Hamesch, U., Cropley, M. & Lang, J. (2014). Emotional versus cognitive rumination: Are they differentially affecting long-term psychological health? The impact of stressors and personality in dental students. Stress and Health Special Issue on recovery from work

Running head: Rumination and Personality

Emotional versus cognitive rumination:

Are they differentially affecting long-term psychological health?

The impact of stressors and personality in dental students

Ulla Hamesch

Institute for Occupational Medicine, RWTH Aachen University, Germany

Mark Cropley

School of Psychology, University of Surrey, United Kingdom

Jessica Lang

Institute for Occupational Medicine, RWTH Aachen University, Germany

Corresponding author actual contact information:

Ulla Hamesch

Institute for Occupational Medicine

RWTH Aachen University

Pauwelsstrasse 30

D – 52074 Aachen (Germany)

Phone: +49-176-700 42 88 0

E-Mail: ulla@hamesch.de

Abstract

In the process of recovery from work, rumination is considered as an important mediating variable in the relationship between work demands and psychological health outcomes. Past research differentiated affective rumination from problem-solving pondering. The aim of the present study was to test a moderated mediation model for these two distinct ruminative states and to show how personality (i.e., neuroticism and conscientiousness) can alter the mediating effect. The present study is based on 119 surveys from dental students with a time lag of 6 months. Participants filled out questionnaires assessing specific study-relevant performance demands, rumination, personality and a screening measure for psychological health status.

Neuroticism was found to moderate the demand-affective rumination association, but conscientiousness did not moderate the demand-problem-solving pondering association. Moderated mediation analysis revealed that affective rumination mediates the impact of demands on psychological health only for individuals low in neuroticism. Findings are discussed regarding potential interventions for dental students to prevent negative psychological health outcomes due to increased work-related demands in the long-term.

(Word Count 7596)

Keywords: affective rumination, problem-solving pondering, personality, psychological health, dental students

Introduction

Within occupational stress research one major research topic aims to understand the mechanism by which work-related demands exert a long-term influence on individual psychological health outcomes (Kompier, 2002). In recent years, research on recovery from work demands, has added additional knowledge to our understanding of how work-stressors impact on psychological well-being. Specifically, recovery from the (psycho-) physiological activation due to work-related demands has been described as one crucial mechanism to prevent chronic health impairments (Geurts & Sonnentag, 2006). A prerequisite for complete recovery from work is not only the physical absence from work and work-related tasks or demands but also the psychological detachment within the individual (Cropley, Dijk, & Stanley, 2006; Sonnentag & Fritz, 2007). To mentally switch off from work-related demands it is necessary to guarantee that no additional effort expenditure occurs in relation to work tasks post-work, according to the Effort Recovery Model (Meijman & Mulder, 1998). In that way, load reactions can be reduced and the individual returns to the pre-demand level. In a similar vein, Brosschot and colleagues put forward the perseverative cognition hypothesis (Brosschot, Gerin & Thayer, 2006) where rumination is seen as the mechanism responsible for the prolonged activation of physio-biological systems due to a maintained cognitive response to the perceived environmental “threat”.

Rumination

Considering the relevance of psychological detachment for the recovery process, recent research has examined specific forms of work-related rumination (e.g., affective rumination and problem-solving pondering) as important factors responsible for delaying unwinding or sustaining activation, which over time can lead to negative physical and psychological health outcomes (e.g., Cropley, Michalianou, Pravettoni, & Millward, 2012; Kompier, Taris, & van Veldhoven, 2012). The process by which rumination impacts the association of environmental stressors and health outcomes has been described as a mediation effect in accordance with the above mentioned

perseverative cognition hypothesis (Brosschot et al., 2006). Brosschot and colleagues argued that “perseverative cognition can act as a mediator or pathway, by which psychosocial stress may produce sustained activation...” (p. 115). Continuing to process demands from the environment as repetitive thoughts can prolong physiological activation of several bio-psychological systems relevant to our (psychological) health. From the Allostatic Load Model (Mc Ewen, 1998) we know that the accumulation of stress reactions and prolonged activation of the stressor systems, results in Allostatic Load; a state when the body is no longer able to compensate for the continuously required activation of specific systems adaptations. Ultimately, individual health will suffer leading to actual long-term ill-health and disease. Therefore, the present research examines the long-term influence of two distinct forms of work-related rumination (i.e., affective rumination and problem-solving pondering) as mediators of the impact of work stressor on psychological health outcomes.

Affective Rumination

Rumination can be defined as a recurrent representation of a stressor in the individual’s mind so that a stressful event can continue in one’s thoughts and affect (Zawadzki, Graham, & Gerin, 2013). In general, past research has predominantly focused on the emotional aspect of rumination by defining rumination as a repetitive thinking process that focuses on one’s distress symptoms where attention is directed on the feelings related to a problem (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). In fact, extensive research on the effects of rumination shows that the emotional form of rumination interferes with people’s ability to focus on problem-solving and results in dwelling on negative thoughts about past failures (Lyubomirsky, Caldwell, & Nolen-Hoeksema, 1998; Mellings & Alden, 2000), and/or worries about problems anticipated in the future (Brosschot, et al., 2006; Cropley & Zijlstra, 2011). Past research on affective rumination mainly stems from clinical psychology or health psychology and has linked affective rumination to negative psychological health outcomes like depression (e.g., Lyubomirsky et al., 1998, Nolen-Hoeksema, 2000; Zawadzki et al., 2013).

Problem-solving pondering

Despite the predominant focus on the negative impact of repetitive emotionally laden thoughts, there is also research explicitly differentiating between affective rumination and more problem-related cognitions. For example, Segerstrom and colleagues (2003) differentiated between adaptive and maladaptive repetitive thinking, whereby adaptive repetitive thinking included processing, mental simulation and reflection as types of cognitive coping strategies (Segerstrom, Stanton, Alden, & Shortridge, 2003). Within this context, repetitive thoughts and perseverative cognition are understood in terms of rehearsal and thinking through the needed steps to solve a problem, which may be less detrimental to health outcomes. Watkins (2008) reviewed research on constructive and unconstructive repetitive thoughts, which can lead to either unconstructive consequences (e.g., depression or anxiety) or to constructive consequences like recovery and anticipatory planning. However, according to the perseverative cognition hypothesis (Brosschot et al., 2006) both affective and cognitive repetitive thoughts are assumed to lead to poor health outcomes since the shared features of the concepts are the “chronic activation of a psychological stressor” (p. 114). And in addition, in their review of the literature on repetitive thoughts Watkins (2008) found both positive and negative health consequences were associated with unemotional repetitive thinking. Thus, the impact of problem-solving pondering on health outcomes is yet not well understood.

Work-related problem-solving pondering versus affective rumination

In accordance to past research from clinical and health psychology, Cropley and Zijlstra (2011) differentiated ‘affective’ and ‘cognitive’ work-related rumination. Affective rumination is defined as the experience of work-related intrusive, pervasive, and recurrent thoughts causing negative affect, and problem-solving pondering is defined as unemotional and prolonged thinking about solutions to particular work-related problems (see also Pravettoni, et al., 2007). Since the sustained arousal due to negative affect is largely absent within problem-solving pondering, overall

it is assumed that health should be less impaired. In fact, subsequent studies have found affective rumination to have a stronger impact on negative health behaviors and outcomes than problem-solving pondering (Cropley et al., 2011; Querstret & Cropley, 2012).

Rumination and Personality

Taking into consideration the different perspectives of rumination and their potential differential effects on individual well-being the question arises whether there are specific conditions under which work-related stressors can evoke one type of the ruminative thinking (Seegerstrom et al., 2003, Watkins, 2008). In particular past researchers have argued the need to include personality factors in longitudinal recovery research (Geurts & Sonnentag, 2006). In general, personality influences the way we perceive and experience our environment and how we behave accordingly. Geurts and Sonnentag (2006) suggested that personality factors such as neuroticism may have an influence on cognitive processes in response to stressors. They proposed for example that neurotic individuals may be predisposed to repetitive and ruminative thoughts when confronted with stressors due to their more anxious nature.

When considering the impact of personality factors on psychological well-being, a recent meta-analysis (Kotov, Gamez, Schmidt, & Watson, 2010) has revealed significant and strong association of individual differences with psychological health outcomes (i.e. diagnostic groups of psychological disorders). In particular, Kotov and colleagues found neuroticism to be significantly higher in all diagnostic groups (mean Cohens d .1.65) of psychological disorders and conscientiousness to be significantly lower for all diagnostic groups of psychological disorders (mean Cohens d -.1.01). Therefore, in our goal to understand the distinct mediating effect of cognitive and affective rumination in the path from work stressors to psychological health outcomes, the present study additionally considers the influence of the above stated personality factors. In doing so, we try to extend the current knowledge on the antecedents of ruminative thinking by comprehensively looking at both environmental and individual influencing factors.

Neuroticism

Neuroticism can be seen as the general tendency to experience negative affect (e.g., Costa & McCrae, 1980; Gross, Sutton, & Ketelaar, 1998). Even when facing minor stressors neurotic individuals react with increased negative emotionality, which is also associated with rapid and long lasting arousal even after stressor termination (Barnhofer & Chittka, 2009). Similarly, it has been reported that neuroticism is associated with the tendency to worry and to repetitively think of past events as well as to appraise environmental situations as generally stressful (Widiger, Hurts, & Frances, 1984). A common theme among all the neurotic tendencies is the general difficulty in emotion regulation (Eysenck & Eysenck; 1991). In their study on cognitive reactivity (i.e., the fast reactivation of implemented negative thoughts by minor mood changes) Barnhofer and Chittka (2010) conclude, that neuroticism is the basis for maladaptive reactions including rumination. Research on recovery from work, has identified job demands as one initiator of ruminative thinking (Cropley et al., 2006), however there are also possible personality characteristics that predispose an individual to activate a specific style of thought processing. In the case of neuroticism, high emotional lability seems to predispose individuals to affective rumination.

Conscientiousness

On the other hand, conscientiousness can be defined as the general tendency to be disciplined and organized. Being disciplined implies that individuals high in conscientiousness must exert a high level of individual effortful control over their emotions (Crawford et al., 2007). The link between effortful control and conscientiousness is well established (for an overview see MacDonald, 2008). John and Srivastava (1999) characterize conscientious individuals as being goal-directed, and goal-directed thinking focused on a specific problem is an aim, and outcome of problem-solving pondering. In processing and analyzing the problem/stressors the individual achieves solutions to their work-related problems. According to Segerstrom and colleagues (2003), problem-solving pondering could be categorized as an adaptive cognitive coping style leading

therefore to less maladaptive consequences. Consequently when confronted with high work-related demands, individuals high in conscientiousness should show increased problem-solving pondering since their predisposition to control their emotions opens them the cognitive processes for problem-solving. In comparison a goal oriented approach to problem-solving should be impaired by individuals who do not tend to control their emotions.

By simultaneously taking into consideration personality factors as well as work stressors the present study follows an early health psychological model proposed by Adler and Matthews (1994), where the authors explicitly point out the importance of the person-environment interaction for its impact on (psychological) health outcomes or health relevant actions. In fact, other applied research has already shown successfully that perceptions of and reactions to job stressors can be moderated by personality (e.g., Bowling & Eschelman, 2010).

The aim of the present study was therefore to look at the associations of work stressors, personality characteristics (neuroticism, conscientiousness) and two types of rumination (affective, cognitive) and their impact on long-term psychological health outcomes (i.e., depression). By integrating theoretical findings of past research as outlined above, we propose a moderated mediation model to combine the variables of interest (see Figure 1). For the single pathways we have the following hypotheses.

Hypothesis 1a: Work stressors will be positively associated with affective rumination.

Hypothesis 1b: Work stressors will be positively associated with problem-solving pondering.

Hypothesis 2a: The relationship between work stressors and affective rumination will be moderated by neuroticism, such that the association of work stressors on affective rumination will be stronger for individuals high in neuroticism.

Hypothesis 2b: The relationship between work stressors and problem-solving pondering will be moderated by conscientiousness, such that the association of work stressors on problem-solving pondering will be stronger for individuals high in conscientiousness.

Hypothesis 3a: Affective rumination will be positively related to long-term psychological health outcomes (i.e., depression after six months).

Hypothesis 3b: Problem-solving pondering will be positively related to long-term psychological health outcomes (i.e., depression after six months).

In summarizing hypotheses 1 to 3 and by looking at the overall models depicted in Figure 1 the present study proposes a conditional indirect effect of work stressors on depression by studying whether the expected mediation by rumination is dependent on specific personality factors. Hypothesis 4 therefore summarizes the overall model by analyzing the paths simultaneously.

Hypothesis 4: Work stressors will be related to long-term psychological health outcomes (i.e., depression after a time lag of six months) via conditional indirect effects, such that the work stressors relationship with the outcome will be moderated by personality factors and mediated by rumination.

The present study examines the above hypothesis within a sample of dental students. The existence of stress in dental schools has been documented in various studies beginning as early as 1970 (Alzahem, van der Molen, Alaujan, Schmidt, & Zamakhshary, 2011). In particular, many studies have shown that dental students are more strained than medical students and that they generally suffer from high amounts of stress, which has been demonstrated in several countries (e.g., Polychronopoulou & Divaris, 2009, Dahan & Bedos, 2009). As Polychronopoulou and Divaris (2009) stated, dental education has been declared as one of the most challenging, demanding, and stressful fields of study. As students practice with patients during their education, they usually need to spend more than 40 hours weekly in dental school to attend their obligate lectures and training sessions. Moreover, dental students need ample time for self-study activities and to satisfy practical requirements (Alzahem et al., 2011). Hence, the structure and time devoted to curriculum requirements by dental school students is comparable to a full-time employment. In

their systematic review Alzahem and colleagues (2011) found that high levels of perceived stress among dental students have been associated with a variety of physical symptoms (e.g., ill health, gastrointestinal symptoms) as well as psychological symptoms (e.g. depression, anxiety or emotional exhaustion). The practical relevance to investigate work stressors as well as personality in such a highly exposed and relatively young group could be to highlight the importance of providing interventions for preventing negative psychological health outcomes in the long-term.

Methods

Procedure

Participants were approached twice with an identical questionnaire at baseline and at follow up (after a time lag of six months) during required courses at the university and asked for their voluntary participation in the study. All participants provided informed consent, and they were informed that they could withdraw participation at any time without any disadvantage or explanation. Additionally, students received contact information for personal support if they felt the need to talk to someone about their stress. The study was approved by the student dean of the medical faculty as well as by the local ethics committee (EK 019/12). Surveys from both measurement occasions were matched by unique individual codes.

Participants

Overall, 201 students participated in the study, but we were able to match only the surveys of 119 students (age range from 19-35 years) from both measurement occasions due to the curricular structure. The response rate of the students who had been asked to participate was seventy-five percent (75.9%). Out of the 119 matches thirteen percent (13.4%) were from the first semester, twenty-nine percent (29.4%) from the fifth semester, twenty-four percent (23.5%) from the seventh semester and thirty-four percent (33.6%) were from the ninth and final semester. Sixty-seven percent (67.2%) of the respondents were female and thirty-three percent (32.8%) male, which corresponds to the general gender distribution within the present dental school.

Measures

Work Stressors. Student related work stressors were assessed by the (self-translated) academic performance subscale of the dental environmental stress questionnaire (DES; Garbee, Zucker, & Selby, 1980). The DES has been reported to be a reliable and valid instrument, which has been used in the majority of studies on dental students' stress (Murphey, et al., 2008). The academic performance subscale is regarded as a proxy variable for job stressors as it measures

demands specific to student's academic requirements. In addition the construct of academic performance was applicable to all semesters. The subscale included 8 items ($\alpha = .85$). Response options ranged 1 (demand present but not stressful) to 4 (demand present and very stressful). Example of items include stress due to "amount of assigned work" or "competition with fellow students", which are similar to the constructs of a typical work-related stressor scale including job demands and interpersonal conflict.

Rumination. Affective rumination ($\alpha = .89$) and problem-solving pondering ($\alpha = .73$) were assessed with the respective subscales (5 items each) of the Work-Related Rumination Questionnaire (WRRQ; Cropley, et al., 2012; German Version: Lang & Kraus 2012), which is a newly developed self-report measure differentiating affective and cognitive perseverative thinking. Response options are on a 5-point scale ($1 = \text{rarely or never}$, $5 = \text{very often or always}$). Sample items for affective rumination would be "Are you troubled by work-related issues when not at work?" or "Do you become tense when you think about work-related issues in your free time?" and for problem-solving pondering "I find solutions to work-related problems in my free time." or "After work I reflect how to improve my achievements". Past research has shown that affective and problem-solving pondering are two distinct factors (Cropley et al., 2012) and the measure to have good reliability (Querstret & Cropley, 2012).

Personality. The personality dimensions of interest for the present study were assessed with the respective subscales from the short version of the well-established big-five inventory (Rammstedt & John, 2005). Participants were asked to identify on a 5-point scale ($0 = \text{very inapplicable}$, $4 = \text{very applicable}$) their own perceived characteristics regarding neuroticism ($\alpha = .85$, 5 items) and conscientiousness ($\alpha = .70$, 5 items). A sample item for conscientiousness would be "I work reliably and conscientiously" or "I am efficient and finish assignments very fast" and for neuroticism "I always worry much about something" or "I tend to get nervous and doubtful immediately".

Psychological health outcome. The psychological health outcome was operationalized as depression. This construct was assessed with the depression subscale from the German version of the Patient Health Questionnaire (PHQ-D, Löwe, Spitzer, Zipfel, & Herzog, 2002). The PHQ-D is a screening questionnaire for the diagnosis of mental syndromes. Gräfe and colleagues (Gräfe, Zipfel, Herzog, & Löwe, 2004) described a high validity for the PHQ-D. A good internal consistency was especially found for the subscale of depressive syndromes. Depressive syndromes were measured with 9 items. Participants reported how often they felt bothered in the past two weeks by the respective depressive symptoms; sample items are for example “Little interest or pleasure in doing things” or “Feeling tired or having little energy”. All items had a 4-point rating scale from 0 (= “not at all”) to 3 (= “nearly every day”). The manual of the PHQ-D contains an algorithm for the diagnosis of major depressive disorders but it can also be used continuously for assessing the severity of depressive symptoms.

Analytical Strategy

All statistical analyses were performed using SPSS 21.0. The moderated mediation analyses were performed using the SPSS Macro MODMED procedure outlined by Preacher, Rucker, and Hayes et al. (2007). The predictor variables were standardized prior to the analyses to reduce multicollinearity regarding the interaction term.

Results

Descriptive Statistics

Means, standard deviations, and intercorrelations among study variables are shown in Table 1. Scale reliabilities are placed on the diagonal. All correlations are in the expected direction. Specifically, the work stressors are positively correlated with the outcome measure. Neuroticism is also positively related with the psychological outcome measure, whereas conscientiousness does not show a significant correlation. Interestingly, affective rumination correlates on the outcome variable whereas there is no correlation between problem-solving pondering and depression at time 2.

Inferential Statistics

Following the procedure by Preacher et al. (2007) we conducted a moderated mediation analysis, where results are reported stepwise for each model path. Since all hypotheses were directional, we used one-tailed tests (Jones, 1952, 1954; Kimmel 1957). To control for the initial psychological health status we applied the diagnostic algorithm of the PHQ-D scale and exclude 13 students with a major depressive syndrome at baseline measurement, leaving 106 participants for the hypotheses tests. In addition, all analyzes include gender, age, and academic year as potential covariates on the variables of interest.

Hypothesis testing

In a first step, results are presented for the mediator variable model (see top of Table 2 and 3), where the mediator variable of the overall model (i.e. the respective rumination component) represents the dependent variable and the predictor, the moderator and their interaction the independent variables. Within the mediator variable model hypothesis 1 and 2 are tested. In a second step, the dependent variable model presents results for hypothesis 3a and b (see bottom of Table 2 and 3). The focus within this step is the impact of the mediator on the health outcome variable (controlling for the predictor and moderator variable from the first step).

Hypothesis 1:

Regarding hypothesis 1, the analysis revealed a significant and positive main effect of work stressors on both affective and problem-solving pondering which supports hypotheses 1a and 1b. The more individuals report experiencing work-related stressors the more they tend to report to affectively and cognitively ruminating about their work in their free time.

Hypothesis 2:

2a: The proposed interaction effect of hypothesis 2a was significant. Neuroticism moderates the stressor-affective rumination association (see Figure 2). Individuals high on neuroticism show a higher level of affective rumination irrespective of work-related stressors, whereas affective rumination is only elevated under high work stress for emotional stable individuals. In fact, simple slope analysis revealed that only the slope of low neuroticism is significantly different from zero ($p < .05$).

2b: Conscientiousness did not moderate the stressor- problem-solving pondering link so that hypothesis 2b is not supported.

As the second step of the moderated mediation approach by Preacher and colleagues (2007) we now come to the dependent variable model (see bottom of tables 2 and 3). In the dependent variable model depression is the outcome variable and the impact of the respective mediator is analysed (according to hypothesis 3) by controlling for all other model variables.

Hypothesis 3

3a: Results for hypothesis 3a revealed a positive relationship for affective rumination on depression. Individuals who report more affective rumination also tend to report more depressive symptoms after six months. Thus, hypothesis 3a was supported.

3b: There was no impact of problem-solving pondering on the outcome variable. Therefore, hypothesis 3b was not supported. Problem-solving pondering thus not increase the amount of depression.

Finally, hypothesis 4 examines the conditional indirect effect of the present model. Since neither conscientiousness functioned as a moderator nor problem-solving pondering as a mediator, we only examined the overall effect for the model of affective rumination as the mediating variable. To examine the significance of the conditional indirect effect we report the magnitude of the indirect effect at specific levels of the moderator variable (at the mean value of the moderator, as well as at one standard deviation above and below the mean). The information on the test of the indirect effect is presented in Table 4. In addition, we employed bootstrapping techniques provided by the SPSS MACRO to report on the respective confidence intervals (see last two columns of Table 4).

Hypothesis 4:

As can be seen from Table 4 the mediation is only significant at low levels of the moderator (i.e. neuroticism). That is, the moderation exerts a significant mediation effect on depressive symptoms for individuals high in emotional stability. The conditional indirect effect is not significant at high levels of neuroticism.

Overall, results provide partial support for the moderated mediation model presented in Figure 1 for neuroticism and affective rumination. The impact of work stressors on depression was mediated by affective rumination for lower levels of neuroticism.

Discussion

The purpose of the present study was to investigate the long-term psychological health impact of work stressors in dental students on depressive symptoms through two distinct forms of work-related rumination (affective rumination and problem-solving pondering). Thereby, relevant individual personality characteristics – specifically neuroticism and conscientiousness – have been integrated in the analyses by functioning as a moderator between the work stressor and respective ruminative states investigating conditional indirect effects.

Our results revealed that work stressors in dental students were clearly associated with ruminative thinking both affectively (emotionally laden) and cognitively (problem-oriented). Both ruminative states can be described as two different coping reactions an individual initiates in response to work-related demands. This is in line with past recovery research that reported reduced psychological detachment from work, when work demands are high (e.g., Cropley, et al., 2006; Geurts & Sonnentag, 2006).

However, only affective rumination had a detrimental effect on the psychological health outcome variable of depression. Ruminating affectively about work-related issues – which implies the activation of emotions in ones thinking – has the potential to lead to poor psychological health outcomes after a time period of six months. Instead, depressive symptoms seem to be unaffected by problem-solving pondering, which per definition does not involve strong emotions in ones thoughts (Cropley & Zijlstra 2011).

This finding is also in line with past research that has found more detrimental health effects for emotionally laden repetitive thoughts rather than for problem-solving pondering (e.g. Querstret & Cropley, 2012). Repetitive thoughts related to problem-solving may very well momentarily elevate arousal and therefore is likely to impede recovery. However, this may also be a general sign of increased workload as can be seen due to the positive association of work stressors and problem-solving pondering in the present study. Researchers have theorized that problem-solving pondering

may be an adaptive coping style (cf. Segerstrom et al., 2003, Watkins, 2008), and this style of thinking may actually facilitate psychological detachment and relaxation following the successful solution to a work-related problem. Problem-solving pondering therefore might not generally be detrimental to psychological well-being and recovery.

Considering the role of personality characteristics, the present study revealed a moderation effect of work stressors as the environmental component and neuroticism as the individual component on affective rumination. Whereas affective rumination is only elevated for participants with emotional stability under high work stress conditions, participants high in neuroticism reported high levels of affective rumination irrespective of the environmental surrounding. The personality characteristic may predispose an individual to exert strong emotional repetitive thoughts even under low stressor levels. This is in line with the assumption that neurotic individuals generally perceive their environment as more stressful and threatening (Widiger et al., 1984). In combination with the lack of emotional regulation, individuals high on neuroticism tend to also report high levels of affective rumination, resulting in increasing symptoms of depression in the long-term. In comparison, conscientiousness did not moderate the relationship between work stressors and problem-solving pondering. Consistent with previous work, there was a significant positive correlation between both variables (e.g., MacDonald, 2008) although no moderation effect occurred with work stressors in the present study.

Limitations

Although the study revealed some novels, there are limitations that need to be addressed and considered when interpreting the results. Participants in the present study are derived from a student sample with an age range of 19 to 35 years. The generalizability of the findings with regard to older adults and other occupational settings is therefore restricted. For example, past research has found differential effects for ruminative thinking in different occupational groups (i.e., white and blue collar workers; Pravettoni et al., 2007) so that future research should extend the application of the

presented model to broader occupational settings. In addition, the research involved students from one local university, therefore it is not known whether the findings would generalize to other student samples. However, when comparing our reported stressor values with students attending different universities, we were able to find compatible levels (e.g., Gorter, Freeman, Hammen, Murtomaa, Blinkhorn, & Humphris, 2008; Murphy, Gray, Sterling, Reeves, & DuCette, 2008) so that we feel confident that the environmental factors were representative for the respective sample.

Due to the relatively small sample size ($N = 106$) results are presented using tests for conditional indirect effects based on regression equations. It would have been favorable to run the analyses by applying structural equation modeling (SEM) techniques, which use latent variables corrected for the unreliability of the measures (Preacher & Hayes, 2004). However, the requested sample size for SEM lies over 250 cases (Hu & Bentler, 1998).

Furthermore, all presented data relies on self-report measures, so a common method bias can not be excluded (Sudman, Bradburn, & Schwarz, 1996; Tourangeau, Rips, & Rasinski, 2000). However, due to the follow-up assessment of the participants after six months a potential bias can be restricted. Additionally, past research has shown that self-report data does not necessarily lead to significant interaction effects (Jex & Bliese, 1999).

Future directions and implications

From a theoretical perspective, the present study has supported and extended past research on work-related recovery. First, the present study extended past research by simultaneously considering environmental and individual characteristics in the process of rumination and recovery. The impact of work-related stressors on depression was mediated by affective rumination for individuals low in neuroticism. When looking at the overall model for neuroticism and affective rumination within the present sample, one major implication would be to offer more stress intervention classes from the beginning at the first year of university.

Second, the present study provided further evidence that affective rumination functions as a mediator in the path from work-related stressors to depressive symptoms. By thinking about work-related stressors during non-work time, we limit our time for recovery as psychological detachment is very important for complete recovery. Future research is needed to replicate the mediation model within a larger sample from different occupational settings to determine whether the present findings are a function of the special occupational environment under study or generalize across occupational groups. This generalizability is particularly important for understanding the degree to which problem-solving pondering does in fact mediate the relationship between work stressors and depressive symptoms.

Third, the different types of ruminative states have thereby differential effects on depressive symptoms. The emotionally laden affective ruminative state is particularly detrimental to depressive symptoms, whereas problem-solving pondering does not appear to be associated with the occurrence of depressive symptoms. One option for future research is to include positive work-related antecedents and positive outcomes for well-being to disentangle alternative effects of problem-solving pondering (e.g., work engagement, life satisfaction, or measures of recovery).

Medical students in general and dental students in particular (Alzahem et al. 2011, Polychronopoulou & Divari, 2009) are known to suffer from increased work demands and psychological strain. It has been demonstrated that high levels of stress leading to depression may already be present in dental students and hence may predispose them to professional burnout as employers. Dental student's stress has been associated with serious psychological health impairments like emotional exhaustion, anxiety or depression (Stewart, de Vries, Singer, Degen, & Wener, 2006). In addition, dental education has been linked to negative health behaviors such as alcohol abuse, drug consumption and also thoughts of suicide (e.g., Newbury-Birch, Lowry, & Kamaly, 2002). Past research has found some evidence for linking stress in medical students and future risk for depression (see Meta-Analysis by Dyrbye, Thomas, & Shanafelt, 2006) and also a

general effect for the profession of dentistry has been discussed (Drummond, 1997). One potential approach described in the literature would be to decrease stressors on the one hand for instance by lowering the density of learning matters, smaller group assignments, student-centered methodologies, reduction of educational costs, and on the other hand by increasing resources, for example by individual counseling on how to cope with stress or giving more time to recover (Polychronopoulou & Divari, 2009, Iwasaki, 2003, O'Driscoll & Cooper, 1996, Murphy et al., 2009). On the other hand, as it seems unrealistic to reduce the content of dental curricula, faculty members may rethink the way they are designed.

Personality characteristics are stable but nevertheless a twin study conducted by Maas and Spinath (2012) was able to conclude that coping with professional demands was largely independent from personality effects. Maas and Spinath conclude that interventions aiming at improving individual coping styles should not need specific consideration of personality characteristics. Therefore, as Kay and Lowe (2008) suggest, dental faculties should implement stress management courses for their students, to improve individual competencies in dealing with external demands. Successful stress intervention before graduation are considered a relevant preventive measure for stress after graduation and in the long run may decrease early retirement and drop-out of work in dentistry (Alzahem et al., 2011).

In summary: The present findings showed that neuroticism not conscientiousness, moderated the demand-affective rumination association, and affective rumination mediates the impact of work demands on psychological health but only for individuals low in neuroticism. The present findings also highlight the need to introduce stress management interventions early on in dental training in order to prevent long-term psychological health issues.

References

- Adler, N., & Matthews, K. (1994). Health psychology: Why do some people get sick and some stay well? *Annual Review of Psychology*, 45, 229-259.
- Alzahem, A. M., van der Molen, H. T., Alaujan, A. H., Schmidt, H. G., & Zamakhshary, M. H. (2011). Stress amongst dental students: a systematic review. *European Journal of Dental Education*, 15, 8-18.
- Barnhofer, T., & Chittka, T. (2010). Cognitive reactivity mediates the relationship between neuroticism and depression. *Behaviour Research and Therapy*, 48, 275-281.
- Bowling, N. A. & Eschleman, K. J. (2010). Employee personality as a moderator of the relationship between work stressors and counterproductive work behavior. *Journal of Occupational Health Psychology*, 15, 91-103.
- Brosschot, J. F., Gerin, W., & Thayer, J. F. (2006). The Perseverative Cognition Hypothesis: A Review of Worry, Prolonged Stress-Related Physiological Activation and Health. *Journal of Psychosomatic Research*, 60, 113-124.
- Costa, P. T., Jr., & McCrae, R. R. (1980). Influence of extraversion and neuroticism on subjective well-being: Happy and unhappy people. *Journal of Personality and Social Psychology*, 38, 668-678.
- Crawford, T. N., Shaver, P. R., & Goldsmith, H. H. (2007). How affect regulation moderates the association between anxious attachment and neuroticism. *Attachment & Human Development*, 9, 95 - 109.
- Cropley, M., Dijk, D.-J., & Stanley, N. (2006). Job strain, work rumination and sleep in school Teachers. *European Journal of Work and Organizational Psychology*, 15, 181-196.

- Cropley, M., Michalianou, G. Pravettoni, G., & Millward, L. (2012). The relation of post work ruminative thinking with eating behaviour. *Stress and Health*, 28, 23-30.
- Cropley, M. & Zijlstra, F. R. H. (2011). Work and Rumination. In J. Langan-Fox, & C. L. Cooper, (Eds). *Handbook of Stress in the Occupations*. Edward Elgar Publishing Ltd., U.K.
- Dahan, H., & Bedos, C. (2010). A Typology of Dental Students According to Their Experience of Stress: A Qualitative Study. *Journal of Dental Education*, 74, 95-103.
- Drummond, J. R., & Duguid, R. (1997). Student drop-out from UK dental schools. *British Dental Journal*, 182, 347-349.
- Dyrbye, L. N, Thomas, M. R, & Shanafelt, T. D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Academic Medicine*; 81, 354-73.
- Eysenck, H. J., & Eysenck, S. B. G. (1991). *Manual of the Eysenck Personality Scales (EPS Adult)*. London: Hodder and Stoughton.
- Garbee, W. H. Jr., Zucker, S. B., & Selby, G. R. (1980). Perceived sources of stress among dental students. *Journal of the American Dental Association*, 100, 853-857.
- Geurts, S. A. E., & Sonnentag, S. (2006). Recovery as an explanatory mechanism in the relation between acute stress reactions and chronic health impairment. *Scandinavian Journal of Work, Environment & Health*, 32, 483-492.
- Gräfe, K., Zipfel, S., Herzog, W., Löwe, B., 2004. Screening psychischer Störungen mit dem „Gesundheitsfragebogen für Patienten (PHQ-D)“ – Ergebnisse der deutschen Validierungsstudie [Screening for psychological disorders with the patient health questionnaire (PHQ-D)“ – Results from a German validation study]. *Diagnostica*, 50, 171-181.
- Gorter, R., Freeman, R., Hammen, S., Murtomaa, H., Blinkhorn, A., & Humphris, G. (2008). Psychological stress and health in undergraduate dental students: fifth year outcomes

- compared with first year baseline results from five European dental schools. *European Journal of Dental Education*, 12, 61-68.
- Gross, J., Sutton, S., & Ketelaar, T. (1998). Relations between affect and personality: Support for the affect-level and affective-reactivity views. *Personality and Social Psychology Bulletin*, 24, 279–288.
- Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, 3, 424-453.
- Iwasaki, Y. (2003). Roles of leisure in coping with stress among university students: A repeated-assessment field study. *Anxiety, Stress, and Coping*, 16, 31-57.
- Jex, S. M., & Bliese, P. D. (1999). Efficacy beliefs as the moderator of the impact of work-related stressors: A multilevel study. *Journal of Applied Psychology*, 84, 349-361.
- John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (2nd ed., pp. 102–138). New York: Guilford Press.
- Jones, L. V. (1952). Tests of hypotheses: One-sided vs. two-sided alternatives. *Psychological Bulletin*, 49, 43–46.
- Jones, L. V. (1954). A rejoinder on one-tailed tests. *Psychological Bulletin*, 51, 585–586.
- Kay, E. J., & Lowe, J. C. (2008). A survey of stress levels, self-perceived health and health-related behaviours of UK dental practitioners in 2005. *British Dental Journal*, 204, E 19.
- Kimmel, H. D. (1957). Three criteria for the use of one-tailed tests. *Psychological Bulletin*, 54, 351–353.
- Kompier, M. (2002). The psychosocial work environment and health – what do we know and where should we go? *Scandinavian Journal of Work Environment & Health*, 28, 1-4.

- Kompier, M. A. J., Taris, T. W., & van Veldhoven, M. (2012). Tossing and turning – insomnia in relation to occupational stress, rumination, fatigue, and well-being. *Scandinavian Journal of Work, Environment & Health*, 38, 238-246.
- Kotov, R., Gamez, W., Schmidt, F., & Watson, D. (2010). Linking „Big“ personality traits to anxiety, depressive, and substance use disorders: A meta-analysis. *Psychological Bulletin*, 136, 768-821.
- Lang, J., & Kraus, T. (2012). Emotional vs. cognitive rumination: Are they differentially associated with physical and psychological health? *Proceedings of the 10th conference of the European Academy of Occupational Health Psychology*.
- Löwe, B., Spitzer, R.L., Zipfel, S., Herzog, W., 2002. PHQ-D – *Gesundheitsfragebogen für Patienten, Manual – Komplettversion und Kurzform – Autorisierte deutsche Version des „Prime MD Patient Health Questionnaire (PHQ)“*, [Patient Health Questionnaire, Manual – Full and short Version – authorized German Version of the Prime MD Patient Health Questionnaire (PHQ)]. Heidelberg: Pfizer.
- Lyubomirsky, S., Caldwell, N. D., & Nolen-Hoeksema, S. (1998). Effects of Ruminative and Distracting Responses to Depressed Mood on Retrieval of Autobiographical Memories. *Journal of Personality and Social Psychology*, 75, 166–177.
- Maas, H. & Spinath, F. M. (2012). Personality and coping with professional demands: a behavioral genetics analysis. *Journal of Occupational Health Psychology*, 17, 376-385.
- MacDonald, K. B. (2008). Effortful control, explicit processing, and the regulation of human evolved predispositions. *Psychological Review*; 115, 1012-1031.
- Mc Ewen, B. S. (1998). Protective and damaging effects of stress mediators. *The New England Journal of Medicine*; 338, 171-179.

- Meijman, T. F., & Mulder, G. (1998). Psychological aspects of workload. In P. J. D. Drenth & H. Thierry (Eds.), *Handbook of work and organizational psychology: Vol. 2. Work psychology* (pp. 5–33). Hove, England: Psychology Press.
- Mellings, T. M. B., & Alden, L. E. (2000). Cognitive processes in social anxiety: the effects of self-focus, rumination and anticipatory processing. *Behaviour Research and Therapy*; 38, 243–257.
- Murphy, R. J., Gray, S. A., Sterling, G., Reeves, K., DuCette, J. (2008). A comparative study of professional student stress. *Journal of Dental Education*, 73, 328–337.
- Newbury-Birch, D., Lowry, R. J., Kamali, F. (2002). The changing patterns of drinking, illicit drug use, stress, anxiety and depression in dental students in a UK dental school: a longitudinal study. *British Dental Journal*. 192, 646–649.
- Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology*, 109, 504–511.
- Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky (2008). Rethinking Rumination. *Perspective on Psychological Science*, 3, 400–424.
- O’Driscoll, M. P., & Cooper, C. L. (1996). A critical incident analysis of stress-coping behaviours at work. *Stress Medicine*, 12, 123–128.
- Pravettoni, G., Crompton, M., Leotta, S. N., & Bagnara, S. (2007). The Differential Role of Mental rumination among Industrial and Knowledge Workers. *Ergonomics*, 50, 1931–1940.
- Preacher, K. & Hayes, A. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Psychonomic Society*, 717–731
- Polychronopoulou, A., & Divaris, K. (2009). Dental students’ perceived sources of stress: a multi-country study. *Journal of Dental Education*, 73, 631–639.

- Querstret, D. & Cropley, M. (2012). Exploring the relationship between work-related rumination, sleep quality and work-related fatigue. *Journal of Occupational Health Psychology*, 17, 341-353.
- Rammstedt, B., & John, O. P. (2005). Kurzversion des Big Five Inventory (BFI-K): Entwicklung und Validierung eines ökonomischen Inventars zur Erfassung der fünf Faktoren der Persönlichkeit, [Short version of the Big Five Inventory (BFI-K): Development and validation of economic inventory for the assessment of the big five personality factors]. *Diagnostica*, 51, 195-206.
- Segerstrom, S. C., Stanton, A. L., Alden, L. E., & Shortridge, B. E. (2003). A multidimensional structure for repetitive thought: What's on your mind, and how, and how much? *Journal of Personality and Social Psychology*, 85, 909-921.
- Sonnentag, S., & Fritz, C. (2007). The recovery experience questionnaire: Development and validation of a measure for assessing recuperation and unwinding from work. *Journal of Occupational Health Psychology*, 12, 204-221.
- Stewart, D.W., de Vries, J., Singer, D. L., Degen, G. G., & Wener, P. (2006). Canadian dental students' perceptions of their learning environment and psychological functioning over time. *Journal of Dental Education*, 70, 972-981.
- Sudman, S., Bradburn, N. M., & Schwarz, N. (1996). *Thinking about answers: The application of cognitive processes to survey methodology*. San Francisco: Jossey-Bass.
- Tourangeau, R., Rips, L. J., & Rasinski, K. (2000). *The psychology of survey response*. New York: Cambridge University Press.
- Watkins, E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin*, 134, 163-206.
- Widiger, T. A., Hurt, S. W., & Frances, A. (1984). Diagnostic efficiency and DSM-III. *Archives of General Psychiatry*, 41, 1005-1012.

Zawadzki, M., Graham, J. E., & Gerin, W. (2013). Rumination and anxiety mediate the effect of loneliness on depressed mood and sleep quality in college students. *Health Psychology, 32*, 212-222.

Table 1

Mean, Standard Deviations, and Correlations of Study Variables

Variable		Mean	SD	1	2	3	4	5	6
1	Stressors	2.69	0.56	(.72)					
2	Neuroticism	2.08	0.95	.38**	(.85)				
3	Conscientiousness	2.70	0.72	.04	.17	(.72)			
4	Affective Rumination	2.91	0.83	.56**	.42**	-.02	(.86)		
5	Problem-solving pondering	3.37	0.67	.41**	.30**	.28**	.44**	(.73)	
6	Depression t2	0.96	0.57	.42**	.38**	-.05	.41**	.17	(.86)

Note. $p^* < .05$, $p^{**} < .01$ for two-sided tests. Cronbach's α reliabilities are placed on the diagonal in parentheses.

Table 2

Regression Results for Estimated Coefficients of the Moderated Mediation Model: Affective Rumination and Neuroticism

Predictor	B	SE	Effect size (Cohen's f ²)
Mediator variable model: Affective Rumination			
Constant	3.73***	0.63	
Age	-0.54*	0.28	
Gender	0.04	0.15	
Semester	0.09***	0.03	
Work Stressors	0.31***	0.08	
Neuroticism (Nc)	0.22***	0.07	
Interaction (Work Stressor*Nc)	-0.14*	0.08	.02
Model R ² (ΔR^2 interaction term)	.42**	.02*	
Dependent Variable Model: Depression t2			
Constant	0.01	0.59	
Age	0.03	0.02	
Gender	0.10	0.12	
Semester	-0.03	0.02	
Affective Rumination	0.16*	0.08	
Work Stressors	0.14*	0.07	
Neuroticism	0.11*	0.06	
Interaction	0.03	0.06	
Model R ²	.22*		

Note. f² = .02 small; f² = .15 moderate; f² = .35 large * $p < .05$ one-sided; ** $p < .01$ one-sided; *** $p < .001$ one-sided.

Table 3

Regression Results for Estimated Coefficients of the Moderated Mediation Model on Depression: Conscientiousness (Moderator) & Problem-solving pondering (Mediator)

Predictor	B	SE	Effect size (Cohen's f ²)
Mediator variable model: Problem-solving pondering			
Constant	2.75****	0.58	
Age	0.01	0.03	
Gender	0.29*	0.13	
Semester	0.02	0.03	
Work Stressors	0.22****	0.06	
Conscientiousness (C)	0.18****	0.06	
Interaction (Stressors*C)	0.08	0.06	.01
Model R ² (ΔR^2 interaction term)	.25**	(.01)	
Dependent Variable Model: Depression t2			
Constant	0.70	0.58	
Age	0.01	0.02	
Gender	0.19	0.12	
Semester	-0.02	0.02	
Problem-solving pondering	-0.02	0.09	
Work Stressors	0.24****	0.06	
Conscientiousness	-0.04	0.06	
Interaction	0.02	0.06	
Model R ²	.15*		

Note. $f^2 = .02$ small; $f^2 = .15$ moderate; $f^2 = .35$ large * $p < .05$ one-sided; ** $p < .01$ one-sided; *** $p < .001$ one-sided.

Rumination and Personality

Table 4

Bootstrapping Results for Test of Conditional Indirect Effects at Specific Values of the Moderator Neuroticism

Dependent Variable	Value of Neuroticism	Conditional indirect effect	SE	95% CI	
				Lower	Upper
Depression	-1SD "low Nz"	,07	,04	,01	,17*
	Mean	,05	,03	,01	,12*
	+1SD "high Nz"	,03	,03	-,01	,12 (n.s.)

*Note. Results are based on 5,000 bootstrap samples. Conditional indirect effects tests are one-tailed. Nz = Neuroticism, CI = Confidence Interval; * $p < ,05$.*

Figure Captions

Figure 1. Moderated Mediation Model of work stressors and psychological health outcomes, considering neuroticism as the moderator and affective rumination as the mediator.

Figure 2. Moderating effect of neuroticism on the relationship between work stressors and affective rumination.

Rumination and Personality

Figure 1

Figure 2.