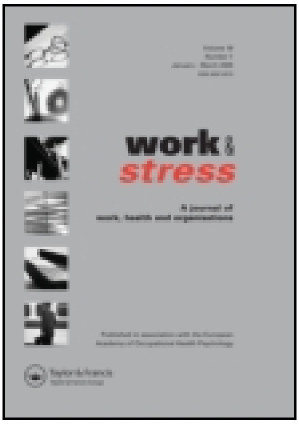

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Burnout and impaired cognitive functioning: The role of executive control in the performance of cognitive tasks

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Burnout patients often report deficits in cognitive control, and there is a need to understand the processes involved. Drawing on recent findings, we hypothesized that emotional exhaustion and task-related demands on executive control would interact in predicting performance in tasks requiring the updating and monitoring of working memory as well as the inhibition of prepotent (dominant or automatic) responses. In accordance with recent conceptualizations of burnout, we focused on emotional exhaustion as the core symptom of burnout. The sample comprised 81 employees recruited from nursing homes for elderly care in Germany, who participated in a laboratory study involving cognitive tasks. Based on a median split, participants were divided into two groups: those with high burnout and those with low burnout. In line with our hypotheses, the high exhaustion participants performed less well than those with low exhaustion only when tasks put high demands on their executive control. As predicted, high levels of emotional exhaustion were associated with more errors and longer reaction times when demands on executive control were high, whereas no performance differences were found when both tasks put low demands on executive control. The implications for practice are discussed.

Keywords: executive control; burnout; emotional exhaustion; cognitive tasks; prepotent responses; working memory

Introduction

Burnout is usually considered to be a chronic strain response to work-related stressors that is characterized by emotional exhaustion, depersonalization and low personal accomplishment (Maslach, Schaufeli, & Leiter, 2001). After nearly 30 years of research, empirical evidence unequivocally indicates that burnout is negatively related to various indicators of job performance (Halbesleben & Wheeler, 2011; Taris, 2006). To provide a theoretical explanation, some scholars argue that motivational deficits and a lack of resource reciprocity determine this relationship (e.g. Halbesleben & Wheeler, 2011). In contrast, a growing body of evidence suggests that burnout is not only related to motivational or resource deficits, but is also

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associated with chronic impairments of executive control of mental and behavioural processes (Österberg, Karlson, & Hansen, 2009; Oosterholt, van der Linden, Maes, Verbraak, & Kompier, 2012; Sandström, Nyström Rhodin, Lundberg, Olsson, & Nyberg, 2005; van Dam, Keijsers, Eling, & Becker, 2011; van der Linden, Keijsers, Eling, & van Schaijk, 2005). In other words, deficits in executive control may explain why burnout impairs job performance, which, to an increasing extent, is cognitively driven (Hunt & Madhyastha, 2012). Although theorists diverge in its precise definition, executive control refers to a set of interrelated cognitive mechanisms that enable people to voluntarily regulate their representational, attentional and motor processes in order to adaptively deal with novel, complex and changing task demands (Hofmann, Schmeichel, & Baddeley, 2012; Norman & Shallice, 1986). Experimental studies have revealed that people suffering from burnout perform worse than those with low burnout on tasks which require executive control (van der Linden et al., 2005).

While these performance differences have emerged in several cognitive tasks (such as task switching and sustained attention to response task), past research has, however, failed to specify the exact functions of executive control that are affected in persons suffering from burnout. Without building upon a solid theoretical framework, we are left with the question of which specific processes are impaired in the case of high burnout. This is examined in the present study, using two groups of participants: one with high burnout and the other with low burnout. Moreover, given that job-related demands vary across work tasks (Hunt & Madhyastha, 2012) and time (Kühnel, Sonnentag, & Bledow, 2012), we investigate the specific conditions under which employees with high emotional exhaustion perform worse than those with low exhaustion, as tasks differ in the extent to which they put demands on executive control. Because recent conceptualizations of burnout (Maslach et al., 2001) and several longitudinal studies (Diestel & Schmidt, 2010) suggest that emotional exhaustion is the core symptom of burnout, we focus on this burnout dimension rather than examining all three dimensions.

To understand the relationship between exhaustion and executive control, we sought to clarify two issues. First, we examined differences between the high and low exhaustion participants in performing laboratory tasks that require two functions of executive control, namely the updating and monitoring of working memory representations (the N-back test) and inhibition of prepotent (dominant or automatic) response tendencies (the Stroop test). Both these executive mechanisms are involved in goal-directed behaviour regulation at work that is required to meet job demands in a wide range of occupational settings (e.g. Diestel & Schmidt, 2012). Thus, our study aims to provide insight into the nature of cognitive deficits, which may be manifested in impaired behaviour regulation and hence, explain lower job performance in cases of high levels of exhaustion. Second, we varied the degree to which both tasks require executive control, to test whether high burnout (exhaustion) is related to low performance in cases of both low and high demands on executive control. Variation in task demands on executive control help to identify the specific conditions under which goal-directed behaviour may be impaired when exhaustion is high. The relevance of this issue is further emphasized by the empirical fact that burnout has not always been related to low executive control in previous studies (e.g. Österberg et al., 2009; Oosterholt et al., 2012).

We first elaborate on executive control and how it is required in facing job demands. Next, we review recent findings from research on the relationship between burnout and executive control. Finally, we develop our hypotheses.

Executive control and its relevance for goal-directed behaviour at work

The most prominent and well-founded theoretical conceptualization of executive control was developed by Miyake et al. (2000; see also Hofmann et al., 2012). According to their model, executive control is based upon three mechanisms that are interrelated, but inherently independent from each other. First, task shifting refers to switching back and forth between multiple tasks, operations or goals (Monsell, 1996). Second, updating and monitoring of working memory representations requires the controlling and coding of incoming information of relevance to the task and then appropriately revising the items represented in the working memory by replacing irrelevant information with relevant information (Morris & Jones, 1990). Third, response inhibition involves the ability to deliberately control or suppress prepotent responses and impulses when necessary (Logan, 1994). Because past research has provided evidence on the relationship between burnout and performance in task shifting (van Dam et al., 2011), we focus on the updating and monitoring of participants' working memory representations and the inhibition of prepotent responses to a visual stimulus.

Although the psychometric validity of the three executive mechanisms has been repeatedly confirmed (e.g. Huizinga, Dolan, & van der Molen, 2006), several studies strongly suggest that all three mechanisms share a common limited cognitive resource. Accordingly, these studies have identified that the three mechanisms share substantive variance and overlap in subserving brain regions (Tabibnia et al., 2011). Moreover, in support of the notion that cognitive capacity has a limited resource reservoir, acting on one executive mechanism temporarily reduces the ability to exert executive control in the same or in the other two domains (Hofmann et al., 2012; Schmeichel, 2007).

Action Regulation Theory (Frese & Zapf, 1994; Hacker & Richter, 1990) assumes that goal-direct behaviour at work involves executive control – especially when regulating processes at higher perceptual-conceptual or intellectual levels such as developing action plans, flexible adaptation to novel, changing tasks or modifying emotional expressions in social interactions. Consistent with this assertion, the functional role of executive control in the relationship between demanding task characteristics (high demands on speed and intensity of action regulation) and employees' burnout experience (especially emotional exhaustion) has been repeatedly emphasized and empirically confirmed in previous studies (Diestel & Schmidt, 2012; see also Wieland-Eckelmann, 1992). In particular, updating and monitoring of working memory are required in situations where several incoming information cues belong to one global task and thus, have to be related to each other, such as car driving, taking care of several patients within a short time slot or coordinating different tasks within a larger project (Miyake et al., 2000). In contrast, emotional labour often puts high demands on inhibition of prepotent responses, especially when in interactions with clients, patients or customers, emotions have to be displayed that are not genuinely felt (Diestel & Schmidt, 2011; Robinson & Demaree, 2007). In conclusion, as suggested by Action Regulation Theory, executive control is highly required for achieving job-related goals and is thus an integral part of daily work processes. In support of this conclusion, studies have found executive control to predict task performance (Causse, Dehais, & Pastor, 2011; Nelson, 2003).

Experimental research has revealed that the N-back task (Kane, Conway, Miura, & Colflesh, 2007) and the Stroop interference task (Miyake et al., 2000) are most valid to reflect updating and monitoring working memory and response inhibition, respectively. The N-back task requires participants to decide whether each stimulus (a letter of the alphabet) in a sequence matches the one that appeared N items ago or was defined at the beginning of the task (0-back). In a visually presented letter 2-back task, participants see a series of letters one by one and have to decide whether each letter matches the one seen two steps before in the sequence. In such a condition, executive control will be required, because participants have to update and to monitor the information (letter sequence) in their working memory. Performance in the N-back task has been recently found to negatively relate to smoking behaviour, which indicates control deficits in real life (Greenstein & Kassel, 2009). The main goal of the Stroop task is to name the colour of the font in which a colour word is printed. Sometimes the font and the word are congruent (the word *Green* in green font), and sometimes the font and the word are incongruent (the word *Green* in blue font). Because of the prepotent tendency to respond to the meaning of the word, executive control is most required when the font is incongruent with the word's meaning. Performance in the Stroop task has been found to negatively relate to socio-economic stress and household chaos (Deater–Deckard, Chen, Wang, & Bell, 2012) and to predict emotional control (Storbeck, 2012).

Burnout and impaired executive control

Scholarly interest in the relationship between burnout and executive control was originally inspired by clinical observations indicating that persons with high levels of burnout often complain about impairments of attention and memory, affective instability and limited flexibility in dealing with novel and changing tasks (Schaufeli & Enzmann, 1998; van der Linden et al., 2005). Inspired by these observations, scholars have begun to investigate executive functioning of individuals who reported high levels of burnout, compared with those with low burnout. In laboratory studies, burnout has been negatively related to cognitive performance assessed in tasks requiring sustained attention (van der Linden et al., 2005), goal and task switching (van Dam et al., 2011) or updating working memory (Oosterholt et al., 2012). High and low burnout levels were defined by standardized cut-off values, participation in clinical interventions, or additional diagnostic information, such as work-related neurasthenia.

However, the result patterns were not always consistent. For example, Österberg et al. (2009) reported that, contrary to expectations, performance differences in a sustained attention task that requires scanning a set of letters and responding to critical stimuli were not significant between high and low burnout groups (see also Oosterholt et al., 2012). Because previous studies have not shown variation between high and low demands on executive control, this finding suggests that high burnout is not always related to lower executive control. In particular, as results from field studies on job demands on executive control suggest (Diestel & Schmidt, 2011), burnout may only account for variance in performance when task demands on executive control are high. Thus, burnout might be only associated with deficits in higher-order executive processing, but not in processes that involve low executive control.

This suggestion relies on the theoretical notion of a limited resource that is temporarily depleted by executive processes (Hofmann et al., 2012; Muraven & Baumeister, 2000). The magnitude of resource depletion depends on the extent to which a given demand or task requires executive control (Hofmann et al., 2012, p. 177; Schmeichel, 2007). Recent evidence indicates that burnout experience (especially emotional exhaustion) involves chronic impairments of the limited resource capacity (Diestel & Schmidt, 2011; Oosterholt et al., 2012). That is, in the presence of high (job-related) demands on executive control, employees with a high level of emotional exhaustion have a lower capacity for accomplishing such demands and should thus perform worse compared to those with low exhaustion. In contrast, when demands on executive control are low, employees with high exhaustion should not perform worse than those with low exhaustion, because the limited self-control capacity is not heavily utilized. Thus, we predict that performance differences between high and low exhaustion levels will emerge, if – and only if – tasks put high demands on executive control. In the light of the relevance of updating and monitoring working memory as well as response inhibition for goal-directed action regulation at work (Hacker, 2005), we focus on executive functioning in these two domains.

> *Hypothesis 1:* In conditions of high demands on executive control, task performance in the updating and monitoring of working memory (Hypothesis 1a) and in response inhibition (Hypothesis 1b) will be lower in the high emotional exhaustion group than in the low exhaustion group, whereas no group differences in both tasks will occur when executive demands are low.

The present study design

We focus on emotional exhaustion (feelings of being overextended and drained of one's emotional and physical resources), because exhaustion constitutes the core symptom of the burnout experience (Maslach et al., 2001). By way of contrast, low personal accomplishment has been repeatedly revealed to result from developing burnout (Diestel & Schmidt, 2010; Taris, Le Blanc, Schaufeli, & Schreurs, 2005). Similarly, recent research has found depersonalization to reflect a dysfunctional coping strategy that is most likely to be adopted when exhaustion is high (Diestel & Schmidt, 2010). That is, depersonalization is thought to be rather behaviour-related than an indicator of inherent strain experience.

In most studies on burnout and executive control, burnout has been diagnosed on the basis of standardized cut-off values or disorder criteria (van Dam et al., 2011; Österberg et al., 2009). Only van der Linden et al. (2005) provided some indications that people who report high burnout, but are not diagnosed on the basis of such criteria, show impaired cognitive control. In a real work setting, employees often experience high exhaustion but nevertheless continue to face job demands, with negative consequences for their health and job performance. Examining the cognitive performance of employees who report high exhaustion provides support for the argument that burnout experience *at work* negatively relates to executive control. Thus, our study was conducted in a nursing setting, which has been found to put high demands on executive control (Schmidt, 2010).

Finally, depressive and burnout symptoms (especially emotional exhaustion) are strongly interrelated (Toker & Biron, 2012) and the effects of depression on the relationship between exhaustion and executive control have not been examined so far. To exclude the possibility that differences between high and low exhaustion in executive control are spurious, we controlled for depressive symptoms in our analyses.

Methods

Participants and procedure

The sample consisted of health care workers of a municipal organization for residential elderly care located in a federal state of Germany. All participants were involved in the daily care of elderly people, including physical care, medical support and social activities. Participants were recruited through announcements at staff meetings and memos sent by the home managers. Health care workers were assured that participation in the study was voluntary and that their data would remain confidential. A response rate of 75.7% yielded a final sample of 81 participants who completed a questionnaire and conducted experimental tasks (described below). Reasons for participation were not assessed. The participants averaged 38.3 years of age ($SD = 10.5$; range = 20–62). Among the participants, 90% were women, and 69% were full-time employees. All participants had completed junior high school and were trained as geriatric nurses.

The study was conducted in a sound-attenuated room during working time. For each participant, the whole experiment (including questionnaire and cognitive tasks) lasted for 60 minutes (10 to 11 a.m.). All participants successively performed two tasks, the N-back task and Stroop-task. The stimuli for the tasks were presented to the participant at the centre of a computer monitor located at a 50cm distance from the bridge of the participant's nose. Participants were seated in a comfortable chair facing the computer monitor. Before the participants engaged in both tasks, they completed a questionnaire encompassing several scales that assess emotional exhaustion and depressive symptoms (see below) and were instructed by an experimenter. After completing the questionnaire and conducting both tasks, each participant received €20, as had previously been promised. Given that motivational incentives do not relate to executive control of those with high burnout (van Dam et al., 2011), biasing or self-selecting effects can be generally excluded.

Measures and tasks

Emotional exhaustion. The burnout dimension of *emotional exhaustion* was measured by Büssing and Perrar's (1992) German translation of the Maslach Burnout Inventory (MBI; Maslach & Jackson, 1986). Emotional exhaustion (nine items; $\alpha = .88$) refers to feelings of being overextended and drained by work demands (e.g. "I feel emotionally drained from my work"). All items are scored on a six-point intensity rating scale (1 = *not at all*, 6 = *very strong*).

Depressive symptoms. To provide evidence for the notion that burnout and depressive symptoms do not overlap in their relationships with executive control, depressive symptoms were introduced as a covariate. A shortened German version (Schmitt & Maes, 2000) of the Beck Depression Inventory (Beck, Steer, & Garbin, 1988) was used to measure depressive symptoms. The 15 items ($\alpha = .93$) address various symptoms such as reduced initiative, irritation, sadness and tiredness. All items are rated on a six-point frequency rating format (0 = *never*, 5 = *very often*).

Updating and monitoring working memory representations: N-back task. Each participant engaged in a 0- and 2-back version of the N-back task. Consequently, we analyzed a repeated measure design in which every participant completed both N-back conditions. For the 0-back condition, participants were instructed to identify the letter "X" (target stimulus) when it occurred within a quasi-random sequence of letters (non-target stimuli). A total of 102 letters (which included all the letters of the alphabet) were presented one at a time on a computer screen. Of these letters, 23 were target stimuli. For the 2-back condition, each letter had to be compared with the letter presented two letters before. The participants were instructed to press a button for each letter that was a target stimulus. In this condition, 31 of 156 stimuli were target stimuli. A practice trial preceded each condition, with 10 letters and two target stimuli in the 0-back condition and 15 letters and three target stimuli in the 2-back condition. Stimulus duration was 1200ms, with a 1800ms inter-stimulus interval. Consistent with Shucard, Lee, Safford, and Shucard (2011), the 2-back condition was defined as high demands on executive control, whereas the 0-back condition was proposed to put low demands on executive control.

Inhibition of prepotent responses: Stroop task. We chose the Stroop task to analyze differences between high and low exhaustion in inhibition of prepotent responses. Stroop stimuli were the colour words, "red", "blue", "yellow" and "green", displayed in red, blue, yellow or green. Again, every participant completed two conditions of the Stroop task: The colour words were presented either in an incongruent (e.g. "red" displayed in the colour blue) or a congruent colour (e.g. "red" displayed in red). Overall, the task encompassed 52 trials, with 26 congruent and 26 incongruent Stroop stimuli. The Stroop stimuli were presented one by one at the centre of the screen on a black background. Participants were instructed to react to the colour (font) of the words by pressing two buttons on two small pads, each for one colour (blue: left index finger; yellow: right middle finger; red: left middle finger; green: left index finger). Participants were asked to work as quickly as possible without skipping any or making mistakes. Again, experimental trials were preceded by 12 randomly presented practice trials in which six words each occurred once in a congruent and an incongruent colour. Inter-stimulus interval was fixed to 1000ms. For each trial, before presenting the Stroop stimuli, a fixing point appeared for 300ms. Each reaction was followed by a feedback indicating whether the answer was right (+) or wrong (−). The feedback was displayed for 500ms followed by the fixing point (300ms) indicating the next trial. According to Botvinik, Braver, Barch, Carter, and Cohen (2001), the congruent condition is defined as low demands on executive control, whereas the incongruent condition requires high executive control.

Data analysis

Reaction time. Following Osinsky et al. (2009), all error trials (where the participant did not respond correctly) were excluded from the reaction time (RT) analysis because RT of error trials typically does not reflect executive control. Post-error trials were also excluded because an error typically leads to a slow-down in the subsequent trial (Rabbitt, 1966). All participants with RTs less than 200ms and above two standard deviations of the mean RT were excluded from the analyses. Very short RTs are rather unlikely due to controlled stimulus processing. Long RTs may be influenced by other stimuli or processes within the person which are not related to the task. According to these exclusion criteria, only one data point had to be eliminated when testing performance differences in the N-back task.

Error rate. The error rate was calculated as the percentage of errors relative to all trials minus the excluded outliers (see *reaction time*).

Results

Descriptive statistics

The sample was divided into two groups (high/low exhaustion) on the basis of the median (Mdn) score for exhaustion, which was 3. Descriptive statistics for both groups are provided in Table 1. As can been seen, emotional exhaustion and depressive symptoms significantly differed between the subgroups. Moreover, employees reporting high levels of exhaustion were significantly older than those with lower levels of exhaustion. To control for possible spurious effects, we used age and depressive symptoms as covariates in our analyses. Descriptive statistics for the N-back task and the Stroop task are provided in Table 2.

N-back task: Updating and monitoring working memory

To analyze differences between high and low exhaustion in reaction time (RT) and error rate across N-back conditions, we performed a Group (high, low exhaustion: between-subject factor) X Condition (0-, 2-back: within-subject factor) ANCOVA (repeated measure) predicting RT and error rate, with depressive symptoms and age

Table 1. Characteristics of the high and low emotional exhaustion subgroups.

	Emotional exhaustion (Median = 3.00)	
	low	*high*
n	41	40
Percentage of women	95%	85%
Percentage of full-time employees	71%	68%
Age*	35.7 (9.8)	40.90 (10.6)
Emotional exhaustion**	1.87 (0.45)	3.40 (0.60)
Depressive symptoms**	0.71 (0.62)	1.66 (0.91)

Note: For age, exhaustion and depressive symptoms, mean values are given, with standard deviations in parentheses.
$*p < .05$; $** p < .01$.

Table 2. Means and standard deviations of reaction time (ms) and error rate for the high and low emotional exhaustion subgroups in the N-back and Stroop tasks.

	Emotional exhaustion			
	High		Low	
	M	*SD*	*M*	*SD*
N-back task				
Reaction time 0-back	427.07	45.92	412.18	52.30
Reaction time 2-back	601.56	87.25	534.72	79.21
Error rate 0-back	0.07	0.26	0.16	0.37
Error rate 2-back	3.65	2.35	2.19	1.81
Stroop task				
Reaction time congruent	983.18	189.58	804.14	199.51
Reaction time incongruent	1252.64	307.05	929.09	220.68
Error rate congruent	0.23	0.58	0.41	0.77
Error rate incongruent	3.80	5.22	1.00	1.27

as covariates. Given that our design involved repeated measures (different conditions of both tasks), we were required to conduct Analyses of Covariances that account for dependent data and possible effects of covariates. In the present case, adopting alternative statistical procedures (such as moderated regression analyses) would violate mathematical assumptions (e.g. independence of residuals; Mason, Gunst, & Hess, 2003).

ANCOVAs revealed significant main effects of Condition on reaction time ($F\,(1, 76) = 8.18$; $p < .01$; $\eta^2 = .10$), whereas this effect on error rate was not significant ($F\,(1,\ 76) = 3.34$; n.s.; $\eta^2 = .04$). In the 2-back condition, RT was higher. For RT, participants with high exhaustion did not differ from those with low exhaustion ($F\,(1,\ 76) = 2.87$; n.s.; $\eta^2 = .04$). For error rate, differences between high and low exhaustion were significant ($F\,(1,\ 76) = 7.70$; $p < .01$; $\eta^2 = .09$). Those with higher exhaustion had higher RTs (see Table 2). The main effects of age on RT and error rate were significant (RT: $F\,(1,\ 76) = 10.19$; $p < .01$; $\eta^2 = .12$; error rate: $F\,(1,\ 76) = 4.95$; $p < .05$; $\eta^2 = .06$). Age was positively related to RT and error rate. The interaction effect between age and Condition on both outcomes failed to reach significance (RT: $F\,(1,\ 76) = 2.46$; n.s.; $\eta^2 = .03$; error rate: $F\,(1,\ 76) = 3.82$; n.s.; $\eta^2 = .05$). Depressive symptoms were not related to RT ($F\,(1,\ 76) = 0.53$; n.s.; $\eta^2 = .01$) and error rate ($F\,(1, 76) = 1.97$; n.s.; $\eta^2 = .03$) and did not interact with Condition (RT: $F\,(1, 76) = 0.05$; n.s.; $\eta^2 < .01$; error rate: $F\,(1, 76) = 3.55$; n.s.; $\eta^2 = .05$). Finally, and theoretically more important, we found significant interactions between Group and Condition (RT: $F\,(1,\ 76) = 4.70$; $p < .05$; $\eta^2 = .06$; error rate: $F\,(1,\ 76) = 11.06$; $p < .01$; $\eta^2 = .13$).

In addition, we conducted several *t*-tests that compared high and low exhaustion for each condition, separately (0-back and 2-back; congruent and incongruent), because post-hoc tests are not available for ANCOVA with a within-subject factor. As Figure 1 and Table 2 show, under conditions of low demands on executive control (0-back) no differences between low and high levels of exhaustion emerged (RT: $t(78) = 1.35$; n.s.; error rate: $t(78) = 1.27$; n.s.). However, when the N-back task put high demands on executive control (2-back), participants reporting high levels of exhaustion performed significantly worse as compared to those with low levels of

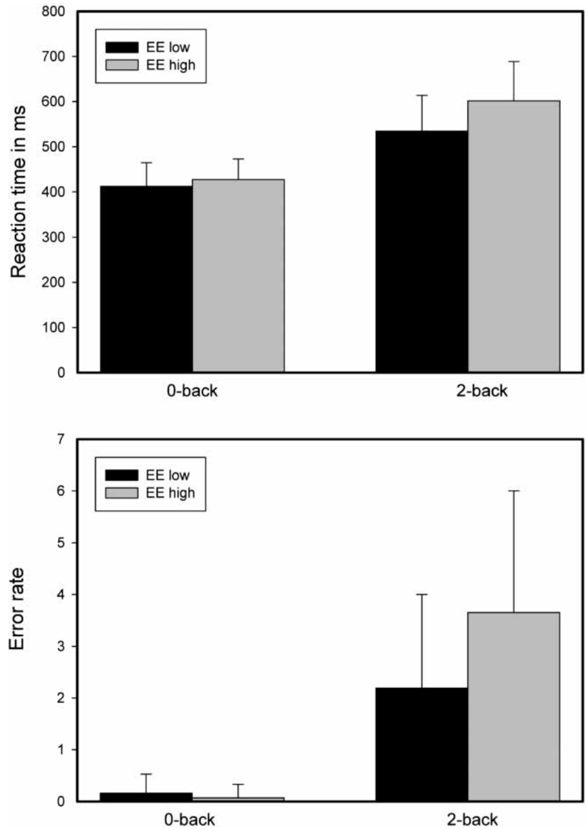

Figure 1. Reaction times (top figure) and error rates for both the low and the high emotional exhaustion groups in the N-back task. EE = emotional exhaustion.

exhaustion (RT: $t(78) = 3.60$; $p < .01$; error rate: $t(78) = 3.12$; $p < .01$). In all, Hypothesis 1a received strong support.

Stroop task: Inhibition of prepotent responses

Again, we conducted a Group (high, low exhaustion: between-subject factor) X Condition (congruent: word meaning and font are the same; incongruent: word meaning and font are different; within-subject factor) ANCOVA predicting RT and error rate, with age and depressive symptoms as covariates. For RT, age ($F\,(1, 78) = 27.51$; $p < .01$; $\eta^2 = .26$) and Group $F\,(1, 78) = 14.88$; $p < .01$; $\eta^2 = .16$) accounted for significant proportions of variance. In particular, age was positively related to RT and participants with high exhaustion showed higher RT (see Table 2). Age did not interact with Condition in predicting RT (F (1, 78) $= 1.42$; n.s.; $\eta^2 = .02$). Neither Condition ($F\,(1, 78) = 0.82$; n.s.; $\eta^2 = .01$) nor depressive symptoms ($F\,(1, 78) = 0.03$; n.s.; $\eta^2 < .01$) exerted main effects on RT. The interaction of both was also not significant (F (1, 78) $= 0.92$; n.s.; $\eta^2 = .01$). For error rate, no main effects were revealed (age: F (1, 78) $= 0.04$; n.s.; $\eta^2 < .01$; depressive symptoms: F (1, 78) $= 2.42$; n.s.; $\eta^2 = .03$; Group: $F\,(1, 78) = 3.01$; n.s.; $\eta^2 = .04$; Condition: $F\,(1, 78) = 0.10$; n.s.;

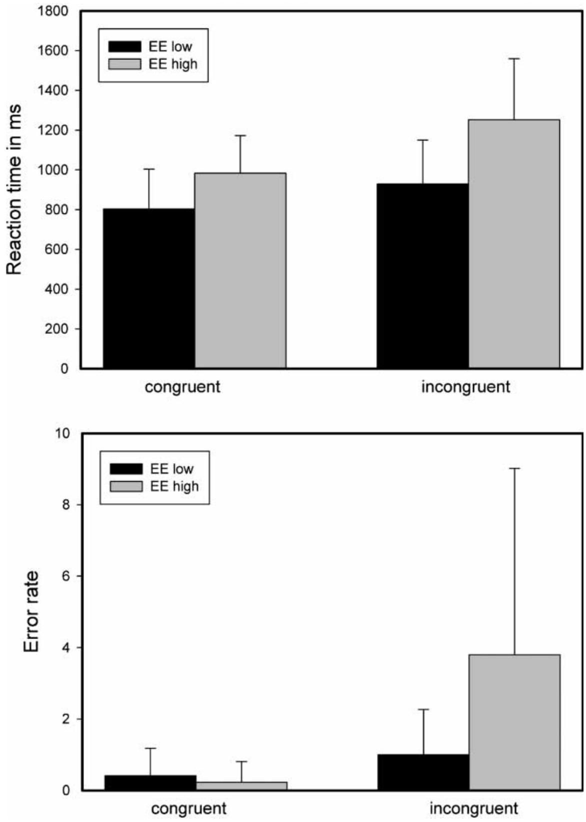

Figure 2. Reaction times (top figure) and error rates for both the low and the high exhaustion groups in the Stroop task. Congruent indicates that the word shown is congruent with its colour. EE = emotional exhaustion.

$\eta^2 < .01$). Neither age (F (1, 78) = 0.32; n.s.; $\eta^2 < .01$) nor depressive symptoms (F (1, 78) = 2.22; n.s.; $\eta^2 = .03$) interacted with Condition. Finally, and as hypothesized, we found significant interaction effects of Group and Condition on RT (F (1, 78) = 5.01; $p < .05$; $\eta^2 = .06$) and error rate (F (1, 78) = 4.17; $p < .05$; $\eta^2 = .05$).

As Figure 2 shows, only when the Stroop task put high demands on executive control (incongruent condition), did participants reporting high exhaustion perform significantly worse compared to those with low exhaustion (RT: $t(79) = 5.46$; $p < .01$; error rate: $t(79) = 3.34$; $p < .01$). Under conditions of low demands (congruent condition), these differences were generally lower and significant for RT ($t(79) =$ 4.14; $p < .01$), but not significant for error rate: $t(79) = 1.25$; n.s.). To summarize, our results support Hypothesis 1b.

Discussion

In light of the adverse effects of burnout on job performance (Halbesleben & Wheeler, 2011; Taris, 2006) and the clinical observation that burnout patients often report deficits in cognitive control (Schaufeli & Enzmann, 1998), scholars have recently begun investigating the relationship between burnout experience and cognitive processes (van Dam et al., 2011; van der Linden et al., 2005). However, the findings on differences in executive functioning due to burnout have been somewhat inconsistent (e.g. Österberg et al., 2009; Oosterholt et al., 2012), suggesting that differences in executive functioning between individuals with high and low burnout only become manifest when tasks put high demands on executive control. To extend our knowledge about this issue, the present study was designed to clarify two aspects. First, we examined differences in two of the three core executive mechanisms (namely the updating and monitoring of working memory representations and the inhibition of prepotent responses) that have been found to underlie general cognitive functioning and to draw on a particular cognitive capacity (Hofmann et al., 2012; Miyake et al., 2000). Second, we varied the extent to which the tasks require executive control and thus deplete the limited cognitive capacity that is proposed to be chronically impaired in persons reporting high emotional exhaustion.

After controlling for depressive symptoms and age, we found that employees who reported high exhaustion performed less well than those with low exhaustion when the N-back task and the Stroop task put high demands on executive control. In comparison, the two groups did not differ in their performances in cases of low demands on executive control. In line with the notion of a chronically impaired cognitive capacity in cases of burnout, the present results imply that differences between high and low levels of exhaustion in executive control are only manifested when high executive control is required and thus draws on the limited capacity. Moreover, given that we introduced depressive symptoms as a covariate in our analyses, the result patterns provide further evidence for the psychological distinctness of the burnout syndrome (especially exhaustion) that has often been suggested to constitute a specific form of depression (Toker & Biron, 2012). That is, high levels of exhaustion are considered to reflect a specific job-related strain syndrome that shares unique proportions of variance with performance in tasks requiring executive control over and beyond that accounted for by depressive symptoms. In addition, our sample was recruited in an occupational setting that often puts high demands on executive control (Schmidt, 2010). That is, we found evidence that high exhaustion *at work* relates to low cognitive performance that reflects impaired executive control. Finally, the interactions were invariant across different domains of executive control and different performance indicators, facilitating internal validity of our findings.

Recently, Oosterholt et al. (2012) also examined differences between high and low burnout in executive control. Their study design also drew on Miyake et al.'s (2000) distinction between three executive mechanisms. However, differences between burnout levels were only found in the domain of updating and monitoring working memory (N-back), whereas no differences regarding response inhibition and task switching were reported. Differences between their and our results may be explained by the operationalization of executive control. For response inhibition, Oosterholt et al. (2012) used the Sustained-Attention-to-Response-Test (SART). However, SART has been considered to reflect attention control rather than response inhibition (Berwid et al., 2005). Moreover, in light of the interaction found in our study, the degree of demands on executive control may also explain the different result patterns. In conclusion, future studies should exactly define the specific executive mechanism under investigation and the extent to which executive control is required.

Several neurophysiological mechanisms have been suggested to underlie the relation between burnout and impaired executive control (Sandström et al., 2005; van der Linden et al., 2005). Scholars have proposed that long periods of stress have adverse effects on the regulation of stress hormones as well as on specific regions of the cerebral cortex, such as the amygdala and the prefrontal cortex. Both mechanisms are involved in prolonged and sustained activation of the human stress response system (allostatic load) (McEwen, 2000). Accordingly, chronically high activation of this system causes dysregulation of the hypothalamic–pituitary–adrenal axis (HPA-axis) resulting in psychosomatic diseases, such as depression, anxiety and other symptoms related to emotional exhaustion (Danhof-Pont, van Veen, & Zitman, 2011). The exertion of high executive control has also repeatedly been found to induce low blood glucose levels, high heart rate and high blood pressure, indicating high allostatic load (Segerström & Solberg Nes, 2007). That is, chronic exposure to high demands on executive control may affect the HPA-axis, and the associated impaired cognitive capacity might lead to high levels of exhaustion. Previous findings on deficits in burnout patients who are less responsive than other individuals to motivational stimuli when performing executive tasks support this theoretical view (van Dam et al., 2011).

Study limitations

The present study is subject to several limitations that need to be discussed. First, the cross-sectional study design prevents strong causal inferences. Specifically, while we defined performance in tasks requiring executive control as a dependent variable, we are left with the question whether (1) emotional exhaustion causes impairments in executive control (Schaufeli & Enzmann, 1998); (2) lower executive control makes employees more vulnerable to job-related stress (Diestel & Schmidt, 2011); or (3) exhaustion and impaired executive control develop simultaneously as a result of chronically high job-related stress (Boksem & Tops, 2008). To clarify this question, a more complex explanation has found support in the literature (Boksem & Tops, 2008; van Dam et al., 2011). Accordingly, high demands on executive control at work can lead to exhaustion and impaired executive control because of increased allostatic load and associated deficits in the limited cognitive capacity. However, since individuals differ in cognitive capacity and thus in the ability to exert executive control (Hofmann et al., 2012), low executive control can amplify the adverse effects of job-related stress on psychological well-being. Future studies should use event sampling and longitudinal designs to test this explanation more thoroughly.

Second, to define two groups with higher and lower exhaustion, we used median-split. Dichotomization of continuous variables is associated with losses of information and may thus decrease statistical power (Cohen, 1983; MacCallum, Zhang, Preacher, & Rucker, 2002). However, the present design aimed at group analysis to compare our findings with those reported in past studies on this issue. So far, these studies have either used standardized cut-off values (van Dam et al., 2011) or disorder criteria (Österberg et al., 2009). However, for the German version of the MBI (Büssing & Perrar, 1992), standardized cut-off values are not defined and clinical definitions of burnout do not apply in the German health care system. Given that health and safety services are not able to diagnose burnout, many German employees may be left in the "danger zone" and thus might develop a chronic mental disorder that is later diagnosed, e.g. as major depression (Schaufeli & Enzmann, 1998). Thus, for testing our hypotheses, we feel confident that our procedure is useful to separate employees with low exhaustion from those who experience high exhaustion and thus are faced with an increased risk of suffering from chronic disease. Moreover, in light of our consistent findings on this topic, our procedure is conservative; also, dichotomization is methodologically justified when group analysis is applied (DeCoster, Iselin, & Gallucci, 2009).

Third, a related issue refers to the sample that was recruited from a specific occupational setting. None of the participants were diagnosed or interviewed to identify symptoms related to burnout. Moreover, all participants were still working and not on sick leave. Thus, in light of the risk of self-selection and the high proportion of women, the generalizability of our findings would be somewhat limited. However, in extending the findings provided by van der Linden et al. (2005), we sought to test whether differences in exhaustion *while at work* relate to executive functioning under conditions of high demands on executive control. We found that reduced performance in tasks requiring executive control could even be found in employees who were still on the job but reported high exhaustion.

A final issue refers to the omission from our study of task and goal switching, which is conceptualized as a core mechanism of executive control (Miyake et al., 2000). However, past research has shown that it is difficult to disentangle the executive processes in task switching from other relevant influences and thus to define the specific conditions of high and low executive demands (Schneider & Logan, 2005). In addition, the role of task switching in goal-directed action regulation is not entirely clear or theoretically grounded (Frese & Zapf, 1994). Nevertheless, given that van Dam et al. (2011) found differences in task switching between high and low burnout individuals, a more thorough conceptualization of task switching in the context of burnout is imperative.

Practical implications and conclusions

On the basis of our findings, we invite scholars to think about several possible implications. First, we found that performance differences between employees with high and low levels of exhaustion only emerged when tasks put high demands on their executive control. That is, even in similarly structured tasks, the extent to which employees who experienced high levels of exhaustion performed worse than those with low exhaustion depended on the level of demands on executive control. Consequently, as reduced executive control impairs successful adaption to job demands (Schmidt, Hupke, & Diestel, 2012; van der Linden et al., 2005), intervention programmes should include effective task allocation that explicitly considers the emotional exhaustion levels of employees and supports those employees who return from sick leave due to burnout, to gradually increase their task performance depending on their ability to exert executive control.

Second, given that we controlled for depressive symptoms, our findings suggest that emotional exhaustion at work and depression are not identical. Thus, we suggest that researchers need to define specific criteria for a psychological or clinical diagnosis of burnout that is related to the individual's performance with regard to cognitive control. In light of the fact that burnout is not classified as a disease (ICD-10, World Health Organization, 2010), current practices that are based on standardized cut-off values or classifications of related diseases (such as chronic fatigue or depression) seem to be insufficient. Since participants with high exhaustion showed impaired executive control in the present study, many employees suffering from high exhaustion may not be identified or may be reluctant to report their impairments, increasing the risk of their suffering a major depression (Schaufeli & Enzmann, 1998). For practitioners, clear definitions of, and valid criteria for, the burnout syndrome might be useful to reduce burnout at work and thus to prevent impairments in the performance of tasks requiring high cognitive control.

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