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The Effect of a Computerized Growth-Mindset Intervention on Teaching Students' Mindset and Cognitive Stress Appraisal

Melissa Joy Montagna, Tamara Marksteiner and Oliver Dickhäuser*

School of Social Sciences, University of Mannheim, Mannheim, Germany

The present study assessed the impact of a one-time computerized mindset intervention on teaching students' cognitive stress appraisal before an upcoming exam. Previous research highlights the long-term effectiveness of growth-mindset interventions. Based on theoretical assumptions derived from the transactional stress theory as well as recent empirical evidence on intelligence mindset and stress, we proposed that changing students' mindset would also impact their cognitive stress appraisal. In order to test this hypothesis, a sample of teaching students received a one-time computerized growth-mindset intervention aiming to foster viewing abilities as incremental. We found a significant as well as relatively lasting impact on participants' mindset but no significant effect on participants' stress appraisal. Nevertheless, an exploratory mediation analysis revealed that the intervention's effect on participants' appraisal of their coping ability (as part of the cognitive stress appraisal) was fully mediated by participants' mindset. The results highlight the effectiveness of the utilized intervention and provide first practical insights into how a person's mindset and their stress appraisal relate.

Keywords: mindset intervention, growth mindset, short intervention, transactional stress theory, implicit theory of intelligence, academic self-concept, growth mindset, cognitive stress appraisal

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****Correspondence:***
Tamara Marksteiner
t.marksteiner@uni-mannheim.de

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INTRODUCTION

How individuals subjectively perceive and interpret the world has a fundamental impact on their well-being, their thoughts, and, in turn, their actual behavior (Greifeneder et al., 2018). This subjective construction and interpretation of a person's social reality and, consequently, their reactions to it depends on the social context. In addition, a person's subjective perception is substantially influenced by naïve or implicit theories (Dweck et al., 1995; Molden and Dweck, 2006). In academic contexts, for example, the subjective construal and perception of intelligence—a person's *intelligence mindset*—affects their perception of performance and learning. A person's reaction to academic shortcomings, their reactions when facing academic challenges, and their achievement trajectories are all affected by their intelligence mindset (Dweck and Leggett, 1988; Aronson et al., 2002; Molden and Dweck, 2006; Blackwell et al., 2007; Yeager and Dweck, 2012; Paunesku et al., 2015; Yeager et al., 2019). People's view of intelligence can be categorized into two opposing assumptions: a *fixed mindset* or a *growth mindset*. Someone adhering to a fixed mindset perceives intelligence as a fixed entity that cannot be changed or modified, whereas someone with a growth mindset views intelligence as something that can be molded and cultivated through sufficient effort and time (Dweck and Leggett, 1988; Dweck and Yeager, 2019).

Previous research has repeatedly demonstrated the benefits of a growth mindset (as compared to a fixed mindset) regarding a variety of academic outcomes (Aronson et al., 2002; Blackwell et al., 2007; Paunesku et al., 2015; Yeager et al., 2019). Moreover, the beneficial value of a growth mindset seems to be especially apparent in challenging performance situations (Aronson et al., 2002; Blackwell et al., 2007). Furthermore, how challenging a performance situation is perceived to be should not only be impacted by a person's perception of intelligence as fixed or moldable but should additionally be impacted by an individual's subjective evaluation of their academic abilities, for example, a student's *academic self-concept*. The academic self-concept represents the cognitive representation of a person's own abilities in academic settings (like mathematics). This concept is partly based on previous performance experiences and partly on comparisons made to an important comparison group (Dickhäuser et al., 2002; Moschner and Dickhäuser, 2018). Previous studies have already highlighted the link between students' academic self-concept and how they effectively react to performance situations (Frenzel et al., 2007; Ahmed et al., 2012). A higher academic self-concept is generally associated with less negative affect regarding performance situations (Frenzel et al., 2007) as well as with less negative consecutive performance-related emotions like math anxiety (Ahmed et al., 2012).

Due to the benefits associated with a stronger growth mindset, much of the current research focusing on intelligence-mindsets has been dedicated to designing interventions that promote and nurture a stronger growth mindset (Aronson et al., 2002; Blackwell et al., 2007; Paunesku et al., 2015; Yeager et al., 2016). These interventions have repeatedly proven to be effective in shaping students' mindsets (Aronson et al., 2002; Blackwell et al., 2007).

As a consequence of the positive impact those initial growth-mindset interventions had, there has been a growing demand for more practical mindset interventions that can easily be scaled up and, therefore, be relevant to policymakers and practice (Paunesku et al., 2015; Yeager et al., 2016; Dweck and Yeager, 2019). However, most of these initial mindset interventions were designed to be applied in either a classroom or a laboratory setting and therefore generally require repeated intervention sessions as well as guidance by an instructor. As a consequence, the application of such interventions on a grander scale involves a significant investment of time and resources.

The current study expands upon these approaches by using existing intervention materials (Aronson et al., 2002; Paunesku et al., 2015) in designing and testing a relatively short (25 min), one-time, easily applicable online mindset intervention for teaching students. The intervention materials were especially designed for teaching students due to the influence teachers' beliefs have on their teaching, the feedback they give in the classroom, and, consequently, their students' beliefs (Esparza et al., 2014; Schmidt et al., 2015; Dickhäuser et al., 2017).

Mindset researchers have started to investigate further benefits associated with a stronger growth mindset beyond academic achievement outcomes. For example, King et al. (2012) found that middle school students' intelligence mindset significantly predicted their negative achievement-related emotions such as anxiety and shame. In a longitudinal intervention study, Miu and Yeager (2015) found that teaching adolescents a growth mindset about personal traits, that is, that people can change, reduced the incidence of clinically significant levels of self-reported depressive symptoms 9 months after the intervention.

In the present study, we investigate a subjective experience that is most likely affected by a person's mindset, that is, a person's cognitive *stress appraisal when facing challenging performance situations*. The idea that a person's mindset could potentially impact a person's cognitive stress appraisal is based on the theoretical rationale formulated in the *transactional stress theory* (Lazarus, 1966; Lazarus and Folkman, 1984). According to this theory, stress results from cognitive appraisal processes in which 1) potentially threatening external events and 2) one's own capacity in successfully mastering these events are assessed (Lazarus and Folkman, 1984). Since a person's mindset influences how they interpret and perceive performance and learning situations (Dweck and Leggett, 1988; Dweck and Yeager, 2019), lastingly impacting students' mindset could prove to be effective in reducing the stress students experience before such a challenging performance situation. Furthermore, the impact the mindset has on the evaluation of performance situations should be even more pronounced the more challenging a performance situation is perceived to be (Dweck and Yeager, 2019). A recent finding by Lee et al. (2019) seems to support this theoretical reasoning. Lee et al. (2019) tested the assumption that academic stressors (e.g., a decline in grades upon the entry of high school) lead to a stronger physiological stress response (measured as salivary cortisol level) for students with more of a fixed mindset than for students with more of a growth mindset. Their results supported this assumption: students who viewed their intelligence as a fixed entity were more likely to have elevated cortisol levels when their grades declined upon entering high school, and they showed a higher overall negative stress response compared to students with more of a growth mindset (Lee et al., 2019).

Building upon these previous findings and the presented theoretical arguments, the present study investigates the impact of a relatively short one-time computerized growth-mindset intervention designed for teaching students on their mindset. Moreover, we investigate the potential benefit of this novel growth-mindset intervention for participants' stress appraisal when faced with a challenging upcoming exam. Furthermore, the influence of a person's academic self-concept is taken into account for the potential stress-reducing effect of the administered mindset intervention.

THEORETICAL BACKGROUND

A Practical Mindset Intervention for Teaching Students

A person's mindset creates a meaning system, which in turn affects how ability-related situations are evaluated and approached (Dweck and Yeager, 2019). Even though there is a growing body of research aimed at examining potential benefits associated with a growth mindset (e.g., Yeager et al., 2019), there

have also recently been studies questioning and testing the actual magnitude of the effects reported by mindset-research on learning and performance outcomes (Burgoyne et al., 2020). Additionally, other researchers questioned whether mindset has a causal role in influencing students' achievement or if there is not even a bidirectional relationship between mindset and students' achievement (e.g., see Zhang et al., 2017 for a review). These results additionally highlight the importance of further and rigorously designed mindset-research that replicates and tests the effects of a person's mindset on the perception of performance and learning occurrences as well as their effects on actual performance and learning.

At the same time, previous research has indicated that depending on a person's mindset, an academic failure, struggle, or success will yield different cognitive interpretations (e.g., lower helplessness attributions when faced with academic setbacks for a stronger growth mindset; Blackwell et al., 2007) and affective responses (e.g., a stronger fixed mindset predicts negative achievement-related emotions; King et al., 2012). Further, a person's mindset also affects behavioral outcomes in such situations (e.g., improvement in GPA-scores; Aronson et al., 2002; Blackwell et al., 2007).

Moreover, research highlights that a person's mindset itself is not something that is unchangeable and can be impacted through mindset interventions (Aronson et al., 2002; Blackwell et al., 2007; Paunesku et al., 2015; Yeager et al., 2019). A prominent example of such a mindset intervention was designed by Aronson et al. (2002). Aronson and colleagues sought to lastingly affect students' mindsets. First, they introduced participants to the idea that they could develop their intelligence and abilities. Second, they asked participants repeatedly to support this claim 1) by making participants endorse the assumption that abilities are malleable in front of another person and 2) by having participants generate supportive examples based on their own experiences. These initial face-to-face mindset interventions successfully impacted students' mindsets and, beyond that, their academic performance (e.g., Aronson et al., 2002; Blackwell et al., 2007). Nonetheless, as Dweck and Yeager (2019) pointed out, many of these interventions had not been designed for or tested on a grander scale. They had mostly been applied in classrooms or in laboratory settings and require participants to partake in repeated intervention sessions as well as continuous guidance and instruction by a teacher or a researcher (Aronson et al., 2002; Blackwell et al., 2007; Dweck and Yeager, 2019). Therefore, in recent years, there has been a growing interest in designing more practical growth-mindset interventions that can easily be scaled up and applied in larger contexts (Paunesku et al., 2015; Yeager et al., 2016; Dweck and Yeager, 2019). Building upon already existing and successful classroom and laboratory interventions (Aronson et al., 2002; Blackwell et al., 2007), Paunesku et al. (2015) and Yeager et al. (2016) responded with two successful and relatively short online interventions. Whereas Paunesku et al. (2015) tested existing *generic* growth-mindset intervention material for its successful applicability on a sample of high school students, Yeager et al. (2016) adapted existing materials for a more tailored user-centered intervention targeting middle school students transitioning to high school.

The current study expands upon these approaches by using existing intervention materials (Aronson et al., 2002; Paunesku et al., 2015) in designing and testing a relatively short (25 min), one-time, easily applicable online mindset intervention for teaching students. The designed intervention followed recommendations by Aronson et al. (2002) who applied an approach based on persuasion research (i.e., Higgins and Rholes, 1978; Higgins, 2012). In our intervention, students were first asked to read a short text about the plasticity of intelligence and were then asked to respond to a fictitious school scenario in which they were approached by a student after a lesson in which they had discussed the text in class that questioned the text's applicability to their personal experience (i.e., the student claimed to be too dumb for mathematics). Participants were asked to describe in 150 words how they would react to the student (i.e., they were asked to formulate supportive arguments about why abilities are malleable through effort). Furthermore, participants were asked to describe in 120 words a personal experience in which they were able to successfully master an academic obstacle through investing effort and working hard. The text was supposed to be published anonymously on a website for a project for motivating underperforming students.

The intervention materials were especially designed for teaching students due to the influence teachers' beliefs have on their teaching, the feedback they give in the classroom, and, consequently, their students' beliefs (Esparza et al., 2014; Schmidt et al., 2015; Dickhäuser et al., 2017). For example, Dickhäuser et al. (2017) were able to show that classes with a higher teacher tendency to report growth to their students (the so-called temporal reference norm orientation) were associated with more positive development of students' motivation as compared to classes with a lower temporal reference norm orientation of teachers. Furthermore, the effectiveness of mindset interventions targeting students depends on the class teacher's mindset (Esparza et al., 2014; Schmidt et al., 2015). These findings emphasize the relevance of designing and testing interventions that target teaching staff as well as future teachers due to the potential benefit that such interventions could provide beyond solely influencing teachers' and teaching students' mindsets and their approach to performance situations. Therefore, this study explores the effect of a one-time computerized growth-mindset intervention specifically designed for teaching students.

Based on the previously expressed theoretical arguments and empirical results, we derived and tested the following hypotheses: Our computerized one-time growth-mindset intervention will have a significant impact on the mindset of a sample of university students studying to become teachers (H1). For the intervention group, we further hypothesize that this one-time administered mindset intervention will lead to a significant gain in growth mindset (H1a). Furthermore, we hypothesize that there will be a significant difference in growth mindset when comparing the intervention group with the active control group after the intervention (H1b).

Beyond Mindset's Effect on Academic Outcomes: The Effect on Cognitive Stress Appraisal

Lazarus and Folkman (1984) conceptualize stress as resulting from two consecutive cognitive appraisals about 1) the potential of an external event to harm well-being (i.e., *threat appraisal*) and 2) one's own capabilities in dealing with this event (i.e., *coping-ability appraisal*). Inherent in this approach is the idea that those consecutive evaluative stress appraisal processes are prone to be influenced by a person's naïve theories and generalized beliefs (Lazarus and Folkman, 1984). One especially important naïve theory in an academic context is a person's intelligence mindset (Dweck and Yeager, 2019). This crucial belief about the malleability of abilities could in turn influence a person's perception of how well they are equipped to deal with a demanding performance situation and in turn affect the resulting overall cognitive stress appraisal.

To this point, research has not examined the potential processes that could link a person's intelligence mindset and their cognitive stress appraisal. Nevertheless, it seems probable that a person's generalized idea about the plasticity of intelligence (i.e., their intelligence mindset; Molden and Dweck, 2006) could substantially influence their perceptions of a demanding academic performance situation. An individual's perception of an academic performance situation in turn should affect their resulting cognitive stress appraisal.

A recent field study conducted by Lee et al., 2019, supports this reasoning. The researchers hypothesized that, depending on a person's mindset, their appraisal of an intellectually demanding situation should differ. More specifically, they tested the hypothesis that high school students would show differing physiological stress responses (measured as salivary cortisol levels) during an academically challenging transition to high school depending on their mindset. In support of their assumption, they found that students whose grades were declining and who held more of a fixed mindset were more likely to exhibit elevated salivary cortisol levels, compared to students who held more of a growth mindset. In addition, students whose grades were declining and held more of a fixed mindset were also more likely to perceive that they did not possess the resources to adequately cope with their daily stressors.

The assumption that one's mindset could potentially influence similar control-related beliefs had previously already been introduced through a study conducted by King et al. (2012). They proposed that a person's mindset could potentially influence control-related assessments and, therefore, have an impact on achievement-related emotions. Their results partially support this idea: A person's fixed mindset positively predicted negative achievement-related emotions, such as anger, anxiety, and shame, whereas such a relation was not found for predicting positive achievement-related emotions (King et al., 2012).

Based on these theoretical arguments and previous empirical findings, we investigate the impact of a growth-mindset intervention on participants' overall cognitive stress appraisal regarding a challenging upcoming exam. We tested the following hypotheses: The applied growth-mindset intervention will influence participants' cognitive stress appraisal regarding an upcoming challenging performance event (H2). Within the intervention group, we further hypothesize that the growth-mindset intervention will lead to a significant reduction in reported cognitive stress appraisal (H2a). Finally, we assume that the intervention group will show a significantly lower reported cognitive stress appraisal than the active control group after having received the growth-mindset intervention (H2b).

Academic Self-Concept's Influence

A person's perception of their ability to successfully deal with a demanding performance situation is impacted by how they view their own abilities, that is, their academic self-concept (Kadir and Yeung, 2016). A person's academic self-concept is based on previous performance experiences as well as on a person's abilities compared to a relevant comparison standard (Kadir and Yeung, 2016). Therefore, the academic self-concept is an important determinant for cognitive and affective responses to performance situations (Frenzel et al., 2007; Ahmed et al., 2012). A higher academic self-concept is generally associated with less negative affect regarding performance situations (Frenzel et al., 2007) as well as with less negative subsequent performance-related emotions like math anxiety (Ahmed et al., 2012).

We therefore propose that, when considering the effects of a person's mindset on their cognitive stress appraisal regarding a demanding performance situation, the person's academic self-concept needs to be taken into account. A pronounced cognitive stress response should accordingly only emerge if a person perceives their abilities to be low and therefore is not sure whether they can display the required performance. If a person is convinced of their abilities, then even an upcoming challenging performance situation should not be perceived as a threat. In consequence, independent of a person's mindset, no pronounced stress response should emerge. Only when a person believes that his/her academic abilities are rather low–which implies that the situation would be seen as more challenging and potentially threatening–, the person's mindset should influence his/her stress appraisal. This assumption is based on the notion that a person's mindset influences motivation and behavior especially in challenging performance situations (Dweck and Leggett, 1988; Dweck and Yeager, 2019).

Accordingly, we hypothesize that an individual's academic self-concept moderates the influence of the intervention on the ensuing cognitive stress appraisal. We expect that the positive (i.e., reduction in cognitive stress appraisal) effect of the intervention on a participant's cognitive stress appraisal will be more pronounced for individuals with a lower academic self-concept (H3).

MATERIALS AND METHODS

Participants

The final sample consisted of $N = 77$ participants (56 female), all from the same German university. The mean age of the

participants was $M = 21.6$ years ($SD = 2.35$) and participants were on average in the fourth semester ($M = 4.32$; $SD = 2.41$). Requirements for participating in the study were that participants were teaching students and that they were currently facing an imminent personally challenging performance situation (e.g., an upcoming graded exam) which was assessed through self-reported assessment of the upcoming performance situation as demanding.

General Procedure

Participants were recruited online, through e-mail or advertising on university bulletins and distributed in classes. They were told that the primary aim of the study was to assess middle school materials and that they would have to evaluate these materials. First, participants had to preregister. During this preregistration, they indicated if they were enrolled in the BA Education Study program and if they found themselves facing an imminent challenging academic performance situation (e.g., an exam). Additionally, their initial intelligence mindset and cognitive stress appraisal regarding said upcoming exam were assessed as well as their general academic self-concept. Participants were assured that their responses would remain confidential and would be used for scientific purposes only. Second, participants meeting the inclusion criteria were invited to participate in the computerized intervention that was conducted in one of the research laboratories of the university. We randomly assigned participants to either the active control condition or the growth-mindset intervention condition. The growth-mindset intervention as well as the control exercise lasted approximately 25 min and the administered surveys in total lasted approximately 20 min. Right after the laboratory session, participants answered a postintervention survey that assessed their mindset and cognitive stress appraisal regarding their indicated upcoming exam. Third, two days after the laboratory session, participants received an e-mail with a link for the follow-up survey that assessed participants' mindset and cognitive stress appraisal as well as demographics. On average, participants answered the follow-up survey $M = 4.6$ ($SD = 2.22$; $Min = 2$; $Max = 13$) days after the intervention. Participants were rewarded with the corresponding amount of participant credits assigned to study participants by the university.

Measures

Challenging Upcoming Exam

Participants were asked to indicate if they had any upcoming relevant and personally challenging performance situations (e.g., an exam). This could range from written to oral exams and graded papers to ungraded presentations. After participants affirmed that they had a challenging exam coming up, they were asked to indicate the name of the class that required the indicated performance.

Academic Self-Concept

Additionally, we assessed participants' academic self-concept through the scale of academic self-concept ("Skala zum akademischen Selbstkonzept"; $\alpha = 0.95$; Dickhäuser et al., 2002). The scale consists of 22 items and four subscales. Participants' agreement with the presented items (e.g., "My academic competencies are. . .") was assessed through a 7-point semantic differential scale (e.g., 1 = low; 7 = high). The academic self-concept was calculated as mean agreement with the items. Higher values indicate a higher academic self-concept. See **Supplementary Appendix A** for a frequency distribution of academic self-concept.

Mindset

The mindset of the participants was assessed at three points in time (premeasurement, postmeasurement, and follow-up measurement) through the German version of the implicit theories scale by Dweck et al. (1995). The German scale has already been repeatedly successfully evaluated for German student samples (Spinath and Stiensmeier-Pelster, 2001). The scale consists of three items that indicate a fixed mindset (e.g., "I possess a certain amount of intelligence, and there is not much I can do about it"). Participants indicated how much they agreed with the presented statements through a 6-point Likert scale (1 = *I completely agree*; 6 = *I don't agree at all*; $\alpha_{t0} = 0.80$, $\alpha_{t1} = 0.85$, and $\alpha_{t2} = 0.86$). Due to the sample size being too small to calculate for measurement invariance (see, e.g., Kline, 2015), we calculated Cronbach's alpha for the intervention and control condition as an approximation. The results indicate acceptable reliability in both groups ($\alpha = 0.74$ for the intervention group; $\alpha = 0.82$ for the control group). The mindset of participants was computed by averaging the agreement with the statements. Higher values represent a growth mindset and lower values represent a fixed mindset.

Cognitive Stress Appraisal

At three points in time, the reported cognitive stress appraisal of participants when thinking of their upcoming exam was assessed through the *Primary Appraisal Secondary Appraisal* questionnaire (PASA; Gaab, 2009). After having indicated the title of the upcoming challenging exam, participants were explicitly asked to think of this exam when answering the PASA's questions (at the post- and follow-up measurement, participants were asked to reindicate the title of the exam stated at premeasurement and they were reminded to consider this upcoming exam when answering the PASA's questions). The PASA is based on the transactional stress theory (Lazarus and Folkman, 1984) and allows a separate assessment of participants' primary (threat appraisal) and secondary appraisal (coping-ability appraisal) regarding a specific challenging potentially stress-inducing situation (Gaab, 2009). The questionnaire consists of two primary scales (threat appraisal: $\alpha_{t0} = 0.83$, $\alpha_{t1} = 0.85$, and $\alpha_{t2} = 0.87$; coping-ability appraisal: $\alpha_{t0} = 0.81$, $\alpha_{t1} = 0.82$, and $\alpha_{t2} = 0.81$) that each consists of eight items. Participants indicated their agreement to statements through a 6-point Likert scale (1 = *completely false*; 6 = *completely true*). The threat appraisal scale assessed the evaluation of the threat potential of the situation (e.g., "This situation challenges me."). Higher threat appraisal values indicate that a situation is perceived as highly threat inducing, whereas higher values in the coping-ability appraisal indicate a stronger perception of one's own ability to cope with the situation successfully (e.g., "I don't

know at all what I am supposed to do"). The PASA score is calculated as the difference between the threat appraisal and coping-ability appraisal scale and results in an overall cognitive stress appraisal measure. There are no normed reference values that differentiate between high and low cognitive stress appraisal values. The values have to be interpreted in the specific context and can be used as a means to compare participants' cognitive stress appraisal (Gaab, 2009).

Demographics

Participants were asked if they were enrolled in the BA Education program of the University. After finishing the follow-up survey, participants were asked to indicate their age, gender, and their semester.

Quality Check

Participants were randomly given three instructed response items (Merkle et al., 2016) that asked them to check a certain answer (e.g., "please check the option at the far left"). This was done in order to assess how attentively participants were answering the questionnaires. This approach is in line with recommendations given by Oppenheimer et al. (2009).

Experimental Manipulation and Manipulation Checks

Growth-Mindset Condition

The applied novel growth-mindset intervention is based on materials that have already been successfully applied in previous research (Aronson et al., 2002; Mindset Works Inc., 2002; Paunesku et al., 2015) and that were adapted for a German sample of teaching students. At first, participants were instructed to read a text titled "*You can develop your intelligence*" and to assess if this text could potentially be used as classroom material for teaching biology to middle school students. Before participants proceeded with the intervention tasks, they answered two multiple choice questions referring to the text's content in order to assess if participants had read the text carefully, which was a prerequisite for the following intervention instructions. To ensure that the sample size would not have to be diminished due to inattentive participants that would not be able to answer the multiple choice questions correctly, participants who did not correctly answer the multiple choice items at first were asked to reread the intervention text. In the two subsequent tasks, participants were then asked to endorse and support the text's main arguments. The first task asked participants to describe how they would answer and motivate a student that believes that she can never change her ability in mathematics based on the previously read text. Then in a second task, participants were instructed to connect the arguments they used to persuade the student with a personal experience in which they had successfully mastered a similar challenge and subsequently grown their abilities through investing effort and hard work. Participants received the information that their personal example could supposedly be selected for a university funded project to strengthen the motivation of middle school students with academic difficulties. Through a link (https://ein-blick-hinter-die-kulissen.jimdosite.com/), participants were able to access said website in order to maintain the believability of the scenario. In order to affect participants' mindsets lastingly, the study was built upon intervention materials and tasks that had already proven successful in previous research (Aronson et al., 2002) and that are based on different approaches and findings in persuasion research (e.g., Gopinath and Nyer, 2009). For example, the study applied the *saying-is-believing effect* (Higgins, 2012) by asking participants to write a text that reflects the opinion that intelligence is malleable. The underlying assumption is that explicitly and publicly endorsing an opinion influences the speaker's (in this case "the writer's") own opinion in the direction of the publicly endorsed one. This shifting of one's own opinion to the publicly advocated opinion often happens unintentionally (Higgins, 2012; Higgins and Rholes, 1978). Additionally, we tried to create an atmosphere of public commitment by telling participants that their texts could be published (see **Supplementary Appendix B** for the intervention group's tasks) which should induce an even stronger acceptance of one's publicly endorsed opinion (Cialdini, 2009).

Active Control Condition

Participants in this condition read a text illustrating the functions of the brain's different regions which addresses middle school students (Hilmer, 2017). A text for the ninth grade was chosen for the control group in order to maintain as much similarity as possible between the intervention and control group materials. The intervention group material was evaluated through a small pilot test with teaching students (n = 3) who had to evaluate which grade level the intervention group's material could realistically be used in. Mean evaluation was M = 9.67.

Participants had to evaluate the text's appropriateness for middle school students as classroom material. Afterward, participants had to reproduce the text's main message as they would convey it to a student who did not completely understand the text's content. In a second task, participants were asked how they would teach the summarized content to a class of middle school students (see **Supplementary Appendix C** for the control group's tasks).

Debriefing and Final Questions

Debriefing

Since participants were repeatedly confronted with their challenging upcoming exam, participants were consequently given a few examples of how to deal with stressful events positively. Participants were asked to indicate how they dealt with stress. Additionally, participants received the website and phone contact of the university's psychological counseling center and were encouraged to seek support if needed. Participants were given the opportunity to leave their e-mail to be notified about the study and its results.

Final Questions

Participants had the opportunity to indicate any reason as to why their data should not be used at the end of the post- and follow-up

questionnaire. Additionally, participants had the option to comment on the study.

Attrition, Exclusion of Participants, and Missing Data

Attrition

In total, we collected a sample of $N = 90$ who completed the premeasurement and, subsequently, $N = 83$ participants who participated in the intervention. Of these participants, $n = 41$ were in the intervention group (70.7% female) and $n = 42$ in the control group (71.4% female). At the follow-up measurement, data of $N = 82$ participants, $n = 40$ in the intervention group (72.5% female) and $n = 42$ in the control group (71.4% female), were assessed. Overall, there was attrition of 9.1% ($n = 8$) from premeasurement to follow-up measurement. To test if dropout was systematic, we first created a dummy variable (1 = dropout; 0 = no dropout).

A multivariate analysis of variance (MANOVA) with initial mindset and stress as dependent variables revealed a statistically nonsignificant overall multivariate effect of the dropout on mindset, $F_{(1,\ 86)} = 1.36$, $p = 0.247$, and $\eta_p^2 = 0.02$, and on stress, $F_{(1,\ 86)} = 1.30$, $p = 0.258$, and $\eta_p^2 = 0.02$.

Exclusion of Participants and Missing Data

Of the $N = 83$ participants that took part in the intervention, we excluded $n = 6$ participants from the analysis due to repeatedly incorrectly answering the quality check items (participants were only excluded if they answered the quality check items for at least two measurement points incorrectly). Of those excluded participants, $n = 4$ belonged to the intervention group and $n = 2$ participants to the control group with a mean age of $M = 23.20$ ($SD = 3.63$; 50% female). To test for systematic differences between the excluded and not excluded participants, we created a dummy variable (1 = included in the analysis; 0 = excluded from the analysis).

A MANOVA with mindset and stress at pre-, post-, and follow-up measurement revealed a statistically nonsignificant effect of the dummy variable on mindset at pre-, post-, and follow-up measurement, ps > 0.507, as well as for stress at pre- and follow-up measurement, ps > 0.081. However, a significant effect of the dummy variable on stress at postmeasurement, $F_{(1,\ 78)} = 4.06$, $p = 0.047$, and $\eta_p^2 = 0.049$, was found.

Overall, 6.3% of the data values were missing. Missing data ranged from low of 2.2% to high of 8.9% (e.g., for items assessing mindset at the follow-up measurement). As suggested by Schlomer et al. (2010), we calculated Little (1988) MCAR test: the results indicate that the data values were missing at random, $\chi^2\ (10) = 11.10$; $p = 0.350$.

Analytical Procedures

To test effects on mindset and cognitive stress appraisal, we conducted two separate repeated measures analysis of variance (ANOVA) with mindset and cognitive stress appraisal as dependent variables. Time (time: premeasurement (t_0) vs. postmeasurement (t_1) vs. follow-up measurement (t_2)) was a within-subjects factor and condition (condition: intervention condition vs. control condition) was the between-subjects factor.

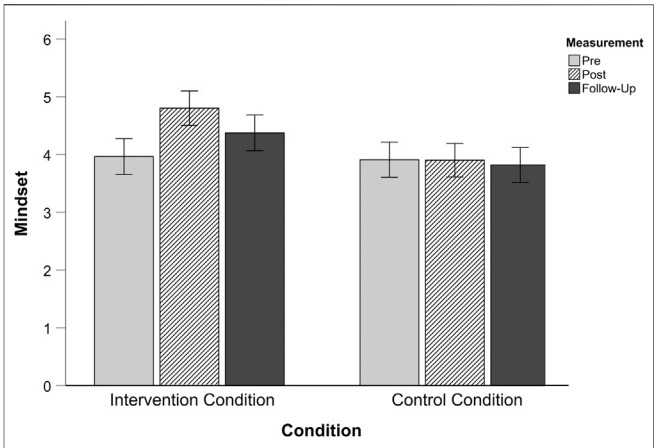

FIGURE 1 | Mean mindset values of the intervention and control condition at premeasurement, postmeasurement, and follow-up measurement. Error bars represent standard errors (95% CI). A mindset value ≥ 4 corresponds to a growth mindset.

RESULTS

Preliminary Analyses

Before testing our main hypotheses, we ran preliminary analyses to check whether randomization of participants to the two experimental conditions was successful and whether preliminary differences between the two groups regarding the interesting variables existed. Several independent sample t-tests with condition as a predictor and mindset and threat and coping-ability appraisal as dependent variables revealed no statistically significant preliminary differences between the two groups (all ts < 0.19).

Effects on Mindset

In line with the first hypotheses, we found a significant main effect of condition, $F_{(1,\ 73)} = 5.53$, $p = 0.021$, and $\eta_p^2 = 0.07$. Mean values of mindset for the conditions for each measurement point are depicted in **Figure 1**. To test hypotheses 1a and 1b, multiple Bonferroni-corrected pairwise contrasts were tested for significance. In correspondence with hypothesis 1a, a significant difference in the intervention condition was found for mindset-value pre- and postintervention, $M_{Diff} = 0.92$, $p < 0.001$, $d = 1.22$, and 95% CI (0.63, 1.20). Participants in the intervention condition had a lower mindset preintervention, $M = 3.90$ ($SD = 0.85$), than postintervention, $M = 4.81$ ($SD = 0.72$). Furthermore, a significant difference between mindset preintervention and the follow-up measurement was found, $M_{Diff} = 0.48$, $p < 0.01$, $d = 0.65$, and 95% CI (0.15, 0.81). Participants in the intervention condition had a lower mindset score at premeasurement, $M = 3.90$ ($SD = 0.85$), than at the follow-up measurement, $M = 4.38$ ($SD = 0.83$). Additionally, we tested whether the decrease in mindset for the intervention condition from the postintervention measurement ($M = 4.81$; $SD = 0.72$) to the follow-up measurement ($M = 4.38$; $SD = 0.83$) was significant. We found a significant decrease in mindset from the postintervention measurement to the follow-up measurement, $M_{Diff} = -0.44$, $p < 0.01$, and 95% CI (−0.70, −1.67)

TABLE 1 | Means, SD, and range for threat appraisal, coping-ability appraisal, and cognitive stress appraisal scores for all three measurement points and academic self-concept at premeasurement separated by condition.

Scale	Statistical values							
	Intervention group				Control group			
	M	SD	Min	Max	M	SD	Min	Max
Threat appraisal								
t_0	35.19	6.60	19.00	48.00	34.00	8.62	0.00	48.00
t_1	36.60	6.95	22.00	48.00	35.28	6.63	19.00	48.00
t_2	36.46	7.50	21.00	48.00	35.70	6.34	21.00	48.00
Coping-ability appraisal								
t_0	34.86	6.70	19.00	48.00	33.56	7.76	0.00	46.00
t_1	36.16	6.04	22.00	44.00	35.28	4.55	24.00	46.00
t_2	36.81	5.54	26.00	48.00	34.70	5.33	22.00	47.00
Cognitive stress score								
t_0	0.33	12.03	−25.00	24.00	0.44	10.10	−21.00	33.00
t_1	0.78	11.24	−18.00	22.00	0.00	9.46	−25.00	24.00
t_2	−0.35	11.63	−22.00	19.00	1.00	9.84	−26.00	26.00
Academic self-concept	4.96	0.72	3.09	6.41	4.83	0.70	2.64	5.91

Note. *The cognitive stress score is calculated as the difference between coping-ability appraisal and threat appraisal values. Higher stress score values correspond to a higher level of cognitive stress appraisal.* t_0 *= premeasurement (before the intervention),* t_1 *= postmeasurement (directly after the intervention),* t_2 *= follow-up measurement (three days after the intervention ends). The academic self-concept was only measured at premeasurement. Higher values indicate a higher academic self-concept (theoretical range: 1–7).* N = *77 (intervention group:* n = *37; control group:* n = *40 participants).*

Additionally, hypothesis 1b was supported, as a significant difference in mindset score between the intervention and control condition at the postmeasurement was found, $M_{\text{Diff}} = 0.90$, $p < 0.001$, $d = 1.06$, and 95% CI (0.48, 1.32). Participants in the intervention condition had more of a growth mindset, $M = 4.81$ ($SD = 0.72$), than participants in the control condition, $M = 3.91$ ($SD = 1.06$).

Effects on Cognitive Stress Appraisal

No significant effect of condition on the composite cognitive stress appraisal score was found, $F < 1$. To test hypothesis 2a that there would be a difference in cognitive stress appraisal in the intervention condition between pre- and post- as well as pre- and follow-up cognitive stress appraisal, Bonferroni-corrected pairwise contrasts were tested for significance. No significant differences were found (all $ps \geq 1$). Hypothesis 2b, which predicted that there would be a significant difference between the control and intervention condition at the postmeasurement in cognitive stress appraisal, was also tested through a Bonferroni-corrected pairwise contrast. Hypothesis 2b could not be supported ($p > 0.71$; mean values and standard deviations and range for the threat appraisal scale, the coping-ability appraisal scale, and the overall cognitive stress appraisal separated by condition are presented for all measurement points in **Table 1**. Additionally, mean values and standard deviations for the whole sample are presented for all measurement points in **Supplementary Appendix D**).

Interaction of the Academic Self-Concept and the Intervention Condition

In hypothesis 3, we formulated the assumption that the academic self-concept moderates the relation between the intervention condition and the ensuing cognitive stress appraisal (mean values, standard deviations, and range separated by condition are presented in **Table 1**). To test this hypothesis, two separate regressions were conducted with cognitive stress appraisal (postintervention and at the follow-up measure). The intervention condition was dummy coded (0 = control condition; 1 = intervention condition). We found a significant main effect of the academic self-concept on cognitive stress appraisal at postmeasurement, $b = -8.14$, $SE = 1.44$, $t(74) = -5.66$, and $p < 0.001$, and on cognitive stress appraisal at the follow-up measurement, $b = -8.06$, $SE = 1.52$, $t_{(74)} = -5.30$, and $p < 0.001$. But no significant main effect of the intervention condition on cognitive stress appraisal was found for the postintervention nor for the follow-up-intervention measurement, $|ts| < 0.94$. Additionally, no significant interaction of the condition x academic self-concept on cognitive stress appraisal at the postintervention-measurement point, $|t| < 1$, nor on the cognitive stress appraisal at the follow-up measurement point was found, $|t| < 1$. Therefore, hypothesis 3 was not supported.

Exploratory Analyses

We expected an effect of the intervention condition due to our assumed impact of students' actual mindset on their subsequent cognitive stress appraisal. The reason is that people with a stronger fixed mindset would view their abilities as less malleable. Therefore, a person with a stronger fixed mindset would believe that they possess less control over dealing with a challenging performance situation (Dweck and Leggett, 1988; Dweck and Yeager, 2019). This assumption seems to be in agreement with recent results reported by Lee et al. (2019) who found that students whose grades were declining and held more of a fixed mindset were more likely to report being less confident in handling their daily academic stress (i.e., their

ability to cope with the academic stressors). Therefore, we conducted additional exploratory analyses to test whether we would find a direct effect of students' mindset on their cognitive stress appraisal (especially their coping-ability appraisal) and whether in line with this argumentation the intervention would show an indirect effect on students' cognitive stress appraisal mediated by the participant's mindset. We therefore conducted a series of additional exploratory regression analyses.

Direct Effect of Mindset on Cognitive Stress Appraisal, Threat Appraisal, and Coping-Ability Appraisal

To test whether students' mindset significantly predicted students' overall cognitive stress appraisal (postmeasurement), their coping-ability appraisal, and threat appraisal at the postmeasurement, we conducted three separate regression analyses. We did not find a significant direct effect of students' mindset at postmeasurement on their cognitive stress appraisal at postmeasurement, $b = -0.12$, $SD = 1.13$, and $p = 0.290$, nor on their threat appraisal at postmeasurement, $b = 0.01$, $SD = 0.09$, and $p = 0.960$. However, we did find a significant and positive effect of students' mindset on their coping-ability appraisal at postmeasurement, $b = 0.25$, $SD = 0.07$, and $p = 0.031$. Thus, there seems to be a direct effect of participants' mindset on their coping-ability appraisal.

Furthermore, to test whether students' mindset significantly predicted students' overall cognitive stress appraisal (follow-up measurement), their coping-ability appraisal, and threat appraisal at the follow-up measurement, we conducted three additional separate regression analyses. We did not find a significant direct effect of students' mindset at postmeasurement on their cognitive stress appraisal at follow-up measurement, $b = -1.67$, $SD = 1.17$, and $p = 0.156$, nor on their threat appraisal at follow-up measurement, $b = 0.00$, $SD = 0.09$, and $p = 0.998$. However, we did find a significant and positive effect of students' mindset on their coping-ability appraisal at postmeasurement, $b = 0.20$, $SD = 0.07$, and $p = 0.006$. Thus, there seems to be a direct effect of participants' mindset on their coping-ability appraisal.

Mediating Influence of Mindset Postintervention on the Relation Between Condition and Coping-Ability Appraisal

Since we exploratively found a direct effect of students' mindset on their coping-ability appraisal, we tested whether mindset mediates the effect of the intervention on coping-ability appraisal and threat appraisal at the postmeasurement by conducting two separate mediation analyses using PROCESS version 3.0 for SPSS (Hayes, 2018). In both analyses, we incorporated mindset (postintervention measure) as a mediator. The results reveal a statistically significant indirect effect of the intervention on coping-ability appraisal (postmeasurement) through mindset (see **Figure 2**). Mindset fully mediated the intervention effect on coping-ability appraisal, $b = 0.16$; 95% BCA CI (0.035, 0.351). Students in the intervention group reported a stronger growth mindset than students in the active control group, $b = 0.97$; $p < 0.001$, and the more students reported having a growth mindset, the more they reported being able to cope with the threatening event, $b = 0.17$; $p = 0.042$.

The results of the mediation analysis on threat appraisal reveals no significant indirect effect of the intervention through mindset, $b = -0.05$; 95% BCA CI [−0.387, 0.283].

Mediating Influence of Mindset on the Relation Between Condition and Coping-Ability Appraisal at the Follow-Up Measurement

Additionally, we tested whether the mediating influence of mindset on the relation between intervention condition and coping-ability appraisal would still show at the follow-up measurement. We conducted an additional mediation analysis using PROCESS version 3.0 for SPSS (Hayes, 2018). We incorporated mindset (follow-up-intervention measurement) as a mediator. The results reveal a statistically significant indirect effect of the intervention on coping-ability appraisal (follow-up measurement) through mindset (follow-up measurement). Mindset fully mediated the intervention effect on coping-ability appraisal, $b = 0.11$; 95% BCA CI (0.009, 0.246) (see **Figure 3**). Students in the intervention group reported a stronger growth mindset than students in the active control group, $b = 0.57$; $p = 0.012$, and the more students reported having a growth mindset, the more they reported being able to cope with the threatening event, $b = 0.19$; $p = 0.020$.

DISCUSSION

Our aims with this study were threefold. First, we assessed the effectiveness of a novel one-time computerized mindset intervention specifically designed for teaching students. Second, we examined the intervention's influence on students' cognitive stress appraisal. Third, we investigated whether the assumed effect of our mindset intervention on students' subsequent cognitive stress appraisal would be more pronounced for those with a lower academic self-concept.

The first hypothesis expressed the assumption that the intervention would have a significant and stable effect on participants' mindset. This assumption was supported. After the intervention, participants in the intervention group displayed, on average, more of a growth mindset, whereas participants in the control group had, on average, more of a fixed mindset. Furthermore, the intervention still showed a significant effect on the intervention group's mindset, on average, five days after the intervention session with a medium-sized effect of $d = 0.65$ (on average, participants answered the follow-up survey $M = 4.6$ days after the intervention; $SD = 2.22$; $Min = 2$; $Max = 13$)[1].

The tested intervention materials and tasks that extended and modified existing intervention materials (Aronson et al., 2002) specifically for a sample of teaching students effectively impacted teaching students' mindset. The applied variations were in fact

[1]We tested whether the length of delay between postmeasurement and follow-up measurement had a significant effect on the intervention condition's change in mindset. No significant effect of delay on magnitude of mindset change was found, $b = -0.06$; $p = 0.122$.

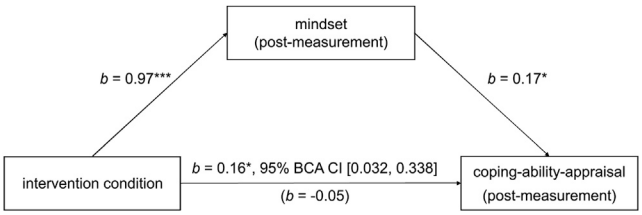

FIGURE 2 | Mediation model for the relationship between the intervention and coping-ability appraisal at postmeasurement mediated by mindset at postmeasurement indicated by standard regression coefficients. The standardized regression coefficient between the intervention and coping-ability appraisal, controlling for mindset, is in parentheses (direct effect). BCA CI, bootstrapped CI. *$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$. $N = 77$.

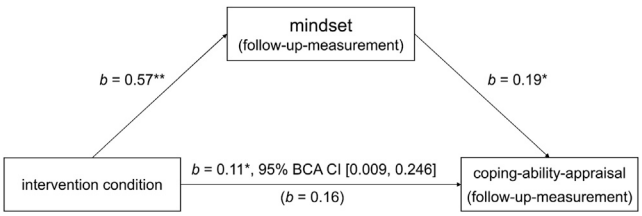

FIGURE 3 | Mediation model for the relationship between the intervention and coping-ability appraisal at follow-up measurement mediated by mindset at follow-up measurement indicated by standard regression coefficients. The standardized regression coefficient between the intervention and coping-ability appraisal, controlling for mindset, is in parentheses (direct effect). BCA CI, bootstrapped CI. *$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$. $N = 77$.

quite simple; we presented a scenario in which teaching students found themselves confronted with a student doubting their ability to change their mathematics achievement. They were further asked to convey a personal example that stresses the value of effort in developing one's ability that would supposedly be used for a project that encourages underperforming students. Furthermore, the described results relate to results reported by Paunesku et al. (2015) who showed for a sample of high school students that even a variation in the tasks provided in the initial intervention given by Aronson et al. (2002) could create relatively lasting mindset changes (they shortened the intervention tasks used by Aronson et al., 2000 to a one-time 45 min-long intervention session). It seems that even relatively short mindset interventions can effectively impact participants' mindsets. The present research moreover extends these findings by displaying their applicability to a sample of teaching students. The results therefore illustrate that even interventions that require little time and resources can have an impact on participants' mindsets. The tested intervention thus responds to the demand for more economic and practical mindset interventions that can efficiently be applied on a grander scale (Dweck and Yeager, 2019).

The second hypothesis furthermore expressed the assumption that the intervention would directly impact participants' cognitive stress appraisal regarding an upcoming performance situation. This claim was based on the assumption that a person's mindset as a generalized belief would influence a person's appraisal of how well they would be able to cope with a self-identified stress-inducing performance situation and therefore influence the overall cognitive stress appraisal. Contrary to our hypothesis, no significant main effect of the intervention on participants' cognitive stress appraisal was found.

Even when taking participants' academic self-concept into account, we found neither a direct effect of the intervention on participants' cognitive stress appraisal nor a significant interaction between students' academic self-concept and the intervention condition on students' cognitive stress appraisal. What we found was that participants' academic self-concept significantly related to participants' cognitive stress appraisal. Participants with a higher academic self-concept already showed at premeasurement a significantly lower stress response regarding their reported upcoming exam and kept this low level of cognitive stress appraisal until the follow-up measurement. This finding concurs with previous research that has already displayed academic self-concept's link to achievement-related cognition and emotions (Frenzel et al., 2007; Ahmed et al., 2012). For example, Frenzel et al. (2007) were able to show that students who viewed their own mathematics abilities as low showed more negative achievement-related emotions than students who viewed their mathematics abilities as higher. Additionally, Ahmed et al. (2012) reported that students' mathematic self-concept significantly influenced their subsequent achievement-related emotions (here: math anxiety).

Even though we did not find any evidence for a direct effect of our intervention on participants' overall cognitive stress appraisal, we found an indirect effect of the intervention on

participants' coping-ability appraisal as a secondary step in the formation of cognitive stress appraisal (a person's appraisal of their capabilities in dealing with an event; Lazarus, 1966) that was fully mediated by participants' mindset. These findings correspond to recent results reported by Lee et al. (2019). Lee et al. (2019) found that students whose grades were declining and who held more of a fixed mindset were more likely to exhibit elevated salivary cortisol levels, compared to students who held more of a growth mindset. In addition, students whose grades were declining and held more of a fixed mindset were also more likely to perceive that they did not possess the resources to adequately cope with their daily stressors (measured through the following item: "overall how confident are you that you can handle the stresses you experienced today?"; Lee et al., 2019).

Furthermore, our results reveal a potential benefit that could be derived from utilizing mindset interventions in not only changing how students approach challenging learning and performance situations but also could potentially—through influencing their mindset—change how students cognitively appraise academically challenging situations and in turn influence their cognitive stress appraisal as well as their physiological stress response. Obviously, further research is required to examine these propositions and to shed further light on the processes that link a person's mindset to their cognitive stress appraisal and their physiological stress response.

At the same time, new questions arise regarding the theoretical rationale in which to position our and previous results that point to a connection between a person's mindset and their cognitive or physiological stress response. In order to investigate these questions and build upon our and previous research, other frameworks that try to explain the genesis of stress when encountering academic challenges or other achievement-related emotions could be taken into account.

The control-value theory of achievement emotions (Pekrun et al., 2007) potentially provides a preliminary framework that links a person's mindset to either their physiological stress response, their belief of being able to cope with current academic stressors (Lee et al., 2019), or achievement-related emotions like anxiety (King et al., 2012). The control-value theory of achievement emotions integrates a vast variety of emotion-related theories. Among these, the theory takes the predictions and theoretical assumptions of the transactional stress theory into account (Lazarus and Folkman, 1984; Pekrun et al., 2007). Test anxiety, for example, is assumed to be dependent on two main factors: a person's control appraisals and the value a person ascribes to the outcome of the performance situation. Accordingly, test anxiety ensues if a person views an upcoming exam as highly relevant and their ability to effectively be able to control the outcome as highly unlikely (Pekrun et al., 2007). Extending this argumentation, we argue that a person's mindset—if it has no direct impact on the overall cognitive stress response itself—could potentially influence a person's control appraisals, which in turn would then influence the ensuing cognitive stress response. The control-appraisal on the other hand is, according to Pekrun et al. (2007), dependent on a person's achievement-related convictions. A person's mindset represents such an implicit achievement-related belief that should in turn influence a person's appraisal of their capacity to deal with a demanding performance situation (Molden and Dweck, 2006).

Limitations and Future Directions

Even though the intervention was effective in influencing participants' mindset and we discovered an interesting insight into how participants' mindset relates to their appraisal of their coping ability, the following limitations need to be addressed.

First, even though we assessed the development of participants' cognitive stress appraisal through repeated measurements, no conclusion can be drawn about the actual stress potential of the reported exam and performance situations. Additionally, we did not explicitly assess when the reported exam had to be taken. Therefore, we cannot conclude if the time proximity of the upcoming exam might have played a relevant role in the actual stress potential of the situation. In addition, we did not test whether the repeated prompt for participants to write down the title of their upcoming exam before asking for their appraisal of the stress potential was able to activate a vivid representation of the upcoming performance situation.

In order to test the replicability and applicability of the designed intervention for teaching students and teaching staff, the material needs to be further tested in order to assess their long-term robustness and effectiveness. Even though the intervention's effect was still significant a few days after the intervention was conducted (M = 4.6; SD = 2.22), the effect was less pronounced than right after the intervention. From a practical point of view, this observation suggests that a second intervention at this time point could potentially aid the long-term effectiveness of the intervention.

Additionally, in order to test their actual generalizability and practical use, the materials could be applied to a sample of high school or middle school teachers. For example, the effect of applying the utilized intervention materials to a sample of teachers and how this could affect their students' mindset and performance could be assessed to evaluate the utility of the intervention for a potentially larger scale utility.

Future research should also revisit the question of a connection between mindset and stress appraisal and the crucial role the mindset plays in participants' coping-ability appraisals when faced with demanding performance situations. This could be done in a more standardized manner by manipulating how demanding a performance situation is or by examining the effects of mindset interventions on stress appraisal of students taking the same upcoming exam.

Lastly, even though we did not find a main effect of the intervention on the overall cognitive stress appraisal, our exploratory results point to an indirect effect of the intervention through mindset on participants' coping-ability appraisal. This provides a noteworthy insight into the potential link between a person's mindset and their cognitive stress appraisals facing academic challenges. Taking previously reported research results into account (King et al., 2012; Lee et al., 2019) as well as our own, a potential route to take for subsequent research could be to extend the provided theoretical rationale and further investigate potential processes that link a person's mindset to their overall emotional and cognitive experiences when faced with academic challenges.

CONCLUSION

This study highlights the beneficial and robust effects of a novel growth-mindset intervention designed for teaching students. Furthermore, this study provides insights into how a person's mindset relates to their cognitive stress appraisal. The question about the influence of a person's mindset on their overall stress response and the underlying mechanisms can at this point not be unequivocally answered but our results point to a possible interesting avenue for subsequent research and provide insights into a potential overarching theoretical framework.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the University of Mannheim. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2021.634684/full#supplementary-material.

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