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Experimentally Based, Longitudinally Designed, Teacher-Focused Intervention to Help Physical Education Teachers Be More Autonomy Supportive Toward Their Students

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Using the field's state-of-the-art knowledge, we designed, implemented, and assessed the effectiveness of an intervention to help physical education (PE) teachers be more autonomy supportive during instruction. Nineteen secondary-school PE teachers in Seoul were randomly assigned into either an experimental or a delayed-treatment control group, and their 1,158 students self-reported their course-related psychological need satisfaction, autonomous motivation, amotivation, classroom engagement, skill development, future intentions, and academic achievement at the beginning, middle, and end of the semester. Observers' ratings and students' self-reports confirmed that the intervention was successful. Repeated-measures ANCOVAs showed that the students of teachers in the experimental group showed midsemester and end-of-semester improvements in all dependent measures. A multilevel structural equation model mediation analysis showed why the teacher-training program produced improvements in all six student outcomes—namely, teachers in the experimental group vitalized their students' psychological need satisfaction during PE class in ways that teachers in the control group were unable to do, and it was this enhanced need satisfaction that explained the observed improvements in all six outcomes.

Keywords: autonomy support, coaching, motivation, physical education, teaching

When successful, a secondary-school physical education (PE) class introduces students to a wide range of sport and exercise activities and, in doing so, enhances their classroom motivation and engagement, promotes their sport- and exercise-related skills, and grows their intentions to continue in lifelong physical activity. Unfortunately, students do not universally culminate their PE classes with such

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positive experiences (Brooks & Magnusson, 2006; Ntoumanis, Pensgaard, Martin, & Pipe, 2004). Recognizing this, the threefold premise on which the current study was undertaken was that PE teachers influence their students' course-related motivation and outcomes, this influence occurs largely through a teacher's classroom motivating style, and teacher-provided autonomy support enhances (whereas teacher control undermines) students' motivation and outcomes (following Reeve, 2009).

In the self-determination theory of student motivation (SDT; Deci & Ryan, 2000; Ryan & Deci, 2000), three psychological needs—autonomy, competence, and relatedness—are collectively conceptualized as psychological nutrients that students need fulfilled if they are to enhance their classroom functioning (e.g., engagement, learning, and performance) and personal growth (e.g., intrinsic motivation, task enjoyment). Though these needs are hypothesized to be inherent in all students, they exist as unrealized latent potentials that require supportive classroom conditions for their satisfaction. In SDT, environmental support comes largely through the teacher's motivating style during instruction (Deci, Schwartz, Sheinman, & Ryan, 1981; Reeve, 2009). Specifically, teacher-provided autonomy support, structure, and involvement support students' psychological needs for autonomy, competence, and relatedness, respectively (Ntoumanis & Standage, 2009; Taylor & Ntoumanis, 2007). In the current study, we followed Deci's original theoretical framework (Deci et al., 1981) to adopt a narrow conceptualization of motivating style that focused only on autonomy support rather than generally on autonomy support, structure, and involvement. We did so because teachers' provision of autonomy support has been shown to be fully capable of nurturing all three psychological needs (Standage, Duda, & Ntoumanis, 2006) and because we wanted to focus teachers' attention during the training on the single-minded instructional task of supporting their students' autonomy.

Self-determination theory is unique among theories of motivation and approaches to instruction in that the teacher strives to vitalize students' psychological needs to the point that psychological need satisfaction, rather than the teacher or external events per se, energizes and directs students' classroom activity. To vitalize these needs, autonomy-supportive teachers begin instruction by adopting their students' perspective and by incorporating students' input and suggestions into the day's instruction (Reeve & Halusic, 2009). During instruction, they enact the following: *nurture inner motivational resources* by tapping into and vitalizing students' psychological needs; *rely on noncontrolling language* by communicating in ways that convey flexibility (e.g., offering information about options) and minimize pressure (absence of "have to's"); *provide explanatory rationales* to help students understand why a particular request or activity (e.g., stretching before class) has personal utility; and *acknowledge and accept negative affect* by acknowledging that some teacher requests are legitimate despite being in conflict with students' preferences. These autonomy-supportive acts of instruction are derived from self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000), have been described in detail with examples elsewhere (Reeve, 2009, 2011), have been empirically validated as autonomy supports through both laboratory experiments and classroom-based investigations (Assor, Kaplan, & Roth, 2002; Koestner et al., 1984; Reeve & Jang, 2006; Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005), and predict positive outcomes in the context of both PE instruction (Ntoumanis, 2005; Shen, McCaughy, Martin, & Fahlman, 2009; Vansteenkiste, Simons, Soe-

nens, & Lens, 2004) and the coaching of athletes (Amorose & Anderson-Butcher, 2007; Mageau & Vallerand, 2003).

Intervention Programs Designed to Help Teachers Support Student Autonomy

Physical education teachers, exercise instructors, and athletic coaches can learn how to be significantly more autonomy supportive toward their students and athletes (Chatzisarantis & Hagger, 2009; Edmunds, Ntoumanis, & Duda, 2008; Tessier, Sarrazin, & Ntoumanis, 2008, 2010). These intervention-based studies all first invited experienced teachers (or instructors, coaches) to participate in a training intervention that was based on SDT principles of autonomy support; second, asked those teachers to implement autonomy-supportive teaching over the course of weeks or months; and third, assessed the course-specific (or sport-specific) outcomes their students or athletes experienced. The two general findings have been that, first, trained teachers, instructors, and coaches do generally learn how to be more autonomy supportive and, second, the students of these trained participants show meaningful gains in terms of their motivation and indices of physical activity.

Su and Reeve (2011) conducted a meta-analysis of 19 autonomy-supportive intervention studies (including those both inside and outside of sport, exercise, and physical education) to explain why some interventions were more effective than were others. The relatively less effective interventions tended to include most of the following: (1) a training experience that featured only a subset of the four earlier-listed autonomy-supportive instructional behaviors; (2) a too-brief training experience; (3) an intervention that focused more on content (what autonomy support is) than on skill (how to be autonomy supportive); (4) the absence of a group discussion component where teachers could express their concerns and share ideas; (5) an over-reliance on reading materials and an under-reliance on electronic media to deliver the intervention; (6) a failure to address participants' pretraining beliefs, values, and personality dispositions that otherwise might conflict with the training message; (7) the absence of supplemental follow-up activities to boost the original intervention experience; and (8) the absence of a continuing flow of support throughout the intervention's implementation, as through the availability of an ongoing mutual support group. Some of these studies also suffered from serious methodological limitations, including the lack of an appropriate control group, failure to use random assignment to conditions, the inclusion of a very low number of participants, a failure to include an appropriate manipulation check, and a failure to obtain objective ratings of posttraining instructional behaviors. In the current study, our goal was to use the field's state-of-the-art knowledge as to what constitutes a highly effective teacher training program and then design, implement, and assess the effectiveness of that best-practices training intervention program.¹

Past teacher-training programs with PE teachers have been very informative, but each has left open the question as to whether trained teachers continue to instruct in autonomy-supportive ways in the future. It is possible that trained teachers might revert back to their naturally occurring (pretraining) motivating styles after their initial training experience, as the effects of the training may wear off or be overwhelmed by day-to-day pressures and circumstances. Alternatively,

it is equally plausible that trained teachers might learn how to become increasingly more autonomy supportive, as they might show initial gains in their capacity to enact autonomy support yet later show an even more advanced capacity to do so with increased experience, familiarity, practice, feedback, and reflection. Hence, our plan was to use a longitudinal research design in which we assessed teachers' motivating style and students' course-related outcomes at three successive points during the semester—at the beginning of the semester, at midsemester, and at end of the semester. By doing so, we sought to track developmental gains (or declines) in both teachers' motivating styles and in their students' course-related outcomes.

Hypothesized Models

We proposed two hypothesized models. Hypothesized Model #1 predicted that the experimental condition (teacher participation in the intervention program) would enhance students' psychological need satisfaction during the PE course. This model predicted a positive effect by midsemester (T2, Time 2), but it further predicted an additional training-induced increase in students' psychological need satisfaction by the end of the semester (T3, Time 3).

Hypothesized Model #2 predicted that experimental conditions would have a direct positive effect on all six T3 student outcomes, but that each of these main effects would be fully mediated by the extent of students' training-induced T2 gains in psychological need satisfaction. We selected six student outcomes that we felt best represented a positive PE course experience—autonomous motivation, (lack of) amotivation, classroom engagement, perceived skill development, intentions for future physical activity, and PE-specific course achievement. As a mediation model, hypothesized Model #2 proposed that the reason why the students of teachers in the experimental group would experience significant T3 improvements in all six student outcomes was because they would first experience experimentally induced gains in their midsemester (T2) psychological need satisfaction (following Adie, Duda, & Ntoumanis, 2008; Markland & Tobin, 2010; Ntoumanis, 2001; Taylor & Lonsdale, 2010; Taylor et al., 2010).

Method

Participants

Teacher Participants. The teacher participants were 21 experienced PE teachers (14 males, 7 females) who taught in one of 21 different schools (18 middle schools, 3 high schools) in Seoul, South Korea.² All teacher participants were ethnic Korean, and all were full-time certified teachers who taught physical education. Each teacher taught between five and seven classes, with class sizes that ranged from 35 to 40 students. The teachers had an average of 4.1 years of teaching experience (*range* = 2–8 years) and were, on average, 30.5 years of age (*range* = 26–37). The content of the courses they taught was designated by the Korean National and Educational Curriculum and included weekly activities devoted to the following sport-based physical activities: track and field, loop jumping, softball, soccer, badminton, basketball, gate ball, ping-pong, and swimming. All 21 teacher participants completed the first wave of data collection, including observers rating their in-class

motivating style and having their students complete the T1 questionnaire. By the second wave of data collection, only 19 of the original 21 teachers were able to continue in the study. The 19 persisting teachers did not differ significantly from the 2 dropout teachers either on the raters' scoring of their instructional behavior or on students' perceptions of their motivating styles ($ts < 1$). For the third wave of data collection, all 19 participating teachers continued in the study. In appreciation for their participation, each teacher received the equivalent of \$40.

Student Participants. The student participants were 1,430 ethnic Korean students. All of these participants completed the T1 questionnaire. During the second wave of data collection, 1,194 of the original student participants completed the questionnaire. Of these 236 dropout students, 140 were in the classes of the two dropout teachers. Excluding the students from these two teachers, the retention rate at T2 was 93% (1194/1290). The 1,194 persisting students from T1 did not differ significantly from the 96 dropout students from T2 on any of the 11 dependent measures assessed at T1, all $ts < 1$. During the third wave of data collection, 1,158 of the 1,194 students from the first two waves of data collection completed the questionnaire at T3. The 1,158 persisters did not differ significantly from the 36 dropouts from T3 on any of the 11 dependent measures, all $ts < 1$. The final sample of 1,158 student participants represented a retention rate of 90% (1158/1290). This final sample consisted of 550 (47%) females and 608 (53%) males, of whom 1,025 (89%) were in middle school and 133 (11%) were in high school.

Procedure

Forty practicing PE teachers in the Seoul metropolitan area were contacted by the Human Performance Laboratory in the Department of Physical Education at Korea University. Twenty-nine of these teachers (73%) expressed an interest in the study, received information about the study and its timeline, and sought the consent of their school principal. Eight of these 29 teachers were charged with duties that made it difficult for them to participate in all phases of the study, so the study began with a sample of 21 volunteer teachers. The timeline for the experimental procedures appears in Figure 1. Teachers were first randomly assigned into either the experimental or control group. The teachers in the experimental group participated in the three-part intervention during the spring semester (late-February through mid-July), whereas teachers in the control group received the intervention training experience after the study ended.

Autonomy-Supportive Intervention Program (ASIP)

Participation in the autonomy-supportive intervention program (ASIP) constituted the study's independent variable. The ASIP was provided in three waves. Part 1 was a 3-hr workshop-like experience. It began with a reflective warm-up activity in which teachers read two teaching scenarios, one that described highly autonomy-supportive teaching and another that described highly controlling teaching, and answered questions about how well these scenarios described their own teaching. A media-rich PowerPoint presentation followed to discuss the nature of student motivation (what it is, where it comes from), teachers' motivating styles toward students, classroom examples of autonomy-supportive instruction, and empirical

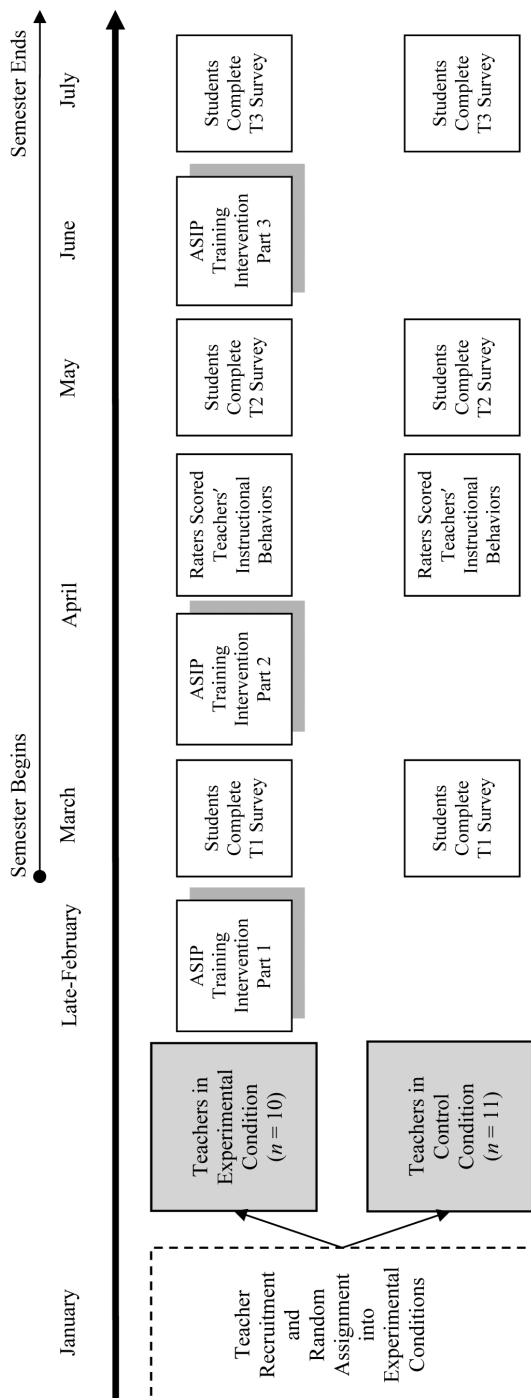


Figure 1 — Procedural timeline for the autonomy-supportive teacher training intervention and data collection.

evidence on the benefits of teacher-provided autonomy support. Part 1 concluded with a group discussion about the feasibility, potential obstacles, and specific “how to” ideas related to enacting an autonomy-supportive style in the context of the Korean PE classroom.

Part 2 took place 6 weeks later, and it lasted 2 hr. It began with a brief PowerPoint presentation of autonomy-supportive teaching that reinforced the presentation from Part 1. Teachers then engaged in a group discussion about the autonomy-supportive instructional behaviors they had experimented with to that point in the semester. It was a shared information and discussion session in which teachers voiced their concerns, identified potential obstacles, and shared, suggested, and critiqued specific approaches to instruction, usually within the context of a specific sport-based activity (e.g., during a badminton activity).

Part 3 took place 6 weeks later. It consisted of a group discussion that centered largely on sharing ideas in how to be autonomy supportive during PE instruction.

For all three parts of ASIP, teacher attendance was excellent. For Part 1, all 10 teachers in the experimental group attended and participated, although 1 teacher from the experimental group later dropped out of the study. For Parts 2 and 3, 8 of the 9 persisting teachers in the experimental group attended and participated. For the absent teacher, a member of the research team visited the teacher the following day during the teacher's open period to provide the materials and to communicate what was discussed and suggested during the group discussion.

Two supplemental booster activities were provided to teachers in the experimental group. The first consisted of a one-page handout that listed three reflective questions, each of which was designed to help the teacher reflect on the day's teaching (e.g., “Would you describe your teaching today as mostly controlling or as mostly autonomy-supportive?”). Using the handout, the teacher was encouraged to set a specific instructional goal for the next PE class in terms of enacting an autonomy-supportive style (e.g., offer explanatory rationales for requests). The second invited teachers to keep a structured diary of their effort to enact an autonomy-supportive motivating style during instruction.

Raters and the Rating Sheet

Before the study, we trained four raters who were highly familiar with SDT in how to score teachers' classroom instruction in terms of autonomy-supportive and controlling teaching. When they visited teachers' classrooms, raters worked in pairs, came to the class unannounced (5 min before the start of class), and did not know into which group (experimental or control) the observed teacher had been assigned. The two raters made independent ratings as they nonintrusively scored the classroom dynamics. A replica of the observer's rating sheet appears in Figure 2. It includes four instructional behaviors presented in a bipolar format with the autonomy-supportive behavior on the right side (scored as 7) accompanied by illustrative descriptors and the controlling behavior on the left side (scored as 1) accompanied by illustrative descriptors. This rating sheet has been used successfully in past studies, and it has produced scores that were both reliable (high interrater reliabilities, high internal consistencies) and valid (observers' ratings correlated with students' self-reports; Reeve et al., 2004). In the current study, the ratings from

Relies on Extrinsic Sources of Motivation * Offers Incentives, Consequences * Utters Directives, Deadlines * Gives Assignments * Seeks Compliance	1	2	3	<u>4</u>	5	6	7	Nurtures Inner Motivational Resources * Tries to Enhance Interest, Enjoyment, Curiosity * Appeals to a Sense of Challenge * Creates Opportunities for Choice, Initiative * Supports Competence, Confidence, Relatedness
Relies on Controlling Language * Is Controlling, Coercive, Intrusive * Says: “Should”, “Must”, “Have to”, or “Got to” * Is Pressuring, Rigid, Ego-Involving, No Nonsense	1	2	3	<u>4</u>	5	6	7	Relies on Informational Language * Is Informational, Flexible, Responsive * Says: “You may” or “You might” want to... * Is Noncontrolling, Nonpressuring
Neglects to Provide Explanatory Rationales * Does <i>not</i> Say: “Because”, “So”, or “The Reason Is...” * Neglects to Identify the Value, Meaning, Use, Benefit, or Importance of a Task or Request	1	2	3	<u>4</u>	5	6	7	Provides Explanatory Rationales * Says: “Because”, “So”, or “The Reason Is” * Identifies/Points Out the Value, Meaning, Use, Benefit, or Importance of a Task or Request
Counters and Tries to Change Negative Affect * Counters Students’ Expressions of Negative Affect or Signals of Task/Request Resistance * Communicates that Negative Affect, Resistance, or Complaints Are <i>not</i> OK, Are Unacceptable, or Are Something to be Changed/Fixed	1	2	3	<u>4</u>	5	6	7	Acknowledges and Accepts Negative Affect * Listens Openly, Non-Defensively, Carefully, Understandingly to Students’ Expressions of Negative Affect and to Signals of Task/Request Resistance * Accepts Negative Affect and Resistance as OK; Communicates that Complaints are OK
<i>Note for Each Rating:</i> Use the bold, underlined 4 as your starting/anchor point.								

Figure 2 — Observers’ rating sheet to score teachers’ autonomy-supportive versus controlling instructional behaviors.

the two observers were highly positively correlated on each instructional behavior (r s of .78, .81, .91, and .92, respectively). Given these high reliabilities, we averaged the two ratings into a single score for each of the four autonomy-supportive instructional behaviors.

Measures

Students completed a four-page questionnaire that assessed 11 dependent measures, 2 of which served as manipulation checks (perceived autonomy-supportive teaching, perceived controlling teaching) and 9 of which served as student outcomes (autonomy need satisfaction, competence need satisfaction, relatedness need satisfaction, autonomous motivation, amotivation, classroom engagement, perceived skill development, future intention toward physical activity, and PE-specific course achievement). Before the study, each measure was translated into Korean following the guidelines recommended by Brislin (1980). We translated each English measure into Korean using a professional English-Korean translator. Once done, two graduate students who were native Korean and fluent in both languages then carried out separate English back-translations. Any discrepancies that emerged between the translators were discussed until a consensus translation was reached. Once translated, 35 middle-school students taking a PE class read the questionnaire for clear meaning, though only minor adjustments were needed. Each scale used the same 1–7 bipolar response scale in which each individual response had its own corresponding description, as follows: 1 = *strongly disagree*; 2 = *moderately disagree*; 3 = *slightly disagree*; 4 = *neutral*; 5 = *slightly agree*; 6 = *moderately agree*; 7 = *strongly agree*.

Perceived Autonomy-Supportive and Controlling Teaching. To assess perceptions of autonomy-supportive teaching, students completed the six-item short version of the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996). The short version of the LCQ has been widely used in investigations of autonomy support (Black & Deci, 2000; Jang et al., 2009). We slightly modified the LCQ by changing “My teacher” to “My PE teacher” (e.g., “My PE teacher provides me with choices and options.”). Scores on the LCQ were internally consistent throughout each student assessment (T1, $\alpha = .83$; T2, $\alpha = .88$; T3, $\alpha = .93$). To assess perceptions of controlling teaching, students completed the slightly modified four-item Controlling Teacher Scale (CTS; Jang et al., 2009), as we changed the “My teacher” wording to “My PE teacher” (e.g., “My PE teacher puts a lot of pressure on me.”). Scores on the CTS showed acceptably levels of internal consistency (T1, $\alpha = .74$; T2, $\alpha = .80$; T3, $\alpha = .84$). Scores from the CTS have been shown to correlate negatively with scores from the LCQ (Jang et al., 2009).

Psychological Need Satisfaction. To assess *autonomy need satisfaction*, students completed a five-item perceived autonomy scale that has been widely used within the PE setting (Cheon & Moon, 2010; Cox & Williams, 2008; Standage et al., 2006; Taylor & Lonsdale, 2010; Taylor et al., 2010). Scores on the autonomy need satisfaction scale (e.g., “In this PE class, I feel that I do PE activities because I want to.”) were highly internally consistent throughout each student assessment (T1, $\alpha = .85$; T2, $\alpha = .88$; T3, $\alpha = .91$). To assess *competence need satisfaction*, students completed the four-item perceived competence subscale from the version

of the Intrinsic Motivation Inventory developed specifically for sport-based activity (McAuley, Duncan, & Tammen, 1989). This perceived competence measure (e.g., “I think I am pretty good at PE.”) has shown strong psychometric properties when applied in PE settings (e.g., internal consistency, factorial and predictive validity; Ntoumanis, 2001; Standage et al., 2006; Taylor et al., 2010). Scores on the competence need satisfaction scale were highly internally consistent (T1, $\alpha = .90$; T2, $\alpha = .90$; T3, $\alpha = .90$). To assess *relatedness need satisfaction*, students completed the four-item perceived relatedness scale that measures students’ felt closeness to their classroom teacher (Furrer & Skinner, 2003). Teacher relatedness is only one aspect of relatedness need satisfaction, as PE students also experience varying degrees of peer relatedness, but we focused only on teacher relatedness because our study was a teacher intervention. We adapted the scale for the PE classroom setting by rewording the stem “When I am with my teacher . . .” to “When I am with my PE teacher. . .” Sample items that complete this stem include, “I feel accepted” and “I feel ignored” (reverse scored). Scores on the relatedness need satisfaction scale showed acceptable internal consistency (T1, $\alpha = .75$; T2, $\alpha = .75$; T3, $\alpha = .78$).

Autonomous Classroom Motivation; Amotivation. To assess both autonomous motivation and amotivation, we used the Perceived Locus of Causality scale for PE (PLOC; Goudas, Biddle, & Fox, 1994), which is a PE-specific version of the more general academic self-regulation questionnaire (Ryan & Connell, 1989). The PLOC for PE offers the stem, “I take part in this PE class...” and lists 20 different reasons for participating in PE class (five scales with four reasons per scale). The intrinsic motivation (IM) scale represents highly autonomous motivation (e.g., “because it is enjoyable”), the identified regulation (ID) scale represents autonomous motivation (e.g., “because it is important”), the introjected regulation (IJ) scale represents controlled (nonautonomous) motivation (e.g., “because I want the teacher to think I am a good student”), and the extrinsic regulation (EX) scale represents highly controlled motivation (e.g., “because that is the rule”). Following the guidelines recommended by Standage and his colleagues (2006), autonomous motivation was scored using the relative autonomy index (RAI) in which the four scale scores are weighted and combined into one overall score, using: $2 \text{ (IM)} + \text{ID} - \text{IJ} - 2 \text{ (EX)}$. Scale reliabilities were as follows: Intrinsic motivation, T1, $\alpha = .89$, T2, $\alpha = .88$, T3, $\alpha = .90$; identified regulation, T1, $\alpha = .82$, T2, $\alpha = .85$, T3, $\alpha = .88$; introjected regulation: T1, $\alpha = .59$, T2, $\alpha = .61$, T3, $\alpha = .67$; and external regulation, T1, $\alpha = .51$, T2, $\alpha = .51$, T3, $\alpha = .52$. While the alpha coefficients for the two controlled motivation scales (IJ and EX) were low, the overall 16-item reliability of the T1, T2, and T3 autonomous motivation measures were adequate (4 IM items, 4 ID items, 4 IJ items—reverse scored, and 4 EX items—reverse scored): T1, $\alpha = .75$; T2, $\alpha = .74$; T3, $\alpha = .79$. The PLOC for PE also contains a fifth scale to score amotivation. Amotivation scores a lack of (autonomous or controlled) motivation (e.g., “but I can’t see what I’m getting out of PE”). Scores on the amotivation scale were highly internally consistent (T1, $\alpha = .90$; T2, $\alpha = .90$; T3, $\alpha = .90$).

Classroom Engagement. Following the consensus perspective in the classroom engagement literature (Christenson, Reschly, & Wylie, 2012; Reeve & Tseng, 2011), we conceptualized students’ classroom engagement as a multidimensional construct consisting of the four following aspects: behavioral, emotional, cognitive,

and agentic. To assess behavioral engagement, we used a slightly modified version of Skinner and colleagues' (2009) five-item scale (modified for the PE classroom context) to assess extent of attention, effort, and persistence during class (e.g., "In PE class, I work as hard as I can."). To assess emotional engagement, we used a slightly modified version of Skinner and colleagues (2009) five-item scale to assess the extent of positive emotions during PE class (e.g., "When I am in PE class, I feel good."). To assess cognitive engagement, we used a slightly modified version of Wolters' (2004) five-item scale to assess the use of sophisticated (rather than superficial) learning strategies while trying to learn PE-related skills (e.g., "When learning a PE activity, I try to relate what I'm learning to what I already know."). To assess agentic engagement, we used a slightly modified version of Reeve and Tseng's (2011) five-item scale to assess students' constructive contribution into the flow of the instruction they received (e.g., "During this class, I express my preferences and opinions."). Scores on all four engagement scales showed acceptable levels of internal consistency: Behavioral engagement, T1, $\alpha = .73$, T2, $\alpha = .85$, T3, $\alpha = .87$; emotional engagement, T1, $\alpha = .78$, T2, $\alpha = .77$, T3, $\alpha = .87$; cognitive engagement, T1, $\alpha = .62$, T2, $\alpha = .74$, T3, $\alpha = .71$; and agentic engagement, T1, $\alpha = .87$, T2, $\alpha = .89$, T3, $\alpha = .90$. As expected, the four scales were intercorrelated, so we equally weighted and averaged the scores into one overall classroom engagement score at T1 (four-item $\alpha = .78$), T2 (four-item $\alpha = .82$), and T3 (four-item $\alpha = .87$).

Skill Development. To assess students' perceptions that they were developing sport- and physical activity-related skills during the PE course, we created a new four-item measure. To create the items, we conducted a focus group interview with several middle-school PE students who had just completed a PE class to ask them what it meant to develop skills in their just-completed PE course. From students' responses and suggestions, we identified four experiences that students voiced as indicative of developing (or not) PE-related skills: "I have learned new and important skills during this PE class"; "I have learned a lot in this PE class"; "I am more physically fit now that I was at the beginning of this PE class"; and "I have improved myself as a person because of this PE class." Scores on this newly developed scale were internally consistent (T1, $\alpha = .83$; T2, $\alpha = .79$; T3, $\alpha = .85$).

Intentions Toward Future Physical Activity. To assess their intentions to engage in postcourse physical activity, students completed the three-item measure of future intentions that has been used successfully in the PE domain (Ntoumanis, 2005; Taylor et al., 2010). A sample item is, "In the future, I intend to make sports and physical activity a part of my life." Scores showed acceptable internal consistency (T1, $\alpha = .83$; T2, $\alpha = .79$; T3, $\alpha = .85$).

Academic Achievement. To assess PE-specific course achievement, students completed the following single item to assess their anticipated achievement at the beginning, middle, and end of the course: "In this PE class, I expect that my course grade will be ____ points (enter a number between 0-100)." This same measure has been used successfully in prior longitudinal research (Jang et al., 2012), and it has been used with Korean middle school students (Jeon, 2004). In the Jeon (2004) study, the anticipated achievement item, assessed during the last 2 weeks of class, correlated highly with the actual school record of students' objective achievement (i.e., their course grade), $r = .91$. While the actual, objectively scored course grade

would almost always be the preferred indicator of student achievement, our student-generated measure had the key advantage of allowing us to include an achievement indicator across all three waves of data collection, something not possible when using only the actual school record (because no achievement score would exist during the earlier waves of data collection).

Results

Preliminary Analyses

Before the main analyses, we tested for possible associations between gender and grade level with the study's dependent measures. Gender was associated with 8 of the 9 student outcome measures assessed at baseline, with males scoring higher than females on perceived autonomy, M_s , 4.44 vs. 4.18, $t(1156) = 3.86$, $p < .01$, perceived competence, M_s , 3.92 vs. 3.46, $t(1156) = 5.44$, $p < .01$, autonomous motivation, M_s , 5.85 vs. 4.31, $t(1156) = 5.06$, $p < .01$, classroom engagement, M_s , 4.27 vs. 3.98, $t(1156) = 5.69$, $p < .01$, skill development, M_s , 4.58 vs. 4.24, $t(1156) = 5.19$, $p < .01$, future intentions, M_s , 4.85 vs. 4.52, $t(1156) = 4.19$, $p < .01$, academic achievement, M_s , 83.1 vs. 79.0, $t(1156) = 3.67$, $p < .01$, and lower on amotivation, M_s , 2.15 vs. 2.45, $t(1156) = 4.13$, $p < .01$. Grade level was associated with two of the nine student outcomes at baseline, with high school students scoring higher than middle school students on perceived autonomy, M_s , 4.51 vs. 4.28, $t(1156) = 2.16$, $p < .05$, and future intentions, M_s , 4.99 vs. 4.63, $t(1156) = 2.89$, $p < .01$. Given these associations, we included gender (females = 0; males = 1) and grade level (middle school = 0; high school = 1) as covariates (i.e., as statistical controls) in all subsequent analyses.

Manipulation Checks

We assessed the fidelity of the ASIP experimental manipulation in two ways. First, trained observers rated teachers' actual classroom instructional behaviors in the first half of the semester. Second, students self-reported their perceptions of their teachers' autonomy-supportive teaching and controlling teaching at three times during the semester.

Objective Ratings of Teachers' Motivating Style. Raters scored the teachers in the experimental group as enacting more autonomy-supportive instructional behaviors than did the teachers in the control group: nurtures inner motivational resources, M_s , 6.10 vs. 5.18; $t(19) = 1.95$, $p < .07$, two-tailed, $d = .90$; relies on informational language, M_s , 5.80 vs. 4.04; $t(19) = 3.55$, $p < .01$, $d = 1.72$; offers explanatory rationales, M_s , 6.25 vs. 4.18; $t(19) = 4.58$, $p < .01$, $d = 2.18$; and acknowledges and accepts expressions of negative affect, M_s , 5.95 vs. 4.63; $t(19) = 2.69$, $p < .01$, $d = 1.17$.

Students' Perceptions of Teachers' Motivating Style. To assess the effect of the teacher training program on students' perceptions of their teachers' motivating style, we conducted a pair of 2 (experimental condition) $\times$ 3 (time of assessment) repeated-measures ANCOVAs (one for perceived autonomy-supportive teaching, a second for perceived controlling teaching). In these ANCOVAs, experimental

condition was the between-participant independent variable, time of assessment was the repeated within-participant independent variable, and the three covariates were gender, grade level, and baseline perception of the teachers' motivating style. Mean scores adjusted for the covariates appear in Figure 3 broken down by both experimental condition and time of assessment. In conducting pairwise mean comparisons, we used the Bonferroni post hoc t procedure. As expected, students' perceptions of their teachers' autonomy-supportive teaching and controlling teaching were consistently negatively correlated: T1, $r(1158) = -.36, p < .01$; T2, $r(1158) = -.36, p < .01$; and T3, $r(1158) = -.41, p < .01$.

For *perceived autonomy-supportive teaching*, the two conditions did not differ at baseline, $t(1154) = 0.63, ns$, the condition main effect was significant, $F(1, 1154) = 47.83, p < .01, \eta^2 = .04$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 48.93, p < .01, \eta^2 = .08$. As illustrated in left-hand panel in Figure 3, perceived autonomy support increased significantly for the students of the teachers in the experimental group from T1 to T2 ($p < .01$) and from T2 to T3 ($p < .01$), whereas it decreased significantly for students of the teachers in the control group from T1 to T2 ($p < .01$) and then leveled off from T2 to T3 (ns).

For *perceived controlling teaching*, the two conditions did not differ at baseline, $t(1154) = 1.27, ns$, the condition main effect was significant, $F(1, 1154) = 34.74, p < .01, \eta^2 = .03$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 20.86, p < .01, \eta^2 = .04$. As illustrated in right-hand panel in Figure 3, perceived controlling teaching decreased significantly for the students of the teachers in the experimental group from T1 to T2 ($p < .01$) and then leveled off T2 to T3 (ns), whereas it increased significantly for the students of teachers in the control group from T1 to T2 ($p < .01$) and from T2 to T3 ($p < .01$).

Student Motivation

For *autonomy need satisfaction*, the two conditions did not differ at baseline, $t(1154) = 0.91, ns$, the condition main effect was significant, $F(1, 1154) = 31.15, p < .01, \eta^2 = .03$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 23.44, p < .01, \eta^2 = .04$. As illustrated in upper-left panel in Figure 4, autonomy need satisfaction increased significantly for the students of teachers in the experimental group from both T1 to T2 ($p < .01$) and T2 to T3 ($p < .01$), whereas it remained unchanged for the students of teachers in the control group from T1 to T2 (ns) and from T2 to T3 (ns).

For *competence need satisfaction*, the two conditions did not differ at baseline, $t(1154) = 0.18, ns$, the condition main effect was significant, $F(1, 1154) = 12.73, p < .01, \eta^2 = .01$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 15.80, p < .01, \eta^2 = .03$. As illustrated in upper-right panel in Figure 4, competence need satisfaction increased for both groups from T1 to T2 ($p < .01$) and from T2 to T3 ($p < .01$), although the rate of increase for the students of teachers in the experimental group was more pronounced than it was for the students of teachers in the control group (as indicated by the significant interaction effect).

For *relatedness need satisfaction*, the two conditions did not differ at baseline, $t(1154) = 1.23, ns$, the condition main effect was significant, $F(1, 1154) = 29.37, p < .01, \eta^2 = .03$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 13.93, p < .01, \eta^2 = .01$. As illustrated in the lower-center panel in Figure 4,

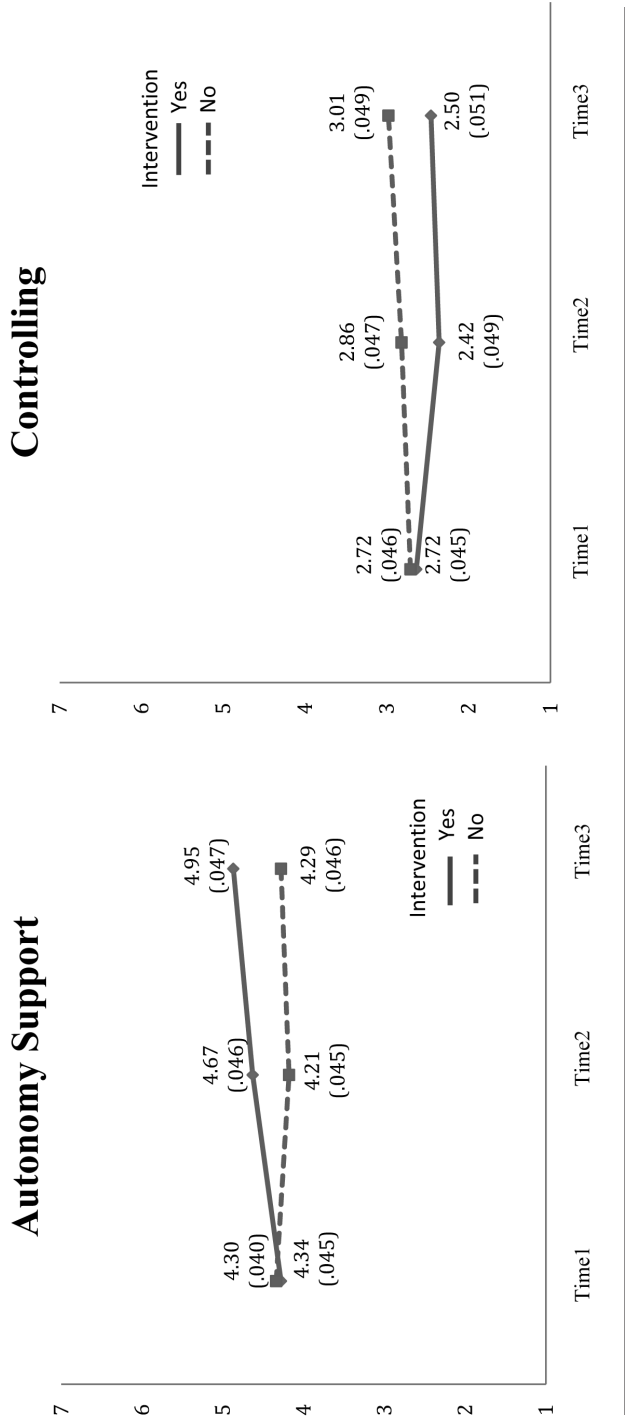


Figure 3 — Students’ self-reports of their teachers’ autonomy-supportive and controlling teaching broken down by experimental condition and time of assessment. *Note.* Numbers without parentheses represent mean scores, while numbers with parentheses represent standard errors.

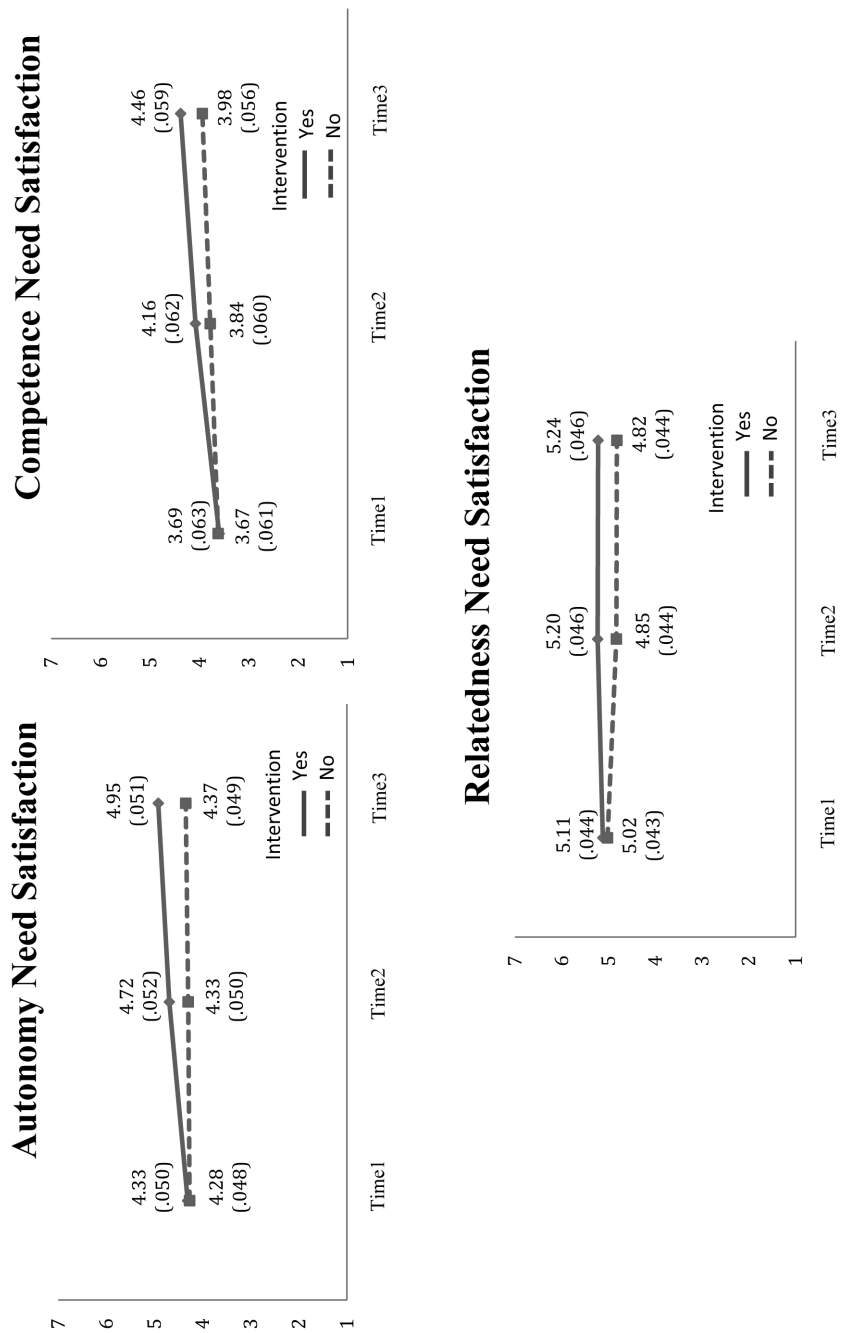


Figure 4 — Students’ self-reports of their psychological need satisfaction during class broken down by experimental condition and time of assessment. *Note.* Numbers without parentheses represent mean scores, while numbers with parentheses represent standard errors.

relatedness need satisfaction initially increased for the students of teachers in the experimental group from T1 to T2 ($p < .01$) but then leveled off from T2 to T3 (*ns*), whereas it initially decreased for the students of teachers in the control group from T1 to T2 ($p < .01$) but leveled off from T2 to T3 (*ns*).

Student Outcomes

For *autonomous motivation*, the two conditions did not differ at baseline, $t(1154) = 0.35$, *ns*, the condition main effect was significant, $F(1, 1154) = 22.51$, $p < .01$, $\eta^2 = .02$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 12.97$, $p < .01$, $\eta^2 = .02$. As illustrated in the left-hand panel in Figure 5, autonomous motivation remained unchanged for the students of teachers in the experimental group from T1 to T2 (*ns*) and from T2 to T3 (*ns*), whereas it decreased significantly for the students of teachers in the control group from both T1 to T2 ($p < .01$) and T2 to T3 ($p < .01$).

For *amotivation*, the two conditions did not differ at baseline, $t(1154) = 1.30$, *ns*, the condition main effect was significant, $F(1, 1154) = 33.88$, $p < .01$, $\eta^2 = .03$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 13.77$, $p < .01$, $\eta^2 = .02$. As illustrated in the right-hand panel in Figure 5, amotivation remained unchanged for the students of teachers in the experimental group from T1 to T2 (*ns*) and from T2 to T3 (*ns*), whereas it increased significantly for students of teachers in the control group from both T1 to T2 ($p < .01$) and T2 to T3 ($p < .01$).

For *classroom engagement*, the two conditions did not differ at baseline, $t(1154) = 0.53$, *ns*, the condition main effect was significant, $F(1, 1154) = 21.68$, $p < .01$, $\eta^2 = .02$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 22.51$, $p < .01$, $\eta^2 = .04$. As illustrated in the upper left-hand panel in Figure 6, classroom engagement increased significantly for the students of teachers in the experimental group from both T1 to T2 ($p < .01$) and T2 to T3 ($p < .01$), whereas it increased significantly for the students of teachers in the control group from T1 to T2 ($p < .01$) but then leveled off from T2 to T3 (*ns*).

For *skill development*, the two conditions did not differ at baseline, $t(1154) = 0.73$, *ns*, the condition main effect was significant, $F(1, 1154) = 34.20$, $p < .01$, $\eta^2 = .03$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 14.80$, $p < .01$, $\eta^2 = .03$. As illustrated in the upper right-hand panel in Figure 6, perceived skill development increased significantly for the students of teachers in the experimental group from both T1 to T2 ($p < .01$) and T2 to T3 ($p < .01$), whereas it remained unchanged for the students of teachers in the control group from both T1 to T2 (*ns*) and T2 to T3 (*ns*).

For *future intentions*, the two conditions did differ at baseline, $t(1154) = 2.32$, $p < .05$ (an unexpected difference that we dealt with through the use of the repeated measures analysis), the condition main effect was significant, $F(1, 1154) = 26.35$, $p < .01$, $\eta^2 = .02$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 13.51$, $p < .01$, $\eta^2 = .02$. As illustrated in the lower left-hand panel in Figure 6, future intentions were initially unchanged for the students of teachers in the experimental group from T1 to T2 (*ns*), but they then increased significantly from T2 to T3 ($p < .01$), whereas future intentions remained unchanged for the students of teachers in the control group from both T1 to T2 (*ns*) and T2 to T3 (*ns*).

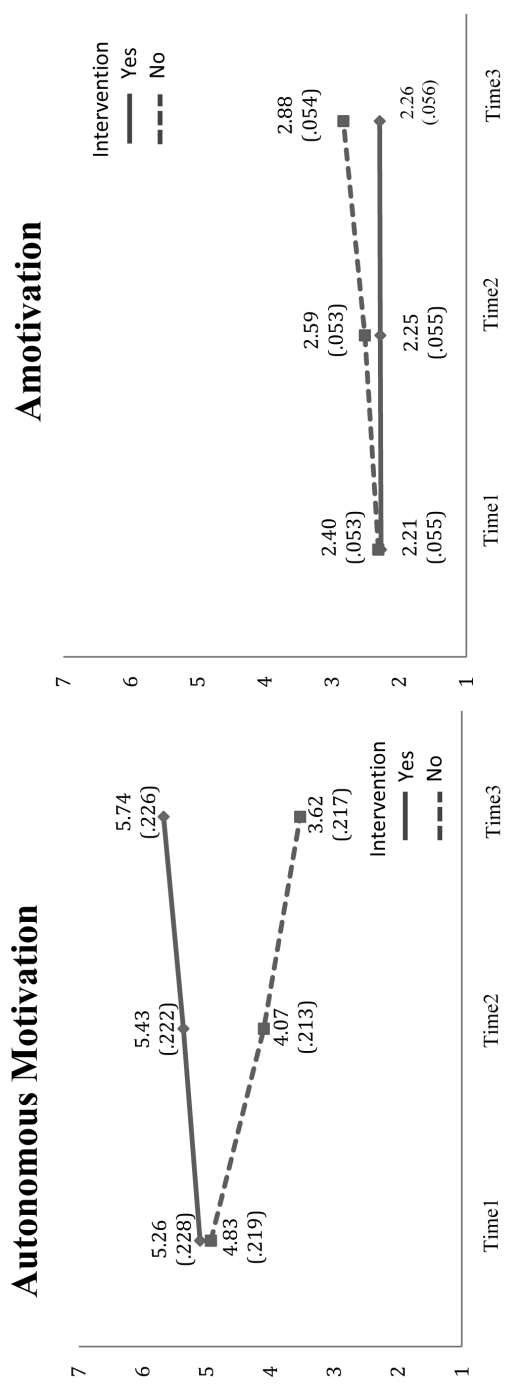


Figure 5 — Students' self-reports of their autonomous motivation and amotivation during class broken down by experimental condition and time of assessment. *Note.* Numbers without parentheses represent mean scores, while numbers with parentheses represent standard errors.

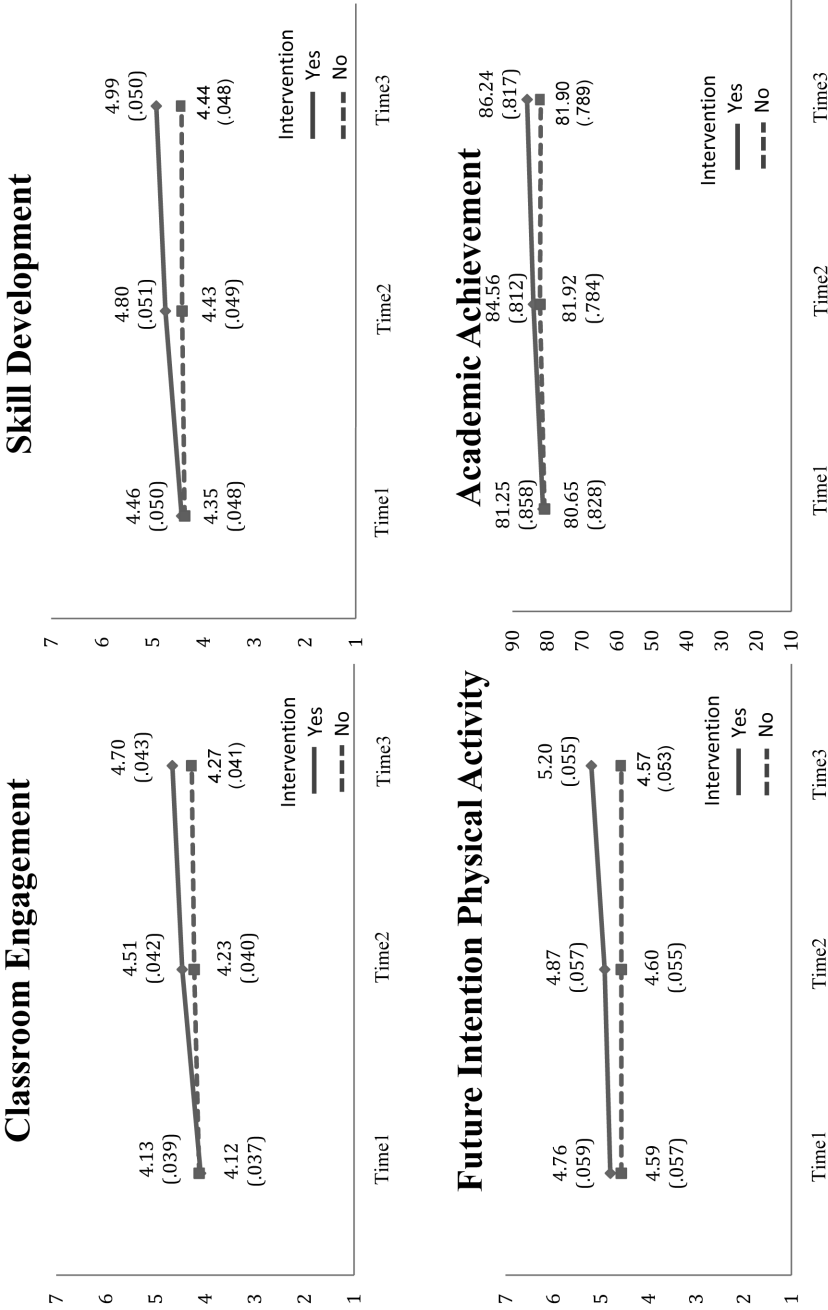


Figure 6 — Students’ self-reports of their classroom engagement, perceived skill development, future intentions, and academic achievement broken down by experimental condition and time of assessment. *Note.* Numbers without parentheses represent mean scores, while numbers with parentheses represent standard errors.

For *PE-specific course achievement*, the two conditions did not differ at baseline, $t(1154) = 0.05$, *ns.*, the condition main effect was significant, $F(1, 1154) = 6.53$, $p < .02$, $\eta^2 = .01$, and the condition $\times$ time interaction was significant, $F(2, 1153) = 4.19$, $p < .02$, $\eta^2 = .01$. As illustrated in the lower right-hand panel in Figure 6, PE-specific course achievement was higher for the students of teachers in the experimental group from both T1 to T2 ($p < .01$) and T2 to T3 ($p < .01$), whereas it remained unchanged for the students of teachers in the control group from both T1 to T2 (*ns*) and T2 to T3 (*ns*).

Test of Hypothesized Models

To test the pair of hypothesized models, we used multilevel structural equation modeling (using LISREL 8.8; Joreskog & Sorbom, 1996). We chose this analytic strategy because the student participant data were nested within teacher (or classroom). To estimate how much of the total variance in the dependent measures could be attributed to the students' particular teachers, we calculated interclass correlation coefficients (ICCs) within hierarchical linear modeling (HLM, version 6.08; Raudenbush, Bryk, & Congdon, 2004). ICCs were low for all T1 dependent measures: 2.7% for perceived autonomy; 3.4% for perceived competence; 2.1% for perceived relatedness; 4.7% for autonomous motivation; 3.6% for amotivation; 4.4% for classroom engagement; 2.2% for skill development; 2.0% for future intentions; and 1.9% for academic achievement. Even though between-teacher differences were small (M ICCs = 3.0%), we analyzed the hypothesized models with multilevel structural equation modeling to respect the nested nature of the student-level data and to properly estimate the standard error terms.

To create the measurement model underlying both hypothesized models, we entered psychological need satisfaction as a latent variable, which was composed of the three indicators of self-reported autonomy, competence, and relatedness. For autonomous motivation, we created four 4-item indicators. For each indicator, we used one item each from the IM, ID, IJ, and EX scales to preserve the RAI weighted formula ($2 \times IM + ID - IJ - 2 \times EX$). For amotivation, we created two 2-item parcels from the scale's four items to serve as indicators. For classroom engagement, we created five 4-item indicators, using one item each from the BE, EE, CE, and AE scales to equally weight each aspect of engagement. For perceived skill, we created two 2-item parcels from the scale's four items to serve as indicators. For future intentions, we used each individual item from that scale to serve as the three indicators. And for PE-specific course achievement, we used students' score on the anticipated achievement item to serve as a single indicator. The intercorrelations among the independent variable, the two statistical controls (gender, grade level), and the 14 latent variables within the just-described measurement model appear in Table 1. To evaluate model fit, we relied on the chi-square test statistic and multiple indices of fit (as recommended by Kline, 2011), including the root-mean-square error of approximation (RMSEA), the standardized root mean square residual (SRMR), the comparative fit index (*CFI*), and the non-normed fit index (NNFI). For RMSEA and RMR, values less than .08 indicate good fit, at least as long as the upper bound of the RMSEA's 90% confidence interval is $\leq .10$; for CFI and NNFI, values greater than .95 indicate good fit, at least as long as these values co-occur with a SRMR value of $\leq .08$ (Hu & Bentler, 1999; Kline, 2011).

Table 1 Intercorrelation Matrix Among the 17 Variables Included in the Test of the Full Structural Model; *N* = 1,158

Latent Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. Experimental Condition	—																
2. Gender (Students)	.14	—															
3. Grade Level (Students)	.37	.01	—														
4. Psychological Needs, T1	.02	.11	.07	—													
5. Autonomous Motivation, T1	.03	.17	.00	.79	—												
6. Amotivation, T1	.04	.13	.03	.66	.86	—											
7. Classroom Engagement, T1	.03	.17	.03	.88	.71	.60	—										
8. Perceived Skill, T1	.03	.16	.00	.75	.65	.57	.78	—									
9. Future Intentions, T1	.07	.13	.09	.60	.58	.52	.60	.53	—								
10. Anticipated Achievement, T1	.00	.11	.02	.44	.38	.36	.45	.37	.38	—							
11. Psychological Needs, T2	.16	.13	.09	.64	.49	.44	.57	.51	.44	.34	—						
12. Autonomous Motivation, T3	.25	.10	.18	.50	.54	.48	.44	.41	.40	.25	.61	—					
13. Amotivation, T3	.24	.12	.13	.41	.45	.51	.38	.39	.36	.24	.50	.87	—				
14. Classroom Engagement, T3	.19	.16	.10	.50	.41	.37	.52	.42	.42	.29	.67	.70	.58	—			
15. Perceived Skill, T3	.22	.13	.08	.45	.39	.33	.43	.42	.38	.26	.60	.69	.59	.88	—		
16. Future Intentions, T3	.25	.12	.19	.43	.37	.36	.41	.34	.50	.27	.54	.65	.61	.73	.77	—	
17. Anticipated Achievement, T3	.11	.10	.07	.34	.29	.30	.35	.26	.31	.44	.38	.34	.45	.42	.42	.41	—

Hypothesized Model #1: ASIP Predicts T2 and T3 Growth in Students' Psychological Need Satisfaction. We tested for the longitudinal effects of experimental condition (of ASIP) on students' (1) midsemester psychological need satisfaction, controlling for early-semester need satisfaction, and (2) end-of-semester psychological need satisfaction, controlling for both early- and midsemester need satisfaction. We also included the two control variables of gender and grade level. Hypothesized model #1 fit the data well, $X^2(108) = 195.60, p < .01$, RMSEA (90% CI) = .032 (.023–.040), SRMR = .033, CFI = .99, NNFI = .99. Both hypothesized paths were significant, as experimental condition predicted psychological need satisfaction at both T2 ($\beta = .14, p < .01$) and T3 ($\beta = .13, p < .01$). One statistical control was significant, as grade level predicted T3 psychological need satisfaction ($\beta = .06, p < .05$). The path diagram showing the standardized estimates for each path in hypothesized Model #1 appears in Figure 7.

Hypothesized Model #2: Students' T2 Psychological Need Satisfaction Mediates the Direct Effect of ASIP on T3 Improvements in Students' Course-Related Outcomes. We tested the mediational effect of students' midsemester psychological T2 need satisfaction to explain the otherwise direct effect that ASIP had on improvements in all six course-related student outcomes, controlling for the T1 levels of these same outcomes. Hypothesized Model #2 fit the data well, $X^2(1,234) = 2,690.24, p < .01$, RMSEA (90% CI) = .046 (.043–.048), SRMR = .041, CFI = .99, NNFI = .99. One control variable, grade level, had a significant effect on two T3 student outcomes (autonomous motivation, future intentions). After adding these two paths, the revised model continued to fit the data well, $X^2(1,232) = 2,656.88, p < .01$, RMSEA (90% CI) = .045 (.043–.048), SRMR = .040, CFI = .99, NNFI = .99, and it fit significantly better than did the hypothesized model, $\Delta X^2(\Delta 2 df) = 33.36, p < .01$. In this revised model, all the hypothesized paths were significant, as ASIP (experimental condition) predicted T2 need satisfaction which, in turn, predicted all six T3 student outcomes (beta values ranged from .27 to .56, all $ps < .01$). The T1 level of each individual student outcome further predicted its corresponding T3 level. The path diagram showing the standardized estimates for each path in the revised version of hypothesized Model #2 appears in Figure 8.

Tests for Hypothesized Mediation. To test for the hypothesized mediation effects, we conducted indirect and total effects analyses for the six student outcomes. These structural equation-based findings appear in Table 2. The data in the table show that (1) the total effects of three predictor variables on the six T3 student outcomes were all statistically significant; (2) most of the effect of T2 psychological need satisfaction on each T3 student outcome was direct rather than indirect; (3) most of the effect of the T1 student outcome on its corresponding T3 assessment was indirect rather than direct (i.e., was mediated by T2 psychological need satisfaction); and, most importantly, (4) some—but not all—of the total effect of experimental condition on each T3 student outcome was indirect. This fourth finding means that T2 psychological need satisfaction partially mediated the effect of experimental condition on the T3 student outcomes. In the Discussion, we explain why the total effect of experimental condition was only partially (rather than fully) mediated by T2 psychological need satisfaction.

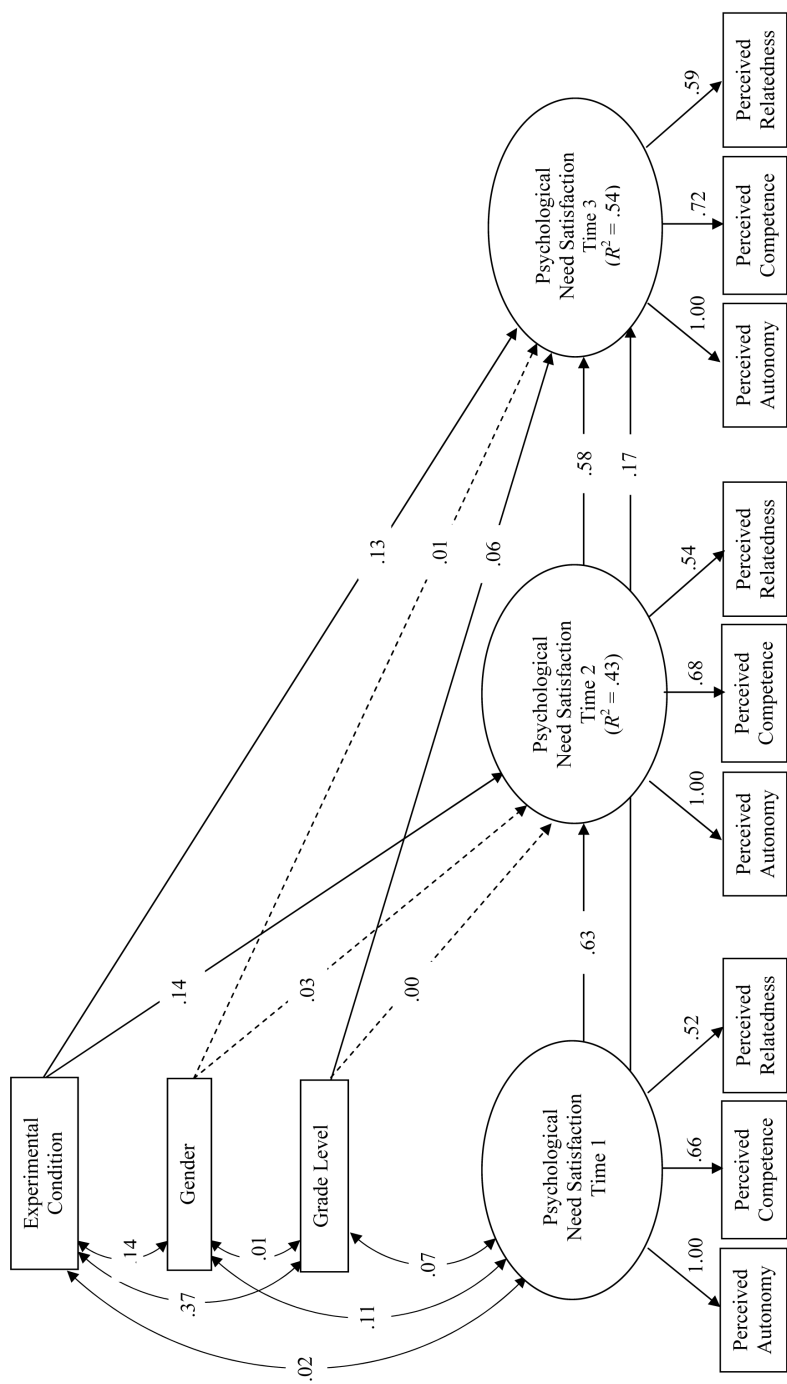


Figure 7 — Hypothesized Model #1: Experimental condition predicts T2 and T3 growth in students' psychological need satisfaction. Solid lines with directional arrows represent significant paths, $p < .05$; dashed lines with directional arrows represent nonsignificant paths. Solid lines with double-side arrows represent correlated error terms.

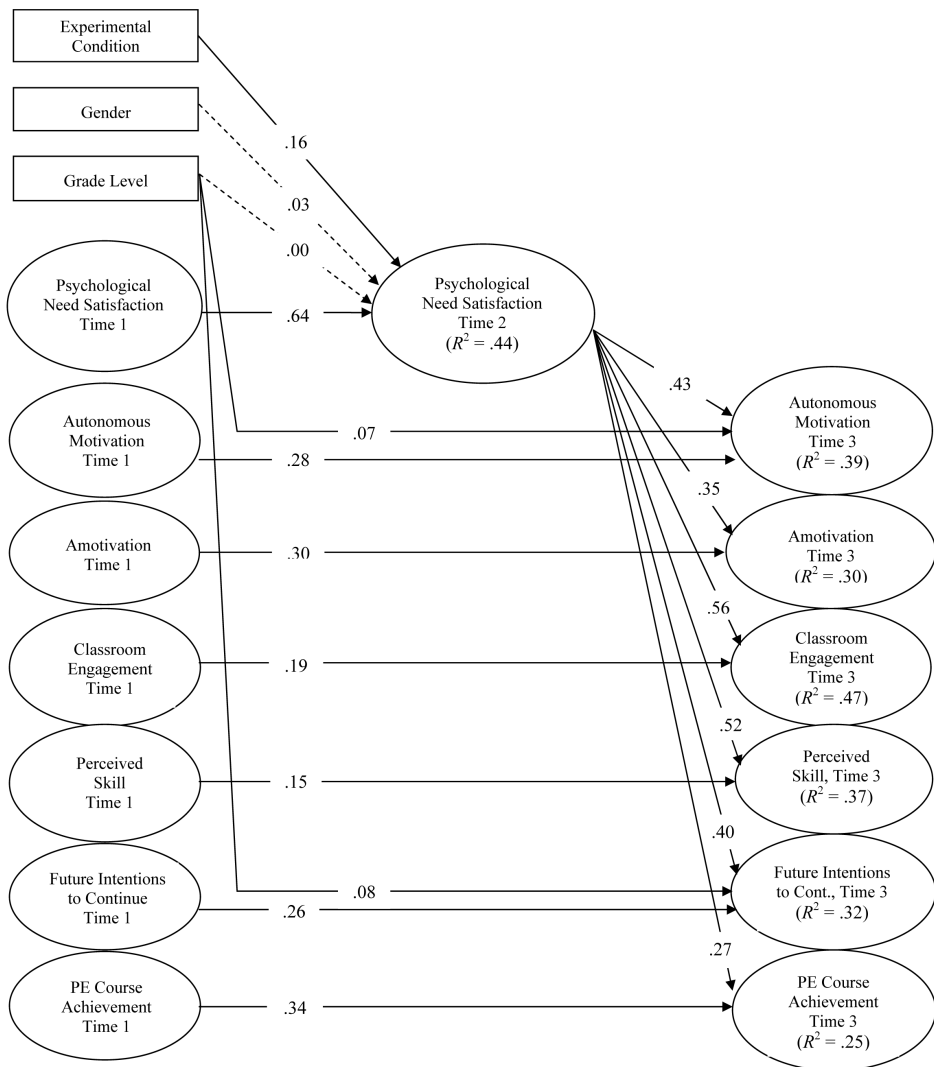


Figure 8 — Hypothesized Model #2: Mediation model in which students’ midsemester changes in psychological need satisfaction explain the experimentally induced T3 growth in students’ course-related outcomes. Solid lines represent significant paths, $p < .05$; dashed lines represent nonsignificant paths. Correlated error terms among T1 latent and observed variables are shown in Table 2.

Table 2 Indirect Effects and Total Effects in the Multilevel Structural Equation Modeling Test of the Hypothesized Motivation Mediation Model

Predictor	T3 Outcome Measure				Autonomous Motivation, T3		Amotivation, T3	
	Autonomous Motivation	Amotivation	Classroom Engagement	Perceived Skill	Future Intentions	PE Course Achievement	Indirect Effects	Total Effects
Experimental Condition	.16**	.14**	.16**	.10**	.15**	.07*	.11	.25
Need Satisfaction, T2	.43**	.35**	.56**	.52**	.40**	.27**	.21	.64
Autonomous Motivation, T1	.28**						.31	.59
Amotivation, T1		.30**						.24
Classroom Engagement, T1			.19**					.54
Perceived Skill, T1				.15**				
Future Intentions, T1					.26**			
PE Course Achievement, T1						.34**		

Note. T1 = Time (or wave) 1; T3 = Time 3. * $p < .05$. ** $p < .01$. (continued)

Table 2 (continued)

Predictor	Classroom Engagement, T3		Perceived Skill, T3		Future Intentions, T3		PE Course Achievement, T3	
	Indirect Effects	Total Effects	Indirect Effects	Total Effects	Indirect Effects	Total Effects	Indirect Effects	Total Effects
Experimental Condition	.09	.19	.07	.22	.10	.25	.04	.11
Need Satisfaction, T2	.14	.70	.11	.63	.15	.55	.14	.41
Autonomous Motivation, T1								
Amotivation, T1								
Classroom Engagement, T1	.35	.54						
Perceived Skill, T1			.30	.45				
Future Intentions, T1					.30	.56		
Anticipated Achievement, T1							.10	.44

Note. T1 = Time (or wave) 1; T3 = Time 3. * $p < .05$. ** $p < .01$.

Discussion

Helping PE teachers learn how to support their students' autonomy represents a key element in what constitutes "best practices" within physical education (Chatzisarantis & Hagger, 2009; Tessier et al., 2008, 2010). The present paper sought to use the field's state-of-the-art knowledge to design and implement an intervention capable of fulfilling this curricular objective. With this objective in mind, we pursued two goals—first, to assess the effectiveness of a teacher-training intervention program and, second, to document its benefits for PE students' motivation and course experience.

Effectiveness of ASIP

The ASIP intervention was successful. Ratings from the observers showed that teachers in the experimental group displayed significantly more autonomy-supportive instructional behaviors, and self-reports from the students showed that teachers in the experimental group were perceived as more autonomy-supportive than were teachers in the control group. As for the observers' ratings, the average effect size across the four instructional behaviors was $d = 1.49$ (M s of 0.90, 1.72, 2.18, and 1.17). This effect size corresponds favorably to the effect sizes on this same dependent measure reported in previous ASIP-like programs (see Su & Reeve, 2011, Table 5, p. 177). As for the students' self-reports, the effect sizes were $d = 0.60$ at T2 and $d = 0.83$ at T3. Again, these effect sizes correspond favorably to those reported in previous ASIP-like programs (see Su & Reeve, 2011, Table 5, p. 177). A third indicator was that the students of teachers in the experimental group perceived their teachers as less controlling. These effect sizes were $d = 0.61$ at T2 and $d = 0.69$ at T3, but we could not compare these effect sizes to previous ASIP-like programs because ours was the first intervention to include this manipulation check.

Overall, these data confirmed that teachers in the experimental group became more autonomy supportive, but they provide an additional insight. The observed effect sizes tended to be larger in the second half than in the first half of the semester. This suggests that our strategy to supplement teachers' initial presemester intervention experience with on-going, in-semester teacher training in the form of follow-up activities (e.g., group discussion) enhanced and strengthened ("boosted") the original intervention experience. Thus, the initial training experience allowed teachers to become more autonomy supportive, while the follow-up activities allowed these teachers to further enhance their capacity to support their students' autonomy.

Benefits of ASIP

Students of the teachers in the experimental group showed meaningful gains in all six course-related outcomes we assessed. The effect sizes from the ANCOVAs for the critical condition $\times$ time interaction effect for each dependent measure were, however, small (η^2 ranged from .01 to .08). This means that the direct effect of the ASIP intervention on students' positive outcomes was significant but modest. The variable that substantially explained T3 improvements in all six student outcomes was students' psychological need satisfaction.

The extent to which the experimentally induced T2 changes in students' psychological need satisfaction improved students' T3 outcomes was remarkable. An inspection of the beta weights from T2 psychological need satisfaction to each T3 student outcome in Figure 8 shows that its effect on each T3 outcome was greater, and often substantially so, than was the T1 level of that outcome students began the course with. For instance, in the prediction of T3 classroom engagement, the beta weight from T2 need satisfaction was .56 whereas the beta weight from T1 classroom engagement was only .19 (significant, but only about one-third the relative size of the beta weight associated with T2 need satisfaction). This means that students' psychological need satisfaction was a better predictor of end-of-course engagement than was how engaged versus unengaged students were at the beginning of the course. The one exception to this pattern was course achievement, as the two beta weights were roughly equal in magnitude.

As impressive as the findings reported in Figure 8 are, it is important to keep in mind that the students of the teachers in the experimental group showed further experimentally induced gains in psychological need satisfaction from T2 to T3 (see Figure 7). That is, students benefited from their teachers' increased autonomy support not only at midsemester (as per Figure 7) but they continued to benefit with even greater psychological need satisfaction by end-of-semester. We suspect that had we included an additional path (in Figure 8) from T3 psychological need satisfaction to each T3 student outcome, then this fuller inclusion of students' experimentally induced psychological need satisfaction would have fully, rather than only partially, mediated the otherwise direct effect than experimental condition had on each of the six T3 student outcomes. We did not include these paths in Figure 8 because they were not included in our hypothesized Model #2. T2 psychological need satisfaction clearly explained much of the reason why the ASIP intervention had a positive effect on each student outcome, but to fully explain the observed ASIP-induced improvements in all six T3 student outcomes likely requires the inclusion of gains in students' T2 and T3 psychological need satisfaction.

Limitations

Students of teachers who participated in ASIP showed a wide-range of course-related benefits, but two concerns limit the scope of this conclusion. First, we do not know how sustainable the training-induced gains in teachers' capacity to be more autonomy supportive is over the long term. Teachers in the experimental group received considerable support during the study, so it is an open question as to whether these teachers can sustain a highly autonomy-supportive teaching once they are on their own. Second, the study relied heavily on self-report data. We did include objective observational data by asking trained raters to score teachers' motivating styles, but we did not collect objective data to evidence the six student outcomes. In future studies, two behavioral measures of particular value might be objective indicators of students' course achievement and extent of physical activity.

There is some caution as to how easily ASIP might be applied to other PE settings, because our teachers were asked to devote considerable time and energy to the study. Teachers did informally communicate a strong enthusiasm for the training experience, but we did not formally assess teachers' acceptability of the training.

The absence of any confirmation that teachers' accepted and reacted positively to the training is a practical utility concern of the study and its potential application to other PE settings.

A final limitation is best categorized as a future opportunity. We did not assess the benefits of the training to the *teachers*. Students benefited from having their teachers participate in ASIP, but it remains a question for future research as to whether the teachers themselves might have benefited in important ways. Possible benefits might include greater teaching efficacy, greater teacher enthusiasm or satisfaction, lesser burnout, or perhaps a greater capacity to provide the other two aspects of motivating style mentioned in the opening paragraphs—namely, teacher-provided structure and involvement.

Conclusion: An Upgraded Course Experience

The students of the teachers in the control group experienced a standard PE course. As the course progressed, these students perceived that their teachers became less autonomy supportive and more controlling, their overall psychological need satisfaction was little changed, and they showed a pattern of outcomes that revealed very few benefits. They also reported a troubling increase in amotivation from T1 to T2 to T3. Overall, these students did not seem to benefit from their PE course experience. The students of the teachers in the experimental group, however, experienced something significantly better than the standard PE course. These students perceived that their teachers became more autonomy supportive and less controlling, they experienced psychological need satisfaction, and they reported meaningful gains in their classroom engagement, skill development, future intentions, and course achievement. Overall, these students encountered a supportive learning environment that created the conditions under which they experienced a wide range of course-related benefits. As their teachers introduced them to a range of sport and exercise activities, these students experienced vitalized psychological need satisfaction that opened the door for them to experience a meaningfully upgraded course experience.

Notes

1. We designed our intervention to capitalize on all the intervention design elements recommended by Su and Reeve (2011) with one exception. Our study did not assess participants' pretraining beliefs, values, and personality dispositions that otherwise might potentially conflict with the pro-autonomy-supportive training message (concern #6 above).
2. Our focus was primarily on PE instruction at the middle school level, as we considered the middle-school physical education class experience as a potential tipping point in students' lifelong development either toward or away from a physically active lifestyle. That said, we nevertheless added the three high school classrooms to the sample to get a sense of how applicable our findings in middle-school classrooms might or might not be to high-school classrooms. Overall, grade level (middle school vs. high school) did not explain much of the variance in the dependent measures, as can be seen in the correlations for "Grade Level (Students)" reported in Table 1 that ranged from $r = .00$ to $r = .09$ for the seven T1 dependent measures. It is worth noting, however, that grade level did explain unique variance in two T3 outcome measures—namely, autonomous motivation ($\beta = .07, p < .01$) and future intentions to continue future physical activity ($\beta = .08, p < .01$), as shown in Figure 8.

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