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Research paper

Burnout is associated with changes in error and feedback processing

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ABSTRACT

Burnout is a pattern of complaints in individuals with emotionally demanding jobs that is often seen as a precursor of depression. One often reported symptom of burnout is cognitive decline. To analyze cognitive control and to differentiate between subclinical burnout and mild to moderate depression a double-blinded study was conducted that investigates changes in the processing of performance errors and feedback in a task switching paradigm. Fifty-one of 76 employees from emotionally demanding jobs showed a sufficient number of errors to be included in the analysis. The sample was subdivided into groups with low (EE-) and high (EE+) emotional exhaustion and no (DE-) and mild to moderate depression (DE+). The behavioral data did not significantly differ between the groups. In contrast, in the EE+ group, the error negativity (Ne/ERN) was enhanced while the error positivity (Pe) did not differ between the EE+ and EE- groups. After negative feedback the feedback-related negativity (FRN) was enhanced, while the subsequent positivity (FRP) was reduced in EE+ relative to EE-. None of these effects were observed in the DE+ vs. DE-. These results suggest an upregulation of error and negative feedback processing, while the later processing of negative feedback was attenuated in employees with subclinical burnout but not in mild to moderate depression.

1. Introduction

1.1. Burnout and its measurement

Burnout is assumed to be a possible outcome of chronic, usually work-related stress and high psychosocial demands at work (Ahola, Honkonen, Virtanen, Aromaa, & Lonnqvist, 2008) that is mainly characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment (Maslach, Schaufeli, & Leiter, 2001, see also Maslach et al., 2008 for conceptual discussion). Those symptoms overlap considerably with those of depression, for example feelings of helplessness, hopeless and powerlessness and absence of positive emotions as well as cognitive impairments (Bianchi, Schonfeld, & Laurent, 2015) but burnout and depression also differ in some aspects (Ahola, Hakanen, Perhoniemi, & Mutanen, 2014; Gajewski et al., in press; Maslach & Leiter, 2017). To date, qualitative differences in symptoms between burnout and depression have not been systematically investigated.

For the most part, burnout has been assessed by questionnaires. The most prominent is the Maslach Burnout Inventory (MBI; Maslach & Jackson 1981) and MBI-General Survey (MBI-GS, Leiter, Maslach, & Jackson, 1996). Later further concepts of burnout and other assessment instruments were established, for example the Burnout Measure (BM; Pines, 1993), Shirom–Melamed Burnout Measure (SMBM; Shirom & Melamed, 2006) or the Copenhagen Burnout Inventory (Kristensen, Borritz, Villadsen, & Christensen, 2005). A more recent questionnaire is the Oldenburg Burnout Inventory (OLBI; Demerouti, Bakker, Vardakou, & Kantas, 2003) which embraces the dimensions emotional exhaustion and disengagement from work. Generally, emotional exhaustion (EE) is often seen as the main symptom of burnout (Maslach et al., 2001). EE is also likely to induce the second symptom, depersonalization, because of a lack of the emotional resources which are necessary to think about, and interact with, people on an emotional level.

Questionnaires such as the MBI and OLBI are easy to administer but have some potential disadvantages like their proneness to deception and social desirability (Krumpal, 2013). For example, some employees may underestimate or even deny the symptoms to avoid long-lasting clinical interventions or stigmatization in the company or social environment (Siebert, 2005). Therefore, attempts have been undertaken

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to measure behavioral and physiological changes accompanying burnout using objective measures to validate the diagnosis c.f. Gajewski et al.,in press.

Based on the core definition of burnout as including physical and emotional depletion due to stress, this depletion may also affect cognition (Demerouti et al., 2003). This seems to be plausible as long-term stress leads to changes in cortisol level (De Vente, Olff, Van Amsterdam, Kamphuis, & Emmelkamp, 2003; Mommersteeg, Heijnen, Kavelaars, & van Doornen, 2006; Oosterholt, Maes, Van der Linden, Verbraak, & Kompier, 2015), which negatively affects brain structures like the hippocampus which is crucial for memory consolidation (Lupien & Lepage, 2001) and the prefrontal cortex which subserves executive functioning (Arnsten, 2009). Accordingly, Sandström et al. (2005) found impairments of memory and attention in women with burnout. While Öhman et al. (2007) found an impairment of attention and executive functions. Jonsdottir et al. (2013) tested a wide range of cognitive functions in subjects with and without burnout. The largest group difference was found for processing speed, working memory and executive control. Moreover, group differences were found for episodic memory and backward memory span, suggesting changes in working memory. In a recent study Oosterholt et al. (2014, 2016) compared subjects with clinical or subclinical burnout to healthy controls using a test battery which covered a number of executive functions like updating, switching and inhibition. The authors defined clinical burnout group as employees seeking treatments for their burnout symptoms diagnosed by professional clinical psychologists, whereas subclinical burnout individuals were employees reporting symptoms of burnout, but were neither diagnosed as such nor seeking help for symptoms. The latest group differed from the healthy control group by higher scores on the Utrechste Burnout Scale (UBOS), a Dutch adaptation of the MBI. Only processing speed was increased but the executive functions were not impaired in the subjects with clinical burnout.

In summary, although the results of cognitive tests in burnout are inconsistent the cited studies show some evidence for cognitive deficits in clinical burnout (Eskildsen, Andersen, Pedersen, Vandborg, & Andersen, 2015; Jonsdottir et al., 2013; Sandström, Rhodin, Lundberg, Olsson, & Nyberg, 2005; Öhman et al., 2007; Oosterholt et al., 2012; Österberg et al., 2009; Van der Linden, Keijsers, Eling, & Van Schaijk, 2005). Overall, mainly memory and executive functions appear impaired, mostly when tasks are sufficiently complex. In contrast, Oosterholt et al. (2014) and Sokka et al. (2016) found no cognitive deficits in subjects with subclinical burnout compared to healthy controls. Thus, it is unclear whether individuals with subclinical levels of burnout are susceptible to cognitive deficits at all. A further problem with test performance is the possibility of compensation in subclinical burnout when the symptoms are relatively mild: people with depleted cognitive resources in some cognitive areas may invest more resources in other functions to compensate for performance deficits. The present study aims at addressing these limitations by assessing event-related potentials (ERPs), in conjunction with behavioral task performance in a memory-based task switching paradigm.

In contrast to pure behavioral measures event-related potentials (ERP) extracted from scalp-recordings of the electroencephalography (EEG) can yield information about timing and strength of different cognitive processes, also those which are not directly reflected in behaviour. ERPs have an excellent time resolution and allow analysis of different cognitive processing steps constituting overt behaviour or detection of errors or evaluation processes like feedback processing. ERPs can also detect processing changes that are not yet seen in overt behaviour (Falkenstein, Hoormann, & Hohnsbein, 2001) and even compensatory processes (Wild-Wall, Hahn, & Falkenstein, 2011; Yordanova, Kolev, Hohnsbein, & Falkenstein, 2004).

1.2. ERPs and burnout

To our knowledge, there are only a few studies that used ERPs to investigate cognitive changes accompanying burnout. Van Luijtelaar et al. (2010) compared ERPs in 13 patients with clinical burnout assessed by Utrechste Burnout Scale compared to healthy controls. The burnout patients showed reduced P300 (P3b) amplitude in an auditory oddball task. Sokka et al. (2014) presented speech stimuli with emotional valence to subjects with job burnout symptoms and healthy controls. The burnout group showed a shorter latency of the P3a (reflecting involuntary shift of attention) after emotionally negative stimuli, and a longer latency after emotionally positive stimuli. The results indicate that in burnout, attention capture is faster for negative stimuli, and slower for positive stimuli compared to controls. In a subsequent study Sokka et al. (2016) used a visual working memory task that was interrupted by occasional distractor sounds. The P3a to the auditory distractors was reduced in the burnout group, which suggests deficits in attentional processing of novel and potentially important events. Moreover, in the visual task, the parietal P3b was decreased among individuals with subclinical burnout. Similar reduction of the P3a and P3b was found in subclinical burnout in our recent study (Gajewski et al. in press) In sum, the few ERP studies showed a reduction in the P3a and P3b components reflecting impairments of attentional and working memory processes in burnout relative to healthy individuals.

Despite using ERPs, however, none of the preceding studies investigated error and feedback processing associated with burnout.

1.3. Electrophysiology of error and feedback processing

Two prominent ERP components emerge after incorrect motor responses: the error negativity (Ne; Falkenstein, Hohnsbein, Hoormann, & Blanke, 1991), termed also error-related negativity (ERN; Gehring, Goss, Coles, Meyer, & Donchin, 1993), and the subsequent error positivity (Pe; Falkenstein et al., 1991, 2000). Ne and Pe occur in a multitude of tasks after response errors, such as in alternative-choice tasks (Falkenstein et al., 2001; Gehring et al., 1993), or after false alarms in Go/NoGo tasks (Falkenstein, Hoormann, & Hohnsbein, 1999; Scheffers, Coles, Bernstein, Gehring, & Donchin, 1996). The Ne is a negative deflection with fronto-central maximum that peaks between 50 and 100 ms after an incorrect response, which is larger compared to a similar negative wave seen after correct responses (Nc or CRN, Ford, 1999; Vidal, Hasbroucq, Grapperon, & Bonnet, 2000). The Nc/CRN is likely related to general response monitoring (Allain, Carbonnell, Falkenstein, Burle, & Vidal, 2004). The Ne is believed to be associated with the early detection of full or partial response errors (Burle, Roger, Allain, Vidal, & Hasbroucq, 2008; Edwards, Calhoun, & Kiehl, 2012; Falkenstein et al., 1991). The Pe is a positive deflection following the Ne, which is only seen after full but not partial errors (Allain, Hasbroucq, Burle, Grapperon, & Vidal, 2004). The Pe is usually thought to reflect the conscious perception of a full error, a response strategy adjustment after such a perception, and/or the affective assessment of the error (Endrass, Reuter, & Kathmann, 2007;Falkenstein et al., 1991; Overbeek, Nieuwenhuis, & Ridderinkhof, 2005). No subsequent positivity is seen after the Nc/CRN.

After feedback stimuli with negative valence there is a fronto-central negative deflection that peaks approximately 250 ms after feedback onset. This feedback-related negativity (FRN; Miltner, Braun, & Coles, 1997) signals negative outcomes (such as incorrect actions or erroneous decisions), which is usually followed by a positivity (called P300 by Ferdinand and Kray 2013). To avoid confusion with the classical P300, we call this component feedback-related positivity (FRP) in the present study. These components are not seen after feedback stimuli that signal positive outcomes. FRN and FRP after negative feedback are similar to the Ne and Pe after motor errors (Bellebaum & Colosio, 2014; Eppinger, Kray, Mock, & Mecklinger, 2008; Holroyd & Coles, 2002); hence, it appears safe to relate FRN and FRP to early and late aspects of processing negative feedback. Ferdinand and Kray (2013) relate the FRP to the later evaluation of negative feedback.