ORIGINAL PAPER

College Students' motivational beliefs and use of goal-oriented control strategies: Integrating two theories of motivated behavior

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Abstract

In college, students often encounter situations in which they struggle to meet their academic goals in difficult courses. We integrate the Motivational Theory of Life-Span Development and Situated Expectancy-Value Theory to investigate how motivational beliefs and experiences in a difficult course predict the use of goal engagement oriented and goal adjustment oriented control strategies that can help students stay engaged in challenging courses. We used survey data collected in two academic quarters at a public university in the U.S. ($N=231$). Students who perceived their midterm exam as more difficult than expected and students with higher course-specific subjective task values reported using more goal engagement oriented and goal adjustment oriented control strategies. Students with higher course-specific ability beliefs were less likely to use goal adjustment strategies. Results further showed that students planned to use control strategies depending on their experienced setbacks or success in exams. Findings provide important insights into how motivational orientations and course experiences relate to adaptive and goal-oriented behavior in college courses.

The first year in college requires students to adjust to a new and academically challenging environment. Compared to high school, college students are afforded more autonomy in their academic choices and activities. Simultaneously, they are required to navigate an academically challenging environment with a myriad of simultaneous tasks in demanding courses. Students likely encounter situations in which a course or exam turns out to be more difficult than expected, and in which they struggle to meet their academic goals. How do students think about these challenging situations? What strategies do they use to control and regulate their achievement-related behavior productively?

The authors of the Motivational Theory of Life-Span Development (MTD; Heckhausen et al., 2010; Heckhausen & Schulz, 1995) describe different strategies of optimizing control that reflect goal engagement or goal disengagement, both of which can be highly adaptive or maladaptive depending on available individual resources, contextual demands, and environmental settings (Haase et al., 2013; Hall, Perry, Ruthig, et al., 2006). The authors of the Situated Expectancy-Value Theory (SEVT; Eccles 1983; Eccles & Wigfield, 2020) describe expectancies of success and subjective task values (STV) as two central drivers of students' educational choices, engagement, aspirations, and goals. We build on both theoretical frameworks to investigate how course experiences, course-specific STV, and course-specific

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ability beliefs predict students' use of control strategies (i.e., goal engagement, goal adjustment, and self-protection) in a course they perceive as their most difficult course. We are particularly interested in whether students with higher STV and ability beliefs are more likely to use control strategies that help them stay committed and engaged in a challenging college course.

The Motivational Theory of Life-Span Development (MTD)

The authors of the MTD (Heckhausen et al., 2010, 2019; Heckhausen & Schulz, 1995) describe a set of strategies that can be classified into broad categories of motivational function, being either conducive to *goal engagement* or *goal adjustment and disengagement.* Grounded on the dual-process model of perceived control (Rothbaum et al., 1982), the MTD describes primary and secondary control strategies to either foster goal pursuits or adjust and disengage from goals in case of unforeseen challenges and setbacks. *Primary control strategies* refer to actions that align the environment to one's own goals and wishes and reflect goal engagement. Heckhausen et al., (2010, 2019) further distinguish between *selective primary control strategies* and *compensatory primary control strategies*. *Selective primary control strategies* serve the function of sharpening the focus of an individual's behavior, for example, by increasing invested time and effort to approach and reach a goal. *Compensatory primary control strategies* provide compensatory relief for a shortfall in effective behavioral means to reach a goal, for example, through help-seeking behaviors to compensate for currently lacking individual skills or resources. In the context of college, a student could seek help from peers, tutors, or the instructor to study for an exam in a difficult course.

Most *secondary control strategies* facilitate goal adjustment or goal disengagement. They target the internal world of the individual's goals, thoughts about failure, and causal attribution. These compensatory secondary control strategies help individuals to distance themselves from over-ambitious and draining goals, adjust goals to more realistic levels of aspiration, and make these adjustments while protecting their confidence in own abilities. In the context of college, *goal adjustment* can refer to the adjustment of grade aspirations in a course. *Self-protection strategies* include the use of self-protective causal attribution after experiences of failure. For example, if students remind themselves that their peers are struggling as well, or that it was not their fault that they were struggling in an exam (Hamm et al., 2013; Heckhausen et al., 2010).

In short, each of these control strategies can serve as highly functional approaches to either persist on the path of pursuing a given goal or to disengage or adjust a goal in situations of major unexpected setbacks and failure experiences when a previous goal is no longer attainable. It is important to note that in some situations adjusting a goal to a more realistic level is the only way an individual can keep pursuing it. So, goal disengagement and adjustment can ultimately promote primary control striving (Heckhausen et al., 2010, 2019).

Although research on control strategies and goal attainment originated in developmental and life-span psychology and is typically applied to long-term goals, it is also relevant for more short-term goal pursuits in academic settings (e.g., a good grade in a course: Bermeitinger et al., 2018; Hamm et al., 2013; Villarreal, 2006). The adaptive use of control strategies in college can promote academic achievement and success as well as help students cope with unexpected challenges and excessive ambitions in a healthy and self-protective way.

Control Strategies, Achievement, and Well-being in College

Several studies reported positive associations between the use of primary control strategies and achievement outcomes (Daniels et al., 2014; Hall, Perry, Ruthig, et al., 2006; Hamm et al., 2013): Students who apply goal engagement strategies by increasing the time and energy they invest studying have better subsequent performance outcomes, such as grades or more completed courses. In line with the theory's proposition of adaptive selective secondary control strategies, empirical research has demonstrated that under particularly challenging settings, primary control strategies are not sufficient, but should be complemented by the utilization of selective secondary control strategies. Hall et al., (2006) have shown that only the initially successful students could afford to merely rely on the use of primary control strategies to attain high academic achievement outcomes. Unsuccessful students attained better subsequent achievement outcomes when they used both primary and secondary control strategies. In sum, struggling students had better performance outcomes when they used additional strategies, such as focusing on positive outcomes of goal pursuit or attributing their failure to external and unstable factors rather than to their ability.

These findings show that control strategies are relevant drivers for students' behavior to facilitate positive learning and achievement outcomes. But they also serve a function for students' coping with challenging achievement-related situations and well-being. The use of both

primary and secondary control strategies is related to lower perceived stress and anxiety and to higher positive affect and learning-related emotions (Haase et al., 2008; Hall, Perry, Chipperfield, et al., 2006; Hall, Perry, Ruthig, et al., 2006). Particularly after experiences of failure, the use of secondary control strategies, such as using external attributions, is an effective coping mechanism (Hall, 2008; Hall, Perry, Ruthig, et al., 2006, Tomasik & Salmela-Aro, 2012). Research on control strategies in educational contexts has mainly focused on associations with subsequent academic or psycho-emotional outcomes. Less is known about potential group differences in the adaptive use of control strategies by gender or family background. Although some studies included gender and parents' educational background as control variables in their models (see, e.g., Haase et al., 2008; Hamm et al., 2013; Wrosch et al., 2003), many of them did not find differences in control strategy usage. With the exception of Hamm et al., (2013), who found that female students were less likely to use selective primary control strategies.

An important and unanswered question in research about effective control strategy use by college students is, when and under which conditions students choose primary and secondary control strategies to regulate goal pursuit in their courses. Results from longitudinal studies with college students showed that students were more likely to engage in secondary control strategies when they were struggling or had recent experiences of failure (Hall, 2008; Hall, Perry, Ruthig, et al., 2006). These findings show that the use of secondary control strategies, such as adjusting goal aspirations or using self-protective attributions, are effective coping strategies after experiencing academic setbacks.

Daniels et al., (2014), instead, investigated predictors of control strategy use from a motivational perspective. College students with mastery goal orientation were more likely to use both primary and secondary control strategies, whereas students with performance goal orientation were more likely to use only primary control strategies (Daniels et al., 2014). The authors discuss that students who primarily want to gain competence in their courses (mastery goal orientation) would use a broader range of control strategies and adjust their behaviors, goals, and attributions, in order to experience control and stay committed to their mastery goals in the course (Daniels et al., 2014).

The Situated Expectancy-Value Theory (SEVT)

Findings from Daniels et al., (2014) indicated that students' motivation could be relevant for students' control strategy use. Eccles et al.'s SEVT describes central drivers of students' aspirations, goal-directed academic behavior, and educational choices (Eccles, 1983; Eccles & Wigfield, 2020). Within this framework, students' expectancies of success and subjective task values are described as proximal drivers of achievement-related behavior and choices. *Expectancies of success* are defined as students' "beliefs about how well they will do in upcoming tasks, either in the immediate or longer-term future" (Wigfield & Eccles, 2000, p. 70). Such expectancies have often been operationalized through students' domain-specific ability self-concepts or domain-specific self-efficacy (Eccles & Wigfield, 2020; Trautwein et al., 2012; Wigfield & Eccles, 2000). *Subjective task values (STV)* are defined as the perceived value of engaging in a particular task or college course. In this case, STV derive from a student's estimates of the potential gains and losses from engaging in the course. STV derive from at least four different sources of value: attainment, intrinsic, utility, and cost value (Eccles, 1983; Eccles & Wigfield, 2020). *Attainment value* is linked to students' identities and describes the extent to which it is personally important for them to engage and succeed in the course. *Intrinsic value* refers to the enjoyment a student experiences while engaging in a course. U*tility value* describes the perceived usefulness of engaging in a course for a student's short- and long-term goals. *Cost value* refers to the extent to which a student perceives a course as costly compared to other options, in terms of stress, time and effort consumption, and lost opportunities to do other things.

The SEVT framework suggests that students with higher expectancies of success and STV for a specific course are more likely to have higher aspirations, engage and persist in achievement-related behaviors, and attain better performance outcomes than students with lower expectancies of success and STV (Eccles, 1983; Eccles & Wigfield, 2020). Empirical research over the past four decades supports these assumptions of the SEVT framework. Research from high school and college contexts has shown that students with higher ability beliefs and STV attain higher performance outcomes (Guo et al., 2015; Hulleman et al., 2008; Trautwein et al., 2012). Even more relevant in the context of the current study are findings showing that students with higher ability beliefs and STV are more persistent and put more effort into their courses and homework activities (Lazarides & Rubach, 2017; Trautwein & Lüdtke, 2007; Wu et al., 2020; Wu & Fan, 2017). Finally, empirical research has shown that ability beliefs and STV are central predictors of educational and occupational aspirations and goals. Students with higher math ability beliefs and STV take more advanced math courses in high school. They are also more likely to enroll in STEM majors at university, pursue STEM careers, and have higher aspirations to pursue higher education STEM degrees (Guo et al., 2015; Lauermann et al.,

2015, 2017; von Keyserlingk et al., 2020, 2021; Wu et al., 2020).

In SEVT research, gender differences in students' motivational beliefs received a great deal of attention. Empirical research consistently shows that male students on average report higher math and science ability beliefs and interest values (Gaspard et al., 2015; Guo et al., 2015; Nagy et al., 2008). Findings on gender differences in math and science utility and attainment values do not show a consistent pattern favoring either male or female students (Gaspard et al., 2017; Watt, 2004). Female students, on the other hand, report higher ability beliefs and STV in verbal domains (Gaspard et al., 2017; Watt, 2004). Far less research has focused on potential differences in SEVT components by other background characteristics, such as first-generation status. Some findings indicate that first-generation and continuing-generation college students do not differ in their major-related ability beliefs and STV in the first college years (Harackiewicz et al., 2016; Robinson et al., 2019).

Taken together, these findings indicate that students with higher ability beliefs and STV have higher aspirations, are more engaged and committed, and are more successful in their achievement-related behavior in courses. A remaining question is if students with higher ability beliefs and STV are more likely to use control strategies that help them stay engaged and committed to their academic goals and achievement-related behavior in challenging courses. Transitioning to a university comes with many challenges in navigating a new academic environment, especially as individuals have to self-regulate academic goals and balance their study activities with competing courses and tasks. Adaptive use of control strategies could help students master these challenges in college. This study aims to investigate when and under which circumstances students use control strategies. Findings of whether students are more likely to use primary and secondary control strategies if they have higher (or lower) ability beliefs and STV or when they experience academic obstacles in a course are important contributions to the literature on motivation research. It also would be helpful to identify situations where instructors could provide targeted support to help students stay engaged in challenging courses. For example, by encouraging students (with generally lower course motivation, or higher/lower motivation after negative performance feedback) to increase study efforts, seek help, or use self-protecting attribution strategies after experiences of failure.

The Current Study

We built on the theoretical frameworks of the MTD (Heckhausen et al., 2010; Heckhausen & Schulz, 1995) and SEVT (Eccles & Wigfield, 2020) to investigate how students' course-specific ability beliefs and STV predict their planned use of control strategies for future exams. Previous empirical research on the MTD has shown that the adaptive use of primary and secondary control strategies helps students to stay engaged and to attain better achievement outcomes in class, particularly after experiencing academic setbacks (Hall, 2008; Hall, Perry, Ruthig, et al., 2006). Furthermore, research has shown that students' ability beliefs and STV are central drivers of achievement-related choices, engagement, and performance (e.g., Guo et al., 2015; Lauermann et al., 2015; Trautwein & Lüdtke, 2007). We conducted the first study that combines both theoretical approaches to investigate how students' ability beliefs and STV are associated with the use of control strategies in challenging college courses.

We investigate four main research questions (RQs):

RQ1: To what extent does the perceived difficulty of a midterm exam predict the planned use of goal engagement or goal adjustment related control strategies to adapt students' study behavior for a future course exam?

Prior research has shown that students are more likely to engage in secondary control strategies after recent experiences of academic failure (Hall, 2008; Hall, Perry, Ruthig, et al., 2006). Therefore, we hypothesized that students who perceived their midterm exam as more difficult than expected would be more likely to plan using control strategies that reflect goal-adjustment and self-protection to adapt their behavior for a future course exam.

RQ2: To what extent do STV in students' most difficult courses predict the planned use of goal engagement related or goal adjustment related control strategies to adapt students' study behavior for a future course exam?

Based on the SEVT literature, we expected that students with higher STV in their most difficult courses would be more likely to use a broad range of control strategies. STV are central predictors of students' academic choices, aspirations, and performance (e.g., Guo et al., 2015; Trautwein et al., 2012). Therefore, we expected that students who perceived their course as important, useful, and interesting would be more likely to plan using control strategies that reflect goal engagement: i.e., selective primary control strategies (increasing time and effort) and compensatory primary control strategies (seeking help) in a future exam. Because higher domain-specific STV predict higher aspirations in corresponding domains (Lauermann et al., 2015; Musu-Gillette et al., 2015), we expected that these students would not be likely to adjust or lower their aspirations. Based on the findings of Hamm et al., (2013), we further expected that students with higher STV would more likely plan to use self-protection strategies to facilitate continued goal engagement in students' most difficult courses.

RQ3: To what extent do course-specific ability beliefs in students' most difficult courses predict planned use of goal engagement related and goal adjustment related control strategies to adapt students' study behavior for a future course exam?

We had more exploratory propositions about the association between students' course-specific ability beliefs in their most difficult course and their planned use of control strategies. Prior research from Hall et al., (2006) has shown that higher-achieving students relied more on selective control strategies, such as increasing their time and effort in studying. Based on these findings, we expected that students with higher course-specific ability beliefs would plan to use selective primary control strategies. We had no direct hypothesis about the association between students' course-specific ability beliefs and the planned use of compensatory primary control strategies (i.e., seeking help). Finally, we expected that students with higher ability beliefs in their most difficult course would not plan to use goal-adjustment or self-protection related control strategies for a future course exam.

RQ4: To what extent does the perceived difficulty of the midterm exam in students' most difficult course moderate the relationship between motivational beliefs and the planned use of control strategies for a future course exam?

One central aspect of the MTD is the adaptive use of control strategies to facilitate goal pursuit, depending on recent experiences and available resources (Heckhausen et al., 2010). We would expect that students would be more likely to plan using control strategies that reflect either goal engagement or goal adjustment, when they missed an academic goal, such as when their midterm exam was more difficult than expected. Hereby, we further expect that particularly students with higher motivational beliefs in the course (i.e., with higher STV and ability beliefs) would be more likely to plan using goal engagement and goal adjustment strategies for future exams after experiencing such academic setbacks.

The design of our study provides an optimal framework to investigate the association between students' motivational beliefs in their perceived most difficult course and their planned use of control strategies at specific time points. Students' course-specific ability beliefs and STV were assessed several weeks into the academic quarter after students had time to obtain a realistic understanding of the course content and course demands. Students' planned control strategy used for a future exam in their most difficult course was assessed shortly after students received the scores of their midterm exams. Hence, the planned use of control strategies was assessed after students received graded feedback on their course performance. We used data from the fall

2019 quarter and winter 2020 quarter, which allowed us to replicate our findings with data from two academic quarters.

Methods

Participants and Procedure

We used data from the ongoing longitudinal UCI-MUST study (Arum et al., 2021) at a highly divers public university in California. The study was designed to investigate undergraduates' experiences and success and was approved by the university's Institutional Review Board (IRB). In the summer of 2019, all undergraduates that were about to start their freshman or junior year were invited to participate in the study. A convenience sample of $N = 1,275$ undergraduates consented to participate. Data collection began in September 2019, before the start of classes. A subsample of $n = 357$ students consented to participate in an in-depth version of the study, which required them to complete short online surveys weekly across the academic year 2019–20. Of these students, 307 students regularly completed weekly surveys in fall 2019 and 272 students continued to regularly complete weekly surveys in winter 2020. Survey questions varied across weeks to assess different attitudes, behavior, and experiences in a time-sensitive manner. At the beginning of the quarter, for example, surveys included questions about students' course expectations and learning-related needs. Questions about study behavior and experiences with midterm exams were asked in the middle of the quarter.

We used data from the subsample that completed weekly surveys in the fall 2019 quarter and winter 2020 quarter. We used data from surveys that were administered in the middle of each quarter and included questions on students' midterm exams, course-specific STV, course-specific ability beliefs, and control strategies in their most difficult courses. In the first week of the quarter, students selected the course they perceived as their most difficult one in the quarter from all their enrolled courses. Because midterm exams take place on different dates in courses, filter questions were used after week 5 to ask if students already received their midterm scores in the selected course. If students responded to this filter question with 'yes', they received questions on experiences with their midterm exams, motivational beliefs, and planned control strategy use for future course exams. Figure 1 provides an overview of the used time points and variables of this study. 15% of the students in fall 2019 and 17% of the students in winter 2020 had no midterm exam in their selected difficult course and were therefore excluded from the analyses in our study. The final sample consisted of $n = 231$ students (65% female; 83% freshman; 56% first-generation college students; 51% Asian/Asian American; 33%
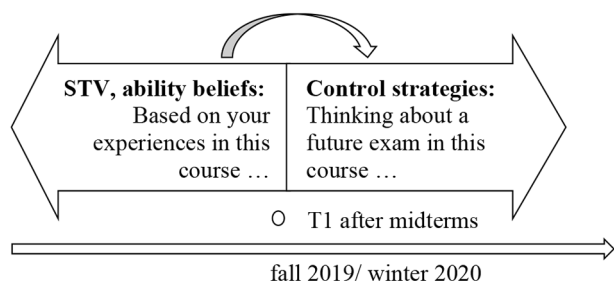
Fig. 1 Conceptual model and overview about the used constructs in the study. *Note*. STV = subjective task values

Hispanic; 10% White non-Hispanic; 6% other or unknown). Students were enrolled in majors across all fields of study (9% undeclared; 19% physical sciences, math, engineering, and computer sciences; 19% biological and health sciences; 39% applied social sciences; 6% humanities).

Measures

Control strategies. Eight items were used to measure students' control strategy use. Items were administered in the middle of each quarter after students received the midterm exam scores in their most difficult course. Items were developed by the research team based on the control strategies literature in the MTD (Heckhausen et al., 2010, 2019; Heckhausen & Schulz, 1995). Each control strategy was measured with two items. An example of a *selective primary control strategies* item is: "Thinking about the next exam in your difficult course [course name], how likely is it that you will increase your time and effort invested in this course?" Reliability of the items was assessed with the Spearman-Brown coefficient (fall 2019: $r = .89$; winter 2020: $r = .91$). An example item for *compensatory primary control strategies* is: "Thinking about the next exam in your difficult course [course name], how likely is it that you will get help from classmates or friends?" (Spearman-Brown coefficient fall 2019: $r = .55$; winter 2020: $r = .62$). An example item for *goal adjustment strategies* is: "Thinking about the next exam in your difficult course [course name], how likely is it that you will adjust your grade aspirations for this course?" (Spearman-Brown coefficient fall 2019: $r = .87$; winter 2020: $r = .89$). An example item for *self-protection strategies* is: "Thinking about the next exam in your difficult course [course name], how likely is it that you will remind yourself that others are struggling too in this course?" (Spearman-Brown coefficient fall 2019: $r = .87$; winter 2020: $r = .72$). Students responded to these items on a slider scale from 0 (*not at all likely*) to 100 (*extremely likely*) in fall 2019. The first quarter of the study served as a pilot to test the surveys (for further information on the response scales see Supplement A). The response scale of the items on control

strategies in winter 2020 was changed to a 7-point Likert scale from 1 (*not at all likely*) to 7 (*extremely likely*). To have the same metric of items in both quarters, we used linear interpolation to transform the 0 to 100 response scale into a 1 to 7 response scale. We used a latent modeling approach to model the planned use of the four control strategies with two indicators in fall 2019 and winter 2020. Factor loadings of both indicators of each latent factor were fixed to 1 and the intercepts of both indicators were set free.

Course-specific ability beliefs. We used measures of course-specific ability beliefs assessed in the middle of the fall 2019 and winter 2020 quarters to operationalize students' expectancies of success. We used three items to measure students' ability beliefs in their most difficult course. One example item is "Over the last few weeks, how good have you been in learning new things in your most difficult course [course name]?" Items were developed by the research team based on the SEVT literature (Eccles & Wigfield, 2020; Wigfield & Eccles, 2000). Students responded to these items on a slider scale from 0 (*not at all good*) to 100 (*extremely good*) in fall 2019. The response scale of the items was changed to a 7-point Likert scale from 1 (*not at all good*) to 7 (*extremely good*) in winter 2020. To have the same metric (1 to 7) of items in both quarters, we used linear interpolation. We used a latent modeling approach to model ability beliefs in fall 2019 and winter 2020. Internal consistency of the items was satisfactory (fall 2019: $\alpha = 0.79$; winter 2020: $\alpha = 0.90$).

Subjective task values. We used two items each to measure students' utility value, intrinsic value, and attainment value in their most difficult course. Three example items are: "Based on your experiences in this course, how much is your most difficult course [course name] interesting to you?" (intrinsic value), "Based on your experiences in this course, how much is your most difficult course [course name] useful in terms of your long-term goals?" (utility value), and "Based on your experiences in this course, how much is your most difficult course [course name] important to your academic identity?" (attainment value). Items were developed by the research team based on the SEVT framework (Wigfield et al., 2020; Wigfield & Eccles, 2000). Students responded to these items on a slider scale from 0 (*not at all*) to 100 (*very much*) in fall 2019. The response scale of the STV items was changed to a 7-point Likert scale from 1 (*not at all good*) to 7 (*extremely good*) in winter 2020. To have the same metric (1 to 7) of items in both quarters, we used linear interpolation. Most existing surveys on students' ability beliefs and STV based on the SEVT framework are designed to assess students' motivational beliefs in high-school contexts and/or towards specific domains, such as math or verbal domains (see e.g., Eccles et al., 2005; Gaspard et al., 2017; Wigfield & Eccles, 2000). In the current

Table 1 Model fit information of confirmatory factor analysis to specify latent constructs of students' STV, ability beliefs, and control strategies

Model	X²	df	RMSEA	CFI	TLI	SRMR
Subjective task values	197.06	114	0.05	0.96	0.95	0.05
Ability beliefs	5.05	5	0.01	1.00	1.00	0.02
Control strategies	98.46	76	0.03	0.98	0.97	0.05

Note. RMSEA = root mean square error of approximation, CFI = comparative fit index, TLI = Tucker Lewis indicator, SRMR = standardized root mean square residual

study, items were adjusted to assess students' motivational beliefs in specific college courses regardless of the course domain. Furthermore, the research team decided to use construct-specific anchors of the response scales to avoid often used agree-disagree statements that have been criticized in survey research (see e.g., Gehlbach 2015; Saris et al., 2010). We used a latent modeling approach to model course-specific STV with six indicators in fall 2019 and winter 2020. We allowed correlations of the residuals of the two items measuring utility value, of the two items measuring intrinsic value, and of the two items measuring attainment value. Internal consistency of the items was good (fall 2019: α = 0.88; winter 2020: α = 0.92). In this study, we were interested in investigating the relationship between students' ability beliefs, STV, and the planned use of control strategies, rather than examining differential effects of specific STV sub-components. Therefore, we decided to model one STV factor rather than specifying separate factors for each value component. This approach is often used in STV research (see e.g., Eccles & Wigfield 1995; Kosovich et al., 2015; Wigfield & Cambria, 2010).

Perceived difficulty of the midterm exam. We used one item to assess if students perceived their midterm exam as more difficult than expected. The item was "From what you had expected about this exam in your difficult course [course name]. The exam was: 1 = *easier*, 2 = *as expected to* 3 = *more difficult.*

Background variables. We included information about students' gender, first-generation college student status, and high school GPA in our analyses. This information was retrieved from the university's administrative data. Prior research did not report differences in control strategy use by gender or family background. Therefore, we had no specific hypotheses about the associations of these variables and control strategy use. Nevertheless, we were interested in exploring group differences in control strategy use, and if students with higher academic achievement in high school would be likely to use other control strategies than students with lower prior achievement.

Gender. We used a binary variable (0 = *female*, 1 = *male*) as indicator for students' biological gender.

First-generation college student status. We used a binary variable (0 – *continuing generation college student status*, 1 – *first-generation college student status*) as an indicator for the educational background of students' parents. In

the university's administrative data, students were assigned a 1 if none of their parents had a college degree.

High school GPA. We used students' high school GPAs as an indicator of prior achievement in our analysis. High school GPA was available on a weighted 5.0 scale for all study participants that accounted for the difficulty of high school courses (e.g., when AP courses were taken).

Statistical Analysis

We used the statistical software IBM SPSS Statistics, version 26.0 (IBM Corp., 2019) to clean survey data and to use linear interpolation to bring measures of both quarters onto the same metric. We used the software Mplus, Version 8.4 (Muthen & Muthen, 1998–2017) to conduct structural equation models (SEMs). Before running the statistical analyses, we used confirmatory factor analysis (CFA) to specify latent models for students' STV, ability beliefs, and control strategies. Table 1 provides model fit information of the CFAs to specify the three latent constructs. The model fits were good according to Hu and Bentler's (1999) criteria, with a root mean square error of approximation (RMSEA) of less than 0.08, a comparative fit index (CFI) of more than 0.95, a Tucker-Lewis index (TLI) of more than 0.95, and a standardized root mean square residual (SRMR) of less than 0.06.

We used SEMs to address our research questions. We used four models (Model 1–4) to predict the planned use of control strategies (goal engagement strategies: selective and compensatory primary control strategies, goal adjustment strategies, and self-protection strategies) by students' background characteristics, perceived difficulty of the midterm exam, STV, and ability beliefs in fall 2019 and winter 2020 (RQs 1–3). To address RQ4, we ran four additional models (Model 5–8) and included two interaction terms of the perceived difficulty of the midterm exam with (a) students' STV and (b) their ability beliefs to predict the planned use of control strategies. We report confidence intervals at a 95% level of all estimated coefficients in Models 1–8. To control for the clustered data structure of students' course affiliation with data from fall 2019 and winter 2020, we used the option TYPE = COMPLEX to adjust the standard errors in the models. We used Wald-χ²-Tests to compare coefficients in both quarters.

Table 2 Descriptive statistics on students' perceived difficulty of the midterm exam, perceived final grade, STV, course-specific ability beliefs, and control strategies

Variable	Fall 2019 M	Fall 2019 SD	Winter 2020 M	Winter 2020 SD
Difficulty of midterm exam	2.19	0.73	2.31	0.70
Subjective task values	4.53	1.45	4.03	1.61
Course-specific ability beliefs	4.52	1.41	3.90	1.38
Selective primary control strategies	5.89	1.14	5.62	1.28
Compensatory primary control strategies	3.95	1.62	3.48	1.80
Goal adjustment strategies	4.87	1.70	4.18	1.72
Self-protection strategies	3.70	1.74	3.14	1.63

We used the full information maximum likelihood (FIML) approach (Enders, 2010) to address missing data in our analyses in Mplus. Missing data was low in the final samples with 1–3% missing values in variables on the perceived difficulty of the midterm exam, ability beliefs, STV, and control strategies in fall 2019. Missing data of the final sample in winter 2020 was slightly higher with 1–5% missing values in variables on the perceived difficulty of the midterm exam, ability beliefs, STV, and control strategies.

Results

Table 2 provides descriptive statistics (means and standard deviations) of students' STV, ability beliefs, and control strategies in fall 2019 and winter 2020. Supplement B shows additional descriptive statistics by gender and first-generation college student status. Table 3 provides correlation matrices of students' background characteristics, perceived difficulty of the midterm exam, STV, ability beliefs, and planned use of control strategies in both quarters. These data show negative correlations between students' course-specific ability beliefs and perceived difficulty of the midterm exam. As expected, based on the SEVT literature, students' ability beliefs and STV were positively correlated, and the correlation coefficients were high ($r = .4$ to $r = .5$). Furthermore, control strategies were positively correlated with each other, indicating that students who used primary control strategies also used secondary control strategies ($r = .2$ to $r = .7$).

Tables 4 and 5 provide results from regression analyses regarding RQ 1–3. Results of the planned use of selective primary control strategies are presented in Model 1 and 2 in Table 4. Results from Model 1 show that students who perceived their midterm exam in fall 2019 as more difficult than expected were more likely to plan to increase their time and effort to study for a future course exam (selective primary control strategies). This association also had a positive

Table 3 Correlation matrix with data from fall 2019 quarter (above the diagonal) and winter 2020 quarter (below the diagonal)

Variable	1	2	3	4	5	6	7	8	9	10	11
1 First-generation college student	-	-0.07	-0.07	0.06	0.09	0.06	-0.08	-0.08	0.16	**0.14**	0.04
2 Male	-0.07	-	0.11	-0.06	-0.07	0.05	**0.16**	-0.03	-0.04	-0.05	0.10
3 HS GPA	-0.07	0.12	-	-0.04	-0.07	-0.07	0.06	-0.01	0.08	-0.06	-0.00
4 Perceived difficulty midterm	0.05	0.00	0.02	-	0.08	-0.06	**-0.34**	**0.20**	**0.28**	**0.25**	**0.12**
5 Perception of the final grade	**0.20**	0.00	-0.02	0.08	-	**-0.16**	**-0.22**	-0.03	-0.10	0.03	-0.07
6 Subjective task values	0.13	0.05	-0.08	-0.11	-0.06	-	**0.39**	**0.37**	**0.28**	0.09	**0.15**
7 Ability beliefs	0.04	0.93	0.06	**-0.42**	-0.09	**0.48**	-	0.09	-0.04	-0.14	-0.07
8 Selective prim. cont. strategies	0.13	-0.12	0.03	0.11	-0.02	**0.25**	0.10	-	**0.61**	**0.48**	**0.22**
9 Compensatory prim. cont. strategies	0.14	-0.15	0.00	**0.17**	0.16	**0.27**	0.00	**0.64**	-	**0.60**	**0.70**
10 Goal adjustment strategies	0.11	-0.03	0.06	**0.17**	0.10	0.06	**-0.15**	**0.27**	**0.56**	-	**0.49**
11 Self-protection strategies	-0.02	-0.11	0.04	0.09	0.02	**0.17**	0.06	**0.22**	**0.45**	**0.53**	-

Note. Correlation coefficients in bold font are statistically significant ($p < .05$)

direction in winter 2020, but the regression coefficient was not statistically significant. However, results from a Wald-χ^2-Test indicated that the regression coefficients of the perceived difficulty of the midterm exam predicting the use of selective primary control strategies were not significantly different in both quarters ($\chi^2 = 0.87$, $p = .35$). Results from Model 1 further showed that students with higher STV were more likely to plan to use selective primary control strategies to prepare for a future course exam in fall 2019 and winter 2020. This finding is consistent with our hypothesis. Contrary to our hypothesis, results showed that ability beliefs were not associated with the planned use of selective primary control strategies.

Model 2 shows results regarding the planned use of compensatory primary control strategies (seeking help of peers, instructors, or support services). Perceiving the midterm exam was more difficult than expected and ability beliefs were not associated with the planned use of compensatory primary control strategies in both quarters. Students with higher STV were more likely to plan to use compensatory primary control strategies for a future exam in winter 2020 ($b = 0.28$, $S.E. = 0.12$, $p = .02$). In fall 2019, this regression coefficient had a positive direction, but was not statistically significant ($b = 0.18$, $S.E. = 0.09$, $p = .06$). However, results from a Wald-χ^2-Test indicated that the association between STV and compensatory primary control strategies was not statistically different in both academic quarters ($\chi^2 = 1.95$, $p = .16$).

Results did not show a consistent pattern regarding group differences in the use of primary control strategies by student background. Only in the winter 2020 quarter, first-generation college students did report more selective primary control strategies, and male students reported less compensatory primary control strategies.

Table 5 shows results regarding the planned use of secondary control strategies (Model 3 and 4). Students who perceived the midterm exam in the most difficult course as more difficult than expected were more likely to adjust their grade aspirations for a future exam in fall 2019 ($b = 0.50$, $S.E. = 0.16$, $p < .01$). This positive association was not statistically significant in winter 2020, but again, results from a Wald-χ^2-Test showed that coefficients did not differ in both quarters ($\chi^2 = 1.43$, $p = .23$). Students with higher STV were more likely to adjust their aspirations for a future exam in both quarters. Results revealed a negative association between students' ability beliefs and planned use of goal adjustment strategies. Students with higher ability beliefs were less likely to adjust their grade aspirations for a future course exam in winter 2020 ($b = -0.33$, $S.E. = 0.14$, $p = .02$). This effect pointed in the same direction in the fall 2019 quarter but did not reach a statistically significant level. Results from a Wald-χ^2-Test showed that coefficients in both quarters did

not differ significantly ($\chi^2 = 2.04$, $p = .15$). Regarding the use of self-protection strategies, results showed that only STV were associated with the planned use of these strategies. Students with higher STV were more likely to plan using self-protection strategies in winter 2020 ($b = 0.21$, $S.E. = 0.09$, $p = .03$) and this association pointed into the same direction in fall 2019, even though the regression coefficient was not statistically significant ($b = 0.15$, $S.E. = 0.11$, $p = .18$). Results from a Wald-χ^2-Test showed that these two coefficients were not statistically different from each other ($\chi^2 = 0.23$, $p = .63$). Results showed no differences in the use of secondary control strategies by first-generation college student status or gender.

Tables 6 and 7 show results regarding RQ4 about potential interaction effects of the perceived midterm exam difficulty and students' STV and ability beliefs. Table 6 includes results on the planned use of primary control strategies and Table 7 includes results on the planned use of secondary control strategies. We expected that, particularly when students perceived their midterm exam as more difficult than expected, STV and ability beliefs should be central drivers of using control strategies for future exams. Hence, when students perceived an academic setback in a challenging course, students with higher motivational beliefs in the course should be more likely to use goal-oriented control strategies for future exams. Results revealed some interesting findings that partially supported our hypotheses.

Results showed a statistically significant negative interaction effect of the perceived difficulty of the midterm exam and STV on selective primary control strategies in both quarters (see Model 5 in Table 6). The simple slopes reported in this model illustrate this interaction (see Table 6; Fig. 2). We calculated the slope of perceived difficulty predicting primary control strategies at mean level STV (intercept/mean = 0), low STV (one standard deviation below the intercept/mean), and high STV (one standard deviation above the intercept/mean). Results show that when students had high STV, the predictive effect of the perceived difficulty of the midterm exam on the planned use of selective primary control strategies was not statistically significant ($b = -0.05$, $S.E. = 0.08$, $p > .05$). For students with middle ($b = 0.34$, $S.E. = 0.13$, $p < .01$) and low STV ($b = 0.73$, $S.E. = 0.10$, $p < .01$), however, perceiving the midterm exam as more difficult than expected had a statistically significant and stronger positive effect on planned use of selective primary control strategies. Taken together with results from Model 1 (Table 4), these findings indicate that students with high STV were generally more likely to use selective primary control strategies, independent of their experiences with exams. For students with lower STV, however, the experience of setbacks in the exam played a more activating role and the association between the perceived difficulty of

Table 4 Results from regression analyses to predict the planned use of primary control strategies in fall 2019 and winter 2020 by students' background characteristics, perceived difficulty of the midterm exam, and motivational beliefs

	Primary control strategies						Compensatory primary control strategies					
	Selective primary control strategies											
	Model 1						Model 2					
	Fall 2019			Winter 2020			Fall 2019			Winter 2020		
Variable	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI
First-gen	-0.27	(0.15)	[-0.51, -0.03]	0.42	(0.18)*	[0.13, 0.72]	0.12	(0.21)	[-0.22, 0.46]	0.15	(0.26)	[-0.28, 0.57]
Male	-0.21	(0.15)	[-0.47, 0.04]	-0.27	(0.19)	[-0.58, 0.04]	-0.15	(0.22)	[-0.51, 0.20]	-0.59	(0.22)*	[-1.03, -0.15]
HS GPA	-0.37	(0.36)	[-0.97, 0.23]	0.24	(0.42)	[-0.46, 0.93]	0.26	(0.51)	[-0.58, 1.09]	-0.26	(0.61)	[-1.25, 0.74]
Midterm	0.35	(0.10)**	[0.18, 0.52]	0.19	(0.15)	[-0.05, 0.43]	0.25	(0.14)	[0.02, 0.49]	0.32	(0.20)	[-0.01, 0.66]
STV	0.27	(0.07)**	[0.15, 0.39]	0.17	(0.08)*	[0.05, 0.30]	0.18	(0.09)	[0.02, 0.33]	0.28	(0.12)*	[0.08, 0.48]
Ab. beliefs	-0.02	(0.07)	[-0.14, 0.10]	-0.02	(0.10)	[-0.14, 0.10]	-0.01	(0.10)	[-0.16, 0.17]	-0.05	(0.12)	[-0.16, 0.17]
R^2	0.18			0.09			0.10			0.16		

Note. CI = confidence interval, First-gen = first generation college student status, HS GPA = high school grade point average, Midterm = midterm exam was more difficult than expected, STV = subjective task values, Ab. Beliefs = ability beliefs. Model fits: Model 1: RMSEA = 0.05, CFI = 0.94, TLI = 0.92, SRMR = 0.06; Model 2: RMSEA = 0.04, CFI = 0.94, TLI = 0.93, SRMR = 0.06

$* p < .05, ** p < .01$

Table 5 Results from regression analyses to predict planned use of secondary control strategies in fall 2019 and winter 2020 by students' background characteristics, perceived difficulty of the midterm exam, and motivational beliefs

	Secondary control strategies						Self-protection strategies					
	Goal adjustment strategies						Model 4					
	Model 3											
	Fall 2019			Winter 2020			Fall 2019			Winter 2020		
Variable	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI
First-gen	0.30	(0.23)	[-0.08, 0.68]	0.44	(0.25)	[0.03, 0.85]	0.08	(0.25)	[-0.33, 0.49]	0.09	(0.24)	[-0.30, 0.48]
Male	-0.17	(0.24)	[-0.57, 0.23]	-0.12	(0.26)	[-0.54, 0.31]	-0.28	(0.26)	[-0.71, 0.15]	-0.47	(0.24)	[-0.87, -0.07]
HS GPA	-0.28	(0.58)	[-1.24, 0.68]	0.59	(0.59)	[-0.39, 1.57]	-0.19	(0.63)	[-1.22, 0.85]	0.28	(0.55)	[-0.62, 1.18]
Midterm	0.50	(0.16)**	[0.32, 0.77]	0.19	(0.21)	[-0.15, 0.53]	0.10	(0.17)	[-0.17, 0.38]	-0.02	(0.18)	[-0.31, 0.28]
STV	0.22	(0.11)*	[0.04, 0.39]	0.22	(0.11)*	[0.04, 0.39]	0.15	(0.11)	[-0.03, 0.33]	0.21	(0.09)*	[0.05, 0.36]
Ab. beliefs	-0.07	(0.11)	[-0.26, 0.11]	-0.33	(0.14)*	[-0.56, -0.09]	-0.08	(0.12)	[-0.27, 0.11]	-0.08	(0.12)	[-0.28, 0.12]
R^2	0.10			0.10			0.03			0.07		

Note. CI = confidence interval, First-gen = first generation college student status, HS GPA = high school grade point average, Midterm = midterm exam was more difficult than expected, STV = subjective task values, Ab. Beliefs = ability beliefs. Model fits: Model 3: RMSEA = 0.04, CFI = 0.95, TLI = 0.94, SRMR = 0.04; Model 4: RMSEA = 0.05, CFI = 0.94, TLI = 0.92, SRMR = 0.06

* $p < .05$, ** $p < .01$

Table 6 Results from regression analyses with interaction terms and simple slopes to predict the planned use of primary control strategies in fall 2019 and winter 2020

	Primary control strategies						Compensatory primary control strategies					
	Selective primary control strategies											
	Model 5						Model 6					
	Fall 2019			Winter 2020			Fall 2019			Winter 2020		
Variable	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI
First-gen	-0.28	(0.14)	[-0.51, -0.05]	0.41	(0.18)*	[0.12, 0.70]	0.13	(0.20)	[-0.21, 0.46]	0.14	(0.25)	[-0.28, 0.56]
Male	-0.20	(0.14)	[-0.44, 0.03]	-0.24	(0.18)	[-0.53, 0.05]	-0.14	(0.22)	[-0.50, 0.23]	-0.50	(0.25)	[-0.91, -0.10]
HS GPA	-0.35	(0.36)	[-0.93, 0.23]	0.38	(0.37)	[-0.23, 0.99]	0.35	(0.48)	[-0.44, 1.13]	-0.08	(0.59)	[-1.05, 0.90]
Midterm	0.34	(0.10)**	[0.17, 0.51]	0.08	(0.17)	[-0.20, 0.35]	0.21	(0.14)	[-0.02, 0.44]	0.09	(0.24)	[-0.30, 0.48]
STV	0.99	(0.25)**	[0.57, 1.41]	0.90	(0.34)**	[0.34, 1.45]	0.34	(0.28)	[-0.12, 0.81]	1.08	(0.43)**	[0.38, 1.79]
Ab. beliefs	-0.46	(0.29)	[-0.93, 0.01]	-0.85	(0.44)	[-1.57, -0.12]	-0.32	(0.36)	[-0.91, 0.26]	-0.96	(0.74)	[-2.18, 0.25]
STV*midterm	-0.32	(0.10)**	[-0.48, -0.15]	-0.28	(0.13)*	[-0.50, -0.07]	-0.08	(0.12)	[-0.28, 0.12]	-0.29	(0.16)	[-0.56, -0.02]
A. Beliefs*midterm	0.19	(0.11)	[0.01, 0.37]	0.31	(0.16)*	[0.04, 0.57]	0.13	(0.14)	[-0.10, 0.35]	0.28	(0.27)	[-0.16, 0.72]
R^2	0.26			0.17			0.11			0.23		
Simple slopes												
L stv - midterm	0.73	(0.10)**	[0.42, 1.04]	0.48	(0.23)*	[0.09, 0.86]	0.31	(0.19)	[-0.01, 0.62]	0.51	(0.30)	[0.03, 1.00]
M stv - midterm	0.34	(0.13)**	[0.17, 0.51]	0.07	(0.17)	[-0.20, 0.35]	0.21	(0.14)	[-0.02, 0.44]	0.09	(0.24)	[-0.30, 0.48]
H stv - midterm	-0.05	(0.08)	[-0.26, 0.16]	-0.33	(0.27)	[-0.76, 0.11]	0.11	(0.22)	[-0.25, 0.47]	-0.34	(0.36)	[-0.93, 0.26]
L a. bel. - midterm	0.10	(0.18)	[-0.20, 0.41]	-0.29	(0.28)	[-0.75, 0.17]	0.05	(0.25)	[-0.37, 0.46]	-0.24	(0.45)	[-0.97, 0.50]
M a. bel. - midterm	0.34	(0.10)**	[0.17, 0.51]	0.07	(0.17)	[-0.20, 0.35]	0.21	(0.14)	[-0.02, 0.44]	0.09	(0.24)	[-0.30, 0.48]
H a. bel. - midterm	0.58	(0.16)**	[0.32, 0.84]	0.44	(0.21)*	[0.09, 0.79]	0.37	(0.19)*	[0.06, 0.68]	0.41	(0.32)	[-0.12, 0.95]

Note. CI = confidence interval., First-gen = first-generation college student status, HS GPA = high school grade point average, Midterm = midterm exam was more difficult than expected, STV = subjective task values, Ab. Beliefs = ability beliefs, STV*midterm = interaction term of subjective task values*perceived difficulty of the midterm exam, A. Beliefs*midterm = interaction term of ability beliefs*perceived difficulty of the midterm exam, L stv − midterm = slope of the perceived difficulty of the midterm exam on control strategy, when subjective task values are one standard deviation below the intercept/mean, M stv − midterm = slope of the perceived difficulty of the midterm exam on control strategy when subjective task values are at the intercept/ mean, H stv − midterm = slope of the perceived difficulty of the midterm exam on control strategy when subjective task values are one standard deviation above the intercept/mean, L a. bel. − midterm = slope of the perceived difficulty of the midterm exam on control strategy, when ability beliefs are one standard deviation below the intercept/mean, M a. bel. − midterm = slope of the perceived difficulty of the midterm exam on control strategy when ability beliefs are at the intercept/mean, H a. bel. − midterm = slope of the perceived difficulty of the midterm exam on control strategy, when ability beliefs are one standard deviation above the intercept/mean. * $p < .05$, ** $p < .01$

Table 7 Results from regression analyses with interaction terms and simple slopes to predict the planned use of secondary control strategies in fall 2019 and winter 2020

	Secondary control strategies						Self-protection strategies					
	Goal adjustment strategies											
	Model 7						Model 8					
	Fall 2019			Winter 2020			Fall 2019			Winter 2020		
Variable	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI	b	(SE)	95% CI
First-gen	0.29	(0.23)	[-0.09. 0.66]	0.42	(0.25)	[0.01. 0.83]	0.08	(0.38)	[-0.55. 0.71]	0.12	(0.34)	[-0.44. 0.68]
Male	-0.15	(0.25)	[-0.56. 0.27]	-0.09	(0.27)	[-0.53. 0.36]	-0.29	(0.382)	[-0.92. 0.34]	-0.47	(0.37)	[-1.07. 0.13]
HS GPA	-0.10	(0.55)	[-1.01. 0.81]	0.70	(0.59)	[-0.28. 1.67]	-0.20	(0.94)	[-1.75. 1.35]	0.30	(0.96)	[-1.28. 1.88]
Midterm	0.42	(0.16)*	[0.15. 0.68]	0.05	(0.22)	[-0.31. 0.04]	0.10	(0.27)	[-0.35. 0.55]	-0.19	(0.28)	[-0.66. 0.28]
STV	0.84	(0.35)*	[0.27. 1.41]	0.80	(0.40)*	[0.14. 1.45]	0.80	(0.70)	[-0.36. 1.95]	0.55	(0.68)	[-0.57. 1.67]
Ab. beliefs	-1.28	(0.37)**	[-1.90. -0.67]	-1.26	(0.58)*	[-2.21. -0.31]	-0.10	(0.65)	[-1.27. 0.98]	-1.28	(0.86)	[-2.69. 0.14]
STV*midterm	-0.27	(0.14)*	[-0.49. -0.04]	-0.22	(0.16)	[-0.48. 0.04]	-0.26	(0.28)	[-0.72. 0.21]	-0.11	(0.25)	[-0.53. 0.31]
A. Beliefs*midterm	0.51	(0.15)**	[0.26. 0.75]	0.36	(0.21)	[0.01. 0.70]	0.00	(0.26)	[-0.42. 0.42]	0.46	(0.33)	[-0.08. 1.00]
R²	0.19			0.16			0.05			0.18		
Simple slopes												
L stv - midterm	0.75	(0.24)**	[0.35. 1.14]	0.36	(0.31)	[-0.16. 0.87]	0.38	(0.39)	[-0.26. 1.01]	-0.03	(0.43)	[-0.74. 0.68]
M stv - midterm	0.42	(0.16)**	[0.15. 0.68]	0.05	(0.22)	[-0.31. 0.40]	0.10	(0.27)	[-0.35. 0.55]	-0.19	(0.28)	[-0.66. 0.28]
H stv - midterm	0.09	(0.22)	[-0.27. 0.44]	-0.26	(0.32)	[-0.79. 0.25]	-0.18	(0.43)	[-0.87. 0.52]	-0.35	(0.49)	[-1.15. 0.46]
L a. bel. - midterm	-0.22	(0.24)	[-0.62. 0.17]	-0.38	(0.37)	[-0.99. 0.23]	0.10	(0.44)	[-0.63. 0.82]	-0.74	(0.55)	[-1.65. 0.17]
M a. bel. - midterm	0.42	(0.16)**	[0.15. 0.68]	0.05	(0.22)	[-0.31. 0.40]	0.10	(0.27)	[-0.0.35. 0.55]	-0.19	(0.28)	[-0.66. 0.28]
H a. bel. - midterm	1.06	(0.26)**	[0.63. 1.49]	0.47	(0.28)	[0.00. 0.93]	0.10	(0.41)	[-0.57. 0.78]	0.36	(0.41)	[-0.31. 1.04]

Note. CI = confidence interval., First-gen = first-generation college student status, HS GPA = high school grade point average, Midterm = midterm exam was more difficult than expected, STV = subjective task values, Ab. Beliefs = ability beliefs, STV*midterm = interaction term of subjective task values*perceived difficulty of the midterm exam, A. Beliefs*midterm = interaction term of ability beliefs*perceived difficulty of the midterm exam, L stv − midterm = slope of the perceived difficulty of the midterm exam on control strategy, when subjective task values are one standard deviation below the intercept/mean, M stv − midterm = slope of the perceived difficulty of the midterm exam on control strategy when subjective task values are at the intercept/mean, H stv − midterm = slope of the perceived difficulty of the midterm exam on control strategy when subjective task values are one standard deviation above the intercept/mean, L a. bel. − midterm = slope of the perceived difficulty of the midterm exam on control strategy, when ability beliefs are one standard deviation below the intercept/mean, M a. bel − midterm = slope of the perceived difficulty of the midterm exam on control strategy, when ability beliefs are at the intercept/mean, H a. bel. − midterm = slope of the perceived difficulty of the midterm exam on control strategy, when ability beliefs are one standard deviation above the intercept/mean. * *p* < .05, ** *p* < .01
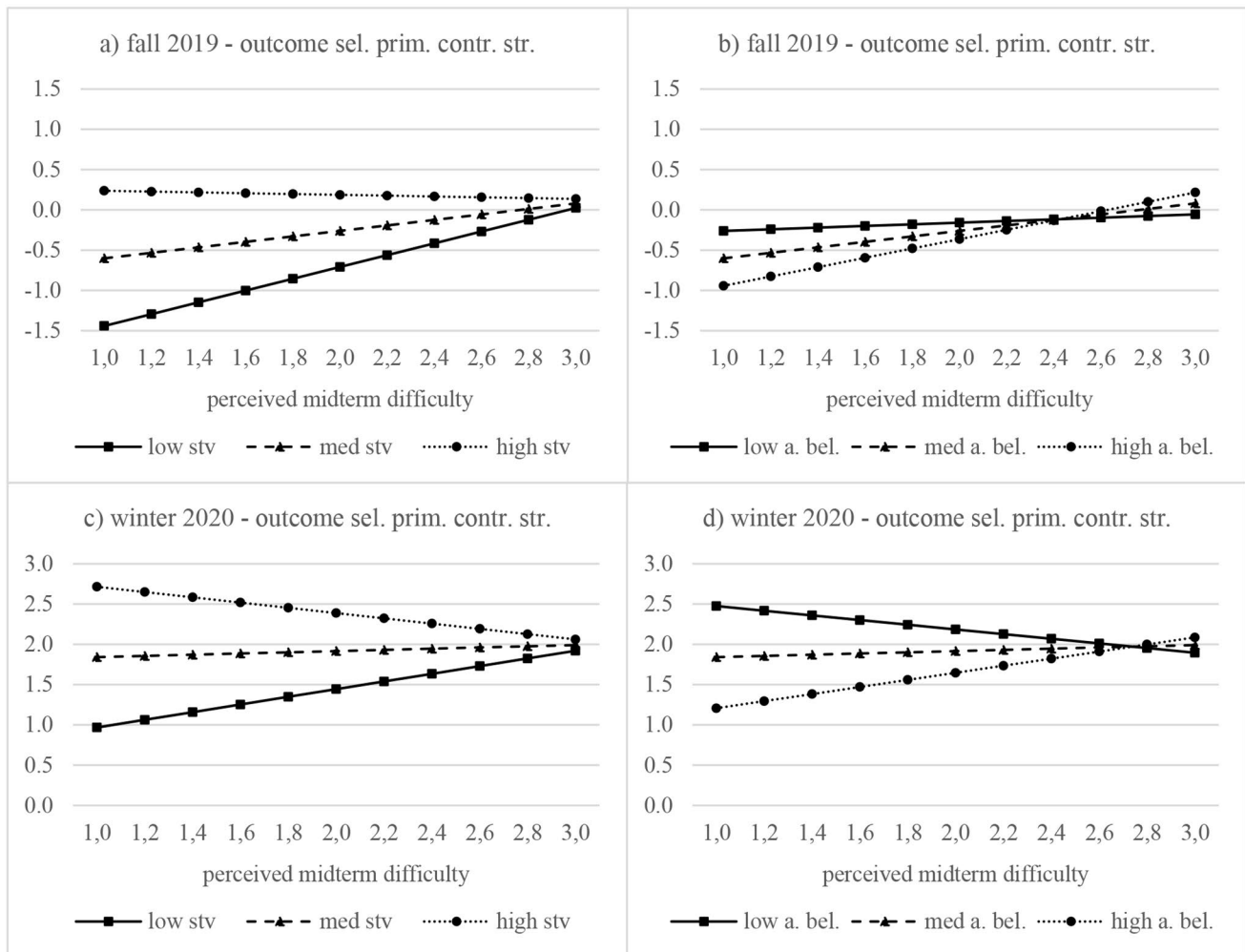
Fig. 2 Simple slopes of perceived difficulty of the midterm exam predicting selective primary control strategies. *Note.* a) simple slopes at high, medium, and low subjective task values in fall 2019. b) simple slopes at high, medium, and low ability believes in fall 2019. c) simple slopes at high, medium, and low subjective task values in winter 2020. d) simple slopes at high, medium, and low ability believes in winter 2020.

the exam and the planned use of selective primary control strategies was stronger.

The interaction of perceived difficulty of the exam and ability beliefs pointed into the opposite direction. Although this interaction effect missed statistical significance in Model 5 (fall 2019: $b = 0.19$, S.E. $= 0.11$, $p = .08$; winter 2020: $b = 0.31$, S.E. $= 16$, $p = .06$), simple slopes indicate that perceived difficulty of the midterm exam had a more activating role for students with higher ability beliefs (see Model 5, Fig. 2). Hence, students who perceived the midterm exam as more difficult than expected were more likely to plan to use selective primary control strategies when they had medium (fall 2019: $b = 0.34$, S.E. $= 0.10$, $p < .01$) or high ability beliefs (fall 2019: $b = 0.58$, S.E. $= 0.16$, $p < .01$) in their most difficult course.

Similarly, results in Model 7 (Table 7) showed a negative interaction effect of STV and perceived midterm exam difficulty ($b = -0.27$, S.E. $= 0.14$, $p = .04$) and a positive

interaction effect of ability beliefs and perceived midterm exam difficulty ($b = 0.51$, S.E. $= 0.15$, $p < .01$) on planned use of goal adjustment strategies in fall 2019. Hence, students with high STV were more likely to plan using goal adjustment strategies overall (see Model 3 in Table 5). But when students had medium or low STV, perceiving the midterm exam as more difficult than expected had a stronger positive predictive effect on the planned use of goal adjustment strategies (see simple slopes in Model 7 in Table 7; Fig. 3). In contrast, students with higher ability beliefs were generally less likely to plan using goal adjustment strategies (see Model 3 in Table 5). But when students had high ability beliefs and perceived their midterm exam as more difficult than expected, they were more likely to plan using goal adjustment strategies (see simple slopes in Model 7 in Table 7; Fig. 3). Interaction effects predicting the planned use of compensatory primary control strategies (Model 6 in
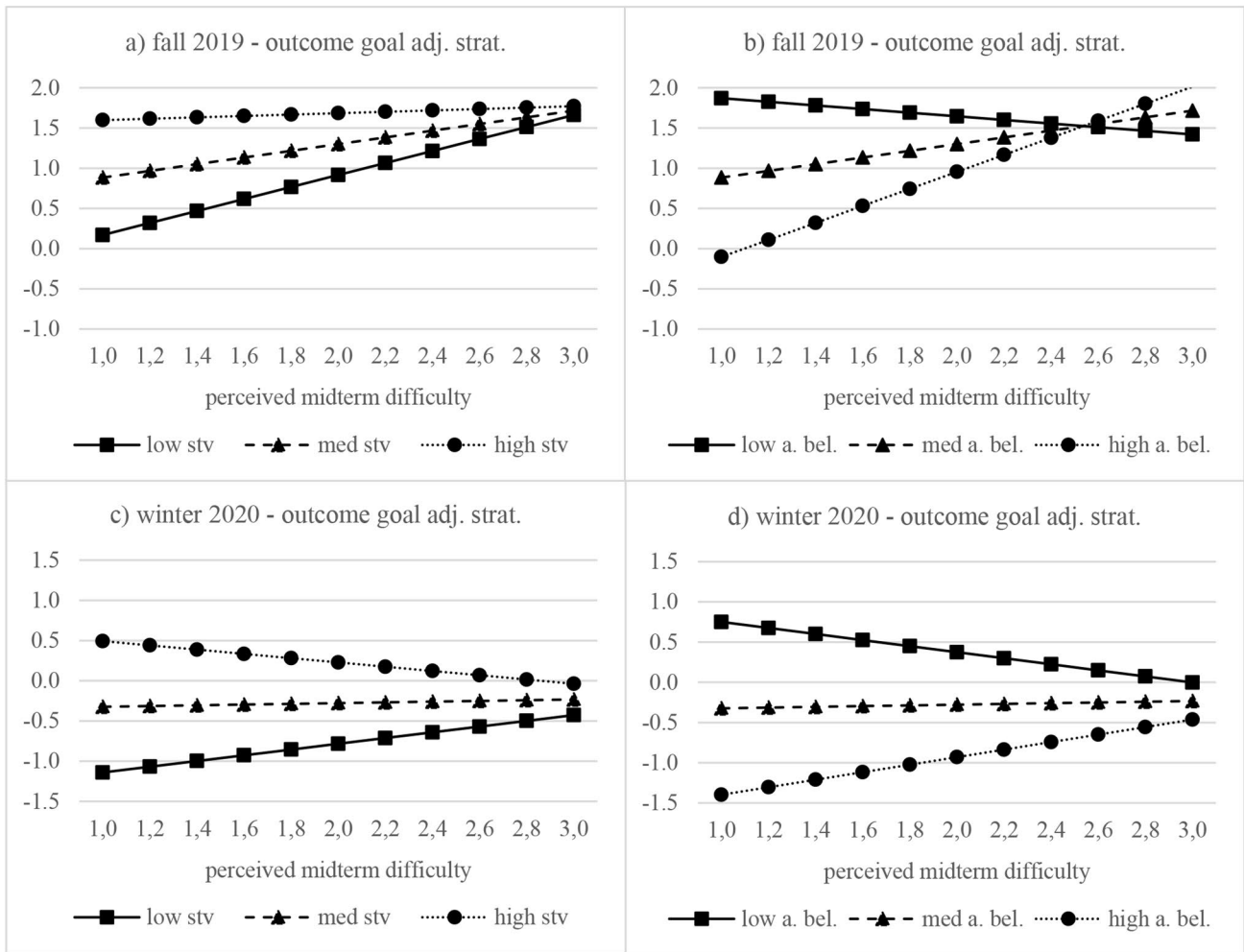
Fig. 3 Simple slopes of perceived difficulty of the midterm exam predicting goal adjustment strategies. *Note*. a) simple slopes at high, medium, and low subjective task values in fall 2019. b) simple slopes at high, medium, and low ability believes in fall 2019. c) simple slopes at high, medium, and low subjective task values in winter 2020. d) simple slopes at high, medium, and low ability believes in winter 2020.

Table 6) and self-protection strategies (Model 8 in Table 7) were not statistically significant.

It is important to note, that we only considered interaction effects and simple slopes in Tables 6 and 7 (Model 5–8) for interpretation. Regression coefficients of STV and ability beliefs changed substantially compared to results in Tables 4 and 5 (Model 1–4). Such high regression coefficients usually indicate multicollinearity among predictor variables. However, this does not affect the interpretability of the interaction effects and is expected in moderation analysis, given that ability beliefs and STV highly correlate with the added interaction terms (McClelland et al., 2017).

Discussion

During college, students are required to navigate an academically challenging environment and manage their study activities to pursue their individual academic goals. Control strategies can help students to organize their study behaviors to reach their goals productively. The current study was designed to investigate how students' experiences with midterm exams and motivational beliefs predict the planned use of primary and secondary control strategies to study for a future course exam.

Results regarding RQ1 only partially supported our hypotheses. Based on the literature (e.g., Hall 2008), we expected that students who experienced an academic setback would be more likely to plan using secondary control strategies (i.e., goal adjustment and self-protection strategies) to cope with experienced struggles or failure. Results showed that students who perceived their midterm exam as more difficult than expected were more likely to plan to use selective primary control strategies and goal adjustment strategies for a future exam. However, perceived difficulty was not related to the planned use of compensatory primary

control strategies or self-protection strategies. Overall, these findings indicate that students who experienced academic setbacks were more likely to plan changes in their behavior, in terms of selecting and sharpening their actions towards goal pursuit (i.e., selective primary control strategies), rather than using mostly secondary control strategies to cope with academically challenging experiences.

Prior research has shown that the combined use of primary and secondary control strategies is optimal for positive achievement outcomes and students' emotional well-being (Daniels et al., 2014; Hall, Perry, Ruthig, et al., 2006). Particularly, lower-achieving students benefit from the combined use of primary and secondary control strategies (Hall, Perry, Ruthig, et al., 2006). Although our results only partially confirmed our hypothesis regarding RQ1, findings are promising in that experiencing academic challenges in a difficult course did not primarily lead to goal adjustment and self-protection among students. Instead, these students planned to use both goal engaging and goal adjusting control strategies in the future.

Results regarding RQ2 about the association between STVs and control strategies, overall, showed that students with higher course-specific STVs were more likely to plan to use both primary and secondary control strategies for future course exams. Students with higher STVs in their most difficult course were more likely to plan to use selective primary strategies. These findings support our hypothesis that students who perceive their course as important, useful, and interesting are more likely to plan to use selective strategies that facilitate goal pursuit and engagement in their courses. In addition, these students planned to use compensatory control strategies, such as seeking help from friends or peers. These compensatory primary control strategies can help students to stay engaged and pursue a goal in a course if students' current individual abilities or capacities are not sufficient to succeed in the anticipated way (Hamm et al., 2013). Furthermore, results showed that students with higher STV were more likely to use goal adjustment and self-protection strategies. This finding is contrary to our hypotheses that students with higher STV would not lower their goals and aspirations in their most difficult course. It is important to note, however, that adjusting initially overambitious and unattainable goals can be a highly adaptive strategy (Heckhausen et al., 2010). When students start a course with overambitious aspirations, goal adjustment strategies can help students to set more realistic and reachable goals for the course, and therefore stay engaged in future study activities.

Overall, our findings regarding RQ2 point in a similar direction as findings from Daniels et al., (2014). Daniels et al., (2014) showed that college students with mastery goal orientation were more likely to use a broad range of primary

and secondary control strategies in their courses, whereas students with performance goal orientation mostly used primary control strategies. Taken together, these findings show that motivational beliefs are relevant drivers of students' self-regulatory control strategy use in college. Students who have the goal to gain competence (mastery goal orientation) and students who perceive their course as important, useful, and interesting (STV) use a broad range of control strategies that help them stay engaged in and committed to their courses.

Results showed a different pattern for the relation of course-specific ability beliefs and planned control strategy use (RQ3). Students' ability beliefs were not predictive of their planned use of selective primary or compensatory primary control strategies for a future exam in their most difficult course. Hence, students with higher course-specific ability beliefs did not plan to change their study behavior in a future course exam, in general. Results from winter 2020 showed that students with higher ability beliefs were less likely to plan to adjust their aspirations for future exams, and results from fall 2019 pointed in the same direction. These findings suggest that students with higher ability beliefs did not see the need to change any of their used learning behaviors and control strategies for future course exams. This is in line with the proposition of the MTD that deciding between enhanced goal engagement and goal disengagement, or adjustment is a function of perceived overall attainability of the goal, which is composed of perceived own ability and task difficulty.

Theoretical models on self-regulation in education describe a cyclical process of goal setting and planning, action and monitoring, and evaluation of the learning outcomes (Pintrich, 2000; Zimmerman, 1990, 2002). One central aspect of this cyclical process is the evaluation phase where students self-assess whether their (learning) behaviors and strategies were effective to reach their initial goals. If students perceive a discrepancy between their intended and reached learning goals, they adjust their goals and/or planned strategies for the next learning cycle. One possible explanation for our finding is that students with higher course-specific ability beliefs were less likely to plan using control strategies for future exams and courses because they reached their academic goals in the course, and thus had no need to increase resources invested in the course. Our findings regarding RQ4 about interaction effects of the perceived difficulty of the midterm exam with ability beliefs and STV favor this explanation. Although ability beliefs, overall, were not associated with the planned use of control strategies, students with higher ability beliefs were more likely to plan to use selective primary control strategies and goal adjustment strategies when they perceived their

midterm exam as more difficult than expected. Hence, when they did not meet their expectations in the exam.

Surprisingly, results on interactions of the perceived difficulty of the midterm exam and STV pointed in opposite directions. Students with higher STV reported planning to use a broad range of primary and secondary control strategies independent of their midterm exam experiences. This result aligns with findings from other empirical studies that students with higher STV are more persistent and put more effort into their studying (Trautwein & Lüdtke, 2007; Wu et al., 2020; Wu & Fan, 2017). For students with medium or lower STV, instead, experiences in the midterm exam were central predictors for subsequent control strategy use: These students were more likely to increase their time and effort invested into their studying (selective primary control strategies) and to adjust their course aspirations when their midterm exam was more difficult than expected. Findings regarding RQ4 showed that students use control strategies adaptively, depending on their experiences and their motivational beliefs in the course. However, one shortcoming of the study design for investigating the adaptive control strategy use was that no information on the perceived attainability of initial course goals was available. For example, when students realize after their midterm exam that initial course goals were overambitious and unattainable, using goal adjustment and self-protection strategies would be highly adaptive to regulate invested effort resources and to stay engaged in the course. Conversely, if a goal remains attainable for a student, using goal engagement strategies (i.e., selective and compensatory primary control strategies) would be adaptive and appropriate. The present study could not clearly identify whether a given pattern of control strategy use reflected adaptive or maladaptive agency. Future research should address this point and take into account information on the attainability of goals, in addition to motivational beliefs and course-specific experiences.

Bringing together the SEVT and the MTD, our results showed that students with higher STVs reported more goal regulating behavior in terms of primary and secondary control strategies. This aligns with our theoretical assumptions that students who perceive their courses as more interesting, important, and useful would use more control strategies that facilitate goal pursuit and help students stay engaged in challenging courses. Results regarding students' ability beliefs and the use of control strategies showed a more context-related pattern. Only after experiencing an academic setback, students with high ability beliefs planned using control strategies to adjust their learning behavior in the course. This finding supports the proposition of the MTD that the use of control strategies can and should be adapted to students' own abilities, available resources, and current demands in the context.

Limitations and future research

We used survey data from an ongoing longitudinal study to investigate the relation of college students' STVs, ability beliefs, and use of control strategies in a challenging college course. Data were collected during two academic quarters to replicate our findings with data from the fall 2019 quarter with data from another course in the winter 2020 quarter. We consider this a strength of the current study.

Nevertheless, a limiting factor of our results is that we used data from only one university. Although the sample is comprised of a diverse group of undergraduates, the sample is not representative of college students in the United States and results need to be replicated with data from other universities and countries.

We used survey data that asked students to report the likelihood of using control strategies for a future course exam. Hence, we used measures of students' intended use of control strategies in the future, but it remains unclear to what extent these students engaged in the respecting control strategies when studying for the next exam. Future research could overcome this limitation by asking specific questions about control strategy use during exam preparations, or by including behavioral trace data on students' study activities. Furthermore, future research could investigate if students' perception about which of their courses is their most difficult changes across the quarter and how such changes might be related to exam experiences, motivational beliefs, and planned use of control strategies.

In the current study, we were most interested in shedding light on the question, of how students' motivational beliefs predict the use of control strategies. Future research should extend this approach and investigate how students' motivational beliefs and the use of control strategies predict subsequent course performance and satisfaction with goal pursuit in the respective courses. Based on our findings and the existing literature, we expect that control strategies are relevant mediators of the association of students' STV, ability beliefs, and subsequent achievement-related behavior and success. Furthermore, some recent studies highlight the benefits of investigating differential effects of specific STV components with subsequent academic outcomes, such as engagement, effort, and educational choices. Results from Guo et al., (2016), for example, indicate that attainment value was more predictive of effort investment than the other value components. Future studies that measure the four STV components with more than two items each could investigate differential effects of intrinsic, attainment, and utility value on the use of control strategies for goal pursuit in challenging college courses.

Conclusions

The main goal of our study was to combine two prominent psychological theories on motivation and goal-oriented behavior – MTD (Heckhausen et al., 2010; Heckhausen & Schulz, 1995) and SEVT (Eccles, 1983; Eccles & Wigfield, 2020). We investigated the relation of students' motivational beliefs with the planned use of control strategies in college courses. Our study revealed two main findings: (a) Motivational beliefs are important predictors of students' planned use of control strategies in challenging college courses. In particular, students with higher course-specific STV were more likely to plan to use a broad range of primary and secondary control strategies to prepare for future exams. (b) Students adaptively plan using control strategies depending on their experiences with setbacks or success in exams. Students with higher ability beliefs and students with medium and lower STVs used selective primary control strategies and goal adjustment strategies, in particular after experiencing an academic setback in their midterm exam, when modifications in students' study behavior and goals seem warranted for successful goal pursuit in future exams. These findings provide important insights into how motivational orientations and specific experiences in college courses relate to highly adaptive and goal-oriented behavior in these courses. Future research should build on these findings to investigate if the use of these various control strategies mediates the relation of students' STVs and ability beliefs with positive course outcomes, such as performance, engagement, and course satisfaction.

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