Running Head: Regulation of Motivation

University Students' Use of Motivational Regulation during One Semester

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Abstract

This study examined the interplay between university students' trajectories of motivational regulation and autonomous motivation across one semester, exploring both between and within person components. Participants (N = 193) from one large class reported motivation in two-week intervals over the course of one semester. Bivariate latent curve models with structured residuals revealed rates of change in motivational regulation and autonomous motivation were not linear, declining across the first ten weeks of the semester then bouncing back in the final month. Between-person effects of individual change demonstrated mirroring relationships of latent intercepts and slopes across the semester. Within-person findings revealed that autonomous motivation was a negative predictor of future motivation regulation. Students' grade point average only predicted students' beginning level of motivational regulation. It appears that students with higher states of autonomous motivation view motivation regulation as unnecessary or even a potential threat to their learning pleasure and satisfaction.

Keywords: academic achievement, autonomous motivation, self-regulation, university students

1. Introduction

Students often experience barriers to initiating and sustaining learning motivation in their daily academic lives, such as exposure to content or instructors that fail to spark their interest, or to challenging assignments that are part of a steeper learning curve than anticipated (Järvelä, Järvenoja, & Malmberg, 2012; Kim, Brady, & Wolters, 2018; Wolters, 1998; Zimmerman & Schunk, 2008). The manner in which students address such motivational barriers can result in a very wide range of outcomes, ranging from advanced academic achievement to dropping out of school (Robbins, Oh, Le, & Button, 2009). One characteristic of high achieving students is the ability to self-regulate different aspects of their learning experiences (Pintrich, 2004; Zimmerman & Schunk, 2008). A key assumption in self-regulated learning (SRL) theoretical frameworks is that students take an active role in monitoring, planning, managing, and reflecting on their own learning experiences. Thus, students who are proficient at self-regulating their learning are better able to detect barriers when they arise and to proactively adopt strategies to minimize or overcome them. Conversely, students less proficient at self-regulating their learning often fail to detect, or address learning barriers effectively (Wolters, 2011).

SRL is especially salient for students attending colleges and universities (Cohen, 2012; Wolters, 1998). University students often face the juxtaposition of increased academic demands and responsibilities with greater freedom to make choices in and out of the classroom. Should I stay home to study or go out with my friends? Should I wake up early to go to class or sleep in? Should I pay attention to this boring lecture or read social media feeds? SRL may be especially difficult to achieve when other options appear more appealing and the learning context provides minimal external accountability. Will I really be missed if I don't attend a lecture with 300 other students? I'm sure that my friend will let me know if I missed anything important, won't he? Furthermore, university classes often place greater emphasis on independent learning outside of the classroom (Pintrich & Zusho, 2007). These contextual structures increase the stakes for university students so that misjudgments in planning, monitoring, and managing learning strategies can more easily lead to severe academic problems than ever before. Difficulties in a single class can disrupt university students' academic progress (Goudas & Boylan, 2012). Despite the emphasis placed on SRL in university settings, previous research suggests that many university students use SRL skills infrequently (Lan, 2005).

The goal of this study is to investigate university students' use of motivation regulation over the course of one semester including seven waves of data. Specifically, we investigate the joint within-and between-person interplay between students' use of motivation regulation and autonomous motivation. In the following paragraphs, we start by explaining the concept of motivation regulation and its importance in university settings. Next, we examine autonomous motivation including its potential links with motivational regulation. Finally, we outline the specific research questions that guided this study and outline how it addresses gaps in the current literature.

1.1 Motivational regulation

Examination of motivational regulation as a unique and substantive component of SRL is gaining momentum in educational research (Järvelä & Järvenoja, 2011; Kim et al., 2018; Miele & Scholer, 2018; Schwinger & Stiensmeier-Pelster, 2012; Smit, Barbander, Boekaerts, & Martens, 2017; Wolters & Hussain, 2015). Wolters (2003) defines motivational regulation as the thoughts, actions, and behaviors students use to influence their choices, effort, and persistence toward academic work. Wolters and Benzon (2013) identified six major motivational regulation strategies used by university students: Regulation of value, regulation of performance goals, self-consequating, environmental structuring, regulation of situational interest, and regulation of mastery goals. Regulation of value occurs when students engage in strategies that makes understanding course content more interesting, useful, and important. For example, students focus on how course knowledge will be useful in their future careers. Regulation of performance goals occurs when students engage in strategies that emphasize the importance of achievement outcomes. For example, students focus on the benefits associated with getting high marks in the course. Self-consequating occurs when students engage in self-reinforcing strategies such as rewarding themselves with their favorite type of food after studying. Environmental structuring occurs when students' purposefully exert control over contextual factors in order to enhance motivation. For example, students find a place to study where interruptions are unlikely. Regulation of situational interest occurs when students engage in strategies that makes course content and activities more enjoyment. For example, students create different games when studying for an exam. Finally, regulation of mastery goals occurs when students engage in strategies that underscore the importance of learning as much as possible. For example, students challenge themselves to learn as much as possible about course topics.

Schwinger Steinmayr, and Spinath (2009) extended Wolters' work, identifying eight commonly used motivational regulation strategies organized into interest-based strategies and goal-based strategies. Interest-based strategies include enhancing situational interest, enhancement of personal significance, and self-consequating. Goal-based strategies include proximal goal setting, mastery self-talk, performance approach self-talk, and performance avoidance self-talk. The final motivational regulation strategy, environmental control, is the only strategy that does not fit into either goal or interest categories. Proximal goal setting and performance avoidance self-talk are the two new strategies that do not closely overlap with those proposed by Wolters and Benzon (2013). Proximal goal setting occurs when students set short-term goals to enhance motivation for long-term or complex tasks. For example, university students may set short-term goals for each exam in a course in order to accomplish the long-term task of getting a high final grade. Performance avoidance self-talk occurs when students focus their thinking on the avoidance of normative incompetence such as doing worse than fellow classmates on assignments or exams. It is important to note that Schwinger et al. (2009) developed these strategies with secondary students, not university students.

More recently, Kim et al. (2018) developed a general measure of university students' motivational regulation, called the Brief Regulation of Motivation Scale (BRoMS). The BRoMS measured students' beliefs about engagement in motivational regulation rather than the use of different strategies. Kim et al. (2018, p. 261) report that the BRoMS evaluates students' "overall tendency to respond to cued motivational challenges in a way meant to sustain or improve their motivation." The BRoMS produced sound psychometric scores for the motivational regulation factor, which consists of eight items, in a sample of approximately 400 university students. The addition of the BRoMS provides researchers with opportunities to explore a global factor of motivational regulation, rather than having to rely on a longer measure focusing on specific regulation strategies.

Similar to other types of SRL (Pintrich, 2000; Zimmerman, 2000), adaptive motivational regulation implementation requires basic elements including meta-motivational knowledge, self-monitoring of motivational states, and managing motivational regulation strategies (Wolters, 2011). First, students must possess knowledge about their own academic motivation including the topics, types of learning activities, and classroom interactions they find interesting, boring, or frustrating. Students must also consciously explore various strategies to use under different motivational conditions (e.g., if these math problems are boring, I should try to make a game out of solving them). Second, students must consistently monitor their current states of motivation. Developing self-awareness about motivational states through monitoring helps students become more responsive to dealing with periods of low motivation when effort, persistence, and engagement are likely to suffer. Finally, students must put their meta-motivational knowledge into action by implementing and managing their use of motivational regulation strategies successfully.

1.2 Autonomous motivation

Wolters (2003) suggests that motivation regulation is closely related but distinct from students' motivation. Specifically, he delineates the contrast between active and subjective control. With motivation regulation, students actively monitor and manipulate the energy and direction underlying behavior whereas motivation is a more subtle process that drives the energy and direction of behavior through perceptions and beliefs. From a self-determination theory perspective, Deci and Ryan (2000) theorize that the underlying reasons of behavior creates a continuum of motivation. This perceived locus of causality ranges from reasons that are completely intrinsic (e.g., pursuing one's interest) to completely extrinsic (e.g., avoiding punishment) in nature (Sheldon, Osin, Gordeeva, Suchkov, & Sychev, 2017). Intrinsic motivation is the healthiest type of motivation and occurs when individuals feel fully autonomous in their actions. In essence, behavioral engagement in and of itself represents the reward that stimulates behavior. For example, a student studies because she finds course content interesting. However, self-determination can still occur through extrinsic regulation when the underlying reasons for behavior are internalized as important and valuable to one's goal pursuits. Deci and Ryan (2000) describe this type of motivation as identified regulation. For example, a student studies because she believes that learning course content will help her achieve future professional goals.

Autonomous motivation is the combination of intrinsic and identified regulation, representing actions powered by an internal locus of causality (Sheldon & Elliot, 1999). In other words, autonomous motivation reflects one's self-determination to engage in behavior. There is extensive evidence that across all levels of education, students' autonomous motivation helps explain adaptive behavioral, cognitive, and affective academic outcomes (Ryan & Deci, 2017). For example, previous longitudinal studies underscore how autonomous forms of motivation predict course grades (Burton et al., 2006) and grade point average (Baker, 2003) while controlling for university students' previous levels of achievement. Guay, Ratelle, Roy, and Litalien (2010) also found that autonomous motivation predicted future academic achievement after controlling for previous achievement in secondary students. These studies have generally revealed a small positive effect with some heterogeneity according to a meta-analysis study (Taylor et al., 2014).

Researchers have also explored relations between autonomous motivation and different aspects of SRL. For example, studies have investigated relationships between autonomous motivation and self-control (Converse, Juarez, & Hennecke, 2019) as well as goal pursuits (Sheldon & Elliot, 1999). Converse et al.

(2019) conclusions from six studies suggest that individuals with higher levels of self-control were more likely to experience autonomous motivation across a variety of contexts including university educational settings. In sports settings, Jordalen, Lemyre, Durand-Bush, and Ivaarsson (2020) demonstrated cross-lagged relationships between intrinsic motivation and trait self-control over time in elite university athletes, with the link between trait self-control to future autonomous motivation being more robust. Self-control appears to have conceptual similarities to motivation regulation because it relies on active control in the face of challenges, temptation, or fatigue (Baumeister, Vohs, & Tice, 2007).

1.3 Potential Links between Motivational Regulation and Autonomous Motivation

Reeve, Ryan, Deci, and Jang (2008) report that self-determination theory helps explain why students regulate different types of behavior whereas most self-regulation theories help explain how students regulate different types of behavior. Wolters (2003) provides a similar perspective, theorizing that motivational regulation guides students' adaption of motivation. Thus, it seems plausible that motivational regulation strategies represent students' attempts to exert control over their self-determination, especially when faced with academic challenges that may undermine it. Reeve et al (2018) hypothesize that students with insufficient levels of autonomous motivation are unlikely to engage in SRL skills consistently or effectively.

No studies that we are aware of have directly examined the interplay of motivational regulation and autonomous motivation. Studies to date explore connections between university students' motivational regulation and motivation constructs such as achievement goals, effort regulation, self-efficacy, and subjective value (Kim et al., 2018; Schwinger & Otterpohl, 2017; Wolters & Benzon, 2013). Some of these studies investigate how global motivational regulation relates to motivation constructs (e.g., Kim et al., 2018; Schwinger & Stienmeier-Pelster, 2012) while other studies examine how each motivational regulation strategy relates to motivation constructs (Schwinger & Otterpohl, 2017; Wolters 1999; Wolters & Benzon, 2013) in both secondary and university students. Findings from studies focusing on global motivational regulation highlight consistent positive, small-to-moderate relations between motivational regulation and effort regulation in secondary students (Schwinger & Stienmeier-Pelster, 2012) as well as mastery goals (Kim et al., 2018), and self-efficacy (Kim et al., 2018) in university students. Interestingly, Kim et al. (2018) revealed small, negative relations with performance-avoidance achievement goals and no correlation with performance approach goals, which are extrinsic-oriented aspects of motivation (Elliot, 1999; Ryan & Deci, 2017).

These findings reflect similarities with motivational regulation studies that examine each strategy with motivation constructs. Specifically, regulation of mastery goals is the motivation regulation strategy most closely related to intrinsic-oriented aspects of motivation such as effort regulation while regulation of performance goals relates to extrinsic-oriented motivation constructs such as performance goal pursuit in both secondary and university students (Schwinger & Otterpohl, 2017; Wolters, 1999; Wolters & Benzon, 2013). However, Schwinger and his colleagues argue that there are many advantages to examining global motivational regulation including providing an authentic, big picture perspective on how students regulate motivation and minimizing potential multicollinearity issues due to strong correlations among the strategies. Global motivation regulation includes diverse intrinsic- and extrinsic-oriented strategies students use to control their motivation. Similarly, autonomous motivation is also a composite of intrinsic and extrinsic forms of motivation (Sheldon et al., 2017). Thus, there appear to be meaningful underlying processes that connect motivational regulation and autonomous motivation.

While there seems to be consensus that motivational regulation and autonomous motivation are related, many questions remain unclarified. It is important to note that a majority of the studies noted above focusing on motivational regulation and motivation rely on cross-sectional research designs (e.g., Kim et al., 2018; Wolters, 1999; Wolters & Benzon, 2013) while longitudinal studies only test the motivational regulation to motivation temporal pathway (Schwinger & Otterpohl, 2017; Schwinger & Stienmeier-Pelster, 2012). Reeve et al. (2008) suggest autonomous motivation may be a key antecedent to self-regulation skills. Thus, there is a clear need to gather evidence on the autonomous motivation – motivation sequence because arguments to date remain theoretical in nature. Gaining better understanding of this sequence can provide guidance for future educational interventions that address multiple aspects of student motivation.

In the present study, we examine the links between motivation regulation and autonomous motivation from an intra-individual process perspective (Hamaker, 2012; Schmitz, 2006). Specifically, our investigation addresses how motivation regulation and autonomous motivation unfold within students over time rather than associations between motivation regulation and autonomous motivation occurring across students (Hamaker, 2012). In doing so, we explore the interplay of trait-like (i.e., one's usual level of motivation) and state-like (i.e., one's momentary deviation from the usual level of motivation) aspects of motivation regulation and autonomous motivation. This intra-individual process perspective assumes that learning phenomena such as motivation (Heemskerk, & Malmberg, 2020; Malmberg & Martin, 2019), interest (Fastrich & Murayama, 2020), and self-regulation (Schmitz & Wiese, 2006) are dynamic rather than static in nature, with students consistently experiencing variations in these phenomena based on various situational factors. This intra-individual process perspective places emphasis on understanding developmental sequences by repeatedly measuring states over short intervals (Schmitz, 2006). Thus, this approach is well suited to explore the temporal sequencing of autonomous motivation and motivation regulation as it plays out for university students over the course of one semester.

For example, Patall et al. (2018) used intra-individual process analysis and noted that secondary students' autonomous motivation toward a science class tended to vary on a daily basis based on whether or not students believed that their teacher provided them with meaningful choices in the class. Similarly, Fastrich and Murayama (2020) used intra-individual process analysis to investigate the interplay between situational interest and knowledge acquisition when learning about a novel topic. Specifically, they demonstrated reciprocal nonlinear sequences whereby interest and knowledge acquisition reinforced one another during the early stages of learning. These are just two examples of how taking an intra-individual process approach can help illuminate developmental aspects of learning phenomena. Because research focusing on motivation regulation relies extensively on learning how it relates to students in the aggregate, applying a process-oriented perspective can add additional understanding to its dynamic characteristics within students (Hamaker, 2012).

1.4 The present study

Associations between motivational regulation strategies, antecedents and outcomes have started to emerge in the research literature on academic motivation. However, this emerging area of research remains in its early stages, with rigorous longitudinal investigations just beginning. In this study, we address substantive gaps in this area of research, aiming to advance understanding of the interplay between university students' motivational regulation and autonomous motivation. We use the bivariate latent curve model with structured residuals to disentangle the interplay between students' trait-like (i.e., between person) and state-like (within person) motivational regulation and autonomous motivation rates of change (Curran, Howard, Bainter, Lane, & McGinley, 2014). Examining whether students with higher reports of autonomous motivation also report higher levels of motivation regulation over time highlights trait-like interplay while examining whether higher levels of autonomous motivation relative to one's trait like level at a specific time point predicts higher reports of motivation regulation relative to the individual at a subsequent time point highlights state-like interplay. While the between person effects provide important information on how autonomous motivation and motivation regulation develop over time, within person effects underscore the possible existence of clear temporal sequencing including potential reciprocal effects between autonomous motivation and motivation regulation (Curran et al., 2014).

Relations between students' motivation and motivational regulation has often been examined as a snapshot in time, whereas the present study was specifically designed to examine their interplay over time. Indeed, previous studies have generally examined effort regulation as an indicator of student motivation (Schwinger et al., 2009). Adopting this perspective, we hypothesize close links between students' autonomous motivation and their use of motivational regulation strategies. Specifically, we posit that self-determined students should have greater awareness of their changing motivational states and willingness to address motivational barriers as they occur (Wolters, 2013; Wolters & Rosenthal, 2000). Although highly motivated university students may need to rely on motivational regulation strategies less frequently (Wolters & Benzon, 2013), research using effort regulation as a proxy for motivation suggests a positive, linear relationship between these two constructs (Schwinger & Otterpohl, 2017). Interestingly, autonomous motivation (Black & Deci, 2000), just like motivational regulation (Schwinger et al., 2009; Wolters & Benzon, 2013), incorporate intrinsic and extrinsic (i.e., identified regulation) components. During a given semester, university students are likely to rely on both types of motivation within a given course. For example, different topics provide students with different levels of interest and challenge.

Finally, theorists typically position academic performance as a distal outcome of motivational regulation, occurring via students' effort regulation (Schwinger et al., 2009; Schwinger & Stiensmeier-Pelster, 2012) or procrastination (Grunschel et al., 2016). In the present study, however, our main goal is to examine how university students' autonomous motivation and use of motivational regulation relate across time. In this context, we consider students' grade point average (GPA) at the beginning of the semester as a fixed predictor of their trajectories of motivational regulation and autonomous motivation over the course of the semester. We also explore the role of students' sex and first generation status as fixed predictors of motivational regulation.

In sum, the purpose of this study was to investigate the joint within- and between-person interplay between students' use of motivation regulation and autonomous motivation. We address the following research questions (RQ):

RQ1: How do students' autonomous motivation and use of motivational regulation toward a specific class evolve over the course of one University semester?

RQ2: To what extent does students' trait-like autonomous motivation and motivational regulation trajectories covary over the course of the semester?

RQ3: What are the temporal relationships in students' state-like autonomous motivation and motivational regulation?

RQ4: To what extent does students' demographic characteristics and GPA at the beginning of the semester predict students' motivational regulation and autonomous motivation trajectories?

2. Method

2.1 Participants and procedures

All participants (N = 193) were kinesiology majors enrolled in an upper-level mandatory course at a large university in the Southeastern United States. The average age of the participants was 20.71 (SD = 2.40) and the sample consisted of more females (70%) than males (30%). Students reported their grade classification as 2nd year (21%), 3rd year (51%), or 4th year (28%). The majority of students reported their race/ethnicity as White (72%) or Black (17%). Approximately 15% of the sample reported coming from a family whereby they were the first generation to attend university.

The Institutional Review Board of the primary researcher's University approved the study protocol. The course instructor granted permission to conduct the study. In the second week of the spring 2019 semester after the drop deadline had passed, the primary researcher visited the kinesiology class and explained the study protocol to the students. Each student in the class received an email later in the day with a link to an online survey. Students had 72-hours to complete the survey. In the first step, students provided informed consent to participate in the study. Next, students completed all study measures. Following this first wave of data collection, students received a link to the online survey every two-weeks throughout the rest of the semester. This resulted in seven waves of data collection. Similar to the first wave, the link at each wave was live for a 72-hour window. Students received one bonus point for each survey they completed. Less than five percent of the class completely declined to participate in the study.

2.2 Measures

We measured motivation regulation with the relevant subscale from the Brief Regulation of Motivation Scale (BRoMS; Kim et al., 2018). This subscale consists of eight items that focus on university students' tendency to respond to motivational barriers in ways that support their motivation. Students received a stem asking them to think about the specific class associated with their participation in this study when answering each item. Example items included "I use different tricks to keep myself working, even if I don't feel like studying" and "If what I am studying seems unimportant, I can still convince myself to stick with it". Each item was answered on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

Students needed a minimum of 2.50 grade point average (GPA) on a 4.3 scale to enroll in the course. Students reported their GPA at the beginning of the semester (T1) by answering the following question: Please mark the category that best represents your current overall GPA: (1) = 2.50–2.99; (2) = 3.00–3.49; (3) = 3.50–3.99; and (4) = 4.00 or above. We obtained official GPA data from a randomly selected subsample ($n = 36$) of students to test concurrent validity. Findings revealed a strong, positive correlation between official GPA and self-reported grades, $r = .91$. [1]

Four items were adapted from the Academic Motivation Scale (Vallerand et al., 1992) to measure students' autonomous motivation toward the class. Two items focused on intrinsic motivation ("Because I think this it is interesting"; "Because I think it is fun") and two items on identified regulation ("Because I think it benefits me"; "Because I think it is important"). Items were measured on a seven-point Likert scale ranging from (1) strongly disagree to (7) strongly agree.

2.3 Data analysis

Analyses were conducted in the Mplus 7.4 statistical package (Muthén & Muthén, 2017) using robust maximum likelihood estimation procedures. Full information maximum likelihood procedures were used to handle missing data based on missing at random assumptions (i.e., allowing missing values to be conditioned on all variables included in the analyses (Enders, 2010). Criteria for judging model fit (Hu & Bentler, 1999) included the robust chi-square ($R\chi^2$) and its degrees of freedom (df), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) ($\geq .95$ = good fit; $\geq .90$= acceptable fit), and the root mean square error of approximation (RMSEA) with its 90% confidence intervals ($\leq .06$ = good fit; $\leq .08$ = acceptable fit).

Latent curve models with structured residuals (LCM-SR) were used to address research questions that guided this study (Curran et al., 2014). We started by testing univariate unconditional LCMs to determine the appropriate trajectory shape of students' motivation regulation and autonomous motivation during the semester (Grimm, Ram, & Estabrook, 2017). This included (a) an intercept only trajectory model highlighting no growth; (b) a linear trajectory model reflecting linear growth over time; (c) a quadratic trajectory model reflecting curvilinear growth over time; and (d) a latent basis trajectory model whereby the shape of the growth trajectory is estimated from the data. No slope was included in the intercept only model. The time scale for the linear slope in the linear and quadratic models was 0, 1, 2, 3 … 6 across the seven waves of data. In the quadratic model, a quadratic slope defined using a squared time scale (i.e., 0, 1, 4, 9 … 36) was added to the linear slope. Finally, in the latent basis model, the slope was scaled as 0 at T1 and 1 at T7 while T2 – T6 were freely estimated.

After determining the appropriate trajectory shape of students' motivation regulation and autonomous motivation, we added SR parameterization to each univariate LCM. This included regressing each time specific residual on its previous time (e.g., T2 residual regressed on T1 residual; T3 residual regression on T2 residual; etc.). In simple terms, we tested autoregressive relations between time adjacent residuals for the motivation regulation and autonomous motivation univariate LCM. Per recommendations from Curran et al. (2014), an equality constraint was placed on these autoregressive relations forcing them to be equal across time. We compared model fit between each univariate LCM with and without SR. Next, we combined the univariate unconditional LCM-SRs into a bivariate unconditional LCM-SR, referred to as a parallel process model by Curran et al. (2014). In this case, the parallel process model provided evidence of relations between latent intercepts and latent slopes of students' motivation regulation and autonomous motivation. We also added additional SR parameterization that included both autoregressive and cross-lagged regressions of time adjacent residuals for the motivation regulation and autonomous motivation (Curran et al., 2014). Equality constraints were used with the autoregressive and cross-lagged pattern of SR relations. Finally, we tested a final bivariate LCM-SR that added students GPA, sex (female = 1; male = 0), and first generation status (1 = first generation; 0 = other) as time invariant antecedents of motivation regulation and autonomous motivation.

3. Results

Students completed 1,114 observations across the seven waves of data collection. The average number of waves completed by each student was 5.77 (*SD* = 1.56) with 88 completing all seven waves, 42 completing six waves, 30 completing five waves, 14 completing four waves, 8 completing three waves, 5 completing two waves, and 6 completing one wave. T1 included the highest number of participants for any given wave (*n*= 170) while T4 and T7 included the lowest (*n* = 150). Correlations, descriptive statistics, and coefficient alpha estimates of scale score reliability for all seven waves of data collection are all reported in the Appendix. Students reported their highest levels of motivation regulation at T1 in mid-January and lowest levels at T5 in mid-March. Autonomous motivation followed a similar pattern, with high and low levels occurring at T1 and T5 respectively. Coefficient alpha estimates for motivation regulation and autonomous motivation were above .70, except T1 autonomous motivation (.68).

Findings from the unconditional latent curve models used to represent motivation regulation and autonomous motivation trajectories are reported in the top section of Table 1. These supported the superiority of the quadratic model for both motivation regulation and autonomous motivation, resulting in a better fit to the data relative to all other models, and in the estimation of a statistically significant quadratic slope. These results led us to retain a quadratic parameterization. The addition of structured residuals enhanced model fit for both quadratic models. Table 2 displays parameter estimates from the quadratic motivation regulation and autonomous motivation latent curve models. At the first time point, the average level motivation regulation was 3.55 on a five-point scale, and revealed the presence of substantial inter-individual heterogeneity around this mean-level (as illustrated by a statistically significant variance of .147, corresponding to .383 SD). The linear and quadratic slopes were also both statistically significant, revealing a decline in motivation regulation across the first three months of the semester (T1-T5) followed by an increasing trajectory in the final month (T5-T7). Figure 1 provides a visual representation of these trajectories. The fact that the linear and quadratic slope variances were non-statistically significant suggested inter-individual homogeneity in the shape of these trajectories, whereby the “gradual decrease bouncing back in the last month” trajectory reflected a normative tendency. The correlation between the intercept and the slopes were not statistically significant, suggesting that initial levels of motivation regulation was unrelated to trajectory shape. The average autoregressive relationship between motivation regulation at T -1 predict T was .106 ($p < .01$).

For autonomous motivation, the average level at the first time point was 4.81 on a seven-point scale with substantive inter-individual heterogeneity. A similar pattern to motivation regulation emerged for autonomous motivation with declines occurring from T1 to T5 with a bounce back in the final month of the semester (T5-T7). The variance component of the linear and quadratic slopes were also statistically non-significant revealing a normative tendency in the sample. Correlation estimates among the intercept and slopes were not statistically significant suggesting the initial level of autonomous motivation did not related to declines or bounce back and that the amount of decline of autonomous motivation did not relate to the amount of bounce back at the end of the semester. Time specific within person autonomous motivation (i.e., structured residuals) predicted time adjacent autonomous motivation, .083 ($p < .05$).

The bivariate latent growth model with structured residuals produced a good fitting model (see bottom of Table 1). Associations between motivation regulation and autonomous motivation intercept and slope parameters are provided in Table 3. There was a positive relation between initial levels of motivation regulation and autonomous motivation (i.e., intercepts). Declines in motivation regulation were positively related to declines in autonomous motivation (i.e., linear slope) and negatively related to students’ autonomous motivation “bounce back” (quadratic slope). Similarly, students’ motivation regulation bounce back was negatively related to declines in autonomous motivation and positively related to autonomous motivation bounce back. In simple terms, motivation regulation and autonomous motivation intercepts and slopes appeared to mirror each other. Table 4 highlights motivation regulation and autonomous motivation autoregressive and cross-lagged structured residuals. Findings yielded positive autoregressive beta coefficients for motivation regulation and autonomous motivation as expected (see Table 4). Cross-lagged beta coefficients revealed time specific within person autonomous motivation was a negative predictor of future time specific motivation regulation controlling for previous motivation regulation. Time specific motivation regulation did not predict future time specific autonomous motivation while controlling for previous autonomous motivation.

The final model, which added first generation status, sex, and GPA as time invariant predictors of motivation regulation and autonomous motivation intercept and slope parameters generated a good model fit (see bottom of Table 1). Table 4 presents all unstandardized beta coefficients in the final model. First generation status was not a predictor for any LCM parameters. On average females experienced a larger decline in autonomous motivation, but had a higher bounce back at the end of the semester compared to males. Finally, students with higher GPAs were more likely to report higher levels of motivation regulation at the beginning of the semester. Students' GPA was a negative predictor of autonomous motivation bounce back at the end of the semester. Mplus code for our LCM-SR analyses is provided in the supplemental materials.

4. Discussion

The purpose of this study was to investigate the joint within- and between-person interplay between university students' use of motivation regulation and autonomous motivation toward one class over the course of one semester. Specifically, we used seven waves of data to explore both trait-like and state-like relations to gain better understanding about change processes between these aspects of motivation. In the following paragraphs, we unpack findings that provide unique insights into how university students' autonomous motivation and motivational regulation evolve and relate over time. Interestingly, previous theoretical arguments about motivation and SRL relations generally match our findings for trait-like but not state-like effects (Reeve et al., 20078; Schwinger & Otterpohl, 2017; Zimmerman, 2000). Results from this study provide new insights about how to enhance educational interventions targeting university students' motivation.

RQ1 addressed how students' motivational regulation and autonomous motivation in one course evolved across the semester. In this sample, student trajectories of autonomous motivation and motivation regulation displayed similar patterns. Students' initial levels of autonomous motivation and motivational regulation at the beginning of the semester were generally high but also displayed substantial inter-individual heterogeneity. Rates of change for both aspects of motivation followed a normative curvilinear trajectory (i.e., shared by most students). This curvilinear trajectory indicated an initial decline in autonomous motivation and the use of motivation regulation over the first 10 weeks of the semester, which then bounced back up near the end of the semester. Previous research has often focused on university students' autonomous motivation in their first year. For example Corpus, Robinson, & Wormington, 2020 reported declines in university students' identified regulation during students' first year of college whereas intrinsic motivation demonstrated a general decline in the fall semester with a slight uptick in the spring semester (Corpus, Robinson, & Wormington, 2020). Brahm, Janert, and Wagner (2017) found similar first semester declines with second semester bounce back in their study of Swiss students attending a business school. Our findings suggest that examining changes in university students' autonomous motivation may need to occur more frequently to obtain a nuanced picture of its short-term fluctuations.

Previous studies of motivational regulation have predominately explored both secondary and university students' use of different types of strategies at a single point in time (Schwinger et al., 2009; Smit et al., 2017; Wolters, 1999; Wolter & Benzon, 2013). According to Wolters (2003, p. 201), "The developmental progress of the regulation of motivation, however, has not been mapped out to any great extent", which remains true more than 15 years later. In creating the BRoMS, Kim et al. (2018) addressed the importance of creating a short, contextually sensitive measure of motivational regulation, which lends itself to examining university students' motivational regulation over time. Our study addresses one aspect of this development issue by examining short-term changes in students' motivational regulation during one semester.

Wolters (2003) suggested that self-regulated learners come equipped with an arsenal of cognitive strategies that can be capitalized upon under different academic circumstances. In terms of motivational regulation, our findings revealed extensive variability at the beginning of the semester. Previous research suggests that variability in students' SRL skills can start as early as middle school (Ahmed, van der Werf, Kuyper, & Minnaert, 2013). The general structure of universities, however, assumes that students' SRL skills already function at a high level (Cohen, 2012; Pintrich & Zusho, 2007). University students must navigate a myriad of academic tasks related to planning, organizing, monitoring, and managing their work in a highly independent manner. Although our finding support that, on the average, students seem to possess these skills to a relatively high level, the presence of a high level of heterogeneity around this average tendency suggests that many students located at the lower end of this spectrum would likely benefit from structural support related to motivational regulation. This support could range from one-on-one counseling sessions with academic advisors to group seminars or classes that teach university students how to implement SRL skills including motivational regulation effectively. Exploring virtual options in future research would also be beneficial.

We consider it important for readers to contextualize our results. Specifically, students were mostly White, female juniors and seniors in a mandatory, upper-level course in Kinesiology at a research- intensive university. The class size was large, encompassing around 200 students. We were not able to track the specific content areas at each wave of data collection. Specific content or academic tasks may produce differing demands on students' autonomous motivation and use of motivational regulation based on factors such as level of interest, task difficulty, and type of instruction (Wolters, 1998, 2011). We recommend examining autonomous motivation, motivational regulation in conjunction with specific course content and academic tasks in future research, while explicitly taking into account the possibility for trajectories to be nonlinear.

RQ2 examined the interplay of students' trait-like changes of autonomous motivation and motivational regulation during the semester. Specifically, covariances between latent intercepts and slopes provided important information on connections between autonomous motivation and motivational regulation characteristics (see Table 3). These findings revealed similarities regarding how these individual level characteristics appeared to work in concert with one another across the semester. At the beginning of the semester, students with higher levels of autonomous motivation also report greater use of motivational regulation. Decline and bounce back rates of change across the semester paralleled one another. Steeper declines of autonomous motivation and motivational regulation appeared to inhibit bounce back effects for motivational regulation and autonomous motivation, respectively. It is important to note that beginning levels of autonomous motivation and motivational regulation was not related to rates of change in motivation regulation and autonomous motivation. The mirroring of both levels and rates of change in the trait-like characteristics of autonomous motivation and motivational regulation reflect theorizing about the close connections between motivation and SRL (Reeve et al., 2008; Wolters, 1999; Zimmerman, 2000). This suggests that educational intervention would likely benefit from implementing strategies that target both the "why" and "how" aspects of trait-level motivation (Reeve et al., 2008). Specifically, incorporating strategies that support students' needs for autonomy, competence, and relatedness (Deci & Ryan, 2000) as well as mastery goal orientation (Kim et al., 2018) would enhance both autonomous motivation and motivational regulation.

It is important to note that evidence regarding RQ2 did not clearly disentangle the temporal sequence of autonomous motivation and motivational regulation. The SR within effects associated with RQ3 was better suited to establish temporal links between these two aspects of motivation (Curran et al., 2014). To reiterate, SR represent a time-specific variation from an individual's normal characteristic. Thus, the within effect tested in our model reflected how well a time-specific variation in autonomous motivation relative to normal levels of autonomous motivation predicted the subsequent time-specific variation in motivational regulation relative to normal levels (and vice versa). The parameterization represents a panel model of within person effects. Interestingly, our findings pertaining to RQ3 contrasted the trait-like relations associated with RQ2. As expected, autoregressive relationships for the within effects of autonomous motivation and motivational regulation were present (i.e., time-specific increases in autonomous motivation/motivational regulation led to subsequent time-specific increases relative to the individual. However, cross-lagged within person effects revealed that time-specific increases in autonomous motivation led to subsequent time-specific decreases in motivational regulation controlling for the previous variation in motivational regulation. There was no within person cross-lagged effect for motivational regulation on autonomous motivation.

There are important implications associated with RQ3. First, it appears that the temporal sequencing of the state-like interplay of autonomous motivation and motivational regulation reflects theorizing by Reeve et al. (2008) that autonomous motivation is a foundational antecedent for SRL skills such as motivational regulation. However, diverging from Reeve and colleagues self-determination theory perspective, this relationship was negative rather than positive. Thus, students who experience increased "state-like" variations of autonomous motivation appear to pull back the reins on subsequent use of motivational regulation strategies. We equate this to arguments made by Wolters (2003) and Wolters and Benzon (2013) who suggest that highly motivated students may have little use for implementing motivational regulation strategies. However, our findings suggest this occurs when students feel more autonomously motivated than they normally do rather than one's rank-order position in a distribution. Taken together, it appears that time-specific increases of autonomous motivation relative to normal trait-like levels limits one's need to actively control motivation. Students in higher autonomous states may be able to address challenges naturally as they arise or even view challenges as opportunities to grow and learn. Furthermore, students in higher autonomous states may view motivational regulation as a potential threat to learning pleasure and satisfaction. Differences between trait- and state- like relations are not uncommon, highlighting the need for gathering evidence on both in order to achieve a more comprehensive understanding of learning phenomenon (Hamacker, 2012).

Previous studies on autonomous motivation and motivational regulation routinely explore academic functioning variables as outcomes across different levels of education (Corpus et al., 2020; Grunschel et al., 2016; Schwinger & Stiensmeier-Pelster, 2012; Taylor et al., 2014; Wolters & Benzen, 2013). However, motivation regulation studies demonstrate an indirect relation between motivational regulation and academic performance through motivation (Schwinger et al., 2009) or procrastination (Grunschel et al., 2016). The meta-analysis conducted by Taylor et al. (2014) revealed that only intrinsic motivation was a consistent predictor of students' achievement. In this study, we took a different approach by exploring university students GPA as a predictor of trajectories of autonomous motivation and motivational regulation. Interestingly, GPA predicted students' initial levels of motivational regulation at the beginning of the semester but did not predict initial levels of autonomous motivation. Schwinger et al. (2009) reported that students with higher intelligence potentially find qualitatively better ways to implement motivational regulation. Our findings add new insights to the topic of motivational regulation and academic achievement, revealing that the quantity of motivational regulation at the beginning of the semester was greater for students with higher GPAs. It is also important to note that higher GPAs did not equate to higher levels of autonomous motivation. Students often view grades as controlling in nature so this non-relationship was not completely surprising (Butler & Nisan, 1986).

Finally, results pertaining to RQ4 found that first generation status had no effect on students' trajectories of autonomous motivation or motivational regulation suggesting that this subgroup of students in the sample were similar to their peers. Females experienced a steeper decline in autonomous motivation compared to males during the first three months of the semester but also experienced a stronger bounce back effect This suggests that educational interventions strategies may need to provide more effective and consistent motivational support for female students starting at the beginning of the semester. Again, we suggest implementing supports for autonomy, competence, and relatedness as outlined by Reeve et al. (2008) which includes strategies such as actively obtaining student feedback, connecting content to meaningful, real-world contexts, holding realistic expectations for student success, and promoting positive interpersonal interactions between instructors and students.

4.1 Limitations and future research

This study is not without limitations. First, by using a general measure of autonomous motivation and motivational regulation, we were not able to discern differences between intrinsic motivation and identified regulation or the different strategies students used or how these strategies changed across the semester. Future studies should examine how the use of different motivational strategies change across time, and the subsequent implications on student achievement. Furthermore, examining how trajectories are affected as a function of different levels of GPA would also provide insightful information on the role of achievement on different aspects of motivation. Second, we examined changes in autonomous motivation and motivational regulation toward one class during one semester. Future research would benefit from exploring how university students from diverse backgrounds use motivational regulation across a wide variety of courses and longer intervals of time. For example, examining students' autonomous motivation and use of motivational regulation across their entire university career or during the transition from high school to university are important next steps in understanding its development (Wolters, 2003). Our results were not able to establish causal ordering between students' autonomous motivation and motivational regulation. Although research to date suggests that motivational regulation represents an antecedent of motivation (Schwinger et al., 2009), future researchers should examine the potential reciprocal effects between the two. Along the same lines, rigorous longitudinal mediation models (Cole & Maxwell, 2002) should help establish relations among motivational regulation, motivation, and academic performance in future research. Motivation regulation strategies are also well suited for intervention. Future research should tailor interventions to specific university student groups such as low achievers, testing their efficacy on meaningful academic outcomes such as increasing GPA, class attendance, and retention.

5. Conclusion

In summary, this study addressed important gaps in the literature concerning the interplay between university students' autonomous motivation and motivational regulation over the course of one semester. This is the first study, that we are aware of to simultaneously examine why (i.e., autonomous motivation) and how (i.e., motivational regulation) motivation processes evolve over short periods of time (Reeve et al., 2008). Our findings revealed that while trait-like between-person relationships between autonomous motivation and motivational regulation supported previous theorizing of mutually beneficial connections (Reeve et al., 2008; Schwinger & Otterpohl, 2017), temporal sequencing of within-person effects produced distinctly different results. Specifically, there was a clear autonomous motivation to motivational regulation sequence highlighting a negative relationship suggesting that when students feel time-specific increases in autonomous motivation relative to their normal levels, reports of subsequent motivational regulation decreased. In essence, higher states of autonomous motivation appeared to reduce the need to implement motivational regulation strategies compared to normal use. This suggests that motivational regulation may be less valued when experiencing higher levels of motivation compared to normal.

The application of these findings have potential to enhance educational practice. For example, university students appear to reduce their subjective and active motivational control as the first few months of the semester unfolds. This may be especially problematic for students with lower GPAs because they start out the semester less likely to use motivational regulation strategies. Thus, university professors, instructors, and academic support professionals should create structures that address both autonomous motivation and motivational regulation early on in the semester and keep them in place past the mid-term. It is currently unclear what structures would work best, but we posit strategies such as using diverse instructional styles (Wolters, 2011), supporting student autonomy (Reeve et al., 2008), scaffolding new knowledge to previous learning and connecting content to real-world competencies (Wolters, 2003). Other strategies might include emphasizing effort and task mastery and helping students create proximal goals (Schwinger & Otterpohl, 2017) as well as implementing learning and engagement measures such as the use of quizzes and in-class question and answers sessions with clickers consistently throughout the semester.

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Footnote.

[1] We also obtained students' final exam score from the course instructor. Bivariate correlations with motivational regulation at each time point, r = |.004, to .159| were non-significant. Adding students' final exam score as an outcome prevented our conditional growth model from converging. Therefore, this variables was excluded.

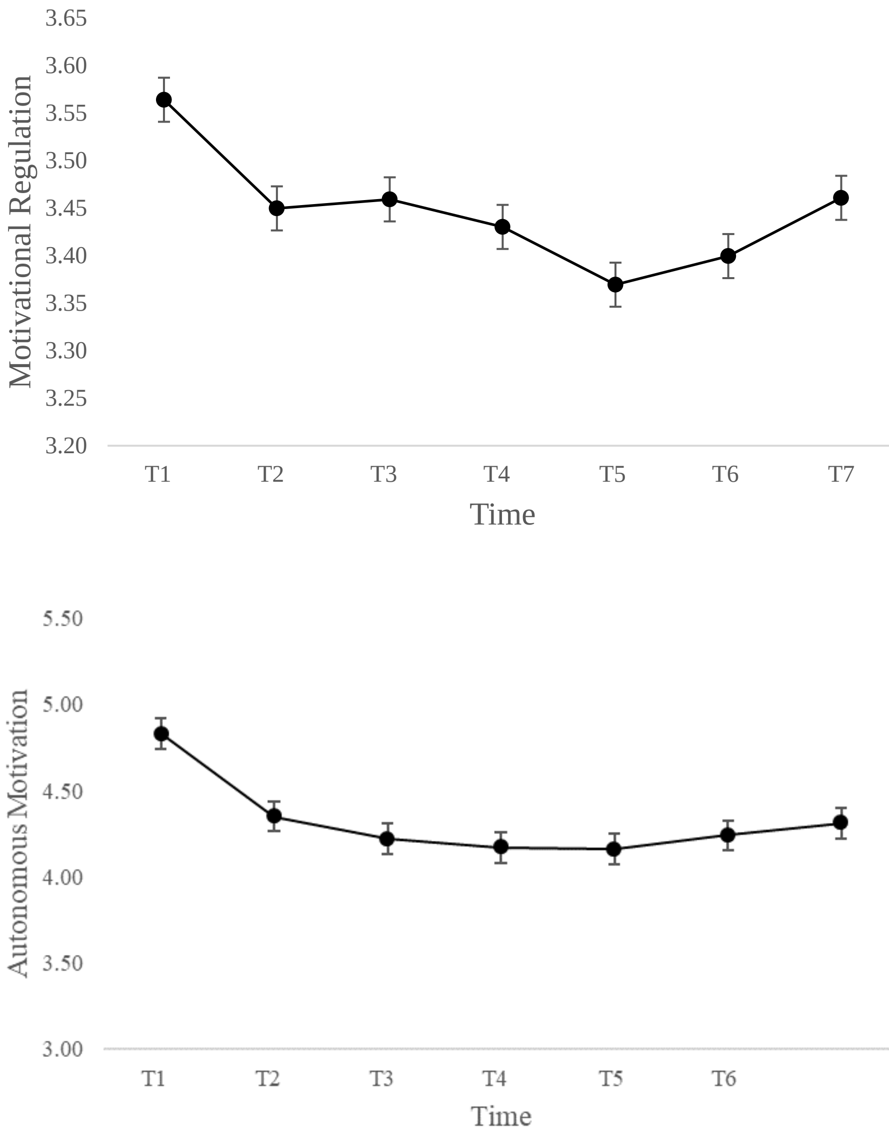

Figure 1. Visual representation of students' use of motivational regulation and autonomous motivation across the semester. Interval between time points is two-weeks. T1 = second week of the semester.

Table 1

Model Fit Statistics for Latent Curve Models

Model	Rχ²	df	CFI	TLI	RMSEA	90% CI
Intercept-Only						
Motivation Regulation	72.411**	26	0.893	0.914	0.096	[.070; .123]
Autonomous Motivation	89.808**	20	0.874	0.868	0.134	[.107, .163]
Linear						
Motivation Regulation	32.838**	23	0.977	0.979	0.047	[.000; .081]
Autonomous Motivation	105.884**	23	0.851	0.864	0.137	[.111, .164]
Quadratic						
Motivation Regulation	15.411	19	1.000	1.000	0.001	[.000; .050]
Motivation Regulation SR	13.567	18	1.000	1.000	0.001	[.001, .046]
Autonomous Motivation	30.295*	19	0.980	0.978	0.055	[.005, .091]
Autonomous Motivation SR	29.788*	18	0.979	0.975	0.058	[.013, .094]
Latent Basis						
Motivation Regulation	21.593	18	0.992	0.99	0.032	[.000; .075]
Autonomous Motivation	30.816*	18	0.977	0.973	0.061	[.019, .096]
Bivariate Quadratic with SR	95.157*	72	0.982	0.977	0.041	[.011, .062]
Final Model	129.264*	96	0.976	0.967	0.044	[.021, .062]

Note. * $p < .05$. SR = structured residuals; Rχ² = robust chi-square; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = root mean square error of approximation; CI = confidence interval.

Table 2

Motivational Regulation and Autonomous Motivation Parameter Estimates

Parameter	Mean (SE)	Variance (SE)
Motivation Regulation		
Intercept	3.549 (.035)*	.147.027)*
Linear Slope	-.083 (.019)*	.011 (.010)
Quadratic Slope	.011 (.003)*	.001 (.001)
SR	.106(.020)**	.111 (.038)**
Autonomous Motivation		
Intercept	4.810 (.070)**	.641 (.113)**
Linear Slope	-.331 (.036)**	.071 (.041)
Quadratic Slope	.043(.005)**	.001 (.001)
SR	.083(.042)*	.084 (.096)

* $p < .05$; ** $p < .01$. SR = structured residual i.e. autoregressive unstandardized beta coefficients.

Table 3

Autonomous Motivation and Motivational Regulation Trajectory Parameter Associations

	MR Intercept	MR Linear	MR Quadratic	AM Intercept	AM Linear	AM Quadratic
MR Intercept	1					
MR Linear	-.003 (.017)	1				
MR Quadratic	.001 (.001)	.001 (.002)	1			
AM Intercept	.252(.053)**	-.040 (.023)	.004 (.003)	1		
AM Linear	-.008 (.022)	.046(.012)**	-.005 (.002)**	-.006 (.055)	1	
AM Quadratic	-.001 (.003)	-.006 (.002)**	.002 (.001)*	-.001 (.007)	-.005 (.005)	1

Note. * p < .05; **p < .01.

Table 4

Results from Final Model with Time-Invariant Predictors

	MR SR T b(SE)	AM SR T b(SE)	MR Intercept b(SE)	MR Linear b(SE)	MR Quadratic b(SE)	AM Intercept b(SE)	AM Linear b(SE)	AM Quadratic b(SE)
MR SR T-1	.104 (.021)**	-.016 (.035)						
AM SR T-1	-.234 (.116)*	.087 (.034)**						
First Generation			.001 (.094)	.054 (.046)	-.011 (.008)	-.014 (.176)	.094 (.095)	-.020 (.014)
Female			.053 (.077)	-.064 (.042)	.008 (.006)	.234 (.150)	-.205 (.079)*	.025 (.012)*
GPA			.105 (.037)**	-.027 (.020)	.004 (.003)	.108 (.065)	.054 (.036)	-.012 (.006)*

Note. * p < .05; **p < .01; *b* = unstandardized regression coefficient (constrained to equality over time); SE = standard error of the coefficient; β = standardized regression coefficient (despite the equal *b*, β can differ slightly over time due to variations in the variance of the predictors).

Appendix

Correlations, Descriptive Statistics, and Reliability

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	T1 GPA	1.00														
2	T1 Motivation Regulation	.21**	1.00													
3	T1 Autonomous Motivation	.10	.36**	1.00												
4	T2 Motivation Regulation	.06	.54**	.35**	1.00											
5	T2 Autonomous Motivation	.13	.40**	.66**	.41**	1.00										
6	T3 Motivation Regulation	.09	.56**	.33**	.64**	.40**	1.00									
7	T3 Autonomous Motivation	.19*	.40**	.65**	.48**	.66**	.52**	1.00								
8	T4 Motivation Regulation	.15	.55**	.26**	.68**	.40**	.74**	.50**	1.00							
9	T4 Autonomous Motivation	.18*	.44**	.60**	.52**	.67**	.39**	.76**	.61**	1.00						
10	T5 Motivation Regulation	.11	.48**	.21**	.58**	.35**	.66**	.52**	.68**	.57**	1.00					
11	T5 Autonomous Motivation	.10	.33**	.49**	.38**	.64**	.40**	.71**	.46**	.75**	.57**	1.00				
12	T6 Motivation Regulation	.00	.44**	.24**	.66**	.37**	.67**	.49**	.75**	.53**	.73**	.47**	1.00			
13	T6 Autonomous Motivation	.12	.27**	.47**	.41**	.61**	.33**	.66**	.43**	.78**	.43**	.75**	.55**	1.00		
14	T7 Motivation Regulation	.18*	.47**	.23**	.60**	.37**	.68**	.56**	.75**	.61**	.79**	.57**	.77**	.56**	1.00	
15	T7 Autonomous Motivation	.07	.36**	.52**	.41**	.62**	.43**	.69**	.51**	.77**	.52**	.78**	.53**	.82**	.59**	1.00
	Mean	2.25	3.56	4.83	3.45	4.35	3.46	4.22	3.43	4.17	3.37	4.16	3.40	4.24	3.46	4.31
	Standard Deviation	.87	.49	.85	.57	1.10	.55	1.09	.57	1.07	.62	1.08	.59	1.20	.62	1.17
	Minimum	1.00	2.25	2.00	1.00	1.25	1.75	1.50	1.00	1.00	1.75	1.00	1.50	1.00	1.88	1.00
	Maximum	4.00	5.00	7.00	4.75	6.25	5.00	6.25	5.00	7.00	5.00	7.00	5.00	7.00	5.00	7.00
	Alpha	na	.75	.68	.83	.76	.81	.75	.85	.73	.86	.72	.86	.80	.85	.78

Note. * $p < .05$; ** $p < .01$; GPA = grade-point-average (1= 2.50 to 2.99; 2 = 3.00 to 3.49; 3 = 3.50 to 3.99; 4 = 4.00+), T = time.