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Reinforcement Sensitivity Theory at Work: Punishment Sensitivity as a Dispositional Source of Job-related Stress

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Abstract

Gray's reinforcement sensitivity theory (RST) describes two important personality constructs; sensitivity to reward and sensitivity to punishment. In two studies, we examine whether these constructs can be considered dispositions to work stress. Results of Study 1 ($N = 105$ employees in different occupations) indicated that employees with strong punishment sensitivity reacted more strongly to work stressors than others. This idea was confirmed in a longitudinal design in Study 2. Reward sensitivity was unrelated to stress in both studies. Overall, results strongly support the idea that punishment sensitivity is a dispositional source of work stress. Results further confirm that RST and its derived personality measures can contribute to theorizing about personality–environment interactions in a highly relevant daily setting, namely the working environment. Copyright © 2007 John Wiley & Sons, Ltd.

Key words: sensitivity for reward and punishment; stress reaction; work characteristics; personality; person–environment interaction; neuroticism and extraversion

INTRODUCTION

It is well-known that working under unfavourable conditions may negatively affect employees' physical and psychological well-being. The working conditions involved are diverse and include aspects such as the level of demands, control, or the balance between effort and reward (Karasek & Theorell, 1990). Yet, apart from such conditions, it is also widely assumed that personality can play a role in the way someone reacts to the environment (Bolger, DeLongis, Kessler, & Schilling, 1989; Judge, Bono, & Locke, 2000; Semmer, 2003). One area in which such person–environment interactions become apparent is in research on (work) stress. For example, when job demands are chronically high, many

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people react with an increase in stress symptoms (de Lange, Taris, Kompier, Houtman, & Bongers, 2002). Still, some people seem to have a disposition to react more strongly than others (e.g. display even more stress symptoms) in a similar situation (Gable, Reis, & Elliot, 2000). Such individual differences are relevant for occupational health research because they may explain why some employees develop stress-related diseases whereas others do not.

In personality literature, there has been considerable interest in dispositions to stress. The famous Big Five model of personality (Costa & McCrae, 1992; Digman, 1990), Eysenck's Psychoticism-Extraversion-Neuroticism (PEN) model (Eysenck, 1967) and Negative and positive affectivity (Tellegen, 1985) have all guided much research in this area, with special emphasis on neuroticism as a trait that is particularly related to stress. For example, Bolger and Schilling (1991) used day-to-day assessments (diaries) to show that high-neuroticism individuals tend to encounter more stressful situations but also react more strongly than others to potential stressors. Similarly, Clark and Watson (1988) showed that trait negative affectivity (which overlaps with neuroticism) is related to daily levels of stress and stressor reactivity. Other personality constructs show less consistent results with regard to stress, although extraversion has sometimes also been found to be associated with lower probability of developing stress-related disorders such as burnout (de Vries and van Heck, 2002; Langelaan, Bakker, van Doornen, & Schaufeli, 2006) Overall, many studies support the notion that certain aspects of personality can affect average stress levels.

The two studies presented in this article contribute to this area by examining dispositions to stress from the perspective of Gray's (1990, 1991) reinforcement sensitivity theory (RST) of personality. Moreover, we do so in the context of a specific and relevant environment, namely occupational settings. RST describes how individuals differ in their reactions to rewarding or punishing stimuli (Corr, 2004). These reactions play an essential role in behaviour and mood regulation. Therefore, RST is presumed to explain at least some of the individual differences in personality. An ongoing discussion involves the position of Gray's RST relative to other personality models (Carver, Sutton, & Scheier, 2000). For example, responsiveness to punishing stimuli more than slightly resembles neuroticism as described in the Big Five or in Eysenk's model (Corr, 2004; Elliot & Thrash, 2002; for details, see Study 1 for details). In addition, responsiveness to reward has much in common with constructs such as described by Depue and colleagues (Depue & Collins, 1999), or Cloninger et al. (1993). Thorough discussions about RST as compared to other personality models can be found in literature (Carver et al., 2000; Corr, 2004; Depue & Collins, 1999; Jackson & Smillie, 2004; Smits & Boeck, 2006). However, one general claim regarding the advantage of RST is that it explains individual differences at different levels of analyses, for example, in terms of its biological underpinnings, its motivational and behavioural manifestations, and its subjective components (mood). Nevertheless, it has to be noted that RST is not unique in this approach (e.g. see Eysencks PEN-model or Cloninger's model).

Despite such discussions about the position of RST in personality theory, the fact is that RST has begun to play an important role in personality research, which becomes apparent in the rising number of publications on this topic. The theory has its own set of assumptions, which have led to purpose-built personality measures (Carver & White, 1994; Smillie & Jackson, 2005). The usefulness and validity of these specific measures have been examined in laboratory studies and in applied areas ranging from addiction (Franken, 2002) to psychopathology (Kasch, Rottenberg, Arnow, & Gotlib, 2002). However, to our knowledge, the theory has only been scarcely applied in addressing work-related issues.

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We believe that doing so could constitute an important step forward in linking occupational health research with recent insights into personality. Therefore, this article presents two studies that show how reward and punishment sensitivity, as basic constructs in RST, can be applied in studying individual differences in the vulnerability to (work) stress. Below we first describe some basic assumptions of RST.

Basic aspects of RST

Most generally, personality can be described as the propensity to show a specific pattern of behaviour or mood across different situations. In RST, *reward and punishment sensitivity* are presumed to be strongly involved in the regulation of behaviour and mood, and in this way they may underlie differences in personality (Gray, 1991; McNaughton & Corr, 2004).

Being *sensitive for reward* implies that one's learning, mood and behaviour are strongly reinforced by positive incentives (e.g. access to resources, job promotion, an attractive mate, or tasty food). Consequently, reward-sensitive individuals tend to engage relatively often in activities they enjoy and to put much effort into gaining positive outcomes of their behaviour, such as winning a game (Smillie & Jackson, 2005; Stewart, 1996). Gray (1991) argued that this drive to obtain rewards is accompanied with mood states that support reward-seeking behaviour. These mood states include hope, elation and happiness, which can be described as positive mood states. Anger, which is not usually referred to as a positive mood state, has also been linked to reward sensitivity (Carver, 2004). However, the aforementioned mood states have in common that they all prompt (or perhaps coincide with) increased energy and persistence in pursuing potentially rewarding goals. The relevance of reward sensitivity for behaviour and mood has been shown in different areas. For example, Jackson (2001) and Stewart (1996) showed reward-sensitive employees to be more responsive than others to monetary incentives at work. Further, Franken (2002) showed that such individuals have a higher probability of becoming addicted.

As RST originates from biological research, reward sensitivity is presumed to be strongly related to activity of an underlying biological system, referred to as the behavioral activation system (BAS). In his research, Gray did not fully specify this system. Yet, it is now generally acknowledged that dopaminergic pathways in the brain (e.g. mesolimbic pathways) play a major role (Gray, 1991). The proposed pathways strongly resemble the ones described by Depue and colleagues (Depue, 1995; Depue & Collins, 1999; Depue, Luciana, Arbisi, Collins & Leon, 1994), who also emphasized the role of reward responsiveness in personality. Basically, an individual is considered to be responsive to reward when his or hers BAS is highly active. Moreover, level of BAS sensitivity is presumed to be largely stable over an individual's life span and is therefore deemed to reflect a trait or disposition (Gray, 1991).

Sensitivity to punishment implies that an individual is strongly responsive to potentially threatening situations or to negative outcomes of actions (e.g. social disapproval or conflict). Consequently, individuals with a strong punishment sensitivity often tend to let their actions be guided by the prevention of negative outcomes instead of by gaining something positive (McNaughton & Corr, 2004). The mood states that accompany punishment sensitivity are anxiety, worry and rumination (Gray, 1991). These mood states support behaviour, typically associated with punishment sensitivity, which includes a tendency to withdraw or otherwise approach in a cautious way. In RST, punishment sensitivity is assumed to be the psychological manifestation of activity in the underlying behavioural inhibition system (BIS) which comprises the septo-hippocampal system and

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the brain stem (Gray, 1990; McNaughton & Corr, 2004). Connections between the psychological construct 'punishment sensitivity' and the biological BIS are quite complex; in a revised version of RST, a third biological system, namely the Fight-Flight-Freeze system, is also ascribed a role (McNaughton & Corr, 2004). It is beyond the scope of the current study to discuss these issues in detail but Corr (2004) and McNaughton and Corr (2004) published excellent reviews on this topic. Here it suffices to state that punishment sensitivity is largely subserved by responsiveness of the BIS, which, again, is considered to be relatively stable over the life span. Therefore, the associated punishment sensitivity may be described as a disposition to react with high levels of anxiety when facing potential threats (Gray, 1990, 1991).

RST and stress

The dispositional nature of reward and punishment sensitivity partly determines individual differences in personality because it affects momentary behaviour and mood states. Specifically, daily life contains many events that are potentially rewarding or threatening, and sometimes both. These events range from small issues such as receiving a small gift (rewarding) or becoming involved in a minor disagreement with a colleague (threatening), to rare and major events such as gaining access to a highly desirable goal (e.g. an attractive mate) or loosing one's job or being in a life-threatening situation. The different types of sensitivity might influence how one reacts to such events. This has been considered as one of the reasons why, in everyday life, reward and punishment sensitivities are associated with average daily mood states. For instance, Gable et al., (2000) showed that reward sensitivity affected the average daily level of positive mood states, whereas punishment sensitivity affected average daily negative mood states. For the current study, the relevant question is whether similar associations exist with regard to work stress and reactions to working conditions.

Stress can be defined as a specific and multi-facetted state following exposure to stressors (objective or perceived threats) and including both psychological and physiological symptoms (McEwen, 1998). The subjective symptoms typically include, feelings of arousal, tension and anxiety (Levenstein et al., 1993). In the current study, we examine personality-stress relationships in terms of such subjective symptoms.

Due to their anxiety-proneness, particularly punishment-sensitive individuals might posses a disposition to experience stress in at least two ways, first they might, more than others, perceive events as potential threatening and stressful; and second they might react more strongly to potential threats (e.g. by displaying more stress symptoms). In the latter case, this would imply that punishment sensitivity interacts with the environment in explaining levels of stress. Specifically, in high-stressor circumstances the relationship between punishment sensitivity and subjective stress symptoms may be stronger than in low-stressor circumstances.

Several studies supported a punishment sensitivity-stress link. For example, Heponiemi, Keltikangas-Jarvinen, Puttonen, and Ravaja (2003) and Heponiemi, Keltikangas-Jarvinen, Kettunen, Puttonen, and Ravaja (2004) found BIS-sensitive individuals (which marks punishment sensitivity) to report higher levels of baseline stress but also to react more strongly than others to a stressful laboratory tasks. Carver and White (1994) reported punishment sensitivity (also assessed with BIS-measures) to predict nervousness when participants were told they would be exposed to a cold-pressor procedure (i.e. placing the hand into ice water).

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The relationship between reward sensitivity and stress is less clear. Reward-sensitive individuals tend to experience more daily positive affect (Gable et al., 2000). But as positive and negative mood states are considered to be relatively independent (Watson, Clark, & Tellegen, 1988), this does not necessarily mean that they also experience lower levels of stress. In fact, several studies have indicated that daily stressors mainly affect negative mood states but have much less effect on positive mood states (Clark & Watson, 1988). In accordance with these notions, the limited number of studies that explicitly looked at reward sensitivity and stress often reported that the two were unrelated. Nevertheless, additional studies on this topic might be useful as the issue has not yet been settled. For example, van der Linden Taris, Beckers, and Kindt (2007) found that reward sensitivity was related to work stress when working conditions were not adverse (see also description below). Therefore, in the current two studies, we also examine relationships between reward sensitivity and work stress under different working conditions.

Reward and punishment sensitivity as dispositions to work stress

Much previous research on RST and stress reactivity was conducted in the laboratory. This has not withheld Gray and others from arguing that the influence of RST-sensitivities would become particularly apparent in important (ego-involving) real-life situations (Corr, 2004; Gray, 1991). Corr (2004) argued that '. . . it is perhaps to be regretted that so few studies have looked at such real-life reactions to reinforcement as function of personality' (p. 322). Even fewer studies have been conducted involving occupational settings, although such settings can be expected to be highly important for a person's well-being. To our knowledge, the first studies that applied RST in occupational settings were conducted by Stewart (1996) and Jackson (2001). Both looked at the relationship between reward sensitivity on the one hand, and work motivation and satisfaction on the other, but they did not describe relationships with (work) stress. A study that *did* explicitly apply RST in studying stress-dispositions at work was reported by van der Linden et al. (2007), who found punishment sensitivity to interact with working conditions: Compared to others, punishment-sensitive individuals reported higher levels of stress when working conditions were unfavourable. This result parallels findings from earlier laboratory studies, showing that punishment-sensitive individuals react strongly to stressors.

For reward sensitivity, it was found that under relatively stable or favourable working conditions, reward-sensitive individuals reported less stress than individuals with low reward sensitivity. However, under unfavourable working conditions this difference no longer reached significance, suggesting that reward sensitivity particularly relates to stress levels when the environment does not contain too many or too prevalent stressors.

The van der Linden et al. (2007) study provided preliminary evidence for the usefulness of RST in examining stress dispositions at work. However, the study also contained some important limitations. First, it employed purpose-built measures (questionnaires) of reward and punishment sensitivity. It is generally acknowledged that such personality measures partly overlap with measures of extraversion and neuroticism (Elliot & Thrash, 2002; Gable et al., 2000). Thus, it is still unclear whether RST and its associated measures contribute to knowledge, beyond what is already known about the relationship between (work) stress one the one hand, and extraversion and neuroticism on the other.

A second limitation was the cross-sectional nature of the study, which did not allow for direct assessment of causality. A third limitation was that the sample consisted of teachers only, meaning that it remains unclear whether the reported relationships between RST and

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work stress, generalize to other occupations. The two studies presented below were designed to extend previous findings on reward and punishment sensitivity in occupational settings by dealing with the limitations mentioned above.

Study 1: RST-based measures to assess stress dispositions, and their relationship to measures of extraversion and neuroticism

The general aim of Study 1 was to test the relationships between RST-based sensitivities and (work) stress, and to compare these relationships to those between extraversion-neuroticism on the one hand, and stress on the other. The latter comparison is relevant because, literature often discusses RST in relation to Eysenck's personality theory (PEN-model). More specifically, reward and punishment sensitivity have been argued to provide neuropsychologically valid underpinnings of extraversion and neuroticism, respectively (Corr, 2004; Gray, 1991; McNaughton & Corr, 2004). In one of his original papers, Gray (1970) suggested to rotate (with approximately 30°) the psychometric axes of Eysenck's constructs, in order to establish reward and punishment sensitivity, which, he presumed, would provide more causally plausible explanations for extraversion and neuroticism. For example, sensitivity for reward is presumed to be the reason why extraverts often seek the company of others—because for humans in general, social interactions can be among the most pleasurable, rewarding events—and why they often pursue 'fun-experiences'. Furthermore, punishment sensitivity is argued to be causal to the on average higher level of anxiety that is typical for neurotics. A thorough discussion of the specific differences between Gray's RST and Eysenck's theories can be found in, for instance, Corr (2004) or Gray (1981); both contrasts the neurobiological aspects of the two theories.

The conceptual overlap between Gray's constructs and extraversion and neuroticism is mirrored in the empirical overlap between the psychometric measures. For example, Jorm, Christensen, Henderson, Jacomb, Korten, and Rodgers (1999) and Smits and Boeck (2006) reported high correlations between punishment sensitivity and neuroticism ($r = 0.64$, and $r = 0.72$ [average over two samples], respectively). Further, Elliot and Thrash (2002) found measures of extraversion and reward sensitivity to load on a single factor, as did neuroticism and punishment sensitivity. In fact, previous RST studies sometimes used extraversion and neuroticism as proxy measures of the underlying sensitivities. However, several scholars argued that measures derived from other personality models might not be as good operationalizations of RST-based sensitivities as purpose-built measures. For example, Gable et al. (2000) argued that 'viewing neuroticism and extraversion as measures of Gray's BAS and BIS is inappropriate because although BIS and BAS appear to be related to extraversion and neuroticism, these traits are clearly not isomorphic'. Carver and White (1994) also adopted this line of reasoning and accordingly developed the BAS and BIS scales, which are now among the most widely used scales in RST research. The scales were developed as measures of the behavioural and mood manifestations of BAS and BIS activation. The questions in these scales directly assess how individuals react to, or anticipate potential rewards (BAS) or potential threats (BIS). The researchers stated that the items in these scales are, more than traditional measures of extraversion and neuroticism, in line with the reactive nature of reward and punishment sensitivity. In the current set of studies, we also use the BAS and BIS scales as measures of reward and punishment sensitivity, respectively.

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Several researchers emphasized the usefulness of comparing results from purpose-built measures of RST to traditional measures of extraversion and neuroticism (Corr, 2004; Jackson, 2001; Jackson & Smillie, 2004). For example, it was already established that neuroticism and stress are related. Thus, as neuroticism and punishment sensitivity overlap, an important question is whether using explicit measures of the latter construct contribute to knowledge, above and beyond existing measures of neuroticism. Similar questions can be raised regarding reward sensitivity and extraversion. One reason why it would be useful to compare different types of personality measures in this way is that RST-based measures have been claimed to provide improved assessment of personality–environment interactions. For example, Carver and White (1994) argued that items in the BAS and BIS scales directly tap reactions to environmental stimuli of different valence (rewarding vs. punishing).

Based on these arguments, Study 1 tests whether scores on the BAS and BIS scales (as measures of reward and punishment sensitivity) interact with working conditions in order to explain (work) stress. In addition, we compare the results based on these scales to those obtained with measures of extraversion and neuroticism. The question is whether the two sets of measures are identical or show differential results and whether the RST-based measures contribute to variance in stress, beyond the effects of the traditional personality measures.

In Study 1 (as in Study 2), we particularly look at the interplay between RST-sensitivities and reactions to stressors at work. Study 1 focuses on work demands as a potential stressor. Obviously, numerous other conditions can also play a role in work stress. However, demands can, irrespective of job content, be assessed in very general terms across many occupations (with self-reports questions such as 'how hard do you have to work'). Moreover, demands have been identified as a central characteristic in many theoretical models of occupational stress (de Lange et al., 2002; van der Doef & Maes, 1999). Against this background, we presume that exposure to high demands is a generally negative working condition that may differentially affect individuals high or low on reward and punishment sensitivity. In line with previous findings, we expect that particularly punishment sensitive individuals report much stress when demands are high. This also fits the notion that punishment-sensitive individuals show increased responsiveness to unfavourable or threatening situations. For reward sensitivity, expectations are less clear as the relationship with stress in previous studies was mixed. van der Linden et al. (2007) reported that reward sensitive individuals experienced less stress but only under moderate to low working demands and not when demands are high. Yet, there was no overall relationship between reward sensitivity and stress. In addition, several studies suggested that there is no relationship between reward sensitivity and stress (Carver & White, 1994; Gable et al., 2000; Heponiemi et al., 2003). Therefore, we do not further specify expectations regarding this type of sensitivity, but adopt a more exploratory approach instead.

STUDY 1

Method

Participants and procedure

The sample in this study consisted of 105 employees (51% males) working at different companies in the vicinity of Nijmegen, The Netherlands. To assure that participants

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differed widely in their occupation, we recruited employees from the research department's network of companies. Within these companies, participants were approached individually and were asked whether they would like to fill out a short questionnaire about their work and about 'how they felt'. With this procedure, we obtained a sample of people with occupations ranging from car mechanics, to sale-persons, to ICT workers. The mean age was 35.5 years (range 19–60 years).

Measures

Reward (*BAS*) *and punishment* (*BIS*) *sensitivity* were measured with the Dutch translation of Carver and White's (1994) BAS and BIS scales (Franken, Muris, & Rassin, 2005). Thirteen BAS items asked how responsive individuals are to potentially rewarding stimuli (e.g. 'I go out of my way to get the things I want', 'It would excite me to win a contest'). Some researchers have argued for the use of three BAS subscales, reflecting different aspects of responding to reward. However, the relevance and empirical evidence for the three subscales is not generally accepted and several researchers argued that overall BAS scores should be used instead (e.g. Quilty & Oakman, 2004). In addition, the notion of sub-classes of reward responsiveness is not in line with Gray's original dichotomy of sensitivities. For the present research, the general conceptualization of BAS was the most relevant as we wanted to look at the overall responsiveness to rewarding stimuli (both in behaviour and mood). Therefore, in line with many other studies, we decided to use the overall BAS score. To examine whether use of the single BAS scale was warranted, we conducted a second-order principal component analysis on four scales (the three BAS subscales and the BIS scales) with varimax rotation and an eigenvalue >1.00 as a threshold. This analysis resulted in two factors, one which included the BIS scale, and the other including the three BAS-scales. This suggests that, in this sample, the three BAS-scales seem to measure the same underlying construct. The overall BAS-scale had a high reliability (alpha $= 0.78$).

Punishment sensitivity was measured with seven BIS items, which explicitly ask how an individual generally reacts to potential threats ('I worry about making mistakes'). This scale also had high reliability (alpha $= 0.81$). The BAS and BIS both consisted of items in a 4-point Likert format.

Extraversion and neuroticism were measured with the extraversion and neuroticism subscales of the Dutch version of the Five Factor Personality Inventory (Hendriks, Hofstee, & de Raad, 1999). These scales consist of 12 items in a 5-point Likert format and are reliable (alphas were 0.87 and 0.80, respectively).

Work demands were measured with the demands sub-scale of the Job Content Questionnaire (Karasek, 1985, e.g. 'do you have to work fast?' and 'do you have much work to do?'). The alpha of this scale was 0.84.

Stress was measured with the items of the tension subscale of the Perceived Stress Questionnaire (Levenstein et al., 1993). The five items in this scale reflect the subjective symptoms that people generally experience when they are exposed to stressors. Therefore, the items assess the subjective symptoms of strain, which become manifest as tension and having trouble relaxing. Participants were asked how often (5-point Likert format) they experienced such symptoms in the past month. The reliability of this scale was 0.77.

Statistical analyses Study 1

To test the relationship between reward (BAS) and punishment (BIS) sensitivity, and stress, we conducted 5-step hierarchical regression analyses. In the first step, we entered the

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background variables age and gender (Jorm et al., 1999). Work demands were entered in the second step. BAS and BIS scores were included in the third step in order to test whether they explained significant proportions of variance in stress, *beyond* the effect of work demands. In the fourth step, we examined the interaction between either BAS or BIS with work demands.

Many previous RST-studies have looked at reward and punishment sensitivity as independent constructs. Yet, it has been argued that in some circumstances, these constructs interact in their effect on behaviour and mood (Corr, 2002, 2004). This should particularly be true in complex environments that contain mixed-incentive events, that is, stimuli that can be rewarding as well as threatening. As the workplace might be one such environment, we also explored the three-way interaction between BAS, BIS and work demands in step five. Main effects and interactions were tested in accordance with guidelines of Aiken and West (1996). Predictor variables were centred before computing the interaction terms. Significant interactions were further analysed with *post hoc* tests as suggested by Aiken and West.

For BAS and BIS scores independently, we also tested for associations with stress, beyond the effects of extraversion and neuroticism, respectively. This was done by regression analyses in which we entered either extraversion or neuroticism *before* looking at the effects of either BAS or BIS.

Finally, we conducted regression analyses which were identical to the initial BAS/BIS analyses, but with extraversion and neuroticism *instead* of (rather than next to) BAS and BIS. These analyses were conducted to examine whether the outcomes with these 'traditional measures' resemble the findings regarding BAS and BIS (e.g. do these analyses lead to the same main effects or interactions with stress?).

Results Study 1

Table 1 shows the intercorrelations between the main variables of this study. In line with previous research, BIS was strongly correlated with neuroticism and BAS was moderately correlated with extraversion (cf., Elliot & Thrash, 2002; Jorm et al., 1999; Smits & Boeck, 2006). BIS and neuroticism were both significantly related to stress. Extraversion was significantly and negatively related to stress but BAS was uncorrelated to stress.

In the first regression analysis (see Table 2) the effects of age and gender in step 1 were not significant. However, step 2 was significant, confirming previous findings that high demands are generally associated with higher levels of stress (de Lange et al., 2002; van der Doef & Maes, 1999). In addition, the R^2 change in step 3 was also significant. Individual

Table 1. Correlations among the main variables of Study 1

	1	2	3	4	5	6	7
1 BAS	—						
2 BIS	−0.04	—					
3 Neuroticism	0.02	0.72**	—				
4 Extraversion	0.30**	−0.40**	−0.40**	—			
5 Stress	−0.01	0.48**	0.58**	−0.25*	—		
6 Work demands	0.09	−0.13	−0.03	0.12	0.35**	—	
7 Age	0.03	0.24*	−0.14	−0.08	0.09	0.22*	—

Note: $^{*}p < 0.05$; $^{**}p < 0.01$.

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Table 2. Regression analysis of incremental value and interaction involving BAS and BIS scores

	Stress
Step 1	
Gender	0.08
Age	0.01
ΔR^2 ($F = 0.63$)	0.01
Step 2	
Work demands	0.43***
ΔR^2 ($F = 14.20$)	0.12***
Step 3	
BAS	0.03
BIS	0.53***
ΔR^2 ($F = 24.42$)	0.28***
Step 4	
BAS × Work demands	0.02
BIS × Work demands	0.21*
ΔR^2 ($F = 3.44$)	0.04*
Step 5	
BAS × BIS × Work demands	0.14
ΔR^2 ($F = 2.65$)	0.01

Note: $^{*}p < 0.05$; $^{***}p < 0.001$.

beta-coefficients in this step showed that, beyond work demands, BIS explained a significant proportion of variance in stress. In contrast, BAS did not show a significant main effect on stress. Interestingly, the BIS × Demands interaction in step 4 was also significant (see Figure 1). In absolute numbers, high-BIS individuals reported overall higher levels of stress. However, *post hoc* tests revealed that when demands were high, the difference in stress between high- and low BIS individuals was significant ($\beta = 0.63$, $p < 0.05$), whereas under low demands this difference did not reach significance ($\beta = 0.38$, $p > 0.05$). The BAS × Demands interaction did not add significantly to variance in stress. Finally, the

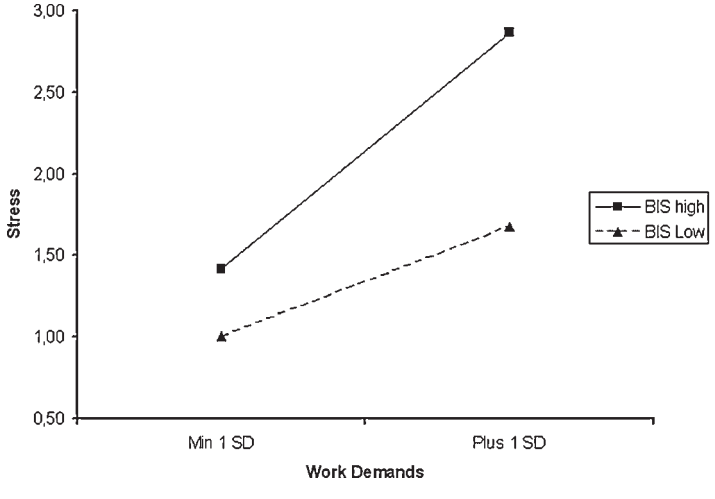

Figure 1. Interaction between punishment sensitivity (measured with BIS scale) and Work demands.

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Table 3. Parallel regression analysis that examines the robustness of the BIS-stress effects after controlling for neuroticism (step 1 contained the control variables age and gender and is similar to Table 2)

	Stress
Step 2	
Work demands	0.36***
Neuroticism	0.43***
ΔR^2 ($F = 44.25$)	0.46***
Step 3	
BIS	0.22*
ΔR^2 ($F = 4.60$)	0.02*
Step 4	
BIS × Work demands	0.18*
ΔR^2 ($F = 6.16$)	0.03*

Note: $^{*}p < 0.05$; $^{***}p < 0.001$.

three-way interaction between BAS, BIS and Demands in step 5 failed to reach significance.

Analyses in which we tested individual effects of BAS and BIS on stress, beyond the effects of 'traditional' measures of extraversion and neuroticism, did not change this pattern of results. More specifically, the main effect of BIS and the interaction with work demands both remained significant after controlling for neuroticism (which was strongly correlated with BIS; see Table 3). Including extraversion also did not change the results for BAS as all relationships between BAS and stress remained non-significant (all $p > 0.05$).

Finally, parallel regression analyses in which we included extraversion and neuroticism *instead* of BAS and BIS showed that, similar to the BIS measure, neuroticism explained variance in stress, beyond work demands (cf. Table 4). However, in contrast to the BIS, the Neuroticism × Demands interaction was not significant. Table 4 also shows that although extraversion displayed a negative simple correlation with stress (Table 1), the relationship between extraversion and stress was not significant in the regression (for the main effect and interaction that involved extraversion, $p > 0.05$).

Table 4. Regression analysis of incremental value and interaction involving extraversion and Neuroticism (step 1 contained age and gender, and step two contained work demands, these steps are similar to Table 1)

	Stress
Step 3	
Extraversion	−0.09
Neuroticism	0.56***
ΔR^2 ($F = 33.93$)	0.35***
Step 4	
Extraversion × Work demands	0.01
Neuroticism × Work demands	0.13
ΔR^2 ($F = 0.96$)	0.01
Step 5	
Extraversion × Neuroticism × Work demands	0.10
ΔR^2 ($F = 1.78$)	0.01

Note: $^{***}p < 0.001$.

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Discussion Study 1

One of the main results of Study 1 was that when participants reported high work demands, the difference in stress between high and low punishment-sensitive (BIS) individuals was more pronounced than when demands were reported to be low. This finding agrees with the general idea that punishment-sensitive individuals react relatively strongly to unfavourable working conditions (van der Linden et al., 2007). In this first study, we also examined to what extent a purpose-built measure of punishment sensitivity (BIS scale) overlapped with a measure of neuroticism. First, simple correlations showed the two types of measures to be highly correlated ($r = 0.72$), which is in line with previous studies showing that the measures considerably overlap (Elliot & Thrash, 2002; Jorm et al., 1999; Smits & Boeck, 2006). Such overlap can be expected as literature considers punishment sensitivity to be the underlying motivational process, explaining why neurotics often experience negative mood states and show the associated behavioural pattern (e.g. withdrawal from potential threat; Corr, 2004; Gray, 1991; McNaughton & Corr, 2004). However, despite substantial overlap and even after controlling for neuroticism, punishment sensitivity (both in main effect and in interaction with work demands) explained a significant additional proportion of variance in stress. This suggests that purpose-built and explicit measures of punishment sensitivity may contribute to occupational health research because it assesses a source of variance in stress that apparently does not overlap with neuroticism. It is also noteworthy that in this sample, neuroticism was related to stress in a similar way as punishment sensitivity. However, whereas the latter construct interacted with work demands, neuroticism did not. This finding supports previous claims that RST-based measures might be better than several other personality measures at detecting effects of personality–environment interactions (Carver & White, 1994; Corr, 2004).

In this study, reward sensitivity was unrelated to stress as none of the main effects or interactions reached significance. This was in contrast to a previous finding in which reward-sensitive individuals showed less stress than individual for whom this sensitivity was weak, but only when demands were low (van der Linden et al., 2007). It is unclear what might have caused such differences in results. It might be due to difference in samples (i.e. teachers only in the van der Linden et al. study vs. a wide range of occupations) or in design (i.e. the previous study also included decision latitude measures). Due to this discrepancy between studies, strong conclusions about the relationship between reward sensitivity and stress cannot yet be made and therefore further studies are required before it can be decided whether or not reward sensitivity and work stress are related.

Limitations of Study 1. Although Study 1 was informative and partly confirmed previous findings, one important limitation remained the cross-sectional nature of the study, which might have led to an overestimation of relationships (e.g. through common method bias). It is well-known that self-report measures do not only reflect objective circumstances but also contain an affective component (e.g. Schmitt, 1994). For example, someone who feels fatigued might rate work demands higher than a non-fatigued person, even if objective demands might be equal. In addition, general trait negativity may affect the reporting of work demands as well as the level of health complaints (e.g. stress; Watson & Pennebaker, 1989). Yet, in the current study there are several reasons to assume that such potential effects did not compromise our conclusions. First, simple correlations in Table 1 showed no significant associations between punishment sensitivity or neuroticism on the one hand, and work demands on the other. Apparently, these constructs did not affect the self-report

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of demands in this sample. Second, several scholars have argued that while affective components in self-reports may artificially enhance main effects, there are no theoretical reasons to expect this process to bias interaction effects (e.g. van Yperen & Janssen, 2002). Thus, the fact that we found an interaction between BIS and Work demands on stress supports our conclusion about the reactive nature of punishment sensitivity regarding negative (work) situations. Finally, the significant main and interaction effects of BIS on stress remained significant after we controlled for neuroticism (Table 3). Thus, any biasing effect of a trait such as neuroticism on stress did not account for these BIS-related outcomes.

Still, the design in Study 1 did not allow direct assessment of causality. In addition, our conclusions about punishment sensitivity would even be more strongly supported if we could conceptually replicate our findings in a research design that does not solely rely on self-report of the working environment but instead compares participants in objectively different situations, such as a relatively relaxed period versus a relatively stressful period. In Study 2, we use a two wave longitudinal design in order to directly assess causality and to partly deal with the limitations of self-reports on work situation.

STUDY 2

Study 2 aimed to confirm longitudinally that punishment sensitivity can affect the strength by which one reacts to potential stressful working conditions. Previous findings were mixed for reward sensitivity. Therefore, we also aimed to examine the relationship between this construct and work stress again but now for a different sample and using a two-wave design. In Study 2, we followed a group of fresh student-nurses who experienced their first major exposure to hospital work and we compared their stress levels to their stress in a period in which they were not yet exposed to such circumstances. In nurse-training it is well-known that exposure to hospital work is inherently stressful to most second-year students. Conditions that contribute to such stress include the daily hassles involved in starting a new job (such as getting to known procedures etc.), finding one's place among new colleagues, being evaluated at work and combining hospital work with study requirements (preparing for upcoming exams). The longitudinal design we applied allowed us to directly examine whether reward and punishment sensitivity, as measured at one point, affected stress at a later point in time. Further, in this design, participants experienced an objective change in their work situation between the two study waves; that is, from relatively relaxed to relatively stressful conditions. This objective change deals with the limitation of Study 1 in which the distinction between favourable versus relatively unfavourable work situation was completely based on self-report data.

Based on previous research and on findings from Study 1, we expect that after approximately 6 months of hospital work, punishment sensitive individuals will show stronger increases in stress than individuals for whom this sensitivity is low. As previous findings showed that support for the reward sensitivity-stress relationship is at least mixed, no strong expectations are formulated regarding the effects of this construct.

Method

Participants and procedure

Participants were 48 nurse students who had just started the second year of their study. In this year, these students had to work in practice for an extended period of several months

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for the first time in their study. This was assumed to be relatively stressful, particularly when compared to the baseline measure of stress. The baseline measure (T1) was conducted at the beginning of the school year, directly after a 6-week holiday period. We assumed that after holidays, students would be relatively relaxed and would not yet have been exposed (or would at least have recovered from) potential study and work stressors. At baseline, students filled in the BAS and BIS scales and questionnaires about their levels of stress. The second measure (T2) was conducted approximately 6 months after the first measure, and included their current level of stress. All participants were female and mean age was 20.1 year (SD = 2.7). Measures of stress at T1 and T2 were done with the same instrument as in Study 1 (alpha = 0.76). Reward and punishment sensitivity were, just as in Study 1, assessed with the BAS and BIS scales (alphas in this sample were 0.74 and 0.77, respectively). As scores on these scales are generally assumed to be relatively stable (similar to other personality measures) and ask about general (and not momentary) reactions to stimuli of different valence, we only applied BAS/BIS scales at T1. In Study 2, operationalization of work stressors, was captured in the difference between situations T1 and T2, which reflected the difference between no exposure (after holiday) and high exposure periods (after 6 months of hospital work). For practical reasons (e.g. explicit requests from the nurse-school), questionnaires had to remain relatively short. Therefore, we were unable to assess the many specific stressors that might or might not have occurred during T1 and T2. However, work demands were measured at T2, allowing us to check whether individual differences in sensitivities were related to reports about demands. Obviously, demands were not measured at T1 because at that time participants did not yet work and could not fill in questions about their job demands.

Statistical analyses

In Study 2, we wanted to test whether reward and punishment sensitivity as measured at T1 affected the level of stress, assessed at T2. To do so, we used a 4-step hierarchical regression analysis in which Time 2 stress was the dependent variable. We entered age as a control variable in the first step. In step 2, we included the baseline stress-level at T1. Step 3 contained the BAS and BIS measures, and in step 4, we included the BAS/BIS interaction term (Aiken & West, 1996).

Results and discussion Study 2

Table 5 shows stress at T1 and T2 to be highly correlated. Further, the only zero-order correlations that were significant were between BIS and the stress measures at T1 and T2 (Table 5). In general, BAS was again, unrelated to stress. Overall stress levels were

Table 5. Correlations among the main variables in Study 2

	1	2	3	4	5	6
1 BAS	—					
2 BIS	−0.25	—				
3 Stress at T1	0.11	0.49**	—			
4 Stress at T2	−0.09	0.54**	0.69**	—		
5 Work demands at T2	−0.03	0.06	0.10	0.22	—	
6 Age	−0.18	−0.20	−0.16	0.01	0.03	—

Note: $^{**}p < 0.001$.

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Table 6. Regression analysis testing the longitudinal effect of BAS and BIS as measured at T1 on stress levels at T2.

	Stress at T2
Step 1	
Age	0.01
ΔR^2 ($F = 0.003$)	0.00
Step 2	
Stress at T1	0.60***
ΔR^2 ($F = 44.98$)	0.49***
Step 3	
BAS	−0.06
BIS	0.29*
ΔR^2 ($F = 4.08$)	0.08*
Step 4	
BAS × BIS	0.08
ΔR^2 ($F = 0.62$)	0.01

Note: $^{*}p < 0.05$; $^{***}p < 0.001$.

significantly higher at T2 ($M = 2.13$, SD = 0.58) than at T1 ($M = 1.59$, SD = 0.41; $T_{\text{paired}} = -9.0, p < 0.001$), supporting the idea that the hospital work period was inherently more stressful than the period immediately after the holiday. Regression analysis (Table 6) confirmed that there was a strong association between stress at the first and the second measure. However, more important was that step 3 also revealed a significant increase in explained variance of stress at T2. Individual beta-weights showed that, beyond the effects of baseline stress (T1), BIS was significantly and positively related to stress at T2 (see also Figure 2). In this step, BAS was unrelated to stress. The interaction between BAS and BIS in step 4 also did not reach significance.

The main operationalization of exposure to working conditions in Study 2 was the objective shift in situation from T1 to T2. However, to support interpretation of the main

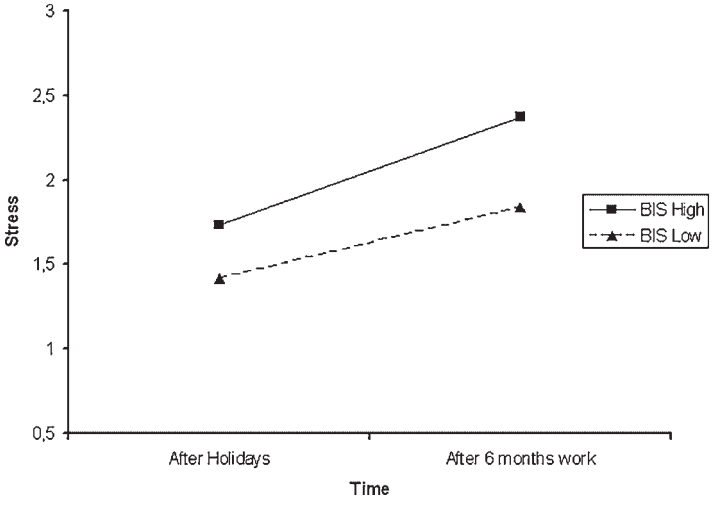

Figure 2. Interaction between punishment sensitivity (measured with BIS Scale) and Time of measurement.

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results, it is important to note that Table 5 showed that there was no direct relationship between BIS and work demands as measured at T2. This suggests that the relationship between BIS and stress was not caused by differential exposure to work demands; both high and low BIS-individuals reported equal levels of demands. In contrast, the more likely interpretation of this result is that individuals who are sensitive for punishment, reacted more strongly to demanding and potential stressful circumstances than individuals for whom such sensitivity is low. This finding agrees with previous statements about the nature of punishment sensitivity.

BAS was neither related to baseline level stress nor to stress increase after 6 months. Thus, we must conclude that reward sensitivity does not protect against stress. Moreover, we failed to find support for a BIS/BAS interaction in explaining stress increase. Overall, the longitudinal design of Study 2 confirmed the presumed causal relation of BIS as a predisposition to stress.

The assets of Study 2 were that RST-effects on stress were replicated in a longitudinal design with some objective change in circumstances in between the two measures. However, this study also had several limitations. First, sample size was relatively small, meaning one has to be cautious regarding generalizability of the results. Nevertheless, the fact that we found significant results even within this sample underlines the potential relevance of RST-constructs in real-life settings. In addition, the current results converged with previous studies on this topic (e.g. van der Linden et al., 2007), which strengthen our conclusions.

A second limitation was that we only measured reward and punishment sensitivity at T1. This decision was based on the idea that the sensitivities are relatively stable across time. However, it might have been useful to also control for reward and punishment sensitivity at T2 as well. On the other hand, current results clearly show that punishment sensitivity, measured at one point, was statistically related to the increase in stress after a potentially stressful period. Regarding this particular stressful period, a third limitation was that we did not directly assess which type of stressors occurred between T1 and T2. It might have been informative to get some insight into the specific (stressful) events that occurred during this period. Yet, the fact that these were not assessed does not compromise our design. Namely, the overall increase in stress we found between T1 and T2 already is sufficient to support our assumptions about the effects of being exposed to hospital work: It confirmed that this exposure was inherently stressful and could therefore be used to examine differential effects of the personality constructs. Finally, the sample in Study 2 was relatively homogenous in terms of age, gender and occupational/study background. The restriction of range in these concepts may have biased their effects downwards.

GENERAL DISCUSSION

Results from the present two studies clearly suggest that punishment sensitivity is a dispositional source of stress. In an occupational setting, this means that when there is an unfavourable shift in working conditions, that is, when job stressors become more prevalent or more salient, punishment-sensitive individuals will react with a stronger increase in stress than others. Cross-sectional Study 1 supported this general idea for a specific work stressor, namely work demands. In addition, it showed that the results obtained with RST-based measures were not identical to those obtained with extraversion

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and neuroticism. In Study 2, this apparent punishment-sensitive reactivity to working conditions was confirmed in a longitudinal design in which nurse students went through the objective shift from a relatively relaxed to a relatively demanding and stressful period. These two sets of findings nicely converge with a previous study among teachers (van der Linden et al., 2007), which also reported a stronger stress reactivity towards unfavourable working conditions for individuals scoring high on punishment sensitivity. Although several earlier laboratory studies had already suggested a link between this type of sensitivity and stressor-responsiveness (Carver & White, 1994; Heponiemi et al., 2003, 2004), the present research underlines and enhances previous findings by showing that they generalize to ecologically valid, real-life environments as well.

The current research also provides some initial cues about whether stress-vulnerability in punishment-sensitive individuals is caused by increased exposure to stressors, or through increase reactivity to stressors, or both. More specifically, in both studies we found that this sensitivity was unrelated to reports about work demands. This suggests that punishment-sensitive individuals do not experience or encounter more demands than individuals for whom this sensitivity is low. Thus, regarding this specific stressor, there were no indications of increased demands exposure or experience as a function of punishment sensitivity. On the other hand, both studies provided evidence that there was increased reactivity in punishment-sensitive individuals, that is, they showed more subjective manifestations of stress. Whether this distinction is specific for work demands or whether it also generalizes to other types of work stressors remains a question to be addressed in future research.

Regarding reward sensitivity, to our knowledge there are currently three individual studies that show that this construct is not *directly* related to occupational stress (i.e. van der Linden et al., 2007; Study 1 and 2 in present research). Such results agree with the general assumption that positive and negative mood states are relatively independent and that reward sensitivity is mainly associated with positive mood states and less so with negative mood states (Gomez & Gomez, 2005; Gray, 1990, 1991). In our two studies, stress is defined in terms of its subjective manifestations that include symptoms such as tension, frustration, or anxiety. Such symptoms can be classified as part of negative mood states, for example, questions about tension and nervousness are also present in the negative affectivity section of the PANAS. This resemblance between stress and negative mood states might be one of the reasons why reward sensitivity is not related to stress.

In one way, our results on reward sensitivity deviated from previous findings. That is, van der Linden et al. (2007) found a BAS $\times$ Work demands interaction indicating that reward-sensitive individuals have lower levels of stress but only when demands were not excessively high. There are several possible reasons why this interaction was not found in the current set of studies (e.g. differences in sample or design) and future studies might be necessary to provide conclusive answers on this issue. Yet, with the current state of knowledge, the safest (preliminary) conclusion might be that reward sensitivity (BAS) is neither strongly nor robustly related to occupational stress.

Potential advantages of using RST in studying work stress dispositions

In general, the idea that personality affects the way employees react to their work is not new and has been pursued in previous studies (Semmer, 2003). For example, in examining the effects of neuroticism on reactions to day-to-day stressors (using diary methods), Bolger

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and Schilling (1991) found that neuroticism moderated the relationship between overload at work and negative mood. However, application of RST might extend current knowledge about this topic both empirically and conceptually. Empirically, the approach we adopted is in line with recommendations of several scholars who suggested to examine how RST purpose-built measures can be applied in real-life settings (Corr, 2004; Gray, 1991). One of the claims made about the particular set of measures we applied is that they might be better able than several other personality measures to predict interactions between the individual and the environment (Carver & White, 1994; Corr, 2004). Current set of results at least partly support this notion as punishment sensitivity interacted with work demands, whereas neuroticism did not show such an interaction (Study 1). This difference might be due to the way these two constructs were measured. Psychometric measures of neuroticism often involve questions about general anxiety levels or mood states. However, psychometric measures of punishment sensitivity mostly comprise questions about how one would react, given specific and potentially threatening situations (e.g. when making errors or when facing conflict). Such differences between neuroticism and punishment sensitivity measures have been identified by others as an asset of RST-based personality assessment (Carver et al., 2000; Gomez & Gomez, 2005).

There may also be several conceptual assets of using RST in occupational research. First, the constructs reward and punishment sensitivity are rather explicit about the basic motivational processes underlying a person's reactions to the environment. For example, it was already known that neuroticism probably causes someone to react more strongly to stressful circumstances. However, looking at such effects in terms of punishment sensitivity might refine our knowledge about the way this is brought about. More specifically, from a RST point-of-view, some people might react stronger to stressors because they are sensitive to the potential threatening consequences. Such an explanation might seem obvious in hindsight but can be considered one of the motivational-based refinements introduced by RST.

Going one step beyond the current data, RST also provides clear assumptions about the biological underpinnings of stress-reactivity as examined in this article. In RST, punishment sensitivity is strongly related to the biological BIS. Thus, it can be expected that the enhanced responsiveness of this system in punishment-sensitive individuals plays an important role in their reactions to stressful circumstances. In general, BIS activation as response to stressors can be considered adaptive as it, through induction of negative mood states, motivates employees to deal with the situation at hand. However, from stress research we know that when reactions to stressors occur too often or are too strong, responses become maladaptive and pose a threat to health (McEwen, 1998).

It is important to note that application of RST in the area of occupational stress research has only recently begun. Consequently, many questions remain to be answered. For example, it might be useful to examine more closely whether reward sensitivity can also affect well-being at work through other mood states than stress (e.g. satisfaction). In the current research, reward sensitivity was unrelated to stress, but several other studies indicated that this construct might be related to positive mood states or work satisfaction (Jackson, 2001; Stewart, 1996; van der Linden et al., 2007). In addition, it would be informative to look at a more fine-grained level to the way RST might affect well-being at work. A more detailed analysis might answer questions such as whether punishment-sensitive individuals react more strongly to certain type of (work) stressors than to other types. One way to examine this might be through using diary studies in a similar way as has been done in previous studies on neuroticism (e.g. Bolger & Shilling, 1991).

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Although such topics require more research, the current set of studies confirms that purpose-built psychometric personality or trait measures, based on RST, can be fruitfully applied in addressing questions about dispositions to work stress. Moreover, the theory might provide a useful framework for studying personality–environment interactions in the workplace. As such, it may advance knowledge in occupational research as well as contribute to insight into the effects of personality in mundane settings.

REFERENCES

Aiken, L. S., & West, S. G. (1996). *Multiple regression: Testing and interpreting interactions*. London: Sage Publications.

Bolger, N., DeLongis, A., Kessler, R. C., & Schilling, E. A. (1989). Effects of daily stress on negative mood. *Journal of Personality and Social Psychology*, *57*, 808–818.

Bolger, N., & Schilling, E. A. (1991). Personality and the problems of everyday life: The role of neuroticism in exposure and reactivity to daily stressors. *Journal of Personality*, *59*, 355–386.

Carver, C. S. (2004). Negative affects deriving from the behavioral approach system. *Emotion*, *4*, 3–22.

Carver, C. S., Sutton, S. K., & Scheier, M. F. (2000). Action, emotion, and personality: Emerging conceptual integration. *Personality and Social Psychology Bulletin*, *26*, 741–751.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*, *67*, 319–333.

Clark, L. A., & Watson, D. (1988). Mood and the mundane: Relations between daily life events and self-reported mood. *Journal of Personality and Social Psychology*, *54*, 296–308.

Cloninger, C., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry*, *50*, 975–990.

Corr, P. J. (2002). J. A. Gray's reinforcement sensitivity theory: Tests of the joint subsystems hypothesis of anxiety and impulsivity. *Personality and Individual Differences*, *33*, 511–532.

Corr, P. J. (2004). Reinforcement sensitivity theory and personality. *Neuroscience and Biobehavioral Reviews*, *28*, 317–332.

Costa, P. T., & McCrae, R. R. (1992). The five-factor model of personality and its relevance to personality disorders. *Journal of Personality Disorders*, *6*, 343–359.

de Lange, A. H., Taris, T. W., Kompier, M. A. J., Houtman, I. L. D., & Bongers, P. M. (2002). Effects of stable and changing demand-control histories on worker health. *Scandinavian Journal of Work, Environment, & Health*, *28*, 94–108.

de Vries, J., & van Heck, G. L. (2002). Fatigue: Relationships with basic personality and temperament dimensions. *Personality and Individual Differences*, *33*, 1311–1324.

Depue, R. A. (1995). Neurobiological factors in personality and depression. *European Journal of Personality*, *9*, 413–439.

Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences*, *22*, 491–569.

Depue, R. A., Luciana, M., Arbisi, P., Collins, P., & Leon, A. (1994). Dopamine and the structure of personality: Relation of agonist-induced dopamine activity to positive emotionality. *Journal of Personality and Social Psychology*, *67*, 485–498.

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, *41*, 417–440.

Elliot, A. J., & Thrash, T. M. (2002). Approach-avoidance motivation in personality: Approach and avoidance temperaments and goals. *Journal of Personality and Social Psychology*, *82*, 804–818.

Eysenck, H. J. (1967). *The biological basis of personality.* Thomas: Spring-field, IL.

Franken, I. H. A. (2002). Behavioral approach system (BAS) sensitivity predicts alcohol craving. *Personality and Individual Differences*, *32*, 349–355.

Franken, I. H. A., Muris, P., & Rassin, E. (2005). Psychometric Properties of the Dutch BIS/BAS Scales. *Journal of Psychopathology and Behavioral Assessment*, *27*, 25–30.

DOI: 10.1002/per

Gable, S. L., Reis, H. T., & Elliot, A. J. (2000). Behavioral activation and inhibition in everyday life. *Journal of Personality and Social Psychology*, *78*, 1135–1149.

Gomez, R., & Gomez, A. (2005). Convergent, discriminant and concurrent validities of measures of the behavioural approach and behavioural inhibition systems: Confirmatory factor analytic approach. *Personality and Individual Differences*, *38*, 87–102.

Gray, J. A. (1970). The psychophysiological basis of introversion-extraversion. *Behaviour Research and Therapy*, *8*, 249–266.

Gray, J. A. (1981). A critique of Eysenck's theory of personality. In H. J. Eysenck (Ed.), *A model for personality* (pp. 246–276). Berlin: Springer.

Gray, J. A. (1990). Brain systems that mediate both emotion and cognition. *Cognition and Emotion*, *4*, 269–288.

Gray, J. A. (1991). The neuropsychology of temperament. In J. Strelau & A. Angleitner (Eds.), *Explorations in temperament: International perspectives on theory and measurement* (pp. 105–128). New York, NY: Plenum Press.

Hendriks, A. A. J., Hofstee, W. K. B., & De Raad, B. (1999). The Five-Factor Personality Inventory (FFPI). *Personality and Individual Differences*, *27*, 307–325.

Heponiemi, T., Keltikangas Jarvinen, L., Puttonen, S., & Ravaja, N. (2003). BIS/BAS sensitivity and self-rated affects during experimentally induced stress. *Personality and Individual Differences*, *34*, 943–957.

Heponiemi, T., Keltikangas-Jarvinen, L., Kettunen, J., Puttonen, S., & Ravaja, N. (2004). BIS-BAS sensitivity and cardiac autonomic stress profiles. *Psychophysiology*, *41*, 37–45.

Jackson, C. J. (2001). Comparison between Eysenck's and Gray's models of personality in the prediction of motivational work criteria. *Personality and Individual Differences*, *31*, 129–144.

Jackson, C. J., & Smillie, L. D. (2004). Appetitive motivation predicts the majority of personality and an ability measure: A comparison of BAS measures and a re-evaluation of the importance of RST. *Personality and Individual Differences*, *36*, 1627–1636.

Jorm, A. F., Christensen, H., Henderson, A. S., Jacomb, P. A., Korten, A. E., & Rodgers, B. (1999). Using the BIS/BAS scales to measure behavioural inhibition and behavioural activation: Factor structure, validity and norms in a large community sample. *Personality and Individual Differences*, *26*, 49–58.

Judge, T. A., Bono, J. E., & Locke, E. A. (2000). Personality and job satisfaction: The mediating role of job characteristics. *Journal of Applied Psychology*, *85*, 237–249.

Karasek, R. (1985). *Job content instrument: Questionnaire and user's guide*. Los Angeles: Department of Industrial and Engineering Psychology.

Karasek, R., & Theorell, T. (1990). *Healthy work: Stress, productivity, and the reconstruction of working life*. New York: Basic Books.

Kasch, K. L., Rottenberg, J., Arnow, B. A., & Gotlib, I. H. (2002). Behavioral activation and inhibition systems and the severity and course of depression. *Journal of Abnormal Psychology*, *111*, 589–597.

Langelaan, S., Bakker, A. B., van Doornen, L. J. P., & Schaufeli, W. B. (2006). Burnout and work engagement: Do individual differences make a difference? *Personality and Individual Differences*, *40*, 521–532.

Levenstein, S., Pantera, C., Varvo, V., Scribano, M. L., Berto, E., Luzi, C., et al. (1993). Development of the perceived stress questionnaire: A new tool for psychosomatic research. *Journal of Psychosomatic Research*, *37*, 19–32.

McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. In S. M. McCann, J. M. Lipton, E. M. Sternberg, G. P. Chrousos, P. W. Gold, et al. (Eds.), *Annals of the New York Academy of Sciences: Neuroimmunomodulation: Molecular aspects, integrative systems, and clinical advances* (Vol. 840, pp. 33–44). New York, NY: New York Academy of Sciences.

McNaughton, N., & Corr, P. J. (2004). A two-dimensional neuropsychology of defense: Fear/anxiety and defensive distance. *Neuroscience and Biobehavioral Reviews*, *28*, 285–305.

Quilty, L. C., & Oakman, J. M. (2004). The assessment of behavioural activation—the relationship between impulsivity and behavioural activation. *Personality and Individual Differences*, *37*, 429–442.

Schmitt, N. (1994). Method bias: The importance of theory and measurement. *Journal of Organizational Behavior*, *15*, 393–398.

DOI: 10.1002/per

Semmer, N. K. (2003). Individual differences, work stress, and health. In M. J. Schabracq, J. A. M. Winnubst, & C. L. Cooper (Eds.), *The handbook of work & health psychology* (2nd ed., pp. 83–120). West Sussex: Wiley, J. & Sons.

Smillie, L. D., & Jackson, C. J. (2005). The appetitive motivation scale and other BAS measures in the prediction of approach and active avoidance. *Personality and Individual Differences*, *38*, 981–994.

Smits, D. J. M., & Boeck, P. D. (2006). From BIS/BAS to the Big Five. *European Journal of Personality*, *20*, 255–270.

Stewart, G. L. (1996). Reward structure as a moderator of the relationship between extraversion and sales performance. *Journal of Applied Psychology*, *81*, 619–627.

Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. H. Tuma & J. D. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 681–706). Hillsdale, NJ, England: Lawrence Erlbaum Associates.

van der Doef, M., & Maes, S. (1999). The job Demand-Control (-Support) model and psychological well-being: A review of 20 years of empirical research. *Work & Stress*, *13*, 87–114.

van der Linden, D., Taris, T. W., Beckers, D. G., & Kindt, K. A. (2007). Reinforcement Sensitivity Theory and Occupational Health: BAS and BIS on the job. *Personality and Individual Differences*, *42*, 1127–1138.

van Yperen, N. W., & Janssen, O. (2002). Fatigued and dissatisfied or fatigued but satisfied? Goal orientations and responses to high job demands. *Academy of Management Journal*, *45*, 1161–1171.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review*, *96*, 234–254.

DOI: 10.1002/per