

**The Potential Protective Nature of Self-regulation Regarding the Relationship Between
Academic Stress and Burnout Symptoms of University Students**

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Abstract

The goal of this study was to research the relationship between academic stress and burnout, as well as how self-regulation might interact with this relationship. Academic stress was expected to positively relate to burnout. It was expected that self-regulation would moderate this relationship; namely, academic stress was expected to be less associated with burnout symptoms regarding participants who engaged in self-regulation as compared to those who did not. These expectations were studied with a correlational design within a sample population of 132 participants studying at Dutch and German universities. Participants' engagement in self-regulation was measured with the Short-Self-Regulation Questionnaire (SSRQ). The Student Life Challenges Scale (SLCS) was used to measure participants' academic stress and the Maslach Burnout Inventory – Student Survey (MBI-SS) was used to measure experienced burnout symptoms (i.e., exhaustion, cynicism, and professional inefficacy). To assess the relationships between academic stress, burnout, and self-regulation, both moderation and mediation analyses were performed with the use of a Hayes' PROCESS-Macro in the program Rstudio. High scores on academic stress were, as expected, associated with high scores on the burnout symptoms. Unexpectedly, self-regulation did not moderate this relationship. Yet, self-regulation did mediate the relationships between academic stress and the burnout symptoms cynicism and professional inefficacy, meaning that academic stress was negatively associated with the use of self-regulation which was in turn associated with the experience of these burnout symptoms. The results of this study align with the idea that experiencing certain heights of (prolonged) academic stress could hinder the use of self-regulation. This indicates that regardless of self-regulation ability, students might be unable to engage in self-regulation to manage stress. Hence, unlike what was suggested by previous research, it might be fruitless to design stress management interventions that solely focus on heightening self-regulation ability. More research is needed to sort out how and why academic stress is associated with self-regulation as well as to assess whether and under which circumstances students can engage in self-regulation.

Keywords: university students, self-regulation, academic stress, burnout, mediation, moderation

The Potential Protective Nature of Self-regulation Regarding the Relationship Between Academic Stress and Burnout Symptoms of University Students

COVID-19 highlighted the notion that research should focus on identifying factors that could protect university students against study related stress. During the COVID-19 pandemic university students experienced higher levels of stress related to their study (Bitter & McCrea, 2022; Charles et al., 2021). These higher levels of stress were associated with negative health effects, such as a rising amount of student burnouts (Aguayo-Estremera et al., 2023; de la Fuente, 2021; Gundogan, 2022). Moreover, experiencing these elevated levels of stress during the pandemic is expected to have an enduring effect afterwards, meaning that students might be more prone to experiencing burnouts in later stages of their lives (Fernández-Castillo, 2021; Gundogan, 2022). Hence, Clabaugh et al. (2021) stressed the need for research on identifying factors that influence how students are affected by study related stress. In line with this identified research need, this study investigated the relationship between stress and burnout in students and the role of self-regulation.

COVID-19 showcases a recent example of the importance of research on university students' stress; the relevance of such research is not limited to the context of COVID-19 (Porru et al., 2022; Robotham, 2008; Stallman & Hurst, 2016). University students nowadays experience more stress than previous generations of students (American Psychological Association, 2018; Porru et al., 2022). More specifically, university students seem to experience high levels of *academic stress* (Bedewy & Gabriel, 2015; Joseph et al., 2021; Porru et al., 2022). Academic stress has been described as a phenomenon that heightens when study related factors disturb students' frame of mind (Karaman et al., 2017; Porru et al., 2022; Stallman & Hurst, 2016). Examples of such factors are obligations such as meeting deadlines and the pressure to perform well academically to avoid disappointing important others (Bedewy & Gabriel, 2015; Stallman & Hurst, 2016; Porru et al., 2022).

Experiencing academic stress is associated with declined academic performance (Kahn et al., 2013; Vaez & Laflamme, 2008). Rudland et al. (2020) argue for the contrary, namely that academic stress could provide students with the push that they need to learn effectively. However, dependent on students' resources such as coping skills, they might be better or less equipped to handle stress (de la Fuente et al., 2020). Consequently, students do not always seem to experience academic stress in this helpful manner; instead, students might relate academic stress to the perception of being overwhelmed (de la Fuente et al., 2020; Hill et al., 2018; Khan et al., 2013). When students experience high academic stress, this can negatively influence both

mental health (e.g., Adiele et al., 2018; Compton et al., 2008; Stallman & Hurst, 2016) and physical health (e.g., Chen et al., 2013; Porru et al., 2022).

Therefore unsurprisingly, academic stress has also been connected with student *burnouts* (Gibbons, 2010; Lue et al., 2010; Santen et al., 2010). A burnout in the context of college life can be described by the following symptoms: exhaustion caused by obligations, a distant attitude towards obligations as well as an unwillingness to work on meeting obligations, and perceiving oneself as an incompetent student (Behrouzi et al., 2013; Dyrbye & Shanafelt, 2016; Schaufeli et al., 2002). Students who experience higher levels of academic stress exhibit these burnout symptoms in a greater degree than students experiencing lower levels of academic stress (Hwang & Kim, 2022; Veyis et al., 2019; Yusoff et al., 2021). As experiencing academic stress might put students at risk for a burnout, it is essential to identify factors that could protect individuals from the negative influence of academic stress.

Self-regulation seems to be such a protective factor. Self-regulation has been broadly defined as the process in which an individual engages if they manage their emotions, cognition, and behaviour, when they are working towards a goal, facing environmental changes, and facing stressors (Carey et al., 2004; Gagnon et al., 2016; Ramli et al., 2018; von Keyserlingk et al., 2022). Miller and Brown (1991) explained this process in more depth by dividing it into seven subprocesses. First, an individual gathers the essential information (1), after which they give meaning to the information by appraising and comparing it to previous gained knowledge and experiences (2). Then, they start to make the initial needed changes based upon the information (3) and they assess potential courses of action (4). Next, they make (5) and execute (6) a plan. Lastly, they reflect upon the efficacy of the plan and its execution (7).

Being able to engage in these self-regulation processes might protect students against the negative effects of academic stress, since these processes help individuals to manage stress in a healthy manner (de la Fuente et al., 2020; Durand-Bush et al., 2015; von Keyserlingk et al., 2022). Lazarus and Folkman's Transactional Model of Coping distinguishes between two different ways in which an individual can react to a stressor (Lazarus and Folkman, 1984). An individual who actively works on resolving a stressor, engages in *adaptive coping*. On the other hand, when an individual distances themselves from the stressor and avoids the stressor, they engage in *maladaptive coping*. Research suggests that reducing the use of maladaptive coping and fostering the use of adaptive coping allows students to deal with academic stress in an effective manner (Joseph et al., 2021; Mahmoud et al., 2012; Thompson et al., 2016). Hence, if self-regulation fosters the reduction of maladaptive coping and growth in adaptive coping use, it might help an individual to deal with academic stress effectively.

Based on Miller and Brown's (1991) description of self-regulation as a seven-step process in which an individual engages to actively manage their emotional, behavioural, and cognitive reaction to a stressor, engagement in self-regulation seems indeed to be in line with adaptive rather than maladaptive coping. Research supports this notion, as children's ability to self-regulate predicted the use of adaptive coping mechanisms (Lengua & Long, 2002). Similar results have been found with regard to college students: students with high self-regulation ability were more likely to use problem-focused coping (i.e., adaptive coping) to attack their stressors, while students with low self-regulation ability were more likely to use emotion-focused coping to avoid their stressors (i.e., maladaptive coping; de la Fuente & Cardelle-Elawar, 2011; de la Fuente et al., 2020).

Summarized, engaging in self-regulation seems to foster the use of adaptive coping mechanisms that allow students to effectively manage academic stress. This presupposes that students could engage in self-regulation to protect themselves against the negative results of experiencing academic stress. More specifically, engagement in self-regulation might protect students from experiencing burnout symptoms brought on by academic stress. Gibbons (2010) found that maladaptive coping was the strongest predictor of academic stress resulting in a burnout. In line with Gibbons, both Thompson et al. (2016) and Vizoso et al. (2019) found that the individuals who use adaptive rather than avoidant (i.e., maladaptive) coping strategies have a decreased risk at burnout. This hints that self-regulation, which seems to foster adaptive and reduce maladaptive coping skill use, might be associated with lower amounts of experienced burnout symptoms. Indeed, individuals who engage more in self-regulation, have found to be less likely to experience burnout symptoms (Bakker & de Vries, 2021; Gagnon et al., 2016; Tikkanen et al., 2017).

Although research on academic stress, self-regulation, and burnout supports the idea of the protective nature of self-regulation, there is also research that presents evidence for the contrary. It is theorized that when high levels of academic stress are experienced, a person's executive functioning is affected by these stress levels. Consequently, a person's ability to engage in self-regulation might be hindered (Orem et al., 2008; Ramli et al., 2018; Williams et al., 2009). Research supports this notion, as students who show low levels of academic stress, seem to engage more in self-regulation than students with higher levels of academic stress (Winterbach, 2007; Pratiwi et al., 2021). Similarly, based on the theory of ego depletion in which is suggested that a person has a limited amount of self-control that they can exert, a person who experiences high levels of academic stress for a longer period of time, might be hindered in using self-regulation as they have depleted their resources (Muraven et al., 2019).

Thus, the protective nature of self-regulation might be irrelevant when academic stress reaches certain levels or is present for an extended period of time, as in these situations students could be hindered from engaging in self-regulation. This seems to suggest that self-regulation both mediates and moderates the relationship between academic stress and burnout: high self-regulation engagement could protect against the effects of academic stress on the amount of experienced burnout symptoms (i.e., moderator effect) and high levels of academic stress could influence the amount of experienced burnout symptoms through its influence on self-regulation engagement (i.e., mediator effect). As the untested potential protective nature of self-regulation is heavily assumed in current research (e.g., de la Fuente et al., 2020), the main focus of this study will be on assessing self-regulation as a potential protective factor (i.e., moderator).

In conclusion, the accepted notion with regard to self-regulation and academic stress, seems to be that self-regulation can protect students from the negative effects that academic stress might have on them as it fosters the use of adaptive coping skills (i.e., self-regulation as moderator). One caveat to this protective nature of self-regulation might be that individuals are hindered from engaging in it when stress levels exceed a certain height for a certain amount of time (i.e., self-regulation as mediator).

Focus of this study

The aim of this study is to further assess the theorized relationship between the factors academic stress, self-regulation, and the amount of burnout symptoms experienced by students. Hence, this study will focus upon the following question: To what extent does self-regulation moderate the relationship between academic stress and experienced burnout symptoms with regard to individuals studying at Dutch and German universities?

This question represents the focus on the general university student-body rather than on specific subsets of this population. In this aspect, the study differentiates itself from previous research on academic stress, as this research often focused on medical students because they are known to report high levels of academic stress (e.g., Adiele et al., 2018; Afolayan et al., 2013; Gagnon et al., 2016).

With regard to the expected answer to this question, based on the research of Yusoff et al. (2021), academic stress was expected to be positively related to the height of experienced burnout symptoms, meaning that it was expected that higher amounts of academic stress would be associated with higher amounts of experienced burnout symptoms. Furthermore, the amount to which a student effectively engaged in self-regulation, was expected to moderate this relationship, based on previous research that suggested the potential protective nature of self-regulation (e.g., de la Fuente et al., 2020; Durand-Bush et al., 2015). This would mean that

when two individuals experience the same amount of academic stress, the individual who engaged less in self-regulation would experience a higher amount of burnout symptoms than the individual who engaged more in self-regulation.

Methods

Design

This study was performed within the framework of a research unit existing out of five student-researchers, who performed the research as their bachelor thesis. Together they aimed to research the relationship between academic stress and experienced burnout symptoms. Each individual researcher assessed the role of a specific variable with regard to this relationship, meaning that all researchers had different research questions. This study specifically focused on the connections between the variables academic stress, self-regulation, and experienced burnout symptoms with regard to a population of university students. In this study, a correlational design was used with academic stress as an independent numerical variable, self-regulation as a numerical moderator, and with experienced burnout symptoms as a dependent numerical variable. The study has been granted ethical approval by the BMS ethics committee (request number: 230182).

Participants

To be able to participate in this study, an individual had to be a university student who was currently studying at a Dutch or German university, who could understand English and who was aged either eighteen or above. Participants were gathered with a combination of volunteer sampling, opportunity sampling and snowball sampling. Volunteer sampling was performed at a Dutch university with the use of the SONA system in which the university students could sign up for the study in exchange for credit after participation. Opportunity sampling combined with snowball sampling was performed by distributing the link to the study among Dutch and German university students in the social networks of the researchers in the research unit, with the attached request to share the link with fellow university students (e.g., the link was shared via, among other platforms, WhatsApp, and Facebook).

Participant responses were included in this study when they filled in the information required for the variables academic stress, self-regulation, and experienced burnout symptoms (i.e., they filled in the questionnaires related to these variables entirely; see Materials). Participant responses were excluded from the study if they indicated that they did not understand the questions (i.e., participant answered “no” on the question “Were there any things that were unclear?” and indicated in their reason for this answer that they had been highly

confused when filling out the questionnaire). Furthermore, participant responses were excluded when they were flagged as speeders (i.e., the participants' response time was flagged by the program Qualtrics, in which the questionnaire was made, as their responses differed ≥ 2 standard deviations from the mean time it took participants to fill in the questionnaire). Participants were also excluded when their answers across different questionnaires showed a distinctive pattern (e.g., on every questionnaire, the participant always chose the option that was most to the right).

With these sampling methods, a total of 161 participants was gathered. Non of the participants had to be excluded due to speeding, due to confusion or due to patterned responses. After excluding the participants who did not fill in the questionnaires measuring academic stress, self-regulation, and burnout, 132 participants remained (see Table 1). Most of these 132 participants were psychology students (i.e., 61 students) and a prominent part of the participants studied at the University of Twente (i.e., 89 students). Furthermore, most of the participants were bachelor students (i.e., 111 students) rather than master students (i.e., 15 students). Other outstanding characteristics of the sample were that most students were female (i.e., 101), and that around half of the students had a German nationality. Lastly, most students started their study in the period 2020 to 2022 (i.e., 108 students).

Table 1*Participant Demographic Information University Students (N = 132)*

Variables	Mean (Range) Number (%)
Age	21.50 (18-39)
Gender	
Female	101 (76.5%)
Males	30 (22.7%)
Other	1 (0.8%)
Nationality	
Dutch	44 (33.3%)
German	69 (52.3%)
Other	19 (14.4%)
Study	
Psychology	61 (46.2%)
Communication Science	17 (12.9%)
Other	54 (40.9%)
Phase of Study	
Bachelor Year 1	29 (22.0%)
Bachelor Year 2	33 (25.0%)
Bachelor Year 3	49 (37.1%)
Master Year 1	12 (9.0%)
Master Year 2	3 (2.3%)
Other	6 (4.6%)
University	
University of Twente	89 (67.4%)
Other	43 (32.6%)
Start Year Study	
2020	45 (34.1%)
2022	32 (24.2%)
2021	31 (23.5%)
Other	24 (18.2%)

Materials

The five studies done within the research unit made use of the same questionnaire, which was made in Qualtrics. This questionnaire existed out of several questionnaires which were included due to their relevance to the researchers their separate studies. The questionnaires that were relevant with regard to this study were the questionnaires that measured the variables academic stress, self-regulation, and experienced burnout symptoms (see Appendix A). The overall questionnaire also contained questions with regard to participant background characteristics and demographics; these questions as well as the questionnaires measuring academic stress, self-regulation, and experienced burnout symptoms, are discussed in the next sections.

Participant Background Characteristics and Demographics

Data was collected about participant background characteristics and demographics with the use of seven questions, which asked the participants to indicate their age, gender orientation, nationality, the university at which they studied, their study (e.g., psychology), phase of study (e.g., bachelor year 1) and the year in which they started their study. To answer the questions regarding age, the university at which participants studied, their study and the year in which they started the study, participants typed out their answer. With regard to the other questions about participants' gender orientation, nationality and phase of study, participants selected the option most befitting them or typed out their answer if an accurate answer option was not present.

The Student Life Challenges Scale

The variable academic stress was measured with the use of the Student Life Challenges Scale (SLCS), as it was used by Porru et al. (2022). They build this scale upon Dahlin et al. (2005) their Higher Education Stress Inventory (HESI) by removing the subscale insufficient feedback that did show low correlation with the other subscales ($r_s = .22$) and by back translating the items. These changes resulted in a scale with 22 items, that can be under divided in six subscales. One of these subscales, low commitment, measured with two items, was not used in this study, because it was bound to correlate highly with the burnout symptom cynicism. Namely, the items of this subscale were judged too similar to the items measuring cynicism (i.e., burnout symptom) in the Maslach Burnout Inventory – Student Survey (i.e., questionnaire used to measure burnout symptoms). Concluding, in this study, academic stress was measured with five subscales, with 20 items in total.

The first subscale, faculty shortcomings, was measured with seven items (e.g., The teachers often fail to clarify the aims of the activities). The internal consistency of this subscale

was acceptable in Porru et al. (2022) their study, but questionable in this study (Porru et al. (2022) Cronbach's $\alpha = .74$; this study Cronbach's $\alpha = .61$). The second category, worries about the future, was measured with three items (e.g., the long hours and responsibilities of my future career worry me). Internal consistency of this subscale was questionable (Porru et al. (2022) Cronbach's $\alpha = .67$; this study Cronbach's $\alpha = .63$). The third category, unsupportive climate, was measured with five items (e.g., there is a competitive attitude among students). Internal consistency of this subscale was questionable (Porru et al. (2022) Cronbach's $\alpha = .65$; this study Cronbach's $\alpha = .70$). The fourth category, high workload, was measured with three items (e.g., the pace of study is too high). Internal consistency of this subscale was acceptable in this study, but questionable in Porru et al. (2022) their study (Porru et al. (2022) Cronbach's $\alpha = .68$; This study Cronbach's $\alpha = .78$). The fifth and last category, financial concerns, was measured with two items (e.g., as a student my financial situation is worrying me). The two items on this subscale were highly correlated in this study, but moderately correlated in Porru et al. (2022) their study (Porru et al. (2022) $r_s = .49$; this study $r = .66$).

Students reacted to the items by indicating on a 4-point Likert scale whether they *totally disagreed* (1), *disagreed* (2), *agreed* (3) or *totally agreed* (4) with the items. With regard to the subscale faculty shortcomings, participant scores to items 1, 3, 5, and 7 were reverse scored, in order for higher scores on these items to represent faculty shortcomings. For each student the mean of the item scores regarding each separate subscale were calculated (i.e., mean of each subscale could theoretically range from 1 to 4). A higher mean score on a subscale indicated a higher level of academic stress with regard to that specific subscale. For example, a higher mean score on the subscale financial concerns, meant that a participant experienced a higher amount of academic stress as indicated by their financial concerns.

Short Self-Regulation Questionnaire

Students' engagement in self-regulation was measured with Carey et al. (2004) their Short Self-Regulation Questionnaire (SSRQ). The SSRQ is a shortened version of the Self-Regulation Questionnaire (SRQ) of Brown et al. (1999). The SRQ contains 63 items that measure engagement in the seven subprocesses of self-regulation. The shortened version, the SSRQ, contains 31 items, that measure a single construct, engagement in self-regulation, rather than the engagement in the seven theorized subprocesses of self-regulation. The SSRQ highly correlates with the original scale ($r = .96$) and was shown to be very reliable (Cronbach $\alpha = .92$; Carey et al., 2004). In the current study, similar results were found (Cronbach $\alpha = .92$).

Students filled in the questionnaire by indicating on a 5-point Likert scale, whether they *strongly disagreed* (1), *disagreed* (2), *neither disagreed or agreed* (3), *agreed* (4) or *strongly*

agreed (5) with the statements made. Of the 31 items, 14 items measured low self-regulation (i.e., item 1, 2, 4, 7, 8, 10, 11, 15, 16, 17, 22, 25, 26, and 31), meaning that participants strong agreement was an indication of low engagement in self-regulation (e.g., I have trouble making up my mind about things). The other 17 items measured high self-regulation, meaning that participants strong agreement was an indication of high engagement in self-regulation (e.g., I usually think before I act). A total score was created by reverse scoring participants their scores on the 14 low self-regulation items and by subsequently summing participants scores on all items. Hence, higher total scores indicated participants who engaged more in self-regulation and total scores on self-regulation could theoretically range from 31 to 155.

Maslach Burnout Inventory – Student Survey

Lastly, participants their experienced burnout symptoms were measured with the Maslach Burnout Inventory – Student Survey (MBI-SS; Schaufeli et al., 2002). The MBI-SS contains a total of 15 items that measure three subconstructs associated with burnouts: exhaustion (e.g., I feel burned out from my studies; five items), cynicism (e.g., I doubt the significance of my studies; four items) and professional efficacy (e.g., in my opinion, I am a good student; six items). Internal consistency of the subscales exhaustion and cynicism was found acceptable across three samples (i.e., Netherlands, Spain, and Portugal; Cronbach $\alpha > .70$). With regard to professional efficacy, internal consistency was acceptable in the Spanish sample (Cronbach $\alpha = .76$) and slightly below acceptable in the other two samples (Netherlands Cronbach $\alpha = .67$; Portugal Cronbach $\alpha = .69$). In this study, internal consistency was found to be acceptable on the professional efficacy scale and excellent on the exhaustion and cynicism scales (Exhaustion Cronbach $\alpha = .90$; Cynicism Cronbach $\alpha = .91$; Professional Efficacy Cronbach $\alpha = .79$).

Participants filled in the questionnaire by using a 7-point frequency rating scale on which they indicated whether the items applied to them on a scale that ranged from *never* (0), *a few times per year* (1), *once a month* (2), *a few times per month* (3), *once a week* (4), *a few times a week* (5), to *everyday* (6). Scores on the items of the scale professional efficacy were reversed coded, in order for higher scores to represent professional inefficacy (i.e., less professional efficacy). Next, participants their mean scores with regard to each of the three subscales were calculated, meaning that scores on each subscale ranged between 0 and 6. A higher mean score on a subscale indicated a higher amount of experienced burnout symptoms with regard to that subscale. For example, if a participant scored higher on the subscale cynicism, this meant that the participant experienced more cynicism burnout symptoms.

Procedure

Participants who considered participating in the study could do so by clicking on an URL. This URL guided the participants to a participant information sheet that contained information about the purpose and procedure of the study, risks of participating in the study, anonymity, and confidentiality, contact information of the researchers, participants' rights, and participants' consent. If, after reading this information, the participant did still wish to participate in the study, they could indicate their agreement to participate by clicking a box that stated that they read and understood the information and agreed to participate in the study.

After consenting, participants were asked to provide general information about themselves, namely their age, gender orientation, nationality, the university at which they studied, their study (e.g., psychology), the phase of their study (e.g., bachelor year 1) and the year in which they started their study.

Next, participants filled in the SLCS and the MBI-SS, followed by five other questionnaires which were provided in a random order: the SSRQ measuring self-regulation, the BRIEF Cope measuring coping styles, the Almost Perfect Scale measuring perfectionism, the Social Provision Scale measuring social support and the Big Five Inventory-2 Short measuring personality.

After filling out these questionnaires, participants were asked to indicate whether the questionnaires presented to them were clear by clicking a box. If this was not the case, they were asked to type out where the unclarities originated from. Subsequently, participants were shown the debriefing sheet which contained further information about the study, links to mental health resources and the contact information of the people that could be contacted if participants had additional questions. After clicking next on the debriefing sheet, the participants were thanked for their participation.

Data Analysis

Data analysis was performed with the program Rstudio. Firstly, an exploratory factor analysis was performed on the mean subscale scores of participants' answers on the SLCS, to assess whether subscales could be combined into one academic stress measurement based on factor loadings. Before performing this analysis, both Kaiser-Meyer-Olkin's measure was calculated, and Bartlett's sphericity test was performed to assess whether a factor analysis would return accurate results.

After it was determined how academic stress would be measured (e.g., as one construct or as multiple), the normality of the data was checked by plotting histograms of the distribution of participant scores on each variable (i.e., the construct(s) of academic stress, self-regulation, exhaustion, cynicism, and professional inefficacy). In addition, the skew and kurtosis value for

each of these distributions were evaluated. If kurtosis and skew values were not indicative of a normal distribution, then z -scores of these values were calculated (e.g., $(\text{kurtosis}_{\text{self-regulation}} - M_{\text{self-regulation}}) / SD_{\text{self-regulation}}$). These z -scores were subsequently used to assess whether the values could be expected of a normal distribution due to chance (i.e., $-1.96 < z < 1.96$). Lastly, Q-Q plots were plotted for each variable. Based on these results, it was considered whether bootstrapping could be an appropriate course of action; bootstrapping is appropriate when data are not normally distributed.

Next, an overview of the data was created by calculating the overall mean score of all participants on the construct(s) with which academic stress was measured, the subscales of the MBI-SS and the SSRQ. In addition, the standard deviations of these scores were calculated. Furthermore, to get a further overview of the data, correlations between all variables were calculated.

Subsequently, the main analysis was performed to assess whether academic stress was positively related to experienced burnout symptoms (i.e., exhaustion, cynicism, and professional inefficacy; hypothesis 1) and whether self-regulation moderated these relationships (hypothesis 2). To test these hypotheses, moderation analyses were run with the use of Hayes' PROCESS-macro in Rstudio (Hayes, 2013). This entails that the process() function was used to perform the main analysis which consisted out of three multiple linear regression models.

To prevent multicollinearity between the variables and the interaction terms, the centred variables and interaction effects were used in the linear models. If previous analyses had shown that bootstrapping was an appropriate course of action, then process() would also be used to perform the main analysis with bootstrapping. Bootstrapping would be performed with a boot of 10,000.

All three linear models in the main analysis included the academic stress construct(s) and self-regulation as numerical independent variables. Furthermore, all three linear models included the potential interaction effect between the academic stress variable(s) and self-regulation (e.g., Academic Stress X Self-regulation). These three linear models differed from each other with regard to the measured dependent variable. The subscales of the MBI-SS (i.e., exhaustion, cynicism, and professional inefficacy) were included as a numerical dependent variable in separate analyses, resulting in three separate linear models.

When interaction effects were significant with regard to a burnout variable, the relationship between academic stress and the burnout symptom was further investigated and visualized with regard to different levels of self-regulation. However, when interaction effects

were not found to be significant and when the direct relationships between self-regulation and burnout variables were found to be significant, then it was assessed whether self-regulation could be an explanatory variable (i.e., mediator) with regard to the relationship between academic stress and burnout. To assess this, similar to the moderation analyses, `process()` was used to perform mediation analyses. The `process()` function does not provide all the necessary information to perform the mediation analyses entirely with bootstrapping. Despite this limitation, `process()` was still used to run the mediation analyses, as the sample size ($N = 132$) was deemed large enough to run these analyses without bootstrapping. The effect of the mediation (i.e., the indirect effect of the academic stress construct(s) on the burnout variables through self-regulation) was bootstrapped though, as it is automatically bootstrapped by `process()`.

Results

Adjustments Made to the Data: Factor Analysis

Based upon the results of the factor analysis, the subscales of the SLCS were submerged into one variable called academic stress (see Appendix B). This submerging entailed that participant scores on the five subscales were averaged, resulting in one variable called academic stress on which participant scores could theoretically range from 1 to 4 (Academic Stress Cronbach $\alpha = .68$).

Creating an Overview of the Data: Descriptive Statistics and Parametric Assumptions

Descriptive Statistics

As can be seen in Table 2, participant scores on academic stress ranged from 1.29 to 3.27. Theoretically, scores could range from 1 to 4, meaning that participants neither scored the minimum nor the maximum academic stress score. Furthermore, the academic stress mean found in this study (i.e., $M = 2.31$) was lower than the middle of the scale (i.e., middle of the scale = 2.50); the middle of the scale was less than a standard deviation away from the found academic stress mean (i.e., $SD = 0.48$).

With regard to the variable self-regulation, the middle of the scale was 93 as scores could theoretically range between 31 and 155. The mean found in this study was higher than the middle of the scale ($M = 108.20$). The middle of the scale was less than a standard deviation away from the found mean (i.e., $SD = 16.82$). In this study, participant scores ranged between 67 and 148, meaning that participants did not score the highest possible score on self-regulation and that participants did not score on the relatively low end of the self-regulation scale (i.e., $31 < \text{self-regulation} < 67$).

With regard to the burnout variables, scores could theoretically range between 0.00 and 6.00, meaning that the middle of these scales was 3.00. The mean of participant scores on the variable exhaustion was close to this middle ($M = 3.10$; $SD = 1.53$). Participant scores ranged between 0.20 and 6.00, meaning that the lowest possible score on exhaustion was not found in the sample, but the highest was. With regard to the burnout variable cynicism, the mean of participant scores was lower than the middle of the scale ($M = 1.61$). The middle of the scale was less than a standard deviation away from the mean found ($SD = 1.63$). The theoretical possible range of participant scores on cynicism and the actual found range were identical (i.e., from 0.00 to 6.00). With regard to the burnout variable professional inefficacy, the mean of participant scores was lower than the middle score of 3.00 ($M = 1.99$). The middle of the scale was around a standard deviation away from the found mean ($SD = 1.02$). Participant scores ranged between 0.00 and 4.83 meaning that the lowest possible score on professional inefficacy was found in the sample and that participants did not score on the relatively very high end of the professional inefficacy scale (i.e., $4.83 < \text{professional inefficacy} \leq 6$).

Table 2

Descriptive Statistics and Pearson Correlations of the Variables Academic Stress, Self-regulation, Exhaustion, Cynicism, and Professional Inefficacy (N = 132)

	<i>M</i>	<i>SD</i>	Range	1	2	3	4	5
1. Academic Stress	2.31	0.48	1.29-3.27	-				
2. Self-Regulation	108.20	16.82	67-148	-.34***	-			
3. Exhaustion	3.10	1.53	0.20-6.00	.61***	-.26**	-		
4. Cynicism	1.61	1.63	0.00-6.00	.52***	-.33***	.47***	-	
5. Professional Inefficacy	1.99	1.02	0.00-4.83	.40***	-.58***	.28**	.48***	-

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Furthermore, as can be seen in Table 2, correlations between all variables (i.e., academic stress, self-regulation, exhaustion, cynicism, and professional inefficacy) were found significant. A strong positive correlation (i.e., $r > .50$) was found between academic stress and the burnout variable exhaustion, as well as between academic stress and the burnout variable

cynicism. This indicates that high scores on academic stress were strongly associated with high scores on these burnout variables. A moderate positive correlation was found between academic stress and the burnout variable professional inefficacy ($r = .40$), indicating that high scores on academic stress were moderately associated with high scores on this burnout variable.

With regard to the relationship between academic stress and self-regulation, a low negative correlation was found ($r = -.34$), indicating that higher scores on academic stress were lowly associated with lower scores on self-regulation.

With regard to the relationship between self-regulation and the burnout variables, a low negative correlation was found (i.e., $-.40 < r < .00$) between self-regulation and the burnout variable exhaustion as well as between self-regulation and the burnout variable cynicism. This indicates that high scores on self-regulation were lowly associated with low scores on these burnout variables. A high negative correlation was found between self-regulation and the burnout variable professional inefficacy ($r = -.58$), indicating that high scores on self-regulation were highly associated with low scores on professional inefficacy.

Parametric Assumptions: Normality

The histograms of all variables (i.e., academic stress, self-regulation, exhaustion, cynicism, and professional inefficacy) showed signs of skewness and kurtosis (see Appendix C). Correspondingly, kurtosis values of the variables were not indicative of a normal distribution (i.e., $1.94 \leq \text{kurtosis} \leq 2.82$). The z -scores of the kurtosis values of the variables academic stress, exhaustion, cynicism, and professional inefficacy, indicated that these kurtosis values were within the limits of what could be expected of a normal distribution ($-0.76 < z < 0.75$). Yet, the z -score of the kurtosis value of the variable self-regulation indicated that this value was unlikely to result from a normal distribution ($z = -6.27$). On the other hand, skew values of all variables were indicative of a normal distribution (i.e., $-1 < \text{skew} < 1$). Lastly, the Q-Q plots of all variables did not show linearity and were thereby not indicative of a normal distribution of participant scores on variables. Overall, the pattern in these results suggested that the normality assumption was violated for the variables. Hence, it was decided to run the subsequent analyses with the addition of bootstrapping.

Inferential Statistics: The Main Analysis

To assess the relationships between academic stress and burnout variables as well as the potential moderation effect of self-regulation on these relationships, three multiple linear regression models were tested. These models each included academic stress and self-regulation as numerical independent variables and the interaction effect between academic stress and self-regulation (Academic Stress X Self-regulation). The three models diverged from each other

regarding the dependent variable, as in each model one of three burnout variables (i.e., exhaustion, cynicism, and professional inefficacy) was included as numerical dependent variable.

As expected, a significant positive relationship was found between academic stress and exhaustion (see Table 3). This indicates, in line with hypothesis 1, that a higher score on academic stress was associated with a higher score on exhaustion. A non-significant relationship was found between self-regulation and exhaustion. This entails that self-regulation was not directly associated with the burnout variable exhaustion. Lastly, unexpectedly, the interaction effect between academic stress and self-regulation was non-significant. This means, unlike what was stated in hypothesis 2, that a higher score on self-regulation was not associated with a decreased impact of academic stress on exhaustion. The additional percentage of the explained variance of the dependent variable (i.e., exhaustion) that arose from the moderation effect (i.e., $R^2 = .001$), was small and further supports the claim that self-regulation was not moderating the relationship between academic stress and exhaustion.

Table 3

Self-regulation as Moderator: Relationships Between Academic Stress, Self-regulation, and Exhaustion (N = 132)

Variables	R^2	F	p	B	SE	95% CI for B	
						LL	UL
Model	.37*	25.59	<.001				
(Outcome: Exhaustion)							
(Intercept)				3.11*	0.11	2.88	3.33
Academic Stress				1.84*	0.21	1.41	2.22
Self-Regulation				-0.01	0.01	-0.02	0.01
Academic stress X Self-regulation	.00	0.20	.66	0.00	0.01	-0.02	0.03

Note. * = Significant as determined by the absence of 0 in the confidence intervals.

Moreover, as expected, a significant positive relationship was found between academic stress and cynicism (see Table 4). This indicates, in line with hypothesis 1, that a higher score

on academic stress was associated with a higher score on cynicism. However, unexpectedly, the interaction effect between academic stress and self-regulation was non-significant. This means that unlike what is stated in hypothesis 2, a higher score on self-regulation was not associated with a decreased impact of academic stress on cynicism. The additional percentage of the explained variance of the dependent variable (i.e., cynicism) that arose from the moderation effect (i.e., $R^2 = .001$), was small and further supports the claim that self-regulation was not moderating the relationship between academic stress and cynicism. Yet, self-regulation in itself, independent of academic stress, was shown to be related to cynicism; a significant negative relationship was found between self-regulation and cynicism, meaning that higher scores on self-regulation were directly associated with lower scores on cynicism.

Table 4

Self-regulation as Moderator: Relationships Between Academic Stress, Self-regulation, and Cynicism (N = 132)

Variables	R^2	F	p	B	SE	95% CI for B	
						LL	UL
Model	.30*	18.28	<.001				
(Outcome: Cynicism)							
(Intercept)				1.58*	0.13	1.33	1.84
Academic Stress				1.55*	0.31	0.93	2.15
Self-regulation				-0.02*	0.01	-0.03	-0.00
Academic Stress X Self-regulation	.00	0.18	.67	-0.01	0.02	-0.04	0.02

Note. * = Significant as determined by the absence of 0 in the confidence intervals.

Lastly, as expected, a significant positive relationship was found between academic stress and professional inefficacy (see Table 5). This indicates, in line with hypothesis 1, that a higher score on academic stress was associated with a higher score on professional inefficacy. In addition, a significant negative relationship was found between self-regulation and professional inefficacy. This means that a higher score on self-regulation was associated with a lower score on professional inefficacy. Lastly, unexpectedly, the interaction effect between

self-regulation and academic stress was non-significant. This means that, divergent from what was stated in hypothesis 2, a higher score on self-regulation was not associated with a decreased impact of academic stress on professional inefficacy. The additional percentage of the explained variance of the dependent variable (i.e., professional inefficacy) from the moderation effect (i.e., $R^2 = .01$) was small and further supports the claim that self-regulation was not moderating the relationship between academic stress and professional inefficacy. However, as a significant negative relationship was found between self-regulation and professional inefficacy; self-regulation in itself, independent of stress, was shown to be related to professional inefficacy.

Table 5

Self-regulation as Moderator: Relationships Between Academic Stress, Self-regulation, and Professional Inefficacy (N = 132)

Variables	R^2	F	p	B	SE	95% CI for B	
						LL	UL
Model	.39*	27.46	<.001				
(Outcome: Professional Inefficacy)							
(Intercept)				2.02*	0.07	1.87	2.16
Academic Stress				0.46*	0.14	0.17	0.74
Self-regulation				-0.03*	0.00	-0.04	-0.02
Academic Stress X Self-regulation	.01	2.06	.15	0.01	-0.00	-0.04	0.02

Note. * = Significant as determined by the absence of 0 in the confidence intervals.

The Relationships Between the Variables Academic Stress, Self-regulation, Cynicism and Professional Inefficacy: Self-regulation as a Potential Mediator

To sum up, self-regulation did not moderate the relationships between academic stress and burnout variables, but a direct relationship between self-regulation and the burnout variables cynicism and professional inefficacy was found. This direct relationship is in line with the idea that self-regulation could be mediating the relationship between academic stress and burnout. Hence, the relationships between academic stress, self-regulation, and the burnout

variables cynicism and professional inefficacy were further assessed with two mediation analyses. These analyses were performed with the use of linear regression models run with the `process()` function in Rstudio.

Firstly, a mediation analysis was run to test whether self-regulation mediated the relationship between academic stress and cynicism. A linear regression model with academic stress as numerical independent variable and with cynicism as numerical dependent variable was tested to assess the relationship between academic stress and cynicism (i.e., the total effect path; see path c in Figure 1). Next, a linear model with academic stress as numerical independent variable and with self-regulation as numerical dependent variable was tested to assess the relationship between academic stress and self-regulation (i.e., see path a in Figure 1). Subsequently, to assess the relationship between self-regulation and cynicism (i.e., see path b in Figure 1) and to assess the relationship between academic stress and cynicism when self-regulation is also included as an independent variable in the model (i.e., direct effect path; see path c' in Figure 1), a linear model was performed with academic stress and self-regulation as independent numerical variables and with cynicism as dependent numerical variable. Lastly, the mediation effect of self-regulation (i.e., the indirect effect of academic stress on cynicism through self-regulation) was assessed. The results of these analyses can be found in Table 6.

Table 6

Self-regulation as Mediator: Relationships Between Academic Stress, Self-Regulation and Cynicism as Shown in Figure 1 (N = 132)

Variables	R^2	F	B	SE	t	p	95% CI for B	
							LL	UL
Model 1	.27	48.59				<.001		
(Outcome: Cynicism)								
(Intercept)			-2.45	0.60	-4.11	<.001	-3.63	-1.27
Academic Stress			1.76	0.25	6.97	<.001	1.26	2.26
Model 2	.12	17.12				<.001		
(Outcome: Self-regulation)								
(Intercept)			135.60	6.76	20.05	<.001	122.22	148.99
Academic Stress			-11.87	2.87	-4.14	<.001	-17.55	-6.20
Model 3	.30	27.51				<.001		
(Outcome: Cynicism)								
(Intercept)			-0.16	1.19	-0.13	.90	-2.50	2.19
Academic Stress			1.56	0.26	5.89	<.001	1.04	2.08
Self-regulation			-0.02	0.01	-2.23	.03	-0.03	-0.00
Indirect Effect Model			0.20	0.13			0.01	0.51
(Mediation)								

Note. $N = 132$.

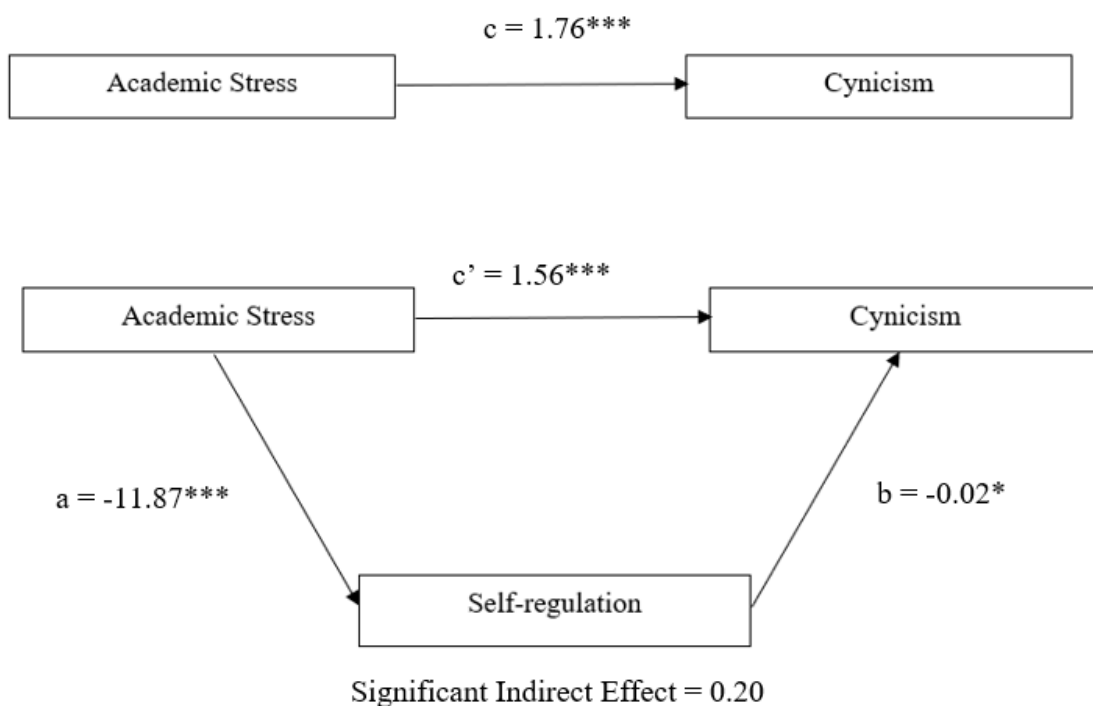
Similar to the results found in the moderation analyses, academic stress was significantly positively related to cynicism, indicating that higher scores on academic stress were associated with higher scores on cynicism. Also similar to the results found in the moderation analyses, self-regulation was significantly negatively related to cynicism, indicating that higher scores on self-regulation were associated with lower scores on cynicism. In addition, academic stress was significantly negatively related to self-regulation, indicating that higher scores on academic stress were associated with lower scores on self-regulation. The direct effect

of academic stress on cynicism was smaller than the total effect of academic stress on cynicism (1.76 vs. 1.56), but both effects were significant (see Figure 1).

To test whether self-regulation did significantly mediate the relationship between academic stress and cynicism, the indirect effect model was consulted. Results showed that self-regulation did significantly mediate the relationship between academic stress and cynicism (see Table 6; see also Figure 1). This means that high academic stress scores were indirectly associated with high cynicism scores: these high academic scores were associated with low self-regulation scores which were in turn associated with high cynicism scores. Because the results of the third model, that included both self-regulation and academic stress as independent variables, indicated a significant direct relationship between academic stress and cynicism, academic stress was both directly and indirectly (i.e., through self-regulation) related to cynicism. This means that self-regulation can be described as a partial mediator which partially explains the relationship between academic stress and cynicism.

Figure 1

Self-Regulation as Mediator of the Relationship between Academic Stress and Cynicism



Note. $*p < .05$, $**p < .01$, $***p < .001$.

With regard to the variable professional inefficacy, similar linear regression models were performed to assess the relationship between this variable and the variables academic

stress and self-regulation. First, a linear regression model with academic stress as numerical independent variable and with professional inefficacy as a numerical dependent variable was performed to assess the relationship between academic stress and professional inefficacy (i.e., the total effect path; see path c in Figure 2). secondly, a linear regression model with academic stress as numerical independent variable and with self-regulation as numerical dependent variable was tested to assess the relationship between academic stress and self-regulation (i.e., see path a in Figure 2). Thirdly, to assess the relationship between self-regulation and professional inefficacy (i.e., see path b in Figure 2) and to assess the relationship between academic stress and professional inefficacy when self-regulation is also included as an independent variable in the model (i.e., direct effect path; see path c' in Figure 2), a linear regression model was performed with academic stress and self-regulation as independent numerical variables and with professional inefficacy as dependent numerical variable. The results of these analyses can be found in Table 7.

Table 7

Self-regulation as Mediator: Relationships Between Academic Stress, Self-regulation, and Professional Inefficacy as Shown in Figure 2 (N = 132)

Variables	R^2	F	B	SE	t	p	95% CI for B	
							LL	UL
Model 1	.16	24.79				<.001		
(Outcome: Professional Inefficacy)								
(Intercept)			0.04	0.40	0.10	.92	-0.75	0.83
Academic Stress			0.84	0.17	4.98	<.001	0.51	1.18
Model 2	.12	17.12				<.001		
(Outcome: Self-regulation)								
(Intercept)			135.60	6.76	20.05	<.001	122.22	148.99
Academic Stress			-11.87	2.87	-4.14	<.001	-17.55	-6.20
Model 3	.38	39.84				<.001		
(Outcome: Professional Inefficacy)								
(Intercept)			4.15	0.70	5.97	<.001	2.77	5.53
Academic Stress			0.48	0.16	3.11	.002	0.18	0.79
Self-regulation			-0.03	0.00	-6.80	<.001	-0.04	-0.02
Indirect Effect Model			0.36	0.12			0.15	0.62
(Mediation)								

Note. $N = 132$.

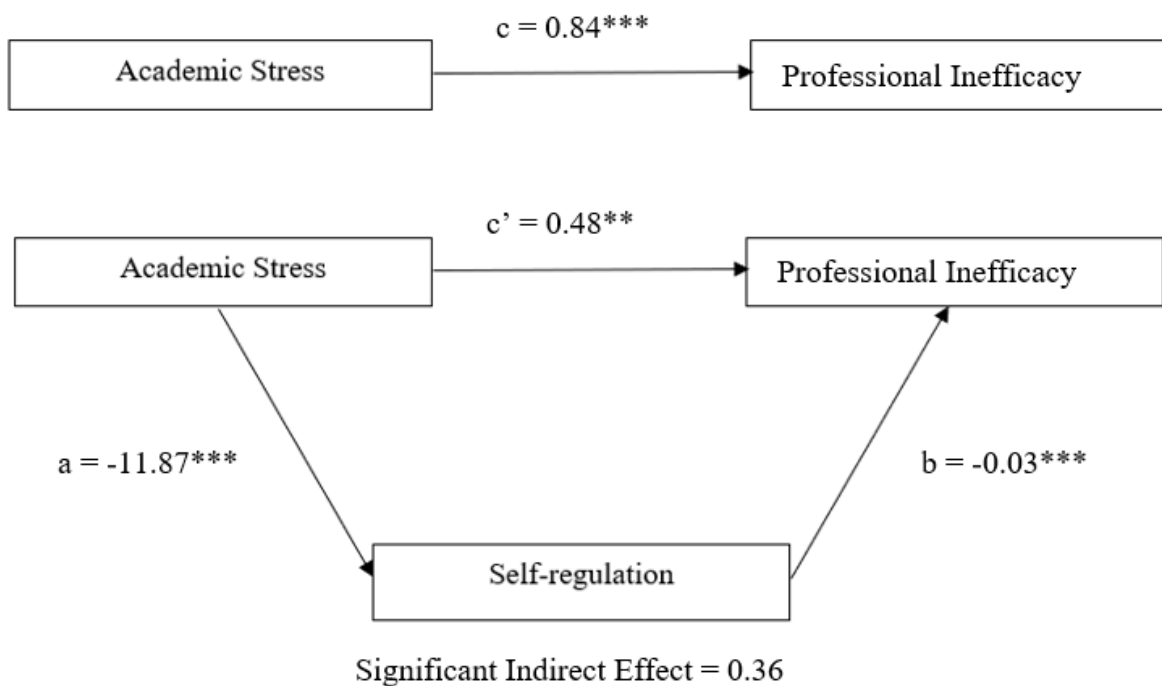
Similar to the results found in the moderation analyses, academic stress was significantly positively related to professional inefficacy, indicating that higher scores on academic stress were associated with higher scores on professional inefficacy. Also similar to the results found in the moderation analyses, self-regulation was significantly negatively related to professional inefficacy, indicating that higher scores on self-regulation were associated with

lower scores on professional inefficacy. In addition, as already indicated in the previous mediation analysis, academic stress was significantly negatively related to self-regulation, indicating that higher scores on academic stress were associated with lower scores on self-regulation. The direct effect of academic stress on professional inefficacy was smaller than the total effect of academic stress on professional inefficacy (0.84 vs. 0.48), but both effects were significant (see Figure 2).

To test whether self-regulation did significantly mediate the relationship between academic stress and professional inefficacy, the indirect effect model was consulted. Results showed that self-regulation did significantly mediate the relationship between academic stress and professional inefficacy (see Table 7; see also Figure 2). This means that high academic stress scores were indirectly associated with high professional inefficacy scores: these high academic scores were associated with low self-regulation scores which were in turn associated with high professional inefficacy scores. As the results of the third model that included both self-regulation and academic stress as independent variables indicated a significant direct relationship between academic stress and professional inefficacy, self-regulation can be described as a partial mediator which partially explains the relationship between academic stress and professional inefficacy. This means that academic stress was both directly and indirectly (i.e., through self-regulation) related to professional inefficacy (see Figure 2).

Figure 2

Self-Regulation as Mediator of the Relationship between Academic Stress and Professional Inefficacy



Note. $*p < .05$, $**p < .01$, $***p < .001$.

Discussion

This study aimed to meet the research need, as stated by Clabaugh et al. (2021), for identifying factors that influence how students are affected by academic stress. Hence, the goal of this study was to research the relationship between academic stress and burnout, as well as how self-regulation might interact with this relationship. Academic stress was expected to be positively related with the experience of burnout symptoms, meaning that higher levels of academic stress were expected to be related to higher levels of burnout symptoms (hypothesis 1). Furthermore, self-regulation was identified as a potential moderator with regard to this relationship, meaning that it was expected that self-regulation could protect individuals from experiencing higher levels of burnout symptoms due to academic stress (hypothesis 2).

As expected, in line with hypothesis 1, higher scores on academic stress were found to be associated with higher scores on the burnout symptoms exhaustion, cynicism, and professional inefficacy. Divergent from what was stated in hypothesis 2, higher scores on self-regulation were not associated with a weaker relationship of academic stress with these burnout symptoms. This means that engaging in self-regulation did not protect individuals against the experience of burnout symptoms due to academic stress (i.e., no moderation).

Higher scores on self-regulation were found to be associated with lower scores on the burnout symptoms cynicism and professional inefficacy. Hence, the relationships between self-regulation, academic stress, cynicism, and professional inefficacy were further assessed with mediation analyses. Self-regulation mediated the relationship between academic stress and cynicism, as well as the relationship between academic stress and professional inefficacy. Self-regulation could be described as a partial mediator, meaning that academic stress was both directly associated with cynicism and professional inefficacy, as well as indirectly through self-regulation. This indirect relationship can be described as a two-step process. First, when an individual experiences academic stress, they are less likely to engage in self-regulation. Second, individuals who are less likely to engage in self-regulation are more likely to experience the burnout symptoms cynicism and professional inefficacy.

Connecting Study Findings to Previous Literature

Participant Scores on Academic Stress, Self-regulation, and Burnout Symptoms

Participant scores on academic stress, self-regulation, and experienced burnout symptoms were lower in this study than in previous studies. However, due to the lack of norms and studies to which findings can be compared, it cannot be stated whether the participants' academic stress, engagement in self-regulation, and experienced burnout symptoms in this study were low, moderate, or high.

Firstly, with regard to academic stress, compared to Porru et al. (2022), who assessed academic stress within a sample of Italian university students, the amount of academic stress experienced by the Dutch and German university students in this study appears to be lower ($M = 2.31$ vs. $M = 2.54$). Porru et al. (2022) assessed participant scores on separate subscales of the Student Life Challenges Scale while this study combined and averaged participant scores on the subscales (note that the subscale low commitment was excluded in this study). For the purpose of comparison, the mean participant scores on the subscales found by Porru et al. (i.e., Faculty Shortcomings $M = 2.50$; Worries About the Future $M = 2.60$; Unsupportive Climate $M = 2.10$; High Workload $M = 2.90$; Financial Concerns $M = 2.6$) were combined and averaged to create an academic stress score similar to the academic stress score in this study (i.e., Academic Stress $M = (2.50 + 2.60 + 2.10 + 2.90 + 2.60) / 5 = 2.54$).

With regard to self-regulation, the university students in this study reported less engagement in self-regulation than students in Carey et al. (2004) their sample of university students ($M = 108.20$ vs. $M = 116.6$).

Lastly, with regard to the experienced burnout symptoms exhaustion, cynicism, and professional inefficacy, the university students in this study reported lower amounts of

experienced burnout symptoms compared to Hwang and Kim (2022) their sample of medical students (Exhaustion, $M = 3.10$ vs. $M_{\text{Hwang \& Kim}} = 3.17$; Cynicism, $M = 1.61$ vs. $M_{\text{Hwang \& Kim}} = 2.19$; Professional Inefficacy, $M = 1.99$ vs. $M_{\text{Hwang \& Kim}} = 2.71$). In addition, when following the criteria Galán et al. (2011), participants in this study scored high on exhaustion (i.e., ≥ 2.8), moderate on cynicism (i.e., $0.6 \leq M \leq 2.25$), and low on professional inefficacy (i.e., ≤ 3.84). However, these criteria are originally based on a sample of the Spanish working population, not on a Dutch or German student population.

Relationships Between Academic Stress, Self-regulation, and Burnout Symptoms

The found positive relationship between academic stress and burnout symptoms was in line with previous research on this relationship (Hwang & Kim, 2022; Veyis et al., 2019; Yusoff et al., 2021). Similarly, to the results of this study, Hwang and Kim (2022) also found positive relationships between academic stress and the burnout symptoms exhaustion, cynicism, and professional inefficacy. They studied these relationships within a population of medical students, but the similarity in results suggests that these relationships also apply to the population of students that this study focused upon; namely, university students in general. Consequently, the question arises whether the main focus of previous research on medical students should be broadened.

With regard to the answer to this question, the results of this study suggest that academic stress and its relationship to burnout should not solely be researched in the context of medical students, because consequences associated with experiencing academic stress (i.e., experiencing burnout symptoms) do not seem to be a unique experience of medical students. In line with this notion, Porru et al. (2022) found that university students' high academic stress levels are associated with poor mental health. Thus, as not only medical students, but also university students in general seem to suffer as a result of experiencing high academic stress, it seems appropriate to broaden the scope of academic stress research to include other student populations.

Although the positive relationship between university students' academic stress and experienced burnout symptoms was in line with previous research, an unexpected finding of this study was that self-regulation did not moderate this relationship. Previous studies on this relationship theorized that engaging in self-regulation could help individuals manage stress in a healthy manner (de la Fuente et al., 2020; Durand-Bush et al., 2015; von Keyserlingk et al., 2022). Namely, engaging in self-regulation was theorized to protect students against experiencing burnout symptoms as it fosters the use of adaptive coping mechanisms and is associated with reduced maladaptive coping (de la Fuente & Cardelle-Elawar, 2011; de la

Fuente et al., 2020; Thompson et al., 2016; Vizoso et al., 2019). Yet, the protective nature of self-regulation was not found in this study: engagement in self-regulation did not interact with the relationship between academic stress and burnout.

Two different theories could explain why the theoretical protective nature of self-regulation was not found to be reality. Firstly, students' capacity to engage in self-regulation could be hindered when stress levels are high. Ramli et al. (2018) found a significant negative relationship between academic stress and students' ability to engage in critical thinking strategies and other executive functioning skills (i.e., self-regulation). This notion is supported by the significant negative relationship between academic stress and self-regulation found in this study. Thus, the theorized protective nature of self-regulation might not be present in reality, as experiencing high levels of academic stress could hinder students from engaging in self-regulation due to its impact on students' executive functioning.

The second theory that might explain why the theoretical protective nature of self-regulation was absent, is the theory of ego depletion. This theory suggests that a person has a limited amount of self-control (i.e., self-regulation engagement) that they can exert. This entails that students who experience certain amounts of academic stress for a prolonged period of time, could be hindered in using self-regulation as they have depleted this resource (Muraven et al., 2019). Similar to the first theory, the theory of ego depletion fits with the results found in this study. Namely, academic stress was negatively associated with engagement in self-regulation. Concluding, this study tentatively supports the notion that self-regulation does not have a protective nature in reality, since the academic stress that students experience can hinder the use of self-regulation through its influence on executive functioning and through ego depletion.

In addition to the found negative relationship between academic stress and self-regulation, this study also signalled the presence of a direct negative relationship between self-regulation and the burnout symptoms cynicism and professional inefficacy. Results showed that self-regulation partially mediated the relationship between academic stress and the burnout symptoms cynicism and professional inefficacy. This mediation effect of self-regulation corresponds with research on the connections between academic stress, self-regulation, and burnout. However, these connections have often been interpreted as reasons for utilizing self-regulation as a protective factor (i.e., self-regulation as moderator; Gagnon et al., 2016; Keyserlink et al., 2022). Yet, this study supports the idea that, at least with regard to the burnout symptoms cynicism and professional inefficacy, it seems more accurate to focus on self-regulation as an explanatory variable that provides insight into how academic stress indirectly relates to burnout (i.e., self-regulation as mediator).

Lastly, in this study self-regulation was not directly related to the burnout symptom exhaustion with regard to university students. On the other hand, Gagnon et al. (2016) did find a direct connection between self-regulation and exhaustion with regard to physicians and medical students. This difference in results can be due to chance, meaning that further research is needed to sort out the relationship between self-regulation and exhaustion. Furthermore, the different results might also be due to lacking nuances in both studies. For example, high levels of self-regulation might directly relate to the height of experienced exhaustion, while low levels of self-regulation might not (or visa versa). As both studies did not differentiate between levels of self-regulation, underlying differences in the studied population with regard to such nuances could be underlying the differences in results.

When assuming that the results of this study do resemble truth, the difference between exhaustion on the one hand and cynicism and professional inefficacy on the other, might explain why exhaustion did not directly relate to self-regulation, while cynicism and professional inefficacy did. When comparing the burnout symptoms, cynicism and professional inefficacy seem to be more cognitive in nature than exhaustion, which can also have a bodily manifestation (e.g., tiredness). Hence, self-regulation, defined as a stepwise process rooted in and dealing with cognition, might not target exhaustion entirely. Winding up, before definitive conclusions can be made about the relationship between self-regulation and exhaustion, further research is needed to establish whether and why there is (not) a relationship between self-regulation and exhaustion.

Strengths and Limitations

By virtue of the correlational design used, information regarding the causation and the directionality of the found relationships is absent. For example, based on theory, it was assumed that participants experienced higher levels of cynicism due to their lack of engagement in self-regulation. However, when interpreting the results outside of the frame that previous research has constructed, it can also be the case that participants' cynicism influenced the amount to which they engaged in self-regulation. Although this limitation is present when using correlational designs, such a design was judged more appropriate than for example an experimental design due to the newness and exploratory nature of this research endeavour (i.e., previous research had theorized, but not yet tested, self-regulation as a moderator).

Likewise, caution should be heeded when discussing the height of participants' scores on the variables studied, as a reference point is lacking. This means that norms to which the scores of this specific population of participants could be compared did not exist. Consequently, there was a limit on the depth of the conclusions that could be drawn regarding the range and

height of participant scores. For instance, the sample did not include participants who scored certain values on the lower end of theoretically possible self-regulation scores. Due to the absence of norm scores, no further conclusion can be made with regard to whether participants in the sample showed low or high engagement in self-regulation.

Contrastingly, the strength of this study's data analysis resides within the use of bootstrapping, meaning that allegations about moderation and mediation effects were based on bootstrapped analyses and were thereby not dependent on a normality assumption. Moreover, the sample size of this study was considerably large enough to assume that the violation of the normality assumption would not influence the outcome of the analyses. These strengths of the data analysis mitigate one of the limitations of the data gathered, namely the limitation that the normality assumption did not seem to be met for the variables used in the analyses.

Another limitation of this study is that the sample of students used might not be representative of the entire student population. The sample was a convenience sample, meaning that participants were not randomly selected from the total population of students. Instead, students were gathered with the use of volunteer sampling which was focused on a single university. In addition, snowball sampling and opportunity sampling were used to gather participants from the researchers their own network. Hence, sample characteristics might have been influenced by the specific university from which participants were sampled as well as by the network of the researchers. Indeed, a lack of diversity was found between the sampled participants' background and demographics (e.g., 70 percent of participants was studying at a singular Dutch university, 50 percent studied psychology and 80 percent identified as female).

The extent to which these participant background and demographics might have influenced participant scores on academic stress, self-regulation, and experienced burnout symptoms is unknown. Such characteristics have rarely been studied in relation to academic stress within the whole population of university students and research that has been done on these characteristics resulted in ambivalence. For example, there seems to be unclarities regarding the influence of gender on academic stress, self-regulation, and burnout (e.g., Durand-Bush et al., 2015).

It could be argued that another limitation of this study resides within the measurement of academic stress. Academic stress was measured with the SLCS in which six subscales are used to measure six different student life challenges. One of these subscales, low commitment, was not used in this study due to its conceptual overlap with the burnout variable cynicism. Based on a factor analysis, the other five subscales were merged into one variable that was theorized to measure academic stress. However, this created academic stress variable showed

questionable internal consistency (i.e., Cronbach $\alpha = .68$). Furthermore, based on the low factor loading of the subscale financial concerns (factor loading $< .40$), it can be argued that this subscale did not measure the same thing as the other four subscales. This raises the question of whether the subscale financial concerns measured the same construct as the other four subscales, namely academic stress.

Regardless of this potential limitation of the created academic stress construct, the five subscales were merged in this study. This decision was based on the argument that financial concerns are a valid indicator of academic stress, as financial concerns are part of the student study experience (e.g., Joo et al., 2008). Among other things, financial concern can arrive from study related expenses (e.g., books and tuition) and can influence the amount of time a student has available for their studies (e.g., the need for a part time job). The other measurements used in this study further illustrate strengths of this study's methodology. The SSRQ used to measure self-regulation, showed excellent internal consistency. Furthermore, the MBI-SS used to measure cynicism, exhaustion, and professional inefficacy, showed excellent internal consistency with regard to cynicism and exhaustion and acceptable internal consistency with regard to professional inefficacy.

Directions for Future Research

Future research should aim to further establish evidence-based assumptions about the relationships between the variables academic stress, self-regulation, and burnout in a diversity of populations (e.g., students from a variety of universities, nationalities, and study programs). The lack of moderation found in this study emphasises that research should scrutinize the theoretically accepted notion that previous found relationships between academic stress, self-regulation and burnout indicate that self-regulation has a protective nature. Thusly, research should assess whether self-regulation does help individuals to manage academic stress (e.g., the relationship between self-regulation and the use of coping strategies), and under which circumstances an individual can engage in self-regulation.

Furthermore, the discovered potential of self-regulation as a mediator signals that research should not solely approach self-regulation from the perspective that this trait should be fostered (i.e., its potential protective nature), but also from the perspective that self-regulation can be an explanatory variable that provides insight into why experiencing academic stress under certain circumstances (e.g., prolonged academic stress or height of academic stress) is associated with burnout. For instance, future research could assess how over time (i.e., longitudinal research) academic stress levels relate to the engagement in self-regulation and the amount of experienced burnout symptoms. In such a manner both the influence of divergent

academic stress levels as well as of prolonged academic stress could be assessed. In this way, further insights could be provided into phenomena such as ego depletion and the influence of academic stress on executive functioning.

Lastly, such future research should have a nuanced focus to create in depth insight into the relationships between academic stress, self-regulation, and burnout regarding different circumstances. For example, this entails that research could focus on how different heights of specific academic stressors (e.g., high workload) influence individuals with diverging amounts of self-regulation ability (i.e., low vs. high theoretical ability to engage in self-regulation) and these individuals' actual engagement in self-regulation (e.g., low vs. high self-regulation engagement). In addition, this research could focus on how such factors and variables influence the presence and height of specific burnout symptoms (e.g., exhaustion).

Practical Applications

Previous research stressed the need for heightening students' self-regulation ability to allow them to manage academic stress in an effective manner (e.g., Durand-Bush et al., 2015). However, the lack of moderation found in this study indicates that the potential protective nature of self-regulation should be approached with caution; students who have the theoretical ability to engage in self-regulation, might be hindered from actual engagement in self-regulation due to the experience of certain heights of (prolonged) academic stress.

Therefore, it is recommended that interventions focussing on protecting students from the negative mental and physical health outcomes associated with academic stress (e.g., burnout), should not solely rely on heightening students' self-regulation ability. At least not until further research has created certainty about the workings of the relationships between academic stress, self-regulation, and burnout. Until further research has indeed addressed this topic, it might be more fruitful to focus in practice on heightening the presence of well-established protective variables (e.g., social support; Thompson et al., 2016).

Lastly, it should be noted that both pertaining to research and practice, the fixation on protecting students against experiencing negative effects due to their high academic stress levels, seems to circumcise assessment of the main problem; that is the height of the academic stress itself. Students experience high levels of (prolonged) academic stress (e.g., Porru et al., 2022). Although students seem unable to manage these high levels of academic stress effectively, this does not implicate that students are unequipped to manage less extreme academic stress levels. In accordance with this notion, both future research and stress management interventions might want to add lowering the height of experienced academic stress as a topic in itself to the list of targets to address.

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Appendix A: Questionnaires Used for Data Collection

Participant Background Characteristics and Demographics

1. How old are you?
2. How would you describe yourself?
 - Male
 - Female
 - Non-binary/third gender
 - Prefer to self-describe:
 - Prefer not to say
3. What is your nationality?
 - Dutch
 - German
 - Others (please indicate):
4. In which phase of your study are you right now?
 - Bachelor year 1
 - Bachelor year 2
 - Bachelor year 3
 - Master year 1
 - Master year 2
 - Other:
5. Which study are you doing?
6. In what year did you start your study?
7. At which university do you study?

Maslach Burnout Inventory – Student Survey

Exhaustion

1. I feel emotionally drained by my studies.
2. I feel used up at the end of a day at university.
3. I feel tired when I get up in the morning and I have to face another day at the university.
4. Studying or attending a class is really a strain for me.
5. I feel burned out from my studies.

Cynicism

1. I have become less interested in my studies since my enrollment at the university.
2. I have become less enthusiastic about my studies.

3. I have become more cynical about the potential usefulness of my studies.
4. I doubt the significance of my studies.

Professional Efficacy

1. I can effectively solve the problems that arise in my studies.
2. I believe that I make an effective contribution to the classes that I attend.
3. In my opinion, I am a good student.
4. I feel stimulated when I achieve my study goals.
5. I have learned many interesting things during the course of my studies.
6. During class I feel confident that I am effective in getting things done.

All items are scored on a 7-point frequency rating scale (0-6) with the following response options:

0 *Never*

1 *A few times a year or less*

2 *Once a month or less*

3 *A few times a month*

4 *Once a week*

5 *A few times a week*

6 *Every day*

The items on the scale Professional Efficacy should be reversed scored to measure professional inefficacy rather than professional efficacy. A mean total score is calculated for each subscale by summing the item scores and dividing the sum by the number of items.

Short Self-Regulation Questionnaire

1. I have trouble making plans to help me reach goals
2. I have a hard time setting goals for myself
3. Once I have a goal, I can usually plan how to reach it
4. I give up quickly
5. I set goals for myself and keep track of my progress
6. When I'm trying to change something, I pay attention to how I'm doing
7. I don't notice the effects of my actions until it's too late
8. I tend to keep doing the same thing, even when it doesn't work

9. I have personal standards, and try to live up to them
10. I get easily distracted from my plans
11. I have trouble following through with things once I've made up my mind to do something
12. I have a lot of willpower
13. I'm able to accomplish goals I set for myself
14. If I make a resolution to change something, I pay a lot of attention to how I'm doing
15. I put off making decisions
16. Most of the time I don't pay attention to what I'm doing
17. I don't seem to learn from my mistakes
18. If I wanted to change, I am confident that I could do it
19. I usually keep track of my progress toward my goals
20. I usually think before I act
21. As soon as I see a problem or challenge, I start looking for possible solutions
22. When it comes to deciding about a change, I feel overwhelmed by the choices
23. I learn from my mistakes
24. I am able to resist temptation
25. Often I don't notice what I'm doing until someone calls it to my attention
26. I have trouble making up my mind about things
27. I know how I want to be
28. I usually only have to make a mistake one time in order to learn from it
29. I can stick to a plan that is working well
30. I can usually find several different possibilities when I want to change something
31. It's hard for me to notice when I've had enough (alcohol, food, sweets)

All items are scored on a 5-point Likert-scale (1-5) with the following response options:

1 *Strongly disagree*

2 *Disagree*

3 *Neither agree or disagree*

4 *Agree*

5 *Strongly agree*

Scores on item 1, 2, 4, 7, 8, 10, 11, 15, 16, 17, 22, 25, 26, and 31, should be reverse coded to represent self-regulation ability rather than low self-regulation ability. A total score is calculated by summing the item scores.

The Student Life Challenges Scale

Faculty Shortcomings

1. I feel that my teachers treat me with respect.
2. The teachers often fail to clarify the aims of the activities
3. The study stimulates my personal development.
4. As a student you are often expected to participate in situations where your role and function is unclear.
5. I am able to influence the studies or curriculum.
6. There is too much focus on passive learning of facts and too little on active seeking of knowledge and time for reflection.
7. I feel that the training is preparing me well for my future profession.

Worries about Future

1. I am worried that I will not acquire all the knowledge needed for my future profession.
2. The long hours and responsibilities of my future career worry me.
3. The insight I have had into my future profession has made me worried about the stressful workload.

Unsupportive Climate

1. Studying has created a climate of anonymity and isolation among the students.
2. The professional role presented in our course conflicts with my moral viewpoint.
3. There is a competitive attitude among students.
4. I feel that the studies have played a role in creating a cold and impersonal attitude among students.
5. It seems to me to be treated worse on the basis of my sex.

High Workload

1. My study controls my life and I don't have a lot of time for other activities.
2. The literature is too difficult and extensive.
3. The pace of study is too high.

Low Commitment

1. I am satisfied with my choice of career.
2. I am proud of my future profession.

Financial Concerns

1. As a student, my financial situation is worrying me.
2. I am worried about my future financial situation and my ability to pay of my student loans.

All items are scored on a 4-point Likert-scale (1-4) with the following response options:

- 1 *Totally disagree*
- 2 *Somewhat disagree*
- 3 *Somewhat agree*
- 4 *Totally agree*

A mean total score is calculated for each subscale by summing the item scores and dividing the sum by the number of items. The items 1, 3, 5, and 7 of the subscale Faculty Shortcomings should be reverse scored to represent faculty shortcomings before the item scores are summed. Similarly, the items on the subscale low commitment should be reverse scored to represent low commitment rather than high commitment.

Appendix B: Results Factor Analysis

Firstly, before running the factor analysis, the Kaiser-Meyer-Olkin factor adequacy was calculated, which indicated there were enough significant correlations between the variables (the five stress scales) to be able to proceed with a factor analysis and find a suitable factor structure ($MSA > .60$; see Table B1). Subsequently, the correlations between the variables were assessed. Results indicated that a factor analysis could be performed (i.e., correlations stronger than .30 were present; see Table B2). Next, Bartlett's sphericity test was performed, which was significant, indicating that the subscales are not orthogonal and can therefore be combined in a meaningful way ($X^2 = 131.75$; $p < .001$).

Afterwards, the factor analysis was run with one factor, as indicated by the scree plot of the eigenvalues (see Figure B1). Factor loadings indicated that the subscales high workload, unsupportive climate, worries about the future and faculty shortcomings belonged on the factor (i.e., factor loadings $\geq .40$; see Table B3), while the subscale financial concerns did fit the factor less well (factor loading = .34). The hypothesis was tested that one factor would be sufficient, which showed an insignificant p -value, indicating that one factor was sufficient ($X^2 = 10.12$; $p = .07$).

Table B1

Measurement of Sampling Adequacy (MSA) for the Subscales High Workload, Unsupportive Climate, Faculty Shortcomings, Financial Concerns and Worries About the Future.

	HW	UC	FS	FC	WAF	Overall
<i>MSA</i>	.72	.71	.71	.85	.76	.73

Note. FC = financial concerns, HW = High workload, UC = Unsupportive Climate, WAF = Worries about the future and FS = Faculty shortcomings.

Table B2

Correlations Between the Subscales High Workload, Unsupportive Climate, Faculty Shortcomings, Financial Concerns and Worries About the Future.

	FC	HW	UC	WAF	FS
FC	-				
HW	.26	-			
UC	.23	.50	-		
WAF	.18	.40	.38	-	
FS	.20	.31	.51	.46	-

Note. FC = Financial Concerns, HW = High Workload, UC = Unsupportive Climate, WAF = Worries About the Future and FS = Faculty Shortcomings.

Figure B1

Eigenvalues of the Factors of the Factor Analysis Performed on the Subscales High Workload, Unsupportive Climate, Faculty Shortcomings, Financial Concerns and Worries About the Future.

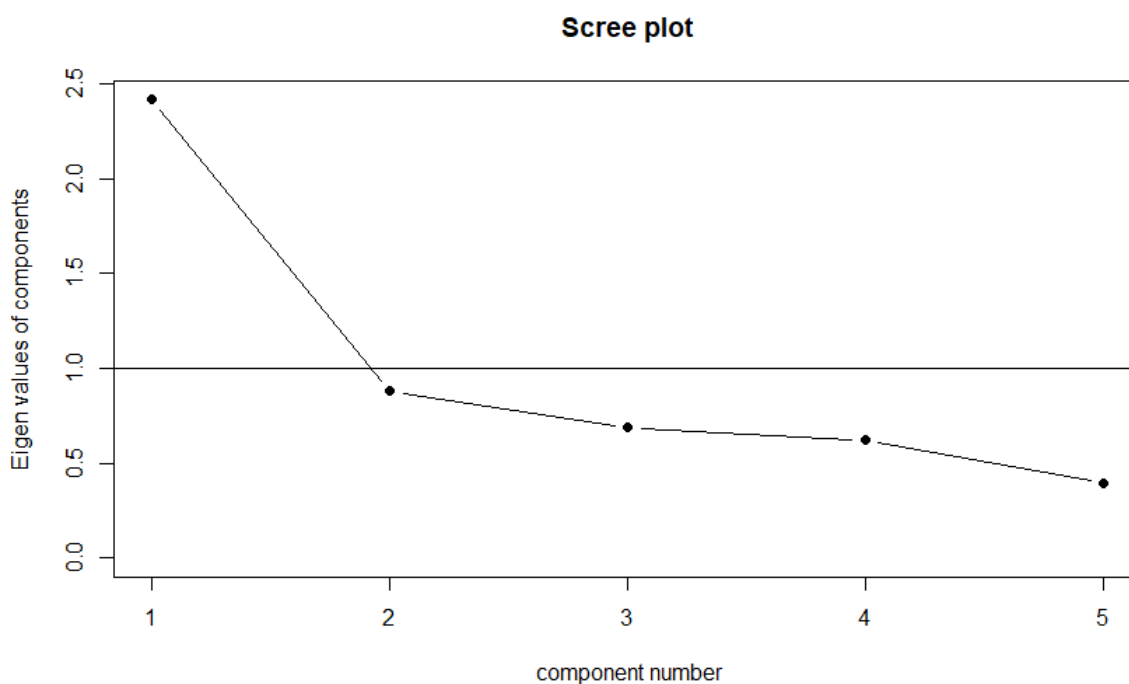


Table B3

Factor Loadings of a One Factor Solution of the Factor Analysis Performed on the Subscales High Workload, Unsupportive Climate, Faculty Shortcomings, Financial Concerns and Worries About the Future.

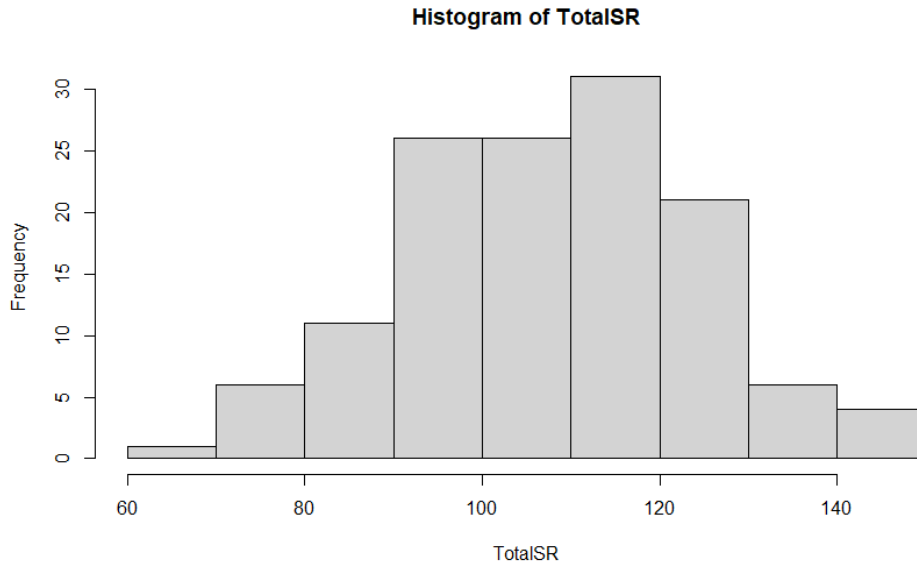
	Factor	Uniqueness Variables
FC	.34	.89
HW	.62	.61
UC	.74	.45
WAF	.60	.65
FS	.65	.58
Proportion Variance	.37	

Note. FC = Financial Concerns, HW = High Workload, UC = Unsupportive Climate, WAF = Worries About the Future and FS = Faculty shortcomings.

Appendix C: Parametric Assumptions

Figure C1

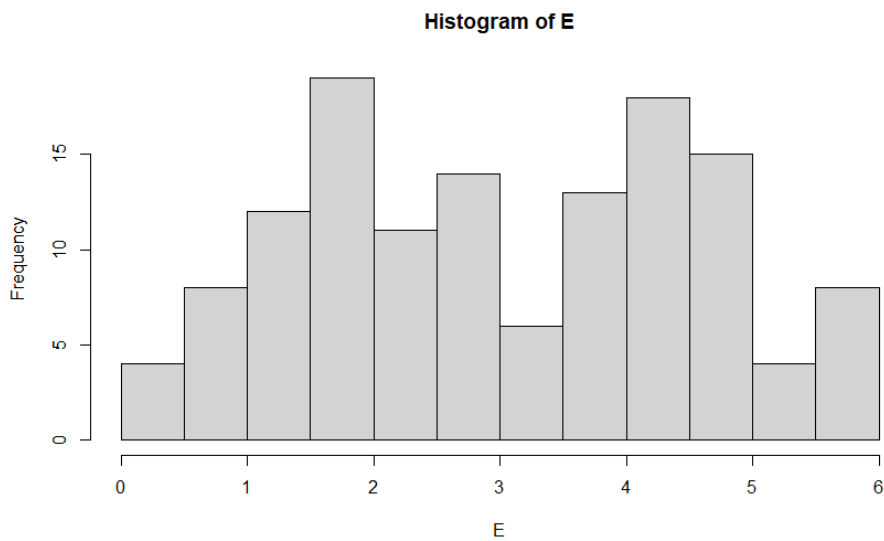
Histogram of Participant Scores (N = 132) on the Variable Self-regulation



Note. TotalSR = Self-regulation.

Figure C2

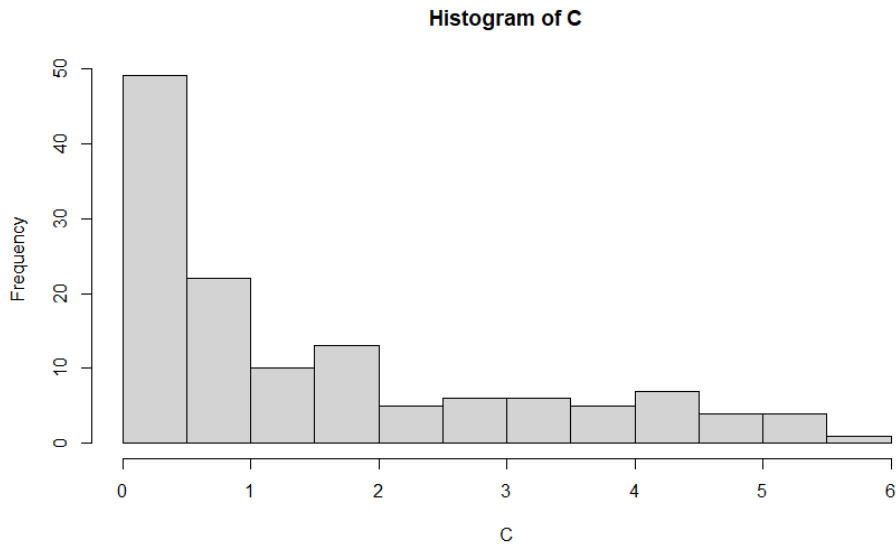
Histogram of Participant Scores (N = 132) on the Variable Exhaustion



Note. E = Exhaustion.

Figure C3

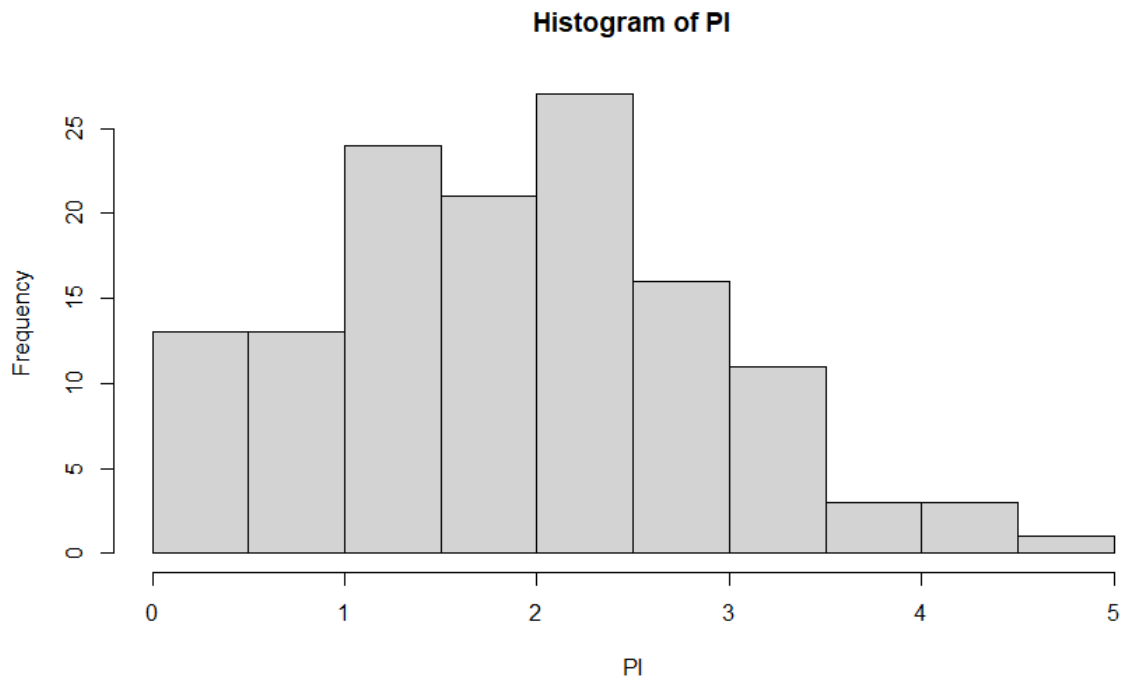
Histogram of Participant Scores (N = 132) on the Variable Cynicism



Note. C = Cynicism.

Figure C4

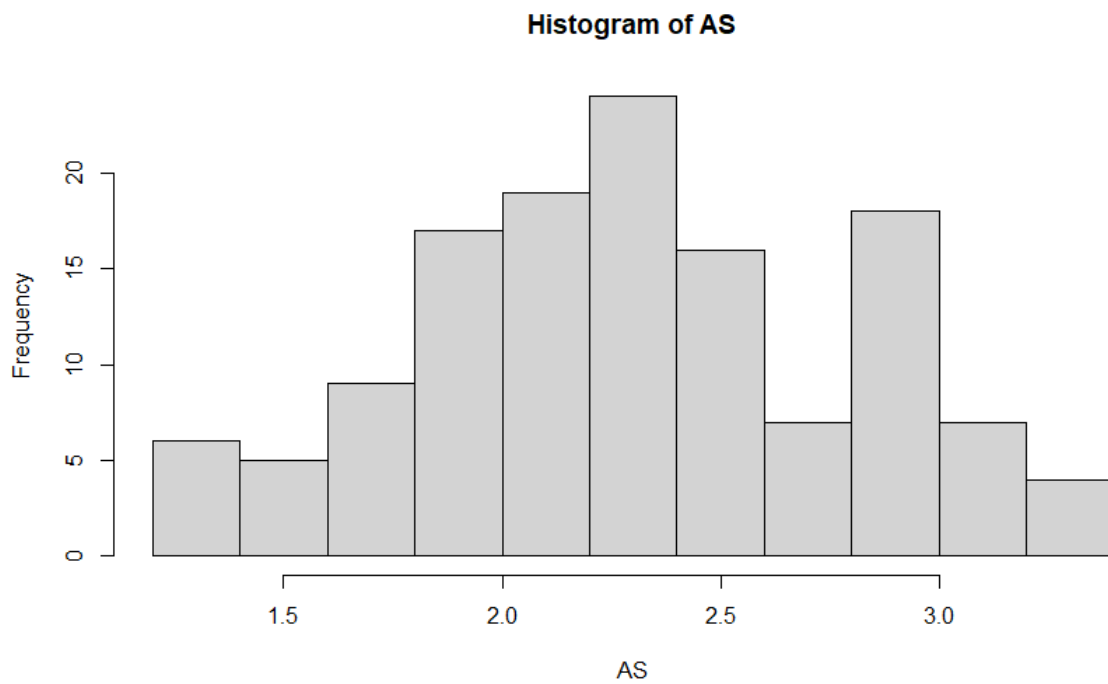
Histogram of Participant Scores (N = 132) on the Variable Professional Inefficacy



Note. PI = Professional Inefficacy.

Figure C5

Histogram of Participant Scores (N = 132) on the Variable Academic Stress



Note. AS = Academic Stress.

Table C1

Skewness and Kurtosis of the Distribution of Participant Scores on the Variables Academic Stress, Exhaustion, Cynicism, Professional Inefficacy and Self-Regulation (N=132)

	Skew	Kurtosis
Academic Stress	0.01	2.32
Exhaustion	0.06	1.94
Cynicism	0.99	2.82
Professional Inefficacy	0.26	2.75
Self-regulation	-0.05	2.77

Table C2

Z-Value of the Kurtosis Value of the Distribution of Participant Scores on the Variables Academic Stress, Exhaustion, Cynicism, Professional Inefficacy and Self-Regulation (N = 132)

	<i>M</i>	<i>SD</i>	Kurtosis value	<i>z</i>
Academic Stress	2.31	0.48	2.32	0.03
Exhaustion	3.10	1.53	1.94	-0.76
Cynicism	1.61	1.63	2.82	0.74
Professional Inefficacy	1.99	1.02	2.75	0.75
Self-regulation	108.2	16.82	2.77	-6.27

Figure C6

Q-Qplot Academic Stress

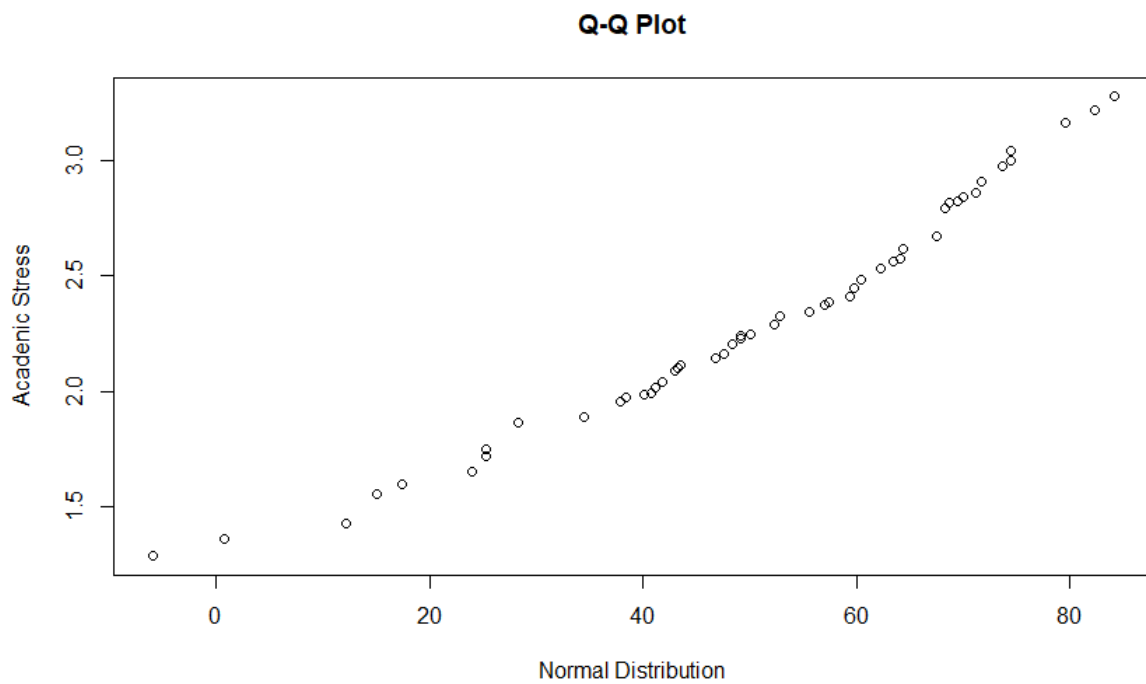


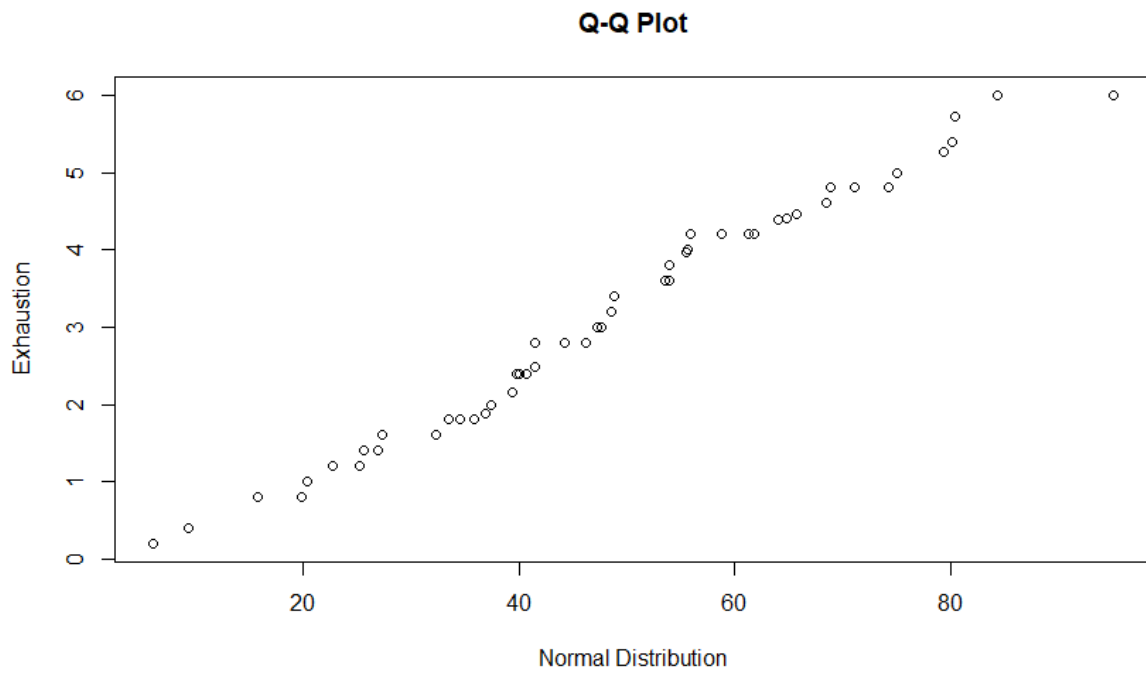
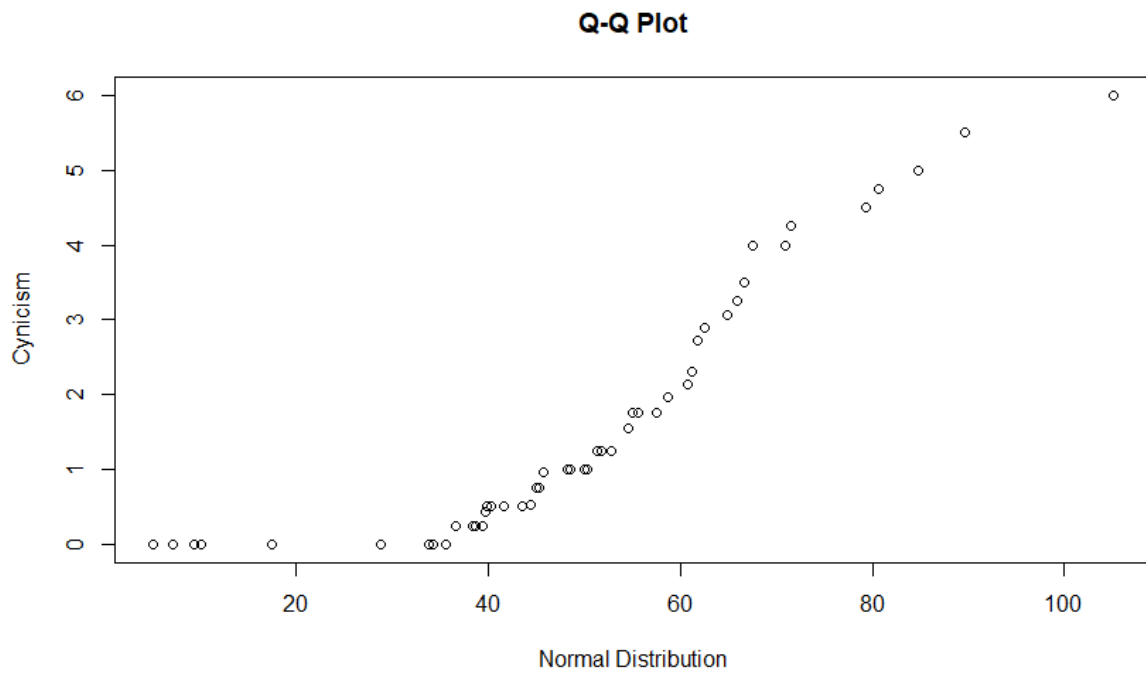
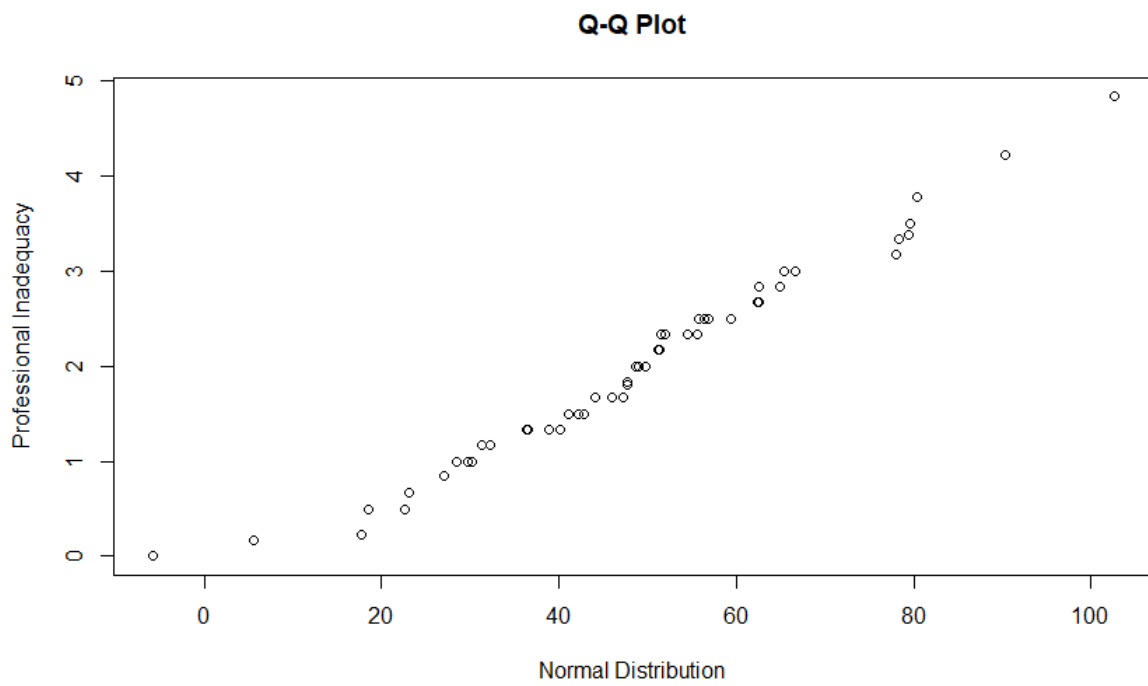
Figure C7*Q-Qplot Exhaustion***Figure C8***Q-Qplot Cynicism*

Figure C9*Q-Q plot Professional Inefficacy***Figure C10***Q-Qplot Self-regulation*