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Students' Classroom Engagement Produces Longitudinal Changes in Classroom Motivation

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Changes in motivation anticipate changes in engagement, but the present study tested the reciprocal relation that changes in students' classroom engagement lead to corresponding longitudinal changes in their classroom motivation. Achievement scores and multiple measures of students' course-specific motivation (psychological need satisfaction, self-efficacy, and mastery goals) and engagement (behavioral, emotional, cognitive, and agentic aspects) were collected from 313 (213 females, 100 males) Korean high school students using a 3-wave longitudinal research design. Two key findings emerged from a multilevel structural equation modeling analysis: (a) Students' initial classroom engagement predicted corresponding longitudinal changes in all 3 midsemester motivations, and (b) early semester changes in engagement predicted corresponding longitudinal changes in end-of-semester psychological need satisfaction and self-efficacy, but not mastery goals. Changes in engagement also predicted course achievement. These findings reveal the underappreciated benefits that high-quality classroom engagement contributes to the understanding, prediction, and potential facilitation of constructive changes in students' in-course motivation.

Keywords: engagement, longitudinal, mastery goals, psychological need satisfaction, self-efficacy

Changes in motivation precede corresponding changes in engagement. Situationally induced interest and enhanced self-efficacy, for instance, are both reliable forerunners to later gains in students' effort (behavioral engagement), enthusiasm (emotional engagement), strategic thinking (cognitive engagement), and proactive contributions into the learning environment (agentic engagement) (Bandura, 1997; Schraw & Lehman, 2001). Recent longitudinal classroom-based research, however, suggests that this motivation-to-engagement relation may be reciprocal, such that the effect that changes in engagement have on changes in motivation may be just as strong and reliable as is the well-studied motivation-to-engagement effect (Jang, Kim, & Reeve, 2012). The purpose of the present study was to test the hypothesis that naturally occurring changes in students' classroom engagement produce corresponding longitudinal changes in students' class-specific motivation.

Changes in Engagement Predict Changes in Motivation

Using a classroom-based longitudinal research design, Jang and her colleagues (2012) assessed students' perceptions of teacher-provided autonomy support, students' motivation (e.g., autonomy need satisfaction), and extent of classroom engagement at the beginning, middle, and end of a semester. As expected, they found that teacher-provided autonomy support predicted changes in students' motivation and that these observed changes in motivation in turn predicted subsequent changes in engagement. These findings were interpreted as support for self-determination theory's motivation mediation model. Of interest to the present study, these researchers further found that early semester changes in students' engagement predicted late-semester changes in autonomy need satisfaction. In explaining their findings, these authors concluded that students' class-specific motivation (i.e., autonomy need satisfaction) was sensitive and responsive to their perceptions of teacher-provided autonomy support during the first half of the semester but was even more sensitive and responsive during the second half of the semester to changes in their own classroom engagement. In essence, students' early semester motivational changes reflected teacher activity (e.g., motivating style, instructional strategies, instructional activities, and approaches to assessment), whereas students' late-semester motivational changes reflected their own activity (e.g., greater or lesser classroom engagement).

Jang and her colleagues (2012) did not predict the "changes in engagement-to-changes in motivation" effect a priori but, rather, observed the effect within their statistical analysis. In the present study, we sought to predict the effect in an a priori (rather than in a post hoc) way. For reasons to be articulated in the next paragraphs, we also believed that the "changes in engagement-to-

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changes in motivation" effect would affect motivation more generally than just autonomy need satisfaction. So, in the present study, we broadened the conceptualization of need-based student motivation from just autonomy need satisfaction to overall psychological need satisfaction, and we also added self-efficacy beliefs and mastery goals to our investigation.

Changes in Engagement Predict Changes in Many Types of Motivation

In self-determination theory, students are said to possess the three psychological needs of autonomy, competence, and relatedness (Ryan & Deci, 2000). Collectively, these three needs provide the psychological nutriments necessary for learning, positive classroom functioning (e.g., engagement), and psychological well-being. This assertion on the downstream educational benefits of psychological need satisfaction has received considerable empirical support (Furrer & Skinner, 2003; Jang, Reeve, Ryan, & Kim, 2009; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004), and it supports the conclusion that the social contextual affordances allow students opportunities to experience psychological need satisfaction (e.g., choice provisions for autonomy, Patall, Dent, Oyer, & Wynn, 2013; optimal challenges for competence, Shapira, 1976; and warm interactions for relatedness, Furrer & Skinner, 2003). But support from the social context is not the only avenue for students to experience psychological need satisfaction, as students can self-generate intentional action to proactively engage themselves in environmental transactions that are potentially capable of yielding need-satisfying experiences. For instance, engaging oneself fully in a potentially interesting activity tends to nurture autonomy, mastering an optimal challenge tends to nurture competence, and socioemotional sharing with one's friends tends to nurture relatedness (Reis, Sheldon, Gabel, Roscoe, & Ryan, 2000). Thus, just as teacher-provided autonomy support can cultivate students' need-satisfying experiences during instruction, an increase in students' own high-quality engagement would seem to be another viable route to these same need-satisfying experiences.

Self-efficacy also provides students with numerous benefits—such as optimistic and resilient beliefs and expectations—that energize and enable positive educational outcomes such as learning, engagement, and skillful performance (Bandura, 1993; Zimmerman, 1995). The sources of self-efficacy are well documented and include personal behavior history, vicarious experience (modeling), verbal persuasion, and physiological activity (Bandura, 1986, 1997). Teacher modeling, instruction, and positive feedback (i.e., vicarious experience, verbal persuasion) are reliable social contextual supports to enhance students' self-efficacy beliefs (Schunk & Swartz, 1993), but the principle route to changes in self-efficacy beliefs is through direct mastery experiences (i.e., personal behavior history; Bandura, 1997). Mere engagement in a task, however, is unlikely to increase task-specific self-efficacy, as task engagement is as likely to yield inefficacy signals as it is to yield efficacy signals, especially during relatively unfamiliar learning activities. Instead, it is more likely that a meaningful increase—an upward spike—in one's engagement is what is necessary to yield new efficacy signals that are capable of growing a confident and resilient sense of "I am confident that I can do this" (Pajares, 2003; Schunk & Swartz, 1993; B. Walker, 2003)—for example, more persistent effort than what was previously applied (i.e., greater behavioral engagement) or deeper and more sophisticated thinking than what was previously applied (i.e., greater cognitive engagement). Thus, just as teacher-provided modeling and verbal persuasion can increase students' self-efficacy during instruction, an increase in students' own high-quality engagement would seem to be another viable route to enhanced self-efficacy beliefs.

In achievement goal theory, the sources of mastery goals (or mastery-approach goals) include the provision of mastery-oriented learning climates (e.g., those that emphasize and recognize progress and improvement, Ames & Archer, 1988; Urdan & Schoenfelder, 2006), personality dispositions (e.g., growth mindset, Dweck & Leggett, 1988; need for achievement, Elliot & Church, 1997), and task-specific competence expectancies (Elliot & Church, 1997). The adoption of mastery goals is generally recognized as a constructive classroom motivation that leads to educationally important benefits such as a preference for challenging tasks, task persistence, greater interest, utilization of conceptually based learning strategies, and adaptive help seeking (Elliott & Dweck, 1988; Meece, Anderman, & Anderman, 2006; Meece, Blumenfeld, & Hoyle, 1988; Newman, 1991). When teachers offer students a mastery-oriented classroom climate, students tend to orient their attention more toward investing effort; focusing on feelings of satisfaction from hard work; using deeper or more sophisticated learning strategies; and viewing others as sources of help, information, and support—that is, they focus on their behavioral, emotional, cognitive, and agentic acts of engagement. How teachers frame classroom events such as evaluation criteria, definitions of success, and reactions to errors and mistakes orients students toward or away from mastery goals, but these same frames also orient students toward greater or lesser behavioral, emotional, cognitive, and agentic engagement that themselves may contribute uniquely toward or away from the adoption of mastery goals. Thus, just as a teacher-provided mastery-oriented classroom climate can cultivate students' mastery goals during instruction, an increase in students' own high-quality engagement may, over time and through reflection on the personal utility of increased engagement on improving one's learning, be another viable route to greater mastery goals.

Nature and Function of Classroom Engagement

Engagement refers to a student's active involvement in a learning activity (Christenson, Reschly, & Wylie, 2012). It is a multidimensional construct that has been conceptualized as consisting of three, and sometimes of four distinct, yet intercorrelated and mutually supportive aspects of behavior, emotion, cognition, and agency (Christenson et al., 2012; Fredricks, Blumenfeld, & Paris, 2004; Reeve, 2013; Reeve & Tseng, 2011; Skinner, Kindermann, Connell, & Wellborn, 2009). *Behavioral engagement* refers to how effortfully involved the student is in the learning activity in terms of attention, effort, and persistence (Skinner, Kindermann, & Furrer, 2009). *Emotional involvement* refers to the presence of positive emotions during task involvement, such as interest, and to the absence of negative emotions, such as anxiety (Skinner, Kindermann, & Furrer, 2009). *Cognitive engagement* refers to how strategically the student attempts to learn in terms of using sophisticated rather than superficial learning strategies, such as elaboration rather than memorization (C. O. Walker, Greene, & Mansell, 2006). *Agentic engagement* is a fourth and newly proposed aspect of student engagement that refers to the extent of the student's constructive contribution into the flow of the instruction they receive in terms of asking questions, expressing preferences, and letting the teacher know what one wants and needs (Reeve, 2013).

What makes classroom engagement a particularly important educational construct is that it functions as a multidimensional pathway to connect students' motivational states with their sought-after educational outcomes (Skinner, Kindermann, Connell, & Wellborn, 2009; Skinner, Kindermann, & Furrer, 2009), such as academic progress and extent of achievement (Hughes, Wu, Kwok, Villarreal, & Johnson, 2012; Jang et al., 2012; Ladd & Dinella, 2009; Reyes, Brackett, Rivers, White, & Salovey, 2012; Skinner, Zimmer-Gembeck, & Connell, 1998). By engaging themselves effortfully, enthusiastically, strategically, and proactively, students have multiple effective pathways to translate their constructive motivational states (e.g., needs, goals) into better developed skills, achieved educational objectives, and academic progress more generally.

Agentic engagement is similar to the other three aspects of engagement, as it too is a constructive student-initiated pathway to academic progress. But agentic engagement is also a meaningfully different type of engagement in that it is uniquely proactive and transactional (Reeve, 2013). Proactively, when students act agentically, they take action before the learning activity begins and before the teacher finalizes the structure of the upcoming learning activity. Transactionally, agentically engaged students negotiate with the provider of the learning environment (e.g., the teacher) for a more motivationally supportive learning environment, as they seek to personalize how need-satisfying, goal-congruent, or personally relevant the learning activity is. Behavioral engagement, emotional engagement, and cognitive engagement, in turn, are more reactive types of engagement, as students use effort, enthusiasm, and strategic thinking as ways of translating teacher-provided instruction into student-acquired knowledge and skill. Overall, although all four aspects of engagement are student-initiated pathways to greater academic progress, agentically engaged students are taking proactive and transactional action that is something more than is their behavioral, emotional, and cognitive engagements.

Each student motivation included in the present study has consistently been shown to contribute directly and positively to students' course-related achievement—including psychological need satisfaction (Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005), self-efficacy (Multon, Brown, & Lent, 1991), and mastery goal orientation (Greene & Miller, 1996). That said, our understanding of the function of student engagement is that it, rather than student motivation per se, is the proximal cause of students' academic progress and achievement. That is, students' engagement in a learning activity fully mediates and explains the otherwise direct effect that constructive motivations have on students' academic progress and achievement.

Hypothesized Model

The hypothesized model appears in Figure 1. Its conceptual basis is that naturally occurring changes in students' classroom engagement produce corresponding longitudinal changes in students' achievement and motivation. That changes in engagement anticipate achievement is not a new prediction (e.g., Alexander, Entwisle, & Dauber, 1993; Jang et al., 2012; Ladd & Dinella, 2009), but we include this path within the hypothesized model to confirm that the early semester changes in engagement reported by our participants were indeed constructive changes (i.e., changes related to achievement). The new contribution within the model is that changes in engagement were hypothesized to produce corresponding longitudinal changes in constructive types of motivation—in students' class-specific psychological need satisfaction, self-efficacy, and mastery goals.

To depict the hypothesis that changes in engagement predict changes in motivation, Figure 1 features three solid boldface upwardly sloped lines from Time 2 (T2) engagement to each Time 3 (T3) motivation. The figure also features three solid thin upwardly sloped lines from Time 1 (T1) engagement to each T3 motivation to represent statistical controls. These three statistical controls are important inclusions because they render the effect of T2 engagement on the T3 motivations as the effect of *changes* in engagement and not the effect of T2 engagement level per se. Hence, the prediction is that students' midsemester or T2 level of classroom engagement, controlling for their early semester or T1 level of engagement (i.e., "changes" in engagement) will explain late-semester changes in all three constructive academic motivations (psychological need satisfaction, self-efficacy, and mastery goals), controlling for the midsemester or T2 level of each corresponding motivation (i.e., "changes" in need satisfaction, self-efficacy, and mastery goals). Figure 1 further includes seven solid thin horizontal lines to represent the stability effect of each variable on itself at a later time/wave (e.g., T1 self-efficacy → T2 self-efficacy; T2 self-efficacy → T3 self-efficacy). These paths simply represent statistical controls.

To further understand the possible reciprocal relations that might occur between motivation and engagement, we tested additional but nonhypothesized paths in the longitudinal model. We included two clusters of these potentially informative paths.

The first cluster of added paths involved the potential effect of the mid-semester nonfocal T2 motivations on late-semester changes in the focal T3 motivation (i.e., T2 self-efficacy and T2 mastery goals → T3 psychological needs). We also added three possible paths from each T2 motivation to achievement. For clarity of presentation, these nine paths do not appear in Figure 1, but they were included in the statistical analyses to confirm that it was changes in students' engagement—and not changes in the other motivations—that explained any observed changes in students' T3 motivations and achievement.

The second cluster of six added paths pertained to the possible early semester relations between motivation and engagement. All six of these nonhypothesized paths appear in Figure 1 as thin dashed (i.e., nonhypothesized) lines. The three downwardly sloped paths each explored for a possible effect that students' initial course motivation might have on their early semester changes in engagement (T1 motivation → changes in T2 engagement). The three upwardly sloped paths explored for a possible effect that students' initial course engagement might have on their early semester changes in motivation (T1 engagement → changes in T2 motivation).

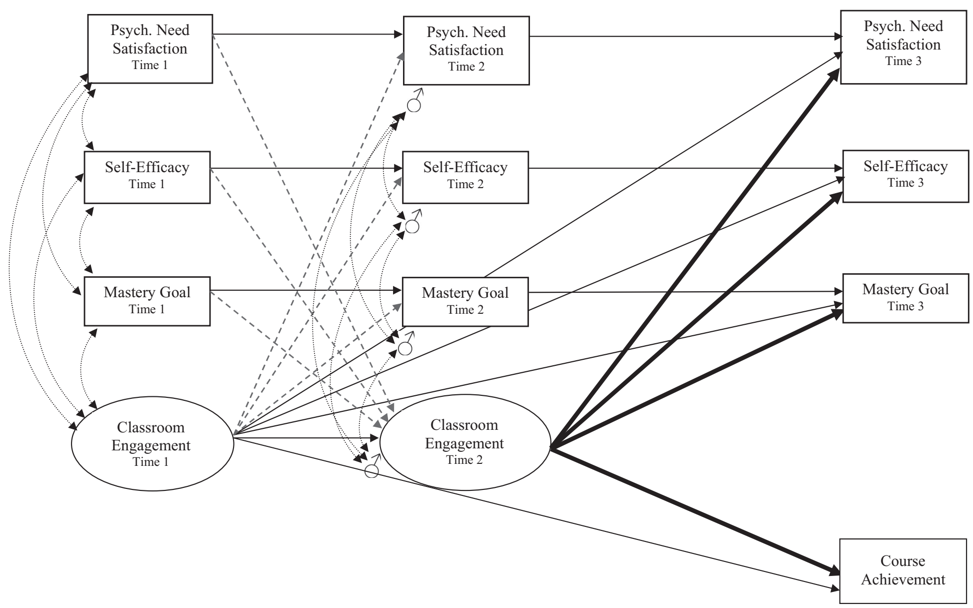

Figure 1. Hypothesized model. The four hypothesized paths emanating out of Time 2 (T2) classroom engagement are represented by the three boldfaced upwardly sloped lines to the Time 3 (T3) motivations and the single boldfaced downwardly sloped solid line to achievement. The four statistical controls emanating out of Time 1 (T1) classroom engagement are represented by the three thin upwardly-sloped lines to the T3 motivations and the single thin downwardly sloped solid line to achievement. The four horizontal lines on the left side of the figure (between T1 and T2) and the three horizontal lines on the right (between T2 and T3) represent statistical controls for the repeated measures. The three dashed upwardly sloped lines and the three dashed downwardly sloped lines on the left side of the figure represent nonhypothesized but possible effects in the model. Curved lines with double-sided arrows on the end represent correlated error terms—covariances of exogenous variables at Wave 1 and covariances of correlated residuals at Wave 2. Psych. Need = Psychological Need.

Method

Participants and Procedure

Participants who consented to participate during the first wave of data collection were 351 high school students taking 12 different classes situated within one of five urban schools in Seoul, Korea. All students and all teachers were ethnic Korean. Students were in Grades 1, 2, or 3 of high school (Grades 10, 11, and 12 in the United States). Five subjects were taught in these 12 classrooms. The subject matters and number of participants taking each course and who completed all three waves of data collection were as follows: English (n = 110); mathematics (n = 62); social science (n = 60); Japanese (n = 55); and Korean (n = 26). Each participant completed the survey in reference to the same class and subject matter across all three waves of data collection.

Participants completed a two-page questionnaire three times during the 17-week semester—during Week 2 (T1), during Week 9 (T2), and during Week 17 (T3). We assessed the dependent measures during Weeks 2, 9, and 17 to divide the course into two equal halves so that we could investigate how changes in the first half of the course affected changes in the second half. This first half/second half division is a commonly occurring structural aspect of the typical Korean high school classroom experience, as the first half of the course prepares students for a midterm examination, whereas the second half prepares them for a final examination. The questionnaire at T1 and T2 assessed students' three motivations and the four aspects of engagement, whereas the questionnaire at T3 assessed only students' motivations. 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 particular class. Students were assured 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 students were asked to write that number on the top of each questionnaire they completed, a procedure that enabled the research team to match students' responses across the three time periods.

During the first wave of data collection, 351 students consented to complete the questionnaire assessing demographic information, the three types of motivation, and the four aspects of engagement. During the second wave, 331 of the original 351 participants consented to complete the second questionnaire. The 331 T1 persisters did not differ significantly from the 20 T2 nonpersisters on any demographic characteristic and on only one of the seven assessed measures—namely, the nonpersisters reported significantly lower T1 behavioral engagement than did the persisters (t = 2.75, $p < .01$). During the third wave of data collection, 313 of the 331 participants from the first two waves completed the questionnaire. The 313 T3 persisters did not differ significantly from the 18 T2 nonpersisters on any demographic characteristic, measure of motivation, or measure of engagement. Thus, the final sample represented an overall retention rate of 89.2% (313/351) and lost some of its behavioral disengaged students between T1 and T2. The final sample of 313 students included 213 girls and 100 boys who were in high school Grades 1 ($n = 62$), 2 ($n = 189$), and 3 ($n = 62$).

Measures

For each measured variable, we began with a previously validated questionnaire and then translated that measure into Korean through 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 1 (*strongly disagree*) to 7 (*strongly agree*) scale, except for the questions assessing the categorical demographic information.

Psychological need satisfaction. To assess extent of psychological need satisfaction, we used the Activity-Feelings States scale (AFS; Reeve & Sickenius, 1994). The AFS was developed from self-determination theory principles to serve as a brief measure of students' three situationally sensitive psychological needs of autonomy, competence, and relatedness, and scores produced by the AFS scales have been shown to predict outcomes such as classroom engagement and course grades (Jang et al., 2009, 2012; Reeve, Nix, & Hamm, 2003; Reeve & Tseng, 2011). The AFS offers the stem, "During this class, I feel:," and lists 13 items, with three items pertaining to each of the three subscales for autonomy, competence, and relatedness (the remaining items are filler items to assess perceived tension). The Perceived Autonomy subscale includes the three items of "free"; "I'm doing what I want to be doing"; and "free to decide for myself what to do." The Perceived Competence subscale includes the three items of "capable"; "competent"; and "my skills are improving." The Perceived Relatedness subscale includes the three items of "I belong and the people here care about me"; "involved with close friends"; and "emotionally close to the people around me." These items were used to assess psychological need satisfaction as an overall, single composite score (following Deci et al., 2001; Quested et al., 2011; Standage, Duda, & Ntoumanis, 2005). The overall nine-item measure showed strong internal consistency across all three waves (αs = .83, .86, and .85 across the three assessments at T1, T2, and T3).

We also performed a supplemental analysis in which we retested the hypothesis that changes in engagement would longitudinally predict changes in psychological need satisfaction by breaking down the one overall nine-item psychological need satisfaction composite score into the three individual AFS scale scores. The internal consistencies of the individual three-item psychological need scores were as follows: perceived autonomy, αs = .70 (T1), .75 (T2), and .66 (T3); perceived competence, αs = .79 (T1), .77 (T2), and .81 (T3); and perceived relatedness, αs = .65 (T1), .74 (T2), and .77 (T3).

To justify treating the three psychological needs as a single composite score in the main analyses, instead of treating each need as its own separate indicator (as in the supplemental analyses), we calculated an exploratory factor analysis on the three psychological needs at each time point. Entering students' mean scores on the autonomy, competence, and relatedness AFS scales as the three individual data points, a one-factor solution emerged from a three-item principal components analysis at T1 (eigenvalue = 1.97; 65.5% of the total variance; factor loadings of .80 for autonomy, .82 for competence, and .81 for relatedness), at T2 (eigenvalue = 2.07; 68.9% of the total variance; factor loadings of .81, .85, and .83, respectively), and at T3 (eigenvalue = 2.03; 67.7% of the total variance; factor loadings of .78, .87, and .81, respectively).

Self-efficacy. To assess extent of class-specific self-efficacy, we used the Academic Efficacy scale from the Patterns of Adaptive Learning Scales (PALS; Midgley et al., 2000). The PALS was developed to assess students' academic perceptions, beliefs, and strategies and includes the assessment of academic efficacy as one of its scales, and its scores have been shown to predict outcomes such as classroom engagement and course grades (Middleton & Midgley, 1997; Roeser, Midgley, & Urdan, 1996). The Academic Efficacy scale includes the following five items: "I am certain I can master the skills taught in this class this year"; "I am certain I can figure out how to do the most difficult work in this class"; "I can do almost all of the work in this class if I don't give up"; "Even if the work is hard in this class, I can learn it"; and "I can do even the hardest work in this class if I try." The five-item measure showed strong internal consistency across all three waves of the data collection (αs = .83, .81, and .85).

Mastery goals. To assess extent of mastery goals, we used the Mastery-Approach Achievement Goal Orientation scale from the revised Achievement Goal Questionnaire–Revised (AGQ-R; Elliot & Murayama, 2008). The AGQ-R was developed to assess students' class-specific achievement goals in terms of both mastery and performance-orienting frameworks and to differentiate these two orientations into approach and avoidance dimensions. The Mastery-Approach Achievement Goal Orientation scale includes the following three items: "I am striving to understand the content of this course as thoroughly as possible"; "My aim is to completely master the material presented in this class"; and "My goal is to learn as much as possible." Scores produced by this scale have been shown to predict outcomes such as classroom engagement and course grades (Elliot & Murayama, 2008; Murayama, Elliot, & Yamagata, 2011). The three-item measure showed acceptable internal consistency across all three waves (αs = .76, .77, and .76).

Classroom engagement. We assessed four interrelated aspects of students' classroom engagement—behavioral, emotional, cognitive, and agentic. For both behavioral and emotional engagement, we used the Behavioral Engagement and Emotional Engagement scales from Skinner, Kindermann, and Furrer's (2009) Engagement vs. Disaffection with Learning measure. The Behavioral Engagement scale includes the following three items (α = .82 at T1, and α = .80 at T2): "I try hard to do well in this class"; "In this class, I work as hard as I can"; and "I pay attention in class." The Emotional Engagement scale includes the following three items (αs = .88 and .88): "When I am in this class, I feel good"; "When we work on something in this class, I feel interested"; and "I enjoy learning new things in this class." Scores from both scales have been shown to correlate with constructive motivations (e.g., psychological needs) and to predict course grades (Jang et al., 2009; Miserandino, 1996; Skinner, Kindermann, Connell, & Wellborn, 2009; Skinner, Kindermann, & Furrer, 2009).

For cognitive engagement, we used Wolters' (2004) Metacognitive Strategies questionnaire (adopted from Pintrich, Smith, Garcia, & McKeachie's, 1993, Motivated Strategies for Learning

Questionnaire). The Metacognitive Strategies scale includes the following three items (αs = .77 and .80): "Before starting an assignment for this class, I try to figure out the best way to do it"; "In this class, I keep track of how much I understand the work, not just if I am getting the right answers"; and "If what I am working on in this class is difficult for me to understand, I figure out how to change the way I learn the material." Scores from this measure have been shown to correlate with constructive motivations (e.g., mastery goals) and to predict outcomes such as course grades (Reeve & Tseng, 2011; Wolters, 2004).

For agentic engagement, we used the Agentic Engagement Scale (Reeve, 2013). The Agentic Engagement Scale includes the following three items (αs = .80 and .84): "During this class, I ask questions to help me learn"; "I let the teacher know what I am interested in"; and "During this class, I express my preferences and opinions"). Scores from this scale have been shown to correlate with constructive motivations (e.g., self-efficacy) and to predict outcomes such as course grades (Reeve & Tseng, 2011).

To justify treating the four aspects of engagement as a single latent factor, instead of treating each aspect of engagement as its own separate indicator, we calculated an exploratory factor analysis on the four aspects of engagement at each time point. Entering students' mean scores on the Behavioral, Emotional, Cognitive, and Agentic Engagement scales as the four individual data points, a one-factor solution emerged from a four-item principal components analysis at T1 (eigenvalue = 2.61; 65.3% of the total variance; factor loadings of .88 for Behavioral Engagement, .85 for Emotional Engagement, .84 for Cognitive Engagement, and .65 for Agentic Engagement), at T2 (eigenvalue = 2.74; 68.5% of the total variance; factor loadings of .87, .86, .83, and .74, respectively), and at T3 (eigenvalue = 2.71; 67.7% of the total variance; factor loadings of .88, .86, .84, and .70, respectively).

Achievement. For course achievement, we collected each student's final score/grade from the objective school record for the particular class in which he or she completed the questionnaires. Hence, our measure of student achievement was final course score/grade, which was reported to us on a scale of 0–100.

Data Analysis

Classroom engagement was assessed and entered into the model as a latent variable, using students' mean score on each engagement scale (Behavioral, Emotional, Cognitive, and Agentic) as the four observed indicators. The three measures of student motivation and the achievement score were entered into the model as observed variables. For psychological need satisfaction, self-efficacy, and mastery goals, we used students' mean scores from the nine-item AFS, the five-item PALS, and the three-item AGQ-R, respectively. This analytic decision was necessitated by the statistical need to keep the ratio of participants (313) to measured variables (18) comfortably above the recommended minimally acceptable 10.0 participants/measured variables ratio (Maxwell, 2000). Had we assessed the three motivations as latent variables, the participants:measured variables ratio would have dropped to an unreliable 5.2 participants:variables (313:60). Alternatively, we could have used a parceling strategy, but because the measure for mastery goals included only three items, such a measurement model strategy would have left us with a too-awkward (apples-to-oranges) model of latent variables indicated by scales (Engagement), parcels (psychological needs, self-efficacy), and items (mastery goals). To evaluate model fit within the structural equation modeling analysis, 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 nonnormed 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).

Results

Preliminary Analyses

Before testing our hypothesized models, we first conducted multilevel analyses using hierarchical linear modeling (Version 7; Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011) to determine whether or not meaningful between-class and between-subject matter differences might have affected students' self-reports and course grade. The hierarchical structure of the data was that students' scores (Level 1) were nested within classrooms (Level 2), and those classrooms were nested within subject matters (Level 3). The intraclass correlations (ICCs) calculated from unconditional models appear in the first column in Table 1. These statistics show that the percentage of the total variance attributable to between-class (Level 2; *M* ICC across all 18 indicators = 2.6%) and between-subject matter (Level 3; *M* ICC across all 18 indicators = 2.7%) effects were moderate (Levels 2 and 3 combined; *M* ICC across all 18 indicators = 5.3%) but meaningful enough to warrant the use of multilevel structural equation modeling (LISREL 8.8; Jöreskog & Sörbom, 1996). In the calculation of multilevel structural equation modeling, LISREL calculates parameter values and model fit by distributing variance at the student (Level 1, $n = 313$), classroom (Level 2, $k = 12$), and subject matter (Level 3, $k = 5$) levels; the ensuing results may be interpreted as student-level effects that are statistically independent of (controlled for) classroom-level and subject matter-level results.

We also explored for possible gender- and grade-level associations with the 18 assessed measures. Gender was associated with students' mastery goal orientation at both T2, $r(313) = .17$, $p < .01$, and T3, $r(313) = .22$, $p < .01$, and with behavioral engagement at T1, $r(313) = .13$, $p < .05$, but not with the other 15 assessed variables, with girls scoring higher than boys on all three measures. Grade level was associated with students' self-efficacy at T3, $r(313) = .17$, $p < .01$, and with course achievement, $r(313) = .24$, $p < .01$, but not with the other 16 assessed variables. A follow-up one-way analysis of variance with Bonferroni post hoc tests showed that students in Grade 3 reported higher T3 self-efficacy than did students in Grade 1 and that students in Grade 3 scored higher on achievement than did students in either Grade 1 or Grade 2, who did not differ significantly from one another. Given these effects in the data, we add five possible paths—three for gender, two for grade level—to the test of the hypothesized (structural) model to represent the significant zero-order correlations gender and grade level had with a few variables in the structural model. These paths were added simply to function as statistical controls.

Table 1
ICCs, Descriptive Statistics, Unstandardized, and Standardized Beta Weights Associated With All 18 Dependent Measures Within the Measurement Model

Observed variable	Time 1						Time 2						Time 3					
	ICC	*M*	*SD*	*B*	*SE*	β	ICC	*M*	*SD*	*B*	*SE*	β	ICC	*M*	*SD*	*B*	*SE*	β
Motivation indicators																		
1. Psych. need satisfaction	5.9	4.06	0.91	1.00		1.00	5.5	4.04	0.98	1.00		1.00	2.2	4.09	0.94	1.00		1.00
2. Self-efficacy	7.7	4.12	1.07	1.00		1.00	4.6	4.04	1.12	1.00		1.00	4.2	4.16	0.98	1.00		1.00
3. Mastery goal	9.0	5.41	1.11	1.00		1.00	6.6	5.41	1.11	1.00		1.00	1.7	5.25	1.12	1.00		1.00
Engagement indicators																		
1. Behavioral engagement	0.2	4.45	1.18	.90	.06	.74	2.2	4.26	1.18	.94	.05	.80						
2. Emotional engagement	8.8	3.89	1.34	.90	.06	.75	7.3	3.91	1.35	.90	.05	.77						
3. Cognitive engagement	4.9	3.91	1.16	1.00		.83	4.5	3.87	1.14	1.00		.86						
4. Agentic engagement	2.3	3.20	1.31	.67	.06	.54	0.8	3.35	1.36	.75	.06	.64						
Achievement indicator																		
1. Course achievement													17.2	56.0	27.9	1.00		1.00

Note. The possible range for each observed variable was 1–7, except for course achievement, which was 0–100. ICC = interclass correlation coefficient, as expressed in a percentage of the variance accounted for in scores on that item by both classroom (Level 2) and subject matter (Level 3) influences. Psych. need = psychological need.

Multilevel Structural Equation Models

Test of the measurement model. The measurement model featured four indicators of classroom engagement at T1 and T2; one indicator of course achievement; and one indicator of psychological need satisfaction, self-efficacy, and mastery goals across all three waves of data collection for a total of 18 (i.e., 8 + 1 + 9) indicators. To represent the longitudinal character of the data set, we allowed the between-wave error terms of each observed engagement indicator to correlate with itself from T1 to T2, and we allowed the between-wave error terms of each observed motivation indicator to correlate with itself from T1 to T2, from T2 to T3, and from T1 to T3. The overall three-wave measurement model fit the data well, χ^2 (392) = 524.71, $p < .01$, RMSEA [90% CI] = .042 [.025, .056], SRMR = .037, CFI = .99, NNFI = .99. The unstandardized and standardized coefficients for each of the 18 items included in the measurement model appear in Table 1. The data in Table 1 show the descriptive statistics for each measured variable and confirm that each of the four scales designed to assess classroom engagement loaded significantly and substantially on its associated latent variable ($p < .001$).

To help in the interpretation of this measurement model, the intercorrelations among all the within-wave indicators appear in Table 2. All four engagement indicators were highly intercorrelated at T1 (range of *r*s = .39–.71, *p*s < .01), T2 (range of *r*s = .50–.72, *p*s < .01), and T3 (range of *r*s = .44–.73, *p*s < .01). To help in the interpretation of the supplemental structural model using the autonomy, competence, and relatedness need satisfaction scores as individual predictors (instead of the single overall need satisfaction measure used in the main analyses), the intercorrelations among the three need satisfaction measures also appear in Table 2. All three needs were highly intercorrelated at T1 (range of *r*s = .46–.50, *p*s < .01), at T2 (range of *r*s = .49–.57, *p*s < .01), and at T3(range of *r*s = .41–.59, *p*s < .01).

Test of the hypothesized structural model. Given that the measurement model fit the data well, we next tested the hypothesized structural model depicted in Figure 1, though we also added the statistical controls of gender and grade level to serve as a pair of supplemental T1 predictor variables. The intercorrelations among the 12 variables within the structural model appear in Table 3. Within T1, the four predictor variables and the two statistical controls (gender, grade level) were allowed to correlate freely. Within T2, the errors of the four within-wave variables were allowed to correlate (as represented by the curved lines with double-sided arrows in Figure 1). For T3, we predicted that the interrelations among the outcome variables would be explained by their common predictors (psychological need satisfaction, self-efficacy, mastery goals, and classroom engagement), and thus the residuals of these factors were not correlated. This means that to predict each T3 outcome, we first allowed for cross-wave matching autoregression effects in which the T2 variable predicted its corresponding T3 variable (e.g., T2 mastery goals → T3 mastery goals), second added the remaining two nonfocal T2 motivation variables, third added T1 classroom engagement, and lastly added T2 classroom engagement as the hypothesized predictor of each T3 outcome. For clarity, we show only the hypothesized and significant paths in Figure 2, but we report all included paths in the text.

The hypothesized structural model fit the data well overall, χ^2 (508) = 773.77, $p < .01$, RMSEA [90% CI] = .057 [.045, .067], SRMR = .084, CFI = .98, NNFI = .98. In the prediction of the "change in motivation" outcomes, two—but not all three—hypothesized paths were significant. The path from T2 engagement to T3 psychological need satisfaction was significant (B = .30, SE = .10, β = .21, t = 2.94, $p < .01$), even after controlling for T1 classroom engagement (β = .00, *ns*) and for the T2 effects from psychological need satisfaction (β = .47, $p < .01$), self-efficacy (β = .00, *ns*), and mastery goals (β = −.01, *ns*). The path from T2 engagement to T3 self-efficacy was significant (B = .33, SE = .10, β = .24, t = 3.14, $p < .01$), even after controlling for T1 classroom engagement (β = .04, *ns*), grade level (β = .09, $p < .01$), and for the T2 effects from psychological need satisfaction (β = .01, *ns*), self-efficacy (β = .36, $p < .01$), and mastery goals (β = .01, *ns*). The path from T2 engagement to T3 mastery goals was not significant (B = .16, SE = .10, β = .11, t = 1.55, *ns*), at least after controlling for T1 classroom engagement (β = .05, *ns*), gender (β = .08, $p < .01$), and for the T2 effects from psychological need satisfaction (β = −.02, *ns*), self-efficacy (β = −.02, *ns*), and mastery goals (β = .56, $p <$

Table 2
Within-Wave (T1, T2, and T3) Intercorrelations Among the Nine Measures of Motivation and Engagement

Variable	1	2	3	4	5	6	7	8	9
Time/Wave 1									
1. Autonomy need satisfaction	—								
2. Competence need satisfaction	.49	—							
3. Relatedness need satisfaction	.46	.50	—						
4. Self-efficacy	.41	.58	.46	—					
5. Mastery goal	.22	.45	.29	.45	—				
6. Behavioral engagement	.33	.62	.47	.69	.50	—			
7. Emotional engagement	.46	.58	.49	.69	.49	.71	—		
8. Cognitive engagement	.35	.58	.45	.74	.38	.66	.59	—	
9. Agentic engagement	.35	.46	.46	.45	.26	.39	.41	.41	—
Time/Wave 2									
1. Autonomy need satisfaction	—								
2. Competence need satisfaction	.54	—							
3. Relatedness need satisfaction	.49	.57	—						
4. Self-efficacy	.41	.61	.47	—					
5. Mastery goal	.25	.35	.39	.48	—				
6. Behavioral engagement	.40	.70	.53	.68	.44	—			
7. Emotional engagement	.55	.66	.52	.66	.42	.72	—		
8. Cognitive engagement	.38	.59	.42	.71	.30	.65	.59	—	
9. Agentic engagement	.36	.55	.48	.54	.23	.50	.53	.49	—
Time/Wave 3									
1. Autonomy need satisfaction	—								
2. Competence need satisfaction	.55	—							
3. Relatedness need satisfaction	.41	.59	—						
4. Self-efficacy	.40	.66	.50	—					
5. Mastery goal	.26	.38	.36	.46	—				
6. Behavioral engagement	.44	.65	.48	.70	.50	—			
7. Emotional engagement	.53	.60	.48	.65	.43	.73	—		
8. Cognitive engagement	.41	.62	.40	.69	.28	.69	.58	—	
9. Agentic engagement	.37	.50	.43	.50	.17	.44	.47	.48	—

Note. $N = 313$. T1, T2, and T3 = Time 1, Time 2, and Time 3. All *r*s, $p < .01$.

.01). In the prediction of achievement, the hypothesized path from T2 classroom engagement to achievement was significant ($B = .29$, $SE = .12$, $\beta = .23$, $t = 2.43$, $p < .02$), even after controlling for T1 engagement ($\beta = .15$, *ns*), grade level ($\beta = .17$, $p < .01$), and the T2 effects from psychological need satisfaction ($\beta = -.05$, *ns*), self-efficacy ($\beta = -.01$, *ns*), and mastery goals ($\beta = .09$, $p < .01$).

Supplemental Analyses

We tested for two additional sets of effects within our data. First, we added the six upwardly sloped and downwardly sloped T1 to T2 paths shown in Figure 1 to the structural model that were not included in the hypothesized model but have been included in the models tested by other researchers (e.g., Jang et al., 2012). Second, given the significant effect that T2 changes in engagement had on T3 changes in psychological need satisfaction, we explored whether changes in T2 engagement predicted changes in one, two, or all three of the individual psychological needs.

Test of the effect of T1 motivation on changes in T2 engagement. To explore for possible effects that students' T1 motivation might have had on changes in their T2 engagement, we

Table 3
Intercorrelation Matrix Among the 12 Variables Included in the Test of the Structural Model

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Psychological need satisfaction, T1	—											
2. Self-efficacy, T1	.61	—										
3. Mastery goal, T1	.40	.46	—									
4. Classroom engagement, T1	.62	.73	.50	—								
5. Psychological need satisfaction, T2	.61	.55	.34	.50	—							
6. Self-efficacy, T2	.47	.78	.45	.58	.60	—						
7. Mastery goal, T2	.32	.45	.50	.41	.39	.49	—					
8. Classroom engagement, T2	.54	.64	.50	.71	.67	.72	.37	—				
9. Psychological need satisfaction, T3	.43	.44	.30	.40	.73	.48	.30	.51	—			
10. Self-efficacy, T3	.42	.62	.32	.45	.47	.60	.37	.53	.64	—		
11. Mastery goal, T3	.25	.35	.43	.37	.30	.38	.54	.37	.42	.47	—	
12. Course achievement	.26	.36	.36	.31	.25	.32	.36	.34	.25	.31	.38	—

Note. $N = 313$. T1, T2, and T3 = Time 1, Time 2, and Time 3. All *r*s, $p < .01$.

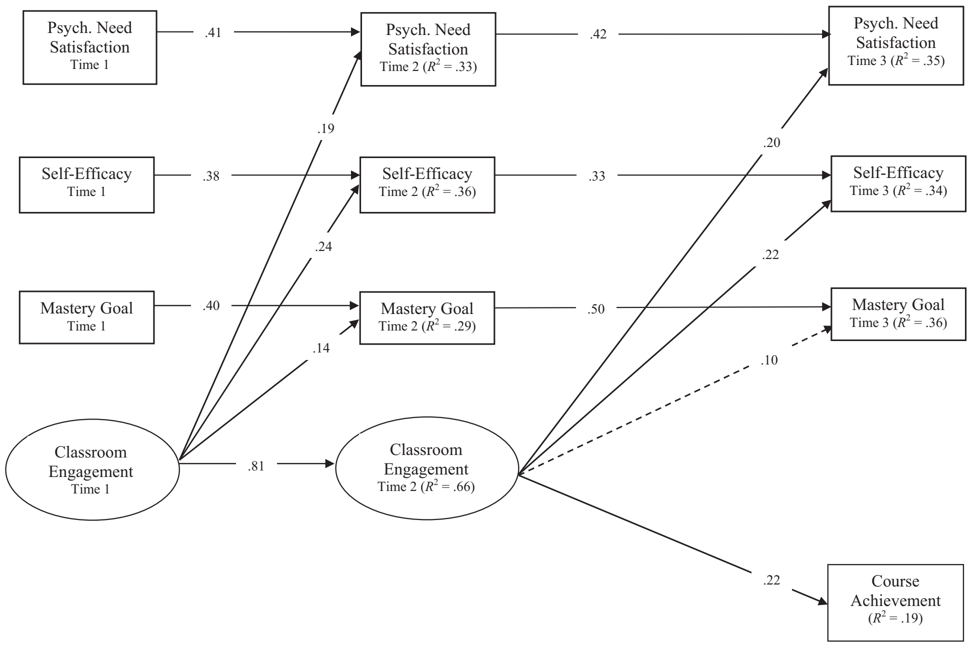

Figure 2. Standardized parameter estimates for the test of the revised hypothesized structural model. Solid lines represent significant paths ($p < .05$); dashed lines represent nonsignificant paths. The numbers overlaying the lines represent standardized parameter estimates (beta coefficients) for that particular path in the structural model. To enhance the clarity of the presentation, the following statistical results are not included in the figure: the within-wave correlations among the four Time 1 exogenous variables and the two statistical controls (gender, grade level); the within-wave correlations among the four Time 2 (T2) error terms; and the beta coefficients for each nonfocal T2 motivation to each of the four Time 3 outcomes. Model fit: $\chi^2(502) = 734.56$, $p < .01$, root-mean-square error of approximation [90% CI] = .056 [.045, .067], standardized root-mean-square residual = .055, comparative fit index = .98, nonnormed fit index = .98. Psych. Need = Psychological Need.

added the three dashed downwardly sloped lines in Figure 1 to the structural model. This alternative model did not fit the data better than did the hypothesized model, $\Delta\chi^2(\Delta 6) = 6.69$, *ns*, and none of the three added paths to predict changes in T2 engagement were individually significant, including the paths from T1 psychological need satisfaction ($\beta = .06$, *ns*), T1 self-efficacy ($\beta = .14$, *ns*), and T1 mastery goals ($\beta = .01$, *ns*).

Test of the effect of T1 engagement on changes in T2 motivation. To explore for possible effects that students' T1 engagement might have had on changes in their T2 motivations, we added the three dashed upwardly sloped lines in Figure 1 to the structural model. This alternative model fit the data significantly better than did the hypothesized model, $\Delta\chi^2(\Delta 6) = 39.21$, $p < .01$, and it fit the data well overall, $\chi^2(502) = 734.56$, $p < .01$, RMSEA [90% CI] = .056 [.045, .067], SRMR = .055, CFI = .98, NNFI = .98. All three supplemental paths were individually significant, as T1 engagement predicted each of the following: (a) changes in T2 psychological need satisfaction ($B = .28$, $SE = .05$, $\beta = .19$, $t = 5.35$, $p < .01$) after controlling for T1 psychological need satisfaction ($\beta = .41$, $p < .01$); (b) changes in T2 self-efficacy ($B = .36$, $SE = .05$, $\beta = .24$, $t = 7.18$, $p < .01$) after controlling for T1 self-efficacy ($\beta = .38$, $p < .01$); and (c) changes in T2 mastery goals ($B = .20$, $SE = .05$, $\beta = .14$, $t = 3.74$, $p < .01$) after controlling for T1 mastery goals ($\beta = .40$, $p < .01$). After adding these three supplemental paths, the hypothesized paths from changes in T2 engagement to changes in T3 psychological need satisfaction, self-efficacy, and achievement remained significant (whereas the path to T3 mastery goals remained nonsignificant). The path diagram showing the standardized estimates for each path in the structural model and each of these three added supplemental paths appear in Figure 2.

Test of T1 and T2 engagement effects on changes in T2 and T3 psychological need satisfaction. To explore the longitudinal effect of changes in T2 engagement on possible changes in the three T3 psychological needs, we calculated a model similar to that depicted in Figure 2, except the three motivational variables were autonomy need satisfaction, competence need satisfaction, and relatedness need satisfaction, rather than overall psychological need satisfaction, self-efficacy, and mastery goals. The two statistical controls of grade level and gender were not included in this supplemental model, as neither correlated significantly with any of these measures of motivation. This supplemental model fit the data well overall, $\chi^2(404) = 621.67$, $p < .01$, RMSEA [90% CI] = .052 [.038, .064], SRMR = .053, CFI = .98, NNFI = .97. All three paths from T1 engagement to changes in T2 need satisfaction were individually significant, as T1 engagement predicted each of the following: (a) changes in T2 autonomy need satisfaction ($B = .30$, $SE = .06$, $\beta = .22$, $t = 4.82$, $p < .01$) after controlling for T1 autonomy ($\beta = .29$, $p < .01$); (b) changes in T2 competence need satisfaction ($B = .38$, $SE = .05$, $\beta = .26$, $t = 7.01$, $p < .01$) after controlling for T1 competence ($\beta = .36$, $p < .01$); and (c) changes in T2 relatedness need satisfaction ($B = .24$, $SE = .05$, $\beta = .16$, $t = 4.37$, $p < .01$) after controlling for T1 relatedness ($\beta = .44$, $p < .01$).

Two—but not all three—of the three paths from changes in T2 engagement to changes in T3 need satisfaction were individually significant. Changes in T2 engagement did not predict changes in T3 autonomy need satisfaction ($B = .22$, $SE = .13$, $\beta = .16$, $t = 1.69$, $p < .10$), at least after controlling for T1 engagement ($\beta = .06$, *ns*) and for the T2 effects from autonomy ($\beta = .28$, $p < .01$), competence ($\beta = .07$, *ns*), and relatedness ($\beta = .01$, *ns*) need satisfaction. Changes in T2 engagement predicted changes in T3 competence need satisfaction ($B = .36$, $SE = .12$, $\beta = .25$, $t = 3.06$, $p < .01$), even after controlling for T1 engagement ($\beta = .01$, *ns*) and for the T2 effects from autonomy ($\beta = -.04$, *ns*), competence ($\beta = .36$, $p < .01$), and relatedness ($\beta = .03$, *ns*) need satisfaction. Changes in T2 engagement predicted changes in T3 relatedness need satisfaction ($B = .25$, $SE = .12$, $\beta = .18$, $t = 2.09$, $p < .05$), even after controlling for T1 engagement ($\beta = .03$, *ns*) and for the T2 effects from autonomy ($\beta = -.06$, *ns*), competence ($\beta = .03$, *ns*), and relatedness ($\beta = .38$, $p < .01$) need satisfaction. In the prediction of achievement, the path from T2 classroom engagement to achievement was significant ($B = .33$, $SE = .14$, $\beta = .25$, $t = 2.30$, $p < .05$), even after controlling for T1 engagement ($\beta = .19$, $p < .05$) and for the T2 effects from autonomy ($\beta = -.16$, $p < .01$), competence ($\beta = .09$, $p < .05$), and relatedness ($\beta = -.04$, *ns*) need satisfaction. The path diagram showing the standardized estimates for each path in this supplemental individual psychological need satisfaction model appear in the Appendix.

Discussion

The contribution offered by the present study was to reveal the underappreciated benefits that classroom engagement contributes to changes in students' academic motivation. The facilitating effect that engagement has on achievement is well appreciated. What is new and important in the present study is that engagement further predicted corresponding changes in motivation—that is, changes in psychological need satisfaction, self-efficacy, and mastery goals. Students' initial classroom engagement predicted changes in their midsemester motivations, and changes in students' early semester classroom engagement further predicted changes in their end-of-semester motivations (psychological need satisfaction and self-efficacy, but not mastery goals).

The focus of the present study was to test the hypothesis that changes in engagement would longitudinally predict corresponding changes in motivation. This was the focus because we expected that only greater (or lesser) engagement than one's original or baseline engagement would generate (a) increased opportunities for need-satisfying environmental transactions, (b) increased opportunities to encounter more frequent or more potent efficacy signals, and (c) increased opportunities for learning and improvement that lead to greater mastery goals. That is, we expected that what enhances motivation would be *extra* effort, *unexpectedly* positive emotion, *deeper* thinking, and *more* proactive contributions (i.e., greater behavioral, emotional, cognitive, and agentic engagement). The findings generally confirmed this engagement-facilitating effect on changes in students' classroom motivations.

The focus of the present study was not to test the possibility that initial engagement would longitudinally predict corresponding changes in motivation. This was not the focus because we expected students' initial engagement to simply reflect, or publically express, students' initial course motivation. As expected, students' T1 engagement correlated positively and significantly with all three T1 motivations (see these correlations in Table 2, row 4). This means that motivation and engagement were correlated cross-sectionally. Unexpectedly, T1 engagement—students' initial engagement status for that particular course—further longitudinally predicted changes in all three T2 motivations. We explain this initial engagement effect by noting that we assessed classroom engagement in a way that has not been assessed in any previous research. Unlike all previous engagement research, we assessed classroom engagement as a latent variable defined by four indicators and, in doing so, uniquely included the additional assessment of agentic engagement. By defining engagement in this multidimensional way—and one that included a proactive aspect (i.e., agentic engagement)—our engagement measure went beyond assessing merely on-task behavior, student involvement, and the like, to tap into what students do during learning activities that generates motivationally relevant classroom experiences such as new encounters with novelty, optimal challenge, effectance- or efficacy-promoting feedback, supportive communications, and opportunities for choice and self-direction (and prevents motivationally suppressing classroom experiences such as new encounters with directives, imposed goals, pressured evaluations, and criticisms).

Future Research

The findings raise several important questions for future research. One question is to understand how changes in motivation occur. What teachers say and do and the quality of the relationship teachers have with their students are important influences on students' classroom motivation, and this is true specifically for psychological need satisfaction (Cheon, Reeve, & Moon, 2012), self-efficacy (Schunk & Swartz, 1993), and mastery goals (Ames & Archer, 1988). This research literature explains how and why changes in students' classroom motivation occur. The present findings, however, add an additional influence on motivation—namely, students' own classroom engagement.

This observed engagement effect was both substantial and consistent throughout the semester, but several important questions remain unanswered. For instance, it is not yet clear whether the engagement contribution is comparable (in terms of effect size) to the well-established influence that teachers and the social context have. These two influences might complement one another, but they might alternatively contribute to changes in students' motivation at different times in a semester. By studying the influence of both of these variables on changes in students' motivation longitudinally, Jang and her colleagues (2012) introduced the interesting possibility that a teacher's effect on changes in students' motivation might be especially influential early in the semester, whereas the students' own engagement effect might be especially influential late in the semester. That said, the data in the present study showed a substantial engagement effect on changes in motivation both early and late in the semester.

The engagement effect occurred for some, but not for all, motivations. T1 engagement predicted changes in all three T2 motivations, whereas changes in T2 engagement predicted changes in T3 psychological need satisfaction and T3 self-efficacy but not in T3 mastery goals. It is not yet clear why initial engagement predicted changes in mastery goals, whereas changes in in-course engagement did not. Further, when the overall psychological need satisfaction effect was broken down into the three individual psychological needs, changes in T2 engagement predicted changes in T3 competence and relatedness need satisfaction but not in T3 autonomy need satisfaction. That changes in engagement did not predict changes in T3 autonomy was particularly surprising because that was the particular effect observed in the Jang et al. (2012) investigation that inspired the present study. That is, although this predictive path from changes in engagement to changes in T3 autonomy was significant in the Jang et al. study ($\beta = .23$, $p < .01$), it was only marginally significant in the present study ($\beta = .16$, $p < .10$). Still, it is interesting to note that the findings did support the other Jang et al. finding that inspired the present study—namely, that the engagement effect on student motivation would be more robust than just a single effect on changes in autonomy need satisfaction and instead would extend to the additional effects involving changes in competence, relatedness, self-efficacy, and mastery goals.

Another unresolved question is to note that the observed engagement effect on changes in motivation was a direct main effect. It is possible, however, that this engagement effect might be moderated by classroom conditions, such as how responsive classroom conditions are to increases in students' engagement. For engagement to translate into need satisfaction, that engagement may need to occur in a context of need supports and not in a context of need thwarts. Similarly, to translate into self-efficacy gains, greater engagement may need sociocontextual guidance to ensure that greater engagement yields efficacy, rather than inefficacy, signals.

It is also possible that the direct main engagement effect might be moderated by actual signs of academic progress. For instance, extent of effort often leads to changes in competency beliefs, but effort exertion can be a two-edged sword in that it may increase perceived competence with task success but decrease it with task failure (Covington, 1984). Although we do not equate effort with engagement, the process may be similar in that the engagement effect may be conditional on the extent to which that increased engagement actually produces sought-after outcomes, such as skill development and course achievement.

Another question for future research would be to ask whether some aspects of engagement might be more predictive of changes in motivation than other aspects. In the present study, we examined classroom engagement as a single coherent latent construct, but it may be additionally fruitful to investigate the one, two, three, or four "active ingredients" within this multidimensional conceptualization of engagement that effect change in classroom motivations. Perhaps only some, but not all, aspects of engagement are responsible for these changes in motivation. Some research has addressed this issue, as one study showed unique predictive effects for behavioral engagement and agentic engagement (Reeve, 2013) and a second study showed unique predictive effects for emotional engagement, cognitive engagement, and agentic engagement (Reeve & Tseng, 2011). Progress in answering this future research question will likely require sharper assessments of each aspect of engagement as well as a recognition that different aspects of engagement likely contribute to different student outcomes.

Future research also needs to investigate from where the changes in our primary predictor variable—changes in T2 engagement—came. Unfortunately, the present study was not designed to confirm our assumption that changes in engagement come from changes in motivation. To do so would require a T3 assessment of engagement and then test for the longitudinal effect of change in T2 motivation on change in T3 engagement. When this path has been included in previous research, the effect that changes in motivation have on subsequent changes in engagement have been shown to be rather strong and reliable (Jang et al., 2012). Although it is fairly clear that changes in motivation predict changes in engagement, it is also clear that motivation per se (T1 motivation) does not predict changes in T2 engagement. None of the paths from T1 motivation to changes in T2 engagement were found to be significant in the present study or in the Jang et al. study. So, it is not yet clear where changes in T2 engagement are coming from. Notice that the stability of T1 engagement to T2 engagement was quite high ($\beta = .81$, $p < .01$), so the changes in T2 engagement that did occur were rather small. Although small in magnitude, these changes are nevertheless important because they predicted subsequent changes in both motivation and achievement. It is therefore important to understand from where these small but important changes in classroom engagement are coming.

A final future research question would be to investigate the extent to which students can effectively become contributors to their own academic motivations. Although motivations rise and fall in response to factors such as task characteristics, the appeal of the curriculum, what teachers say and do, and various social contextual factors, it may also be the case that students can take action to motivate (and demotivate) themselves, at least to the extent to which they can instigate changes in their own course-related behavioral, emotional, cognitive, and agentic engagement. Perhaps students' own high-quality classroom engagement might be a meaningful contributor to constructive (and destructive) changes to their own motivations. If so, such a finding would again cast a spotlight on the question raised in the previous paragraph—namely, from where are these small but important changes in students' classroom engagement coming?

Limitations

One possible limitation is that our investigation focused on only three particular motivations. We selected these particular motivations because we knew in advance that each was highly constructive and engagement-relevant in the classroom setting. It is unknown to what extent changes in classroom engagement might affect other motivations, but we would expect the effect to be limited only to those motivations that are deeply integrated with expressions of classroom engagement. For instance, theoretical portrayals of personal control versus learned helplessness beliefs are highly interconnected to expressions of students' engagement versus disengagement (Skinner et al., 1998) and would therefore be excellent future candidates to test whether changes in engagement affect changes in these motivations. Other motivations, such as external regulation and performance-based achievement goals, however, are less tightly connected to engagement in that they are more aligned with ends (outcomes) than with means (engagement). Therefore, these sorts of motivations would make for less attractive future candidates to test our "changes in engagement-to-changes in motivation" hypothesis.

A second possible limitation for some readers might be our decision to adopt a relatively narrow definition of engagement. We conceptualized and assessed students' engagement as a classroom-specific event, though we recognize that other researchers choose to focus more broadly on "school engagement" (Jimerson, Campos, & Greif, 2003). In addition, our study focused on a limited time frame—a single 17-week semester. This is a limitation because students and teachers alike tend to think of their courses more in terms of an academic year than they do in terms of an academic semester. Because this is the case, we encourage future research to expand the time frame to consider annual changes in students' engagement and motivation.

A final limitation was our reliance on self-report data. We assessed all three motivations and each aspect of engagement with a self-report questionnaire. We did assess student achievement with an objective measure, and it is important to note that our self-report engagement measure predicted objective course achievement (thereby supporting the predictive validity to the self-report engagement measure). Now that it has been confirmed that students' subjective engagement predicts students' subjective motivation, the next step will be to test whether the same is true for objective measures of students' engagement. We could not, however, follow our own advice and use objective measures in the present study, because valid objective measures of emotional engagement, cognitive engagement, and agentic engagement do not yet exist (though valid objective measures of students' behavioral engagement do exist). Hence, we call for future research to develop, validate, and implement objective measures of all four aspects of students' classroom engagement.

Conclusion

Our findings support the conclusion that motivation and engagement are reciprocally related. Students' initial course engagement and students' in-course changes in engagement both longitudinally predicted corresponding downstream changes in their classroom motivation. Just as it is widely embraced that high-quality student motivation is important because it facilitates student engagement, high-quality student engagement is likewise important because it facilitates student motivation.

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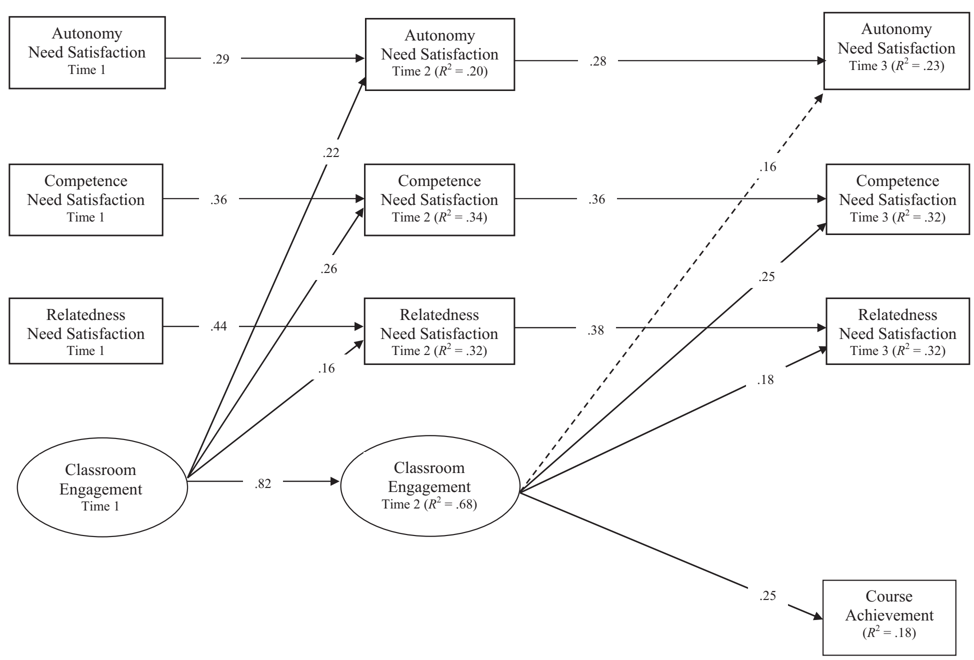
Appendix

Standardized Parameter Estimates for the Test of the Individual Psychological Needs Model



Note. Solid lines represent significant paths ($p < .05$); dashed lines represent nonsignificant paths. The numbers overlaying the lines represent standardized parameter estimates (beta coefficients) for that particular path in the structural model. To enhance the clarity of the presentation, the following statistical results are not included in the figure: the within-wave correlations among the four Time 1 exogenous variables; the within-wave correlations among the four Time 2 (T2) error terms; and the beta coefficients for each nonfocal T2 psychological need to each of the four Time 3 outcomes. Model fit: $\chi^2(404) = 621.67$, $p < .01$, root-mean-square error of approximation [90% CI] = .052 [.038, .064], standardized root-mean-square residual = .053, comparative fit index = .98, nonnormed fit index = .97.

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