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Longitudinal Test of Self-Determination Theory's Motivation Mediation Model in a Naturally Occurring Classroom Context

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This study provides the first longitudinally designed, classroom-based empirical test of self-determination theory's motivation mediation model. Measures of perceived autonomy support, motivation (autonomy need satisfaction), engagement, and achievement were collected from 500 (257 females, 243 males) 8th-grade students in Korea in a 3-wave longitudinal research design. Multilevel structural equation modeling tested the model in which early-semester perceived autonomy support increased mid-semester autonomy need satisfaction, which, in turn, increased end-of-the-semester engagement, which then predicted course achievement. We further tested for possible reciprocal pathways and for the stability of all effects throughout the model. Results revealed a complex, dynamic model that unfolds within naturally occurring classroom processes, one that validated the hypothesized model but also extended and qualified it in important ways. All hypothesized effects were supported, but they were not stable over the course of the semester, largely because of the emergence of several reciprocal effects. Overall, this longitudinal test revealed a more dynamic model than suggested by previous cross-sectional investigations.

Keywords: autonomy, autonomy support, engagement, Korea, self-determination theory

A number of teacher characteristics contribute constructively to students' classroom motivation and functioning. These teacher characteristics include both relationship qualities such as caring (Furrer & Skinner, 2003) and promoting mutual respect among classmates (A. M. Ryan & Patrick, 2001) as well as instructional emphases such as a mastery-oriented classroom goal structure (Ames & Archer, 1988), formative and informational grading practices (Church, Elliot, & Gable, 2001; Clifford, 1990), and the offering of interesting and useful classroom activities (Greene, Miller, Crowson, Duke, & Akey, 2004). According to self-determination theory (SDT; R. M. Ryan & Deci, 2000, 2002), the central teacher characteristic contributing to students' course-related motivation and functioning is motivating style (Standage, Gillison, & Treasure, 2007). Specifically, teachers who rely on an autonomy-supportive style generally vitalize their students' motivation during instruction (in terms of psychological need satisfaction), while teachers who rely on a controlling style generally neglect or even thwart their students' motivation and classroom functioning (Deci, Schwartz, Sheinman, & Ryan, 1981; Reeve, 2009).

To explain the interrelations among a teacher's motivating style and students' motivation and functioning, SDT proposes its motivation mediation model (Jang, Reeve, Ryan, & Kim, 2009). In this model, teacher-provided autonomy support first nurtures students' psychological need satisfaction, the extent of psychological need satisfaction then predicts the extent of classroom engagement, and the extent of engagement in turn predicts course-related outcomes such as learning, performance, and achievement (e.g., course grade; Hardré & Reeve, 2003; Jang et al., 2009; Vansteenkiste, Niemiec, & Soenens, 2010). This motivation mediation model has been empirically supported in the classroom context with cross-sectional research designs (Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Black & Deci, 2000; Jang et al., 2009; Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005; Williams & Deci, 1996). It is crucial to note, however, that cross-sectional correlation-based research designs fail to address the issue of temporal causality in terms of the directional effect that one variable in the model might have on another. Experimental research designs do address this issue, and they too have empirically supported the model, as manipulated autonomy support has predicted changes in students' autonomy need satisfaction (Cheon, 2011; Gurland & Grolnick, 2003; Reeve, Jang, Hardré, & Omura, 2002; Reeve, Nix, & Hamm, 2003), engagement (Guay, Boggiano, & Vallerand, 2001; Jang, 2008; Reeve, Jang, Carrell, Jeon, & Barch, 2004), and learning/achievement (Grolnick & Ryan, 1987; Vansteenkiste et al., 2005). The limitation of these experimental studies, however, is that they fail to address the complex classroom processes that unfold dy-

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namically over time. To test these complex and naturally occurring classroom processes requires the employment of a multiwave longitudinal research design. The purpose of the present study was to provide that empirical test.

Hypothesized Motivation Mediation Model

The hypothesized model appears in Figure 1. The motivation mediation model can be seen in the three downwardly sloped boldface lines drawn within the figure. The first boldfaced line depicts the hypothesis that students' early-semester perceptions of teacher-provided autonomy support explain mid-semester gains or losses in students' autonomy need satisfaction (controlling for early-semester autonomy need satisfaction). The second boldface line depicts the hypothesis that these changes in mid-semester autonomy need satisfaction, once they occur, then explain corresponding increases or decreases in students' late-semester classroom engagement (controlling for mid-semester engagement). The third boldfaced line depicts the hypothesis that these late-semester changes in classroom engagement explain students' end-of-course achievement (controlling for mid-semester achievement).

The Path From Perceived Autonomy Support to Autonomy Need Satisfaction

A teacher's motivating style manifests itself during instruction as the tone of his or her sentiment and behavior while trying to motivate and engage students during learning activities (Deci et al., 1981). The following three characteristics define a teacher's style as autonomy supportive: (a) adopts the students' perspective

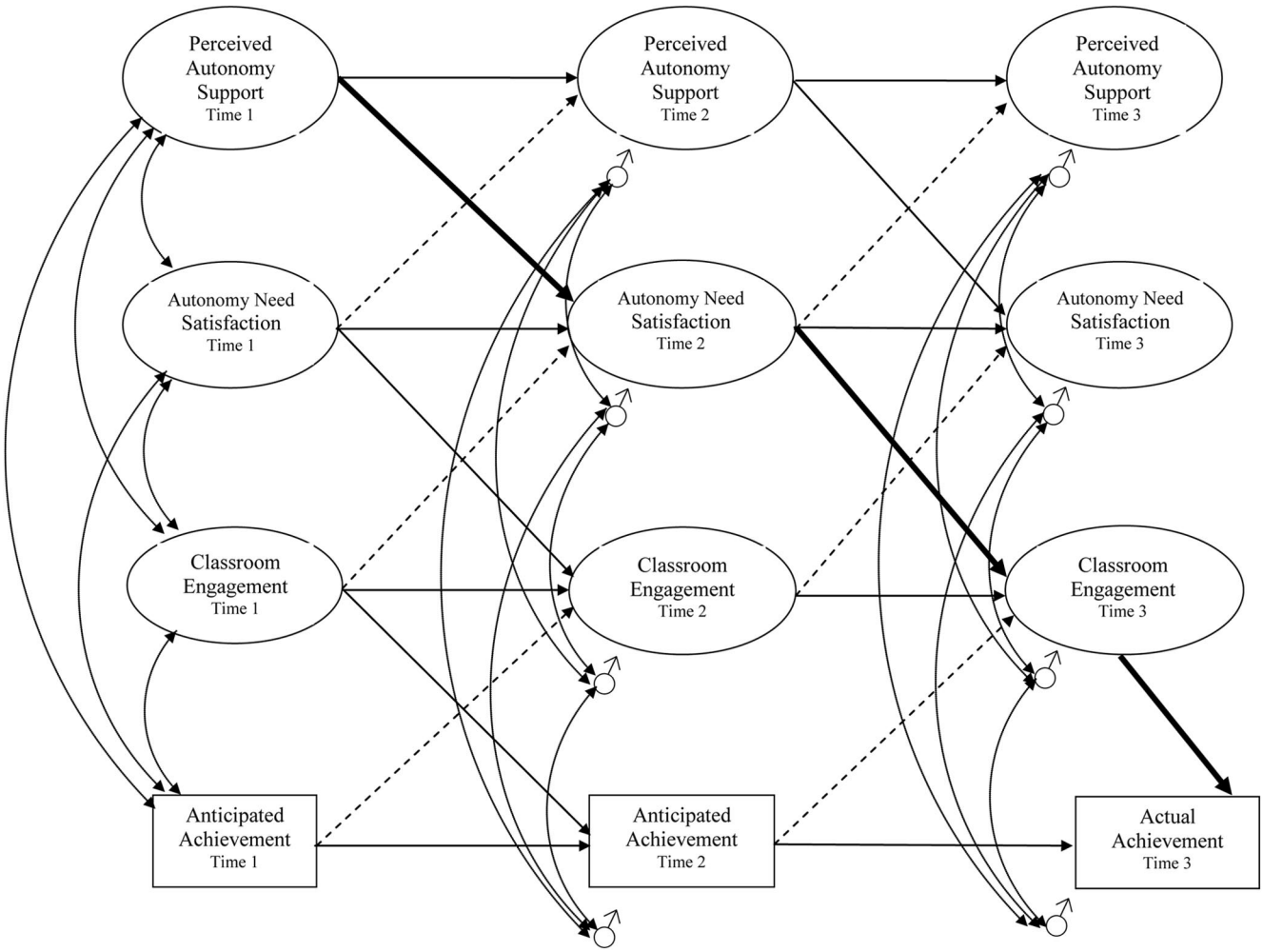

Figure 1. Hypothesized motivation mediation model. The three boldfaced downwardly sloped solid lines represent the hypothesized paths that define the motivation mediation model. The six upwardly sloped dashed lines represent tests for possible reciprocal effects within the overall model. The 10 lines on the left side of the figure (between Time 1 and Time 2) that repeat as parallel lines on the right side of the figure (between Time 2 and Time 3) represent tests for stability of those effects. For clarity of presentation, only the latent variables are shown in the figure, though all observed indicators were included in the statistical analyses and reported in Table 2. Curved dotted lines represent correlated error terms between the latent variables—covariances of exogenous variables at Wave 1 and covariances of correlated residuals at Waves 2 and 3.

and frame of reference during instruction; (b) invites, welcomes, and incorporates students' thoughts, feelings, and behaviors into the flow of instruction; and (c) supports students' capacity for autonomous self-regulation (Deci & Ryan, 1985; Reeve, 2009). Several studies confirm that teacher-provided autonomy support—operationally defined both objectively by trained raters' assessments and subjectively by students' perceptions—predicts students' perceived autonomy (Reeve & Jang, 2006; Su & Reeve, 2011), and this directional relation has been shown to be a causal one (Reeve et al., 2003). Such teacher-provided autonomy support has been further linked—both correlationally and experimentally—to a wide range of important educational outcomes, including students' classroom engagement, learning (e.g., conceptual understanding), and performance (e.g., grades; for an overview, see Reeve, 2009). The theoretical explanation for why teacher-provided autonomy support enhances students' positive functioning is attributed to its capacity to support students' psychological need satisfaction in general and autonomy need satisfaction in particular (i.e., autonomy need satisfaction fully mediates the positive effect that perceived autonomy support has on engagement and achievement; Reeve, Deci, & Ryan, 2004; R. M. Ryan & Deci, 2002; Vansteenkiste et al., 2010).

The Path From Autonomy Need Satisfaction to Classroom Engagement

The term *classroom engagement* refers to the extent of students' active involvement in learning activities (Skinner, Kindermann, & Furrer, 2009). It is a multidimensional construct that consists of the following four distinct, yet intercorrelated, aspects (Christenson, Reschly, & Wylie, 2012; Fredricks, Blumenfeld, & Paris, 2004): (a) on-task attention, effort, and persistence (behavioral engagement; Skinner, Kindermann, & Furrer, 2009); (b) the presence of task-involving emotions such as interest and the absence of task-withdrawing emotions such as distress (emotional engagement; Skinner, Kindermann, & Furrer, 2009); (c) the use of sophisticated and deep, rather than superficial and shallow, learning strategies to create complex knowledge structures (cognitive engagement; Walker, Greene, & Mansell, 2006); and (d) the extent to which students contribute constructively into the flow of the instruction they receive (agentic engagement; Reeve & Tseng, 2011). Teacher-provided autonomy support enhances student engagement (Assor, Kaplan, & Roth, 2002; Jang et al., 2009; Reeve, Jang, et al., 2004; Vallerand, Fortier, & Guay, 1997), and the positive effect of autonomy support has been shown to occur for each specific aspect of engagement, including its behavioral (Assor et al., 2002), emotional (Skinner, Furrer, Marchand, & Kindermann, 2008), cognitive (Vansteenkiste et al., 2005), and agentic (Reeve & Tseng, 2011) aspects. The reason why teacher-provided autonomy support facilitates engagement is because it nurtures students' underlying need for autonomy, thereby vitalizing in them an engagement-fostering source of motivation (Reeve & Halusic, 2009), as perceived autonomy has been shown to be a direct predictor of students' persistence (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004), positive emotionality (Patrick, Skinner, & Connell, 1993), conceptual understanding (Vansteenkiste et al., 2005), and sense of agency (Reeve & Tseng, 2011).

The Path From Classroom Engagement to Achievement

Student engagement is a motivationally enriched classroom quality that has clear implications for student achievement (Skinner, Kindermann, Connell, & Wellborn, 2009). By engaging themselves actively and enthusiastically in academic activities, students learn, develop skills, and generally make academic progress. Hence, both the extent and quality of students' classroom engagement have been shown to predict various aspects of achievement, including course grades and improved standardized test scores (Alexander, Entwisle, & Dauber, 1993; Ladd & Dinella, 2009).

Causal, Reciprocal, and Stationary Effects Within the Hypothesized Model

To assess for temporal causality within the hypothesized model, a fundamental requirement is that the assessed cause must precede the outcome in time (Cole & Maxwell, 2003). Thus, in testing our model, we collected data on the hypothesized cause (perceived autonomy support), the hypothesized mediators (autonomy need satisfaction, classroom engagement), and the targeted outcome (achievement) at each of three points or waves during a 17-week semester. Such a multiwave longitudinal research design allows for the testing of three types of effects, the first of which is the test of *temporal causality*, as indicated by the three downwardly sloping boldface lines in Figure 1.

The second type of effect is a test for *reciprocal causation*. Reciprocal causation refers to the extent to which a variable in the model feeds back to affect its hypothesized cause. These possible effects appear in Figure 1 as the six upwardly sloped dashed lines that propose that students' (a) autonomy need satisfaction may feed back to affect perceptions of perceived teacher autonomy support (both early and late in the semester), (b) classroom engagement may feed back to affect autonomy need satisfaction (both early and late in the semester), and (c) achievement may feed back to affect classroom engagement (both early and late in the semester). These six paths do not represent hypothesized paths but, rather, represent the complex relations that might unfold naturally in classrooms. These reciprocal paths have been suggested in the SDT research literature (i.e., see Pelletier, Seguin-Levesque, & Legault, 2002, p. 194; Reeve, Jang, et al., 2004, p. 151; Skinner & Belmont, 1993, p. 578), but they have not yet actually been empirically tested within a longitudinal research design. Possible reciprocal effects therefore need to be tested for alongside any test of the hypothesized model, at least as long as that empirical test takes place within the context of complex, dynamic, and naturally occurring classroom processes.

The third type of effect is a test for *stationary effects*. Stationary refers to the stability of the effect that one variable has on another early in the semester (from Time 1 [T1] to T2) versus that same effect late in the semester (from T2 to T3). If the two effects are the same, the effect is stationary; if the effect becomes larger, the effect is enhanced or more pronounced over time; and if the effect becomes smaller, the effect is diminished or less pronounced over time. Within the overall model, 10 tests of stationary effects are possible—three involving the hypothesized effects (i.e., perceived autonomy support to autonomy need satisfaction; autonomy need

satisfaction to engagement; and engagement to achievement), three involving the reciprocal effects (i.e., autonomy need satisfaction to perceived autonomy support; engagement to autonomy need satisfaction; and achievement to engagement), and four involving the effects of each variable in the model on itself at a later time. These 10 effects appear in Figure 1 as the parallel paths that occur between the same two variables early in the semester (from T1 → T2) compared with that same path later in the semester (from T2 → T3). As with the reciprocal paths, these 10 paths do not represent hypothesized paths. Rather, they represent the dynamic relations among variables that might unfold naturally in classrooms.

Korean Education

We situated our test of the hypothesized motivation mediation model within Korean middle-school classrooms, and we did so for four reasons. First, in regard to teachers' motivating styles, teachers are an especially salient aspect of the Korean classroom because they change classrooms from hour to hour while their students stay in the same classroom throughout the day, which is the opposite arrangement from schooling in the West. Instruction is typically formal (traditional formalities are observed in the classroom), lecture based, and performance oriented, because it is geared toward achievement of competitive class grades and preparation for rigorous entrance examinations (e.g., top universities, national tests for civil service jobs). Nevertheless, teachers are explicitly placed into the role of classroom motivator, and how teachers choose to enact this role leads them to display a range of motivating styles (e.g., the perspective-taking style inherent within autonomy support vs the no-nonsense, pressure-inducing style inherent within teacher control).

Second, the Korean school year is from March to June (Semester 1) and from September to December (Semester 2), with January–February and July–August set as between-semester breaks. This schedule makes our chosen time frame of a semester's unit of time more suitable to Korean education than to Western education, because the 2-month break makes a semester's work a more salient and somewhat self-contained experience, at least more so than it is in the West.

Third, student autonomy is not as valued in the Korean culture as it is in the West (Kim & Park, 2006). Because this is so, a test of the hypothesized model (that puts students' autonomy at its explanatory center) represents a stringent test of the model, such that supportive evidence within Korean education would enhance confidence in the hypothesized model.

Fourth, in relation to classroom engagement, daily attendance rates are very high (often 100%), while school dropout rates are extremely low. Thus, teachers are more concerned with classroom engagement than they are with school engagement, as is sometimes the preferred emphasis in the study of Western schooling (Jimerson, Campos, & Grief, 2003). Also, a very strong emphasis on achievement exists (Kim & Park, 2006), and Korean classrooms generally reflect a Confucian value that student engagement (e.g., hard work, discipline, and long hours of study) is a reliable path to school achievement.

Method

Participants

Participants were 500 students (257 females, 243 males) from 16 different classes situated in a single large urban middle school in Seoul, Korea. Class sizes averaged 31.3 students per class (SD = 4.5; range = 21–37). All students and all teachers were ethnic Korean. The classrooms were all Grade 2 of middle school, a grade level that is equivalent to the eighth grade in the United States. The subjects taught in these 16 classrooms were biology, geology, earth science, sociology, Korean, and history. Each class met on a daily basis and lasted for 55 min.

Measures

For each measured variable, we began with a previously validated questionnaire and then had that measure translated into Korean by a professional English–Korean translator, following the guidelines recommended by Brislin (1980). Separate English back-translations were carried out by two graduate students who were fluent in both languages and were native Korean. Any discrepancies that emerged between the translators were discussed until a consensus translation was reached.

Participants responded to each questionnaire item using a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), except for the questions assessing achievement and categorical demographic information.

Perceived autonomy support. We assessed students' perceptions of teacher-provided autonomy support, requesting participants to complete the six-item short version of the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996). The short version of the LCQ has been widely used in classroom-based investigations of autonomy support (Black & Deci, 2000; Jang et al., 2009) and includes the following six items: "I feel that my teacher provides me with choices and options"; "I feel understood by my teacher"; "My teacher encourages me to ask questions"; "My teacher listens to how I would like to do things"; "My teacher conveys confidence in my ability to do well in the course"; and "My teacher tries to understand how I see things before suggesting a new way to do things." Students' scores on the LCQ have been shown to correlate significantly with objective raters' scoring of teachers' actual classroom autonomy-supportive behavior (Cheon & Reeve, in press). In the present study, the LCQ showed strong reliability across all three waves of data collection (αs of .89, .93, and .92 across the three assessments at T1, T2, and T3).

Autonomy need satisfaction. To assess the extent to which students experienced autonomy psychological need satisfaction during instruction, we used the Perceived Autonomy subscale from the Activity–Feelings States Scale (AFS; Reeve & Sickenius, 1994). The AFS offers the stem, "During class, I feel:," and lists 14 items. In the present study, we used only scores from the Perceived Autonomy subscale, which includes the following three items: "free"; "I'm doing what I want to be doing"; and "free to decide for myself what to do." The three-item scale showed acceptable reliability across all three waves of the data collection (αs of .67, .75, and .75). We used this particular measure of autonomy need satisfaction because research has shown that it produces scores

with strong psychometric properties (internal consistency, factorial validity), is sensitive to classroom variables known to affect perceived autonomy (e.g., teacher's motivating style), correlates highly with other measures of autonomy need satisfaction (e.g., the Perceived Autonomy subscale from the Basic Needs Scale; Gagné, 2003), and predicts student outcomes such as classroom engagement and course grades (Hardré & Reeve, 2003; Jang et al., 2009; Reeve et al., 2003; Reeve & Tseng, 2011).

Classroom engagement. We assessed four interrelated aspects of student engagement—behavioral, emotional, cognitive, and agentic. To do so, we used items from previously validated and widely used measures, including Skinner, Kindermann, and Furrer's (2009) Behavioral Engagement and Emotional Engagement scales from their Engagement Versus Disaffection With Learning measure to assess those qualities, Wolters' (2004) Metacognitive Strategies questionnaire on motivation, cognition, and achievement (adapted from Pintrich, Smith, Garcia, & McKeachie's [1993] Motivated Strategies for Learning Questionnaire) to assess cognitive engagement, and Reeve and Tseng's (2011) Agentic Engagement Questionnaire to assess agentic engagement. Specifically, we selected and used three high-loading items from a previous factor analysis of the 23 items that these four scales comprise (see Reeve & Tseng, 2001) to construct a briefer 12-item engagement measure. This briefer scale lessened the time burden placed on our student respondents, and its use was justified by pilot work that showed that our briefer three-item behavioral engagement scale correlated highly with its original five-item version ($r = .99$), our briefer three-item emotional engagement scale correlated highly with its original five-item version ($r = .96$), our briefer three-item cognitive engagement scale correlated highly with its original eight-item version ($r = .89$), and our briefer three-item agentic engagement scale correlated highly with its original five-item version ($r = .95$). In the present study, all four engagement scales showed acceptable levels of internal consistency across the three waves of data collection, including T1, T2, and T3 alphas of .83, .86, and .84 for behavioral engagement (e.g., "I listen carefully in this class"), .96, .95, and .96 for emotional engagement (e.g., "When we work on something in this class, I feel interested."), .68, .73, and .73 for cognitive engagement (e.g., "When what I am working on in this class is difficult to understand, I change the way I learn the material."), and .90, .92, and .94 for agentic engagement (e.g., "During this class, I express my preferences and opinions.").

Achievement. For course achievement, we collected each student's final score or grade from the objective school record for the particular class in which he or she completed the questionnaires. These student achievement scores were reported on a scale from 0 to 100. Thus, our measure of student achievement at T3 was final course score or grade from the objective record. For students' early-semester (T1) and mid-semester (T2) achievement, we collected the following single item to assess anticipated achievement: "I anticipate that my grade in this course will be _____ points (enter a number between 0 and 100)." This assessment strategy allowed us to collect three achievement scores (one for each wave of assessment): T1 early-semester anticipated achievement; T2 mid-semester anticipated course achievement, and T3 end-of-semester actual course achievement.

Procedure

Participants completed the same two-page questionnaire three times during the semester—2 weeks into the semester (T1), 1 week after the mid-term exam (T2), and the next-to-last week of the semester (T3). The survey was administered at the beginning of the class period, and students were asked to complete the questionnaire in response to their experiences associated with that hour's particular class, be it biology, geology, earth science, sociology, Korean, or history. The research team arranged to visit the same classes at the same hour across all three waves of data collection, thereby assuring that students always completed the questionnaire in reference to the same teacher and the same class. For each of the three assessments, a native female Korean graduate student took the first 10 min of class time to introduce the questionnaire, administer it to each student who agreed to participate, and collect the completed questionnaires while the teacher was out of the room. She told students that their responses would be confidential and used only for purposes of the research study. In the Korean education system, each student is assigned a student number in each class, so the graduate student asked students to write that number on the top of each questionnaire they completed. Because the research team collected the questionnaires (rather than the teacher) this procedure allowed students' responses to be both confidential and able to be matched across the three time periods.

Five hundred and eighty-eight (588) students agreed to complete the questionnaire at T1, while only 551 of these same students agreed to complete the questionnaire at T2. The loss of 37 students at T2 represented a dropout rate of 6.3% (retention rate, 93.7%). T2 persisters did not differ from dropouts on perceived autonomy support, but dropouts did report significantly lower T1 autonomy need satisfaction, classroom engagement, and anticipated achievement than did persisters ($ps < .01$). Five hundred (500) students agreed to complete the questionnaire at all three time points. The loss of an additional 51 students at T3 represented an overall study-wide dropout rate of 15.0% (88/588) or a retention rate of 85.0% (500/588). T3 persisters did not differ from T2 persisters who dropped out at T3 on any of the T1 or T2 measures of perceived autonomy support, autonomy need satisfaction, classroom engagement, or anticipated achievement. Overall, these data mean that (a) the study's retention rate was relatively high; (b) the sample loss at T2 (through attrition) included some of the relatively less autonomous, less engaged, and less achieving students from the original (T1) sample, which biased the final analyzed sample somewhat toward an overrepresentation of more autonomous, more engaged, and more achieving students; and (c) the sample at T3 was comparable to the sample at T2.

Data Analysis

We assessed each variable in our study three times. Perceived autonomy support, autonomy need satisfaction, and classroom engagement were assessed and entered into the model as latent variables, while the three single-item achievement scores were entered as observed variables. For perceived autonomy support, we used the individual items from the LCQ as the six observed indicators; for autonomy need satisfaction, we used the individual items from the AFS as the three observed indicators; and for classroom engagement, we used students' mean score on each

aspect of engagement (behavioral, emotional, cognitive, and agentic) as the four observed indicators. To evaluate model fit within the structural equation modeling, 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; Steiger, 1990), the standardized root-mean-square residual (SRMR; Hu & Bentler, 1999), the comparative fit index (CFI; Bentler, 1990), and the nonnormed fit index (NNFI; Bentler & Bonett, 1980). For RMSEA and SRMR, values less than .08 indicate good fit, at least as long as the upper bound of the RMSEA's 90% confidence interval (CI) is .10 or less; for CFI and NNFI, values greater than .95 indicate good fit, at least as long as these values co-occur with an SRMR value of .08 or less (Hu & Bentler, 1999; Kline, 2011).

Results

Preliminary Analyses

Before testing our hypothesized model, we first conducted multilevel analyses using hierarchical linear modeling (HLM, Version 6.08; Raudenbush, Bryk, & Congdon, 2004) to determine whether meaningful between-teacher differences might have affected students' self-reports and final course grade. The percentage of the total variance attributable to between-teacher differences exceeded 10% for several measures, and the intraclass correlations associated with each assessed item across the three waves appear in the first column in Table 1.[1] Given the meaningful between-teacher effects on a number of the assessed measures, we chose to use multilevel structural equation modeling (LISREL 8.8; Jöreskog & Sörbom, 1996) in all subsequent analyses. In the calculation of multilevel structural equation modeling, LISREL calculates parameter values and model fit by distributing variance at both the student (Level 1, $n = 500$) and teacher (Level 2, $n = 16$) levels and by partitioning the overall chi-square value into these two sources of information. The ensuing results may be interpreted as student-level effects that are statistically independent of the (controlled for) teacher-level results.

We also explored for possible gender differences across the dependent measures, but females and males did not differ significantly from one another on any measure across all three waves of data collection. Gender did not predict students' scores on perceived autonomy support, autonomy need satisfaction, classroom engagement, and achievement across the three waves of data collection, with the one exception that males self-reported greater T3 autonomy need satisfaction than did females: *M*s, 4.33 vs. 4.05; $t(498) = 2.86$, $p < .01$, or $r(500) = .12$, $p < .01$. Given the lack of gender differences in the data and the lack of gender as an important predictor of the study's four variables, we collapsed the data from the two genders into a single data set.

Multilevel Structural Equation Models

To test our hypothesized motivation mediation model and to explore for the additional possibilities of reciprocal and stationary effects, we conducted the analyses in five steps: test of the measurement model, test of the overall (full) structural model, test for hypothesized mediation, test for reciprocal effects, and test for stationary effects.

Test of the measurement model. The measurement model featured six indicators of perceived autonomy support, three indicators of autonomy need satisfaction, four indicators of classroom engagement, and one indicator for achievement across three waves of data collection (14 indicators × 3 waves = 42 total indicators). We allowed the between-wave error terms of each observed indicator to correlate with itself from both T1 to T2 and T2 to T3. The overall 42-item measurement model fit the data well, $\chi^2(1, 617) = 2{,}586.37$, $p < .01$, RMSEA = .061; 90% CI [.058, .064], SRMR = .050, comparative fit index (CFI) = .98, NNFI = .98. The percentage of the variance in the chi-square attributable to the student level was 83.0% (2,146.70/2,586.37), while percentage of the variance in the chi-square attributable to the teacher level was 17.0% (439.67/2,586.37). The unstandardized and standardized coefficients for each of the 42 items included in the measurement model appear in Table 1. What the data in Table 1 show are that each item loaded significantly and substantially on the factor it was designed to represent.

Test of the overall structural model. Given that the measurement model fit the data well, we next tested the overall structural model. The intercorrelations among the 12 latent variables within the structural model appear in Table 2. The errors of the within-wave variables were allowed to correlate (as depicted by the curved lines in Fig. 1), as their inclusion improved the model fit without significantly changing the magnitude of any of the parameter estimates in the structural model. The results from the overall structural model test—the full model that includes the three hypothesized effects, the six reciprocal effects, and the 10 stationary effects—fit the data well, $\chi^2(1, 652) = 2{,}684.83$, $p < .01$, RMSEA = .062, 90% CI [.059, .065], SRMR = .051, CFI = .98, NNFI = .98. The percentage of the variance in the chi-square attributable to the student level was 83.5% (2,241.75/2,684.83), while the percentage of the variance in the chi-square attributable to the teacher level was 16.5% (443.08/2,684.83). It is important to note that each of the three hypothesized paths was individually significant, as early-semester perceived autonomy support predicted mid-semester autonomy need satisfaction, controlling for early-semester autonomy need satisfaction and classroom engagement ($\beta = .12$, $p < .01$); mid-semester autonomy need satisfaction predicted end-of-semester engagement, controlling for mid-semester engagement and anticipated achievement ($\beta = .28$, $p < .01$); and end-of-semester engagement predicted actual course achievement controlling for mid-semester anticipated achievement ($\beta = .14$, $p < .01$). The path diagram showing the standardized

[1] Not shown in Table 1 are the descriptive statistics associated with each of the 42 assessed items. For the 39 self-reported items assessing perceived autonomy support, autonomy need satisfaction, and classroom engagement, mean scores ranged from a low of 3.00 to a high of 4.71 on a scale ranging from 1 to 7 (*SD*s ranged from a low of 1.05 to a high of 1.64). Skewness values averaged $M = |.17|$ (highest value, −0.82), and kurtosis values averaged $M = |.42|$ (highest value, 1.18). For the three achievement items, mean scores ranged from 65.4 to 74.7 on a scale that ranging from 0 to 100 (*SD*s ranged from 16.8 to 20.4). Skewness values averaged $M = |.60|$ (highest value, −0.83), and kurtosis values averaged $M = |.66|$ (highest value, −0.93). Taken as a whole, these statistics suggest that the data approximated the normal in terms of their underlying distribution of scores.

Table 1
Interclass Correlation Coefficients and Unstandardized and Standardized Beta Weights Associated With All 42 Observed Indicators Within the Measurement Model

	Time 1				Time 2				Time 3			
Observed variable	ICC (%)	*B*	*SE B*	β	ICC (%)	*B*	*SE B*	β	ICC (%)	*B*	*SE B*	β
Perceived autonomy support indicators												
1. Teacher provides choices and options	7.3	0.81	0.04	.71	9.7	0.83	0.04	.73	15.7	0.88	.04	.76
2. Feel understood by my teacher	10.3	1.00	—	.87	11.5	1.00	—	.86	14.1	1.00	—	.87
3. Teacher conveys confidence in me	7.2	0.94	0.04	.82	8.8	0.99	0.04	.86	13.2	0.99	.04	.86
4. Teacher encourages questions	6.0	0.77	0.04	.67	9.6	0.94	0.04	.81	8.3	0.86	.04	.75
5. Teacher listens…	4.7	0.89	0.04	.78	8.9	0.99	0.04	.86	10.3	0.96	.04	.83
6. Teacher understands how I see things	4.5	0.77	0.04	.67	9.0	0.90	0.04	.79	8.5	0.89	.04	.77
Autonomy need satisfaction indicators												
1. I feel free.	17.9	0.87	0.07	.63	14.7	0.91	0.06	.68	13.2	0.97	.06	.73
2. Doing what I wanted to be doing.	4.4	0.81	0.07	.60	2.4	0.89	0.06	.67	5.2	0.86	.06	.65
3. Free to decide for myself	8.6	1.00	—	.72	11.9	1.00	—	.76	3.9	1.00	—	.75
Classroom engagement indicators												
1. Behavioral engagement	8.8	0.99	0.07	.69	4.7	0.92	0.05	.77	5.7	0.89	.05	.70
2. Emotional engagement	30.2	1.01	0.07	.69	15.7	0.91	0.05	.76	9.7	0.95	.05	.75
3. Cognitive engagement	2.9	1.00	—	.68	7.2	1.00	—	.83	4.4	1.00	—	.78
4. Agentic engagement	12.7	0.78	0.07	.53	12.0	0.72	0.05	.60	11.3	0.81	.05	.65
Achievement indicators												
1. Anticipated achievement	2.8	1.00	—	1.00	0.6	1.00	—	1.00				
2. Actual course achievement									4.0	1.00	—	1.00

Note. ICC = interclass correlation coefficient; *B* = unstandardized beta weight; *SE* = standard error; β = standardized beta weight.

estimates for each path in the overall structural model appear in Figure 2.[2]

Tests for hypothesized mediation. While Baron and Kenny (1986) and Sobel (1982) described well-known procedures to test for mediation with cross-sectional research designs, similar procedures to test for mediation with multiwave longitudinal research designs have not yet been developed. In light of this, we conducted analyses to determine the total effects and the indirect effects on the latent variable representing the three dependent measures in the model, and these multilevel structural equation findings are presented in Table 3. In these analyses, we included only the predictor variables represented in the hypothesized model. That is, (a) the predictors for T2 autonomy need satisfaction were T1 perceived autonomy support and T1 autonomy need satisfaction; (b) the predictors for T3 classroom engagement were T1 perceived autonomy support, T1 and T2 autonomy need satisfaction, and T1 and T2 classroom engagement; and (c) the predictors for actual course achievement were T1 perceived autonomy support, T1 and T2 autonomy need satisfaction, T1, T2, and T3 classroom engagement, and T1 and T2 anticipated course achievement. For clarity, Table 3 reports predictive results only for the hypothesized predictors (T1 perceived autonomy support, T2 autonomy need satisfaction, and T3 classroom engagement) and not for the statistical controls.

T2 autonomy need satisfaction. For T2 autonomy need satisfaction, the total effect of T1 perceived autonomy support (controlling for T1 autonomy need satisfaction) was significant ($\beta = .13$, $p < .01$), and all of this effect was direct.

T3 classroom engagement. For T3 classroom engagement, the results were as follows (controlling for T1 and T2 classroom engagement): the total effect of T1 perceived autonomy support was significant ($\beta = .13$, $p < .01$) with most of the effect being indirect ($\beta = .11$) rather than direct ($\beta = .02$); and the total effect of T2 autonomy need satisfaction was significant ($\beta = .29$, $p < .01$), and all of this effect was direct.

End-of-course actual achievement. For end-of-course actual achievement, the results were as follows (controlling for T1 and T2 anticipated achievement): the total effect of T1 perceived autonomy support was significant ($\beta = .07$, $p < .09$), but both the indirect ($\beta = .03$) and direct ($\beta = .04$) effects were small and nonsignificant; the total effect of T2 autonomy need satisfaction was significant ($\beta = .07$, $p < .08$), and all of this effect was indirect; and the total effect of T3 classroom engagement was significant ($\beta = .14$, $p < .01$), and all of this effect was direct.

From these analyses, two conclusions emerged: (a) T2 autonomy need satisfaction fully mediated the otherwise direct effect that T1 perceived autonomy support had on T3 classroom engagement, and (b) T3 classroom engagement fully mediated the otherwise direct effects that both T1 perceived autonomy support and T2 autonomy need satisfaction had on actual course achievement.

[2] We further tested the overall structural model for gender invariance. The structural model fit the data well both for females, $\chi^2(1, 652) = 2{,}082.96$, $p < .01$, RMSEA = .058, 90% CI [.052, .063], SRMR = .066, CFI = .98, and NNFI = .98, and for males, $\chi^2(1, 652) = 2{,}086.46$, $p < .01$, RMSEA = .060, 90% CI [.055, .065], SRMR = .065, CFI = .98, and NNFI = .98. More important, multiple group comparison showed that when the structural coefficients for the males were constrained to be equal to the structural coefficients of females, the chi-square difference test was significant, $\Delta\chi^2(108) = 151.85$, $p < .01$, but the change in CFI was negligible at .001, falling well within the .01 limit proposed by Cheung and Rensvold (2002). This analysis shows that the fit of the overall structural model was gender invariant.

Table 2
Intercorrelation Matrix Among the 12 Latent Variables Included in the Test of the Overall Structural Model

Latent variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Perceived autonomy support, Time 1	—											
2. Autonomy need satisfaction, Time 1	.60	—										
3. Classroom engagement, Time 1	.69	.89	—									
4. Anticipated achievement, Time 1	.24	.41	.56	—								
5. Perceived autonomy support, Time 2	.55	.43	.46	.18	—							
6. Autonomy need satisfaction, Time 2	.48	.67	.62	.29	.62	—						
7. Classroom engagement, Time 2	.47	.61	.69	.40	.70	.80	—					
8. Anticipated achievement, Time 2	.17	.28	.38	.67	.16	.29	.37	—				
9. Perceived autonomy support, Time 3	.35	.34	.34	.14	.59	.49	.49	.13	—			
10. Autonomy need satisfaction, Time 3	.34	.49	.48	.24	.43	.71	.64	.24	.66	—		
11. Classroom engagement, Time 3	.37	.49	.52	.30	.51	.67	.71	.31	.72	.87	—	
12. Actual course achievement, Time 3	.16	.24	.31	.46	.17	.28	.33	.67	.13	.22	.27	—

Note. $N = 500$.

Test for reciprocal causation effects. Three of the six possible reciprocal causation effects were found to be significant.

Reciprocal effect of autonomy need satisfaction on perceived autonomy support. Both effects were significant. Early-semester autonomy need satisfaction predicted mid-semester perceived autonomy support, controlling for early-semester perceived autonomy support ($\beta = .16$, $p < .01$), and mid-semester autonomy need satisfaction predicted end-of-semester perceived autonomy support, controlling for mid-semester perceived autonomy support ($\beta = .21$, $p < .01$).

Reciprocal effect of classroom engagement on autonomy need satisfaction. One effect was significant. While early-semester engagement did not predict mid-semester autonomy need satisfaction ($\beta = .05$, *ns*), mid-semester engagement did predict end-of-semester autonomy need satisfaction, controlling for mid-semester autonomy need satisfaction and perceived autonomy support ($\beta = .23$, $p < .01$).

Reciprocal effect of achievement on engagement. Neither effect was significant (βs = .03 and .05).

Test for stationary effects. We conducted a series of 10 chi-square difference tests to investigate stationary effects throughout the overall structural model. To do so, we constrained the parameter of the path from T2 → T3 to equal the parameter of the path from T1 → T2; hence, a nonsignificant chi-square difference between the constrained-to-be-equal model versus the overall (unconstrained) model communicates a stationary effect while a significant chi-square difference communicates a nonstationary effect.

Effects of the repeated variables on themselves. Three of the four tests were nonsignificant (i.e., were stationary): perceived autonomy support (βs of.45 vs. .46), $\Delta\chi^2(1) = 0.01$, *ns*; autonomy need satisfaction (βs of .55 vs. .58), $\Delta\chi^2(1) = 2.89$, *ns*; and achievement (βs of .67 vs. .63), $\Delta\chi^2(1) = 0.93$, *ns*. Classroom engagement, however, was not stationary (βs of .67 vs. .48), $\Delta\chi^2(1) = 17.57$, $p < .01$, as late-semester engagement was less stable than was early-semester engagement.

Effects of the hypothesized motivation mediation model. All three tests were significant; that is, all three effects were not stationary. Instead of being stationary, the effect of perceived autonomy support on autonomy need satisfaction declined from significant early in the semester to nonsignificant late in the semester (βs of .12 vs. −.09), $\Delta\chi^2(1) = 7.52$, $p < .01$; the effect of autonomy need satisfaction on classroom engagement increased from non-significant early in the semester to significant late in the semester (βs of .01 vs. .28), $\Delta\chi^2(1) = 33.06$, $p < .01$; and the effect of classroom engagement on achievement increased from nonsignificant early in the semester to significant late in the semester (βs of −.01 vs. .14), $\Delta\chi^2(1) = 7.27$, $p < .01$.

Reciprocal effects. One of the three tests was significant. The reciprocal effect of classroom engagement on autonomy need satisfaction was nonstationary (βs of .05 vs. .23), $\Delta\chi^2(1) = 12.13$, $p < .01$, as it rose from nonsignificant early in the semester to significant late in the semester. The reciprocal effect of autonomy need satisfaction on perceived autonomy support was stationary from early to late in the semester (βs of .16 vs. .22), $\Delta\chi^2(1) = 0.22$, *ns*, and the reciprocal effect of anticipated achievement on classroom engagement was stationary from early to late in the semester (βs of .03 vs. .05), $\Delta\chi^2(1) = 0.17$, *ns*.

Discussion

Past empirical tests of SDT's motivation mediation model within the classroom context have consistently (a) found support for the model and (b) relied on a cross-sectional research design. The present study utilized a multiwave longitudinal research design and again revealed support for the model, as all three hypothesized effects were found to be significant (see Figure 2) and both autonomy need satisfaction and classroom engagement mediated and fully explained the otherwise direct effects within the model (see Table 3). But the findings also qualified the hypothesized model in an important way by showing the nonstability of the hypothesized effects. In fact, none of the three hypothesized effects showed multiwave stability.

The effect of perceived autonomy support on autonomy need satisfaction was not stable. Perceived autonomy support contributed to mid-semester gains in autonomy need satisfaction, but this same late-semester effect was not evident. It is very important to note, however, that the relation between perceived autonomy support and autonomy need satisfaction was just as strong late in the semester as it was early in the semester (T1 $r = .48$; T2 $r = .43$; see Table 2). Late in the semester, the otherwise positive effect of perceived autonomy support on autonomy need satisfaction was

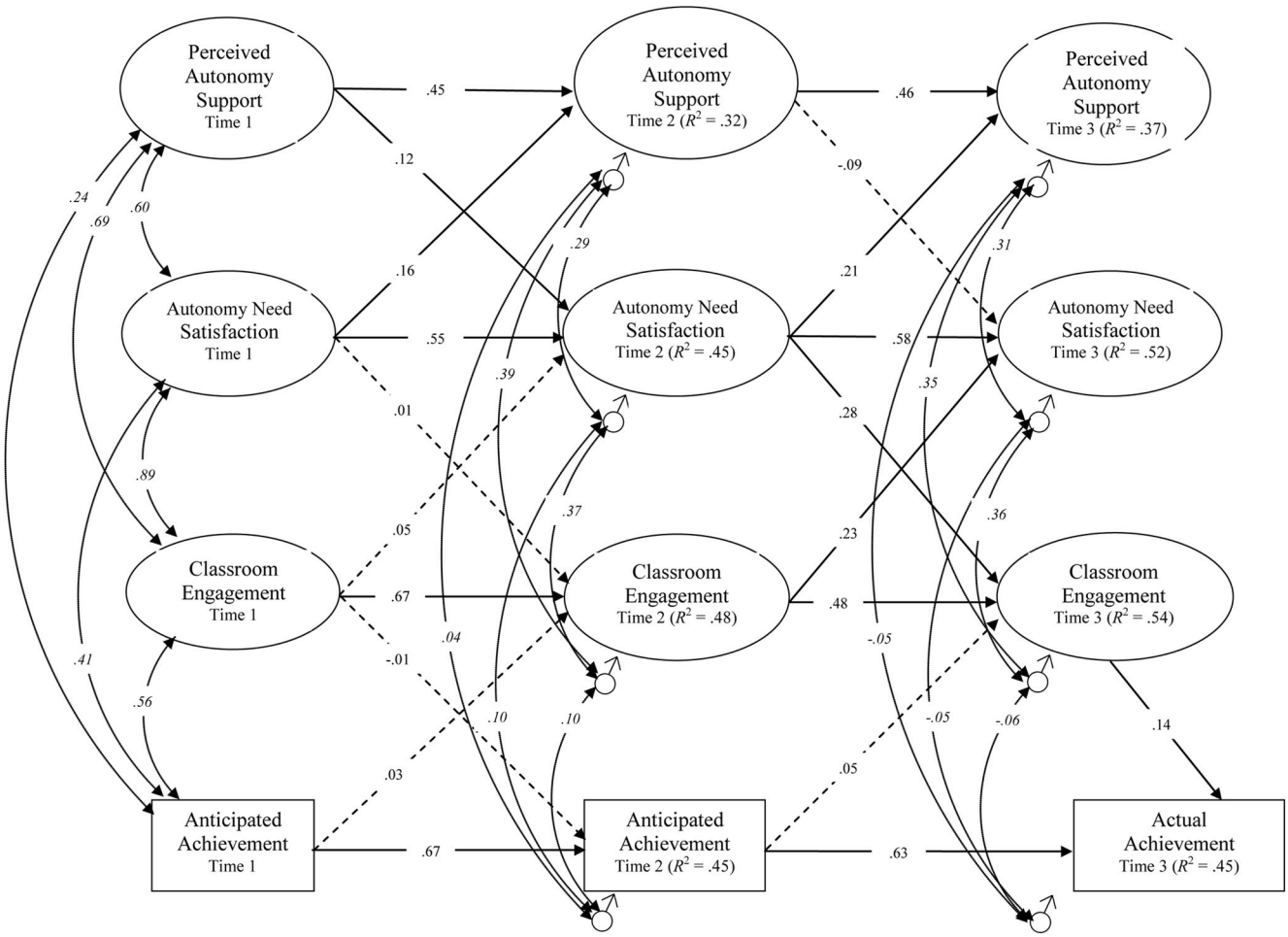

Figure 2. Standardized parameter estimates for the test of the overall structural model. Solid lines represent significant paths, $p < .01$; dashed lines represent nonsignificant paths. The numbers overlaying the straight lines represent standardized parameter estimates within the structural model, while the italicized numbers overlaying the curved lines represent standardized error terms. At Wave 1, the standardized error terms represent correlations among exogenous variables (i.e., covariances of exogenous variables); at Waves 2 and 3, the standardized error terms represent correlations among error terms (i.e., covariances of correlated residuals). Model fit: $\chi^2(1, 652) = 2{,}684.83$, $p < .01$, RMSEA = .062, 90% CI [.059, .065], SRMR = .051, CFI = .98, NNFI = .98.

displaced by a relatively stronger influence—namely, mid-semester changes in students' classroom engagement. Hence, the nonstationary effect of perceived autonomy support on autonomy need satisfaction was fully explained by the emergent influence of changes in students' own mid-semester classroom engagement. This result sheds light on a new phenomenon found to be occurring in these Korean middle-school classrooms—namely, that changes in autonomy need satisfaction were rather strongly responsive to changes in students' own classroom engagement.

It makes intuitive sense that mid-semester gains in students' concentration and effort (behavioral engagement), positive emotionality, more sophisticated learning strategies, and constructive contribution into the flow of instruction (agentic engagement) would provide students with enhanced opportunities for autonomy need–satisfying classroom experiences. That is, by working hard, finding interest in what they do, thinking strategically, and taking initiative in their own learning, students began to create the conditions under which they became more likely to experience autonomy need satisfaction during learning opportunities (or vice versa with declines in these aspects of engagement). That said, past research actually shows little empirical support for the general conclusion that changes in engagement produce changes in motivation (Berger & Karabenick, 2011). Specifically, these researchers used longitudinal research (cross-lagged correlations) to show that early level of cognitive engagement did not predict subsequent changes in either self-efficacy or subject valuing. Hence, the effect observed in the present study is likely specific or unique to autonomy need satisfaction. It is also important to note that this "engagement effect" occurred only in the second half of the semester. These two points lead to the following conclusion: Changes in classroom engagement anticipate later and corresponding changes in autonomy need satisfaction.

Table 3
Total Effects and Indirect Effects of the Predictor Variables in the Hypothesized Motivation Mediation Model on the Three Dependent Measures of Autonomy Need Satisfaction, Classroom Engagement, and Actual Course Achievement

	Dependent measure			Classroom engagement		Actual course achievement	
Predictor	Autonomy need satisfaction at T2	Classroom engagement at T3	Actual course achievement	Indirect effects at T3	Total effects at T3	Indirect effects	Total effects
Perceived autonomy support, T1	.13*	.02	.04	.11	.13	.03	.07
Autonomy need satisfaction, T2		.29*	.00	.00	.29	.07	.07
Classroom engagement, T3			.14*			.00	.14

Note. T1 = Time (or Wave) 1; T2 = Time 2; T3 = Time 3.
* $p < .01$.

The effects of (a) autonomy need satisfaction on classroom engagement and (b) classroom engagement on achievement were also not stationary (i.e., these effects were unstable). Neither effect manifest itself early in the semester, while both effects materialized late in the semester. These results simply underscore the need for longitudinal research. This is so because, as shown in Table 2, the variables involved in these relations were significantly intercorrelated both early and late in the semester (as would be demonstrated in cross-sectional research). Thus, it was only the *changes* in autonomy need satisfaction and it was only *changes* in classroom engagement that produce the observed effects. What this means is that the students who experience gains in their classroom engagement are those who experience early-semester gains in autonomy need satisfaction, not the students who begin the class with initially high autonomy need satisfaction. Similarly, the students who experience gains in achievement are those with early-semester gains in classroom engagement, not the students who begin the class with initially high classroom engagement.

Reciprocal Causation and Stability of Effects

A benefit of our longitudinally based research methodology was that it allowed for the test of reciprocal effects that might unfold within naturally occurring classroom processes. Reciprocal effects did indeed occur. Students' autonomy need satisfaction had a large, positive, and ongoing (i.e., stationary) effect on students' perceptions of their teachers' motivating styles. This reciprocal feedback effect occurred throughout the semester—both early ($\beta = .16$ at T1) and late ($\beta = .21$ at T2). Why it occurred is likely because teachers adjust their classroom motivating styles to students' motivation, and students pick up on their teachers' movement toward greater autonomy support when student autonomy is high and also on their teachers' movement toward lesser autonomy support (more teacher control) when student autonomy is low (Skinner & Belmont, 1993).

A second reciprocal effect was that students' mid-semester engagement predicted their end-of-semester autonomy need satisfaction, even after controlling for their mid-semester autonomy need satisfaction and perceived autonomy support. What this effect suggests is that students can take action to meet their own psychological need for autonomy. To the extent that this is true, then changes in students' autonomy need satisfaction are likely to be a function of perceived teacher-provided autonomy support early in the semester but a function of students' own behavioral, emotional, cognitive, and agentic engagement late in the semester. This reciprocal effect was not stationary, a finding that underscores the conclusion that it is not engagement—but *changes* in engagement—that foreshadow corresponding changes in autonomy need satisfaction. This is an exciting new finding because it substantiates the idea that students can be architects of their own autonomy need satisfaction, at least to the extent that they can be architects of intentional changes in their own course-related behavioral, emotional, cognitive, and agentic engagement.

The overall important lesson learned from the analysis of these reciprocal effects is that classroom processes that are more complex than are those specified by the hypothesized mediation model. The hypothesized model did explain significant variance underlying students' mid-semester changes in autonomy need satisfaction, late-semester changes in classroom engagement, and end-of-course achievement. However, the hypothesized model overlooked two additional and important explanatory paths—namely, that changes in classroom engagement predicted changes in autonomy need satisfaction and also that changes in autonomy need satisfaction predicted changes in perceived autonomy support. Most important, what this means is that perceived autonomy support and classroom engagement both functioned as an antecedent to and a consequence of students' autonomy need satisfaction.

Limitations and Future Research

The goal of the present study was to specify SDT's motivation mediation model as clearly as possible and then test it with a longitudinally designed, classroom-based research methodology. To do so, we focused narrowly on teachers' autonomy support and on students' autonomy need satisfaction rather than broadly on teachers' overall motivating style and on students' overall psychological need satisfaction. While we intentionally adopted this narrow focus, we nevertheless acknowledge that it is possible to portray the motivation mediation model more broadly by conceptualizing (a) teachers' motivating style as perceived autonomy support, perceived structure, and perceived involvement and (b) students' psychological need satisfaction as perceived autonomy, perceived competence, and perceived relatedness (Furrer & Skinner, 2003; Jang, Reeve, & Deci, 2010; Sheldon & Filak, 2008; Tessier, Sarrazin, & Ntoumanis,

2010). Teacher-provided structure and involvement are additionally important aspects of a teacher's motivating style (Jang et al., 2010; Sierens, Vansteenkiste, Goossens, Soenens, & Dochy, 2009; Skinner & Belmont, 1993), and the needs for competence and relatedness are additionally important aspects of students' classroom motivation (as per SDT's "basic needs model"; see R. M. Ryan & Deci, 2002; Vansteenkiste et al., 2010). Now that the present study has confirmed a narrowly-conceptualized mediation model, we encourage future research into a more broadly conceptualized mediation model. We would expect that such a model might account for a greater proportion of the explained variance (R^2) in both (a) mid-semester need satisfaction, because of the additional unique variance explained by perceived structure and perceived involvement, and (b) end-of-semester engagement, because of the additional unique variance explained by perceived competence and perceived relatedness.

A second limitation of the present study is that many of the observed effects featured what looked like low magnitude effects (e.g., βs of .12, .28, and .14 in the hypothesized motivation mediation model). However, all four measured variables showed strong stability (i.e., high test–retest reliabilities from T1 to T2 to T3). Still, even in the context of these relatively high test–retest reliabilities (reported in Table 2), T1 perceived autonomy support still explained changes in T2 autonomy need satisfaction, just as the change in T2 classroom engagement explained changes in T3 autonomy need satisfaction.

A third limitation concerns the unknown generalizability of the findings. Our data set involved middle-school students in an East Asian nation. It is unknown to what extent the observed hypothesized, reciprocal, and stationary effects might generalize to students of other grade levels and to students of other nations. We encourage future research to assess the generalizability of the present findings, and we do so with justified enthusiasm because the previous cross-sectional tests that found support for the motivation mediation model were later shown to generalize well across different grade levels (for preschool, see Koestner, Ryan, Bernieri, & Holt, 1984; for elementary school, see Deci et al., 1981; for middle school, see Vansteenkiste et al., 2005; for high school, see Reeve, Jang, et al., 2004) and across different regions of the globe (for Europe, see Deci et al., 2001; for Asia, see Jang et al., 2009; Lim & Wang, 2009; Vansteenkiste et al., 2005; for the Middle East, see Assor et al., 2005; for South America, see Chirkov, Ryan, & Willness, 2005).

A fourth limitation is that our study extended for only a single semester. Perhaps a more meaningful time frame in the context of middle school would be an academic year, as this year-to-year comparison is often the time frame used to pursue the types of research questions investigated in the present study (e.g., Ladd & Dinella, 2009).

Implications

The findings yield three implications—one related to SDT, a second related to the practical effort to promote students' autonomy need satisfaction, and a third to the practical effect to promote teachers' autonomy support. The implication for SDT is that while the motivation mediation model is valid, it is also incomplete. This is true for two reasons. First, the hypothesized effects were nonstationary. So, while perceived autonomy support predicted changes in autonomy need satisfaction early in the semester, it did not do so late in the semester. Similarly, while autonomy need satisfaction predicted engagement changes and while engagement predicted achievement changes, it was only changes in these antecedents—not their initial levels—that predicted these outcomes. Second, the reason that these hypothesized effects were not stationary was because additional (reciprocal) effects emerged that could better explain the within-semester trajectories of these outcomes. For instance, even though T2 perceived autonomy support was strongly correlated with T3 autonomy need satisfaction, T2 changes in student engagement fed back to better predict changes in students' T3 autonomy need satisfaction. Hence, these findings of nonstationary and reciprocal effects imply that the SDT-based motivation mediation model should be extended and qualified, at least when the model is situated within and applied to the complexity of naturally occurring classroom contexts.

As for promoting students' classroom autonomy, it was a new finding that changes in engagement predicted changes in autonomy need satisfaction. This suggests that not only is motivation a forerunner to subsequent changes in engagement, but changes in engagement may similarly be a forerunner to subsequent changes in students' autonomy need satisfaction. Perhaps any classroom event that enhances high-quality engagement might later support elevated autonomy need satisfaction, including gains in other motivational states (e.g., enhanced self-efficacy, a mastery achievement goal, or piqued situational interest), some instructional strategies, and some approaches to assessment.

As for promoting teacher-provided autonomy support, students' own autonomy need satisfaction can be viewed as a likely antecedent to changes in teachers' classroom motivating styles. That is, students' classroom autonomy need satisfaction may work as an antecedent to increases (or decreases) in teachers' provision of autonomy support. A good deal of research already exists to explain why teachers tend toward an autonomy supportive or controlling style toward students (Pelletier et al., 2002), and the present study adds the new contribution that student motivation itself may play in affecting dynamic changes in teachers' (perceived) motivating style.

Conclusion

The findings from our longitudinally designed, classroom-based empirical test of SDT's motivation mediation model produced two central conclusions. First, the rigorous multiwave research methodology supported the hypothesized model. Second, the emergence of both reciprocal and nonstationary effects qualified the predicted model in important ways. The model that best fit the data from these Korean middle-school students was one that extended the hypothesized model by revealing that perceived autonomy support and classroom engagement both function as antecedents to and consequences of students' autonomy need satisfaction.

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