) than experiment school teachers (Bellg et al., 2004).

The second professional development workshop for the experimental group teachers was conducted three weeks after the first training. The central objective of this three-hour training was to give teachers a voice and an opportunity to process early experiences, such as possible success stories and concerns that the teacher had experienced when trying to implement autonomy supporting teaching practices. In addition, the research team prepared and provided the teachers hands-on experiences on how to implement autonomy supportive content in PE as well as group discussions about the autonomy supportive instructional behaviors that they have experimented with during the current semester. The research team administered and supervised this information and a discussion session, in which teachers shared their positive experiences, voiced their concerns, identified potential obstacles, and critiqued specific approaches to instruction. Finally, the teachers were taken to the gym and introduced to ways to organize their teaching. For instance, the teachers were instructed to engage students in warm-up activities using autonomy supportive ways instead of controlling teaching practices that seem to be a norm in this metropolitan school district.

The teachers in the control group and their students should be entitled to benefit from the experimental intervention. The second three-hour control group workshop for the control group teachers was conducted two months after the intervention, in which autonomy supportive teaching practices were introduced. All workshops were conducted in a conference room or a gym of the local university by professors (first and second author). All intervention materials are available from the first author upon request.

**Measures**

Self-report measures were used to assess the study variables, and all scales have been shown to be valid and reliable (Booth, Okely, Chey, & Bauman, 2001; Black & Deci, 2000; Cheon et al., 2012; Hagger et al., 2003; Markland & Tobin, 2004; Wang, Hagger, & Liu, 2009). Reliability indices of this study can be found in Table 1.

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<th>Variable List</th>
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*Note. p < .05. To report the practical meaningfulness of the statistical significant correlations coefficients, an absolute criterion was used (Zhu, 2012). Thus, the correlations <.20 were considered as not meaningful. PE = physical education, ICC = school level intraclass correlation. T1 = baseline, T2 = Time 2, and T3 = Time 3. Control group means and standard deviations are presented in the vertical columns and experiment group means and standard deviations in the horizontal columns. Cronbach’s alphas (α) for internal consistency internal consistency (full sample) are presented in the vertical column.

*Physical activity scale comprised only two items and, thus, the tests for internal consistency of the scales could not be performed. However, the Pearson’s correlations coefficients between two items indicated good internal consistency.
choices and options”) rating their agreement on a five-point Likert scale (1 = strongly disagree ... 5 = strongly agree).

**Perceived autonomous PE motivation.** To measure students’ autonomous motivation in PE, the Perceived Locus of Causality scale for PE (Wang et al., 2009) was used. The scale presents the stem, “I take part in this PE class ...” and presents 14 different motives for PE participation (4 items for external regulation and introjected regulation and three items for identified regulation and intrinsic motivation) measured on a five-point Likert scale (1 = strongly disagree ... 5 = strongly agree). Stimuli measuring intrinsic motivation in a leisure-time exercise setting, students re-

**Perceived autonomous exercise motivation.** To tap autonomous motivation in a leisure-time exercise setting, students responded to the Behavioral Regulations in Exercise Questionnaire 2 (Mullen & Markland, 1997). Participants were asked, “Why do you participate in active sports and/or vigorous PA in your spare time?” followed by four reasons from each motivational regulation (three for introjected regulation only). Items measuring intrinsic motivation (e.g., “I exercise because I am 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”), extrinsic regulation (e.g., “I exercise because others say I should”), and amotivation (e.g., “I don’t see why I should have to exercise”), were assessed on five-point Likert scales (1 = strongly disagree ... 5 = strongly agree). The Relative Autonomy Index was calculated by weighting the subscales and summing the weighted scores (external −2, introjected −1, identified +1, and intrinsic +2).

**PA intention.** Students’ intentions to be physically active in their leisure-time were assessed with three items drawn from Hagger et al. (2003). The first two items were rated on a seven-point Likert scale: “I intend to do active sports and/or vigorous physical activities” (1 = strongly disagree ... 7 = strongly agree) and “I intend to do active sports and/or vigorous physical activities with the following regularity” (1 = not at all ... 7 = every day). The third item, “During my leisure time over the next 5 weeks, I plan to do active sports and/or vigorous physical activities for at least 60 minutes, ___ days per week, was rated on a continuous open scale.

**PA.** To assess adolescents’ self-report PA, the Health Behavior in School-aged Children Research Protocol was used (Currie, Samdal, Boyce, & Smith, 2002). The scale incorporated a moderate-to-vigorous PA measure. The stem was: “In the next two questions physical activity means all activities which raise your heart rate or momentarily get you out of breath, for example, doing exercise, playing with your friends, going to school, or in school PE. Sport also includes, for example, jogging, intensive walking, roller skating, cycling, dancing, skating, skiing, soccer, basketball, and baseball.” The scale consisted of two items and was rated on an 8-point response scale (0–7 days of the week; e.g., “When you think about your typical week, on how many days are you physically active for a total of at least 60 minutes per day?”).

**Treatment fidelity.** Treatment fidelity, that is teachers’ adherence to intended instruction, was assessed using audiotape recordings. A total of 49 PE lessons were audiotaped, six per teacher, three prior to the start of the professional development and three during the last two weeks of the intervention. Three individuals were trained as observers in using a fidelity checklist designed by Haerens et al. (2013). The checklist consisted of 15 items, five items assessing each need-supportive strategy (autonomy – “takes the perspective of students into account, is empathic,” competence/structure – “uses variation between and within exercises;” and relatedness – “offers help during exercises”). The first author provided the training in three sessions (60–90 minutes each). In the first session, the observers were introduced to need-supportive instruction, starting with theoretical foundation of the model and following with the detailed identification of need-supportive instructional strategies. In the second session, the observers were introduced to the checklist used to distinguish between need-supportive instruction and other instructional forms. During the third training session, all three experts independently coded one PE class from the audiotape that included three stages, lesson warm up, activity, and cool down, using the checklist. Doubts raised during the coding process were discussed and registered. Every five minutes, the observers recorded the checklist items (i.e., “Teacher offers choice to the students?”) that were heard using a 4-point frequency scale (0 = never observed; 1 = sometimes observed; 2 = often observed; 3 = observed all the time).

Interrater reliability (interrater agreement) was calculated as a percent agreement across all 5-minute measurement phases among three observers. For example, if observers rated 10 measurement points agreeing 9 out of 10 times the reliability score was .90 (90%). In addition, an average score was calculated for each teacher combining all interval scores within each three stages of PE class separately for pre- and post-intervention condition. Finally, individual mean scores of every teacher were aggregated to generate a mean score for both experimental and control groups as well as both pre- and post-intervention condition. Haerens et al. (2013) have shown the observation checklist to be a valid measure of autonomy support in PE instruction.

**Data Analysis**

The analyses were performed in two phases, a preliminary and main phase. Normality of the data and tabulated descriptive statistics (means, standard deviations, and Pearson correlations) for all study variables were examined. Three sets of Bonferroni-corrected t tests were conducted to examine preliminary differences, first in all variables between students who completed all three data collection phases (n = 341) and students who had missing values (n = 67), second in baseline variables between the students in the experiment and control groups, and third baseline values in teachers’ observed instructional practices between the experiment and control groups. To examine the intervention effect in teachers’ observed instructional practices, three analyses of covariance were conducted separately for warm-up, main activity, and cooldown instruction. In addition, to test whether the intervention had an effect on outcome measures, we conducted three analyses of covariance separately for perception of PE autonomy support and autonomous PE motivation and PA variables. In these analyses, the post-intervention score was set as a dependent variable, the baseline score as a covariate, and the intervention condition as an independent variable. Finally, post hoc
contrast tests for estimated means were conducted using a Bonferroni-adjustment.

In the main analysis, a path analysis strategy was utilized to test the hypotheses of the study (Mulaik & Millsap, 2000). Based on the TCM, estimated covariance stabilities in regards of a priori default model were estimated as follows: perception of PE autonomy support (T2) → autonomous PE motivation (T2) → autonomous exercise motivation (T2) → PA intentions (T2) → PA participation (T3). Treatment was included in the equation as a dichotomous covariate (dummy variable). To control the role of students’ perceptions of their teachers previous autonomy support and participants’ previous PA behavior, the following covariates were included in the default model: perception of PE autonomy support (T1) to perception of PE autonomy support (T2), perceptions of autonomous motivation in PE (T1) to perception of autonomous motivation in PE (T2), and PA (T1) to perception of autonomous PE motivation (T2), autonomous exercise motivation (T2), PA intentions (T2), and PA (T3). Controlling the effect of previous PA participation is important, because it has shown to relate to motivational processes in PE and out-of-school contexts (Shen, 2012). $H1a$ was tested by examining the significance of the indirect effects from the experimental condition (teacher participation in the intervention program) to students’ perception of PE autonomy via students’ perceptions of autonomy support in PE. $H1b$ was tested by adding a direct regressive path from the experimental condition to autonomous motivation in PE. Our second and third hypotheses focused on the possible transition from PE context to exercise context. $H2$ was tested examining the effect of autonomous PE motivation on PA intentions via autonomous exercise motivation, whereas $H3a$ examined the significance of the indirect effects from the autonomous motivation in exercise to PA via PA intentions. Finally, $H3b$ was tested by adding a direct regressive path from autonomous exercise motivation to PA.

All analyses were performed using the SPSS (version 21) and Mplus (Version 7.1; Muthén & Muthén, 1998–2015). Alpha was set at $p < .05$ for all tests. Standardized mean changes were calculated, with values of 0.2 (small), 0.5 (moderate), and 0.8 (large) used as guidelines for interpreting analyses of covariance (Cohen, 1988). A COMPLEX option with maximum (large) used as guidelines for interpreting analyses of covariance models to correct a possible clustering in the data (Asparouhov, 2005). A model fits the data well when the $p$ value associated with the chi-square test is non-significant. In addition, if the values of the Bentler comparative fit index (CFI; Hair, Anderson, Tatham & Black, 2010) and Tucker-Lewis index (TLI; Awang, 2012) are above .95 and the values of the Root Mean Squired Error of Approximation (RMSEA) are below .06, a good fit between the hypothesized model and the observed data exists (Awang, 2012; Hair et al., 2010). To determine the statistical significance of possible indirect effects, bootstrapped asymmetric confidence intervals (CI) were calculated based on 5,000 bootstrapped samples (i.e., Hayes, 2009). A mediation or indirect effect is supported if the CI does not contain 0, suggesting that the independent variable significantly influences the mediator, which in turn influences the dependent variable. Finally, a chi-square difference test ($\Delta \chi^2$) was used to compare the competing models. In chi-square difference tests, two nested models (H0 and H1) are tested by constraining the subsequent components to be equal. If the $p$ value associated with the chi-square test is non-significant, H0 is rejected and an alternative hypothesis H1 accepted. In other words, a $p$ value <.001 for the chi-square difference tests indicates statistically significant differences in the estimated models.

## Results

### Fidelity Scores

Inter-rater reliability scores among the three observers for the pre-intervention lessons were .93, .94, and .88, and the post-intervention lessons .95, .95, and .89 during the warm-up, activity, and cooldown sessions, respectively. Objectively measured audio-taped pre-intervention scores showed that teachers provided very little autonomy support during PE classes (experimental group: $M_{warm\ up} = .33[.13]; M_{activity} = .61[.12]; M_{cooldown} = .79[.09]$, control group: $M_{warm\ up} = .39[.11]; M_{activity} = .51[.12]; M_{cooldown} = .86[.04]$). Post-intervention scores showed experimental group values to range between 1.25 and 2.15 ($M_{warm\ up} = 1.23[.23]; M_{activity} = 1.21[.46]; M_{cooldown} = 2.15[.29]$), whereas control group values were $M_{warm\ up} = .44[.23], M_{activity} = .59[.11], and M_{cooldown} = .91[.15]$. Analysis of covariance test results showed that there was a significant intervention effect on teachers’ warm up ($F[2,7] = 38.22, p = .002, \eta^2 = .18$), main activity ($F[2,7] = 32.84, p = .002, \eta^2 = .11$), and cooldown ($F[2,7] = 51.17, p = .001, \eta^2 = .14$) instruction. The analyses showed that teachers in the experimental condition were able to modify their teaching practices to be more autonomy supportive.

### Preliminary Analyses

Descriptive statistics are presented in Table 1. As shown, students’ perception of autonomy support in PE, autonomous motivation in PE, autonomous exercise motivation, and PA intention were statistically significant and positively related to each other. PA variables were statistically significant and positively related to PA intention and PE autonomy (T2). Bonferroni-corrected $t$ tests showed that there were no differences between students who responded to all three waves of data collection and the ones with missing values: PE autonomy support (T1) ($t[403] = .48, p = .651$), PE autonomy support (T2) ($t[390] = .78, p = .436$), PE autonomy (T1) ($t[402] = .72, p = .471$), PE autonomy (T2) ($t[378] = .89, p = .374$), exercise autonomy (T2) ($t[388] = .82 p = .412$), intention (T2) ($t[390] = .62, p = .390$), PA (T1) ($t[399] = .69, p = .491$), and PA (T2) ($t[390] = .71, p = .478$). These findings corroborate the assumption that missing values were at random. Similarly, there were no baseline differences between the experiment and control groups in perception of autonomy support in PE the motivation-related study variables: PE autonomy support (T1) ($t[403] = .28, p = .778$), PE autonomy (T1) ($t[402] = .50, p = .617$). However, there were statistically significant medium-sized baseline differences in the PA participation between experiment and control groups ($t[399] = 2.93, p = .004, d = .45$).

Analysis of covariance test results (see Table 2) showed that there was a significant intervention effect on autonomy support in PE ($F[2,407] = 38.29, p < .001, \eta^2 = .09$), autonomous motivation in PE ($F[2,407] = 23.70, p < .001, \eta^2 = .06$), and PA ($F[2,407] = 23.20, p < .001, \eta^2 = .06$). The Bonferroni-adjusted pairwise comparisons with estimated means showed that experimental group students’ perception of autonomy support ($M = 3.62[.83]$), autonomous motivation ($M = 3.59[.61]$), and PA ($M = 5.23[1.47]$) was statistically different from perception of autonomy support ($M = 3.31[.84]$), autonomous motivation ($M = 3.32[.63]$), and PA ($M = 4.12[1.76]$) among control group students.
Main Analyses

First, the default model was estimated. The model fit indices (see Table 2) showed an acceptable model fit: $\chi^2 (15) = 42.08, p < .001$, CFI = .97, TLI = .95, RMSEA = .068, CI 90% [.04, .09]. Next, several models were estimated to test research hypotheses. Finally, $\Delta \chi^2$ tests were used to test statistical differences between competing models.

**Hypothesis 1.** The path analysis (Model 1; $\chi^2 (19) = 59.40, p < .001$, CFI = .67, TLI = .93, RMSEA = .074, CI 90% [.05, .09]) showed that the experiment had a positive effect ($\gamma = .11$) on students’ perception of autonomy support, which, in turn, had a positive effect on student autonomous motivation in PE ($\beta = .29$) (H1a). The size of the effects were moderate to large, with experiment effect (together with baseline values) explaining 51% of the variance in students’ perception of autonomy support and 51% of the variance in their perception of autonomy.

Next, an alternative H1b (Model 2; $\chi^2 (18) = 57.58, p < .001$, CFI = .96, TLI = .93, RMSEA = .076, CI 90% [.05, .10]) were tested, in which an additional path from treatment effect directly to autonomous PE motivation was added. The analysis showed that the experiment did not have a statistically significant direct effect ($\gamma = .04, p > .05$) on students’ perception of autonomy in PE. However, the $\Delta \chi^2$ test showed that by allowing the regressive path the revised model (Model 2) was not statistically different compared to Model 1 ($\Delta \chi^2 = 1.82, p > .05$), thus the additional path was included in the next models. The final model with regressive paths and explanatory strength is illustrated in Figure 2.

**Hypothesis 2.** To test the statistical significance of the indirect effects, the path analysis using Model 2 ($\chi^2 (17) = 57.02, p < .001$, CFI = .95, TLI = .92, RMSEA = .078, CI 90% [.06, .10]) showed that students’ perception of autonomy during PE had a positive effect ($\beta = .63$) on their autonomous exercise motivation and, in turn, autonomous exercise motivation had a positive effect on PA intentions ($\beta = .37$). The indirect effect of students’ perception of autonomy in PE on PA intentions was weak ($\beta = .03, p < .01$, CI 95% [.01, .05]).

**Hypothesis 3.** The path analysis (Model 2) showed that students’ autonomous exercise motivation had a positive effect ($\beta = .37$) on their PA intentions and, in turn, PA intentions had a positive effect on PA ($\beta = .47$). The sizes of the effects were moderate to large, students’ exercise motivation together with their previous PA explaining 34% of the variance in students’ PA intentions and PA intentions together with their previous PA explaining 35% of the variance in their PA.

To test the statistical significance of the indirect effects, an additional direct path from autonomous exercise motivation to PA was estimated (Model 3). The analysis showed that autonomous motivation in exercise did not have a statistically significant direct effect ($\beta = -.03$) on students’ PA. However, a moderate and statistically significant indirect effect from autonomous exercise motivation via PA intentions to PA emerged ($\beta = .17, p < .01$, CI 95% [.11, .22]). Finally, the $\Delta \chi^2$ test showed that allowing autonomous exercise motivation directly to regress PA was not statistically different compared to Model 2 ($\Delta \chi^2 = .555, p > .05$),

**Table 2** Fit Indices of the Hypothesized Analysis of Covariance and Path Models

<table>
<thead>
<tr>
<th>Variables</th>
<th>Condition</th>
<th>Time 1 (Baseline) M(SD)</th>
<th>Time 2 M(SD)</th>
<th>Time 3 M(SD)</th>
<th>Intervention Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived PE autonomy</td>
<td>Experiment</td>
<td>3.54(.84)</td>
<td>3.68(.81)</td>
<td>na</td>
<td>38.29(2, 407)</td>
</tr>
<tr>
<td>PE autonomy</td>
<td>Control</td>
<td>3.53(.81)</td>
<td>3.28(.96)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise autonomy</td>
<td>Experiment</td>
<td>3.46(.61)</td>
<td>3.53(.64)</td>
<td>na</td>
<td>23.70(2, 407)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>3.47(.59)</td>
<td>3.30(.61)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA intentions</td>
<td>Experiment</td>
<td>na</td>
<td>3.71(.57)</td>
<td>na</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>na</td>
<td>3.09(.62)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PA</td>
<td>Experiment</td>
<td>5.13(1.68)</td>
<td>4.35(1.81)</td>
<td>5.17(1.49)</td>
<td>23.20(2, 407)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>4.35(1.81)</td>
<td></td>
<td>4.08(1.81)</td>
<td>&lt;.001(0.06)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>$\Delta \chi^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>42.084</td>
<td>15</td>
<td>&lt;.001</td>
<td>.97</td>
<td>.95</td>
<td>.068</td>
<td>.04, .09</td>
<td>1 vs. 2</td>
</tr>
<tr>
<td>Model 1</td>
<td>59.398</td>
<td>19</td>
<td>&lt;.001</td>
<td>.96</td>
<td>.93</td>
<td>.074</td>
<td>.05, .09</td>
<td>1 vs. 2</td>
</tr>
<tr>
<td>Model 2</td>
<td>57.578</td>
<td>18</td>
<td>&lt;.001</td>
<td>.96</td>
<td>.93</td>
<td>.076</td>
<td>.05, .10</td>
<td>1 vs. 3</td>
</tr>
<tr>
<td>Model 3</td>
<td>57.023</td>
<td>17</td>
<td>&lt;.001</td>
<td>.95</td>
<td>.92</td>
<td>.078</td>
<td>.06, .10</td>
<td>2 vs. 3</td>
</tr>
</tbody>
</table>

Figure 2 — A path model visualization of the intervention effects. Note: Solid arrows indicate the statistically significant effects, dashed significant covarying effects, and dashed-dot lines non-significant effects.

Effects of the intervention within physical education

Effects of the intervention within out-of-school context
thus the Model 3 was the best model to understand the effectiveness of the intervention in students’ PA.

Discussion

The aim of this study was to examine the effectiveness of autonomy supportive PE instruction on urban middle school students’ PE motivation, exercise motivation along with PA intentions and total PA. The findings showed that the PE teachers in an urban school district can learn to be more autonomy supportive and these findings are supported by previous studies implemented in school PE (Chatzisarantis & Hagger, 2009; Cheon et al., 2012). This is encouraging considering the previously identified barriers that may lead to instructional challenges in PE (McCaughtry et al., 2006). The study showed that the intervention was effective with experimental group students having higher perception of autonomy support, autonomous motivation, and PA compared to the students in the control group following the intervention. Specifically, the students whose teachers participated in the seven-week intervention program perceived their teachers’ teaching practices increasingly autonomy supportive whereas students’ in the control condition perceived their teachers’ teaching practices to be more controlling. More importantly, this change had a positive effect on their autonomous PE motivation and, thus, supported our first hypothesis (H1a) related to TCM Proposition 1. These findings corroborate with the previous findings derived from different cultural contexts (Hagger & Chatzisarantis, 2016) suggesting that urban PE students’ motivation can be nurtured using autonomy supportive instructional practices. In addition, the examination of the alternative hypothesis (H1b) showed that the teachers’ teaching practices did not have a direct relationship on students’ autonomous motivation, but the relationship was mediated through students’ perceptions of their teachers’ autonomy. In other words, students have to perceive changes in the teacher autonomy support to be autonomously motivated. Although some empirical findings have supported the alternative hypothesis (Chatzisarantis & Hagger, 2009), this finding highlights the importance of perceived autonomy support as an agent between instructional style and student autonomous motivation and supports the core premises of the TCM (Hagger et al., 2003; Hagger & Chatzisarantis, 2012).

According to TCM and SDT, autonomous motivation provides a basis for the formation of social cognitive judgments toward participating in specific behaviors, in this case, PA in the future (Deci & Ryan, 1985; Hagger et al., 2003). Prior empirical studies have supported this assumption, showing that autonomy support in PE affects an individual’s perceived locus of causality, which in turn influences her/his autonomous motivation in an out-of-school exercise context (Chatzisarantis & Hagger, 2009; Hagger et al., 2003, 2009). The likely mechanism for this is that the adaptive outcomes derived from autonomous activity in PE leads to an increased likelihood to experience autonomy toward PA. This is because individuals are likely to have a stored motivational and affective memory, which becomes a template for motivation toward similar activities (Hagger, 2014). Our study supported this assumption by showing that positive autonomous experiences in PE had a positive impact on their PA intentions through autonomous exercise motivation (H2; Proposition 2). Although the effect between autonomous motivation in PE and exercise along with the effect from autonomous exercise motivation to PA intentions were moderate to strong, the indirect effect from autonomous PE motivation to PA intentions, however, was weak.

In regard to the third hypothesis and Proposition 3, this study showed PA intentions to be the most proximal determinants of PA participation supporting the previous findings (Chatzisarantis & Hagger, 2009; Hagger et al., 2003, 2009) and the central tenets of TCM and TPB (Ajzen, 1991; Hagger et al., 2003). The effect of PA intentions on PA participation was moderately strong, with PA intentions together with previous PA explaining 35% of the variance in the students’ current PA. Interestingly, our study showed (H3a) that autonomous motivation in exercise did not directly predict PA, instead PA intentions acted as an agent transferring autonomous exercise experiences to PA participation. These findings support the SDT assumption in which autonomous motivation toward a given behavior will lead to positive attitudes toward the behavior and intentions to perform the behavior in the future (Deci & Ryan, 1985). It is noticeable, however, that this study did not examine the role of attitudes, subjective norms, and perceived behavioral control as determinants of intentions as theorized by Ajzen (1991) and empirically tested by others (see Hagger & Chatzisarantis, 2012). Based on the TCM, the decision-making process of attitudes, subjective norms, and perceived behavior mediates and explains the process by which autonomy transfers into intentions (Hagger & Chatzisarantis, 2012). The inclusion of these determinants in future studies would be beneficial in understanding how exercise motivation transfers into PA intentions.

As in all applied setting research studies, some limitations were encountered. Although this intervention was effective in impacting students’ perception of autonomy in PE and exercise contexts, the practical meaningfulness of the findings are limited due to small-to-moderate effect sizes. It is likely that longer lasting interventions are needed to influence students’ sustainable PA participation. This study, however, highlighted the pathways through which autonomous experiences in educational contexts may transfer to out-of-school contexts. It is also important to acknowledge that generalizability of our findings to other schools could be limited to schools whose principals and PE teachers are first to volunteer to participate in research studies. In addition, although all PE teachers participating in the study were experienced and tenured teachers, the teachers in the experimental group schools were almost 10 years older than control school teachers. Future studies may want to match not only student but also teacher populations. Adolescents’ PA was assessed with self-report measures, and therefore, the overall weekly PA levels may be biased. The validity and reliability of the World Health Organization’s Health Behavior in School-Aged Children study, however, has been shown to be acceptable (Booth et al., 2001). Finally, PA measures did not account for weather conditions that may change during October – December months. It is noticeable, however, that during the study, all schools participated in indoor PE curricular units and all classes were able to use indoor facilities, or a gym, for their scheduled PE classes.

Future studies are needed that are adopting rigorous intervention and experimental designs to test the specific premises of the TCM. Eventually, the body of evidence will help scholars to better determine the strengths of the relationships that will lead to increased PA participation. One possibility to improve rigor is to apply a structural equation modeling approach with latent variable analyses. This approach will provide possibility to estimate error term for the dependent variables. In addition, cross-cultural studies to examine the utility of TCM between different demographic and socio-economic status groups (both at the student- and teacher-level) are needed. This is important because previous studies
have shown that urban school PE teachers are facing instructional challenges that may impact both teachers and students (McCaughtry et al., 2006). Eventually, cross-cultural evidence should lead to better targeted interventions.

Conclusions

A majority of U.S. adolescents do not engage in the recommended amount of PA (Troiano et al., 2008), and this health dilemma is even more acute in an urban school setting (Dauenhauer & Keating, 2011). Examining various teaching techniques and strategies is essential to assist urban PE teachers to motivate their students to engage in more PA while in and out of school. Specifically, with the implementation of autonomy supportive instruction in their daily work PE teachers can impact their students’ autonomous motivation, which has shown to improve student engagement and effort as well out-of-school PA (Hagger & Chatzisarantis, 2016). Autonomy supportive instruction entails strategies, such as nurturing students’ inner motivational resources, relying on informal and non-controlling language, communicating value and providing rationale, and acknowledging and accepting students’ negative affect (Reeve, 2006).

This study expanded our understanding of motivational pathways to PA by providing evidence that changing urban PE teachers’ teaching practices to be more autonomy supportive has a positive effect on students’ motivation in PE. In addition, the study supported the TCM as a framework to understand the impact of motivational experiences in educational contexts on the motivation in an out-of-school context. Assisting teachers to know about and then how to implement autonomy supportive strategies is a solid approach to eventually motivate students to choose to be active and, therefore, to have a positive impact on their health status.

References


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