Predicting and explaining students’ stress with the Demand–Control Model: does neuroticism also matter?

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University students often report high stress levels, and studies even suggest a recent increase. However, there is a lack of theoretically based research on the structural conditions that influence students’ perceived stress. The current study compared the effects of Karasek’s demand–control dimensions with the influence of neuroticism to address environmental and individual characteristics related to stress. Two points of measurement were included: T1 in the middle of the term and T2 during the examination period. Participants were 146 psychology students at two German universities (\(M_{\text{age}} = 22.6\) years). We applied an adapted version of Karasek’s Job Content Questionnaire, a self-developed stress scale, and the 21-item Big-Five-Inventory. At T1, both neuroticism and demands significantly predicted stress (total adjusted \(R^2 = 0.40\)), although relative weights analyses indicated that the contribution of demands was more pronounced (relative importance: 63%). Longitudinally, controlling for stress at T1, the demand–control dimensions explained additional variance in the increased stress level at T2, whereas neuroticism did not contribute additionally (\(R^2 = 0.52\)). Results indicate that self-reports on stress among university students are not only a reflection of underlying negative affectivity. We conclude that perceived stress can be explained by structural conditions rather than personality, providing opportunities to reduce stress among students.

Keywords: perceived stress; Demand–Control Model; Karasek; neuroticism; negative affectivity; university students

Research on university students has consistently revealed high levels of stress (Abouserie, 1994; Cotton, Dollard, & de Jonge, 2002), and students’ mental health problems seem to be on the increase all over the world (Guo, Wang, Johnson, & Diaz, 2011; Holm-Hadulla, Hofmann, Sperth, & Funke, 2009; Newbury-Birch, Lowry, & Kamali, 2002). Several studies suggest that psychological distress among university students exceeds the levels among the general population (Adlaf, Glicksman, Demers, & Newton-Taylor, 2001; Stewart-Brown et al., 2000) and even among students’ working peers (Cotton et al., 2002; Vaez, Kristenson, & Laflamme, 2004). High levels of stress were found to be related to external control beliefs, low self-esteem, negative temperament, neuroticism, financial problems, perceived pressure of examinations, lack of time and the amount to learn, as well as the

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self-imposed need to do well (Abouserie, 1994; Jacobs & Dodd, 2003; Mangold, Veraza, Kinkler, & Kinney, 2007). As consequences of students’ stress symptoms of depression, anxiety and burnout, increased substance abuse and decreased professional efficacy were identified (Bunevicius, Katkute, & Bunevicius, 2008; Jurkat et al., 2011; Morgan & de Bruin, 2010). In Germany and the UK, student health services report an increase in the number of seriously disturbed students (Andrews & Wilding, 2004; Holm-Hadulla et al., 2009), which is partly attributed to the implementation of the Bologna Process (Holm-Hadulla et al., 2009; Schmidt & Obergfell, 2011). Strikingly, and possibly related to the new system, Holm-Hadulla et al. (2009) found an increase in clinically relevant exam anxiety by 51% since 1993. Schmidt and Obergfell (2011) identified high rates of complaints about the cumulated stress at the end of the term, about high pressure to achieve a place in the master programme or about not having room for own choices.

The search for the determinants of students’ stress appears to be an important issue for identifying opportunities to address the sources of stress and to reduce stress levels among students. However, this goal has thus far seldom been addressed in research using a theoretical approach that focuses on environmental or structural conditions. Studies on students’ stress have focused on individual moderators like coping strategies (Abel, 2002) or locus of control (Abouserie, 1994), or else they have investigated the effect of traumatic incidents on stress (Liverant, Hofmann, & Litz, 2004). To address the influencing factors theoretically, we link student work to regular paid work by following the conception of Winefield (1993) and Cotton et al. (2002) who argue that students also work in hierarchical structures and their progress is also dependent on performance. Similar as in the paid work context, students face a variety of psychological demands such as challenging and simultaneous tasks under time pressure, deadlines and phases of high concentration. They have to undergo examinations regularly and the performance in these examinations determines whether they can continue their studies and whether they will have a chance to enter the job-market successfully after having finished their studies. Moreover, like in the regular work context, students encounter variable levels of control and face a certain degree of discretion, e.g. dependent on the respective lecturer or their current study programme. Therefore, we chose the Demand–Control Model as renowned model explaining workplace stress and applied it to students’ work context and their study environment.

The Demand–Control Model

In a broader organisational context, the incidence and causes of work-related stress have attracted a huge amount of research during the last 30 years. Since the 1980s, the Demand–Control Model (Karasek, 1979; Karasek & Theorell, 1990) has been one of the most influential workplace stress models in occupational health psychology (Ganster & Perrewé, 2011). According to the model, a psychological work environment can be characterised by job demands and job control/decision latitude. Job demands refer to the task requirements and include constructs such as time pressure or role conflicts. Job control refers to the person’s ability to control his or her work activities and includes the breadth of skills used by the employee on the job (skill discretion), and the employees authority to make decisions on the job (decision authority) (van der Doef & Maes, 1999). In particular, the occurrence of high job demands and low job control have been assumed to result in psychological
stress reactions such as high blood pressure and low job satisfaction (Karasek & Theorell, 1990; Theorell & Karasek, 1996).

While Karasek himself put relatively little emphasis on the distinction between additive and multiplicative types of effects in his initial work, later research often addressed this issue by trying to confirm one or the other type of hypothesis and deriving different implications for interventions and workplace design (Häusser, Mojzisch, Niesel, & Schulz-Hardt, 2010). Two systematic reviews by van der Doef and Maes (1998, 1999) and an extension by Häusser et al. (2010) found support for the additive effects of demands and control on general psychological well-being. They found weaker evidence for multiplicative effects as predicted by the ‘buffer hypotheses’ that refers exclusively to an interactive effect of demands and control, in which control is predicted to attenuate (buffer) the negative impact of job demands on well-being. Another review that included only longitudinal studies found good evidence for lagged causal effects of work characteristics, especially for self-reported health or well-being outcomes (De Lange, Taris, Kompier, Houtman, & Bongers, 2003).

We argue that the Demand–Control Model is not only valuable to explain stress in the regular work context but in the student’s work context as well. Concretely, high demands (e.g. having to work under time pressure, having to undergo many examinations) as well as little room for own decisions and creativity (e.g. fixed study plan with little choices, insufficient variety of seminars to choose from, no opportunity to co-deciding on the topics or timing for presentations or exams) are factors that can be expected to influence students’ stress levels. Regarding the working/study context of university students, a recent study investigated the interactions of desire for control with manipulated situational variables in psychology students who participated in activities under low and high conditions of demands and control (Parker, Jimmieson, & Amiot, 2009). Little, however, is known about the relation between the structural conditions of students’ study environments and their levels of stress. Until now, stress in university students has only rarely been addressed by studies using the Demand–Control Model. In an Australian sample, Cotton et al. (2002) found that high levels of psychological distress and low levels of student satisfaction were both linked to high demands and low control. Further, satisfaction mediated the impact of students’ study environments on performance. However, Cotton and colleagues did not refer to the Job Content Questionnaire but used a different scale for demands (subscale work pressure from the Work Environment Scale (Moos, 1986) and the authors designed a 6-item questionnaire for control themselves. Chambel and Curral (2005) replicated and extended these findings in a Portuguese context using a first adaptation of the Job Content Questionnaire in the university context and found that students’ satisfaction with academic life and anxiety/depression levels were strongly dependent on their perceptions of students’ work characteristics. In addition, levels of satisfaction with academic life had a direct impact on student performance and mediated the relation between academic work control and performance.

Two recent studies (Schmidt & Obergfell, 2011; Sieverding, Schmidt, Obergfell, & Scheiter, 2013) examined the relevance of the Demand–Control Model for explaining stress and students’ satisfaction among psychology students (N = 405) in Germany. By comparing students in the newly introduced Bachelor’s programme with students in the former Diploma programme in a cross-sectional design, these studies aimed to explain increases in students’ reports of stress found after the
implementation of the Bologna Process in Germany.\(^1\) In regression analyses, high demands were identified as the main predictor of students’ stress and high demands and low decision latitude as predictors of low student satisfaction. Controlling for age and semester, Sieverding et al. (2013) found that neither the study effort (in hours per week), as used in many German surveys among students, nor the study programme (Bachelor or Diploma) contributed additionally to the explanation of study-related stress and satisfaction. Furthermore, higher stress and lower satisfaction among students in the Bachelor’s programme compared to those in the Diploma programme were to a large extent explained by the demand–control dimensions. Not only with regard to different psychology degrees (Bachelor, Diploma) but also within those groups, there are differences in conditions that influence demands and decision latitude. Students in different study years or from different psychology programmes might face a distinct amount of demands (e.g. having to deal with conflicting tasks) and control (e.g. room for own decisions regarding exams).

Results from the study that by Schmidt and Obergfell (2011) compared psychology students from two universities in three different study programmes which substantially varied in the regulation of the study course support this assumption. Students in the ‘old’ Diploma study course reported the lowest demands and highest decision latitude and the lowest amount of stress, and students in the ‘new’ Bachelor study course reported the highest demands and lowest decision latitude and the highest amount of stress (Cohen’s d for group differences in both the Karasek dimensions and stress exceeded .8, assuming large effects). Students in a modified Diploma study course which already applied several aspects of the new modulated Bachelor system and therefore represented a mixture/compromise between a Diploma and Bachelor study course had scores in between the other two samples with regard to the demand–control dimension and with regard to perceived stress (Schmidt & Obergfell, 2011). These findings together with the findings of Sieverding et al. (2013) corroborate one of the core assumptions of Karasek’s theory: that demands and decision latitude are reflections of (students’) ‘objective’ work characteristics. However, the studies were limited by data collection at only a single point of measurement (Cotton et al., 2002; Sieverding et al., 2013) and the fact that the increased levels of stress during the examination period were not explicitly addressed (Chambel & Curral, 2005). Even more important, there is no study that has used a longitudinal design to explicitly compare the effects of Karasek’s demand–control dimensions to the influence of individual characteristics such as personality factors, especially neuroticism, on university students’ perceived stress.

**Negative affectivity and stress**

According to Watson and Pennebaker’s (1989) often-cited research, self-report health measures and stress scales reflect a pervasive mood disposition of negative affectivity (e.g. operationalised by measures of neuroticism), leading to an overestimation of the true associations. Moreover, negative affectivity is negatively associated with student performance (Pritchard & Wilson, 2003), which underlines the importance of including and examining individual characteristics and personality factors. Negative affectivity is described as a stable personality dimension that is strongly associated with stress. Individuals high in negative affectivity report more stress and physical complaints, even in the absence of any objective stressor or
health issues (Watson, Pennebaker, & Folger, 1987). However, because self-report measures of stress contain a significant negative affectivity component, correlations between factors like neuroticism and self-reported stress are likely to overestimate the true association (Watson & Pennebaker, 1989). Although it has been argued that negative affectivity is an important predictor and moderator of the individual stress experience, self-reports of stress have not been sufficiently investigated in combination with measures of neuroticism or negative affectivity and with the additional consultation of structural conditions, especially in students. Previous research has focused on correlations between physical stress reactions and students’ personalities (Austin, Saklofske, & Mastoras, 2010; García-Banda et al., 2011; Matsushita et al., 2010) or analysed the links between personality traits (e.g. neuroticism) and coping-strategies as well as coping-behaviour (Geisler, Wiedig-Allison, & Weber, 2009; Gunthert, Cohen, & Armeli, 1999; Lee-Baggley, Preece, & DeLongis, 2005). Due to parsimony issues and the fact that Becker (2001) found very high correlations of $r = .80$ between neuroticism (BFI) and negative affectivity (multiple indicators) in his structural analyses of emotions and personality traits in a student sample, we only used a measure of neuroticism in this study.

The current study and hypotheses

Studies using the Demand–Control Model have not controlled for negative affectivity or neuroticism explicitly; thus, there is a need for further research that combines measurements of structural conditions and individual characteristics. We aimed to extend prior research by addressing possible influences of negative affectivity (operationalised with a neuroticism scale) on self-reported stress in students in this study. By contrasting the influence of neuroticism and the Karasek dimensions, we intended to provide a more detailed profile of the relevant predictors of perceived stress. In order to investigate predictors of stress in the course of a semester, we chose a longitudinal design with one point of measurement in the middle of the semester (T1) and a second point of measurement during the examination period (T2), which we presumed would be particularly stressful. Thereby, we aimed to identify the factors that play a role in the (cross-sectional) explanation of concurrent stress at T1 and that are able to (longitudinally) predict stress at T2 at the end of the term. One exploratory research question and two main hypotheses were addressed in our study.

In our first explorative research question, we addressed the relationship of demands and decision latitude as reflections of work conditions and neuroticism as an individual characteristic. Following Watson and Pennebaker’s line of argumentation (Watson & Pennebaker, 1989; Watson et al., 1987), those measures might be correlated due to shared variance of underlying negative affectivity. Otherwise, following Karasek’s descriptions of demands and decision latitude as ‘objective’ characteristics of the working environment (Karasek, 1979; Karasek & Theorell, 1990), the two dimensions should not relate to neuroticism measures. Thus, research question 1 explored the association of neuroticism and self-reported demands as well as decision latitude.

The second aim of our study was to extend research that identified demands and decision latitude (Chambel & Curral, 2005; Cotton et al., 2002) as well as neuroticism (Austin et al., 2010) as being related to perceived stress in university students. We expected those predictors to account for a considerable amount of variance in
students’ stress. As argued by Watson and Pennebaker (Watson & Pennebaker, 1989; Watson et al., 1987), neuroticism could act as a negativity bias, misleadingly inflating the associations between self-report measures of stressors and strain. By comparing the contribution of the Karasek dimensions with the contribution of neuroticism, we addressed both organisational and individual influences on stress as a psychological outcome. We expected that high levels of demands, low levels of decision latitude and high scores on neuroticism would be associated with high levels of perceived stress in students. Earlier studies demonstrated that students who study the same subject (psychology) but in different study programmes differ substantially in stress and this difference can be explained by the dimensions of the Karasek model (Schmidt & Obergfell, 2011; Sieverding et al., 2013). In our first hypothesis, we therefore assumed that self-reports of stress mirror objective stressors in the lives of students and expected that the demand–control dimensions would explain a higher amount of the variance of stress than neuroticism would. Thus, Hypothesis 1a predicted that both the Karasek dimensions and neuroticism would significantly predict students’ stress at the first point of measurement (T1) in the middle of the term. Hypothesis 1b predicted that the demand–control dimensions would have a more pronounced contribution than neuroticism at T1.

We further extended the cross-sectional analysis and investigated the predictive value of the Karasek dimensions in a longitudinal analysis. The second hypothesis aimed to examine the contribution of the Karasek dimensions assessed at in the middle of the term (T1) in explaining perceived stress at the end of the term (T2). As in the explorative research question 1, we were additionally interested in the contribution of neuroticism. Thus, Hypothesis 2 predicted that, controlling for stress level at T1, the Karasek dimensions would significantly predict stress at T2.

Method
Participants
Participants were 146 first to fifth-year full-time students (60% at the end of their first year, 15% at the end of their second year, 19% in their third year and 6% in their fourth or fifth year) at the German Universities of Heidelberg and Potsdam. The students were enrolled in either a Diploma (56%) or a Bachelor degree programme (44%) in psychology. Their mean age was $M = 22.6$ years ($SD = 4.8$), and 86% were women. The study was conducted in two parts during the summer term of 2009. In Germany, there are summer terms and winter terms which are comparable regarding the structural conditions (i.e. amount of lectures, seminars, exams at the end of the term). T1 took place in the middle of the semester, and T2 during the examination period at the end of the semester. On average, the interval between measurements was seven weeks with a range of six to eight weeks. Participants completed the questionnaires during the last 15–20 min of a lecture or seminar. To establish the longitudinal design, we entered the same weekly lectures and seminars again at the end of the term to approach the participants for the second time. Special codes were used to match the two points of measurements for each participant.

A total of 238 students completed the questionnaire at T1, and 174 completed the questionnaire at T2, but we concentrated on those 146 participants who took part in both waves of the study. Analyses showed no systematic dropout at T2 regarding the relevant predictors demands, decision latitude and neuroticism as well as the criterion stress (t-tests comparing the variable means at T1 of participants who...
dropped out vs. participants who also completed T2: decision latitude: \( t(236) = 1.45, p = .15; \) demands: \( t(236) = .92, p = .32; \) neuroticism: \( t(236) = .79, p = .43; \) stress: \( t(233) = 1.14, p = .26; \) similarly, there were no significant differences regarding the standard deviations and correlations between variables). Participants received course credit and took part in a prize drawing.

**Measures**

**Demands and decision latitude**

The most frequently applied instrument for quantifying job demands and decision latitude is the Job Content Questionnaire (Karasek, 1985; Karasek et al., 1998) with the core dimensions psychological demands, decision latitude (with the subdimensions skill discretion and decision authority) and social support. The Job Content Questionnaire was adapted to fit the student environment and was used to measure demands and decision latitude/control (subfactors: decision authority and skill discretion) with nine items each. These 18 items represent the minimum ‘core’ questions recommended by Karasek to measure the two job dimensions. Participants were asked to respond on a 4-point Likert scale according to their extent of agreement ranging from 1 (strongly disagree) to 4 (strongly agree). The adapted version was pretested with a group of students from various disciplines (\( N = 42 \)) and successfully applied in two subsequent studies (Schmidt & Obergfell, 2011; Sieverding et al., 2013). Cronbach’s \( \alpha \) scores were .80 for demands (e.g. ‘In my studies … I have to work hard’, ‘… I have enough time to get the tasks done (reverse coded)’, ‘… I have to deal with conflicting demands’) and .77 for control (e.g. ‘My studies … allow me to make my own decisions’, ‘… require me to be creative’, ‘In my studies … I have an opportunity to develop my own special abilities’).

**Neuroticism**

Personality traits were measured with a 21-item short version of the Big Five Inventory (BFI-K, Rammstedt & John, 2005). Because the focus of this study is on negative affectivity, only neuroticism is included here.\(^2\) Cronbach’s \( \alpha \) for the neuroticism subscale (4 items) was .82.

**Stress**

Students’ perceived stress was measured with three items, which had also been used and pretested in a diploma thesis (Schmidt & Obergfell, 2011): ‘During the last 4 weeks, how stressed did you feel because of your studies?’ with possible values ranging from 0 (not at all stressed) to 100 (completely stressed); ‘During the last 4 weeks, how often did you feel stressed and tense?’ with responses on a 5-point Likert scale ranging from 0 (never) to 4 (daily); ‘How would you describe your life at the moment?’ with possible answers on a 5-point Likert scale ranging from 0 (not at all stressful) to 4 (very stressful). A composite stress score with possible values from 0 to 100 was calculated using the formula (item 1 + (item 2 \( \times 25 \)) + (item 3 \( \times 25 \))/3. Cronbach’s \( \alpha \) for the three items was .84.
Control variables

Several additional variables were included in the questionnaire to control for factors that might confound the relation between demands, decision latitude and perceived stress. Aside from the age of the students and their current study year, we also assessed the workload or study effort in terms of weekly hours spent in lectures or seminars plus the amount of weekly hours studying at home. We furthermore asked the participants to report the weekly hours they usually spend working in part time jobs. In a previous cross-sectional study, Sieverding et al. (2013) found that these variables did not make a relevant contribution toward explaining study-related stress. Similarly, in the present study, the control variables (age, study year, study effort and part time job) did not correlate significantly with students’ stress. Therefore, we concentrated on the role of neuroticism and the demand–control dimensions in explaining perceived stress.

Statistical analyses

The analyses were conducted using SPSS (v. 18.0). In order to explore research question 1, we used bi-variate correlation analyses. In order to address Hypotheses 1 and 2, two separate multiple linear regression analyses were conducted to determine the effect of neuroticism and the demand–control scales on students’ perceived stress at the two points of measurement. Previous analyses did not reveal confounding effects of the variables age, study year and workload. Hence, they were not included in these analyses to simplify the models. The first regression with perceived stress at T1 as the criterion consisted of only one step. Neuroticism, demands and decision latitude were entered simultaneously to evaluate their concurrent contribution in explaining students’ stress. The second regression with stress at T2 as the criterion was carried out in two steps. Perceived stress at T1 was entered in the first step because we aimed to control for students’ previous stress level. In the second step, neuroticism, demands and decision latitude (assessed at T1) were entered to determine the additional amount of explained variance via a significant change in $R^2$. Because the interaction terms demands x decision latitude, neuroticism x demands and neuroticism x decision latitude did not reach the significance level of $\alpha = .05$, we decided to exclude them from the analyses.

As indices commonly produced by multiple regressions can fail to adequately partition variance to the various predictors when they are not orthogonal, Tonidandel and LeBreton call greater attention to estimates of relative importance by describing how relative weights analysis can be a useful addition to traditional regression analysis (Tonidandel & LeBreton, 2011). Otherwise, with regard to change in $R^2$, any shared variance is credited to the factor that was first entered in the regression equation, potentially leading to a misinterpretation of the true contributions. Therefore, to provide a more complete picture of the relative importance of neuroticism compared to the Karasek dimensions in explaining stress, we also carried out a relative weights analysis (Johnson, 2000). According to Tonidandel and LeBreton (2011), such analyses aim to partition the explained variance among multiple predictors in order to better understand the role played by each predictor in a regression equation.
Results

Associations between study variables

Table 1 reports intercorrelations and descriptive statistics for the variables. The two Karasek dimensions were not associated significantly at T1 ($r = -0.06, p > .05$) and slightly related at T2 ($r = -0.17, p < .05$). Karasek et al. (1998) also reported low and very variable correlations between these two scales in six broadly representative populations from advanced industrial societies. Stress was related to demands (T1: $r = 0.54, p < .001$; T2: $r = 0.48, p < .001$) and to neuroticism (T1: $r = 0.43, p < .001$, T2: $r = 0.32, p < .001$), whereas decision latitude and stress were not related at T1 and were only marginally related at T2 ($r = -0.16, p = .057$).

As explored in research question 1, neuroticism was not related to demands ($r = 0.14, p = .09$) or decision latitude ($r = -0.06, p = .50$). These results suggest that students’ ratings of the Karasek dimensions are not biased by negative affectivity.

Explaining perceived stress at T1

A multiple linear regression was carried out to explore the associations of demands, decision latitude and neuroticism with perceived stress. In Hypothesis 1, we aimed to explore the contribution of both the Karasek dimensions and neuroticism in explaining students’ stress at the first point of measurement in the middle of the term. Table 2 shows the results of the regression analysis for T1 and the relative weights according to Johnson (2000). As assumed, both neuroticism and demands were significant predictors of stress. By contrast, decision latitude did not demonstrate a significant effect in the prediction of this criterion. The regression equation explained 40% of the variance in perceived stress. None of the interactions accounted for additional variance and hence are not reported in this paper. In the relative weights analysis, we compared the contribution of the predictors and found that the demand scale accounted for 63% of the explained variance, whereas neuroticism had an also important but smaller influence (RW = 37%).

Predictors of perceived stress at T2

At the first wave of measurement during the summer term (T1), students reached a mean of $M = 53.46$ (SD = 20.11) on the composite stress score with a possible range of 0–100. The second point of measurement at the end of the term (T2) revealed
significantly increased stress levels ($M = 59.64$, $SD = 21.00$), $t(141) = -4.464$, $p < .001$, $d = .3$.

A second multiple linear regression was conducted to examine the associations of the predictors with the levels of stress in the examination period. In Hypothesis 2, we aimed to explore the contribution of both the Karasek dimensions and neuroticism in predicting perceived stress at the second point of measurement at the end of the term. Table 3 shows the results of the regression analysis for T2 and the relative weights. Perceived stress at T1 was entered in the first step in order to control for students’ previous stress level. In this way, we were able to indicate the additional contribution of both the Karasek dimensions and neuroticism in explaining stress at T2.

With a correlation of $r = .70$ ($p < .001$) between stress scores at the two points of measurement, we certainly expected perceived stress at T1 to account for a large amount of explained variance in stress at T2. Indeed, perceived stress at T1 accounted for 64.6% of variance in the stress level at the second point of measurement. Analyses showed that in the second step, neuroticism was not a significant predictor of perceived stress at T2 and accounted for only 8.7% of the explained variance. Relative weights as well as the significant regression coefficient of the demand scale indicated that demands were of more importance in the prediction of students’ stress at T2. Decision latitude also significantly predicted the stress level at T2 in terms of a negative impact on perceived stress, meaning that higher decision latitude was associated with lower levels of stress. However, relative weight estimates revealed a lower contribution of 4.2% compared to the demand scale, which obtained the highest relative weight (22.6%; see Table 3). This second regression equation explained 52% of the variance in perceived stress during the second point of measurement, with the predictors explaining an additional 4% of the variance.

### Table 2. Regression analysis explaining stress in university students at T1.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$\beta$</th>
<th>RW%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuroticism</td>
<td>.35**</td>
<td>36.9</td>
</tr>
<tr>
<td><strong>Karasek dimensions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demands</td>
<td>.49**</td>
<td>62.9</td>
</tr>
<tr>
<td>Decision latitude</td>
<td>.04</td>
<td>.2</td>
</tr>
<tr>
<td><strong>Adj R²</strong></td>
<td>.40</td>
<td></td>
</tr>
</tbody>
</table>

Notes: $N = 146$. Method = Enter. *$p < .05$. **$p < .01$.

### Table 3. Hierarchical regression analysis predicting stress at T2.

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$\beta_{step~1}$</th>
<th>$\beta_{step~2}$</th>
<th>RW%</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Stress T1</td>
<td>.70**</td>
<td>.61**</td>
<td>64.6</td>
</tr>
<tr>
<td>(2)</td>
<td><strong>Neuroticism</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Karasek dimensions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Demands T1</td>
<td></td>
<td></td>
<td>22.6</td>
</tr>
<tr>
<td></td>
<td>Decision latitude T1</td>
<td></td>
<td></td>
<td>4.2</td>
</tr>
<tr>
<td>$\Delta R²$</td>
<td></td>
<td>.49**</td>
<td>.04*</td>
<td></td>
</tr>
<tr>
<td><strong>Adj R²</strong></td>
<td></td>
<td>.49</td>
<td>.52</td>
<td></td>
</tr>
</tbody>
</table>

Notes: $N = 146$. Method = Enter. *$p < .05$. **$p < .01$.
variance in the second step of the analysis. Again, none of the interactions accounted for additional variance and are not reported here. According to Cohen (1992), the effect size index $f^2 (f^2 = R^2/(1 - R^2))$ is defined as large if a value of $f^2 = .35$ is exceeded; this implies a minimum $R^2$ of .26. We, therefore, assumed large effect sizes for the explanation of stress at both points of measurement with $f^2 = .67$ at T1 and $f^2 = 1.08$ at T2.

Discussion
The present study is the first to compare the effects of Karasek’s demand–control dimensions with the influence of neuroticism on university students’ perceived stress in a longitudinal research design. Our findings that demands and – to a lesser extent – decision latitude are related to students’ stress level replicate the prior findings of two studies conducted in a similar context (Chambel & Curral, 2005; Cotton et al., 2002) and research conducted to explore the effects of the Bologna Process in Germany (Schmidt & Obergfell, 2011; Sieverding et al., 2013). Consistent with our hypothesis, demands were shown to be a strong predictor of subjective reports of stress at both points of measurement, whereas decision latitude only contributed significantly during the second wave at the end of the term. In our study, those individuals who reported higher levels of decision latitude and lower levels of demands perceived lower levels of stress during the examination period regardless of their previous stress level, which was controlled in the analyses. Furthermore, our finding of a positive association between neuroticism and stress at the first point of measurement again replicates previous research (Austin et al., 2010; Grant & Langan-Fox, 2006).

Going beyond prior studies, our comparison of the relative weights suggests that the contribution of neuroticism is important but outperformed by the contribution of the demand scale. Neuroticism was not related to either demands or decision latitude. This indicates that the ratings of the Karasek dimensions are not biased by negative affectivity as could be assumed following Watson and Pennebaker’s (1989) often-cited line of argument. Thereby, our results underline the assumption that self-reports on stress among students do not merely reflect an underlying disposition of negative affectivity. Although accounting for a substantial amount of explained variance at T1, neuroticism failed to explain the stress levels at T2, whereas both demands and decision latitude were significant predictors at T2. In line with the conclusions from previous studies (Schmidt & Obergfell, 2011; Sieverding et al., 2013), structural conditions can be considered to be a crucial factor for stress in university students. Given the mean heritable component of neuroticism of about 60% (Eysenck, 1990) and its stability across the life span (Costa & McCrae, 1990), it seems unlikely that students’ stress levels would be altered if we focused on addressing negative affectivity.

Theoretical implications and refinements
The present study shows that designs with more than one point of measurement provide important insights into the relation between environmental conditions for students and stress. In order to ascertain the directionality of the associations between stress, both the Karasek dimensions, and neuroticism, more longitudinal research is needed. Moreover, as found in a previous but only cross-sectional study
(Sieverding et al., 2013), other outcomes such as satisfaction with study conditions and satisfaction with life were associated with the demand and decision latitude scales. This replicates research that found satisfaction with life to be significantly negatively correlated with students’ stress (Weinstein & Laverghetta, 2009). In this study, we applied the two main scales of the Demand–Control Model only. There are additional scales in the Job Content Questionnaire that might be considered in the attempt to explain students’ stress in future studies. Shortly after Karasek’s initial announcement of his theory, social support was integrated into the model as a further fundamental characteristic of the work environment (Johnson, Hall, & Theorell, 1989). In the university context, this dimension could potentially broaden our approach, since the support of supervisors and fellow students might also be important factors for students’ stress. As outlined in the introduction, there is evidence for an increase in the number of seriously disturbed students that are, for example, affected by depressive symptoms or clinically relevant exam anxiety (Andrews & Wilding, 2004; Holm-Hadulla et al., 2009). Our study addressed perceived stress as a criterion, but could be extended with depression or anxiety measures or health-related criteria using the same combination of the demand–control dimensions and neuroticism as predictors.

In a more comprehensive perspective, there are various mechanisms by which neuroticism may play a role for the perception of stress and as well as for coping strategies. Thus, people high in neuroticism show a higher tendency to give threatening interpretations to situations as well as a higher reactivity to stressors (Suls & Martin, 2005). In addition, there is evidence that high neuroticism is associated with more negative social interaction patterns (Karney & Bradbury, 1997), a higher number of maladaptive coping strategies and a lack of efficient coping (Gunthert et al., 1999; Suls & Martin, 2005). Therefore, future studies should also integrate measures of social support or coping mechanisms for a broader understanding of the association of neuroticism, the Karasek dimensions, and perceived stress.

**Practical recommendations and implications**

Hence, with our results indicating that modifiable components like the Karasek dimensions are of higher importance for perceived stress, these findings point to specific opportunities for reducing stress. Decision latitude might be increased, for example, by offering alternative dates for exams instead of a fixed period, by allowing students to choose or co-decide about exam modalities and topics, by easing restrictions on compulsory attendance or by providing space for diversification and creativity. Demands might be lowered by reducing time pressure for tasks or through a modification of the grading system to the effect that not every single seminar paper, presentation or test counts toward the final grade. We came up with these ideas by analysing open-ended questions on stressors within the context of a Diploma thesis (Schmidt & Obergfell, 2011).

**Limitations**

Certainly, our findings are limited, and studies with an intervention stage are needed here to see if these suggested changes induce the predicted improvements to stress outcomes. Some more limitations of our study are worth noting. Our participating students are from a self-selected population, a fact that constrains the generalisation
of our findings. Students who dropped out after T1 did not differ in their stress level compared to those with complete data. However, it is possible that especially those participants who reported low decision latitude and high demands and who perceived high stress at the second point of measurement did not attend the lectures and seminars where the data were collected. Consequently, the situation might even have been underestimated because of students feeling too harried to participate at T2.

More research is needed with larger sample sizes, including students from various study programmes instead of students who came solely from the psychology programme. In order to address possible gender differences and provide more generalisable findings, male students should be included to a comparable proportion. Since our study population was mostly female, there might be a different pattern of the Karasek dimensions, self-reported stress and neuroticism among men that needs to be investigated. There are findings on gender differences in stressors and reactions to stressors among students all over the world, and in most of the cases, female students reported a higher perception of stressors (Day & Livingstone, 2003; Hamaideh, 2012). Future research on university students’ stress might also include alternative methods of data collection. In addition to self-reports of perceived stress, other alternative measures of stress such as physiological stress markers (e.g., blood pressure or cortisol excretion) or behavioural outcomes (e.g., days absent or certificates due to medical conditions) could be used to broaden our findings.

Another limitation could lie in the measure of neuroticism we used, that included only four items and therefore possibly does not depict the entire content domain of neuroticism. The short version of the Big Five Inventory (BFI-K, Rammstedt & John, 2005) that we used has quite satisfactory psychometric properties in terms of acceptable reliability coefficients, factorial validity as well as convergence of self-reports with partner-ratings and with other inventories assessing neuroticism. Nevertheless, in order to better depict the scope of neuroticism, other inventories assessing neuroticism or negative affectivity should be applied in future studies.

Conclusion
In conclusion, the data presented here support the literature that shows strong associations between the variables of demands, decision latitude, neuroticism and perceived stress. We combined the traditional Demand–Control Model with the assessment of neuroticism and indicated that both environmental and individual characteristics were important in the prediction of perceived stress. Our findings have significant implications for universities as well as for students because high levels of distress may lead to health issues, underachieving or student withdrawal. The findings of this study indicated that characteristics like the Karasek dimensions could provide opportunities to reduce stress in university students and should be addressed in further research. As the original Karasek dimensions are internationally well established (Karasek et al., 1998), our study may also stimulate further research and debate in different countries to advance the understanding of environmental conditions in explaining students’ stress.

Notes
1. Compared to the old Diploma system, the new Bachelor programmes are strictly regulated: the curriculum is now obligatory to a large extent, whereas Diploma students only encountered very few compulsive lectures but could complement their study course
and attend seminars in accordance with their own interests. With regard to examinations, Bachelor students now face a higher number of graded presentations and exercises, as well as written exams at the end of each term.

2. For exploratory reasons, the correlations of other personality traits (extraversion, openness, conscientiousness and agreeableness) with self-reports of stress were calculated as well. None of these correlations was significant.

3. We thank Reviewer 1 for this valuable hint.

References


