Shifting of attentional set is inadequate in severe burnout: evidence from an event-related potential study

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Abstract

Individuals with prolonged occupational stress often report difficulties in concentration. Work tasks often require the ability to switch back and forth between different contexts. Here, we studied the association between job burnout and task switching by recording event-related potentials (ERPs) time-locked to stimulus onset during a task with simultaneous cue-target presentation and unpredictable switches in the task. Participants were currently working people with severe, mild, or no burnout symptoms. In all groups, task performance was substantially slower immediately after task switch than during task repetition. However, the error rates were higher in the severe burnout group than in the mild burnout and control groups. Electrophysiological data revealed an increased parietal P3 response for the switch trials relative to repetition trials. Notably, the response was smaller in amplitude in the severe burnout group than in the other groups. The results suggest that severe burnout is associated with inadequate processing when rapid shifting of attention between tasks is required resulting in less accurate performance.

Key words: Job burnout; Work fatigue; Attention; Event-related potentials (ERP); Task switching

1. INTRODUCTION

Individuals who experience prolonged work-related stress often report decreased sense of efficacy in performing their daily work, as well as difficulties in information processing and concentration. Indeed, cognitive weariness is typical of job burnout (Melamed et al., 1999, 2006) which develops gradually as a result of prolonged exposure to emotional and interpersonal stressors at work. It is commonly characterized by emotional exhaustion, cynicism toward work, and decreased professional efficacy (Maslach, Schaufeli, & Leiter, 2001; Schaufeli & Enzmann, 1998).

Several behavioral studies have indicated that chronic occupational stress is associated with impairments in cognitive functioning, especially executive functions, attentional control, and working memory (Deligkaris, Panagopoulou, Montgomery, & Masoura, 2014; Eskildsen, Andersen, Pedersen, Vandborg, & Andersen, 2015; Jonsdottir et al., 2013; Linden, Keijsers, Eling, & Schaijk, 2005; Oosterholt, Van der Linden, Maes, Verbraak, & Kompier, 2012; Sandström, Rhodin, Lundberg, Olsson, & Nyberg, 2005; van Dam, Keijsers, Eling, & Becker, 2011; Österberg, Karlson, & Hansen, 2009). Such impairments are apparent especially in severe burnout. When the symptoms are relatively mild, however, performance can be sustained at an equally good level as that of others (Castaneda et al., 2011; Oosterholt, Maes, Van der Linden, Verbraak, & Kompier, 2014; Sokka et al., 2016). Also brain imaging studies suggest burnout-related alterations, for example, in emotion- and stress-processing limbic networks as reflected by reductions in the gray matter volume (Blix, Perski, Berglund, & Savic, 2013; Savic, 2013) and altered functional connectivity (Golkar et al., 2014; Jovanovic, Perski, Berglund, & Savic, 2011), or dysfunctions of frontoparietal mechanisms involved in cognitive control processes of voluntary and involuntary attention (Liston,

McEwen, & Casey, 2009; van Luijtelaar, Verbraak, van den Bunt, Keijsers, & Arns, 2010), even in participants with relatively mild burnout symptoms (Sokka et al., 2014, 2016). However, the mechanisms behind the association between burnout and cognitive deficits are yet not well understood due to heterogeneity and scarcity of the research literature (for a review, Deligkaris et al., 2014).

In working life, it is common to encounter frequently changing assignments and sudden, unprepared tasks requiring immediate redistribution of focus and cognitive resources. In the present study, we explored the association between burnout symptom severity and shifting between task sets, which is frequently regarded as one of the key executive functions in the literature (Miyake et al., 2000). We used scalp recordings of event-related brain potentials (ERPs) extracted from continuous electroencephalogram (EEG) to measure attention allocation and set shifting with a task switching paradigm in which we embedded random switches and used simultaneous cue-target presentation.

Task switching paradigms require rapid shifting between simple task sets, and they are commonly used to investigate goal-directed control of attention (for a review, see Monsell, 2003), and its neural mechanisms (e.g., Corbetta & Shulman, 2002). Switching from one task to another typically results in substantially slower and, often, more error-prone performance in the switch trials than in the repetition trials, a phenomenon called the switch cost (Meiran, 1996; Monsell, 2003; Rogers & Monsell, 1995). Furthermore, performance immediately after a switch in the task is decreased to a greater extent, as shown by increased switch cost, following sleep deprivation (Heuer, Kleinsorge, Klein, & Kohlisch, 2004), and in certain clinical conditions affecting frontal functions, such as severe burnout (van Dam et al., 2011;

van Dam, Keijsers, Eling, & Becker, 2012), depression (Meiran, Diamond, Toder, & Nemets, 2011), and prefrontal cortical lesions (Barceló & Knight, 2002).

A popular variant of the paradigm is the task-cueing paradigm consisting of a random sequence of switch and repeat trials with the currently valid task indicated by a cue. The time interval between the cue and the target affects the switch cost: the shorter the interval, the larger the switch cost (Logan & Bundesen, 2003, 2004; Meiran, 1996). Furthermore, when the cue and target are presented simultaneously, for example, when the location of the stimulus indicates the task to be completed on a given trial, both the cue and the possible switch need to be encoded in parallel with target stimulus processing which may be disrupted resulting in a further increase in switch cost (Logan & Bundesen, 2003; Nicholson, Karayanidis, Poboka, Heathcote, & Michie, 2005).

ERPs are neural responses that are time-locked to specific events of interest, such as allocation of attention to a stimulus. ERP recordings provide a means to study the cortical basis of fast sensory and cognitive processes, and they are widely applied both in basic research, and in studies with different clinical subgroups such as patients with depression (McNeely, Lau, Christensen, & Alain, 2008), insomnia and/or excessive sleepiness (Gumenyuk, Belcher, Drake, & Roth, 2015), chronic fatigue syndrome (Polich, Moore, & Wiederhold, 1995), or a brain lesion (Knight, 1984; Polich & Squire, 1993). Especially, the P3 response of the ERP has been widely studied in clinical subgroups as it is thought to reflect attention and memory processes engaged during stimulus processing (Polich & Herbst, 2000; Polich, 2007; Soltani & Knight, 2000). The P3 is a large positive response elicited by voluntary detection of task-relevant stimuli, generated by a network of cortical regions, and

peaking approximately 300-500 ms after stimulus onset over parietal scalp sites (e.g., Knight, 1997; Soltani & Knight, 2000). The P3 amplitude has been shown to decrease in association with high stress (Shackman, Maxwell, McMenamin, Greischar, & Davidson, 2011), increased sleepiness following sleep deprivation (Colrain & Campbell, 2007; Polich & Kok, 1995), depression (Cavanagh & Geisler, 2006), and severe burnout (van Luijtelaar, Verbraak, van den Bunt, Keijsers, & Arns, 2010). In addition, our recent study showed reduced working-memory related visual P3b amplitudes over posterior scalp and increased P3b amplitudes over frontal areas even with relatively mild burnout symptoms (Sokka et al., 2016). Additional recruitment of anterior regions to compensate the decrement in posterior activity might be required in order to sustain a similar performance level than that of the controls. Together these findings suggest disturbed processing of task-relevant information in these conditions.

Neural processes related to task switching can be studied separately, for example, in relation to the cue, target, or motor response. ERP responses time-locked to the onset of the cue typically show a larger posterior positivity for switch trials than repetition trials as indicated by enhanced cue-related centro-parietal P3-like responses (Barceló, Periáñez, & Knight, 2002; Gajewski & Falkenstein, 2011; Karayanidis et al., 2010; Kieffaber & Hetrick, 2005; Kieffaber, O'Donnell, Shekhar, & Hetrick, 2007; Kopp & Lange, 2013; Lange, Seer, Müller, & Kopp, 2015; Nicholson, Karayanidis, Bumak, Poboka, & Michie, 2006; Nicholson et al., 2005; Tarantino, Mazzonetto, & Vallesi, 2016), and a fronto-central task-novelty P3 response (Barcelo, Escera, Corral, & Periáñez, 2006; Barceló et al., 2002; Periáñez & Barceló, 2009). Recently, Berti (2016) applied a memory updating task in which either the same or another memory items were compared with the preceding trials, resulting in switch and repetition trials. Both trial types elicited a large bi-phasic P3-like response which was more pronounced

for the switch than the repetition trials. By contrast, P3-like responses time-locked to the target stimulus have typically been shown to be more pronounced for repetition trials than for switch trials (Barceló, Muñoz-Céspedes, Pozo, & Rubia, 2000; Gajewski & Falkenstein, 2011; Goffaux, Phillips, Sinai, & Pushkar, 2006; Hsieh & Liu, 2008; Kieffaber & Hetrick, 2005; Tarantino et al., 2016). However, when the interval between the cue and the target is short, or when the cue and the target are simultaneously presented, there is a substantial temporal overlap between cue-related and target-related processes as indicated by coinciding switch-related positive deflections in the ERP waveforms (Nicholson et al., 2005). Furthermore, ERPs related to the response to the preceding trial are characterized by a parietally maximal negativity between the response and the onset of the subsequent stimulus, reaching its maximal around 400 ms post-response (Karayanidis, Coltheart, Michie, & Murphy, 2003). When the response-stimulus interval is short (e.g., 150 ms) so that there is only little time to prepare for the upcoming stimulus, Karayanidis et al. (2003) observed that the negativity began prior to stimulus onset, and continued after stimulus onset, thereby overlapping with ERP responses associated with subsequent stimulus processing. In sum, several studies applying a wide variety of stimulus and task manipulations indicate that switch-related ERP responses consist of many underlying components, and that various control processes are recruited during task switching, including context monitoring and updating, rapid reconfiguration, and task set preparation and execution (for a review, see Karayanidis et al., 2010).

In the present study, we explored the association between burnout and shifting between tasks in groups of currently working individuals with severe, mild, or no burnout symptoms. To this end, we recorded performance and stimulus-locked ERPs in a task switching paradigm in which switches between task sets occurred randomly, the cue and the target were presented

simultaneously, and the response-stimulus interval was short. Previous research on cognitive and brain functions suggests burnout-related impairments in cognitive performance and alterations in control of attention. Therefore, we expected to observe impaired performance at least when burnout symptoms are severe. In addition, based on previous findings on ERPs related to task switching, we expected that switch trials elicit greater P3-like activation than repetitive trials due to the nature of the present experimental paradigm in which the location of the stimulus signaled the task to be completed on a given trial. Therefore, cue-related and target-related processes cannot be separated in the present study. We also expected that burnout-related alterations in electrophysiological activity related to attentional set shifting might be observed as reflected by the P3.

2 MATERIALS AND METHODS

2.1 Participants

The participants in the present study were the same as those reported in Sokka et al. (2014) except for three participants who did not complete the present task switching paradigm, resulting in a total of 64 participants. They reported having normal or corrected-to-normal vision, and no hearing deficits. The participants were employees of the city of Helsinki or customers of the Occupational Health Centre of the city of Helsinki. They were recruited through advertisements informing about the present research project in which association between burnout symptoms and cognitive functions was explored by means of brain research and neuropsychological methods. The advertisements were displayed at the local occupational health care station, as well as on the intranet sites of the aforementioned organizations. Four participants with mild burnout symptoms, and four participants with

severe burnout symptoms were referred to the study by a physician, psychologist, or nurse during appointments at the local occupational health care station. The rest of the burnout participants and all control participants entered the study after noticing the advertisement. The recruitment process reported here is the same as that reported in Sokka et al. (2014, 2016). The participants were first interviewed by telephone to ensure that the potentially experienced symptoms of burnout were work-related, or to find out whether they volunteered as possible control participants. The interview included questions about, for instance, symptoms and their onset, possible diagnosed neurologic or severe psychiatric illnesses (exclusion criteria), other possible etiology for the symptoms, education, employment status, as well as other possible psychosocial factors affecting psychological well-being such as serious illness of a family member or conflicts with spouse. At the time of the study, the participants were working. All 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., $\geq$ 40 g of alcohol per day for men, $\geq$ 20 g of alcohol 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 as exclusion criteria. After recruitment, an appointment was made for the participation in the study.

Grouping of participants into mild burnout, severe burnout, and control groups was completed only after the ERP recordings, on the basis of their answers on the Finnish version of the Maslach Burnout Inventory – General Survey (MBI-GS; Kalimo, Hakanen, & Toppinen-Tanner, 2006). Based on exclusion criteria of EEG analysis (see section 2.5., “Electrophysiological recording and analysis”), a complete dataset of 57 participants

consisting of 21 participants with mild burnout (mean age = 47.7, SD = 8.6 years, age range: 28-59 years, 2 men, 1 left-handed), 12 with severe burnout (mean age = 47.1, SD = 8.4 years, age range: 32-58 years, 1 man, 2 left-handed), and 24 control participants (mean age = 45.1, SD = 8.7 years, age range: 27-61 years, 4 men, 3 left-handed) was selected for further analysis after discarding data from 7 participants (3 mild burnout, 2 severe burnout, and 2 control participants) due to excessive artifacts in their EEG or technical difficulties in the EEG recordings. The resulting groups did not differ in terms of age, gender, education, and working experience (Table 1).

Table 1.

Written informed consent for voluntary participation was obtained from all participants before entering the study. The protocol followed the Declaration of Helsinki for the rights of the participants and the procedures of the study. An ethical approval of the present research protocol was obtained from The Ethical Committee of the Hospital District of Helsinki and Uusimaa. For their participation in the study, all participants were given a book gift and a gift card.

2.2 Procedure

The participants were tested individually in two sessions, one consisting of measurements of ERPs in five different paradigms (two of them are reported in Sokka et al., 2014, 2016), and the other of neuropsychological assessment. The participants were given an opportunity to attend both sessions on one day or on two separate days, according to their preference.

Approximately one third of the burnout participants and half of the control participants chose to attend the sessions on two separate days. The ERP recordings were always conducted in the morning: they began around at 9 am, and they lasted 2-2.5 hours (including breaks). The ERP recordings were completed in a similar manner for all participants, and the task switching paradigm reported here was always presented as the second paradigm in order. It began approximately 30 minutes after the onset of the entire ERP session, and the recording time for this task was approximately 30 minutes. Within 1-2 months after the entire study protocol, the participants were offered an opportunity to get individual feedback on the self-reports and performance in the neuropsychological assessment, and to discuss their work situation with a psychologist (the corresponding author) and a neurologist from the Finnish Institute of Occupational Health.

2.3 Collection of self-reports

In order to evaluate burnout symptoms, the MBI-GS (Kalimo et al., 2006) was used as it maintains a consistent factor structure across a variety of occupations and is widely used in research (Leiter & Schaufeli, 1996; Schutte, Toppinen, Kalimo, & Schaufeli, 2000). The inventory comprises three subscales: exhaustion, cynicism, and professional inefficacy. According to the instructions provided in the MBI-GS manual, scores (range 0-6) from the subscales were used to calculate the total score. In addition, the following clinical measures were completed: the Finnish versions of Beck's Depression Inventory (BDI-II, scoring range 0-63; Beck, Steer, & Brown, 1996, Finnish norms, 2004) and Beck's Anxiety Inventory (BAI, scoring range 0-63; Beck & Steer, 1990), a modified version of the Basic Nordic Sleeping Questionnaire (BNSQ, scoring range 0-11; Partinen & Gislason, 1995), as well as a questionnaires concerning psychosocial factors, caffeine intake, and current medication for

sleep disturbances and mood disorders such as depression. In order to evaluate subjective workload while performing the preceding task in the ERP recording session (e.g., effort put to the task), the participants were asked to fill in the NASA Task Load Index questionnaire (NASA-TLX; Hart & Staveland, 1988) immediately after the recordings of the task switching paradigm.

2.4 Stimuli and task

Figure 1 illustrates the task switching paradigm applied here, modified from the work of Rogers & Monsell (1995). The stimuli were white letter-number pairs on a black background subtending a visual angle of 2.4º × 1.6º at a distance of 80 cm from the participant. The stimulus pairs consisted of a defined subset of Arabic numbers (2-9) and Latin letters (A, E, I, U, G, K, M, R). A solid, white horizontal stationary line (height 0.3º, length 5.6º) was present at the center of the screen. Each letter-number pair was presented either above or below the line in pseudorandom order with the letter always presented on the left side of the pair. The position of the letter-number pair was always either above or below the horizontal line (with a vertical gap of 0.5º between the letter-number pair and the line), and this served as a cue according to which the participants were required to judge the stimulus pairs: when the stimulus pair occurred above the horizontal line, the participant had to decide whether the number in the letter-number pair was even or odd. When it occurred below the line, the participant had to classify the letter as vowel or consonant. The decision to be made in each task was hence unknown to the participant until the letter-number pair was presented. The participants were instructed to respond to each stimulus pair with a keyboard button press (left and right ctrl buttons covered with tape were used): vowels and even numbers required a response with the right index finger while consonants and odd numbers required a response

with the left index finger. Speed and accuracy of response were equally emphasized in the task instructions. To avoid the possibility of participants fixating their gaze on exact upcoming target locations above and below the line, a horizontal jitter in the location of the target was applied. The pairing of the letter-number combinations (e.g., 'E5') was semi-randomized so that approximately half of the character pairs were incongruent and half of them were congruent, that is, the task-irrelevant character was mapped either to a response with same or the other hand (e.g., when the task was to classify the number as odd or even in 'E5', a correct response was given with left hand, whereas the task-irrelevant character was mapped to a correct response with right hand).

In all, the paradigm consisted of 545 stimulus pairs, with 122 task switches (22%) and 423 task repetitions (78%). A maximum of nine stimulus pairs were presented in succession above or below the line before a switch. In the entire sequence, there were 20 task runs (16%) consisting of only one stimulus pair before a switch, 26 task runs (21%) constituting two repetitions before the switch, and on average 11 task runs (9%) of 3 to 9 repetitions, each.

Each stimulus pair was shown until the participant responded, however, never longer than 2500 ms (Figure 1). The presentation rate was tied to the participant's response in the following way: a correct response was followed by a 150 ms delay period after which the next stimulus pair was presented. An incorrect or missed response was followed by a 1500 ms delay until the presentation of the next stimulus pair. The length of the delay period between the stimulus pairs served as feedback of a correct or incorrect response. Prior to the task recordings, participants were given written instructions, and they practiced the tasks in order to familiarize themselves with the procedure (i.e., first, the tasks were practiced

separately above and below the solid line and, thereafter, the task switching task was practiced). The experiment was divided into two blocks, with a brief break between the blocks.

Figure 1. Schematic example of the experimental design (A), and illustration of the presentation rate (B). The location (above or below the horizontal line) of the stimulus pair signaled the task to be completed on that trial. For illustration purposes, switch trials are highlighted in light gray. [L]: a response with left button press, [R]: a response with the right button press. Inter stimulus interval (RSI; the temporal interval between the response to the previous stimulus and the onset of the next stimulus) was either 150 ms or 1500 ms, depending on the response given (correct or incorrect, respectively). *(For editorial work: 2-column fitting image)*

2.5 Electrophysiological recording and data analysis

The EEG recording was carried out in a soundproofed chamber where the participants were comfortably seated at an office workstation. They were instructed to blink as little as possible. The EEG was recorded using a 32-channel active electrode system (actiCAP, Brain Products GmbH, Gilching, Germany) connected to a neurOne amplifier (Mega Electronics Ltd., Kuopio, Finland). The EEG was recorded from 26 electrodes placed according to the extended international 10-20 electrode system (excluding channels O1, O2, TP9, TP10, PO9, and PO10). The common reference and ground were located at FCz and AFz, respectively. Two additional electrodes were placed at the left and right mastoids to allow re-referencing in later analyses. In addition, a bipolar horizontal electro-oculogram (HEOG) was recorded from two electrodes placed on the left and right canthi, and a vertical electro-oculogram

(VEOG) was recorded from electrodes placed above and below the left eye. All biosignals were sampled at 500 Hz.

The EEG analyses were conducted using EEGLAB (Delorme & Makeig, 2004). The EEG was bandpass-filtered offline (0.5-30 Hz). For the ERP analysis, the EEG was re-referenced to the mean signal of the mastoid electrodes. ERPs were obtained by averaging 800-ms EEG epochs starting 100 ms before each stimulus-pair onset. Epochs contaminated by artifacts caused by eye movements, blinks or other extracerebral factors and producing voltage changes exceeding ±65 μV at any electrode were omitted from averaging.

ERPs for the switch trials were averaged separately, whereas the trials on positions 2 to 9 were averaged together to increase the signal-to-noise ratio as the number of accepted trials for separately averaged repetition trials resulted small. Only trials preceding correct responses were selected for averaging. The number of switch trials included in the single-participant average ERP after rejecting epochs contaminated by artifacts ranged from 45 to 118 (M = 94, SD = 24) in the mild burnout group, from 43 to 115 (M = 88, SD = 22) in the severe burnout group, and from 64 to 119 (M = 97, SD = 16) in the control group. Temporal windows around the ERPs of interest were identified by visual inspection in the grand average signal of the switch condition across all participants. The P3 was double-peaked: its earlier part (early P3) was determined as the largest positive deflection in the measurement windows of 180-280 ms, and the later part (late P3) was measured between 300-400 ms from stimulus onset. Mean amplitudes and peak latencies were computed for the ERPs of interest. The mean voltage of the 100-ms pre-stimulus period served as a baseline for ERP amplitude measurements. The amplitudes were determined as mean amplitudes over 80-ms periods

centered at the grand average peak latency of each phase of the P3 at electrode site Pz. Individual peak latencies were measured from the largest peak occurring at the 100-ms period centered at the peak latency at Pz in the grand average signals in switch and repetition trials.

2.5.1. Statistical analysis of ERP data

In the analysis reported below, subsets of electrodes were taken together to investigate the association between burnout and the topographical distribution of the ERPs. The anterior-posterior distribution of the ERP analysis comprised the following electrode sites: anterior: F3, F7, Fz, F4, F8, Fp1, Fp2; central: C3, Cz, C4, FC1, FC2; and posterior: P3, P7, Pz, P4, P8, CP1, CP2. Mean amplitudes for each of the peaks in the ERP were analyzed using a repeated-measures analysis of variance (ANOVA) with Group (mild burnout, severe burnout, control) as between-participants factor, and Trial Type (switch, repetition), and Electrode Position (anterior, central, posterior) as within-participant factors.

Statistical analyses were carried out using the R software environment for statistical computing and graphics with a set of packages (Lawrence, 2013; R Core Team, 2014; Sarkar, 2008; Wei, 2013; Wickham, 2007, 2009, 2011, 2012). The assumption of sphericity was evaluated using Mauchly's procedure and when violated, the Greenhouse-Geisser correction was used to adjust the degrees of freedom for the ANOVA *F*-distribution. In the results, we report *F*-value together with the original degrees of freedom, corrected *p*-value, Greenhouse-Geisser correction factor epsilon, and the effect sizes using generalized eta squared (Olejnik & Algina, 2003; Picton et al., 2000). After finding a significant main effect or interaction, post-hoc *t*-tests were carried out to investigate the pairwise effects. The *p*-values were adjusted using the Holm-Bonferroni method for multiple comparisons. In addition, a mixed

model analysis was conducted to assess whether burnout symptom severity could predict the P3 response at posterior regions with MBI-GS score and trial type (switch, repetition) as fixed effects, and participant as random effect. We chose to use self-reported depressive symptoms, symptoms of anxiety, and sleep disturbances (BDI-II, BAI, and BNSQ scores, respectively) as covariates in the analyses to ensure that they would not account for group differences in the ERP or behavioral results.

2.5.2. Statistical analysis of behavioral data

A correct button press within 200-2500 ms after stimulus-pair onset was regarded as a hit. We used individual median response times (RT), intraindividual RT variability, and error percentages as behavioral metrics. The median RT was chosen as in a task with varying requirements, the median gives the most stable results (Ratcliff, 1993). The intraindividual RT variability was calculated as follows:

$$A = \frac{\sum_{k=1}^{K_s} |RT_{med} - RT_k|}{K_s},$$

where k indexes reaction times and K_i is the number of reaction times available for subject s. This process is repeated separately for switch and repetition trials. RTs were observed to be comparable for congruent and incongruent trials followed by a correct response (t_{112} = -0.17, p = 0.87). Therefore, all trials followed by a correct response were chosen for further analysis of behavioral RT data as was the case in the ERP analysis. In addition, although the trial position of the repetition trials (positions 2 to 9) had an effect on the RTs ($F_{7, 392}$ = 20.14, $p < 0.001$, ε = 0.48, η^2 = 0.03), the pairwise comparisons revealed no differences between repetition trials in the task runs (Holm-Bonferroni, p > 0.05) except for one difference between the 2nd and the 8th position (p = 0.03). Therefore, for the non-switch trials, trials in positions two to nine in the runs were taken together to explore the association between burnout and task repetition as was

the case in the ERP analysis. Group means of the median RTs as well as intraindividual variability of the RTs were analyzed using a repeated-measures ANOVA with Group (mild burnout, severe burnout, control) as the between-participants factor, and Trial Type (switch, repetition) as the within-participant factor. RT switch costs were calculated as the difference in RT between switch and repetition trials. Also for further analysis of the error rates, all trials followed by an incorrect response were included in the analysis as the difference between the error rates for congruent and incongruent trials was not significant (t_{112} = 1.75, p = 0.08). The group mean error rates were compared using a repeated-measures ANOVA with Group as the between-participants factor and Trial Type as the within-participant factor. As in the ERP analysis, the procedure included correction of sphericity using Mauchly's procedure, and the statistical probability from the ANOVAs was corrected using the Greenhouse-Geisser procedure where appropriate. After finding a significant main effect or interaction, post-hoc *t*-tests were carried out to investigate the pairwise effects. The *p*-values were adjusted using the Holm-Bonferroni method for multiple comparisons. Correlations between symptom variables as well as between burnout severity and behavioral and ERP data were measured with Pearson correlation coefficient *r*.

3. RESULTS

Figure 2 shows the correlations between the self-reported symptoms of burnout, depression, anxiety, and sleep disturbances. As shown in the matrix, the correlations were positive and statistically significant between all evaluated symptom measures except for two insignificant correlations (i.e., the correlations of professional inefficacy as evaluated in MBI-GS with sleep disturbances and symptoms of anxiety).

Figure 2. Correlations between self-reported symptoms of burnout (MBI-GS: total scores and subscales), depression (BDI-II), anxiety (BAI), and sleep disturbances (BNSQ). Data are from 57 participants included in the ERP and behavioral analysis. All correlations were positive**.** Color intensity and the size of the circle are proportional to the correlation coefficients. Level of statistical significance was set at $p < 0.05$. All correlations were statistically significant except those marked with ×. Subcomponents of the MBI-GS: MBI-exh: emotional exhaustion, MBI-cyn: cynisicm, MBI-ineff: professional inefficacy.

The groups did not differ in respect of marital status: $\chi^2(8, N = 57) = 10.59$, $p = 0.22$, or burdening life happenings within a year: $\chi^2(30, N = 57) = 35.03$, $p = 0.24$) such as conflicts with spouse: $\chi^2(6, N = 57) = 6.64$, $p = 0.36$, divorce: $\chi^2(2, N = 57) = 1.62$, $p = 0.45$, or severe illness of spouse: $\chi^2(4, N = 57) = 2.67$, $p = 0.61$. Caffeine consumption 24 hours before the recordings did not differ significantly between the groups (Median value for each group: 1-3 cups of caffeinated drinks; $\chi^2(6, N = 57) = 6.90$, $p = 0.33$). In addition, the usage of prescribed medication for mood disorders and sleep disturbances did not differ significantly between the groups (Mood: $\chi^2(4, N = 57) = 7.03$, $p = 0.13$; Sleep: $\chi^2(4, N = 57) = 7.70$, $p = 0.10$).

In general, the participants found the present paradigm cognitively demanding as switching between task sets was required. There was an insignificant difference for the groups to differ in terms of the subjectively experienced effort put on the task, as evaluated by the NASA-TLX ($F_{2,53} = 2.45$, $p = 0.09$, $\eta^2 = 0.08$). The participants with mild burnout symptoms tended to report that they invested somewhat more effort in the task than those in the control group in order to accomplish their level of performance (Table 1).

3.1 Behavioral results

The group means of individual median RTs as well as group mean error rates for switch and repetition trials in each group are presented in Figure 3. Switch cost was indicated by a significant main effect of Trial Type ($F_{1,54} = 619.74$, $p < 0.001$, $\eta^2 = 0.65$) with RTs on switch trials (M = 1210.4 ms, SD = 165.6 ms) ~400 ms slower than on repetition trials (M = 810.4 ms, SD = 145.6 ms). However, the groups did not differ in terms of RTs (main effect of Group: $F_{2,54} = 0.15$, $p = 0.86$), nor was the interaction between Group and Trial Type significant ($F_{2,54} = 0.26$, $p = 0.77$). The group means of intraindividual RT variability on switch trials were for the control group 7.25 ms (SD = 8.04 ms), for the mild burnout group 7.82 ms (SD = 8.66 ms), and for the severe burnout group 7.60 ms (SD = 8.73 ms). For the repetition trials, the respective means were 12.82 ms (SD = 21.36 ms), 12.72 ms (SD = 21.23 ms), and 13.58 ms (SD = 22.36 ms). A repeated measures ANOVA confirmed that the groups did not differ with respect to the intraindividual variability ($F_{2,54} = 0.01$, $p = 0.99$). However, the main effect of Trial Type was significant ($F_{1,54} = 258.61$, $p < 0.001$, $\eta^2 = 0.43$) with the intraindividual variability being larger for the repetition than switch trials ($p < 0.001$). The interaction of Group and Trial Type was not significant ($F_{2,54} = 0.70$, $p = 0.50$). Notably however, the groups differed with respect to the error rate (main effect of Group: $F_{2,54} = 3.28$, $p = 0.04$, $\eta^2 = 0.09$), the error rate being the largest for the severe burnout group, but comparable in mild burnout and control groups, (Holm-Bonferroni: control vs. mild, $p = 0.67$; mild vs. severe, $p = 0.004$, control vs. severe, $p = 0.009$). The main effect of Trial Type was significant ($F_{1,54} = 28.97$, $p < 0.001$, $\eta^2 = 0.08$), with the error rate being higher for switch trials (5.2%) than for repetition trials (3.1%). The interaction of Group and Trial Type was not significant ($F_{2,54} = 0.58$, $p = 0.56$). Correlations between behavioral data and burnout severity are shown in Table 2.

Figure 3. Group means of the median reaction times (RTs; a), and group mean error rates (b) for the switch and repetition trials in all study groups. Error bars represent standard error of the means.

Table 2.

3.2 ERP results

Figure 4 illustrates the grand average ERPs for each group from the switch and repetition trials. As seen here, the P3 response had two distinct phases for task switch trials: the first peaking around 200-250 ms and the second about 100 ms later. According to scalp potential distribution mapping, the two phases had a similar distribution of the maximum amplitude over parietal scalp regions (Figure 5). The P3 responses were more pronounced on switch trials than on repetition trials as also seen in Figure 6.

Figure 4. Grand average ERPs for each group from the switch and repetition trials at electrode sites Fz, Cz, Pz, and Oz. *(For editorial work: 1-column fitting figure)*

Figure 5. Voltage distribution over the scalp for both phases of the P3 response for each group (panel A: early; panel B: late). *(For editorial work: both panels (A and B) 2-column fitting figures)*

Figure 6. Bar plots showing the group mean amplitudes (μV) with standard error of means of the early (a), and late (b) phase of the P3 for each group at posterior scalp (data from selected electrodes P3, P7, Pz, P4, P8, CP1, CP2, collapsed). *(For editorial work: both figures (5a and 5b) are 1-column fitting figures)*

Statistical analysis for comparing group differences showed that the mean amplitudes of both the early and the late phase of P3 response were larger on switch than repetition trials, as revealed by a main effect of Trial Type (early phase: $F_{1,54} = 95.73$, $p < 0.001$, $\eta^2 = 0.17$; late phase: $F_{1,54} = 227.05$, $p < 0.001$, $\eta^2 = 0.28$). The main effects of Electrode position were also significant (early phase: $F_{2,108} = 54.99$, $p < 0.001$, $\varepsilon = 0.68$, $\eta^2 = 0.15$; late phase: $F_{2,108} = 101.14$, $p < 0.001$, $\varepsilon = 0.75$, $\eta^2 = 0.24$), showing that both phases were the most pronounced at posterior sites as is typical for the P3 response (Holm-Bonferroni: anterior < central < posterior, $p < 0.001$). Notably, the Group × Trial Type interaction effects were significant for both phases of P3 (early phase: $F_{2,54} = 4.37$, $p = 0.017$, $\eta^2 = 0.02$; late phase: $F_{2,54} = 5.01$, $p = 0.01$, $\eta^2 = 0.02$), with the responses being the smallest in the severe burnout group, and mostly comparable between the mild burnout and control groups (see pairwise comparisons in Table 3). The Group × Electrode Position interactions were not significant (early phase: $F_{4,108} = 0.56$, $p = 0.63$, $\varepsilon = 0.68$; late phase: $F_{4,108} = 0.26$, $p = 0.90$, $\varepsilon = 0.75$), neither were the Group × Trial Type × Electrode Position interactions (early phase: $F_{4,108} = 1.27$, $p = 0.29$, $\varepsilon = 0.70$; late phase: $F_{4,108} = 0.75$, $p = 0.51$, $\varepsilon = 0.66$). Correlations between the P3 mean amplitude at posterior electrode sites and burnout score are presented in Table 2. A mixed model analysis at the posterior sites with MBI-GS score and trial type (switch, repetition) as fixed effects, and participant as random effect confirmed that the burnout score was not sufficient to predict the P3 mean amplitudes (early phase: $\chi^2(1) = 1.61$, $p = 0.20$; late phase: $\chi^2(1) = 1.78$, $p = 0.18$).

Group mean peak latencies (ms) at Pz for the switch and repetition trials for both phases of P3 are presented in Table 4. The P3 peak latencies did not differ significantly between the groups (early phase: $F_{2,54} = 0.17$, $p = 0.84$; late phase: $F_{2,54} = 1.54$, $p = 0.22$). The Trial Type had an effect on the P3 peak latencies (early phase: $F_{1,54} = 99.17$, $p < 0.001$, $\varepsilon = 0.35$; late phase: $F_{1,54} = 29.66$, $p < 0.001$, $\varepsilon = 0.20$) with the peak latencies being longer for the switch trials than to repetition trials ($p < 0.001$ for both phases). The interaction of Group and Trial Type did not reach significance for the early phase ($F_{2,54} = 3.09$, $p = 0.054$), but it was significant for the late phase ($F_{2,54} = 3.73$, $p = 0.03$, $\eta^2 = 0.06$). However, pairwise comparisons did not indicate a significant difference between the groups for either trial type (Holm-Bonferroni, $p > 0.05$ in all cases).

Table 3.

Table 4.

4. DISCUSSION

The present study examined the association between burnout symptom severity and the ability to rapidly shift between tasks. We recorded electrophysiological activity time-locked to the onset of the stimulus to examine brain mechanisms related to the cognitive processes in a task switching paradigm in which the location of the stimulus pair indicated the task to be completed on a given trial. The key finding was a decreased P3 amplitude in the severe burnout group compared to the mild burnout and control groups. In addition, the severe burnout group performed less accurately compared to the other groups both in switch and

repetition trials whereas the RTs and intraindividual RT variability were comparable in all groups.

The behavioral results showed that the overall error rate was small. Such small error rates have also been reported in previous task switching studies, for example, with short response-stimulus intervals (Karayanidis et al., 2006), and short cue-stimulus intervals (Nicholson, Karayanidis, Poboka, Heathcote, & Michie, 2005). Notably, however, the error rate in the severe burnout group was significantly larger than in the other groups. Thus, the behavioral results suggest that severe burnout is associated with inadequate processing in cognitive tasks where rapid shifting between tasks is required. Participants in all groups strived to sustain their speed of performance as was stressed in the task instructions. However, in order to do so the accuracy was sacrificed in the severe burnout group. This finding is in accordance with previous behavioral studies suggesting impaired performance in the domains of attention and executive functions in severe burnout, as indicated by slower RTs (Kleinsorge, Diestel, Scheil, & Niven, 2014; Oosterholt et al., 2014), higher error rates (Diestel, Cosmar, & Schmidt, 2013), or both (Sandström et al., 2005; van Dam et al., 2011). Using a task switching paradigm, Lorist and colleagues (2000) showed that with increasing mental fatigue, as induced by time on task, the preparation processes for the upcoming task became less adequate, thereby resulting in more errors in performance. An increased number of errors related to previously relevant rules was also observed in the study of Barceló and Knight (2002) with patients with lesions in the dorsolateral prefrontal cortex. The authors suggested that such lesions not only impair the mechanisms underlying attentional set shifting but also make it difficult for the patients to keep track of the ongoing task set.

All stimulus pairs in the present study were task-relevant requiring voluntary target detection. The P3 response is thought to reflect a range of cognitive processes during task performance, for instance, in the context of task switching, activation of relevant task set, rapid reconfiguration, and task set preparation and execution (Hölig & Berti, 2010; Karayanidis et al., 2010). Consequently, the observed attenuation of the stimulus-locked P3 amplitude in the group of participants experiencing intense symptoms of burnout suggests that burnout is associated with ineffective shifting of attentional set. Such susceptibility of the P3 has also been observed in related conditions such as high stress (Shackman et al., 2011), increased sleepiness (Colrain & Campbell, 2007; Polich & Kok, 1995), and depression (Bruder et al., 1995, 2009; Cavanagh & Geisler, 2006). In addition, our recent study (Sokka et al., 2016) suggested burnout-related dysfunctional cognitive control processes at fronto-parietal regions as reflected by divergent task-related P3 responses in a task requiring working memory updating and information monitoring. Such group differences in topographical distribution were not observed in the present study, possibly due to different cognitive control processes required in the experimental paradigms.

The group differences in the P3 amplitude may reflect differences in activation or selection of relevant task sets (Hölig & Berti, 2010; Kieffaber & Hetrick, 2005; Lange et al., 2015; Nicholson et al., 2006; Sohn, Ursu, Anderson, Stenger, & Carter, 2000) suggesting that greater activation associated with switch trials might reflect increased effort in the selection process. Perhaps, selecting what is relevant and what is irrelevant for the task is ineffective in severe burnout as reflected by reduced P3, resulting in more performance errors. Alternatively, the observed smaller P3 in the severe burnout group might reflect reduced ability to maintain spatial information online in working memory, thereby disrupting working memory processing and further resulting in less accurate performance. Evidence from

neuroimaging studies suggests that orienting attention to a location might functionally overlap with top-down mechanisms such as preparing and executing goal-directed selection for stimuli and responses, thereby recruiting prefrontal cortical areas which together with posterior association cortices are involved in executive control of set shifting (for reviews, see Corbetta & Shulman, 2002; Miller, 2000).

We did not observe significant correlations between burnout symptoms and behavioral results or the P3 mean amplitudes. Also further analysis on the ERP data showed that in our sample, burnout severity was not sufficient to predict the amount of attenuation of the P3 response. This may partially be explained by the sample size. Or perhaps, visual P3, or P3b response, reflecting voluntary target detection is not necessarily as sensitive a marker for burnout as might the P3a response reflecting involuntary capture of attention to task-irrelevant novel events be, as indicated in patients with a brain lesion showing reduced visual P3a but not P3b responses in a simple target detection task (Knight, 1997), and Parkinson's disease showing decreased auditory P3a responses (Solís-Vivanco et al., 2015).

The paradigm of the present study involved features that complicate interpretation of ERP results. First, the interval between correct response to the preceding stimulus and the onset of subsequent stimulus was very short (150 ms). Second, as the target location served as the task cue, the cue and target occurred simultaneously without manipulation of the cue-target interval. The stimuli evoked a pattern of parietally maximal P3 activation with two phases across switch and repetition trials, in accordance with the study of Berti (2016) showing a bi-phasic large positive response in the time-window of 200-400 ms from stimulus onset with more pronounced amplitudes for the switch trials than repetition trials. We chose to label the

phases as “early” and “late”, however, the early phase of P3 could have also been labeled as the P2 due to its early latency (Berti, 2013). Yet, the two subsequent P3 responses had similar scalp distributions suggesting that they reflect the same P3b response including some contribution presumably from an overlapping parietally maximal negativity related to the response given to the previous stimulus (Karayanidis et al., 2003). In the study of Karayanidis and colleagues (2003), such negativity was not affected by switch trials with short response-stimulus intervals. Given these, the processes related to the preceding response were likely to be still in progress when a new stimulus was presented. In addition, as the cue (vertical and horizontal location of the target, indicating the task) and the target were presented simultaneously, and the task switches were not predictable, the participants had no opportunity to predict whether or not the upcoming trial would require a switch in the attentional set. Thus, performance on each trial required both encoding the cue, and selecting and processing of the target character in the stimulus pair. Consequently, there is likely a temporal overlap between cue-related and target-related processes (Nicholson et al., 2005). Unfortunately, the present paradigm limits our possibilities to disentangle these overlapping processes. An experimental paradigm including manipulations of cue-target intervals should be used in the future in order to separate the ERP responses.

Adding to the previous literature on burnout-related cognitive impairments, our present findings with a non-clinical sample of currently working burnout participants suggest that severe burnout is associated with inadequate processing when rapid shifting of attention between tasks is required. However, due to scarcity of the literature and a number of methodological differences between the studies, a coherent theoretical framework for cognitive functioning in burnout is to date still lacking and the underlying brain mechanisms

are largely unknown (Deligkaris et al., 2014). Therefore, conclusions need to be drawn cautiously.

First, job burnout is a heterogeneous condition in nature including, for example, a variety of psychosocial work-related factors, and the inter-individual variation in terms of which working conditions are experienced psychologically stressful (for a review, see Seidler et al., 2014). Second, dysfunctions in attention and cognitive control processes have been also observed in other conditions such as major depression, generalized anxiety disorder, or other stress-related neuropsychiatric conditions (American Psychiatric Association, 2013), and sleep deprivation (Heuer et al., 2004; Kingshott, Cosway, Deary, & Douglas, 2000). Broad overlaps especially between burnout and depressive disorders have been reported (Ahola, Hakanen, Perhoniemi, & Mutanen, 2014; Bakker et al., 2000; Bianchi, Schonfeld, & Laurent, 2015; Schaufeli & Enzmann, 1998). The self-reported symptoms in the present study showing significant positive correlations are in accordance with these widely reported overlaps. It is worth noting that as burnout symptomatology is heterogeneous, the spectrum of depressive and anxiety disorders is heterogeneous, too (for reviews, see e.g., Davidson et al., 2002; Hettema, Neale, Kendler, & Ph, 2001; Olatunji, Cisler, & Tolin, 2007; Richards, 2011; Stein, 2009). They may arise from a multitude of causes, emerging in broad symptoms, and the underlying mechanisms may also differ. Importantly, however, the group differences in the present study remained significant after self-reported depressive symptoms, symptoms of anxiety, and sleep disturbances were controlled for in the analysis suggesting that the observed dysfunctions in attentional set shifting were not merely a by-product of the participants in the severe burnout group reporting more intense symptoms of related conditions.

Third, most of the present participants were females which may be partly due to the recruitment process or reflect previous burnout research suggesting that women are somewhat more emotionally exhausted than men (Ahola et al., 2006; Purvanova & Muros, 2010). Notably, however, the number of female and male participants in all study groups were comparable suggesting that the present results of differences between the groups cannot be easily explained by gender differences. Fourth, most of the participants experiencing symptoms of burnout entered the study due to their own interest after noticing the recruitment advertisement. Therefore, we cannot fully rule out the possibility of some bias in our sample of participants due to the recruitment process. However, the volunteers were carefully interviewed before inclusion in order to ensure that their symptoms were work-related. In addition, the participants were not informed about their group affiliation (i.e., mild burnout, severe burnout, control) before the ERP recordings as it was not assessed by that time yet. Consequently, the present results cannot be explained by the participants' awareness about the final grouping. And fifth, the significant differences observed in the present study had relatively small effect sizes. This suggests that the present study does not provide a method for patient assessment at an individual level. Instead, the present findings are of value characterizing burnout at a group level amongst related conditions with shared and unique features.

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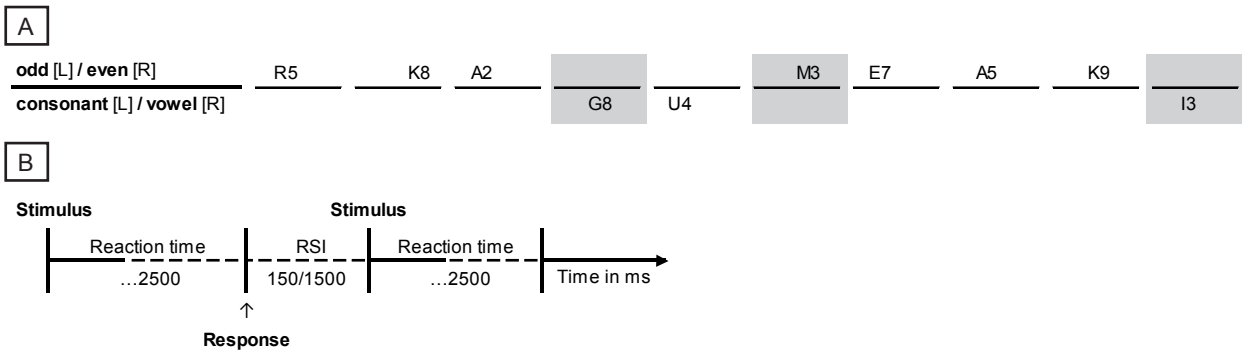
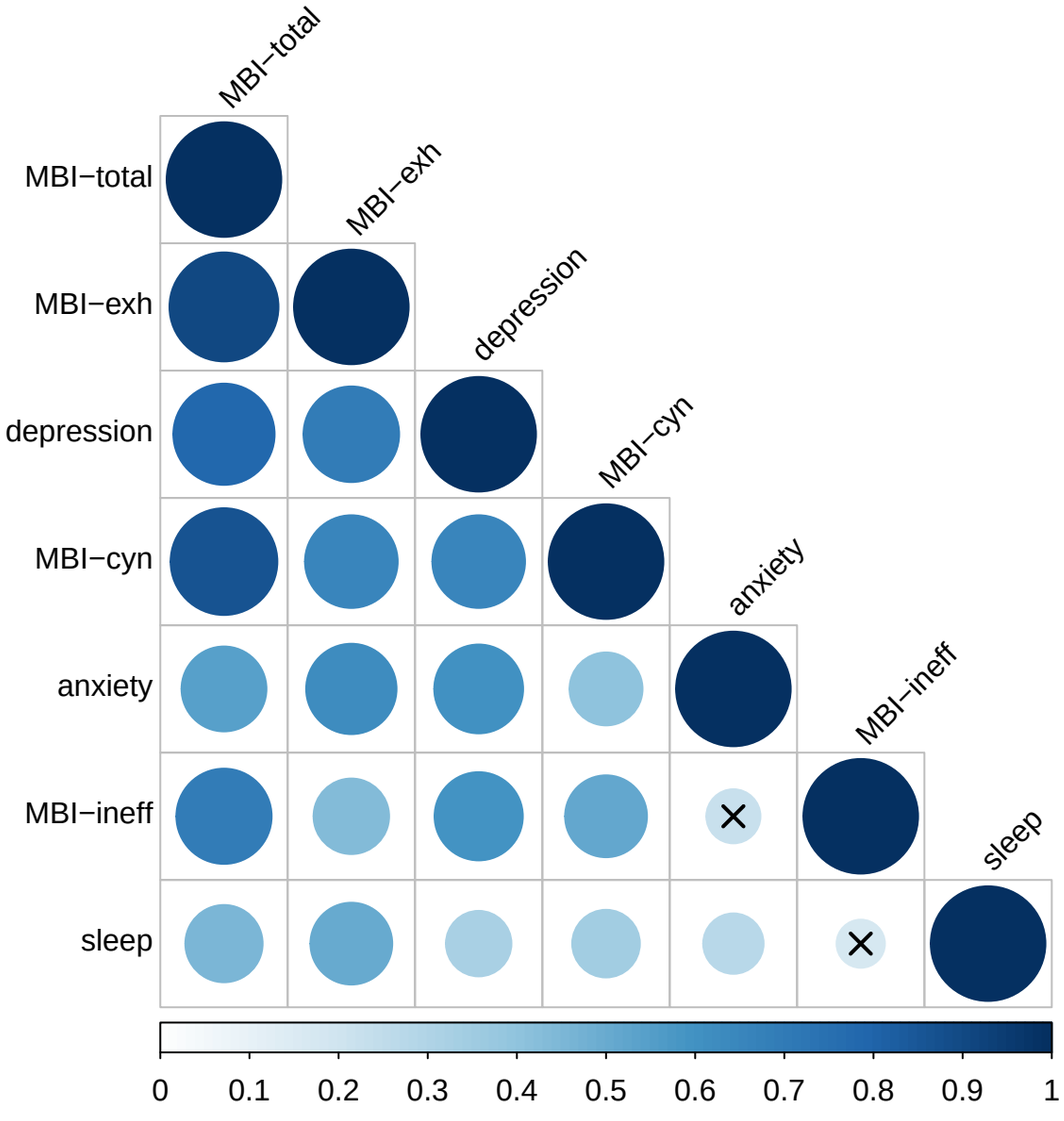

A
odd [L] / even [R]
consonant [L] / vowel [R]
R5
K8
A2
G8
U4
M3
E7
A5
K9
I3
B
Stimulus
Stimulus
Reaction time
…2500
RSI
150/1500
Reaction time
…2500
Time in ms
Response


MBI−total
MBI−exh
depression
MBI−cyn
anxiety
MBI−ineff
sleep
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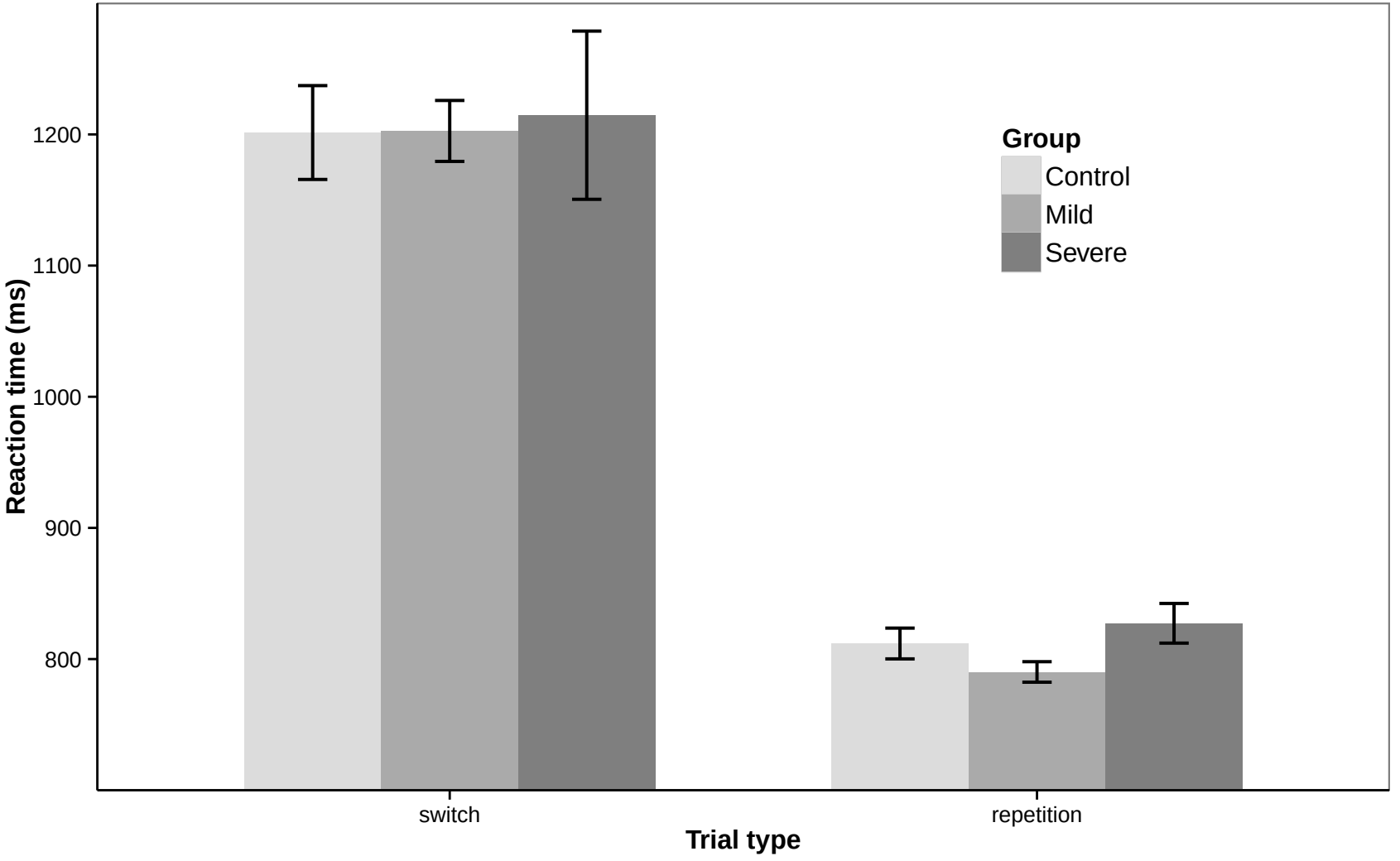
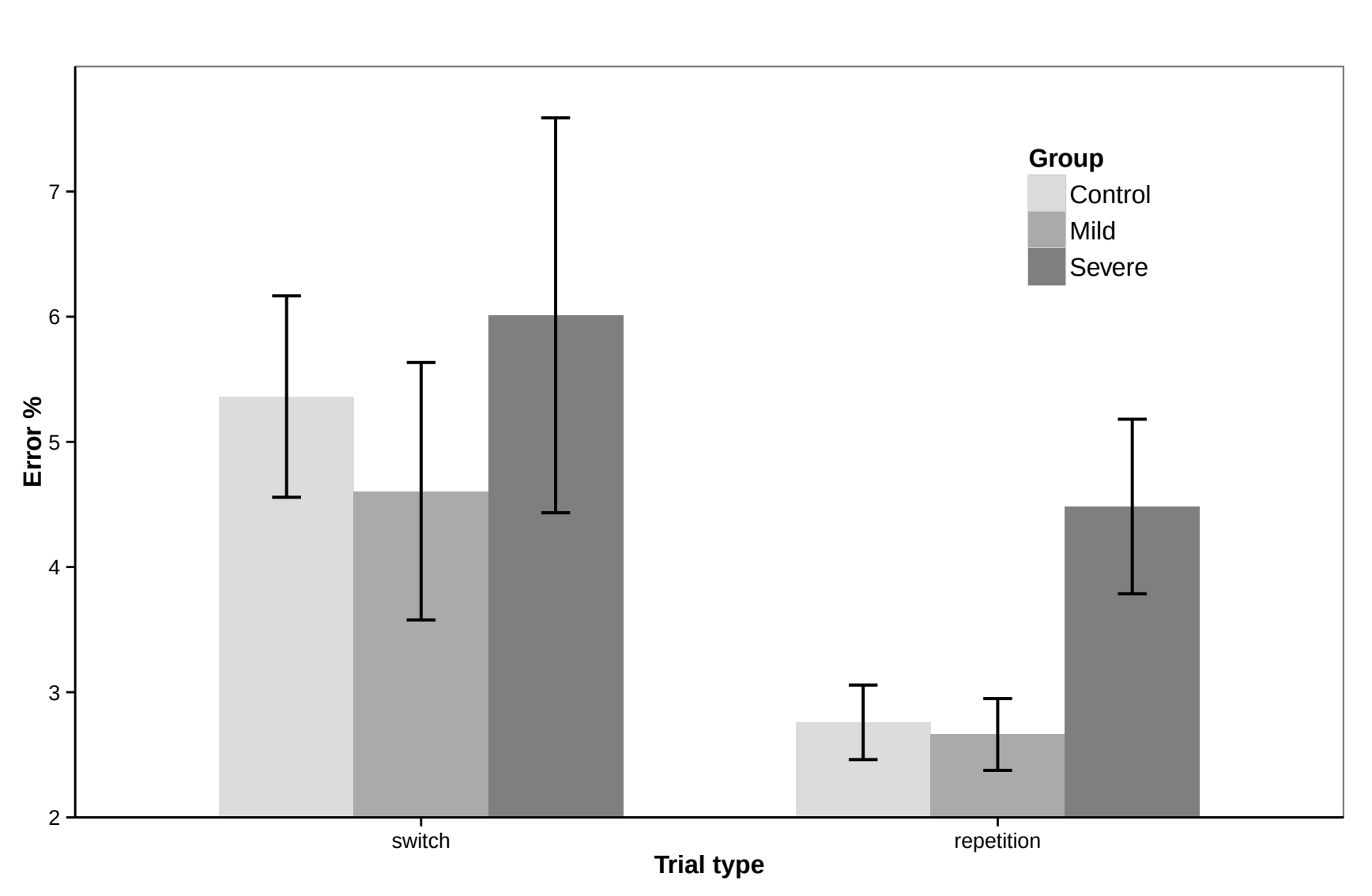
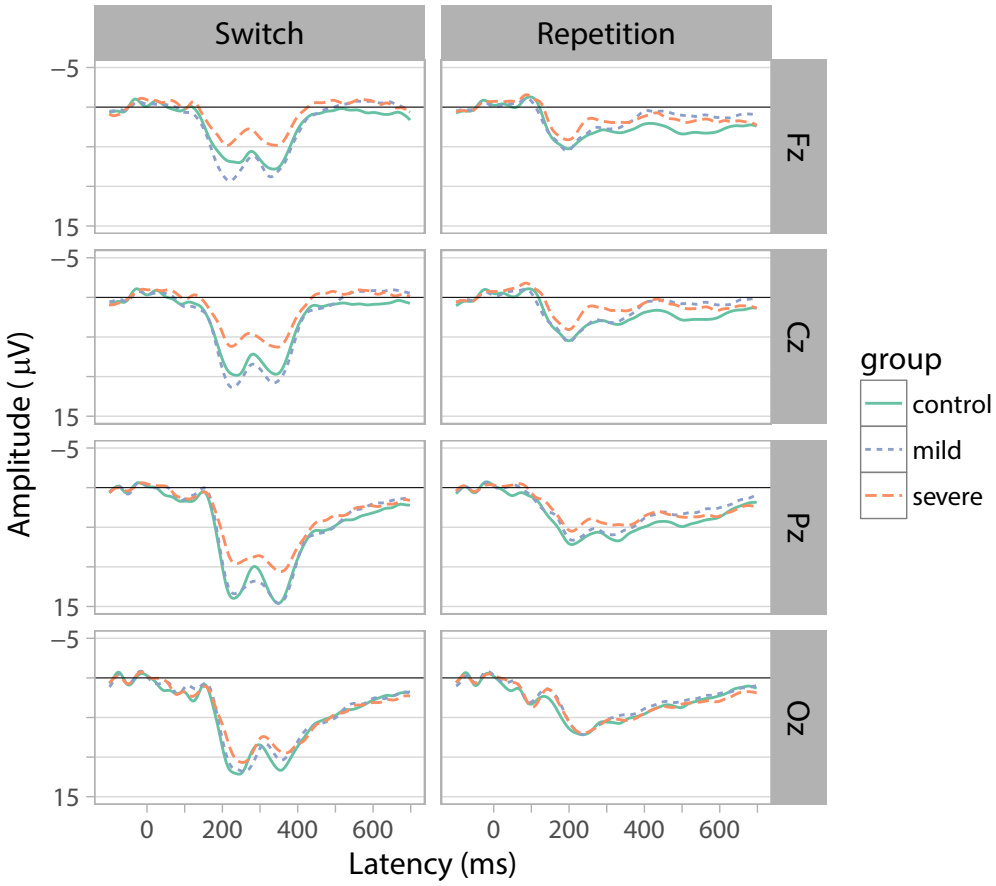
1


Reaction time (ms)
1200
1100
1000
900
800
switch
repetition
Trial type
Group
Control
Mild
Severe


Group
Control
Mild
Severe
Error %
7
6
5
4
3
2
switch
repetition
Trial type


Switch
Repetition
Fz
Cz
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Oz
−5
15
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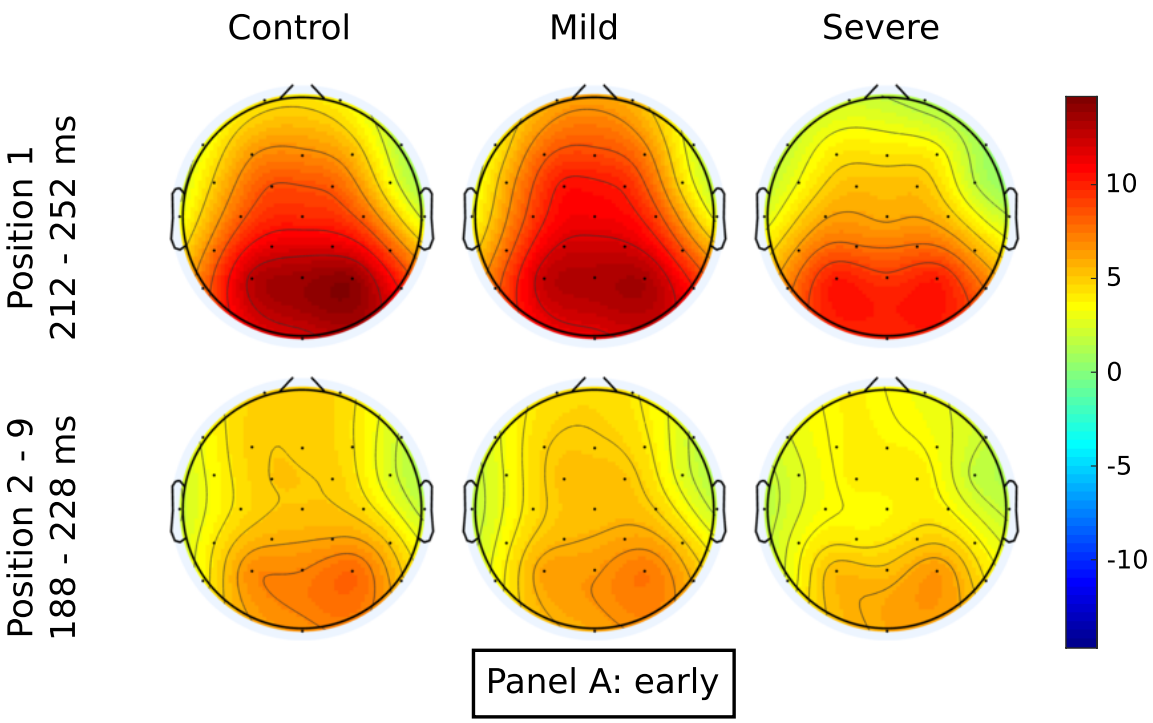
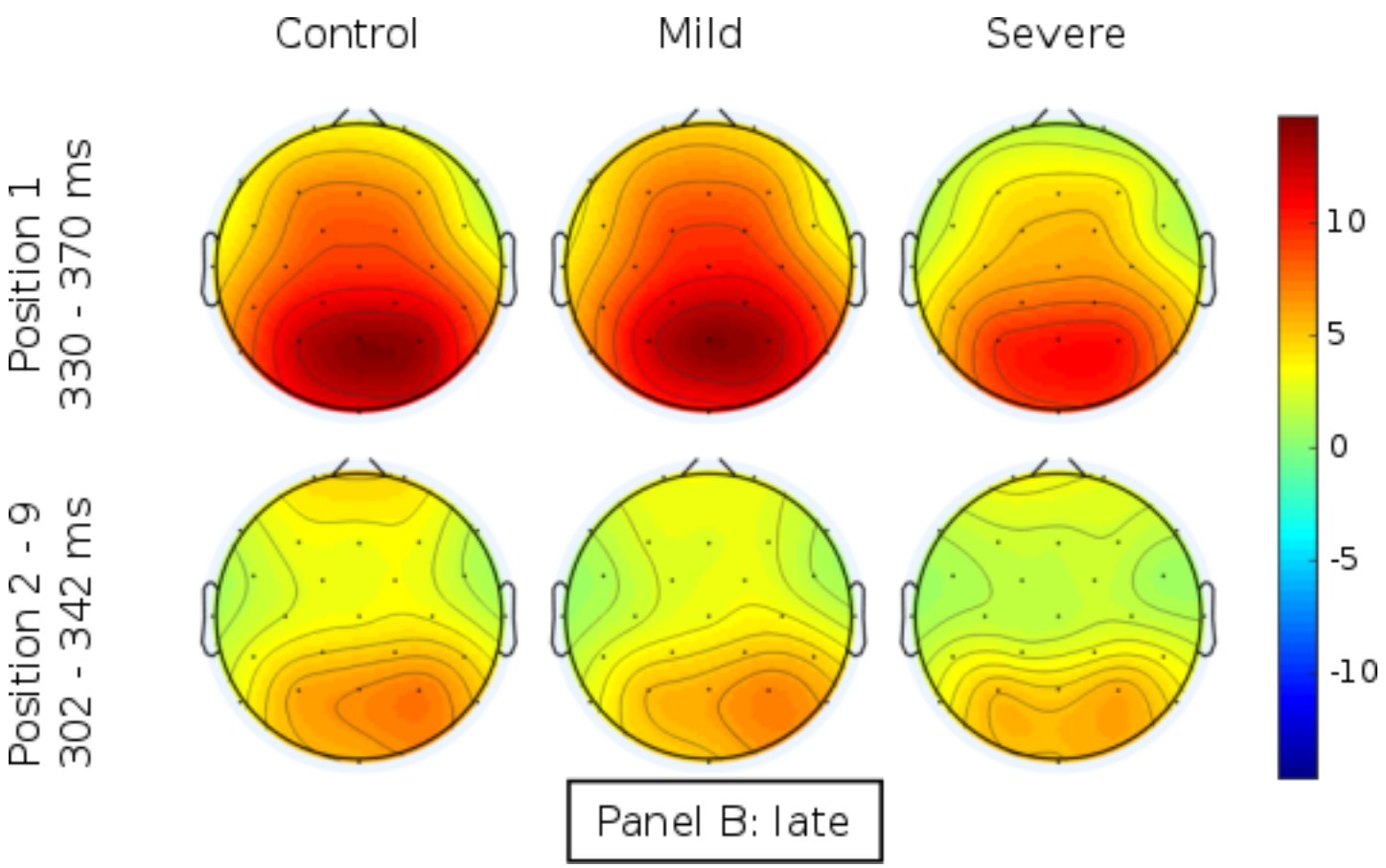
200
400
600
Amplitude (μV)
Latency (ms)
group
control
mild
severe


Control
Mild
Severe
Position 1
212 - 252 ms
Position 2 - 9
188 - 228 ms
10
5
0
-5
-10
Panel A: early


Control
Mild
Severe
Position 1
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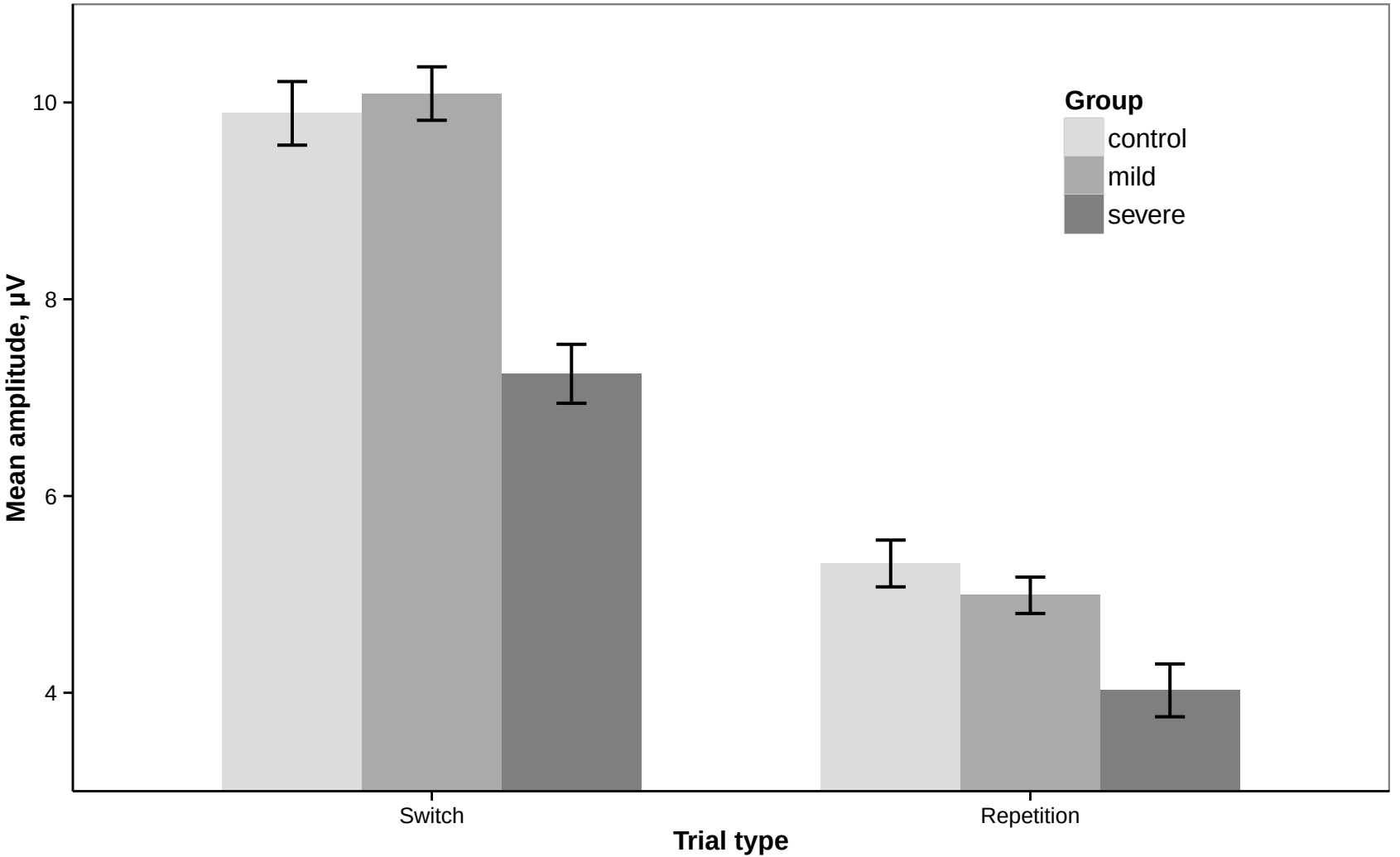
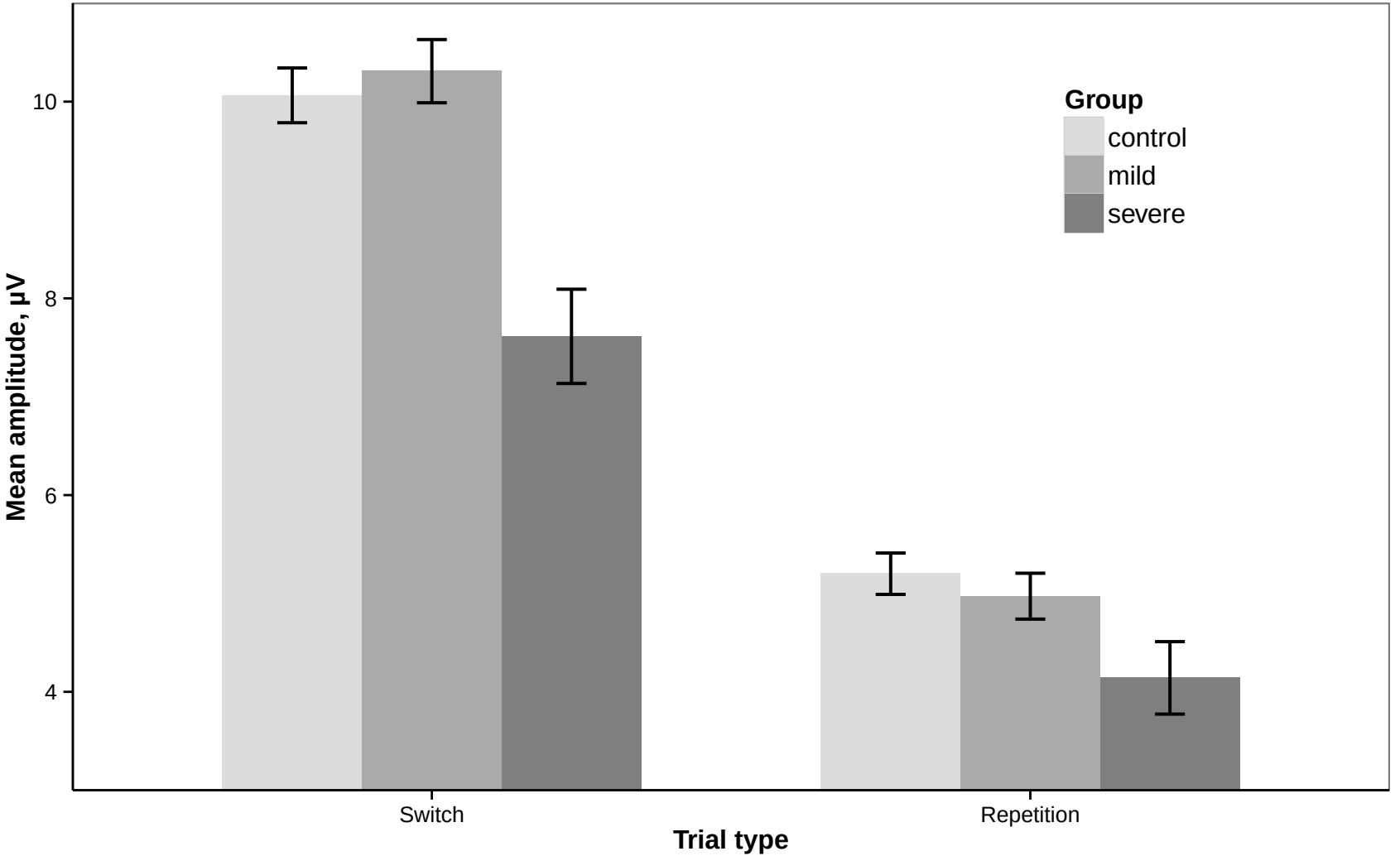
Position 2 - 9
302 - 342 ms
10
5
0
-5
-10
Panel B: late


Group
control
mild
severe
Mean amplitude, µV
10
8
6
4
Switch
Repetition
Trial type


Group
control
mild
severe
Mean amplitude, µV
10
8
6
4
Switch
Repetition
Trial type

Variable	Group					
	Control	**Mild burnout**	**Severe burnout**			
N	24	21	12			
Female / Male	20/4	19/2	11/1			
	Control Mean (sd)	**Mild Mean (sd)**	**Severe Mean (sd)**	**F value df(2,54)**	**p value**	**η^2**
Age	45.08 (8.66)	47.71 (8.60)	47.08 (8.38)	0.54	0.59	0.02
Education (in years)	15.29 (1.94)	15.86 (1.68)	14.92 (2.57)	0.93	0.40	0.03
Working experience (in years)	21.30 (12.89)	20.85 (9.92)	22.13 (11.35)	0.05	0.95	0.002
Job burnout score (MBI-GS)	0.92 (0.39)	2.55 (0.47)	4.23 (0.58)	209.90	<0.001	0.89
Exhaustion	0.87 (0.63)	3.21 (0.90)	5.07 (1.07)	109.00	<0.001	0.80
Cynicism	1.06 (0.82)	2.62 (1.41)	4.58 (0.92)	42.27	<0.001	0.61
Professional inefficacy	0.82 (0.67)	1.59 (1.06)	2.75 (1.21)	16.75	<0.001	0.38
Symptoms of anxiety (BAI)*	3.58 (3.36)	9.10 (3.96)	10.17 (6.55)	12.73	<0.001	0.32
Depressive symptoms (BDI-II)	4.92 (5.25)	14.05 (5.66)	19.92 (5.07)	35.12	<0.001	0.57
Sleep disturbances (BNSQ)**	1.58 (1.58)	2.14 (1.49)	4.08 (2.11)	9.10	<0.001	0.24
NASA-TLX effort***	54.79 (22.75)	67.40 (11.80)	65.17 (24.14)	2.45	0.09	0.08

Table 1. *Characteristics of the participants included in the analysis (n=57) in the mild burnout, severe burnout, and control groups. Standard deviations are presented in parenthesis, F and p values are for the analysis of variance. MBI-GS: Maslach Burnout Inventory – General Survey; BAI: Beck's Anxiety Inventory; BDI-II: Beck's Depression Inventory; BNSQ: Basic Nordic Sleeping Questionnaire.*

**no difference was observed between mild and severe burnout groups, but they both differed significantly from control group*

*** no difference was observed between mild burnout and control groups, whereas severe burnout group differed significantly from the other groups*

**** df (2,53) due to lack of NASA-TLX rating from one participant.*

	Switch trials			Repetition trials		
	r	**t value**	**p value**	**r**	**t value**	**p value**
Behavioral data						
Reaction time	0.06	0.43	0.67	0.02	0.16	0.87
Error rate	0.02	0.13	0.89	0.13	1.00	0.32
Intraindividual variability	0.09	0.64	0.53	0.04	0.27	0.79
ERP data						
Early phase	-0.19	-1.41	0.16	-0.14	-1.05	0.30
Late phase	-0.20	-1.52	0.13	-0.12	-0.93	0.35

Table 2. *Correlations between self-reported burnout symptoms as evaluated by Maslach Burnout Inventory – General Survey (MBI-GS) and behavioral performance data as well as mean amplitudes for the early and late phases of the P3 at posterior electrode sites. Degrees of freedom for the t-tests: df=55.*

		control vs. mild burnout	control vs. severe burnout	mild burnout vs. severe burnout
early phase	switch	0.01	< 0.001	< 0.001
	repetition	0.41	< 0.001	< 0.001
late phase	switch	0.12	< 0.001	< 0.001
	repetition	0.15	< 0.001	0.02

Table 3. *Pairwise comparisons for the Group x Trial Type interactions for both phases of the P3.*

		Group		
		Control	**Mild burnout**	**Severe burnout**
early phase	switch	234 (21)	245 (23)	251 (21)
	repetition	213 (18)	215 (16)	211 (22)
late phase	switch	349 (21)	348 (19)	343 (23)
	repetition	330 (25)	309 (22)	331 (29)

Table 4. *Group mean peak latencies (ms) at Pz for the switch and repetition trials for both phases of the P3. Standard deviations are presented in parenthesis.*