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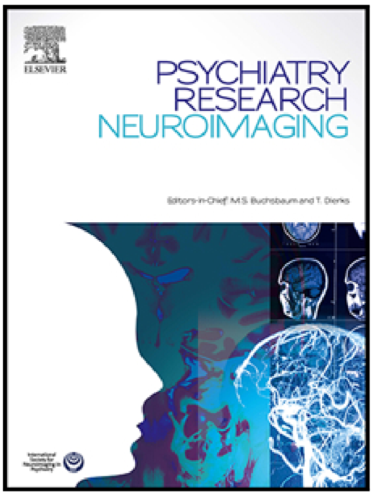

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PII: S0925-4927(18)30276-2
DOI: https://doi.org/10.1016/j.pscychresns.2019.03.009
Reference: PSYN 10934

To appear in: *Psychiatry Research: Neuroimaging*

Received date: 5 October 2018
Revised date: 15 February 2019
Accepted date: 19 March 2019

Please cite this article as: Rhiannon Jones , Michelle Cleveland , Maria Uther , State and trait neural correlates of the balance between work-nonwork roles, *Psychiatry Research: Neuroimaging* (2019), doi: https://doi.org/10.1016/j.pscychresns.2019.03.009

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Highlight:

- Dissatisfaction with balance was associated with reduced alpha synchronisation to work-related cues
- Diminished alpha synchronisation indicates reduced ability to suppress automatic responses
- Diminished alpha synchronisation and dissatisfaction with balance are highly correlated with elevated resting alpha power
- Findings are suggested to reflect an attentional bias to e-mail alerts in individuals dissatisfied with their balance, which interacts with fatigue through reduced cognitive capacity.

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State and trait neural correlates of the balance between work-nonwork roles

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Declarations of interest: None

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Abstract

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Difficulty managing the demands of work and nonwork roles (often referred to in terms of managing balance) can be detrimental to psychological wellbeing and contribute to occupational burnout. The current study investigated the neural correlates of perceived satisfaction with this balance using both trait and state EEG alpha measures. EEG was recorded from 14 participants in full time employment (12 females, aged 35.1 ± 10.1 years) during a resting state and performance of an auditory oddball task; e-mail and messaging alert sounds were used as target stimuli. It was predicted that dissatisfaction with the balance between work and nonwork roles would be associated with increased resting alpha power, consistent with studies of burnout, and diminished alpha response to oddball distractors, consistent with difficulty suppressing automatic responses to work-related stimuli. Significant correlations between self-reported measures of work/nonwork balance and both resting, and task-related alpha responses, supported our predictions. Furthermore, an exploratory partial correlation between work/nonwork balance and resting EEG, controlling for task-related alpha response, suggested that the three variables were interrelated. We propose that dissatisfaction with work/nonwork balance is associated with a state hypervigilance to work-related cues, and a trait neural marker of fatigue, both symptomatic of lowered cognitive capacity.

Key Words: Work/nonwork balance, e-mail, Alpha EEG, attentional bias, suppression

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1. Introduction

Managing the demands of work and nonwork life can be challenging, as it is often necessary for the various roles that one assumes to occur simultaneously (Casper et al., 2018). As such, this management of roles is often referred to in terms of balance; balancing the roles both within and outside of working life, which is considered distinct from the conflict and/or enrichment of work and nonwork roles (Carlson et al., 2009). While there are many different uses and definitions of balance within the literature, recent developments have identified key components to this definition; satisfaction, effectiveness, involvement and fit, all of which come together to produce a multidimensional definition of balance (Casper et al., 2018). Feeling content, or satisfied, with the balance between work and nonwork roles is, therefore, a facet of balance reflecting an individual's perception of their effectiveness at combining their various roles.

Communication technology plays a fundamental role in modern society, offering employees and employers the opportunity to stay connected outside of traditional office hours (Derks et al., 2015). Such advances in technology, whilst offering increased flexibility, also contributes to an increase in work contact; the extent to which an employee engages with work-related communications outside of their contracted working hours (Schieman and Young, 2013). Increased work contact contributes to the difficulty employees can face in being away from work (Derks and Bakker, 2014), while dissatisfaction with the balance one perceives they have between their various demands adversely affects psychological wellbeing, and contributes to occupational burnout (Derks and Bakker, 2014; Peeters et al., 2005). While evidence linking balance with occupational burnout is limited in extant literature, there are some suggestions of a potential relationship. Inefficiency, the perceived

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sense of reduced personal accomplishment, which forms an important component of occupational burnout (Maslach et al., 2001), shows some similarity to the effectiveness component of balance, as outlined by Casper et al. (2018). Additionally, Fisher-McAuley et al. (2003) found that a lack of perceived balance is an occupational stressor that can lead to job strain. To contribute to our understanding of balance, the current study takes an exploratory approach, with the aim of investigating how dissatisfaction with balance between work and non-work roles may relate to neural processing of work-related stimuli, as well as trait neural activity.

Definitions of burnout often include work-related physical and emotional symptoms of fatigue and distress, occurring in individuals who had previously been psychologically healthy, and resulting in negative attitudes and behaviours that impair work performance (Maslach et al., 2001; Van Luijtelaar et al., 2010). Neuroscientific research into burnout has found correlates in both resting and task-related brain activity. In the resting state, alterations in the EEG alpha frequency band are implicated (Tement et al., 2016). Alpha activity has a frequency range of 8 to 12 Hz, and variations of power in this band – indicating a lesser or greater proportion of neuronal populations synchronously activating at that frequency – reflect a stable trait measure when an individual is resting (e.g. Tenke et al., 2018), and modulations of complex cognitive processes when individuals are performing tasks (Klimesch, 1999). In a large-scale resting-state EEG study, Tement et al., (2016) found burnout to be significantly correlated with alpha power. Previous research has shown that alpha power increases as an individual fatigues (Craig et al., 2012; Cajochen et al., 2000 Cajochen et al., 1995). Cajochen et al (2000) and Cajochen et al., (1995), for example, report a significant, positive correlation between alpha 1 power and self-reported fatigue in an eyes-open condition, in adult females undergoing sleep deprivation. This increase of alpha power

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that accompanies fatigue is suggested to reflect an effort to maintain vigilance in the face of lowered cognitive capacity (Klimesch, 1999).

Tement et al., (2016) suggested that the positive correlation of alpha power with burnout resembles the pattern seen in burnout-like states, such as fatigue. We therefore made the tentative hypothesis that we would see a positive correlation between alpha power and an individual's perceived dissatisfaction of their balance between work and nonwork roles, potentially representing an early biomarker of work-related fatigue.

While previous resting-state data is often collected using only an eyes-closed condition (e.g. Tement et al., 2016), we chose to include both eyes-open and eyes-closed states, as alpha power differs substantially between the two states (Geller et al., 2014), and relationships with self-report measures are occasionally found in one state but not the other (e.g. Åkerstedt and Gillberg, 1990; Kaida et al., 2006). Following Tement et al., (2016), we expected this relationship to be present in the eyes-closed condition; furthermore, on the basis of increased alpha power as a reflection of fatigue, we also expected the relationship to be present with eyes open (e.g. Åkerstedt and Gillberg, 1990; Kaida et al., 2006), which was not a condition included by Tement et al., (2016).

Our second research question was whether task-related EEG activity would vary as a function of perceived balance between work-nonwork roles, and whether this would be specific to work-related stimuli. Previous studies of task-related neural activity in individuals suffering from burnout have found differences in event-related potentials (ERPs) in these populations compared to healthy controls (Golonka et al., 2018; Sokka et al., 2016; 2017; Van Luijtelaar et al., 2010). The P3 ERP complex has been implicated with relative consistency; Van Luijtelaar et al. (2010) found a reduced P3 (a and b) amplitude during a standard auditory oddball task, in response to target stimuli. Sokka et al. (2014) also present evidence of differences in the P3a component from an auditory oddball task, in this case with

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novel speech sounds of differing emotional valence. The burnout group was found to have a reduced P3a latency to negative speech sounds, but a delayed latency to positive speech sounds, suggesting that burnout may lead to alterations in emotion-specific attentional capture. However, Sokka et al. (2016) found a mild burnout group to have reduced P3a component in response to novel auditory distractors during a visual n-back task, in which neither auditory nor visual stimuli had emotional relevance. They also found a reduced posterior P3b in response to task-relevant visual stimuli; interestingly, this was accompanied by increased amplitude of the frontal P3a, which was suggested to reflect frontal compensation for posterior decrements. Reduced P3a has also been found during task switching, which was only present in severe rather than mild burnout (Sokka et al., 2017). The results of Sokka et al. (2014) are of particular interest, as they may signal an attentional bias in burnout, as evidenced by enhanced attentional capture by negative emotional stimuli.

Attentional biases, characterized by an inability to flexibly allocate attention to relevant stimuli, are often seen in psychological disorders. These include an increase in the orienting of attention towards threat-related stimuli, and attentional avoidance/ difficulty disengaging attention from irrelevant but negatively valenced stimuli (Cisler and Koster, 2010) – corresponding to the *Sustained Threat* and *Loss* constructs of the Research Domain Criteria (RDoC; NIMH, 2008), respectively (see Gibb et al., 2015). Attentional biases tend to be stimulus-specific and develop in response to the experience of environmental threats, such as; difficulty disengaging from angry faces in children who have experienced abuse (Pollack, 2003), or attentional avoidance of angry faces in children with critical mothers (Gibb et al., 2011). It is possible that a neural signature of attentional bias towards work-related stimuli may precede alterations in the more temporally stable, trait-related resting EEG, or at least be more directly related to the source of psychological distress than an indirect consequence, such as fatigue.

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In the current study, an auditory oddball task in which work-related and non-work-related stimuli were used to specifically address the question of whether dissatisfaction with balance between work and non-work roles was associated with an attentional bias to work-related cues. Given the increased use of email within the working context and the expectation that work-related emails will be responded to immediately (Park et al., 2011; Towers et al., 2006), e-mail alert sounds were used as target stimuli. It was predicted that someone who perceives dissatisfaction with the balance between their work and nonwork roles may have developed an attentional bias to these sounds, seeing them as potentially threat-related, especially when encountered outside of their working hours. Consequently, one might expect neural activity reflecting an increased orienting to the sounds, attentional avoidance of the sounds, or difficulty disengaging attention from the sounds.

Our first analysis of the current dataset examined the amplitude and latencies of ERP components typically elicited by the novelty oddball paradigm – the MMN, the P3a, and the P3b (Uther et al., 2018). The results of previous literature might suggest a negative correlation between P3a latency and dissatisfaction with balance in response to work-related cues, if they were perceived as negative (Sokka et al., 2014), reflecting enhanced orienting of attention towards threat. While Uther et al., (2018) did find an enhanced P3a for work-related, compared to non-work-related cues, there was no correlation with balance. Furthermore, the only correlation with balance related constructs was a negative correlation between reaction time to work related cues and participants' perceived involvement with their job.

The findings reported in Uther et al. (2018) are extended in the current study through the exploration of neural activity preceding the MMN time window, as attentional bias has been shown to modulate very early neural responses. This is especially true of the attentional orienting component of bias, which appears to be automatic – often occurring in the first

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100ms (Cisler and Koster, 2010; Eldar et al., 2010; Pourtois et al., 2004; Santesso et al., 2008; Sass et al., 2010). Increased P1 ERP, for example, has been found in anxious participants compared with controls, suggesting enhanced orienting to negative or threatening stimuli (e.g. Liu et al., 2015; Sass et al., 2010). Conversely, a reduced P1 ERP has been found in individuals with high disgust sensitivity, suggesting a suppression of attention towards disgusting stimuli (Liu et al., 2015). Evidence suggests that these early modulations of attentional orienting have sources in the anterior cingulate (ACC; Santesso et al., 2008), extrastriate and temporal regions (Mueller et al., 2009), prefrontal regions (Hu et al., 2017; White et al., 2016), and the interaction of subcortical threat detection regions, such as the amygdala with visual (Pourtois et al., 2004), or prefrontal areas (White et al., 2016). Amygdala involvement has been proposed to facilitate such early modulation of attention and sensory processing by emotion (Vuilleumier, 2002), as it receives rapid sensory information directly from the thalamus (LeDoux et al., 1990). While we would not be able to see amygdala activation using EEG, its involvement is not out of the question in the current paradigm given its crucial role in novelty detection (Blackford et al., 2010).

Although previous studies investigating early neural correlates of attentional bias have generally examined ERPs such as the P1 component (e.g. Liu et al., 2015; Sass et al. 2010), the current study presents an exploratory analysis of induced alpha activity. There are three reasons for this: i) While ERPs provide a useful measure of stimulus-locked electrical activity, the method of averaging cancels out continuous modulations of ongoing EEG oscillations, and activity which is induced, but not phase-locked, can be lost (see Grandchamp and Delorme, 2011); ii) Event-related alpha is believed to be a reliable measure of top-down sensory gating, underlying the enhancement and inhibition of cortical activity by event-related desynchronization (ERD) and synchronisation (ERS) respectively (see Foxe and Snyder, 2011); iii) In addition to investigating resting and task-related correlates of

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balance satisfaction independently, we also intended to assess the relationship between them. As previous research has shown that the relationship between resting and task-related alpha obtained during an auditory oddball experiment is consistent with a common mechanism underlying all alpha activity (Tenke et al., 2015), remaining in the frequency domain for both analyses was considered the most effective way of identifying an interaction between state and trait correlates.

Alpha fluctuations (ERS and ERD) are believed to control sensory gating and top-down inhibition of cortical processing (Fox and Snyder, 2011; Klimesch, 1999). Alpha ERD in an area of cortex is associated with increased processing in that region; for example, an alpha ERD will be seen in an area of the visual cortex contralateral to an attended stimulus, while an alpha ERS will be seen in an area of the visual contralateral to an ignored stimulus (Payne and Sekuler, 2014; Fox and Snyder, 2011). While this has more commonly been examined in the visual domain, alpha ERS has also been shown to be important in selective inhibition of auditory stimuli, in which is it is seen over the auditory cortex in the first 500ms after stimulus onset (Strauβ et al., 2014; Kerlin et al., 2010).

In addition to suppression of sensory perception or attention, alpha synchronisation is proposed to reflect inhibitory top-down control of motor responses and internal processes such as memory, for example, when retaining short-term memories prior to response, or withholding motor responses (Klimesch et al., 2007; Klimesch, 1999). It therefore appears to be crucial for ignoring both external and internal stimuli (see Payne and Sekuler, 2014).

Based on this inhibitory role of alpha ERS, our speculative hypothesis was that there would be a negative correlation between early alpha power and perceived dissatisfaction with balance between work and nonwork roles, in response to distracting work related stimuli. Our rationale was that a lower alpha ERS (or higher ERD) would reflect difficulty inhibiting the processing of work-related stimuli, or the enhanced orienting towards work-related stimuli.

As this was a relatively exploratory analysis, we did not have strong hypothesis regarding the predicted topography of the correlation; the research outlined above would suggest that suppression of processing auditory stimuli should be reflected in ERS over auditory cortex, however, there is also reason to believe that the relationship would be seen in frontal areas. As outlined above, attentional orienting to and suppression of threat appear to be at least partially mediated by the prefrontal cortex. Furthermore, Thompson and Westwater (2017) present evidence that that early frontal alpha power suppresses Pavlovian responses to social reinforcement learning, which is especially relevant to the current study, as e-mail alerts could be seen to signal impending social reward or punishment. As a previous novelty oddball task showed a midfrontal alpha ERS beginning around 100ms, which was strongest in response to novel distractors (Kayser et al., 2014), the timing of which corresponds to that of an automatic threat orienting response (Cisler and Koster, 2010), we speculated that this might be where we would see a correlation.

Our final research question concerned the potential interaction between the resting and work-related alpha responses. We predicted that if we did find correlations between balance and alpha activity in the resting state and during the task, that these alpha constructs would be significantly correlated, consistent with a common rhythmic alpha mechanism (Tenke et al., 2015).

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2. Methods

The methods (participants, experimental setup) have been described in Uther et al. (2018) but are again detailed below. The current data analysis section differs from the earlier study, as the current analysis focused on resting and task-related activity in the frequency domain, rather than task-related ERP indices.

2.1 Participants

Participants were 14 adults (12 female, 2 male), aged 24 to 60 (35.1 ± 10.1 years) in full-time employment. Participants were not recruited from Psychology department academic staff, in order to ensure naivety of the oddball paradigm. One participant (female, aged 50 years) was taken ill during the Attend condition of the oddball task, and so her data was removed from that condition. Ethical approval was granted by the University Ethics Committee, and all participants provided written consent.

2.2 Measures

Participants completed 6 measures: 1. Balancing work and family/ personal life, 2. Rumination, 3. Job involvement, 4. Psychological detachment, 5. Sound familiarity, 6. Device use and ownership. In order to keep the number of analyses in the current paper to a minimum, and guard against false discovery rate (see Luck and Gaspelin, 2017), only *Balancing work and family/ personal life* was included. Participants' total score was calculated and will be referred to as *Balance* henceforth.

2.2.1 Balancing work and family/personal life.

Satisfaction with the balance between work and nonwork life was measured on a 5-point likert scale, developed by Valcour (2007). Participants rated their satisfaction (from 1 – very

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dissatisfied, to 5 – very satisfied) on five items ($\alpha = .94$), for example: “the way you divide your time between work and personal or family life”. The final item (“the opportunity you have to perform your job well and yet be able to perform home-related duties adequately”) was originally developed by Rothausen (1994).

2.3 Stimuli

In order to investigate the work-specificity of neural responses as a function of satisfaction with balance, work related and non-work-related stimuli were included in different conditions. The Microsoft ‘Outlook’ sound for windows and the Android ‘Whistle’ sound were used as targets in the Outlook (work-related) and Android (non-work-related) conditions, respectively. For each condition, matched distractors were created according to the procedure developed by Souza and Rosen (2009): Each sound was filtered into eight bands across a frequency range of 0.05-10kHz, and the output was full-wave rectified and low-pass filtered backward-forward at 300Hz to extract the amplitude envelope. This was then multiplied by a sine-wave carrier at the band centre frequency of the original filter, and the resulting signal was filtered using the same bandpass filter as in the initial stage. The RMS level was adjusted to match the level of the original band pass filtered signal, before all eight individual signals were summed. The sounds were then normalised and played at 65 dB SPL. White noise stimuli, matched for duration and overall intensity with targets and distractors, were used as standard tones. This resulted in three stimuli per condition: Target (Outlook or Android), Distractor (derived from Outlook or Android), and Noise. Stimuli in the Outlook condition (1.2s) were 100ms shorter than those in the Android condition (1.3s).

2.4 Procedure

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Participants completed the measures on arrival and were seated in a quiet room, approximately 40cm away from a computer monitor, with a partition between themselves and the experimenter. Stimuli were delivered through Sony headphones.

2.4.1 Resting state procedure

A resting state EEG recording was first carried out, during which participants were asked to relax and sit quietly; participants were instructed to close their eyes for 2 minutes and open them when they heard a 400 Hz ‘beep’, at which point they were required to keep their gaze focused on a fixation cross in the centre of the screen. This was repeated three times, producing a total of 6 minutes of eyes closed and 6 minutes of eyes open resting state data.

2.4.2 Novelty oddball procedure.

In addition to a work-related condition (Outlook alert targets), and a non-work-related condition (Android alert targets), both “Ignore” and “Attend” conditions were used, in which participants were required to ignore all stimuli while attending to a video, or attend to the stimuli and respond to targets, respectively.

Within each condition (Ignore and Attend), and each block (Outlook and Android), 60 targets, 60 distractors, and 360 noise trials were presented, randomly, for a total of 480 trials with a 12.5% probability of a target or distractor. Stimuli were 1.2s in the Outlook condition, and 1.3s in the Android condition, with an inter-stimulus interval of 500ms; this amounted to approximately 15 minutes per block. All participants began with the Ignore condition, in which they were instructed to ignore the auditory stimuli and focus on a subtitled travel documentary. Care was taken to ensure that the documentary contained no affective content, and participants were instructed that they would be tested on the content of the documentary at the end of the condition. Participants were asked to keep eye-movements to a minimum,

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but no fixation cross was used in this condition. The Attend condition followed, in which participants were required to attend to the oddball stimuli while maintaining focus on a fixation cross in the centre of the screen. Participants were required to respond by pressing the spacebar on a computer keyboard with their dominant hand as quickly and accurately as possible when they heard the target.

2.4.3 Novelty oddball behavioural analysis

Behavioural data was analysed, as outlined in Uther et al. (2018), providing reaction time (RT) and sensitivity (d') for each condition.

2.5 EEG recording

Sixty-four channel EEG was recorded by active scalp electrodes, and amplified by BioSemi Active Two® amplifiers, filtered between 0.16 and 100 Hz. A sampling rate of 512 Hz was used during the resting state recording, and 256 Hz during the oddball paradigm, as it had originally been intended only for ERP and behavioural analysis. Electrodes were placed according to the 10-20 method of electrode placement (Jasper, 1958), with additional external electrodes above and below the right eye and on the outer cantus of each eye, to monitor eye movements.

2.6 EEG Analysis

All EEG analysis and visualization was carried out using the EEGLAB v13 (Delorme and Makeig, 2004) toolbox for Matlab ®.

2.6.1 Resting-State.

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Data were re-referenced to earlobe electrodes and filtered between 0.5 and 48 Hz. Consecutive 1-second epochs were extracted from the continuous data, and ICA was run. Components reflecting eye-movements were removed (eyes closed components removed: 2.14 ± 0.66, and eyes open: 2.79 ± 2.63 per participant). Participant 12 had a bad channel at P5, so this was replaced using nearest-neighbour interpolation. Epochs with artifacts remaining were identified, semi-automatically, with a threshold of ± 70 µV and rejected (eyes closed epochs rejected: 46.00 ± 36.77; eyes open rejected: 29.43 ± 37.50 per participant). There was no statistical differences between the number of epochs available for the eyes closed (131.00 ± 36.77) and the eyes open condition (139.14 ± 39.24; $t(13) = 1.07$, $p = 0.30$). The power spectrum was calculated for eyes open and eyes closed epochs separately. This was carried out using the EEGLAB ‘spectopo’ function, which estimated the log spectrum via welch method (Welch, 1967), with a window length of 512, and an FFT length of 1024 with zero overlap, producing a frequency resolution of 0.5 Hz. Mean power was calculated for the lower and upper alpha bands (defined as 8-10 Hz and 10.5-12.5 Hz, respectively) for frontal (fp1, fpz, fp2, af7, af3, afz, af4, af8, f7, f5, f3, f1, fz, f2, f4, f6, f8), central (fc3, fc1, fcz, fc2, fc4, c5, c3, c1, cz, c2, c4, c6, cp3, cp1, cpz, cp2, cp4), and posterior (p7, p5, p3, p1, pz, p2, p4, p6, p8, po7, po3, poz, po4, po8, o1, oz, o2) regions.

2.6.2 Novelty Oddball Task.

Data were re-referenced to the earlobes and filtered between 1 and 30 Hz. Epochs of 600ms duration including a -100ms baseline, were created time-locked to stimulus onset. Epochs were baseline corrected, and those corresponding to behavioural errors in the Attend condition (misses and false positives) were discarded. Eye-movement activity was removed using ICA, for Ignore (2.14 ± 0.53 components per participant) and Attend conditions separately (1.15 ± 0.38 components per participant), and epochs containing further artifacts

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were rejected semi-automatically, with a threshold of ±70 µV (Ignore: 35.21 ± 30.19; Attend: 63.69 ± 81.80 epochs rejected per participant). There were no significant differences in the number of epochs corresponding to each target and distractor condition for each condition ($p < 0.05$), although there were naturally significantly more noise epochs due to the study design (all $p < 0.001$).

Following Luck and Gaspelin (2017), care was taken to ensure that time windows and electrode clusters were chosen prior to analysis. We chose to analyse a time window of 100-150ms as this covered the timing of an alpha event-related synchronisation previously reported for an auditory oddball task (Kayser et al., 2014). As we did not have any strong predictions regarding lateralization or localization and wished to keep comparisons minimal, the same regions were used as in the resting state (frontal, central, posterior).

Event-related (log) spectral perturbations (ERSP; Grandchamp and Delorme, 2011; Makeig, 1993) was calculated (using the EEGLAB 'newtimef' function) by zero-padded FFT with Hanning window tapering. The ERSP method was chosen firstly to retain consistency with Kayser et al. (2014), on whose findings our time window was based, and secondly as it provides a measure of both event-related synchronisation (ERS) and desynchronization (ERD). The method provides a generalization of ERS and ERD by giving the log spectral differences following the stimulus relative to the pre-stimulus baseline (in dB). Relative increases (ERS) and decreases (ERD) in event related power were calculated as the log10-transformed ratio of overall power and average (not single trial) baseline power (multiplied by 10), using a 32 sample (125ms) sliding window. This produced a frequency resolution of 4 Hz (range 4 – 48 Hz) for 122 timepoints between -39.5ms and 433.5ms. Due to low frequency resolution, a single alpha band (8-12 Hz) was analysed. For plotting Figure 3, the spectrum is plotted from 6-14 Hz, with a padratio of 16.

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To investigate differences in spectral power between conditions, independent of Balance Score, Attending, and Non-Attending conditions were analysed separately, as were Outlook and Android conditions. Within each of these conditions, a repeated measures ANOVA of Stimulus (Noise, Target, Distractor) and Region (Frontal, Central, Posterior) was run, with simple contrasts to compare i) Noise with Target, ii) Noise with Distractor.

To investigate relationships with Balance score, mean alpha activity was calculated for each of the three regions for each of the oddball-contrasts (Target-Noise Attend; Distractor-Noise Attend; Target-Noise Ignore; Distractor-Noise Ignore). The use of contrasts reduces individual differences in non-task related EEG power (e.g. related to generic auditory stimulation rather than the meanings of the specific stimuli), which is particularly important with small sample sizes. As our research questions were focused on the way that participants would respond to work-related distractors – those which they were required to ignore in order to efficiently complete the tasks – we were particularly interested in the Target-Noise contrast in the Ignore condition, and the Distractor-Noise contrast in the Attend condition. According to our hypothesis, when participants were required to concentrate on a video and make no behavioral responses (the Ignore condition), we would expect greater dissatisfaction with balance to be associated with an increased orienting towards (or difficulty ignoring) e-mail alert sounds (targets). Similarly, when participants are required to attend to e-mail alert sounds (targets) but ignore distractors with similar auditory qualities (distractors), we would expect greater dissatisfaction with balance to be associated with an increased orienting towards – or difficulty ignoring – these matched distractors.

In order to keep false discovery rates as low as possible (Luck and Gaspelin, 2017), only analyses specifically addressing the research question were carried out; to this end correlations were run between Balance score and alpha ERSP at each region, for each condition. As we had no predictions concerning the linearity versus monotonic nature of

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hypothesised relationships, and Shapiro-Wilk tests showed minor violations of normality in some variables, Spearman’s rank correlations were used throughout**.** Corrections for multiple comparisons were carried out using the Benjamini and Hochberg method (1995) within each condition separately (Attend and Ignore). Post-hoc analysis of correlations between behavioural measures and alpha ERSP was run only on contrasts found to correlate significantly with Balance.

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3. Results

3.1 Behavioural Results

No significant difference in RT was observed between Outlook (608.25 ± 155.83) and Android (653.53 ± 237.64) conditions (t (12) = -1.10, p = .29). As in the larger sample of Uther et al. (2018), perceptual sensitivity (d') was found to be significantly lower for Outlook targets (4.10 ± 1.75) than android targets (5.77 ± 0.92; t (12) = -3.60, p = .004).

3.2 Resting Alpha Power

In the eyes-open condition, strong inverse correlations were observed between *Balance* and lower alpha power in the eyes open condition in central (*Rho* = -0.584, *p* = 0.028) and posterior (*Rho* = -0.717, *p* = 0.004) regions, and upper alpha power in central regions (*Rho* = -0.534, *p* = 0.049). Correlations in the eyes-closed condition did not reach significance. Inspection of the scatterplots suggested that a genuine relationship may have been masked by a multivariate outlier (Figure 1.d), however, calculation of Mahalonobis distance showed this not to be the case. Following correction for multiple comparisons (*k* = 12), only posterior lower alpha power remained significantly correlated with *Balance*. The full correlation matrices for eyes open and closed can be found in Table 1.

[Figure 1 around here]

3.3 Novelty Oddball Task

In the Outlook conditions, Time-frequency representations indicated alpha synchronisations time-locked to stimulus-onset at 100-150ms in both oddballs (target and distractor) and both conditions (Attending and Non-Attending) of the Outlook condition, but not the Android condition. Bar charts of mean event-related alpha power are shown for the

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Attending and Non-Attending conditions in Figure 2, and time-frequency representations for the Outlook condition are shown in Figure 3.a.

[Figure 2 here]

3.3.1 Spectral power differences between conditions

In the Attend condition, no significant effects of *Stimulus* were seen on event-related alpha power for either the Outlook or the Android conditions (see Table 2).

3.3.1.2 Ignore Condition

In the Ignore condition, no significant effects of *Stimulus* were seen in the Android condition. For the Outlook condition, a significant *Stimulus* effect was present (F (2, 26) = 8.05, $p = 0.002$, η_p^2 =0.38). Planned contrasts showed there to be greater alpha power in response to both the target (F (1, 13) = 12.68, $p = 0.003$, η_p^2 =.0.49) and matched distractor (F (1, 13) = 8.21, $p = 0.01$, η_p^2 =.0.39), compared with the noise stimulus. See Table 3 for a summary of ANOVA results.

3.3.2 Correlations with Balance Score

3.3.2.1 Ignore Condition.

Moderate positive correlations were observed between *Balance* and the target-noise contrast at frontal (*Rho* = 0.63, $p = 0.02$) regions, however; this did not remain significant following FDR correction. No significant correlations were observed in the Android condition (Table 5).

3.3.2.2 Attend Condition.

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Large positive correlations were observed between *Balance* and the distractor-noise contrast in frontal (*Rho* = 0.78, *p* = 0.002) and central regions (*Rho* = 0.61, *p* = 0.03) in the Outlook condition. In the Android condition, a moderate negative correlation was observed between *Balance* and the distractor-noise contrast in posterior regions (*Rho* = -0.61, *p* = 0.03). Following FDR correction for multiple (*N* = 12) comparisons within the condition, only the correlation between *Balance* and the distractor-noise contrast in frontal regions of the Outlook condition remained significant, as shown in Figure 3b.

[Figure 3 around here]

3.4 Correlation between resting and oddball-induced alpha

Exploratory correlations were run between the variables that had remained significantly correlated following multiple comparison correction. This revealed significant negative correlations between resting posterior alpha power and frontal alpha synchronisations in the distractor-noise contrast of the Attend condition (*Rho* = -.65, *p* = .02), showing that elevated resting alpha is associated with reduced alpha synchronisation to distractors during the task.

A partial Spearman correlation showed that when controlling for the alpha synchronisation in the distractor-noise Attend contrast, the relationship between *Balance* and resting state alpha power was no longer significant (*Rho* = -0.51, *p* = 0.09), suggesting that the trait and state neural correlates of balance between work and non-work roles were related.

3.5 Correlations with behavioural measures

Correlations were non-significant between *Balance* and d’ for Outlook stimuli (Rho = -0.40, p = 0.17) and Android stimuli (*Rho* = 0.10, *p* = 0.75), however, the relationship

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between *Balance* and Outlook d' appeared to be heavily influenced by an outlier. Inspection of d' values showed one participant to have very low sensitivity to the stimulus (0.25), which was found to be a significant outlier when comparing the probability of its Mahalonobis distance of 6.36 against the chi squared distribution (*p* = .04). Consequently, this participant was removed from analysis of behavioural responses. Although this led to a trend towards a relationship between Outlook d' and *Balance*, it remained non-significant (*Rho* = -0.55, *p* = 0.07). Outlook d' was found to be significantly correlated with resting posterior alpha power (*Rho* = 0.64, *p* = 0.03), such that higher posterior alpha was associated with better performance, whereas no relationship between resting alpha and Android d' was observed (*Rho* = 0.39, *p* = 0.21). There was also a trend towards a correlation between Outlook d' and the frontal Distractor-Noise contrast in the Attend condition (*Rho* = -0.56, *p* = .06). Full correlations can be seen in Table 6.

3.6 Age and Gender effects

The age range is large, mainly due to two outliers (aged 50 and 60). To ensure that this was not having an effect on the data, we removed these participants and re-ran our analyses (*N* = 12, aged 31.75 ± 5.59). In the resting state, correlations between *Balance* and alpha power remained significant at Frontal (*Rho* = -0.64, *p* = .03), central (*Rho* = -0.62, *p* = .03), and posterior regions (*Rho* = -0.72, *p* = 0.008). In the Ignore condition the strength of the relationship with *Balance* increased (*Rho* = 0.69, *p* = .013), and the effect size and significance of correlations in the Attend condition remained largely unchanged (Frontal: *Rho* = 0.79, *p* = .002; Central: *Rho* = 0.64, *p* = .03).

As some studies have observed gender differences in EEG-based indicators of burnout and risk for depression, we also re-ran our analyses on our dataset with the removal

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of male participants. In the resting state (*N* = 12, aged 35.92 ± 10.40), the correlation with *Balance* was reduced in all regions, leaving only a marginally significant relationship with posterior alpha power (*Rho* = -0.58, *p* = .05). In the Ignore condition (*N* = 12, aged 35.92 ± 10.40), the removal of male participants substantially reduced the correlation between the frontal alpha Target-Noise contrast and *Balance* score (*Rho* = 0.47, *p* = 0.12). However, the correlations in the Attend condition (*N* = 11, aged 34.64 ± 9.96) remained significant in both frontal (*Rho* = 0.77, p = 0.006), and central regions (*Rho* = 0.62, *p* = .04).

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4. Discussion

The first research question of the current study investigated whether dissatisfaction with balance between work and nonwork roles is associated with elevated resting alpha power.

In partial agreement with our hypothesis, we found a negative correlation between satisfaction with perceived balance and resting alpha power, however, this was only observed in the eyes-open condition. The lack of a relationship between balance and alpha power in the eyes-closed condition was unexpected, because the previous finding of a correlation between burnout and increased resting alpha were found with eyes closed (Tement et al., 2016). However, in the case of Tement et al., (2016) the experimenters did not record an eyes-open condition. A stronger relationship might be observed between dissatisfaction with perceived balance and elevated EEG alpha power when eyes are open rather than closed due to excessive sleepiness. Both magnitude of alpha power with eyes open, and ratio of alpha power with eyes-open compared to eyes-closed, have been found to correlate with sleepiness (Åkerstedt and Gillberg, 1990; Kaida et al., 2006; Cajochen et al, 2000; Cajochen et al., 1995).

Although the finding of a positive correlation between alpha power and dissatisfaction with balance was in line with our prediction, it should be noted that the relationship between burnout and elevated resting alpha power is by no means consistent. Van Luijtelaar et al. (2010), for example, found lower individual alpha frequency (IAF) in burnout patients compared with healthy controls, but no difference in alpha power. Given the proposal that elevated alpha power reflects increased effort to maintain vigilance when fatigued, it could be argued that the participants in Van Luijtelaar et al’s sample had reached a level of burnout at which efforts are reduced. In their sample, the burnout patients had worked for 50% or less of their usual working hours for at least 3 months, suggesting that their attempts to

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compensate for their reduced cognitive capacity may have diminished. If this is the case, then we might expect an inverted U-shaped relationship between resting alpha power and burnout: as work demands increase and satisfaction with perceived balance decreases, increased mental effort – indexed by elevated alpha power – is required to offset fatigue-induced cognitive deficits. As time goes on, an individual may reach the point where they no longer have the cognitive capacity to offset the effects of increasing fatigue, so they begin to reduce their efforts to maintain vigilance – at which point elevated alpha power would no longer be seen. An alternative (although not mutually exclusive) explanation, is that the elevated alpha reflects resilience (Tenke et al., 2018), in which case these participants may be able to maintain their compensatory mechanisms. Although it is not possible to test these hypotheses with the current sample, a future cross-sectional study with a large cohort of individuals who range from fully employed and satisfied with their perceived balance, through to those who have reduced their working hours due to burnout, could explore whether such a pattern exists.

For our second research question, we examined the relationship between satisfaction with perceived balance and event-related alpha response to email alert sounds. We hypothesised that increasing dissatisfaction with balance would be associated with signs of attentional bias towards e-mail alert sounds. On the basis of previous literature, which has shown alpha synchronisation (ERS) to mediate top-down inhibition of cortical processing (Fox and Snyder, 2011; Klimesch, 2007; 1999), accompanying active suppression of stimulus or modality specific processing (see Payne and Sekuler, 2014), or conditioned social responses (Thompson and Westwater, 2017), we predicted that dissatisfaction with perceived balance would be associated with reduced alpha activity in response to work-related cues, which they are required to ignore; therefore, the distractor in the Attend condition and the target in the Ignore condition. Based on Kayser et al. (2014) we expected target and distractor

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stimuli to elicit a midfrontal alpha ERS, relative to noise stimuli, between 100-150ms. As previous research suggests that attentional biases indexing the automatic orienting (Liu et al., 2015; Sass et al., 2010) or attentional avoidance (Liu et al., 2015) of threat occurs in this early window, and may be subserved at least partially by prefrontal regions (Hu et al., 2017; White et al., 2016), we hypothesised that we may see a negative relationship between alpha ERS and dissatisfaction with balance in this region. However, it was also acknowledged that a correlation may alternatively be seen in temporal regions consistent with suppression of auditory processing (Kerlin et al., 2010; Strauβ et al., 2014).

Once again, our findings were in partial agreement with our hypotheses. Visual inspection of the time-frequency representations indicated an alpha ERS in the expected time-window of the Outlook condition; however, this was not present for the Android condition. Furthermore, while contrasts showed weak trends in the Outlook-Attend condition, the ERS in response to distractor and target stimuli compared to noise was non-significant. Only in the Outlook-Ignore condition was a significant ERS seen, with a particularly large effect for the contrast of Target-Noise.

Dissatisfaction with perceived balance was correlated with a diminished alpha response to the distractor in the Outlook-Attend condition, and in response to the target in the Outlook-Ignore condition. However, only correlations in the Attend condition survived correction for multiple comparisons.

The left frontal topography of the effect is consistent with previous reports of inefficient response inhibition in a novelty oddball task (Wolf et al., 2008), however the timing of the effect was far too early for this to reflect the suppression of a motor response (e.g. Wolff et al., 2017). Furthermore, the effect is also seen (albeit non-significantly) in the Ignore condition, in which motor responses were not made to the target. It is, therefore, likely

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that we are seeing a reduced ability to ignore work-related but irrelevant stimuli on a more cognitive or emotional level.

The frontal topography along with the early timing of the effect are suggesting enhanced processing of the work-related distractors, but at this point we cannot state whether it reflects increased attentional orienting or reduced attentional suppression. Both the topography and the timing of the effects are more consistent with the findings of Thompson and Westwater (2017), who found increased early (100-300ms) alpha power to accompany the suppression of conditioned Pavlovian responses to socially rewarding or punishing stimuli. The authors suggested that this reflects a mechanism for controlling how we feel in response to feedback from others and proposed that the frontal distribution may reflect the involvement of brain regions involved in determining the social importance of environmental cues.

This suggests an intuitively attractive explanation for our current findings. Workplace emails are, by their nature, concerned with distributing and carrying out tasks, and with that comes a certain degree of social pressure. Emails will often include – either implicitly or explicitly – socially rewarding or punishing content; furthermore, the decision of whether to open a work email when received out of working hours comes with its own social pressure or expectations. It could, therefore, be argued that the social pressure of constant work emails leads to a conditioned emotional response to e-mail alert sounds, leading to an attentional bias. Given the very early timing of the effect that we see here, we would further suggest that this email specific bias reflects hypervigilance to potential threat (Eldar et al., 2010; Hu et al., 2017; LeDoux et al., 1990; Mueller et al., 2011; Pourtois et al., 2004; Santesso et al., 2008; Vuilleumier, 2002; White et al., 2016).

Significant correlations were also observed between satisfaction with perceived balance, and both the resting and task-related alpha activity, and a partial correlation

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suggested that the variance in perceived balance explained by resting (trait) alpha overlapped with that explained by task-related (state) alpha activity. In our current conceptualisation of the findings, we suggest that the correlation between dissatisfaction with perceived balance and increased resting alpha activity reflects effortful attempts to compensate for reduced effectiveness caused by fatigue. We further suggest that the correlation between dissatisfaction with perceived balance and diminished alpha response to irrelevant work-related cues reflects a diminished ability to suppress automatic cognitive or emotional responses to these stimuli. Without longitudinal data we can only speculate as to the relationship between these two neural measures, but a direct causal link between them has rational appeal – in both directions: i) The sustained mental effort required to compensate for cognitive deficits resulting from fatigue (elevated resting alpha) could reduce the cognitive capacity available to suppress the processing of irrelevant but salient stimuli (diminished alpha response); ii) A reduced ability to suppress the processing of irrelevant but salient stimuli (diminished alpha response) will use up cognitive and attentional resources, leading to fatigue which must be effortfully compensated for (elevated resting alpha). The role of posterior resting alpha as reflecting compensation strategies and vigilance is further supported by its significant correlation with enhanced sensitivity to cues in the Outlook condition.

The primary limitation of this study is that the sample size is relatively small. While this is not uncommon for neuroimaging studies (e.g. Taylor et al., 2014; Van Luijtelaar et al., 2010), and substantial efforts were made to minimize false positives in the analysis of the EEG data, we must be tentative when making generalizations. This is especially true when generalizing across age and gender: our sample has a wide age range and is predominantly female. It is well known that attentional processes are affected by age, particularly regarding selective attention and inhibition (Powell et al., 2018). When re-running our analysis with the

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exclusion of the two older participants, our observed effects were stronger, and therefore may be more characteristic of balance correlates in younger adults. Research has also suggested that younger generations of employees place a higher value on achieving balance between their work and nonwork lives than their older counterparts (Lewis et al., 2002). With only two males in our sample, we also cannot generalize across gender. Gender differences in the relationship between EEG measures and burnout or depression have been reported: Tement et al., (2016), for example, found that the positive correlation between alpha power and burnout was only present in the males of their sample, and in a female sample, no relationship was reported between alpha power and chronic stress (Peng et al., 2013). Conversely, Stewart et al., (2010), found that the relationship between leftward frontal alpha asymmetry and depression was very strong in females, but variable (or even reversed) in males. The sample size of the current study does not allow us to speculate on gender differences. However; this is an important area for future study, particularly considering recent research has suggested there are gender differences in perceptions of work-life balance and stress (Ip et al., 2018), and there are mixed findings in the wider work-family interface literature (e.g. Shockley et al., 2017).

A further limitation is the absence of explicit fatigue measurements. Our hypothesis concerning the correlation between resting state alpha power and dissatisfaction with balance was based on evidence that alpha power correlates with fatigue, and with the assumption that difficulty balancing the demands of work and nonwork roles would result in fatigue. Without specific measurements of fatigue we should keep in mind that the alpha activity may reflect a different characteristic of balance dissatisfaction. For example, rather than reflecting increasing fatigue, an increase of alpha power with increasing dissatisfaction may come about as a result of negative affect. Although findings are not consistent, with some studies finding reduced alpha power to be associated with negative affect (Jiang et al., 2016; Zoon et al.,

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2013), a number of studies have found significant positive relationships (Joworska et al., 2012; Pollock and Schneider, 1990; Roemer et al., 1992; Baehr et al., 1998; Kemp et al., 2010). For example, an increase of frontal and parietal alpha power has been seen in a mixed-gender sample of depressed individuals compared with healthy controls, in both eyes open and eyes closed resting conditions (Joworska et al., 2012). Therefore, it would also have been beneficial to collect data regarding participants' symptoms of depression and anxiety.

If dissatisfaction with balance is indeed a precursor to burnout, as we suggest, then it is likely to be positively correlated with depression and anxiety symptoms in a similar way (e.g. Sokka et al., 2017). Burnout has been considered by some to be, at its core, a depressive disorder (Bianchi, Schonfeld and Laurent, 2015), as it shares a substantial amount of variance with depressive symptoms and may lead to increased depression over time (Ahola et al., 2014; Hakanen and Schaufeli, 2012). As such, this may pose a potential difficulty in identifying the unique contributions of depression or anxiety symptoms in relation to a dissatisfaction with balance. Considering the above; we suggest that the condition in which our task-related correlations with balance occurred (in the work-related Outlook condition, but not in the non-work-related Android condition) strengthens the argument that we are seeing a more balance-specific effect, rather than a general consequence of depression or anxiety symptoms occurring. Further, while we cannot state that the correlation between resting alpha power and balance in our current sample was not due to depression or anxiety symptoms, the correlation between this measure and performance in the work-related Outlook condition of the oddball task suggests that even if the alpha power is reflective of negative affect, it is negative affect as a result of poor balance.

In order to contribute to our understanding of balancing work and non-work roles, the current study adopted an exploratory approach to investigating a dissatisfaction with this balance in relation to burnout; suggesting that dissatisfaction with balance would be a

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precursor to burnout (based on previous links found between balance and burnout, such as; Fisher-McAuley et al., 2003). However, as burnout is a strain-based concept (Maslach et al., 2001), it must be acknowledged that the results of the study may have been different if a conflict-based measure, such as work-family conflict (Carlson, et al., 2000), had been used. It is hoped that the findings from this study will lead to future research into the neural correlates of other aspects of work and non-work life, such as conflict.

To conclude, we suggest that our study provides tentative evidence of an attentional bias towards work-related stimuli, which is closely related to an individual's resting, or trait, alpha power, and varies according to satisfaction with balance between work and non-work roles. It has been hypothesised that after the formation of an attentional bias concerning a specific personally threatening stimulus, in time, the bias may generalise to other stimuli or contexts (Gibb et al., 2011). Thus, while an attentional bias regarding email alert sounds may not be debilitating, it could potentially contribute to the development of depression or occupational burnout. If we are to view this work in the context of research into burnout, we suggest it extends the literature in two primary ways: Firstly, the finding of an effect at a 100-150ms time-window indicates that enhanced processing due to balance dissatisfaction can occur at an entirely automatic, pre-attentive stage of processing if the stimuli are work-related. Secondly; this is the first study to show both trait and state neural correlates of balance (or balance related constructs, such as burnout), which are also interrelated. We suggest that future work should attempt to clarify the potential role of dissatisfaction with balance as a precursor to burnout and disentangle the temporal order of its state and trait neural correlates over time.

Funding: This work was supported by an internal grant from the University of Winchester

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Table 1. Spearman's rank correlations between Balance score and Alpha 1 (8-10 Hz) and Alpha 2 (10.5-12.5 Hz) EEG power, at frontal, central, and posterior regions, in the eyes-open (above the diagonal) and eyes-closed (below the diagonal) resting conditions (*N* = 14).

	Balance Score	Frontal Alpha 1	Central Alpha 1	Posterior Alpha 1	Frontal Alpha 2	Central Alpha 2	Posterior Alpha 2

Balance	-	-0.520	-0.584	-0.717	-0.465	-0.534	-0.404
Score		(0.056)	(0.028)	(0.004)	(0.094)	(0.049)	(0.152)
Frontal	-0.225	-	0.934	0.873	0.864	0.846	0.754
Alpha 1	(0.439)		(< 0.001)	(< 0.001)	(<0 .001)	(< 0.001)	(0.002)
Central	-0.287	0.969	-	0.895	0.916	0.925	0.837
Alpha 1	(0.320)	(<0.001)		(<0.001)	(< 0.001)	(< 0.001)	(< 0.001)
Posterior	-0.313	0.890	0.925	-	0.767	0.802	0.785
Alpha 1	(0.276)	(<0.001)	(<0.001)		(0.001)	(0.001)	(0.001)
Frontal	-0.276	0.587	0.609	0.451	-	0.886	0.798
Alpha 2	(0.340)	(0.027)	(0.021)	(0.106)		(< 0.001)	(0.001)
Central	-0.293	0.508	0.565	0.547	0.899	-	0.921
Alpha 2	(0.309)	(0.064)	(0.035)	(0.043)	(<0.001)		(<0.001)
Posterior	-0.421	0.468	0.543	0.609	0.758	0.938	-
Alpha 2	(-.134)	(0.091)	(0.045)	(0.021)	(0.002)	(<0.001)	

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Table 2. Results of repeated measures ANOVA with simple contrasts, showing differences between alpha response to oddball stimuli for the Attending condition, with Greenhouse-Geisser correction applied.

Comparison	Degrees of freedom	F value	P value	Effect size (Partial Eta squared)
Outlook				

Stimulus	2, 24	1.70	0.20	0.12
Region	2, 24	10.56	0.001	0.47
Stimulus x Region	4, 48	1.46	0.23	0.11
Planned contrasts of stimulus				
Distractor vs. Noise	1, 12	1.88	0.19	0.14
Target vs. Noise	1, 12	2.68	0.13	0.18
Android				
Stimulus	2,24	1.16	0.33	0.09
Region	2,24	18.55	<0.001	0.61
Stimulus x Region	4,48	0.93	0.45	0.07
Planned contrasts of stimulus				
Distractor vs. Noise	1, 12	3.22	0.10	0.21
Target vs. Noise	1, 12	1.19	0.30	0.09

Table 3. Results of repeated measures ANOVA with simple contrasts, showing differences between alpha response to oddball stimuli for the Ignore condition, with Greenhouse-Geisser correction applied where sphericity was violated.

Comparison	Degrees of freedom	F value	P value	Effect size (Partial Eta squared)
Outlook				

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Stimulus	2, 26	8.05	0.002	0.38
Region	2, 26	19.19	< 0.001	0.60
Stimulus x Region	4, 52	4.23	0.02	0.25
Planned contrasts of stimulus				
Distractor vs. Noise	1,13	8.21	0.01	0.39
Target vs. Noise	1,13	12.68	0.003	0.49
Android				
Stimulus	2, 26	0.34	0.72	0.03
Region	2, 26	19.98	<0.001	0.61
Stimulus x Region	4, 52	0.91	0.46	0.07
Planned contrasts of stimulus				
Target vs. Noise	1, 13	0.09	0.77	0.01
Distractor vs. Noise	1, 13	0.80	0.39	0.06

Table 4. Spearman's rank correlations between Balance score and Alpha (8-12 Hz) EEG power, at frontal, central, and posterior regions, in the Ignore condition (*N* = 14)

	Outlook Target-Noise Contrast			Outlook Distractor-Noise Contrast		
	Frontal Alpha	Central Alpha	Posterior Alpha	Frontal Alpha	Central Alpha	Posterior Alpha
Balance Score	0.63 (0.02)	0.43 (0.12)	0.15 (0.61)	0.23 (0.43)	0.01 (0.97)	-0.39 (0.17)

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	Android Target-Noise Contrast			Android Distractor-Noise Contrast		
	Frontal Alpha	Central Alpha	Posterior Alpha	Frontal Alpha	Central Alpha	Posterior Alpha
Balance Score	0.13 (0.67)	0.25 (0.38)	0.26 (0.37)	-0.05 (0.88)	-0.06 (0.83)	-0.22 (0.46)

Table 5. Spearman’s rank correlations between Balance score and Alpha (8-12 Hz) EEG power, at frontal, central, and posterior regions, in the Attend condition (*N* = 13)

	Outlook Target-Noise Contrast			Outlook Distractor-Noise Contrast		
	Frontal Alpha	Central Alpha	Posterior Alpha	Frontal Alpha	Central Alpha	Posterior Alpha
Balance Score	0.515 (0.08)	0.03 (0.93)	-0.11 (0.73)	0.78* (0.002)	0.61 (0.03)	-0.17 (0.59)
	Android Target-Noise Contrast			Android Distractor-Noise Contrast		
	Frontal Alpha	Central Alpha	Posterior Alpha	Frontal Alpha	Central Alpha	Posterior Alpha
Balance Score	0.30 (0.31)	0.44 (0.13)	-0.04 (0.90)	0.40 (0.17)	0.17 (0.58)	-0.61 (0.03)

Table 6. Spearman’s correlations between behavioural measures during the Attend condition of the novelty oddball task, resting posterior alpha 1 power, and frontal alpha response in contrasts of Target-Noise in the Ignore condition, and Distractor-Noise in the Attend condition.

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	Balance	Outlook d’	Android d’	Outlook RT	Android RT	Open Posterior α1	Ignore Outlook Frontal T-N	Attend Outlook Frontal D-N
1	**-**	-0.55	0.08	0.17	0.17	-0.77	0.60	0.77
		(.07)	(0.80)	(0.60)	(0.61)	(0.003)	(0.04)	(0.004)
2			0.56	0.03	-0.24	0.64	-0.43	-0.56
			(0.06)	(0.93)	(0.45)	(0.03)	(-.16)	(0.06)
3				0.55	0.24	0.39	-0.31	-0.35
				(0.07)	(0.45)	(0.21)	(0.33)	(0.27)
4					0.75	0.01	-0.25	-0.13
					(0.05)	(0.97)	(0.43)	(0.68)
5						-0.05	0.06	0.14
						(0.88)	(0.86)	(0.67)
6							-0.59	-0.67
							(0.04)	(0.01)
7								0.85
								(<.001)

1 = Balance; 2 = Outlook d’; 3 = Android d’; 4 = Outlook RT; 5 = Android RT; 6 = Posterior alpha 1 power in the resting state; 7 = Frontal Target-Noise contrast in the Outlook Ignore condition; 8 = Frontal Distractor-Noise contrast in the Outlook Attend condition.

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Figure Captions

Figure 1. Topographical distribution of resting state lower alpha (8-10 Hz) power (dB) in the (a) eyes open, and (b) eyes closed condition. Scatter pots show the correlation between satisfaction with work-life balance (Balance Score) and lower alpha power in the (c) eyes open, and (d) eyes closed conditions.

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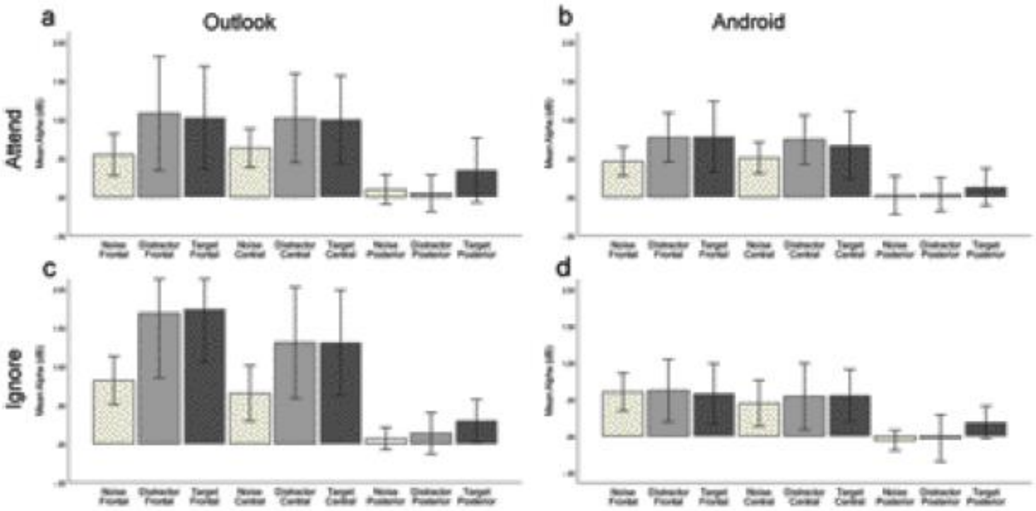

Figure 2. Bar charts showing mean event-related alpha power (dB) in the novelty oddball task, as follows: (a) Outlook-Attend (b) Android-Attend, (c) Outlook-Ignore, (d) Android-Ignore. Error bars for 2 standard errors of the mean.

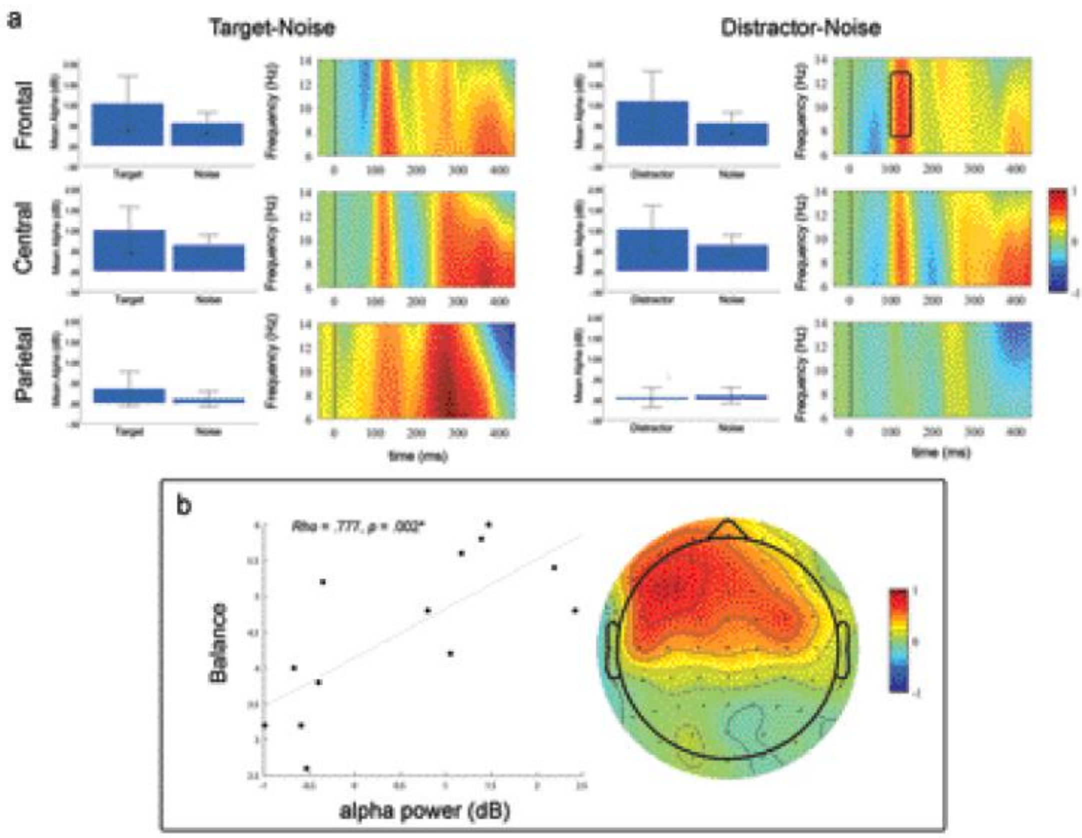

Figure 3. Event-related spectral perturbations in the Outlook Attend condition: (a) Time-frequency representation showing spectral power (dB) for the full epoch length in contrasts of Outlook Target-Noise (left) and Distractor-Noise (right) in frontal, central and posterior regions. Bar charts show mean power for each contrast during the 100-150ms time-window (b) Topographical distribution of the mean power during the 100-150ms time-window (right) and scatterplots showing its correlation with satisfaction with balance in frontal regions (left) are shown for the Outlook Distractor-Noise contrast in the Attend condition. Please note that the figures have been smoothed for illustrative purposes as data was only available for a 4 Hz frequency resolution.

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