Expanding Autonomy Psychological Need States from Two (Satisfaction, Frustration) to Three (Dissatisfaction): A Classroom-Based Intervention Study

Sung Hyeon Cheon, Kangwon National University

Johnmarshall Reeve, Korea University

Youngsun Lee, Inha University

Nikos Ntoumanis, Curtin University

Nicolas Gillet, Université-François Rabelais de Tours

Bo Ram Kim, Kangwon National University

Yong-Gwan Song, Korea University

Authors' Note. Address all correspondence concerning this manuscript to Johnmarshall Reeve, 633 Uncho-Useon Hall, Department of Education, Korea University, Anam-dong, Seongbuk-gu, Seoul 02841, Korea. Email is reeve@korea.ac.kr.

This research was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2015S1A5B6036594).

Running head: AUTONOMY DISSATISFACTION

Expanding Autonomy Psychological Need States from Two (Satisfaction, Frustration) to Three (Dissatisfaction): A Classroom-Based Intervention Study

Date of Submission: July 16, 2018

Abstract

We propose that students experience "autonomy dissatisfaction" when the learning environment is indifferent to their psychological need for autonomy. We hypothesized that (1) students could distinguish this newly-proposed need state from both autonomy satisfaction and autonomy frustration, (2) autonomy dissatisfaction would explain unique and rather substantial variance in students' classroom disengagement, and (3) a full understanding of the psychological need for autonomy necessitates expanding the current emphasis from two need states (satisfaction, frustration) to three (dissatisfaction). In the experimental condition, 20 secondary-school physical education (PE) teachers learned how to teach in an autonomy-supportive way; in the control condition, 17 PE teachers taught using "practice as usual". Their 2,669 students (1,180 females, 1,489 males) self-reported their autonomy satisfaction, autonomy dissatisfaction, autonomy frustration, engagement, and disengagement throughout a semester. Objective raters scored the manipulation check (teachers' autonomy-supportive instructional behaviors) and the engagement-disengagement outcome measure. Autonomy dissatisfaction longitudinally increased in the control group and longitudinally decreased in the experimental group. Most importantly, intervention-enabled decreases in autonomy dissatisfaction decreased students' end-of-semester disengagement, even after controlling for mid-semester changes in autonomy satisfaction and autonomy frustration. We discuss the theoretical and practical benefits of adding autonomy dissatisfaction to the self-determination theory explanatory framework.

Keywords: autonomy support; autonomy satisfaction; autonomy frustration; autonomy dissatisfaction; disengagement; intervention.

Impact Statement

Educational Impact and Implications Statement

This study sought to provide a motivational explanation as to why students become increasingly disengaged throughout a semester. For the first time, we showed the important motivational role played by students' experience of autonomy dissatisfaction in explaining the rise in students' disengagement. We also showed how teachers' motivating styles increase or decrease the student experiences of autonomy satisfaction, dissatisfaction, and frustration. The study includes an intervention to help teachers learn how to become more autonomy supportive during instruction. Our two-fold conclusion was that, first, when teachers become more autonomy supportive then their students experience less autonomy dissatisfaction and hence less classroom disengagement and, second, when teachers are not autonomy supportive then their students experience more autonomy dissatisfaction and hence more classroom disengagement.

Expanding Psychological Autonomy Need States from Two (Satisfaction, Frustration) to Three (Dissatisfaction): A Classroom-Based Intervention Study

According to self-determination theory (SDT; Ryan & Deci, 2017), psychological needs provide motivational support for classroom engagement. A psychological need is an essential nutriment for students' interest-taking, challenge-seeking, personal growth, and well-being (Ryan & Deci, 2017). Classroom-based research confirms that such need-satisfying experiences, when they occur, energize students' positive classroom functioning, such as greater engagement and conceptual learning (Assor, Kaplan, & Roth, 2002; Jang, Reeve, & Kim, 2016; Jang, Reeve, & Halusic, 2016; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004; Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005).

Three Psychological Need States

Initially, SDT researchers studied and measured psychological need satisfaction unidimensionally, such that need satisfaction ranged from low to high with high levels of satisfaction predicting adaptive functioning and low levels predicting maladaptive functioning (Deci, Ryan, Gagne, Leone, Usunov, & Kornazheva, 2001; Jang, Reeve, Ryan, & Kim, 2009; Sheldon, Ryan, & Reis, 1996). At the start of this decade, SDT researchers introduced the dual-process model to make the distinction between need satisfaction and need frustration (Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011a). This research showed that need frustration was conceptually and empirically distinct from (low) need satisfaction, because the two motivational experiences correlated (negatively) only modestly, factor analyzed into distinct constructs, arose from different antecedents, and predicted different outcomes (Amoura et al., 2015; Bartholomew, Ntoumanis, Mouratidis, Katartzi, Thøgersen-Ntoumani, & Vlachopoulos, 2018; Bartholomew et al., 2011a; Cheon, Reeve, & Ntoumanis, 2018; Cheon, Reeve, & Song, 2016; Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015; Jang et al., 2016). The contribution of the

dual-process model was to show that need satisfaction represented the "bright side" of student motivation that explained adaptive functioning and outcomes, while need frustration represented the "dark side" of student motivation that explained maladaptive functioning and outcomes (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011b; Vansteenkiste & Ryan, 2013).

The premise on which we based the present investigation was that a full understanding of the psychological need construct requires the specification of three—and not just one or two—need states. That is, just as the dual-process model revealed the theoretical and practical implications of adding psychological need frustration to the explanatory network, the purpose of the present study was to reveal the theoretical and practical benefits of adding a third hypothesized psychological need state to the SDT explanatory framework—namely, dissatisfaction.

One empirical study has investigated the theoretical and practical utility of adding dissatisfaction as a third psychological need state (Costa, Ntoumanis & Bartholomew, 2015). The two-fold purpose of this pioneering study was (1) to demonstrate that need dissatisfaction could be measured separately from need frustration (and need satisfaction) and (2) to demonstrate the differential predictive effects of need satisfaction, need dissatisfaction, and need frustration on optimal and diminished functioning in one particular domain (interpersonal relationships). This investigation succeeded in realizing its first (measurement) goal, but it did not succeed in realizing its second (predictive) goal, concluding that "need dissatisfaction demonstrated poor predictive utility in the current study" (Costa et al., 2015, p. 21).

The Costa and colleagues (2015) study sought to predict two outcomes—interpersonal competence (optimal functioning in the context of interpersonal relationships) and interpersonal sensitivity (diminished functioning in interpersonal relationships). In the

prediction of interpersonal competence, need satisfaction was a strong predictor (β = .39, p < .01), while need dissatisfaction was not (β = -.02, *ns*). In the prediction of interpersonal sensitivity, need frustration was a strong predictor (β = .59, p < .01), while need dissatisfaction was a "marginally significant" predictor (β = .14, *ns*). What this means is that need dissatisfaction did not uniquely predict either outcome measure. But, this failed predictive capacity may be explained by the specific outcome measure used. It is becoming increasingly clear that need frustration best predicts indicators of maladaptive functioning such as antisocial behavior, bullying, negative emotion (e.g., anger, anxiety), stress, and oppositional defiance (Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Bartholomew et al., 2011b; Haerens et al., 2015; Hein, Koka, & Hagger, 2015). In contrast, we thought about what sort of outcomes need dissatisfaction might explain in an educational context, and we initiated the present study to predict and explain the educationally-relevant "diminished functioning" outcome of disengagement. In using psychological need dissatisfaction as a predictor of students' classroom disengagement, we were trying to do what the earlier Costa et al. (2015) study was not quite able to do—i.e., predict and explain unique variance in a key indicator in diminished functioning (i.e., disengagement).

A careful observation of students' classroom behavior suggests that students' maladaptive functioning can manifest itself in two different ways—one reflecting a type of reactive and defiant functioning (e.g., antisocial behavior, bullying, disruptive behavior, anger, oppositional defiance) and another reflecting a type of passive and diminished functioning (e.g., amotivation, boredom, disengagement). As shown in the Costa and colleagues' investigation—and in additional investigations using the SDT dual-process framework (Bartholomew et al., 2011a; Cheon et al., 2018; Haerens et al., 2015; Hein et al., 2015)—defiant functioning characteristically arises out of a state of having one's need for autonomy thwarted and actively suppressed to the extent that it can be overridden by a

demanding social control (i.e., autonomy frustration). Diminished functioning, on the other hand, more likely arises out of a state of having one's need for autonomy disconnected from one's current activity so that behavior becomes listless and non-volitional in an amotivated way that is void of interest-taking, challenge-seeking, and personal goal striving (autonomy dissatisfaction).

Psychological needs (for autonomy, competence, and relatedness) are inherent and ever-ready motivational states to invigorate students' proactive engagement, interest-taking, assimilation of information, psychological growth and well-being (Ryan & Deci, 2017). This intrinsic activity nevertheless depends on need-supportive environmental conditions. A student may walk into class with a need for relatedness, for example, and have that relatedness need state vary from satisfaction with interpersonal acceptance to frustration with interpersonal rejection to dissatisfaction with interpersonal indifference. Figure 1 attempts to illustrate how a psychological need may take on any one of these three states during classroom instruction. As shown, students enter a learning opportunity (or the classroom more generally) naturally inclined to self-author and whole-heartedly self-endorse their classroom activity, yet they also wait provisionally to see what sort of environmental conditions are offered to them, as the teacher makes an announcement, introduces a topic, or walks over to the student's desk to begin a conversation. What the teacher offers is a tone of voice (speech prosody), speech content (e.g., uttering a directive, providing a rationale), and interpersonal behavior (e.g., listening patiently, displaying a no-nonsense facial expression) that can be understood as one of three types of motivating styles/voices—need supportive, need indifferent, or need thwartive, each of which has its own unique motivational effect on the student's psychological need state flow (Assor et al., 2002; Reeve, 2016; Vansteenkiste et al., 2018; Zougkou, Weinstein, & Paulmann, 2017).

Teacher autonomy support—tighter pitch, slower speech rate, and milder voice combined with perspective taking, initiative support, and communicating a sense of choice and flexibility about what to do (Assor et al., 2002; Zougkou et al., 2017)—promotes adaptive attention to the task as the student realizes that the upcoming activity is need supportive (Reeve & Jang, 2006). As a motivating style, teacher autonomy support features a tone of understanding and perspective taking that provides students with a constant flow of opportunities for volitional action and encourages students to seek out information and learning activities that are relevant to their interests and personal goals (Aelterman et al., 2018). A teacher with an autonomy-supportive motivating style may say, "I'm here to support you and your strivings. What would you like to do?" Given such support, the student shows an uplifting (energy-mobilizing) experience of psychological need satisfaction (Streb, Keis, Lau, Hille, Spitzer, & Sisic-Vasic, 2015) that tends students toward adaptive functioning such as intrinsic motivation, engagement, acceptance and internalization of socially-recommended values, high-quality (conceptual) learning, skill development, and academic achievement (Cheon, Reeve, & Moon, 2012; Patall, Dent, Oyer, & Wynn, 2012). Intervention programs have been developed (and validated) to help teachers learn how to become more autonomy supportive toward their students during instruction (Cheon et al., 2012; Cheon et al., 2016; Cheon et al., 2018).

Teacher indifference—in tone, content, and interpersonal behavior, we suggest here for the first time, pays little or no attention to the student's needs, goals, or concerns, usually because the teacher pays so much attention to his or her own needs, goals, and concerns. As a motivating style, it neglects, ignores, or asks students to "set aside" their psychological needs. A teacher with an indifferent motivating style may say, "You need to attend to and do this activity (that has little or nothing to do with your own personal needs, goals, or concerns)." Hearing such, we propose that the student begins to realize that the upcoming learning

activity will be unrelated to or disconnected from his or her psychological needs, which then tends him or her toward an episode of autonomy need dissatisfaction—an energy-depleting experience that is accompanied by emotions (boredom), motivations (amotivation), and ill-being (apathy) indicators of energy (need) depletion. With an experience of need dissatisfaction, the students' inherent proactive capacities begin to wane. Our reasoning is that, with teacher indifference, the psychological need is not suppressed (as with teacher control) but is instead set aside (made irrelevant or unfulfilled for the moment) or simply neglected out of an indifference to it.

Teacher control (i.e., need-thwartive teacher talk and behavior)—lower pitch, louder tone, faster speech rate, and harsher voice combined with prescriptive content and pressure-inducing interpersonal behaviors (Reeve, 2009; Zougkou et al., 2017)—gains students' attention, but its urgency for instant compliance generates too-rapid information processing that leads to galvanizing negative emotions such as anger and anxiety (Assor et al., 2005), compulsion and behavioral dysregulation (Boone, Vansteenkiste, Soenens, Van der Kaap-Deeder, & Verstuyf, 2014), poor discrimination in decision-making (Di Domenico, Le, Liu, Ayaz, & Fournier, 2014), and rumination (Thomsen, Tonnesvang, Schnieber, & Olesen, 2011). A teacher with a controlling motivating style may say, "Stop what you are doing! Do what you are told—whether you want to or not." Controlling teacher talk suppresses (and overrides) students' psychological needs and tends the student toward an energy-disorganizing experience of psychological need frustration. As a motivating style, teacher control features a tone of pressure that intentionally and explicitly suppresses students' psychological needs and volitional activity to the point that it gives the controlling teacher the room he or she needs to use pressure-inducing tactics to bring the student's behavior under "have to" environmental (teacher) control (Reeve, 2009).

The important contribution of Figure 1 is to illustrate how a teacher's attempt to motivate the student to engage in a learning activity yields in the student not just two possible need states (satisfaction, frustration) but three (dissatisfaction). SDT emphasizes three basic psychological needs, including autonomy (need to experience volition and self-endorsement in one's behavior), competence (need to experience effectance and mastery in one's interactions with the environment), and relatedness (need to experience a close, warm connection in one's interpersonal relationships). In the present study, however, we focused only on the psychological need for autonomy. Of the three needs, autonomy is considered to be most central to SDT, and it also raises the most controversy and debate in terms of its motivational potency and classroom relevance (Ryan & Deci, 2017). This narrower focus allowed us to offer teachers a targeted intervention experience, one that was designed to help them learn a set of six specific autonomy-supportive instructional strategies (e.g., take the students' perspective, provide explanatory rationales for teacher requests) rather than simultaneously learn competence-supportive (e.g., communicate expectations, provide guidance; Jang, Reeve, & Deci, 2010) and relatedness-supportive (e.g., converse one-on-one, promote cooperation and teamwork; Sparks, Dimmock, Lonsdale, & Jackson, 2016) instructional strategies. Thus, we expected that teacher participation in the intervention would produce a significant effect on students' experiences of autonomy satisfaction, dissatisfaction, and frustration (but not necessarily on students' experiences of competence or relatedness satisfaction, dissatisfaction, and frustration).

What is new to Figure 1 is the hypothesized psychological need state of dissatisfaction, so we explain the nature of this state a bit more. Our reasoning is that, because students have psychological needs, they possess an inherent proactive tendency for intrinsic motivation and autonomous self-regulation. Environmental learning activities present students with a personal growth opportunity—an opportunity to discover new

information, to learn something worthwhile, to acquire skill, to make a new friend, etc., and such learning/growth opportunities require attention, concentration, interest-taking, challenge seeking, as well as effort, persistence, and acts of choice to realize their benefits (Tsai, Kunter, Ludtke, Trautwein & Ryan, 2008). But when learning activities (and learning environments more generally) lack need-satisfying opportunities and instead offer only need indifference, then a state of psychological need dissatisfaction is likely to occur. Under such energy-depleting circumstances, a student would likely disengage himself or herself from the learning activity—partially or fully.

Engagement-Disengagement

We used measures of students' classroom engagement and disengagement as two indicators of the quality of their involvement with the learning environment. Educators generally consider students' engagement and disengagement to be tell-tale signs of their academic thriving and floundering (Christenson, Reschly, & Wylie, 2013; Fredricks, Reschly, & Christenson, 2018), and this is so for four reasons. First, student engagement predicts the sort of outcomes that educators prioritize, such as achievement and academic progress (Alexander, Entwisle, & Dauber, 1993; Ladd & Dinella, 2009; Reeve & Tseng, 2011). Second, student disengagement predicts the sort of outcomes that deeply worry educators, such as withdrawing from instruction and dropping out of school (Christenson & Reschly, 2010; Jimerson, Egeland, Sroufe, & Carlson, 2000). Third, changes in students' psychological need states (or motivation more generally) predict subsequent changes in students' engagement and disengagement (Jang, Kim, & Reeve, 2016). Finally, engagement and disengagement are viewed as relatively malleable student characteristics that are open to constructive influences, such as a teacher's support (Birch & Ladd, 1997) or a gain in autonomy need satisfaction (Jang, Kim, & Reeve, 2012; Skinner & Belmont, 1993).

Engagement and disengagement share the same four-dimensional structure of behavior, emotion, agency, and cognition (Christenson et al., 2013; Fredricks, Blumenfeld, & Paris, 2004; Reeve, 2013). Behavioral engagement is the investment of effort and persistence into a learning activity; emotional engagement is the presence of energy-mobilizing emotions (e.g., interest); agentic engagement is speaking up to make a constructive contribution to improve the learning environment (e.g., making a suggestion, expressing a preference); and cognitive engagement is the use of sophisticated learning strategies (e.g., elaboration, critical thinking, mental simulations). Behavioral disengagement is being off-task, procrastinating, avoiding effort, and withdrawing one's effort rather quickly (e.g., doing something else); emotional disengagement is the presence of energy-depleting emotions (e.g., sadness); agentic disengagement is passively and unilaterally receiving instruction as it is given (e.g., being silent and doing what you are told without trying to personalize the lesson to better fit one's interests or goals); and cognitive disengagement is an unplanned or disorganized approach to learning or skill development. While they share the same four-dimensional structure, engagement and disengagement are best conceptualized as two distinct (though negatively correlated) constructs. This is because engagement and disengagement separate into distinct factors (e.g., factor analyses), arise from different antecedents (e.g., autonomy support *vs*. teacher control) and predict different outcomes (e.g., academic progress *vs*. dropping-out) (Elliot, McGregor, & Gable, 1999; Jang, Kim, & Reeve, 2016; Reeve, 2013).

Plan of the Study, Hypotheses, and Hypothesized Model

The study's independent variable was teacher participation (or not) in the "autonomy-supportive intervention program" (ASIP). What teachers learn during an ASIP is how to (1) take their students' perspective prior to and during instruction, (2) offer learning activities and lesson plans in ways that satisfy (rather than are indifferent to or outright suppress/thwart) students' need for autonomy, and (3) provide a teacher-student relationship

of support and understanding so that teachers become more in synch with (rather than indifferent to or in conflict with) their students, especially when students struggle with difficult problems such as disengagement, poor performance, and misbehavior.

The dependent measures were autonomy satisfaction, autonomy frustration, autonomy dissatisfaction, engagement, and disengagement. The plan of the study was to assess students' autonomy satisfaction, frustration, and dissatisfaction at the beginning of a 19-week semester and track (1) how these three need states increased or decreased as the teacher offered a learning environment that either was or was not highly autonomy supportive and (2) how the intervention-enabled rise and fall of the three autonomy need states predicted longitudinal changes in students' classroom engagement and disengagement (with a special emphasis on disengagement).

In an experimental group, we provided the teachers of these students with an ASIP so that we could assess students' need states, engagement, and disengagement under autonomy-supportive teaching conditions. For these students, we were interested in the rise and fall of the full range of their autonomy need states over the course of the semester, expecting that autonomy-supportive teaching would increase students' autonomy satisfaction and decrease their autonomy dissatisfaction and autonomy frustration. Such autonomy dynamics were expected to contribute to a corresponding end-of-semester rise in engagement and decline in disengagement.

In a control group, we assessed students' naturally occurring need states, engagement, and disengagement under "practice as usual" teaching conditions. For these students, we were most interested in their experience of autonomy dissatisfaction, as we expected their autonomy dissatisfaction to rise over the course of the semester, because many teachers find autonomy support to be a "foreign" (Skinner & Belmont, 1993) or an ineffective (Reeve et al., 2014) approach to teaching that tends them to teach in autonomy indifferent ways. Such a

mid-semester rise in autonomy dissatisfaction was expected to predict a corresponding end-of-semester rise in classroom disengagement.

We further predicted that intervention-enabled increases in autonomy satisfaction and intervention-enabled decreases in autonomy dissatisfaction would affect longitudinal changes in students' end-of-semester engagement and disengagement. This hypothesized model appears in Figure 2. The three downwardly-sloped lines in the upper-left of the figure hypothesize that students of teachers who participated in the intervention would report greater T2 autonomy satisfaction and lesser T2 autonomy dissatisfaction and autonomy frustration. The six downwardly-sloped lines in the lower-right of the figure hypothesize that (a) increases in T2 autonomy satisfaction would predict an increase in T3 engagement and a decrease in T3 disengagement, (b) decreases in T2 autonomy dissatisfaction would predict a longitudinal decrease in T3 disengagement and an increase in T3 engagement, and (c) decreases in T2 autonomy frustration would predict a longitudinal decrease in T3 disengagement and an increase in T3 engagement. The importance of these hypothesized effects in the lower right section of Figure 2 was to test whether or not the intervention-enabled decreases in T2 autonomy dissatisfaction would explain unique variance in both greater T3 disengagement and lesser T3 engagement after controlling for the predictive effects of T2 autonomy satisfaction (on T3 engagement) and T2 autonomy frustration (on T3 disengagement). Such critical findings would show the importance (and necessity) of including the newly-hypothesized autonomy dissatisfaction need state in predicting changes in students' adaptive and maladaptive (i.e., diminished) classroom functioning.

Method

Participants

Teacher-participants included 37 ethnic Korean certified physical education teachers, 8 women and 29 men. Teachers taught in 37 different secondary schools (25

middle, 12 high) in the Seoul metropolitan area. Teachers averaged 36.0 years of age (*SD* = 4.4) and 6.5 years of teaching experience (*SD* = 2.6). At the conclusion of the study, each participating teacher received the equivalent of $50 in appreciation of his or her participation. No teacher dropped out over the course of the semester-long study.

Student-participants were those who completed the study questionnaire over all three waves of data collection. At T1, 2,873 ethnic Korean students completed the questionnaire. At T2, 2,770 students completed the questionnaire for a second time, while 103 of the T1 students did not. The persisting students did not differ from the dropouts on experimental condition, gender, grade level, or any T1 measure. At T3, 2,669 of the students completed the questionnaire for a third time, while 101 of the T2 persisting students did not. The T3 persisting students did not differ from the T2 dropouts on experimental condition, gender, grade level, or any T1 or T2 measure. The final analyzed sample represented a retention rate of 94.1% (2,669/2,837) and consisted of the following: 1,180 (44.2%) females and 1,489 (55.8%) males; 1,986 (74.4%) middle school and 683 (25.6%) high school students; and 1,478 (55.4%) in the experimental group and 1,191 (44.6%) in the control group.

This research was approved by the Institutional Review Board of the first author's university. Permission to conduct the research was provided by the principal at each school. Participating teachers volunteered to have their classes join the study, and individual teachers were approached to obtain agreement. Teacher-participants and student-participants were both informed of the scope and aims of the study before agreeing to participate with signed permission forms.

The Korean PE Course

We collected our data and implemented the ASIP intervention in the domain of physical education (PE) and in the nation of Korea. The Korean secondary educational system is structured around the major subject areas of Korean (Language), English, Math,

and Science, and students take courses in these subject areas every day. These subject areas are prioritized because of their centrality to the university entrance examination (a post-graduation, high-stakes, standardized test). PE is a mandatory course but, in contrast to these major subject areas, the content of the PE course is not included on the university entrance examination and PE courses are offered two or three (but not all five) days of the week. Course content is designated by the Korean National and Educational Curriculum, and it includes weekly activities devoted to sport-based physical activities such as softball, football (soccer), basketball, badminton, loop (rope) jumping, table tennis, and track and field. While some classes do take place in a traditional classroom setting, most PE courses take place in a gym or field in which PE teachers follow an almost universal 3-part daily script. For the first 10 minutes, students exercise and the teacher then addresses the whole class to introduce the day's lesson and learning objective and to provide group-based instruction (e.g., how to use a badminton racket). Students then spend the majority of class time engaged (and disengaged) in the sport or exercise activity of the day, as the teacher roams to provide one-on-one and small group instruction, feedback, and grade-relevant evaluations. For the last 10 minutes, students return to the whole class structure and the teacher provides feedback, commentary, and preparation for the next class.

For two reasons, we regarded the PE subject matter to be well suited to our study: (1) disengagement is not that uncommon a classroom behavior [because PE is not part of the university entrance exam, which leads some students (and their parents) toward classroom disengagement] and (2) autonomy, engagement, and disengagement have all been heavily previously studied (and understood) in PE classes (Cox & Williams, 2008; Lim & Wang, 2009; Londale, Sabiston, Taylor, & Ntoumanis, 2011; Ntoumanis, Barkoukis, & Thøgersen-Ntoumani, 2009; Van den Berghe, Cardon, Tallir, Kirk, & Haerens, 2016).

As to the nation of Korea, student autonomy is not as valued in the Korean culture as it is in the West (Kim & Park, 2006). In Korean culture, the group is the core unit of society and individuals are expected to fit into the group (e.g., Oyserman, Coon, & Kemmelmeier, 2002). So, in Korean secondary education, teachers' motivating styles tend to weigh group priorities over personal interests, utilize a directive and authoritarian communication style, pace instruction around the teacher's concerns and goals, and push students toward group consensus but away from individual choice. Thus, we expected that the student-participants in the no-intervention control group would sometimes encounter teachers who tended toward an autonomy indifferent motivating style. In a more positive light, the Korean educational system is a good setting to conduct longitudinally-based intervention research, partly because it has such a high regard for education that it is open to interventions and professional developmental opportunities designed to improve classroom practice (e.g., ASIP) and also because the student attendance rate is extremely high (often 100% of students are in class each day), which minimizes potential participant attrition problems.

Measures

Each questionnaire used the same 1-7 response scale (1 = *strongly disagree*; 7 = *strongly agree*). We used previously-validated Korean-translated versions (available from Authors, 2015, 2017) of each English-language questionnaire.

Students' Perceived Autonomy-Supportive Teaching. To assess perceived autonomy-supportive teaching, we used the 6-item version of Learning Climate Questionnaire (LCQ; Williams & Deci, 1996). The LCQ includes items such as, "My PE teacher listens to how I would like to do things" and "I feel understood by my PE teacher." This measure has been used in previous studies to assess autonomy-supportive teaching (Jang et al., 2009), including studies in the PE context (Standage, Duda, & Ntoumanis, 2005) and studies in the Korean PE context in particular (Cheon et al., 2016; Cheon et al., 2018).

Students' LCQ scores in the present study were internally consistent at both T1 (α = .90) and T2 (α = .93).

Students' Autonomy Need Satisfaction, Dissatisfaction, and Frustration. To assess autonomy need satisfaction, we used the 5-item Perceived Autonomy scale (Standage, Duda, & Ntoumanis, 2006). The items all began with the stem "In this PE class," and all five items appear in Table 1. This measure has been widely used in previous studies to assess autonomy need satisfaction in the PE context and to predict measures of student engagement (Cox & Williams, 2008; Taylor & Lonsdale, 2010; Taylor, Ntoumanis, Standage, & Spray, 2010), and it has been used specifically for these purposes in the Korean PE context (Cheon & Reeve, 2013; Cheon et al., 2016). Scores were internally consistent at both T1 (α = .87) and T2 (α = .90).

To assess autonomy need dissatisfaction, we used the 5-item Autonomy subscale from the Psychological Need Dissatisfaction scale (PND; Costa et al., 2015), which is the only existing measure of psychological need dissatisfaction. The items all began with the stem "In this PE class," and all five items appear in Table 1. In their pioneering study, Costa and colleagues (2015) reported acceptable psychometric properties for the autonomy subscale of the overall PND scale (i.e., α = .85, *M* = 3.86, *SD* = 1.29, *range* = 1—7, skewness = -.07, kurtosis = -.29). In the present study, scores on the autonomy dissatisfaction scale were internally consistent at both T1 (α = .91) and T2 (α = .94).

To assess autonomy need frustration, we used the 4-item Autonomy subscale from the Psychological Need Thwarting Scale (PNTS; Bartholomew et al., 2011b), which is the most widely-used scale to assess need frustration in tests of the dual-process model (Bartholomew et al., 2018; Gunnell et al., 2013). The items all began with the stem "In this PE class," and all four items appear in Table 1. The PNTS has been used in the PE context (Hein et al.,

2015; Liu & Chung, 2015), and it has been used specifically in the Korean PE context (Cheon et al., 2016). Scores were internally consistent at both T1 (α = .74) and T2 (α = .75).

Exploratory Structure Equation Modeling of the Three Need States Measures. Because no study had ever used these measures of autonomy satisfaction, dissatisfaction, and frustration together, we conducted an exploratory structural equation modeling (ESEM) analysis of these 14 items, using Mplus (Muthen & Muthen, 2015). We used the robust maximum likelihood estimator (MLR) with oblique rotation to examine the parameter estimates and goodness-of-fit indices for the 2-, 3-, and 4-factor solutions. As expected, the 3-factor solution fit the data reasonably well, X^2 (52) = 413.97, $p < .001$, *RMSEA* = .051 (.047 - .056), *SRMR* = .015, *CFI* = .976, *TLI* = .958. An examination of the parameter estimates, shown in Table 2, revealed well-defined factors (satisfaction: |λ| = .757 to .932, *M* = .829; dissatisfaction: |λ| = .806 to .979, *M* = .881; and frustration: |λ| = .441 to .910, *M* = .695) with minimal cross-loadings (satisfaction: (|λ| = .002 to .057, *M* = .024; dissatisfaction" |λ| = .001 to .044, *M* = .024; and frustration: |λ| = .004 to .326, *M* = .085). The 3-factor solution provided a significantly better fit than did the alternative 2-factor solution (that combined the dissatisfaction and frustration items into a second factor; MD Δ X^2 = 1,279.34, *df* = 12, $p <$ .001; Δ *CFI* = .033). The MPlus program was unable to generate a X^2 value for the 4-factor solution, but it was able to generate parameter estimates, which were difficult to interpret because the 4-factor solution split the 5 items from the autonomy satisfaction scale into 2 separate factors.

Another measurement concern might be whether participants could distinguish the measure of perceived autonomy support from the measures of autonomy satisfaction, dissatisfaction, and frustration. So, we conducted a supplemental 20-item ESEM by adding the six items from the Learning Climate Questionnaire to the 14 items listed in Table 1. The 4-factor solution fit the data reasonably well, X^2 (116) = 913.87, $p < .001$, *RMSEA* = .051

(.048 - .054), *SRMR* = .016, *CFI* = .969, *TLI* = .950. An examination of the parameter estimates, shown in the Appendix, revealed well-defined factors (perceived autonomy support: |λ| = .662 to .954, *M* = .822; satisfaction: |λ| = .609 to .927, *M* = .747; dissatisfaction: |λ| = .794 to .958, *M* = .866; and frustration: |λ| = .431 to .886, *M* = .675) with cross-loadings that were small in magnitude (perceived autonomy support: |λ| = .000 to .109, *M* = .033; satisfaction: |λ| = .005 to .185, *M* = .055; dissatisfaction: |λ| = .001 to .046, *M* = .023; and frustration: |λ| = .003 to .328, *M* = .062). The 4-factor solution provided a significantly better fit than did the alternative 3-factor solution (that combined the perceived autonomy support and autonomy satisfaction items into a first factor; MD Δ X^2 = 1,475.46, *df* = 17, $p < .001$; Δ *CFI* = .016). An alternative 5-factor solution was uninterpretable, as it separated the perceived autonomy support items into 2 separate factors.

Students' Classroom Engagement and Disengagement. We assessed both engagement and disengagement as multidimensional constructs that featured behavioral, emotional, agentic, and cognitive aspects (Jang et al., 2012, 2016; Reeve, 2013). To assess the behavioral and emotional aspects of engagement-disengagement, we used the 5-item behavioral engagement (αs at T1 and T3 = .91 and .94), 5-item emotional engagement (αs = .83 and .88), 5-item behavioral disaffection (αs = .88 and .91), and 5-item emotional disaffection (αs = .92 and .94) scales from the Engagement versus Disaffection with Learning measure (Skinner, Kindermann, & Furrer, 2009), each of which has been use in previous tests of the SDT framework (Jang et al., 2012, 2016; Skinner et al., 2009). To assess agentic engagement and disengagement, we used the 5-item agentic engagement (αs = .91 and .94) and the 5-item agentic disengagement (αs = .87 and .92) scales from the Agentic Engagement Scale (Reeve, 2013), both of which have been used previously in SDT investigations (Cheon et al., 2016; Jang et al., 2016). To assess cognitive engagement, we used the 4-item Deep Learning measure (Senko & Miles, 2008). This measure has been used previously as an

outcome measure (Pintrich & De Groot, 1990), and it showed high internal consistency in the present study (αs = .85 and .91). To assess cognitive disengagement, we used the 5-item Study Disorganization measure (Elliot et al., 1999). This measure has also been used as an outcome measure (Senko & Miles, 2008), and it showed high internal consistency in the present study (αs = .92 and .94).

Raters' Scoring of Teachers' Autonomy Support and Students' Engagement-Disengagement. During weeks 10 and 11 (see Fig. 3), a group of four trained raters scored the two dependent measures described below. To do so, they worked in pairs, came to the class unannounced 5–10 min before its start, did not know into which group (experimental or control) the observed teacher had been randomly assigned, and made independent ratings.

The autonomy-supportive teaching rating sheet assessed the following five instructional behaviors: vitalizes autonomy; provides explanatory rationales; uses invitational language; accepts negative affect; and displays patience (Reeve, Jang, Carrell, Jeon, & Barch, 2004). This rating sheet has been used frequently in previous studies in the Korean PE context (Cheon & Reeve, 2015; Cheon et al., 2012; Cheon et al., 2018). Raters used a 1-7 unipolar scale (1 = *never, not at all*, 7 = *always, frequently*). The two observers' ratings were positively correlated for all five behaviors (*r*'s ranged from .70 to .87, all $p < .001$), so we averaged the two rater's score on each behavior into a single score for each behavior. We then averaged these five intercorrelated ratings into one overall score (5-item, α = .95).

The engagement-disengagement rating sheet was the 4-item Engagement Rating Sheet (Reeve et al., 2004), which has been used previously in classroom settings (Jang, Reeve, & Halusic, 2016), including PE classrooms (Tessier, Sarrazin, & Ntoumanis, 2010; Van den Berghe et al., 2016). Raters scored students' collective (whole class) behavioral (effort), emotional (enjoyment), agentic (proactive participation), and cognitive (extent of learning) engagement using a bipolar format with the engaged behavior on the right side

(scored as 7) accompanied by illustrative descriptors and the disengaged behavior on the left side (scored as 1) accompanied by illustrative descriptors. Raters scored each of the four aspects of engagement-disengagement with high agreement (*r*'s ranged from .65 to .77, $p < .001$), so we combined these four averaged ratings into one overall score (4-item $\alpha = .92$).

Procedure and Implementation of the ASIP

One month prior to the beginning of the school year, we contacted 40 PE teachers who worked in Seoul metropolitan area to invite them to participate in our semester-long study. Thirty-seven teachers agreed to participate and were randomly assigned into either the experimental ($n = 20$) or control ($n = 17$) condition. The full procedural timeline for the intervention program and the three waves of data collection appear in Figure 3.

For teachers in the experimental condition, we delivered the ASIP in three parts. Part 1 was a 3-hour morning workshop conducted by the first and seventh authors to introduce autonomy-supportive teaching and to recommend six autonomy-supportive instructional behaviors. The first was "take the students' perspective", as perspective taking allows one the mindset to relate to others in an autonomy-supportive way (Deci, 1995; Ryan & Deci, 2000). The second was "vitalize students' autonomy during instruction". For instance, teachers learned how to give students more say in what they do, and teachers learned how to ask for and integrate students' input, suggestions, and preferences into the flow of their lesson plans. The current ASIP differed from previous ASIPs (e.g., Cheon et al., 2012, 2016, 2018) on this particular autonomy-supportive instructional behavior in that teachers were taught specifically how to vitalize students' autonomy during instruction rather than how to vitalize students' psychological needs (autonomy, competence, and relatedness) more generally. The four remaining autonomy-supportive instructional behaviors were as follows: "provide explanatory rationales for teacher requests"; "use non-pressuring and invitational language"; "display patience"; and "acknowledge and accept students' expressions of negative affect as

okay". Collectively, these acts of instruction allow teachers to address and solve student problems of disengagement, poor performance, and misbehavior in ways that respect—rather than overlook or suppress—students' autonomy.

Part 2 was a 3-hour afternoon "how to" workshop conducted by the first and seventh authors that took place after a lunch break on the same day as Part 1. During Part 2, teachers viewed professionally-created videos of actors modeling each of the six autonomy-supportive instructional behaviors. The workshop described each act of instruction, offered mentoring and scaffolding as teachers practiced enacting them, and provided corrective feedback and discussion to help teachers develop the skill needed to deliver each instructional behavior in their own classroom.

Part 3 was a 2-hour group discussion that occurred one month into the semester. Teachers shared their hands-on classroom experiences with autonomy-supportive teaching. During this peer-based group discussion, each teacher both gave and received numerous tips and strategies for autonomy-supportive teaching, and the group discussed and resolved any problems and obstacles they encountered in being more autonomy supportive.

As to the students' data collection, it was conducted in three waves in which students completed the measures for perceived autonomy-supportive teaching and the three autonomy need states at the beginning (T1, week 1) and middle (T2; week 10) of the spring semester and the measures for engagement and disengagement at the beginning (T1) and end (T3; week 19) of the semester. On each occasion, the survey was administered at the beginning of the class period, began with an informed consent form, referred only to that particular class, and included an assurance that all responses would be confidential.

As to the raters' data collection, a pair of trained raters visited each teacher's classroom halfway through the semester (during either week 10 or 11) to score objectively each teacher's in-class autonomy-supportive instructional behaviors. These ratings served as

an objective manipulation check on the effectiveness of the ASIP. Raters also scored students' collective (class-level) engagement-disengagement during this same visit. These ratings provided an objective outcome measure to assess whether teacher participation in the ASIP promoted students' adaptive classroom functioning.

Data Analyses

The student data had a 3-level hierarchical structure with repeated measures (level 1) nested within students (level 2) nested within teachers (level 3). Intra-class correlation coefficients (ICCs) calculated from unconditional models for the student-reported baseline measures averaged 10.0% (range, 5.8% to 18.3%), which warranted multilevel modeling. At level 1, we scored the ''time'' independent variable as 0 at T1 and as 1 at T2 or T3 (depending on the dependent measure) to have a meaningful interpretation of the intercept. At level 2, we entered the student-level individual differences of gender and grade level as group mean centered covariates to function as a pair of statistical controls in each analysis. At level 3, we entered experimental condition as an un-centered independent variable (control group = 0, experimental group = 1). Finally, we entered the condition *x* time interaction as a cross-level predictor (experimental condition was a level 3 predictor, time was a level 1 predictor) to test the extent to which the changes in the T2 or T3 scores depended on experimental condition.

To estimate effect sizes for each hypothesized condition *x* time interaction effect, we used the independent-groups pretest-posttest design test ($d_{IGPP\text{-}RAW}$) that is appropriate for multilevel, repeated-measures group comparisons to determine the magnitude of the change in the intervention group relative to the change in the control group (Feingold, 2009). The $d_{IGPP\text{-}RAW}$ statistic may be interpreted in the same was as is Cohen's *d*, which is .10 for a small effect, .35 for a moderate effect, and .50 for a large effect (Cohen, 1988). To estimate effect sizes for each within-group longitudinal change score, we report Cohen's *d* statistic.

In the test of the hypothesized model (Fig. 2), we used multilevel structural equation modeling (LISREL 8.8; Joreskog & Sorbom, 2006). We assessed each variable in the model (except for experimental condition and the two statistical controls) as latent variables. For the measures of autonomy satisfaction, dissatisfaction, and frustration, we used the individual items on these scales as indicators of the corresponding construct. For the measures of engagement and disengagement, we used the four mean scores from the behavior, emotion, agency, and cognition scales as indicators. 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 SRMR, values less than .08 indicate good fit; for CFI and NNFI, values greater than .95 indicate good fit (Hu & Bentler, 1999; Kline, 2011).

ASIP Manipulation Checks

We conducted two manipulation checks of the study's independent variable—rater-scored and student-perceived autonomy-supportive teaching. These two measures were significantly positively correlated, as mid-semester rater-scored autonomy-supportive instructional behavior, which was aggregated at the teacher level (n = 37, M = 4.92, SD = 0.88), significantly predicted (i.e., agreed with) students' mid-semester perceived autonomy-supportive teaching (n = 2,669, M = 5.09, SD = 1.08): B = .32, SE = .02, t(2,667) = 13.84, p < .001.

For rater-scored autonomy support, we used a t-test to compare the mean scores of the experimental *vs*. control groups of teachers. Raters scored teachers in the experimental group as enacting more autonomy-supportive instructional behaviors than did the teachers in the control group (Ms, 5.51 *vs*. 4.23), t(35) = 6.30, p < .001, d = 2.13.

For student-reported autonomy support, the critical condition *x* time interaction, after controlling for student gender and grade level, was significant, $t(5,299) = 19.10$, $p < .001$ ($d_{\text{IGPP-RAW}} = 0.62$). Perceived autonomy-supportive teaching increased significantly for students of teachers in the experimental group from T1 to T2 (*M*s = 4.70 *vs*. 5.37), $\Delta = +0.67$, $t = 25.13$, $p < .001$ ($d = 0.66$), while it remained unchanged for students of teachers in the control group from T1 to T2 (*M*s = 4.72 *vs*. 4.75), $\Delta = +0.03$, $t = 1.12$, $p = .263$ ($d = 0.04$).

Results

Preliminary Analyses

Missing data among the student- and rater-reported scores were rare (< 0.1%), so we used the expectation-maximization (EM) algorithm to produce a multiple imputed data set (generating 200 iterations). Values for skewness and kurtosis for the individual items and for the aggregate scores were all less than |1.7|, indicating little deviation from normality. We tested for possible associations between gender and grade level with the 12 student dependent measures. Gender was associated with 5 of the 12 dependent measures, while grade level was associated with 11 of the 12 measures (as shown in the last two rows of Table 3). Given these associations, we included student gender (males = 0; females = 1) and grade level (middle = 0; high = 1) as covariates (i.e., as statistical controls) in all the analyses.

Effects of the ASIP Manipulation on Students' Need States[1]

For autonomy satisfaction, the critical condition *x* time interaction, after controlling for student gender and grade level, was significant, $t(5,299) = 18.70$, $p < .001$ ($d_{\text{IGPP-RAW}} = 0.77$). Autonomy satisfaction increased significantly for students of teachers in the experimental group from T1 to T2 (*M*s = 4.75 *vs*. 5.34), $\Delta = +0.69$, $t = 25.26$, $p < .001$ ($d = 0.70$), while it decreased significantly (though modestly) for students of teachers in the control group from T1 to T2 (*M*s = 4.86 *vs*. 4.80), $\Delta = -0.06$, $t = 2.20$, $p = .028$ ($d = 0.06$).

For autonomy dissatisfaction, the critical condition *x* time interaction, after controlling for student gender and grade level, was significant, $t(5,299) = 8.27$, $p < .001$ ($d_{\text{IGPP-RAW}} = 0.38$). Autonomy dissatisfaction decreased significantly for students of teachers in the experimental group from T1 to T2 (*M*s = 2.53 *vs*. 2.21), $\Delta = -0.32$, $t = 10.75$, $p < .001$ ($d = 0.29$), while it increased significantly (though modestly) for students of teachers in the control group from T1 to T2 (*M*s = 2.57 *vs*. 2.65), $\Delta = +0.08$, $t = 2.45$, $p = .014$ ($d = 0.08$).

For autonomy frustration, the critical condition *x* time interaction, after controlling for student gender and grade level, was significant, $t(5,299) = 9.36$, $p < .001$ ($d_{\text{IGPP-RAW}} = 0.46$). Autonomy frustration decreased significantly for students of teachers in the experimental group from T1 to T2 (*M*s = 3.07 *vs*. 2.71), $\Delta = -0.36$, $t = 13.22$, $p < .001$ ($d = 0.36$), while it increased significantly for students of teachers in the control group from T1 to T2 (*M*s = 3.03 *vs*. 3.17), $\Delta = +0.14$, $t = 4.47$, $p < .001$ ($d = 0.13$).

Effects of the ASIP Manipulation on Students' Engagement-Disengagement

For rater-scored engagement-disengagement, raters scored students of teachers in the experimental group as displaying greater collective classroom engagement than they scored students of teachers in the control group (*M*s, 5.55 *vs*. 4.71), $t(35) = 4.00$, $p < .001$, $d = 1.35$.

For student-reported classroom engagement, the critical condition *x* time interaction, after controlling for student gender and grade level, was significant, $t(5,299) = 22.16$, $p < .001$ ($d_{\text{IGPP-RAW}} = 0.98$). Engagement increased significantly for students of teachers in the experimental group from T1 to T3 (*M*s = 4.48 *vs*. 5.27), $\Delta = +0.79$, $t = 32.08$, $p < .001$ ($d = 0.94$), while it remained unchanged for students of teachers in the control group from T1 to T3 (*Ms* = 4.60 *vs*. 4.55), $\Delta = -0.05$, $t = 1.82$, $p = .069$ ($d = 0.05$).

For student-reported classroom disengagement, the critical condition *x* time interaction, after controlling for student gender and grade level, was significant, $t(5,299) = 11.07$, $p < .001$ ($d_{\text{IGPP-RAW}} = 0.50$). Disengagement decreased significantly for students of

teachers in the experimental group from T1 to T3 (*M*s = 2.77 *vs*. 2.35), Δ = -0.42, $t = 14.79$, $p < .001$ ($d = 0.41$), while it increased significantly for students of teachers in the control group from T1 to T3 (*M*s = 2.75 *vs*. 2.85), Δ = +0.10, $t = 3.19$, $p = .001$ ($d = 0.10$).

Test of the Hypothesized Model

We first tested the measurement model, which featured 10 latent variables, including 5 indicators for autonomy satisfaction at both T1 and T2, 5 indicators for autonomy dissatisfaction at T1 and T2, 4 indicators for autonomy frustration at T1 and T2, 4 indicators for engagement (behavioral, emotional, agentic, and cognitive) at T1 and T3, and 4 indicators for disengagement at T1 and T3. The measurement model fit the data reasonably well, X^2 (1,822) = 7,666.78, $p < .001$, *RMSEA* = .049 (.048 - .050), *SRMR* = .045, *CFI* = .983, *NNFI* = .983, with most of the variance occurring at the student (X^2 = 5,832.02; 76.1%) rather than at the teacher (X^2 = 1,834.76, 23.9%) level. Table 2 shows the descriptive statistics and factor loadings for all 44 individual indicators included in the measurement model, while Table 3 shows the intercorrelations among experimental condition, the 10 dependent measures (represented as latent variables), and the two statistical controls (gender, grade level, represented as observed variables).

We next tested the hypothesized model, and it too fit the data reasonably well overall, X^2 (2,078) = 8,792.22, $p < .001$, *RMSEA* = .049 (.048 - .050), SRMR = .071, *CFI* = .981, *NNFI* = .981. Because the hypothesized model included only one of the three psychological needs emphasized in the self-determination theory framework (i.e., it included autonomy, but excluded both competence and relatedness), we conducted a supplemental analysis by testing if the addition of the two direct effects of experimental condition on the two outcomes (T3 engagement, T3 disengagement) might improve the model fit. Adding these two direct effect paths to the hypothesized model did produce a good overall fit, X^2 (2,076) = 8,567.47, $p < .001$, *RMSEA* = .048 (.047 - .049), SRMR = .069, *CFI* = .982, *NNFI* = .981, and it produce a

fit to the data that was significantly better than that provided by the original hypothesized model, ΔX^2 ($\Delta df = 2$) = 224.75, $p < .001$. So, we added the two direct effect paths from experimental condition onto the hypothesized model, and the path diagram showing the standardized estimates for each path in this revised hypothesized model appears in Figure 4. For clarity, we do not show the statistical controls in Figure 4, but we do report all the effects for gender and grade level in the text below.

Teacher participation in the ASIP (i.e., experimental condition) predicted (1) high *T2 autonomy satisfaction* ($B = .25$, *SE B* = .02, $\beta = .31$, $t = 16.92$, $p < .001$), even after controlling for T1 autonomy satisfaction ($\beta = .47$, $p < .001$), gender ($\beta = -.06$, $p < .001$), and grade level ($\beta = .03$, $p = .152$); (2) low *T2 autonomy dissatisfaction* ($B = -.18$, *SE B* = .02, $\beta = -.20$, $t = 10.94$, $p < .001$), even after controlling for T1 autonomy dissatisfaction ($\beta = .38$, $p < .001$), gender ($\beta = .02$, $p = .211$), and grade level ($\beta = .02$, $p = .332$); and (3) low *T2 autonomy frustration* ($B = -.20$, *SE B* = .02, $\beta = -.24$, $t = 12.16$, $p < .001$), even after controlling for T1 autonomy frustration ($\beta = .37$, $p < .001$), gender ($\beta = -.01$, $p = .453$), and grade level ($\beta = .00$, $p = .900$).

In the prediction of *T3 engagement*, high T2 autonomy satisfaction ($B = .40$, *SE B* = .03, $\beta = .36$, $t = 13.72$, $p < .001$) and low T2 autonomy dissatisfaction ($B = -.21$, *SE B* = .03, $\beta = -.20$, $t = 6.93$, $p < .001$) were both individually significant predictors, while low T2 autonomy frustration was not ($B = .00$, *SE B* = .03, $\beta = .00$, $t = 0.14$, $p = .889$), at least not after controlling for T1 engagement ($\beta = .22$, $p < .001$), experimental condition ($\beta = .25$, $p < .001$), T1 autonomy satisfaction ($\beta = -.03$, $p = .420$), T1 autonomy dissatisfaction ($\beta = .04$, $p = .188$), T1 autonomy frustration ($\beta = .00$, $p = .901$), gender ($\beta = .02$, $p = .331$), and grade level ($\beta = -.01$, $p = .451$).

In the prediction of *T3 disengagement*, low T2 autonomy satisfaction ($B = -.25$, *SE B* = .03, $\beta = -.24$, $t = 8.86$, $p < .001$), high T2 autonomy dissatisfaction ($B = .27$, *SE B* = .03, $\beta =$

.28, t = 9.25, p < .001), and high T2 autonomy frustration (B = .10, *SE B* = .03, β = .10, t = 3.54, p < .001) were all individually significant predictors, even after controlling for T1 disengagement (β = .23, p < .001), experimental condition (β = -.12, p < .001), T1 autonomy satisfaction (β = .00, p = .932), T1 autonomy dissatisfaction (β = .00, p = .913), T1 autonomy frustration (β = -.02, p = .459), gender (β = -.02, p = .117), and grade level (β = -.02, p = .249).

The model proposed in Figure 1 was a mediation model, so we tested for indirect effects via the three need-state mediated paths from experimental condition (the ASIP intervention manipulation) to both engagement and disengagement. As reported above, the two freely estimated direct paths were both statistically significant (ASIP to engagement, B = .23, *SE B* = .02, β = .25, t = 15.17, p < .001; ASIP to disengagement, B = -.10, *SE B* = .02, β = -.12, t = 6.82, p < .001). *For the T3 engagement outcome*, the total effect was B = .372 (t = 22.89, p < .01). Indirect effect estimates for the model (Fig. 4) indicated that ASIP had a significant indirect effect of β = .140 (t = 13.99, p < .001) on engagement, of which .102 (73% of the indirect effect, 27% of the overall effect) was transmitted via need satisfaction, .037 (27% of the indirect effect, 10% of the overall effect) was transmitted via need dissatisfaction, and .001 (1% of the indirect effect, 0% of the overall effect) was transmitted via need frustration. *For the T3 disengagement outcome*, the total effect was B = -.232 (t = 14.66, p < .001). Indirect effect estimates for the model (Fig. 4) indicated that ASIP had a significant indirect effect of β = .132 (t = 13.40, p < .001) on disengagement, of which .063 (47% of the indirect effect, 27% of the overall effect) was transmitted via need satisfaction, .048 (37% of the indirect effect, 21% of the overall effect) was transmitted via need dissatisfaction, and .021 (16% of the indirect effect, 9% of the overall effect) was transmitted via need frustration.

Discussion

A student's autonomy need state varies over the course of instruction, and the premise on which we based the present investigation was that a full understanding of the autonomy psychological need construct requires the specification of three—and not just one or two—need states. Both the exploratory structural equation model analysis (Table 2) and the measurement model (a confirmatory factor analysis; Table 3) showed that student-participants could make reliable distinctions in their experiences of autonomy satisfaction, autonomy dissatisfaction, and autonomy frustration. Students were further able to distinguish perceived autonomy support from these same three autonomy need states (see Appendix). In the only other empirical study that investigated psychological need dissatisfaction, Costa, Ntoumanis, and Bartholomew's (2015) used a multi-trait, multi-method analysis to also show that need dissatisfaction was experientially distinct from both low need satisfaction and high need frustration. Such findings—our investigation in the context of the physical education classroom and their study in the context of interpersonal relationships, collectively support the proposal that the SDT explanatory framework may be expanded from two need states (satisfaction, frustration) to three (satisfaction, dissatisfaction, frustration).

Evidence for the necessity of adding autonomy dissatisfaction to the SDT explanatory framework emerged from the finding that autonomy dissatisfaction predicted unique variance in students' end-of-semester classroom disengagement. This effect occurred even after controlling for mid-semester changes in students' autonomy satisfaction and autonomy frustration, and it also occurred after controlling for the direct effect of experimental condition. The predictive effect of T2 autonomy dissatisfaction was fairly strong (β = .28; see Fig. 4), so it raises the question as to why self-determination theorists have overlooked the unique contribution of autonomy dissatisfaction on measures of students' diminished functioning (i.e., disengagement) in the past. Low autonomy satisfaction also significantly

and uniquely predicted students' T3 disengagement (β = -.24), so the answer seems to be that these theorists made the assumption that high autonomy dissatisfaction was subsumed by low autonomy satisfaction (i.e., satisfaction and dissatisfaction were two sides of the same coin, or construct). We did find that these two need states were negatively correlated (*r*s = -.61 and -.62 at T1 and T2), but we also found that each state loaded as its own distinct factor with minimal cross loadings and each accounted for unique variance in predicting late-semester changes in disengagement. This suggests that high autonomy dissatisfaction cannot be equated with low autonomy satisfaction, and it further substantiates the major claim tested in the present study, which was that if motivation researchers wish to more fully understand and explain students' classroom tendencies toward diminished functioning (i.e., longitudinal gains in disengagement) then it becomes necessary to expand the existing SDT framework to include the third psychological need state of autonomy dissatisfaction.

A third unique predictor of students' end-of-semester classroom disengagement was a decrease in students' mid-semester T2 autonomy frustration. This finding suggests that autonomy dissatisfaction and autonomy frustration represented somewhat different motivational pathways to explain how autonomy dissatisfaction and autonomy frustration might both feed into classroom disengagement. There may be merit in making a distinction between dissatisfaction-related "passive disengagement" and frustration-related "active disengagement" (Earl, Taylor, Meijen, & Passfield, 2017). Working on an unappealing learning activity (autonomy dissatisfaction) may lead to passive disengagement (e.g., on-task minimal effort), while working on a learning activity that one is strongly pressured to do (autonomy frustration) may lead to active disengagement (e.g., off-task reactance or defiance). It is reasonable to expect that both of these types of classroom experiences occur over the course of a semester and feed differentially into classroom disengagement.

As to predicting changes in students' end-of-semester classroom engagement, high autonomy satisfaction and low autonomy dissatisfaction (but not low autonomy frustration) emerged as individually significant predictors. This result again suggests two somewhat separate motivational pathways to changes in engagement—one that contributes an enhancing effect (β = .36) and one that contribute a diminishing effect (β = -.20). Working on a learning activity that one freely chose to engage in (a rise in autonomy satisfaction) may lead to excited or energized engagement, while working on a learning activity that is unrelated to what one wants to do (a rise in autonomy dissatisfaction) may lead to a lethargic, impoverished, or diminished engagement.

Under typical conditions (i.e., teachers do not participate in the ASIP), students' autonomy dissatisfaction toward PE activities rose over the course of the semester. This rise was small but it was significant (d = .08, p = .014), suggesting that teaching under typical conditions is likely characterized by a modest rise in autonomy indifferent instruction. Currently there is no measure to assess a teacher-provided "autonomy indifference" instructional style, so we would suggest future research be devoted to the development of a scale to assess this style. To stimulate this effort, we suggest that whereas autonomy support assesses "my teacher understands me" and autonomy thwart assesses "my teacher pressures me", autonomy indifference would assess "my teacher pays little attention to my concerns".

Under autonomy supportive conditions (i.e., teachers participate in the ASIP), students' autonomy dissatisfaction toward PE activities declined over the course of the semester. This decline was moderately large (d = .29, p < .001). Autonomy-supportive teaching represents highly skilled teaching, motivationally speaking, and it benefited students not only by providing them with engagement-fostering experiences of autonomy satisfaction but also by minimizing or preventing episodes of disengagement-fostering autonomy dissatisfaction. So, autonomy-supportive teaching both enhanced autonomy satisfaction and

diminished autonomy dissatisfaction. That said, our study did not include an "autonomy indifferent teaching" experimental condition, and our study did not assess student perceptions of autonomy indifferent teaching. Given the generally positive findings reported in the present study, we would invite future research to investigate the motivational implications of an autonomy indifferent motivating style.

Our study focused on the three needs states of autonomy satisfaction, autonomy dissatisfaction, and autonomy frustration. In one way, this targeted focus can be regarded as a study limitation, as we recognize that we assessed only one of the three psychological needs central to self-determination theory (autonomy, but neither competence nor relatedness). In preparing our investigation, we considered this to be a necessary limitation because our teacher-focused intervention was designed to promote only autonomy-supportive teaching but not necessarily either competence-supportive or relatedness-supportive teaching. But the tests of the direct effects of experimental condition (the ASIP manipulation) on longitudinal changes in students' T3 engagement and T3 disengagement showed that our exclusive focus was an important limitation. The three autonomy need states were not able to fully explain (fully mediate) all the observed changes our student-participants reported experiencing over the course of the semester. For engagement, the three autonomy need states explained 38% of the total effect (.140/.372); and for disengagement, the three autonomy need states explained 57% of the total effect (.132/.232). In retrospect, the significant direct effects are not all that surprising, as autonomy support is associated with gains not just in autonomy satisfaction but in competence and relatedness satisfactions as well (Baard, Deci, & Ryan, 2004) and this same effect has occurred in ASIP interventions in which teachers who learn how to become more autonomy supportive provide instruction not only in autonomy satisfying ways but also in competence-satisfying and relatedness-satisfying ways as well (see Cheon & Reeve, 2013, Fig. 3, p. 514; Cheon et al., 2012, Fig. 4, p. 379). We believe that the (unmeasured) capacity

of the experimental manipulation to promote longitudinal gains in students' competence and relatedness need satisfaction explains why the three autonomy needs states were not able to fully mediate the direct effects of ASIP on engagement and disengagement. If this reasoning is correct, then we suggest that a productive next step in psychological need dissatisfaction research would be to include all three needs—both in their measurement and in the design and implementation of the teacher-focused intervention program.

Three additional concerns limit the conclusions that can be reached from our investigation. First, our study took place in the context of secondary-school PE Korean classrooms. PE instruction often occurs in a non-traditional setting (in a gym or open field in which teachers often interact with groups of students and converse about physical rather than cognitive skills), and it is not yet clear how the PE context may apply to classroom instruction and student-teacher interactions in more traditional settings and subject matters.

Second, teachers randomly assigned into the control group were not given a professional developmental opportunity in the same way teachers in the experimental group were, and this methodological feature means that a Hawthorne effect (the tendency for participants in an experiment to work harder and to perform better merely because of the extra attention paid to them by the researchers) cannot be ruled out. In the current study, we compared teachers in the experimental group against teachers who continued to teach with their existing motivating styles ("standard practice in the PE course"), so it may now be helpful if a future study will use an alternative control group that features an intervention experience, but one that is unrelated to motivating style (for one example, see Chatzisarantis & Hagger, 2009).

Third, we tested our hypothesized model with only self-reported data from our student-participants. We did collect observational data, as trained raters scored teachers' in-class autonomy-supportive instructional behaviors and students' in-class displays of

engagement-disengagement. These rater-scored observational data did correspond well with students' self-reported data, but these observational data were not used in the test of the hypothesized model (because it was a longitudinal model, whereas the observational data was collected only at T2). We acknowledge that our study would be made methodologically stronger with the inclusion of objective sources of data in the test of our study hypotheses.

Conclusion

Students enter learning activities and teacher-student interactions with an intrinsically-endowed, energy-generating psychological need for autonomy. When learning activities and teacher-student interactions are indifferent to students' need for autonomy, then students likely tend toward a state of autonomy dissatisfaction. Once experienced, greater autonomy dissatisfaction tends students' classroom activity toward disengagement. If prevented, however, as through autonomy-supportive teaching, then lesser autonomy dissatisfaction tends students toward engagement.

Footnote

1. For each of the 6 multilevel modeling analyses (one each for perceived autonomy-supportive teaching, autonomy satisfaction, autonomy dissatisfaction, autonomy frustration, engagement, and disengagement), we report only the results for the hypothesized test, which was the condition *x* time interaction effect. Across all 6 of these analyses, the 6 unreported condition main effects were all non-significant, the 6 unreported time main effects were all statistically significant ($p < .001$), and the 6 unreported random effects test for meaningful teacher-level variance were all statistically significant ($p < .001$).

References

Aelterman, N., Vansteenkiste, M., Soenens, B., Fontaine, J., Haerens, L., Delrue, J., & Reeve, J. (2018). Towards a fine-grained understanding of the components of need-supportive and need-thwarting teaching: The merits of a gradual approach. *Journal of Educational Psychology*.

Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1993). First-grade classroom behavior: Its short and long-term consequences for school performance. *Child Development, 64*, 801-814.

Amoura, C., Berjot, S., Gillet, N., Caruana, S., Cohen, J., & Finez, L. (2015). Autonomy-supportive and controlling styles of teaching: Opposite or distinct teaching styles? *Swiss Journal of Psychology, 74*, 141-158.

Assor, A., Kaplan, H., & Roth, G. (2002). Choice is good, but relevance is excellent: Autonomy-enhancing and suppressing teacher behaviours in predicting student's engagement in school work. *British Journal of Educational Psychology, 72*, 261-278.

Assor, A., Kaplan, H., Kanat-Maymon, Y., & Roth, G. (2005). Directly controlling teachers' behaviors as predictors of poor motivation and engagement in girls and boys: role of anger and anxiety. *Learning and Instruction, 15*, 397-413.

Authors. (2015).

Authors. (2017).

Baard, P. P., Deci, E. L., & Ryan, R. M. (2004). Intrinsic need satisfaction: A motivational basis of performance and well-being in two work settings. *Journal of Applied Social Psychology, 34*, 2045-2068.

Bartholomew, K., Ntoumanis, N., Mouratidis, A., Katartzi, E., Thøgersen-Ntoumani, C., & Vlachopoulos, S., (2018). Beware of your teaching style: A school-year long investigation of controlling teaching and student motivational experiences.

Learning and Instruction, 53, 50-63.

Bartholomew, K. J., Ntoumanis, N., Ryan, R., Bosch, J. A., & Thøgersen-Ntoumani, C. (2011a). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology, 37,* 1459-1473.

Bartholomew, K. J., Ntoumanis, N., Ryan, R. M., & Thøgersen-Ntoumani, C. (2011b). Psychological need thwarting in the sport context: Assessing the darker side of athletic experience. *Journal of Sport and Exercise Psychology, 33,* 75-102.

Birch, S. H., & Ladd, G. W. (1997). The student–teacher relationship and children's early school adjustment. *Journal of School Psychology, 35,* 61–79.

Boone, L., Vansteenkiste, M., Soenens, B., Van der Kaap-Deeder, J., & Verstuyf, J. (2014). Self-critical perfectionism and binge eating symptoms: A longitudinal test of the intervening role of psychological need frustration. *Journal of Counseling Psychology, 61,* 363-373.

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

Cheon, S. H., & Reeve, J. (2013). Do the benefits from autonomy-supportive PE teacher training programs endure? A one-year follow-up investigation. *Psychology of Sport and Exercise, 14,* 508-518.

Cheon, S. H., & Reeve, J. (2015). A classroom-based intervention to help teachers decrease students' amotivation. *Contemporary Educational Psychology,* 40, 99-111.

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

Cheon, S. H., Reeve, J., & Ntoumanis, N. (2018). A needs-based intervention to help PE Teachers enhance students' prosocial behavior and diminish antisocial behavior. *Psychology of Sport and Exercise, 35*, 74-88.

Cheon, S. H., Reeve, J., & Song, Y.-G. (2016). A teacher-focused intervention to decrease PE students' amotivation by increasing need satisfaction and decreasing need frustration. *Journal of Sport and Exercise Psychology, 38*, 217-235.

Christenson, S. L., & Reschly, A. L. (2010). Check & Connect: Enhancing school completion through student engagement. In E. Doll & J. Charvat (Eds.), *Handbook of prevention science*. Mahwah, NJ: Lawrence Erlbaum.

Christenson, S. L., Reschly, A., & Wylie, C. (Eds.) (2013). *Handbook of research on student engagement*. New York: Springer.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Mahwah, NJ: Erlbaum.

Costa, S., Ntoumanis, N., & Bartholomew, K. J. (2015). Predicting the brighter and darker sides of interpersonal relationships: Does psychological need thwarting matter? *Motivation and Emotion, 39*, 11-24.

Cox, A., & Williams, L. (2008). The roles of perceived teacher support, motivational climate, and psychological need satisfaction in students' physical education motivation. *Journal of Sport and Exercise Psychology, 30*, 222-239.

Deci, E. L. (1995). *Why we do what we do: Understanding self-motivation.* New York: Penguin Books.

Deci, E. L., Ryan, R. M., Gagné, M., Leone, D. R., Usunov, J., & Kornazheva, B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former Eastern Bloc country. *Personality and Social Psychology Bulletin, 27*, 930-942.

Di Domenico, S. I., Le, A., Liu, Y., Ayaz, H., Fournier, M. A. (2014). Basic psychological needs and neurophysiological responsiveness to decisional conflict: An event-related potential study of integrative self-processes. *Cognitive Affective and Behavioral Neuroscience, 68,* 96-110.

Earl, S. R., Taylor, I. M., Meijen, C., & Passfield, L. (2017). Autonomy and competence frustration in young adolescent classrooms: Different associations with active and passive disengagement. *Learning and Instruction, 49,* 32-40.

Elliot, A. J., McGregor, H. A., & Gable, S. (1999). Achievement goals, study strategies, and exam performance: A mediational analysis. *Journal of Educational Psychology, 91,* 549-563.

Feingold, A. (2009). Effect sizes for growth-modeling analysis for controlled clinical trials in the same metric as for classical analysis. *Psychological Methods, 14*, 43–53.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research, 74*, 59–109.

Fredricks, J., Reschly, A., & Christenson, S. L. (2018). *Handbook of student engagement interventions: Working with disengaged youth*. Amsterdam, Netherlands: Elsevier Press.

Gunnell, K., Crocker, P. R. E., Wilson, P. M., Mack, D. E., & Zumbo, B. D. (2013). Psychological need satisfaction and thwarting: A test of basic psychological needs theory in physical activity contexts. *Psychology of Sport & Exercise, 14,* 599-607.

Haerens, L., Aelterman, N., Vansteenkiste, M., Soenens, B., & Van Petegem, S. (2015). Do perceived autonomy-supportive and controlling teaching relate to physical education students' motivational experiences through unique pathways? Distinguishing between the bright and dark side of motivation. *Psychology of Sport and Exercise, 16*, 26–36.

Hein, V., Koka, A., & Hagger, M. S. (2015). Relationships between perceived teachers' Controlling behavior, psychological need thwarting, anger, and bullying behavior in high-school students. *Journal of Adolescence, 42,* 103-114.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

Jang, H., Kim, E. J., & Reeve, J. (2012). Longitudinal test of self-determination theory's motivation mediation model in a naturally-occurring classroom context. *Journal of Educational Psychology, 104,* 1175-1188.

Jang, H., Kim, E.-J., & Reeve, J. (2016). Why students become more engaged or more disengaged during the semester: A self-determination theory dual-process model. *Learning and Instruction, 43,* 27-38.

Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology, 102,* 588-600.

Jang, H., Reeve, J., & Halusic, M. (2016). A new autonomy-supportive way of teaching that increases conceptual learning: Teaching in students' preferred ways. *Journal of Experimental Education, 84, 686-701.*

Jang, H., Reeve, J., Ryan, R. M., & Kim, A. (2009). Can self-determination theory explain what underlies the productive, satisfying learning experiences of collectivistically-oriented South Korean adolescents? *Journal of Educational Psychology, 101,* 644-661.

Jimerson, S. R., Egeland, B., Sroufe, L. A., & Carlson, E. (2000). A prospective longitudinal study of high school dropouts: Examining multiple predictors across development. *Journal of School Psychology, 38*, 525-549.

Joreskog, K. G., & Sorbom, D. (2006). *LISREL 8.80 for Windows* [Computer software]. Lincolnwood, IL: Scientific Software International.

Kim, U., & Park, Y. S. (2006). Indigenous psychological analysis of academic achievement in Korea: The influence of self-efficacy, parents, and culture. *International Journal of Psychology, 41,* 287–292.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford Press.

Ladd, G. W., & Dinella, L. M. (2009). Continuity and change in early school engagement: Predictive of children's achievement trajectories from first to eighth grade? *Journal of Educational Psychology, 101,* 190 –206.

Lim, B. S. C., & Wang, C. K. (2009). Perceived autonomy support, behavioural regulations in physical education and physical activity intention. *Psychology for Sport and Exercise, 10,* 52-60.

Liu, J. D., & Chung, P. K. (2015). Development and initial validation of the Chinese version of psychological needs thwarting scale in physical education. *Journal of Teaching in Physical Education, 34,* 402-423.

Lonsdale, C., Sabiston, C. M., Taylor, I. M., & Ntoumanis, N., (2011). Measuring student motivation for physical education: Examining the psychometric properties of the Perceived Locus of Causality Questionnaire and the Situational Motivation Scale. *Psychology of Sport and Exercise, 12,* 284-292.

Muthen, L. K., & Muthen, B. O. (2015). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthen & Muthen.

Ntoumanis, N., Barkoukis, V., & Thogersen-Ntoumani, C. (2009). Developmental trajectories of motivation in physical education: Course, demographic differences, and antecedents. *Journal of Educational Psychology, 101,* 717-728.

Oyserman, D., Coon, H., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: Evaluation of theoretical assumptions and meta-analyses.

Psychological Bulletin, 128, 3-72.

Patall, E. A., Dent, A. L., Oyer, M., & Wynn, S. R. (2012). Student autonomy and course value: The unique and cumulative roles of various teacher practices. *Motivation and Emotion, 37,* 14-32.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82,* 33–40.

Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist, 44,* 159-178.

Reeve, J. (2013). How students create motivationally supportive learning environments for themselves: The concept of agentic engagement. *Journal of Educational Psychology, 105,* 579-595.

Reeve, J. (2016). Autonomy-supportive teaching: What it is, how to do it. In J. C. K. Wang, W. C. Liu, and R. M. Ryan's (Eds.), *Building autonomous learners: Perspectives from research and practice using self-determination theory* (Chpt 5, pp. 129-152). New York: Springer.

Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during learning activities. *Journal of Educational Psychology, 98,* 209-218.

Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion, 28,* 147-169.

Reeve, J., & Tseng, C.-M. (2011). Agency as a fourth aspect of students' engagement during learning activities. *Contemporary Educational Psychology, 36,* 257-267.

Reeve, J., Vansteenkiste, M., Assor, A., Ahmad, I., Cheon, S. H., Jang, H., Kaplan, H., Moss, J. D., Olaussen, B. S., & Wang, C. K. J. (2014). The beliefs that underlie autonomy-supportive and controlling teaching: A multinational investigation.

Motivation and Emotion, 38, 93-110.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78.

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

Senko, C., & Miles, K. M. (2008). Pursuing their own learning agenda: How mastery-oriented students jeopardize their class performance. *Contemporary Educational Psychology, 33,* 561-583.

Sheldon, K. M., Ryan, R. M., & Reis, H. T. (1996). What makes for a good day?: Competence and autonomy in the day and in the person. *Personality and Social Psychology Bulletin, 22,* 1270–1279.

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology, 85,* 571–581

Skinner, E. A., Kindermann, T. A., & Furrer, C. J. (2009). A motivational perspective on engagement and disaffection: Conceptualization and assessment of children's behavioral and emotional participation in academic activities in the classroom. *Educational and Psychological Measurement, 69,* 493-525.

Sparks, C., Dimmock, J., Lonsdale, C., & Jackson, B. (2016). Modeling indicators and outcomes of students' perceived teacher relatedness support in high school physical education. *Psychology of Sport and Exercise, 26,* 71-82.

Standage, M., Duda, J. L., & Ntoumanis, N. (2005). A test of self-determination theory in school physical education. *British Journal of Educational Psychology, 75,* 411-433.

Standage, M., Duda, J. L., & Ntoumanis, N. (2006). Students' motivational processes and their relationship to teacher ratings in school physical education: A self-determination

theory approach. *Research Quarterly for Exercise and Sport, 77*, 100-110.

Streb, J., Keis, O., Lau, K., Hille, I., Spitzer, M., & Sosic-Vasic, Z. (2015). Emotional engagement in kindergarten and school children: A self-determination theory perspective. *Trends in Neuroscience and Education, 4*, 102-107.

Taylor, I. M., & Lonsdale, C. (2010). Cultural differences in the relationship among autonomy support, psychological need satisfaction, subjective vitality, and effort in British and Chinese physical education. *Journal of Sport and Exercise Psychology, 32*, 655-673.

Taylor, I., Ntoumanis, N., Standage, M., & Spray, C. M. (2010). Motivational predictors of physical education students' effort, exercise intentions, and leisure-time physical activity: A multilevel linear growth analysis. *Journal of Sport and Exercise Psychology, 32*, 99-120.

Tessier, D., Sarrazin, P., & Ntoumanis, N. (2010). The effect of an intervention to improve newly qualified teachers' interpersonal style, students' motivation and psychological need satisfaction in sport-based physical education. *Contemporary Educational Psychology, 35*, 242-253.

Thomsen, D. K., Tonnesvang, J., Schnieber, A., & Olesen, M. H. (2011). Do people ruminate because they haven't digested their goals? The relations of rumination and reflection to goal internalization and ambivalence. *Motivation and Emotion,35*, 105-117.

Tsai, Y.-M., Kunter, M., Lüdtke, O., Trautwein, U., & Ryan, R. M. (2008). What makes lessons interesting? The role of situational and individual factors in three school subjects. *Journal of Educational Psychology, 100*, 460-472.

Van den Berghe, L., Cardon, G., Tallir, I., Kirk, D., & Haerens, L. (2016). Dynamics of need-supportive and need-thwartive teaching behavior: The bidirectional relationship with student engagement and disengagement in the beginning of a lesson.

Physical Education and Sport Pedagogy, 21, 653-670.

Vansteenkiste, M., Aelterman, N., De Muynck, G.-J., Haerens, L. Patall, E., & Reeve, J. (2018). Fostering personal meaning and self-relevance: A self-determination theory Perspective on internalization. *Journal of Experimental Education, 86*, 30-49.

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration, 23*, 263–280.

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic role of intrinsic goals and autonomy support. *Journal of Personality and Social Psychology, 87,* 246 –260.

Vansteenkiste, M., Simons, J., Lens, W., Soenens, B., & Matos, L. (2005). Examining the motivational impact of intrinsic versus extrinsic goal framing and autonomy-supportive versus internally controlling communication style on early adolescents' academic achievement. *Child Development, 2*, 483-501.

Williams, G. C., & Deci, E. L. (1996). Internalization of biopsychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology, 70,* 767-779.

Zougkou, K., Weinstein, N., & Paulmann, S. (2017). ERP correlates of motivating voices: Quality of motivation and time-course matters. *Social Cognitive and Affective Neuroscience, 12*, 1687-1700.

Table 1
Standardized Parameter Estimates for the ESEM 3-Factor Solution of the 14 Autonomy Satisfaction, Dissatisfaction, and Frustration Items

	Satisfaction (λ)	Dissatisfaction (λ)	Frustration (λ)
Items from the Autonomy Satisfaction Scale			
1. In this PE class, I can decide which activities I want to do.	**.807**	.005	-.028
2. In this PE class, I have a say regarding what skills I want to practice and learn.	**.877**	-.002	.003
3. I feel that I do PE because I want to.	**.932**	.053	-.008
4. In this PE class, I have a certain freedom of action.	**.757**	-.057	.030
5. In this PE class, I have some choice in what I want to do.	**.772**	-.048	-.008
Items from the Autonomy Dissatisfaction Scale			
1. In this PE class, I generally don't feel free to choose how to do things for myself.	-.027	**.806**	.044
2. In this PE class, I usually feel like I have to pretend to be something different from what I really am.	-.001	**.876**	.006
3. In this PE class, I believe I have no choice about doing what I usually do.	.035	**.979**	-.032
4. What I do during PE class is often not what I'd like to do.	-.022	**.859**	-.006
5. In this PE class, I usually feel like I have to keep my ideas and opinions to myself.	.025	**.887**	.042
Items from the Autonomy Frustration Scale			
1. In this PE class, I feel under pressure to agree to do the activities that I am provided.	.085	-.159	**.553**
2. In this PE class, I feel pushed to behave in certain ways.	-.024	.004	**.875**
3. In this PE class, I feel obliged to follow decisions that have already been made for me.	.010	.022	**.910**
4. In this PE class, I feel prevented from making choices with regard to what I can and cannot do.	-.049	.326	**.441**

Table 2

Descriptive Statistics, Unstandardized, and Standardized Beta Weights Associated with the 44 Indicators in the Measurement Model

	Time 1					T2 for Needs; T3 for Engagements				
Dependent Measure	*M*	(*SD*)	*B*	SE	*β*	*M*	(*SD*)	*B*	SE	*β*
Autonomy Need Satisfaction Indicators										
In this PE class,										
1. I can decide which activities I want to do.	4.92	(1.21)	.92	.02	.73	5.20	(1.26)	.92	.02	.78
2. I have a say regarding what skills I want to practice and learn.	4.99	(1.35)	.97	.02	.77	5.25	(1.34)	.98	.02	.84
3. I feel that I do PE because I want to.	4.96	(1.22)	1.00	-	.79	5.26	(1.24)	1.00	-	.85
4. I have a certain freedom of action.	4.49	(1.24)	.91	.02	.73	4.82	(1.29)	.89	.02	.76
5. I have some choice in what I want to do.	4.67	(1.14)	.99	.02	.79	4.96	(1.24)	.95	.02	.81
Autonomy Need Dissatisfaction Indicators										
In this PE class,										
1. I generally don't feel free to choose how to do things for myself.	2.62	(1.27)	.92	.02	.79	2.52	(1.33)	.92	.02	.84
2. I usually feel like I have to pretend to be something different from what I really am.	2.26	(1.23)	.94	.02	.81	2.21	(1.25)	.93	.02	.84
3. I believe I have no choice about doing what I usually do.	2.45	(1.29)	1.00	-	.86	2.34	(1.30)	1.00	-	.91
4. What I do during PE class is often not what I'd like to do.	2.85	(1.46)	.92	.02	.79	2.60	(1.43)	.94	.01	.86
5. I usually feel like I have to keep my ideas and opinions to myself.	2.56	(1.29)	1.00	.02	.86	2.38	(1.28)	.98	.01	.89
Autonomy Need Frustration Indicators										
In this PE class,										
1. I feel prevented from making choices with regard to what I can and cannot do.	4.11	(1.45)	.35	.02	.31	4.00	(1.53)	.35	.02	.31
2. I feel pushed to behave in certain ways.	2.92	(1.33)	.98	.02	.86	2.75	(1.35)	.93	.02	.82

3. I feel obliged to follow decisions that have already been made for me.	2.82	(1.34)	1.00	.02	.88	2.63	(1.31)	1.00	-	.88
4. I feel under pressure to agree to do the activities that I am provided.	2.38	(1.26)	.74	.02	.65	2.28	(1.26)	.85	.02	.75
Classroom Engagement Indicators										
1. Behavioral engagement	5.09	(1.04)	.89	.02	.80	5.32	(1.10)	.95	.01	.89
2. Emotional engagement	4.85	(1.08)	1.00	-	.90	5.11	(1.15)	1.00	-	.94
3. Agentic engagement	3.80	(1.22)	.57	.02	.51	4.10	(1.36)	.69	.02	.65
4. Cognitive engagement	4.40	(1.09)	.54	.02	.49	4.59	(1.22)	.71	.02	.67
Classroom Disengagement Indicators										
1. Behavioral disengagement	2.75	(1.09)	.96	.02	.83	2.59	(1.16)	.96	.02	.86
2. Emotional disengagement	2.57	(1.18)	1.00	.02	.87	2.44	(1.20)	.99	.01	.89
3. Agentic disengagement	2.79	(1.18)	1.00	-	.87	2.60	(1.19)	1.00	-	.90
4. Cognitive disengagement	2.92	(1.20)	.89	.02	.77	2.72	(1.24)	.91	.02	.81

Possible range for each variable, 1—7.
M = mean; *(SD)* = standard deviation; *B* = unstandardized beta weight; *SE* = standard error; β = standardized beta weight.
Note. For the indicators of autonomy need satisfaction, frustration, and dissatisfaction, the statistics are for T1 and T2; for the indicators of engagement and disengagement, the statistics are for T1 and T3.
All *B*s are statistically significant ($p < .001$).

Table 3

Intercorrelation Matrix among Experimental Condition, the 10 Latent Dependent Measures, and the 2 Statistical Controls Included in the Test of the Hypothesized (Structural) Model

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Experimental Condition	-												
2. Autonomy Need Satisfaction, T1	-.02	-											
3. Autonomy Need Dissatisfaction, T1	-.07	-.61	-										
4. Autonomy Need Frustration, T1	-.03	-.47	.70	-									
5. Engagement, T1	.00	.80	-.55	-.39	-								
6. Disengagement, T1	-.07	-.67	.80	.58	-.74	-							
7. Autonomy Need Satisfaction, T2	.30	.46	-.30	-.23	.38	-.34	-						
8. Autonomy Need Dissatisfaction, T2	-.24	-.23	.40	.28	-.22	.33	-.62	-					
9. Autonomy Need Frustration, T2	-.25	-.17	.27	.37	-.14	.23	-.54	.72	-				
10. Engagement, T3	.41	.34	-.28	-.20	.36	-.32	.62	-.51	-.43	-			
11. Disengagement, T3	-.29	-.33	.38	.28	-.32	.41	-.56	.59	.50	-.78	-		
12. Student Gender (females, 0; males, 1)	-.05	-.10	.05	-.02	-.10	.10	-.12	.05	-.01	-.07	.05	-	
13. Grade Level (middle, 0; high, 1)	-.28	-.12	.19	.12	-.13	.16	-.12	.15	.10	-.18	.13	.01	-

N = 2,669. All r's $\geq$ .05, p < .01. T1 = Time (wave) 1; T2 = Time 2; T3 = Time.

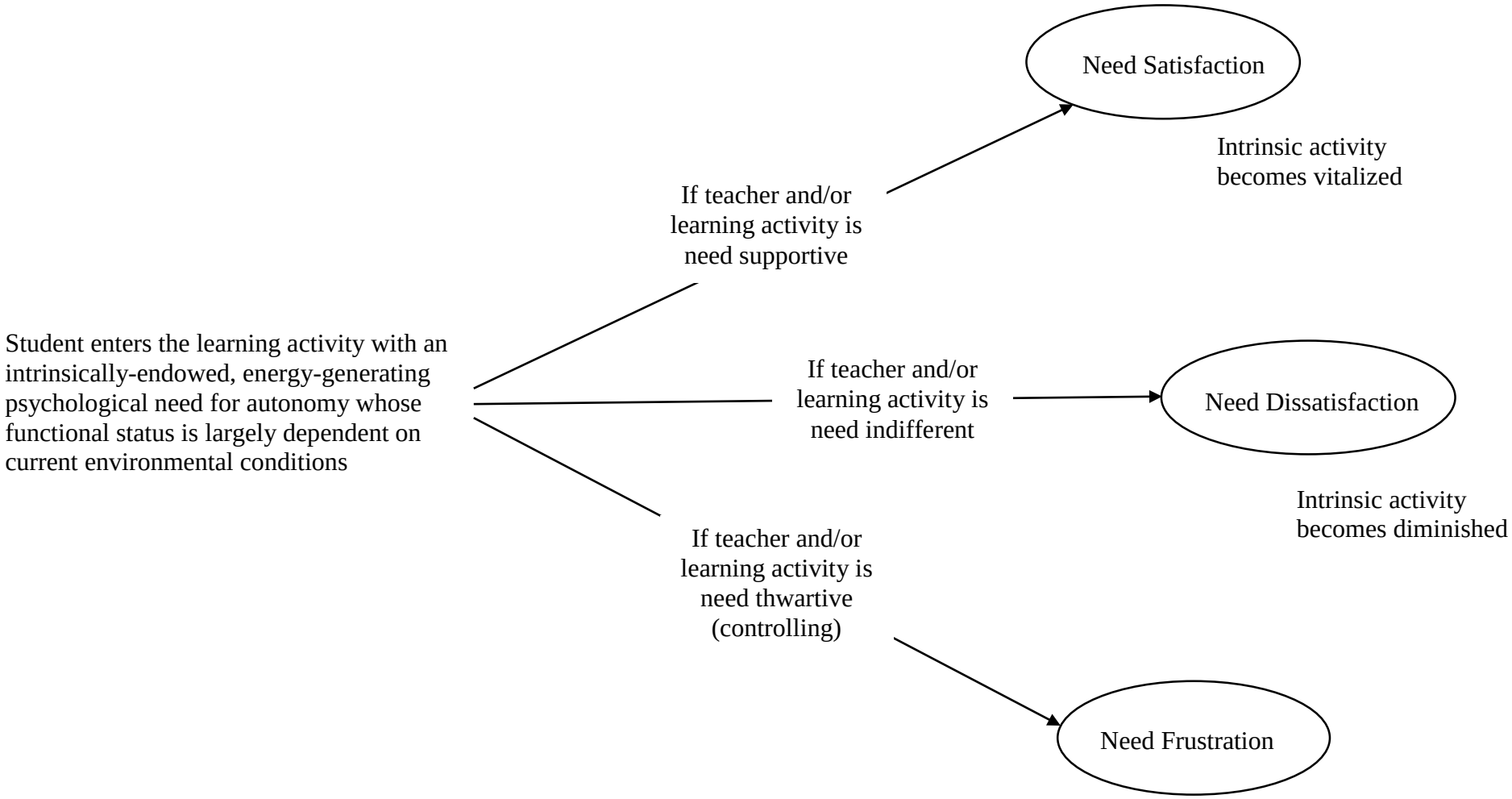

Figure 1. How the satisfaction, dissatisfaction, or frustration of a psychological need depends on current environmental conditions of support, thwart, or indifference.

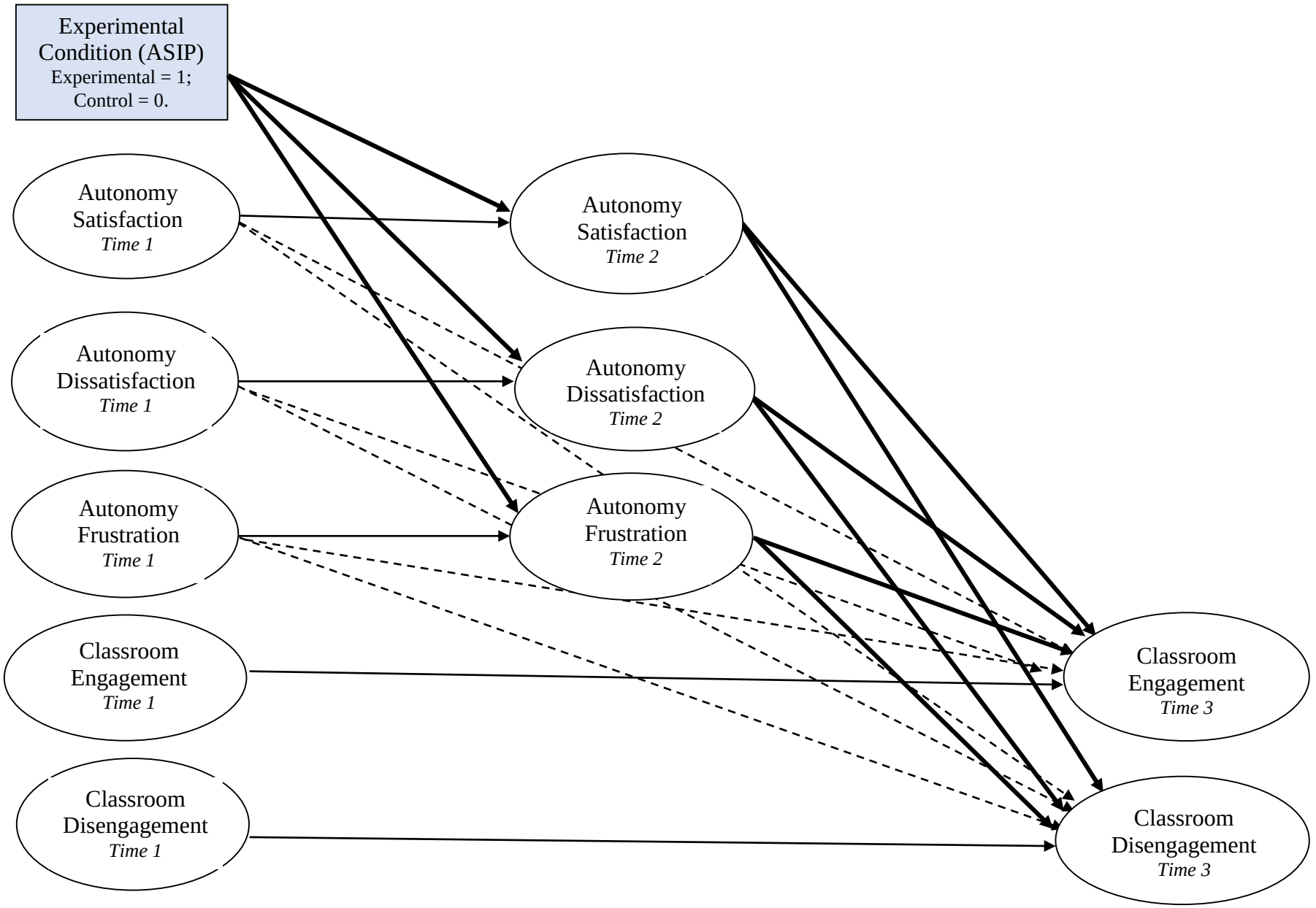

Figure 2. Hypothesized model. The 9 solid, boldface, downwardly-slopped lines represent hypothesized paths, while the 6 thin, dashed, downwardly-slopped lines and the 5 thin, solid, horizontal lines represent statistical controls.

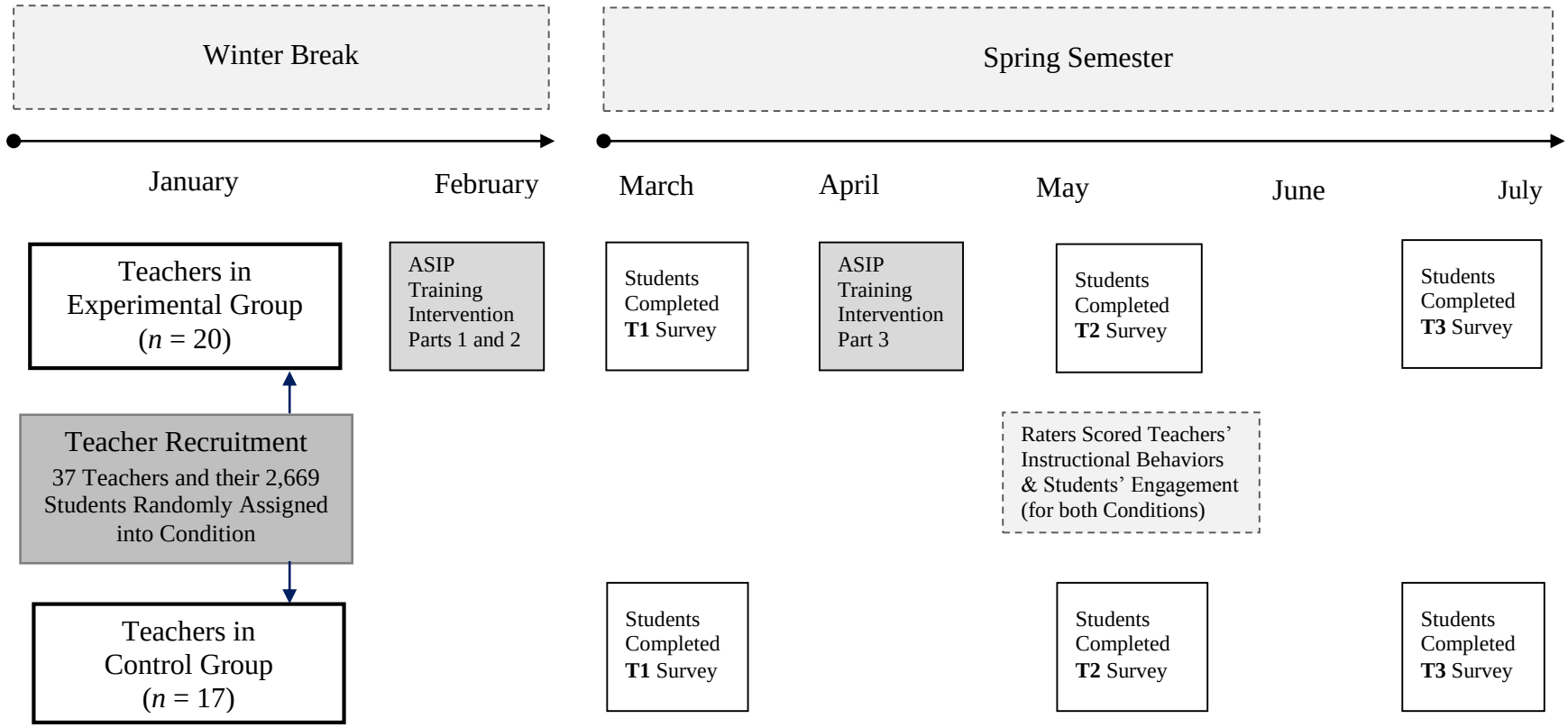

Figure 3. Procedural timeline for the 3-part autonomy-supportive teacher training program and the three waves of data collection.

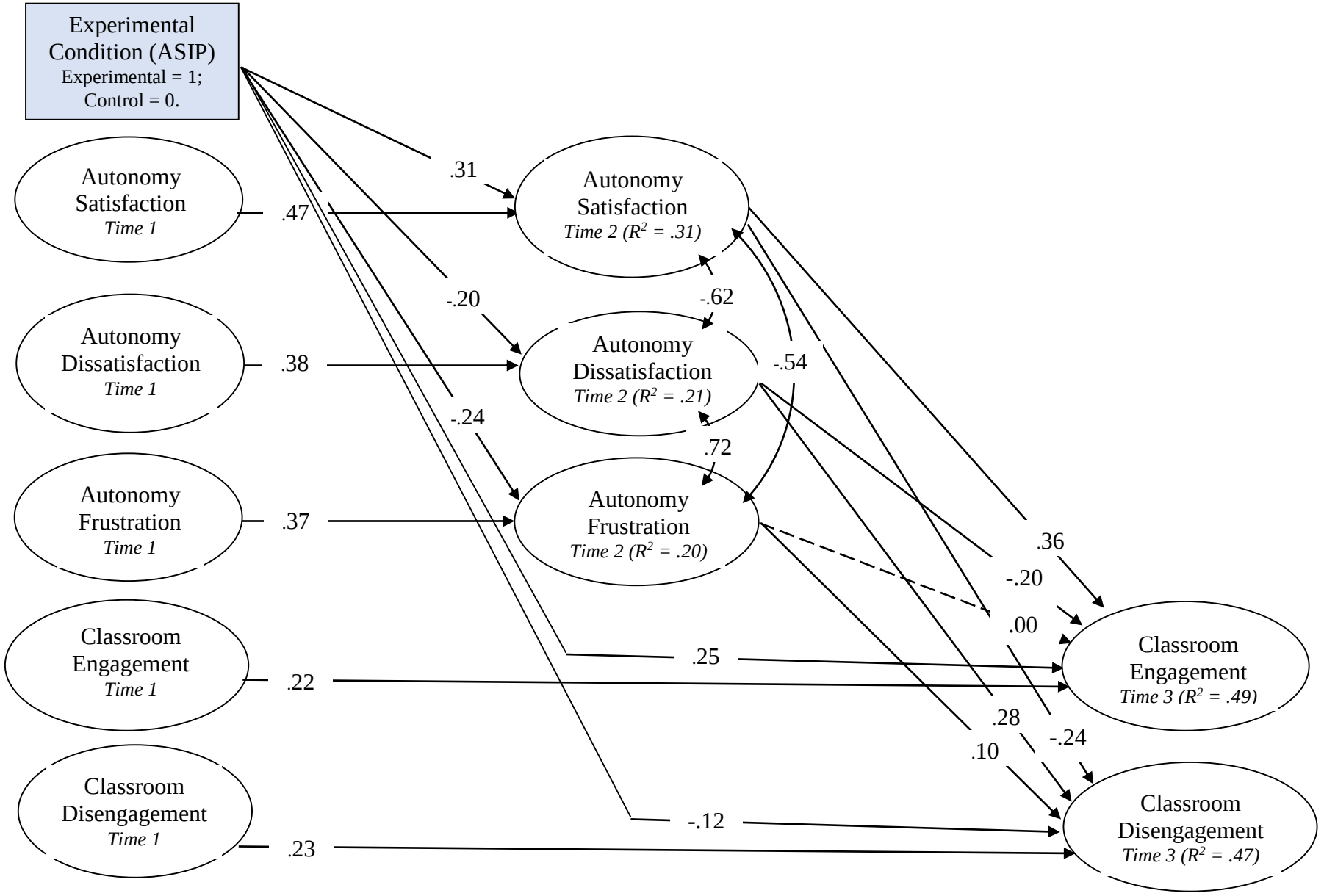

Figure 4. Standardized parameter estimates for the test of the hypothesized model. Solid lines represent significant paths, while dashed lines represent non-significant paths. Numbers represent standardized beta coefficients.

Appendix

Standardized Parameter Estimates for the ESEM 3-Factor Solution of the Autonomy Satisfaction, Dissatisfaction, and Frustration Scales

	Autonomy Support (λ)	Satisfaction (λ)	Dissatisfaction (λ)	Frustration (λ)
Items from the Perceived Autonomy Support Scale				
1. I feel that my PE teacher provides me with choices and options.	**.622**	.102	-.010	-.028
2. I feel understood by my PE teacher.	**.738**	.041	.001	-.037
3. My PE teacher encourages me to ask questions.	**.922**	-.062	-.032	.004
4. My PE teacher listens to how I would like to do things.	**.954**	-.050	.000	-.021
5. My PE teacher conveys confidence in my ability to do well in the course.	**.843**	.074	.009	.007
6. My PE teacher tries to understand how I see things before suggesting a new way to do things.	**.814**	.109	-.003	.009
Items from the Autonomy Satisfaction Scale				
1. In this PE class, I can decide which activities I want to do.	.179	**.660**	-.009	-.022
2. In this PE class, I have a say regarding what skills I want to practice and learn.	-.036	**.892**	-.011	-.018
3. I feel that I do PE because I want to.	-.013	**.927**	.042	-.028
4. In this PE class, I have a certain freedom of action.	.105	**.645**	-.080	.022
5. In this PE class, I have some choice in what I want to do.	.185	**.609**	-.067	-.005
Items from the Autonomy Dissatisfaction Scale				
1. In this PE class, I generally don't feel free to choose how to do things for myself.	-.027	-.021	**.794**	.046
2. In this PE class, I usually feel like I have to pretend to be something different from what I really am.	.012	-.028	**.859**	.014
3. In this PE class, I believe I have no choice about doing what I usually do.	-.003	.017	**.958**	-.025
4. What I do during PE class is often not what I'd like to do.	.009	-.042	**.846**	.001
5. In this PE class, I usually feel like I have to keep my ideas and opinions to myself.	-.024	.027	**.874**	.044
Items from the Autonomy Frustration Scale				
1. In this PE class, I feel under pressure to agree to do the activities that I am provided.	.017	.058	-.148	**.535**
2. In this PE class, I feel pushed to behave in certain ways.	-.017	-.034	.023	**.847**
3. In this PE class, I feel obliged to follow decisions that have already been made for me.	-.012	-.003	.038	**.886**
4. In this PE class, I feel prevented from making choices with regard to what I can and cannot do.	-.018	-.053	.328	**.431**