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Job burnout is associated with dysfunctions in brain mechanisms of voluntary and involuntary attention

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ABSTRACT

Individuals with job burnout symptoms often report having cognitive difficulties, but related electrophysiological studies are scarce. We assessed the impact of burnout on performing a visual task with varying memory loads, and on involuntary attention switch to distractor sounds using scalp recordings of event-related potentials (ERPs). Task performance was comparable between burnout and control groups. The distractor sounds elicited a P3a response, which was reduced in the burnout group. This suggests burnout-related deficits in processing novel and potentially important events during task performance. In the burnout group, we also observed a decrease in working-memory related P3b responses over posterior scalp and increase over frontal areas. These results suggest that burnout is associated with deficits in cognitive control needed to monitor and update information in working memory. Successful task performance in burnout might require additional recruitment of anterior regions to compensate the decrement in posterior activity.

1. Introduction

Job burnout is a work-related chronic affective state, developing gradually over time as a consequence of prolonged stress at work. Usually it is characterized by emotional exhaustion, cynicism, and decreased effectiveness and professional inefficacy (Maslach, Schaufeli, & Leiter, 2001; Schaufeli and Enzmann, 1998). Disturbed sleep, physical fatigue, and cognitive weariness are typical of job burnout (Ekstedt et al., 2006; Melamed et al., 1999). The symptoms overlap considerably with depression and psychological distress, especially in the more severe forms of job burnout but there is an increasing body of evidence supporting the argument that burnout and depression are not identical concepts (Ahola, Hakanen, Perhoniemi, & Mutanen, 2014; Bakker et al., 2000; Brenninkmeyer, Van Yperen, & Buunk, 2001; Iacovides, Fountoulakis, Kaprinis, & Kaprinis, 2003; Marchand, Durand, Juster, & Lupien, 2014).

Individuals who experience job burnout often report having cognitive difficulties. To date, the impact of burnout on cognitive processes has been mainly assessed through behavioral studies, which suggest an association with impairments in voluntary control of attention (Van der Linden, Keijsers, Eling, & Van Schaijk, 2005; Sandström, Rhodin, Lundberg, Olsson, & Nyberg, 2005), processing speed (Österberg, Karlson, & Hansen, 2009), and working memory (Oosterholt, Van der Linden, Maes, Verbraak, & Kompier, 2012). However, these results have been found mostly in clinical samples with high levels of burnout. In fact, in a population-based study of young adults with relatively mild symptoms, no association between self-rated symptoms of burnout and cognitive difficulties was observed (Castaneda et al., 2011). So far, only a few related electrophysiological studies have been published suggesting reduced allocation of attentional resources to the task at hand (Van Luijtelaar, Verbraak, van den Bunt, Keijsers, & Arns, 2010), and more recently, an attention capture tendency towards negative over positive emotional sounds in individuals who complain of job

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burnout (Sokka et al., 2014). In the present study, we extend our previous work by measuring event-related brain potentials (ERPs) to task-relevant visual stimuli in tasks with varying memory loads as well as task-irrelevant distractor sounds (no response required) in participants suffering from job burnout and in their matched non-burnout peers.

We used the n-back task, in which the participants are asked to monitor a series of stimuli and to respond if the incoming stimulus matches to the one presented *n* trials before (Owen, McMillan, Laird, & Bullmore, 2005). Typically, an increase in memory load increases response time and decreases accuracy (e.g., Smith & Jonides, 1997). Task-relevant stimuli elicit a P3b response, peaking approximately at 300–500 milliseconds after stimulus onset, and reflecting brain activity related to context updating (Picton, 1992; Polich, 2007; Soltani & Knight, 2000). Neuroimaging studies indicate that working memory updating gives rise to significant load-dependent activation on a widespread fronto-parietal network, including the dorsolateral prefrontal cortex, posterior and inferior regions of the frontal cortex, and the posterior parietal cortex (Alain, Shen, Yu, & Grady, 2010; Carlson et al., 1998; Cohen et al., 1997; Leung & Alain, 2011; Owen et al., 2005; Smith & Jonides, 1997).

It has been argued that P3b is sensitive to the demands placed on working memory as reflected by reduced responses over parietal and central regions (Wintink, Segalowitz, & Cudmore, 2001). Decrement of the P3b at centro-parietal regions was also demonstrated in the study of Pratt et al. (2011) but only in task conditions were task-irrelevant stimuli were present. In addition, there is evidence of P3b being susceptible to stress as well as fluctuations in the participant's level of arousal, tending to decrease in amplitude in conjunction with higher stress (Shackman, Maxwell, McMenamin, Greischar, & Davidson, 2011), fatigue, or low arousal state stemming from sleep disruption (Colrain & Campbell, 2007; Polich & Kok, 1995).

Unexpected novel sounds elicit a P3a response, which is thought to index involuntary capture of attention (Alho et al., 1998; Escera, Alho, Winkler, & Näätänen, 1998; Friedman, Cycowicz, & Gaeta, 2001; Knight, 1984; Knight, Scabini, Woods, & Clayworth, 1989), as such sounds also cause a delay in participants' responses to task-relevant stimuli (Escera et al., 1998; Escera, Yago, & Alho, 2001; Escera & Corral, 2007). Studies using the auditory-distraction paradigm, i.e., participants are instructed to perform a visual task and ignore the concomitant auditory stimulation, have identified two distinct consecutive phases – early and late – of the auditory P3a response, peaking approximately 230 ms and 320 ms after stimulus onset, respectively (Escera et al., 1998; Winkler, Denham, & Escera, 2015; Yago, Escera, Alho, Giard, & Serra-Grabulosa, 2003). The scalp distribution of the P3a is more anterior than that of the P3b suggesting different neural generators (Escera et al., 1998; Friedman et al., 2001; Knight et al., 1989; Knight, 1997; Schröger, Giard, & Wolff, 2000; Soltani & Knight, 2000). The auditory P3a is generated by a widespread network of cortical regions, including the prefrontal cortex, the auditory cortex, temporo-parietal junction, medial frontal gyrus, and anterior cingulate gyrus (Alho et al., 1998; Friedman et al., 2001; Knight, 1984; Knight et al., 1989). Further, the early phase of the P3a is maximal over temporo-parietal and fronto-temporal locations, whereas the later phase has a wider distribution spreading towards prefrontal and superior parietal regions (Escera et al., 1998; Yago et al., 2003). When the task requires working memory, the memory load modulates the distraction caused by the stimuli irrelevant for the task (Berti & Schröger, 2003). As working memory load increases, distraction reduces behaviorally, and P3a responses elicited by the novel sounds diminish in amplitude, especially the later phase of the P3a response (SanMiguel, Corral, & Escera, 2008). Furthermore, P3a, like P3b, has also been suggested to attenuate in amplitude due to sleep deprivation (Colrain & Campbell, 2007).

To sum up, previous research findings on burnout suggest that cognitive weariness, disturbed sleep, and psychological distress are typical of burnout. In addition, previous ERP studies have suggested that the P3a and P3b responses are susceptible to stress and fatigue. Therefore, we should observe a group difference in electrophysiological activity elicited by both the task-relevant visual stimuli and the distractor sounds not relevant to the task. More specifically, we hypothesize smaller auditory P3a and visual P3b responses in the burnout group. Previous behavioral studies have reported differences in cognitive processes, however mainly in severe burnout. Thus, we might observe comparable task performance between those with job burnout symptoms and those without symptoms as our sample is non-clinical in nature reporting a wide range of burnout symptoms, however relatively mild on average.

2. Methods

2.1. Participants

The participants in the present study were the same as reported in Sokka et al. (2014) except for one participant who did not complete the n-back paradigm, resulting in a total of 66 participants. The grouping of the participants into the burnout and control groups was implemented as follows: the Finnish version of the Maslach Burnout Inventory—General Survey (MBI-GS; Kalimo, Hakanen, & Toppinen-Tanner, 2006) was completed after the ERP recordings, and used as a grouping criterion (cut-off point: the total score 1.5, i.e., at least mild job burnout). The groups resulted in no clear differences in age, gender, education, and working experience (see Table 1). Based on the exclusion criteria of the EEG analysis (see "Electrophysiological recording and analysis" section for more detailed information), a final sample of 30 participants with job burnout (mean age = 47.5, SD = 8.2 years, 2 left-handed) were compared with a sample of 19 non-burnout control participants (mean age = 43.3, SD = 8.7 years, 1 left-handed). Data from 17 participants (10 job burnout, 7 control participants) were discarded due to excessive artifacts, or technical difficulties. All participants had self-reported normal hearing, and normal or corrected-to-normal vision. The participants were recruited from among customers of the Occupational Health Centre of the city of Helsinki and employees of the city of Helsinki through advertisements displayed at the local occupational health care station, as well as on the intranet sites of the aforementioned organizations. Of the job burnout participants, 80% entered the study after noticing the advertisement, and 20% were referred by a physician, psychologist, or nurse during appointments at the local occupational health care station. The participants were at work, they reported encountering cognitively demanding situations in their daily work (e.g., interruptions), and they worked only during daytime (i.e., shift workers were included but night-shift workers were excluded). Other exclusion criteria were (i) excessive use of alcohol (i.e., 40 g of alcohol or more regularly per day for men, 20 g of alcohol or more per day for women; Alcohol: Current Care Guidelines, 2011) or drugs, (ii) diagnosed severe psychiatric or neurological disorders, and (iii) schizophrenia in first grade family members. Also other diagnosed illnesses of organic origin resulting in fatigue, such as an organic sleep disorder or severe anemia, were considered exclusion criteria.

2.2. Materials

2.2.1. Self-reports

In the beginning of the whole ERP session and just before the start of the n-back task (approximately one hour from the