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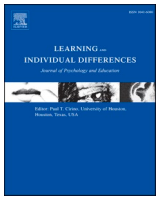

Applying a three-component approach to motivational regulation: Relations of frequency, situation-specific fit and application quality of motivational regulation strategies with students' well-being☆

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ABSTRACT

While motivational regulation has been shown to predict study motivation and success, its relations with student well-being have received little attention. The few studies available indicate an interplay between motivational and emotional processes within self-regulated learning and the importance of motivational regulation for outcomes beyond achievement. Prior research has mostly focused on frequency of strategy use, but recent findings advocate for conceptually broader approaches to self-regulation. We adopted a three-component approach to motivational regulation differentiating between frequency of strategy use, situation-specific fit, and application quality, and examined their relations with perceived regulatory effectiveness as a proximal and well-being as a distal correlate in two studies with university students ($N_1 = 234$; $N_2 = 890$, representatively stratified quota sample). All three components contributed additively and, in part, interactively to effectiveness and well-being. Effectiveness was also related to greater well-being. The findings have implications for motivational regulation theories and well-being interventions.

Educational relevance and implications statement

This research expands our knowledge about three core components of motivational regulation and their relations with students' affective and cognitive well-being. Results of two studies, one of them involving a representatively stratified quota sample, indicate that the frequency of strategy use, the situation-specific fit between regulation strategies that are used and the motivational problems they target, and the application quality of strategy use are connected to more positive and less negative emotional experiences, and to higher study and life satisfaction. In conclusion, promoting students' motivational regulation competencies – not only in terms of knowing which strategies are available, but also in which situations and how to use them – should be considered for fostering not only academic success and motivation, but also students' well-being.

1. Introduction

Multiple studies have identified motivational regulation as an important predictor of study motivation and academic success (Kryshko et al., 2020; Schwinger et al., 2009; Steuer et al., 2019; Wolters, 1998, 1999). In contrast, the potential impact of motivational regulation for emotional outcomes and students' well-being has received little empirical attention to date, despite initial theorizing about these linkages (e.g., Zimmerman & Schunk, 2008). As motivation and emotion share common antecedents such as expectancy-, control-, and value-related appraisals, and as motivational regulation targets these appraisals, it seems likely that motivational regulation might influence not only motivation and learning behavior, but affective processes and well-being as well. From this perspective, the impact and thus importance of motivational regulation may be more far-reaching than currently depicted in the literature. There is a limited number of studies that provide initial evidence for linkages between motivational regulation and well-being (e.g., Grunschel et al., 2016; Kryshko et al., 2022). However, these studies have focused solely on the *frequency of motivational regulation strategy use*, while recent research indicates that the relative effectiveness of students' motivational self-regulation also depends on additional aspects of strategy implementation, including the

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situation-specific fit between used regulation strategies and motivational problems (e.g., Steuer et al., 2019), and the *application quality of motivational regulation strategies* (e.g., Engelschalk et al., 2017). Building on these findings, we conducted two studies examining the interrelations between students' frequency of strategy use, the situation-specific fit, and the application quality of motivational regulation strategies, as well as affective and cognitive facets of their well-being as distal outcomes of motivational regulation. Perceived regulatory effectiveness was additionally included as a core proximal consequence of motivational regulation (Engelschalk et al., 2016). Herein, our aim was to provide more nuanced insight into linkages between different components of motivational self-regulation with outcomes beyond academic performance and the interplay between motivational and emotional processes within self-regulated learning. Such insights can help inform support programs which foster students' self-regulation, well-being, and their academic flourishing.

1.1. A three-component approach to motivational regulation

Motivational regulation is conceptualized as encompassing all deliberate activities aiming to initiate, maintain, or increase motivation to achieve a certain task or goal (e.g., Wolters, 2003). It can also be seen as a process in which learners constantly monitor their motivation in order to deal with motivational problems as soon as they arise (Miele & Scholer, 2017; Schwinger & Stiensmeier-Pelster, 2012). To manage motivational problems within this process, learners can apply motivational regulation strategies such as ability-focus self-talk (enhancing self-awareness of own abilities or actively remembering how similar situations have been handled successfully in the past), enhancement of personal significance (increasing awareness of links between a task and one's own life), or proximal goal setting (splitting a large or complex task into smaller parts to facilitate achievability).

Past theorizing as well as research indicate that the frequency of use of such strategies can have positive effects on several aspects connected to students' learning. Several studies reported positive links between frequency of strategy use and aspects of student motivation (e.g., goal orientations, value, self-efficacy) as well as their use of cognitive and metacognitive strategies (Wolters, 1998, 1999; Wolters & Benzon, 2013). In terms of learning behavior, effort and persistence also have been shown to be positively influenced by frequency of strategy use; moreover, observed effects on academic success in terms of achievement and dropout intentions were mostly mediated by effort (Kryshko et al., 2020; Schwinger et al., 2009, 2012; Schwinger & Stiensmeier-Pelster, 2012). However, interestingly, the effects of frequency of strategy use on different aspects of learning were often lower than expected (Engelschalk et al., 2017). Building on this observation, scholars have recently identified two additional components that influence regulatory success, beyond frequency of strategy use.

First, the applied strategies must be suitable for targeting the specific motivational problem and the situation at hand. For example, ability-focus self-talk should be more suitable for motivational problems related to low expectancy of success rather than low subjective value (Wolters, 1998, 1999). If students are not motivated to prepare for an exam because they do not believe that they will pass successfully, reflecting on one's past accomplishments such as mastering previous exams is likely to increase their motivation, as it increases expectancy of success. However, if these students are not motivated for exam preparation because they perceive the exam topic as boring or useless, strategies that aim to increase the topic's perceived value will be more suitable (e.g., enhancement of personal significance). Schwinger and Stiensmeier-Pelster (2012) included the component of strategy fit concerning the nature of the motivational problem in their process model within a monitoring subphase in which learners determine the reason for the motivational problem they are facing and choose a strategy accordingly. Apart from the nature of the motivational problem (e.g., expectancy vs. value problems), the learning phase during which the problem occurs (e.g., pre-actional or actional phase) can also influence strategy suitability because they impose different tasks and possible motivational challenges onto learners (Schmitz & Wiese, 2006): While the pre-actional phase requires learners to define goals and plan their strategy use, for example, monitoring and maintaining one's motivation takes precedence in the actional phase.

Essentially, this situation-specific fit component of motivational regulation reflects that learners are required to have knowledge about the fit between used regulation strategies and motivational problems and to apply this conditional strategy knowledge when selecting a motivational regulation strategy (Paris et al., 1983; Steuer et al., 2019). In a similar vein, Miele and Scholer (2017) posit that metamotivational knowledge about one's self, tasks and strategies are key determinants of motivational regulation strategy selection, an idea that is closely related to the notion of situation-specific strategy fit. In a cross-sectional study with undergraduate students, using a situational judgment test, Steuer et al. (2019) found positive relations between knowledge about situation-specific fit and perceived regulatory effectiveness as well as effort above and beyond the (rather small) relations for frequency of strategy use. Two diary study with university students by Bäulke et al. (2021) replicated that strategy fit has unique effects on learning behavior, in this case the development of procrastinatory behavior.

Second, regulatory success should also depend on the quality of strategy application. High application quality entails that all motivational regulation processes are being optimally controlled by using metacognitive processes such as planning, coordinating, implementing, monitoring, and adapting ineffective strategy use (e.g., Pintrich, 2000; Zimmerman, 2000) and that strategy use is accurate as well as target-oriented, and consequently, effective. For example (cf., Engelschalk et al., 2017), during exam preparation, university students might engage in ability-focus self-talk to improve their expectancy of success, and consequently, study motivation. By monitoring changes in their motivation and evaluating the effectiveness of strategy implementation, they might perceive a need for strategy adaption, due to unchanged low motivation, to make their strategy use more target-oriented: Instead of choosing an ill-fitting comparison (e.g., accomplishments in high school), they should rather reflect on own accomplishments closely linked to this exam (e.g., completing all exercises in the course for this exam). In addition to this control process, planning their strategy use and setting implementation intentions to apply ability-focus self-talk whenever thoughts about failure come to mind could improve application quality further. In conclusion, application quality is assumed to be essential for successful motivational regulation. The component of application quality is also alluded to in the process model by Schwinger and Stiensmeier-Pelster (2012). In a study with undergraduate students, Engelschalk et al. (2017) revealed positive relations between application quality of motivational regulation strategies and perceived regulatory effectiveness, effort, and academic achievement. In a diary study with university students during exam preparation, Eckerlein et al. (2019) reported positive effects of frequency of strategy use and application quality on effort in exam preparation and exam performance as well as a moderating effect of only application quality on negative effects of motivational difficulties on invested effort, meaning that students with higher application quality reported more invested effort even if motivational difficulties arose during exam preparation.

In conclusion, three components of motivational regulation have been identified so far. However, contemporary process models of motivational regulation have considered only select parts of the three-component approach to motivational regulation. To the best of our knowledge, there is no model incorporating all three, although it is theoretically reasonable that all three components are important in concert and that each component provides unique aspects and adds to effective regulation of motivational problems while studying. Above and beyond additive effects of each of the three components, interactions between them are in line with theoretical deliberations. It can be assumed that learners must implement each component at least to a

certain degree for effectively regulating one's motivation. In particular, a high frequency of strategy use may not be effective when exclusively non-suitable strategies are used or application quality is completely lacking. So far, there is no research on potential interactions between the three components.

Previous research has provided initial support for the assumption that all three components are relevant to motivational regulation, learning behaviors and academic achievement. Furthermore, those findings also show that all three components – as expected – have effects on a core proximal construct: perceived regulatory effectiveness, that is, learners' perceptions of to which extent motivational difficulties can be overcome. Perceived regulatory effectiveness is thus a subjective measure for learners' perceived success at dealing with motivational challenges by applying motivational regulation strategies. Perceived regulatory effectiveness, in turn, determines effects of motivational regulation on more distal outcomes, such as learning behaviors, achievement, and well-being. Both Engelschalk et al. (2017) and Steuer et al. (2019) provided evidence that perceived regulatory effectiveness mediated the effects between components of motivational regulation and learning behaviors and academic achievement. This observation is in line with other studies that reported indirect rather than direct effects of motivational regulation on academic achievement, study dropout intentions, and well-being (Bäulke et al., 2018; Grunschel et al., 2016; Schwinger et al., 2009).

1.2. Linkages between motivational regulation and subjective well-being

Motivational regulation has emerged as a topic of research almost entirely independent from research on emotion regulation so far despite motivation and emotion being closely linked concepts and despite similarities between definitions of motivational regulation and emotion regulation: Both motivational regulation and emotion regulation efforts aim at achieving a desired motivational or emotional state by applying certain strategies more or less consciously (Gross, 2015; Harley et al., 2019; Wolters, 2003). Only recently have there been efforts to systematically connect research on motivational regulation and emotion regulation (Stockinger et al., in press). On a similar note, although accumulating evidence corroborates that motivational regulation is an important predictor of study motivation and academic success, little is known about the potential impact of motivational regulation for emotional outcomes and students' well-being, despite initial hypotheses about these relations: For instance, in outlining his seminal taxonomy of motivational regulation strategies, Wolters (2003) explicitly linked self-consequating (setting positive incentives for oneself) as a motivational regulation strategy that may increase students' general well-being. Specifically, he refers to findings by Heiby (1981, 1983) that link higher levels of depression with less frequent use of self-reinforcement. Furthermore, Zimmerman and Schunk (2008) argue that motivational regulation should be positively related to positive emotional experiences and negatively to negative emotional experiences building on early research on the influences of self-regulation strategies on affective outcomes such as depression, elation or self-satisfaction.

Emotional experiences are, in turn, a core element of subjective well-being. Subjective well-being pertains to individuals' evaluations of their lives and can be conceptualized as a multidimensional construct (Diener et al., 2009; Marsh et al., 2020). Following Diener et al. (2009), subjective well-being comprises affective as well as cognitive facets that are related but contribute uniquely to a person's subjective well-being. In the context of higher education, affective facets of subjective well-being comprise both positive and negative emotional experiences such as study-related joy, hope, boredom, or anxiety. There are different approaches to conceptualizing affective subjective well-being in the literature – recent research on emotions in higher education underscores that students' emotional experiences are best conceptualized and captured in terms of discrete positive and negative emotions (Pekrun et al., 2023). In terms of cognitive facets in the context of higher education, students' domain satisfaction refers to students' satisfaction with their academic lives in this context, while general life satisfaction encompasses evaluations of one's life overall.

The idea that motivational regulation may also impact students' affective and cognitive subjective well-being, as implied by Zimmerman and Schunk (2008), is grounded in the close connections between student motivation and emotion. Past theorizing and research have shown that both motivation and emotion are integral components of students' learning, achievement, and well-being that interact closely and share common conceptual as well as functional characteristics (Eccles & Wigfield, 2020; Meyer & Turner, 2006; Pekrun, 2023). A brief comparison of core propositions of two major theories on student motivation and emotion, namely expectancy-value theory (EVT; Eccles & Wigfield, 2020) and control-value theory (CVT; Pekrun, 2018), illustrates these linkages. According to EVT, students are motivated for a task when they believe that they can master the task successfully (expectancy of success) and when they see value in that task (task value). According to CVT, students experience different achievement emotions depending on their perceptions of control over learning tasks and their outcomes, which can include their expectancy for success, and on their perceptions of task and outcome values. Students experience subjective control when they believe themselves to be able to control the situation at hand. Control-related appraisals can entail expectancy of success and current perceptions of control within a situation. Value-related appraisals pertain to whether students perceive a learning task or outcome as positive or negative as well as how important or significant they perceive the task or outcome.

As such, antecedents of motivation as well as emotions we experience in learning and achievement situations clearly overlap. As several motivational regulation strategies directly target expectancy- and value-related appraisals, motivational regulation may affect not only motivation, but emotional experience as well. For example, applying ability-focus self-talk when working on a difficult task increases students' expectancy of success by reminding them of relevant abilities and resources for the task at hand. In addition, this should also increase their perceived control over the learning situation, and consequently reduce anxiety and foster hope and joy. Similarly, enhancing personal significance when working on a boring task increases students' perceived value of this task by making them aware of connections between the task and their personal goals. This should also increase value-related appraisals relevant for achieving emotions, and consequently reduce boredom and foster joy.

Furthermore, satisfaction with one's studies might be positively influenced by motivational regulation if the strategies used boost students' expectancy of success and perceived value in their studies, as these appraisal patterns may also facilitate more positive evaluations of their overall academic lives. This assumption is supported by the model of Miele and Scholer (2017) who link motivational regulation with expectancy- and value-related aspects of motivation as well as previous research reporting positive associations of study motivation in terms of expectancy of success and value with aspects of study satisfaction in longitudinal studies with undergraduate STEM students (Fleischer et al., 2017; Fleischer et al., 2019).

Lastly, on a fundamental level, Emmons (1996) points out that the attainment of personally meaningful goals that are consistent with one's self is a key factor for subjective well-being. As motivation plays an important role for setting (meaningful) goals and supports our striving for goals (e.g., via increased persistence and effort; Rheinberg & Vollmeyer, 2012), improving motivation via motivational regulation strategies may also have a positive effect on subjective well-being on a general level. In conclusion, it can be argued that regulating motivation may not only influence students' motivation, but also affective and cognitive subjective well-being.

In general, subjective well-being is associated with a variety of positive outcomes including, but not limited to, academic achievement (e.g., better health; Diener et al., 2018; Lyubomirsky et al., 2005), and

thus a focal target for interventions aiming to support students on their academic journeys. Consequently, from a practical perspective, examining its relations with students' motivational self-regulation is important in that it provides insight into a possible means for promoting subjective well-being among students in higher education.

1.3. Prior research on linkages between motivation regulation and subjective well-being

Few studies provide initial evidence for the assumption that motivational regulation can influence students' affective and cognitive subjective well-being. Grunschel et al. (2016), and Kryshko et al. (2022) examined relations between the frequency of use of different motivational regulation strategies and subjective well-being. A longitudinal study by Kryshko et al. (2022) over four consecutive semesters with university students enrolled in different majors revealed positive interrelations between the frequency of strategy use and aspects of study satisfaction at the between-person level. In a cross-sectional study with university students, Grunschel et al. (2016) found positive relations between the frequency of overall use of motivational regulation strategies and affective and cognitive subjective well-being in terms of positive and negative affect and study as well as life satisfaction. The frequency of use of each strategy individually (except performance-avoidance self-talk) was positively related to subjective well-being as well. Moreover, these relations were mediated by academic procrastination (except for self-consequating and environmental control). Performance-avoidance self-talk had a negative indirect effect on satisfaction via procrastination. Although these studies provided important initial evidence on the effects for motivational regulation on subjective well-being, they considered solely frequency of motivational regulation strategy use. Furthermore, affective facets of subjective well-being were either not considered at all, or only in terms of general positive or negative affect, but not in terms of discrete study-related emotions which form core affective units of students' academic lives.

1.4. The present research: aims and hypotheses

Previous research on the relation between motivational regulation and subjective well-being has solely focused on the frequency of strategy use, and is largely limited to relations with cognitive facets of subjective well-being. However, there is growing recognition that besides the frequency of strategy use, the situation-specific fit between used regulation strategies and motivational problems, and the application quality of motivational regulation strategies, are also important determinants of the perceived effectiveness of students' motivational regulation (e.g., Engelschalk et al., 2017; Steuer et al., 2019). The present research systematically examined linkages of these three components of students' motivational self-regulation with both affective and cognitive facets of subjective well-being. Herein, we sought to advance our theoretical understanding of the potential outcomes of motivational regulation and its relevance for important student outcomes beyond academic performance.

Frequency of strategy use was conceptualized on a general level across various motivational regulation strategies, as we focused on examining motivational regulation on the more general level of competencies that make motivational regulation successful. Regarding affective subjective well-being, as research suggests that students' emotional experiences are best conceptualized and captured in terms of discrete positive and negative emotions compared to affect (Pekrun et al., 2023), we selected four discrete achievement emotions to conceptualize positive and negative emotional experiences, namely anxiety, boredom, hope, and joy. With this selection, we address two positive and two negative relevant achievement emotions that are among the most frequently reported emotions in academic settings and that have been shown to be closely related to achievement and health (e.g., Pekrun et al., 2002; Pekrun et al., 2023). As, according to the taxonomy by Pekrun et al. (2023), not only valence, but also the object focus of achievement emotions play a role in determining the antecedents and functions of achievement emotions, our selection also includes two activity and two outcome emotions. The concept of object focus parallels the learning phase relevant in the process of motivational regulation here: corresponding to the preactional learning phase, anxiety and hope are prospective outcome emotions that are determined by expectancy of success; corresponding to the actional learning phase, boredom and joy are activity emotions that are determined by current perceptions of control within a situation. Furthermore, we conceptualized cognitive subjective well-being with two aspects following multidimensional conceptualizations of subjective well-being (Diener et al., 2009; Marsh et al., 2020): study satisfaction as a domain-specific facet of cognitive subjective well-being, and general life satisfaction.

Four hypotheses were investigated. First, in line with previous research (Engelschalk et al., 2017; Steuer et al., 2019), all three components of motivational regulation (frequency of strategy use, situation-specific fit, and application quality) should make a specific contribution to the overall perceived effectiveness of motivational regulation and be related to perceived regulatory effectiveness positively (Hypothesis 1), as we assume that each aspect of motivational regulation is relevant for successfully dealing with motivational challenges. Second, as all three components of motivational regulation contribute to the process of motivational regulation that targets beliefs and appraisals relevant for students' subjective well-being, we hypothesized that all three components of motivational regulation are related to students' affective and cognitive subjective well-being. Specifically, a more frequent, fitting, and well-executed use of motivational regulation strategies should be associated with the experience of more positive and less negative achievement emotions and higher cognitive subjective well-being (Hypothesis 2a). Furthermore, perceived regulatory effectiveness should be negatively linked to anxiety and boredom, and positively linked to hope, joy and cognitive subjective well-being (study satisfaction, general life satisfaction; Hypothesis 2b), as effective motivational regulation should influence subjective appraisals that are also highly relevant to subjective well-being. Third, we hypothesize that the interrelations between the components of motivational regulation and different facets of subjective well-being are in line with the theoretical assumption that the various components of motivational regulation contribute first of all to a core proximal consequence of motivational regulation, perceived regulatory effectiveness, which contributes to the various aspects of subjective well-being as theoretically more distant consequences of motivational regulation (Hypothesis 3).

Lastly, we assume that, while each motivational regulation component contributes a unique aspect to effective regulation, their functions also depend on each other, implying that they interact in predicting overall perceived regulatory effectiveness. Therefore, we hypothesize that interactions between the different pairs of components of motivational regulation additionally predict perceived regulatory effectiveness (Hypothesis 4). In particular, we hypothesize that higher frequency of strategy use is not effective when either situation-specific fit (Hypothesis 4a) or application quality (Hypothesis 4b) are low. Moreover, we hypothesize that situation-specific fit can compensate for a lack of application quality, and vice versa, to some degree (Hypothesis 4c) as selecting suitable strategies, and monitoring and controlling strategy application are two aspects of good strategy use and thus can compensate each other.

Two empirical studies were conducted with university students to test the proposed relations. While Study 1 focused on undergraduate STEM students and served to test Hypotheses 1, 2 and 3, Study 2 was based on a larger, representatively stratified quota sample of university students and served to examine the robustness and replicability of our findings in Study 1 as well as test Hypothesis 4.

2. Study 1

2.1. Participants and procedure

In Study 1, undergraduate STEM students at a German university were invited to an online survey in the first session of a computer science lecture that was mandatory for their study program. Two hundred thirty-four students (28.8 % female, Age: $M = 21.0$; $SD = 3.0$) completed the survey in which they reported on their motivational regulation and subjective well-being, and were included in the final sample. Of these students, 85.9 % were enrolled in computer science bachelor degree programs, 8.4 % in mathematics bachelor degree programs, and 4.7 % in a physics bachelor degree program. On average, they were enrolled in the third semester of their study program ($M = 3.1$; $SD = 2.1$). Prior to the study, students were informed of the purpose of the study and data protection measures and provided informed consent. The procedure was covered by institutional review board approval. Students received 5 Euro for participating.

2.2. Measures

Internal consistencies for all measures are reported in Table 1 and were acceptable.

2.2.1. Motivational regulation

2.2.1.1. Frequency of motivational regulation strategy use. We assessed the frequency of strategy use with a well-established German questionnaire developed by Schwinger et al. (2007; an English version can be found in Schwinger et al., 2009) which builds on Wolters' (2003) taxonomy of motivational regulation strategies covering eight motivational regulation strategies (three to five items per strategy): enhancement of situational interest (e.g., "I consider a way to make work more entertaining"), enhancement of personal significance (e.g., "I look for connections between the tasks and my life as such"), mastery self-talk (e.g., "I persuade myself to work intensely for the sake of learning"), performance-approach self-talk (e.g., "I call my attention to the fact of how important it is to obtain good grades"), environmental control (e.g., "I make sure that distractions occur as seldom as possible"), self-consequating (e.g., "I promise myself that, after work, I will do something that I like"), and proximal goal setting (e.g., "I approach work step-by-step in order to get the feeling that I proceed well"). The strategy of performance avoidance self-talk that is also included in Schwinger et al.'s instrument was not included as several studies have identified it as maladaptive (e.g., Grunschel et al., 2016; Schwinger & Otterpohl, 2017). In line with Engelschalk et al. (2015), four additional items were used to measure the frequency of strategy use for ability-focus self-talk (e.g., "I tell myself that I have always mastered similar situations well so far"). The 31 items in total were answered on a Likert-type scale ranging from 1 (*very rare/never*) to 5 (*very often*). A total mean score reflecting the frequency of motivational regulation strategy use was computed in accordance with Schwinger et al. (2009) by averaging the scores for all assessed strategies.

2.2.1.2. Situation-specific fit between used regulation strategies and motivational problems. Situation-specific fit was assessed with a short version of the Situational Judgment Test (SJT) developed by Steuer et al. (2019). This SJT tests students' conditional motivational regulation strategy knowledge to gauge situation-specific fit of motivational regulation strategies. The instrument uses a standardized scenario-based approach in which students are asked to imagine themselves experiencing specific motivational problems described in short vignettes (e.g., "You are faced with the task of writing a term paper. Therefore, you have to independently search for literature and write an academic text for a specific deadline. The content you have to work with is boring (e.g., uninteresting, scarcely useful, not important). This is why you are not motivated to begin."). In line with Bäulke et al. (2018), we selected five vignettes pertaining to typically encountered motivational problems while studying which differ in the motivational quality of the problem at hand (task value or expectancy problem; Engelschalk et al., 2017), in terms of whether motivation is low for either initiating or maintaining a learning activity, and in the type of study task (studying for an exam or writing at term paper; Dresel et al., 2015; Steuer et al., 2019). The order of presentation of the vignettes was randomized. After reading each vignette, students rated the suitability of nine motivational regulation strategies to deal with the motivational problem at hand on a Likert-type scale ranging from 1 (*not suitable at all*) to 6 (*completely suitable*). These included all strategies that were also assessed for the measurement of frequency of strategy use. The instrument by Steuer et al. (2019) uses standards identified via expert ratings (included in these standards were strategies that were consistently seen as unambiguously functional or unambiguously dysfunctional). Based on these expert standards, students' ratings about the suitability of motivational regulation strategies were compared via pair comparison scores within each vignette: A high comparison score reflects that a student rated a functional strategy as very suitable and a dysfunctional strategy as not suitable, which indicates good conditional knowledge about the situation-specific fit between used regulation strategies and motivational problems. Overall, 19 pair comparison scores were computed across all vignettes. Their average serves as the single indicator for the situation-specific fit.

2.2.1.3. Application quality of motivational regulation strategies. Application quality was measured with an established instrument developed by Engelschalk et al. (2017) which encompasses five items for each of the five vignettes described in Section 2.2.1.2. The scale covers target orientation, implementation accuracy, and control (i.e., monitoring

Table 1
Descriptive statistics and internal consistencies for Studies 1 and 2.

		Study 1				Study 2			
	Potential range	Actual range	*M*	*SD*	α	Actual range	*M*	*SD*	α
Motivational regulation									
Frequency of strategy use	1–5	1.2–4.5	3.3	0.6	.74	1.0–5.0	3.4	0.6	.75
Situation-specific fit	–5–5	−3.0–4.2	1.6	1.3	.93	−3.6–4.5	1.6	1.2	.93
Application quality	1–6	1.0–6.0	3.4	1.2	.93	1.0–6.0	3.5	1.1	.91
Perceived regulatory effectiveness	1–6	1.0–6.0	4.0	1.1	.88	1.0–6.0	3.8	1.0	.87
Subjective well-being									
Anxiety	1–5	1.0–5.0	3.0	1.0	.82	1.0–5.0	3.2	1.0	.77
Boredom	1–5	1.0–5.0	3.0	0.9	.77	1.0–5.0	3.1	0.9	.75
Hope	1–5	1.0–5.0	3.3	0.9	.82	1.0–5.0	3.3	0.9	.83
Joy	1–5	1.0–5.0	3.3	0.8	.71	1.0–5.0	3.3	0.8	.67
Study satisfaction	1–6	1.2–6.0	3.9	0.9	.85	1.0–6.0	3.7	0.9	.85
Life satisfaction	1–10	1.0–10.0	6.6	2.1	–	1.0–10.0	6.5	1.9	–

Note. Study 1: $N = 234$; Study 2: $N = 890$. Life satisfaction was assessed with a single-item measure.

one's strategy use). A sample item reads: "When I use this strategy, I check regularly to determine if my motivation is improving or not". After reading each vignette, students were asked to describe a strategy they would use to increase their motivation in the described situation and then rate their agreement with the five statements regarding this strategy on a Likert-type scale ranging from 1 (*completely disagree*) to 6 (*completely agree*). Overall, 25 items (5 items across 5 vignettes) were averaged into a single indicator for application quality. The instrument is conceptualized as a unidimensional measure of application quality of motivational regulation strategies (see supplemental materials, Tables S9 and S10 for supporting evidence from CFA analyses).

2.2.1.4. Perceived effectiveness of motivational regulation. Perceived effectiveness of motivational regulation was measured with two items ("In this situation I am able to motivate myself", "In this situation I am able to control my motivational problem"; Engelschalk et al., 2017) that also were presented for each of the five vignettes described in Section 2.2.1.2. Students rated their agreement with these statements on a Likert-type scale ranging from 1 (*disagree completely*) to 6 (*agree completely*). Overall, ten items (2 items across 5 vignettes) were averaged into a total score indicating perceived regulatory effectiveness.

2.2.2. Subjective well-being

Following multidimensional conceptualizations of subjective well-being (Diener et al., 2009; Marsh et al., 2020), affective facets in the form of achievement emotions and cognitive facets in terms of study satisfaction and general life satisfaction were measured.

As facets of affective subjective well-being, we measured two positive and two negative achievement emotions using a validated short version of the Achievement Emotions Questionnaire (AEQ-S; Bieleke et al., 2021) with four items for each emotion. These included anxiety (e.g., "When I study I am anxious and nervous"), boredom (e.g., "I am bored with the work for my studies"), hope (e.g., "I am confident when learning"), and joy (e.g., "I enjoy engaging with the subject matter"). All items were answered on a Likert-type scale ranging from 1 (*disagree completely*) to 5 (*agree completely*).

In terms of cognitive subjective well-being, we assessed study satisfaction and general life satisfaction. Study satisfaction was measured with ten items pertaining to satisfaction with study subjects (e.g., "Overall, I am satisfied with my current study subject") or satisfaction with study conditions (e.g., "I wish that study conditions were better at my university") or satisfaction with coping with study-related stress (e.g., "I often feel tired and exhausted due to my studies"; Schiefele & Jacob-Ebbinghaus, 2006). Responses ranged from 1 (*disagree completely*) to 6 (*agree completely*). For our analyses, the total score of all items was computed. Life satisfaction was measured with a one-item-scale ("How satisfied are you at present, all in all, with your life?"; Beierlein et al., 2014) that was answered on a scale from 1 (*not satisfied at all*) to 10 (*completely satisfied*). As it offers a reliable and valid as well as economic measurement of general life satisfaction, we chose this one-item-scale.

2.3. Analyses

The hypotheses were tested using structural equation modeling (SEM) in R (version 4.2.1; R Core Team, 2022) with the lavaan package (v.06-15; Rosseel, 2012). As all items were mandatory in the online tool, there were no missing data on item level for students who completed the survey. All constructs aside from life satisfaction (single-item measure) were assessed on a latent level. Following a priori decision for data analysis, we parceled all variables except life satisfaction following the item-to-construct balance approach with two parcels per construct (Little et al., 2002), as our research questions focus on the relationships between latent variables, and not between latent variables and their measures, and parceling offers several benefits in terms of model estimation and the psychometric qualities of parcels compared to individual items (cf., Little et al., 2013). As the distributions of some variables (hope and life satisfaction) were moderately left-skewed, we treated all variables as ordered categorical variables and the Means and Variance Adjusted Weighted Least Squares Estimator (WLSMV) was used.

First, we specified the Correlational Model in which latent correlations between all variables were estimated to test hypotheses H1, H2a, and H2b. To test hypothesis H3, we specified the Additive Structural Model including the hypothesized relations (i.e., main effects) between the three motivational regulation components (frequency of strategy use, situation-specific fit, application quality), perceived regulatory effectiveness, and the various facets of subjective well-being. Due to our hypotheses being directed, we used one-sided testing. We applied the guidelines proposed by Gignac and Szodorai (2016) to interpret the magnitude of effects (r = .10, .20, and .30 as benchmarks for small, moderate, and large effects, respectively), as they are empirically grounded in meta-analytically derived correlations in the personality psychology literature.

2.4. Results and discussion

2.4.1. Descriptive statistics

The descriptive statistics for all variables in Study 1 can be found in Table 1.

On a descriptive level, all measured constructs had means slightly above the midpoint of the rating scale. All measured constructs had relatively large variances and ranges, indicating considerable interindividual differences between students.

2.4.2. Relations between motivational regulation components and perceived regulatory effectiveness

The Correlational Model showed an excellent fit to the data (χ^2 = 78.19; df = 108; p = .986; RMSEA = 0.000; CFI = 1.000; TLI = 1.011; SRMR = 0.042).[1] A TLI index above 1 is not unusual and might result from the rather small sample in relation to the number of estimated parameters in Study 1 (Anderson & Gerbing, 1984). The latent correlations for all variables in Study 1 can be found in Table 2.

In line with Hypothesis 1a, frequency of strategy use, situation-specific fit, and application quality were significantly and positively correlated with perceived regulatory effectiveness (ranging between .33 and .72; large effects).

2.4.3. Relations between motivational regulation components and subjective well-being

Frequency of strategy use, situation-specific fit, and application quality were significantly and negatively correlated with anxiety and boredom (ranging between −.13 and −.38; small to large effects) and significantly and positively with hope, joy, study satisfaction, and life satisfaction (ranging between .20 and .60; moderate to large effects). Taken together, the latent correlations between the three motivational regulation components and all facets of subjective well-being and their magnitude in terms of effect sizes corroborate Hypothesis 2a.

Perceived regulatory effectiveness as a core proximal outcome of motivational regulation was significantly and negatively correlated with anxiety and boredom (−.38 and −.52; large effects), and significantly and positively with hope, joy, study satisfaction, and life satisfaction (ranging between .35 and .65; large effects; Hypothesis 2b).

2.4.4. Relations between motivational regulation components, perceived regulatory effectiveness and subjective well-being

The Additive Structural Model showed an excellent fit to the data as well (χ^2 = 120.96; df = 126; p = .610; RMSEA = 0.000; CFI = 1.000; TLI = 1.002; SRMR = 0.052). Fig. 1 displays the estimation of the

[1] Factor loadings, residual variances, and residual correlations for the model in both Studies 1 and 2 are provided in the electronic supplement.

Table 2
Latent correlations resulting from the correlational model for Studies 1 and 2.

	1	2	3	4	5	6	7	8	9	10
1. Frequency of strategy use		.31*	.54*	.50*	.12*	−.20*	.57*	.62*	.18*	.23*
2. Situation-specific fit	.38*		.10*	.20*	−.11*	−.29*	.11*	.20*	.20*	.04
3. Application quality	.65*	.20*		.68*	−.09*	−.21*	.41*	.40*	.17*	.24*
4. Perceived regulatory effectiveness	.60*	.33*	.72*		−.34*	−.37*	.58*	.52*	.40*	.35*
5. Anxiety	−.16*	−.19*	−.13*	−.38*		.54*	−.60*	−.21*	−.57*	−.42*
6. Boredom	−.38*	−.35*	−.37*	−.52*	.48*		−.41*	−.47*	−.50*	−.25*
7. Hope	.60*	.30*	.49*	.65*	−.68*	−.48*		.70*	.47*	.45*
8. Joy	.58*	.29*	.45*	.54*	−.13	−.54*	.62*		.35*	.30*
9. Study satisfaction	.23*	.28*	.20*	.35*	−.75*	−.43*	.65*	.34*		.53*
10. Life satisfaction	.38*	.23*	.28*	.42*	−.59*	−.34*	.64*	.36*	.58*	

Note. Study 1: $N = 234$; Study 2: $N = 890$. Correlations of Study 1 are depicted below the diagonal, correlations of Study 2 above.
* $p < .05$ (one-tailed).

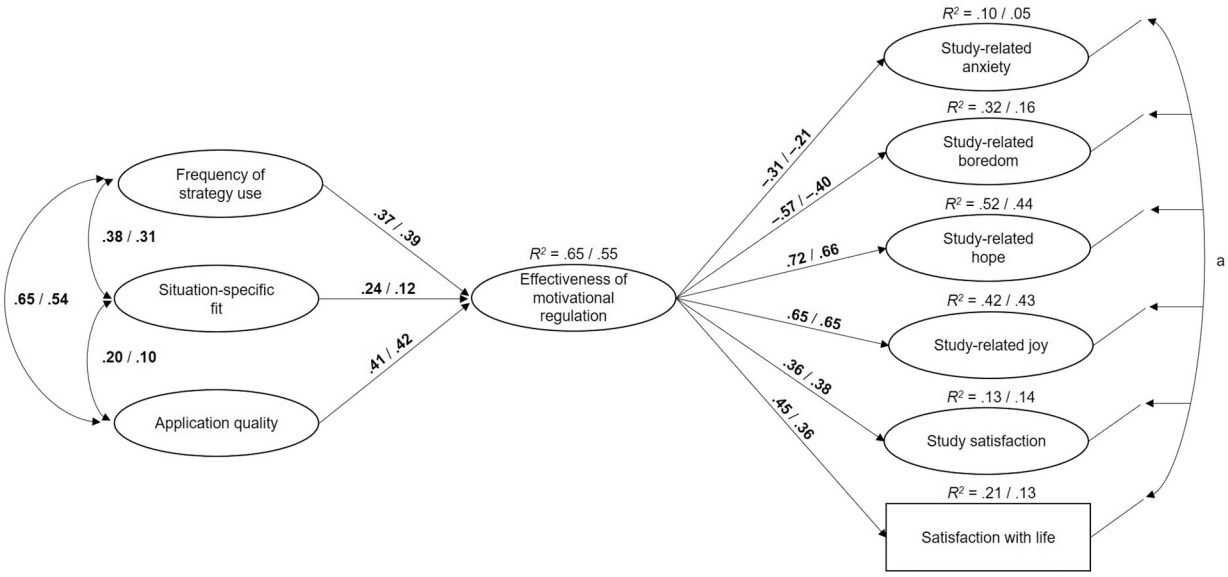


Fig. 1. Estimation of the hypothesized Additive Structural Model in Studies 1 and 2 with standardized coefficients and correlations between predictors.

hypothesized Additive Structural Model in Study 1 with standardized coefficients and correlations between predictors.

According to Hypothesis 3, the three motivational regulation components should contribute first of all to a core proximal consequence of motivational regulation, perceived regulatory effectiveness, which contributes to the various aspects of subjective well-being as theoretically more distant consequences of motivational regulation. In line with this hypothesis, all three motivational regulation components also had unique effects on perceived regulatory effectiveness in the Structural Model (large effects for frequency of strategy use and application quality, moderate effect for situation-specific fit). Effectiveness, in turn, was negatively linked with anxiety and boredom (large effects), and positively linked with hope, joy, study satisfaction, and life satisfaction (large effects).

For a more parsimonious model, direct paths between the three motivational regulation components and the facets of subjective well-being were not estimated in the Structural Model displayed in Fig. 1. In addition to this model, we also estimated a model without perceived regulatory effectiveness, that is, a model including paths from all three motivational regulation components to all facets of subjective well-being. This model revealed again, that all three motivational regulation components are relevant for affective and cognitive subjective well-being in that they are significantly linked to several of the measured facets of subjective well-being. Details could be obtained from the electronic supplement.

In sum, the results in Study 1 indicate that a more frequent, fitting, and well-executed use of motivational regulation strategies and effective motivational regulation are connected to the experience of more positive and less negative achievement emotions as well as higher cognitive subjective well-being.

3. Study 2

3.1. Procedure and participants

Study 2 drew on a larger, representatively stratified quota sample to verify the initially observed patterns in Study 1 and included 890 students (56 % female, Age: $M = 23.6$; $SD = 4.4$) from multiple German universities who completed the online survey. Of these students, 17.7 % were enrolled in humanities programs, 30.9 % in law, economics, or social sciences programs, and 38.4 % in STEM programs. They were on average in the fourth semester of their study program ($M = 4.4$; $SD = 2.7$). This multi-site sample is representatively stratified by type of higher education institution, semester, gender, and study subject area based on official data from the German Federal Statistical Office (Statistisches Bundesamt, 2021). The recruitment process included two steps: First, staff members and student representatives of 149 German universities and universities of applied sciences were asked to forward

the invitation to students at their university. Second, students were invited via university mailings lists. Participation was voluntary and students received gift vouchers (value: 5 Euro) for their participation. Prior to the study, students were informed of the purpose of the study and data protection measures and provided informed consent. The procedure was covered by institutional review board approval.

3.2. Measures

Study 2 employed the same measures as in Study 1 to assess frequency of motivational regulation strategy use, situation-specific fit between used regulation strategies and motivational problems, application quality of motivational regulation strategies and perceived effectiveness of motivational regulation, as well as affective and cognitive facets of subjective well-being. Again, internal consistencies for all measures were acceptable and can be found in Table 1.

3.3. Analyses

The analyses for Study 2 were conducted in a similar manner as in Study 1. Again, we specified a corresponding Correlational Model to test hypotheses H1, H2a, and H2b and a corresponding Additive Structural Model to test hypothesis H3. Additionally, to test hypothesis H4, we specified the Interactional Structural Model by adding the interaction terms of frequency and situation-specific fit (H4a), frequency and application quality (H4b) as well as situation-specific fit and application quality (H4c) to the Additive Structural Model in order to examine whether they predicted perceived regulatory effectiveness significantly (supporting synergistic relations). We used Latent Interaction Analysis in SEM in R (version 4.2.1; R Core Team, 2022) with the modsem package (v.1.0.1; Solem Slupphaug, 2024) for this analysis. There were no missing data on the item level for students who completed the survey, as all items were mandatory. As the distributions of application quality, perceived regulatory effectiveness, hope, and life satisfaction were moderately left-skewed, all variables were treated again as ordered categorical variables and the WLSMV estimator was applied. For modeling the latent interaction terms, we used a match-paired approach (Marsh et al., 2004) and the double-mean-centering strategy (e.g., Lin et al., 2010), as this strategy is also suitable if indicators are not normally distributed.

3.4. Results and discussion

3.4.1. Descriptive statistics

The descriptive statistics for all variables in Study 2 can be found in Table 1. For all measured constructs, means were slightly above the midpoint of the rating scale. All measured constructs had, descriptively, relatively large variances and ranges that indicate substantial interindividual differences between students.

3.4.2. Relations between motivational regulation components and perceived regulatory effectiveness

The Correlational Model showed an excellent fit to the data ($\chi^2 = 183.44$; $df = 108$; $p < .001$; RMSEA = 0.028; CFI = 0.993; TLI = 0.990; SRMR = 0.034). The latent correlations for all variables in Study 2 can be found in Table 2.

In line with Hypothesis 1, frequency of strategy use, situation-specific fit, and application quality were significantly and positively associated with perceived regulatory effectiveness (ranging between .20 and .68; large effects for frequency of strategy use and application quality, moderate effect for situation-specific fit).

3.4.3. Relations between motivational regulation components and subjective well-being

Anxiety was negatively correlated with situation-specific fit (−.11; small effect) and application quality (−.09), as expected, but positively with frequency of strategy use (.12; small effect), surprisingly. Frequency of strategy use, situation-specific fit, and application quality were significantly and negatively correlated with boredom (ranging between −.20 and −.29; moderate effects), and significantly and positively with hope, joy, and study satisfaction (ranging between .11. and .62; small to large effects), aligning with our assumptions for Hypothesis 2a. Life satisfaction was positively correlated with frequency of strategy use (.23) and application quality (.24; moderate effects). Taken together, however, these findings largely corroborate Hypothesis 2a and indicate that motivational regulation is linked with different facets of students' subjective well-being. Correlations between the three components of motivational regulation and all facets of subjective well-being and their magnitude in terms of effect sizes point to the significance of their interrelations.

As a core proximal outcome of motivational regulation, perceived regulatory effectiveness was significantly and negatively correlated with anxiety and boredom (−.34 and −.37; large effects), and significantly and positively related with hope, joy, study satisfaction, and life satisfaction (ranging between .35 and .58; large effects; Hypothesis 2b).

3.4.4. Relations between motivational regulation components, perceived regulatory effectiveness and subjective well-being

The hypothesized Additive Structural Model showed a good fit also to the data of Study 2 ($\chi^2 = 491.02$; $df = 126$; $p < .001$; RMSEA = 0.057; CFI = 0.968; TLI = 0.957; SRMR = 0.056). Its estimation is displayed in Fig. 1. In line with Hypothesis 3, frequency of strategy use, situation-specific fit, and application quality all had unique effects on perceived regulatory effectiveness in the Structural Model (large effects for frequency of strategy use and application quality, small effect for situation-specific fit). Effectiveness, in turn, was negatively linked with anxiety (moderate effect) and boredom (large effect), and positively linked with hope, joy, study satisfaction, and life satisfaction (large effects). Again, for a more parsimonious model, direct paths between the three motivational regulation components and the facets of subjective well-being were not estimated in the Structural Model (see Fig. 1). As in Study 1, an additionally estimated model without perceived regulatory effectiveness revealed that all three motivational regulation components are relevant for affective and cognitive facets of subjective well-being (see electronic supplement).

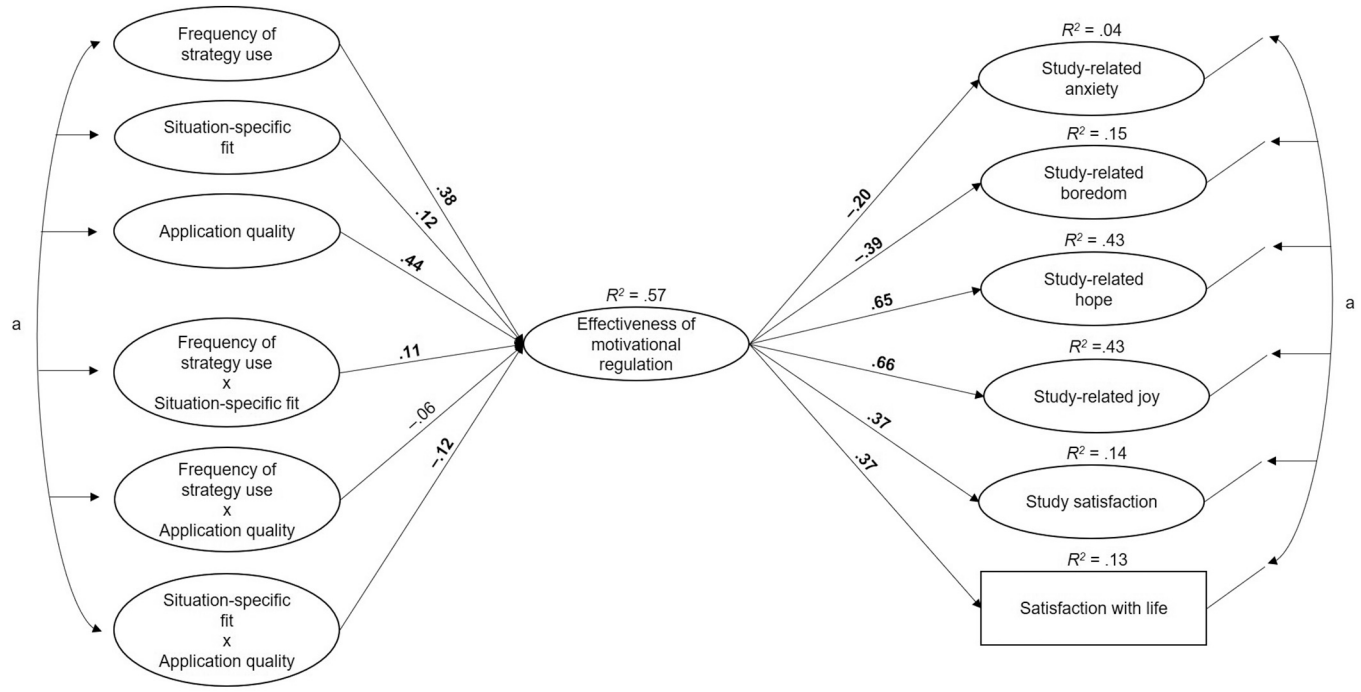
3.4.5. Interactions between motivational regulation components

For models with latent interaction terms, traditional fit indices are not provided. Nevertheless, as the additive baseline model showed a good fit to the data (see Section 3.4.4), this can also be assumed for the extended model. Fig. 2 shows the estimation of the hypothesized Interactional Structural Model with standardized coefficients.[2]

The relations between frequency of strategy use, situation-specific fit, and application quality with perceived regulatory effectiveness and between perceived regulatory effectiveness and the facets of subjective well-being were very similar to the Additive Model. Corroborating our hypotheses, the interaction effects between frequency and fit ($\beta = .11$, $p = .048$; H4a) and the interaction between fit and quality ($\beta = -.12$, $p = .035$; H4c) on perceived regulatory effectiveness were significant. However, the interaction between frequency and quality (H4b) was not significant ($\beta = -.06$, $p = .101$). Overall, the interaction effects were rather small, and the Interactional Model explained only little more variance than the Additive Model (57 % vs. 55 %, respectively).

The nature of the interaction effect between frequency and fit is illustrated in Fig. 3 with model-implied regression lines for different student groups. Perceived regulatory effectiveness was particularly high for students who reported high frequency of strategy use *and* high

[2] Factor loadings, residual variances, residual correlations, and correlations between the predictors for this model are provided in the electronic supplement.



Note. Significant coefficients are printed in bold (p <.05, one-tailed).
[a] Correlations between predictors and residual correlations can be found in the Supplementary Material.

Fig. 2. Estimation of the hypothesized Interactional Structural Model in Study 2 with standardized coefficients.

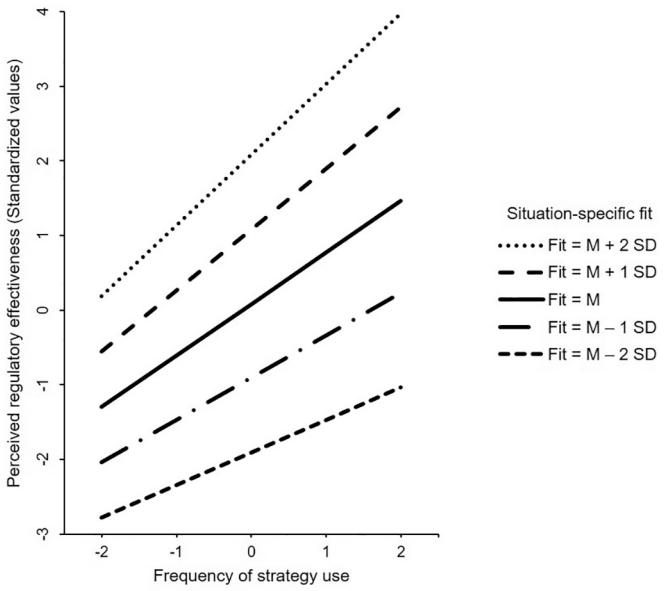


Fig. 3. Interaction between frequency of strategy use and situation-specific fit in predicting perceived regulatory effectiveness.

situation-specific fit. For students with high situation-specific fit, perceived regulatory effectiveness increases from average to far-above average with increasing frequency of strategy use. Students with low situation-specific fit, in contrast, do not benefit as much from higher frequency of use in terms of perceived regulatory effectiveness, and show below-average perceived regulatory effectiveness with far-above average frequency of strategy use.

The nature of the interaction effect between fit and quality is visualized in Fig. 4. As depicted, students with poor application quality benefit most from higher situation-specific fit in terms of perceived regulatory effectiveness. Meanwhile, students with good application quality benefit less from increasing situation-specific fit in terms of perceived regulatory effectiveness. Moreover, students with far below-average fit, but far above-average quality still report far above-average perceived regulatory effectiveness.

In sum, the results in Study 2 largely replicate the findings in Study 1 and indicate that the three components of motivational regulation as well as perceived regulatory effectiveness are connected to higher affective as well as cognitive subjective well-being. They also reveal small interaction effects between frequency of strategy use and situation-specific fit as well as situation-specific fit and application quality, but corroborate that each component of motivational regulation also contributes uniquely to perceived regulatory effectiveness independently from the other components.

4. General discussion

Motivational regulation has been shown to predict study motivation and academic success. In the present research, we examined whether the importance of students' motivational regulation extends to their personal subjective well-being as well, as advancing our understanding of the potential outcomes of motivational regulation can help to foster learning more effectively and efficiently: Essentially, fostering motivational regulation would serve as a means for not only improving motivation and achievement, but subjective well-being as well. We built on recent advances in motivational regulation research and adopted a multicomponent perspective of motivational regulation that is grounded in the assumption that successful motivational regulation not only entails frequent, but also situation-specific and high-quality implementation of motivational regulation strategies. We examined relations between these three components of motivational regulation and with perceived regulatory effectiveness as well as with affective and cognitive facets of students' subjective well-being. In this comprehensive approach to motivational regulation and subjective well-being lies an important

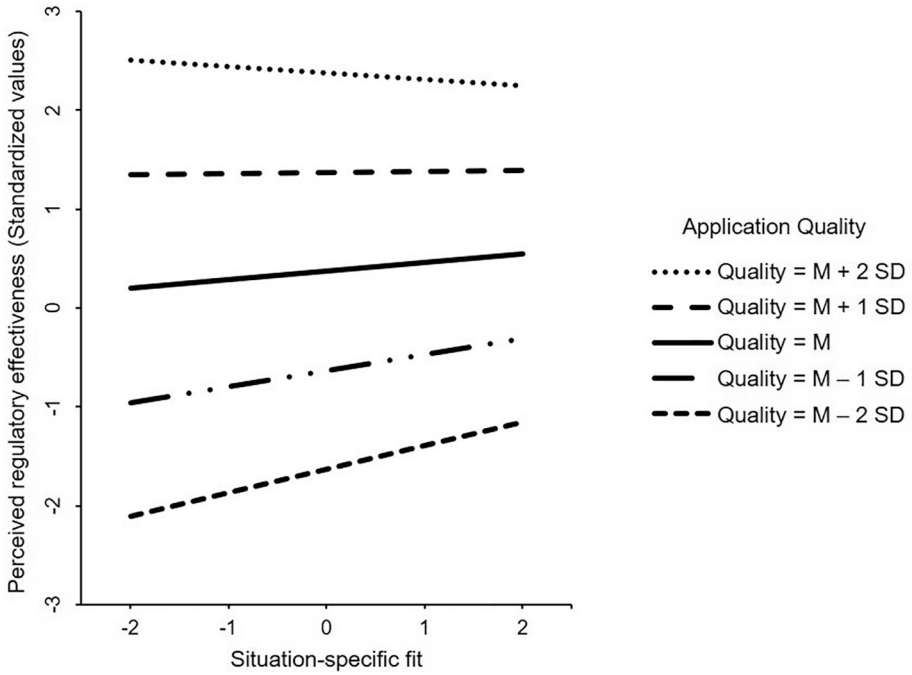


Fig. 4. Interaction between situation-specific fit and application quality in predicting perceived regulatory effectiveness.

strength of the present studies. With regard to motivational regulation, it distinguishes between three components of motivational regulation that complement each other and contribute at least in part synergistically to the perceived effectiveness of motivational regulation: In the second study, not only additive but also interaction effects between the three components in terms of perceived regulatory effectiveness were investigated. In addition, as the situation-specific fit between used regulation strategies and motivational problems was measured with a situational judgment test, this motivational regulation component was even assessed on the level of knowledge or competences. To test the proposed relations and probe the robustness of our findings, we conducted two studies, one of them including a large representatively stratified quota sample which strengthens the generalizability of our results.

4.1. Summary and discussion of findings

The hypothesized interrelations between students' motivational self-regulation and their subjective well-being were largely confirmed across both studies. Overall, our results indicate that more frequent, fitting, and well-executed, and overall more effective, motivational regulation is connected to greater subjective well-being in terms of more positive and less negative emotional experiences and higher study and life satisfaction.

In line with Hypothesis 1a, higher levels of frequency of strategy use, situation-specific fit, and application quality were associated with higher perceived effectiveness of motivational regulation in both studies. Interestingly, application quality had the strongest link with perceived effectiveness of motivational regulation on a descriptive level. Frequency of strategy use had strong links in both studies as well. Although situation-specific fit had the smallest association with perceived regulatory effectiveness, the relation was still substantial with a strong effect in Study 1 and a moderate effect in Study 2. In line with previous research (Engelschalk et al., 2017; Steuer et al., 2019), our results suggest that all three components are in fact relevant for successful and effective motivational regulation.

In line with Hypothesis 2a, students who reported more frequent use of motivational regulation strategies, better knowledge about situation-specific fit, and higher application quality also indicated greater well-being: They reported less boredom related to their studies, and more hope, joy, study satisfaction, and life satisfaction. These findings were consistent in both studies in terms of directions and similar in terms of magnitude of effects, with only one exception: Situation-specific fit and life satisfaction were uncorrelated in Study 2. In terms of magnitude, the effects for boredom, hope, and joy were mostly larger on the descriptive level across both studies than the effects for study and life satisfaction, which means that the effects between motivational regulation components and affective facets of subjective well-being tended to be descriptively larger than the effects with cognitive facets of subjective well-being. This seems plausible considering the strong similarities in antecedents of motivation and emotion that are targeted by motivational regulation (Eccles & Wigfield, 2020; Meyer & Turner, 2006; Pekrun, 2023).

Some unexpected results occurred for anxiety: While students with more knowledge about situation-specific fit (both studies) and better application quality (only Study 2) reported less anxiety, students with higher frequency of strategy use reported more anxiety in Study 2. This result might indicate that students with higher levels of anxiety might possibly experience a higher need for regulation and employ more strategies. The effects for anxiety were among the smallest for both studies, descriptively speaking. The results on relations between frequency of strategy use and affective and cognitive aspects of subjective well-being are generally in line with previous research (Grunschel et al., 2016; Kryshko et al., 2022), although discrete achievement emotions were not considered in previous research to the best of our knowledge – thus, the present research adds to the literature in this regard.

Furthermore, our results concerning Hypothesis 2b support that also effective motivational regulation is connected to higher subjective well-being. Concerning negative emotional experiences, strong negative associations between perceived regulatory effectiveness and anxiety as well as boredom could be observed in both studies. In both studies, perceived regulatory effectiveness was strongly positively associated with study-related hope and joy as well as, descriptively to a slightly smaller extent, study and life satisfaction. These results are in line with previous research on motivational regulation and subjective well-being (e.g., Grunschel et al., 2016; Kryshko et al., 2022), but also broaden our understanding of how motivational regulation and subjective well-being

are connected: Although there were strong connections between perceived regulatory effectiveness and the cognitive facets of subjective well-being, the connections with affective facets of subjective well-being mostly tended to be considerably stronger on a descriptive level. When exploring the links between motivational regulation and subjective well-being, future research should thus also consider affective facets of subjective well-being in the form of discrete study-related emotions. Furthermore, these findings align with current research addressing possible intersections between motivational and emotional self-regulation in that students' motivational regulation is related to their emotional experiences (Stockinger et al., in press; Trautner & Schwinger, 2020).

Lastly, in line with Hypothesis 3, all motivational regulation components contributed significantly to perceived regulatory effectiveness, and effectiveness, in turn, was significantly connected to all aspects of subjective well-being. These results underline the theoretical assumption that the three components of motivational regulation uniquely contribute to the perceived effectiveness of motivational regulation as a core proximal outcome of motivational regulation that in turn is linked to subjective well-being as a more distal outcome of motivational regulation. Therefore, all three components of motivational regulation should be essential to subjective well-being, however, motivational regulation also has to be effective to benefit subjective well-being.

In line with Hypothesis 4, the interactions between frequency of strategy use and situation-specific fit and between situation-specific fit and application quality were both significantly associated with perceived regulatory effectiveness. Regarding the interaction between frequency and situation-specific fit (H4a), the results show that merely applying strategies more frequently cannot fully compensate for a lack of suitable strategies. For students with knowledge on suitable strategies, applying motivational regulation strategies more frequently can enhance perceived regulatory effectiveness greatly. In contrast, applying strategies more frequently does not benefit students with far-below average knowledge as much. For these students, perceived regulatory effectiveness is still far below-average, even if they use strategies far more frequently than average. This is in line with theoretical expectations as, for example, applying a motivational regulation strategy targeting task value more frequently should not be as effective for a lack of expectancy of success.

Unexpectedly, the interaction between frequency of strategy use and application quality (H4b) was not significantly linked with perceived regulatory effectiveness. One possible explanation for this might be that application quality is always important for successful motivational regulation, irrespective of how frequent students apply a motivational regulation strategy. All students might benefit from an increase in application quality. However, this warrants further investigation on the interplay between the components of motivational regulation in future research.

In terms of the interaction between situation-specific fit and application quality (H4c), the results indicate that knowledge about suitable strategies can compensate poor application quality at least to some extent, and vice versa. The results also show that for students with far-above average application quality, increasing situation-specific fit might have no added positive effect in terms of perceived regulatory effectiveness. A possible explanation for this might be that application quality in itself entails monitoring and adapting strategy use which should consequently improve situation-specific fit of the chosen strategies. This might also suggest that application quality is particularly important for students to experience their regulation efforts as successful, which is consistent with the results for Hypothesis 1.

In sum, the results for Hypothesis 4 support the notion that there are mutual interdependencies between the motivational regulation components and that situation-specific fit and application quality can have certain compensatory effects, but that the components each contribute unique aspects to effective motivational regulation and predominantly impact perceived regulatory effectiveness in terms of additive effects (i.e., main effects), as interaction effects are rather small.

The results for Hypothesis 1 as well as for Hypothesis 4 also underline that it is not sufficient to inform students about different motivational regulation strategies that are generally available; they also need to be able to choose a suitable strategy depending on the motivational problem at hand and apply that strategy well in terms of planning, implementing, monitoring and reflecting their strategy use. Taken together, our results underscore the importance of adopting a more differentiated view of motivational regulation and synergistic approaches when examining its correlates.

In sum, both studies provide evidence that regulatory competencies in terms of the three-component approach to motivational regulation are associated with more positive and less negative emotional experiences as well as higher cognitive subjective well-being.

4.2. Limitations and directions for future research

While the present studies add to previous research by several strengths, several limitations should be mentioned that should be considered for future research. First, the present studies do not allow for causal interpretations of the tested relations due to their cross-sectional design. Based on theoretical assumptions, we argue that motivational regulation influences subjective well-being. However, it is likely that the components of motivational regulation and the various facets of subjective well-being influence each other reciprocally over time. Consequently, subjective well-being may also impact learners' use of motivational regulation strategies. For example, students' emotions can influence the availability of cognitive resources and flexibility required for selecting, implementing, and monitoring regulatory strategy use for managing motivation. Negative achievement emotions, for example, can reduce cognitive resources and undermine the use of flexible learning strategies and self-regulation, while positive achievement emotions promote attention, effort, and self-regulation (e.g., Pekrun et al., 2023). Nevertheless, the proposed direction of relations was supported by theoretical deliberations and, as this research explores uncharted territory, it lays an important foundation for future research that should employ longitudinal designs to examine interrelations between motivational regulation and subjective well-being over time as well as experimental designs. Second, apart from situation-specific fit being measured with a situational judgment test, all other constructs were assessed with self-report measures. Especially for frequency of strategy use, application quality, and regulatory effectiveness, behavioral data may be helpful for gaining deeper insight into students' deployment of motivational regulation strategies, although this is challenging for strategies that primarily rely on cognitive processes (e.g., self-talk). Third, Study 1 involved only students in a STEM undergraduate program and used a rather small sample (as indicated also by TLI indices above 1). However, almost all findings were replicated with Study 2 in which a large quota sample representatively stratified for students in Germany across subjects, gender, type of university, and study progress was realized. Furthermore, due to the small sample size in Study 1, the interactions between the three components of motivational regulation could only be tested in Study 2. While our results regarding these interactions are an important first step in investigating this interplay, further research is needed to corroborate these effects and gain more insights. Lastly, we only considered four discrete achievement emotions in the present studies. While this choice was theoretically grounded, future research should examine whether the patterns observed in the present studies can be transferred to other achievement emotions (e.g., anger, pride, shame, hopelessness).

4.3. Conclusions and practical implications

Taken together, our results support Zimmerman and Schunk's (2008) assumptions regarding the relation between motivational regulation and subjective well-being, as our findings imply that effective motivational

regulation is connected to greater subjective well-being in terms of more positive and less negative emotional experiences and higher study and life satisfaction. These findings expand our theoretical knowledge on motivational regulation not only in terms of intersections with students' subjective well-being, but also show the importance of regulatory competencies in terms of frequency of strategy use, situation-specific fit, and application quality for student's subjective well-being. Future research on motivational regulation would benefit from including all components of motivational regulation and their interactions as well as consider theoretical approaches to students' motivation as well as emotional experiences to gain a comprehensive understanding of the constituents and impact of motivational self-regulation. While motivation, emotion, and their regulation are distinct constructs, they also share considerable conceptual as well as functional overlap (e.g., Stockinger et al., in press; Bong et al., 2023). As such, integrating theoretical perspectives from both fields can help to illuminate the interplay of different components of self-regulated learning. Moreover, it can also help reduce theoretical redundancies and make findings more easily accessible for researchers as well as practitioners. In this vein, there have been recent efforts to systematically connect research on motivational and emotional regulation (Stockinger et al., in press). In a similar vein, not only frequency, but also situation-specific fit and application quality of regulatory strategy use should also be important when regulating cognitive and metacognitive processes underlying learning. Thus, jointly considering these components can enrich research on learners' regulatory strategy use more generally when investigating what makes learners' self-regulation successful (see Glogger et al., 2012; Leutner et al., 2007; Paris et al., 1983, for similar reasoning).

The insights into the intersections between motivational and emotional processes from both studies can also help inform the development of effective and efficient support programs that promote students' self- regulation, subjective well-being and academic success. First, our findings show that promoting motivational regulation can be one important pathway to increasing students' subjective well-being especially in terms of emotional experiences in higher education. As motivational regulation has been shown to be linked to learning behaviors (e.g., effort) and academic success as well (e.g., Engelschalk et al., 2017; Schwinger et al., 2009), support programs aiming to foster motivational regulation could prove to be an effective and efficient way to promote both student health and academic success. Furthermore, our findings also highlight that support programs should not only promote knowledge about which motivational regulation strategies are available, but also how to choose a strategy that fits the specific motivational problem and learning situation and how to apply that strategy accurately, precisely and target-oriented (Steuer et al., 2024). Our results suggest that investing efforts especially in promoting better strategy application (also in terms of planning, implementing, monitoring and reflecting one's strategy use well) might improve training effects for motivational regulation. Moreover, advising students that simply applying strategies more frequently may not be beneficial when unsuitable strategies are chosen or when strategy use is not executed well may offer students further guidance on what to pay particular attention to when applying motivational regulation strategies. In conclusion, our findings have implications for integrative theory building and developing effective measures promoting student subjective well-being.

CRediT authorship contribution statement

Sophie von der Mülbe: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Raven Rinas:** Writing – review & editing, Formal analysis. **Markus Dresel:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Kristina Stockinger:** Writing – review & editing, Methodology, Formal analysis, Conceptualization.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.lindif.2024.102561.

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