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A PILOT STUDY INVESTIGATING THE QUANTITATIVE ELECTROENCEPHALOGRAM PROFILES OF ACADEMIC STAFF WITH BURNOUT

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Dedication

To my parents, I would not be completing my MA without your ongoing support. Particularly my mother, Ena Theron, whose encouragement, support, and love knows no bounds.

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Abstract

The construct and diagnosis of burnout are hotly debated in the literature. There is a lack of consensus regarding the conceptualisation, measurement, and the associated neural correlates of burnout, as well as its relationship with depression. University Faculty (referred to as academic staff in the South African context) represents an understudied population that is vulnerable to burnout. The main aim of this study was to conduct a pilot-study investigation to explore the psychometric and electrophysiological profile of academic burnout, as part of a wider longitudinal study investigating the efficacy of neurofeedback training as an intervention for academic burnout. The pilot study consisted of a two-stage sample design. Stage-one drew on survey-based methods with a sample of 55 academic staff members from the University of the Witwatersrand (Wits). Burnout was measured using the Burnout Assessment Tool (BAT) and the Maslach Burnout Inventory (MBI) and the Beck Depression Inventory (BDI-II) for depression. Psychometric analysis was performed using descriptive and correlational analyses of BAT, MBI, and BDI-II scores to address the research aims. The sample (n = 55) presented with high levels of burnout as determined by the BAT. Moderate and low levels of burnout were found as determined by the MBI, with a high correlation between the two measures. Mild levels of depression were found as measured by the BAT-II on average with categorical analysis revealing a maximum of 36.36% overlap between depression and burnout. Treated dimensionally, depression and burnout were significantly and strongly correlated. The consistent replication of our findings across various measures, samples, and countries, strongly questions the discriminant validity of burnout versus depression. Stage-two included a smaller sample of academic staff (N=11) drawn from the wider sample and utilised quantitative electroencephalogram (qEEG) methods at rest for the eyes open and closed conditions. Data analysis included a descriptive comparison of this sample to a normative database provided by the qEEG-Pro software. Although individual qEEG results showed substantial deviations from the norm, the group average revealed no qEEG deviations among our sample of academic staff scoring high on burnout. It appears that there is a lack of consistency among research focused on the qEEG correlates of burnout for the alpha, beta, and delta bands. Therefore, it is currently impossible to draw definite conclusions about the direction and existence of specific brain wave abnormalities in the burnout population, which signals the need for further exploration to establish reliable neurobiological markers of burnout.

Keywords: Burnout; qEEG; neurofeedback; academic staff; depression

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Nomenclature

Academic staff: The individuals working as research and teaching staff at higher education institutions.

Burnout: A debated psychological syndrome with a symptomatic description containing elements of exhaustion, depersonalisation, sense of reduced personal accomplishment, cognitive, and emotional impairments.

Depression: Prolonged feelings of intense sadness or hopelessness lasting a minimum of two weeks. It disrupts daily activities and may manifest physically, leading to symptoms like pain, fluctuations in weight, disruptions in sleep patterns, or a decrease in energy levels. Individuals with depression might also encounter difficulties concentrating, perceptions of low self-worth or overwhelming feelings of guilt, and recurrent contemplation of death or suicidal thoughts.

Melancholic subtype of depression: Characterised by a loss of interest or pleasure in all, or almost all, activities. Individuals with melancholic depression do not show reactivity to normally pleasurable stimuli and do not show even temporary improvements in mood following good events. In addition, at least three of the following symptoms are present: The sensation that depression is worse in the morning than in the evening, significant weight loss or loss of appetite, insomnia characterised by early morning awakening, psychomotor agitation, and excessive or inappropriate guilt.

Atypical subtype of depression: Individuals with atypical depression show mood changes in response to actual life events. Their mood might temporarily brighten with the development of good news, for example. In addition, individuals also demonstrate two or more of the following symptoms: Significant weight gain or appetite increase, hypersomnia, feelings of heaviness in the limbs, and a long-standing pattern of sensitivity to interpersonal rejection.

Neurofeedback: A process in which sensors are placed on the scalp and devices are used to monitor and provide moment-to-moment information that is fed back to the individual about his or her physiological brain activity for purposes of improving brain functioning.

Quantitative electroencephalogram (qEEG): The qEEG method uses computer algorithms to statistically transform, process, and analyse EEG data. Transforming EEG data into qEEG parameters enables the investigator to objectively evaluate an individual's EEG features, such as power, coherence, phase, amplitude, and frequency, compared to a normative database.

Nomological networks: A nomological network is a representation of the concepts of interest in a study, their observable manifestations, and the interrelationships between them.

Convergent validity: Convergent validity refers to how closely a test is related to other tests that measure the same (or similar) constructs.

Discriminative validity: Discriminant validity refers to the extent to which a test is not related to other tests that measure different constructs.

List of key acronyms

APA: American Psychiatric Association

APF: Alpha peak frequency

BAT: Burnout Assessment Tool

BDI: Beck's Depression Inventory

BM: Burnout Measure

CBI: Copenhagen Burnout Inventory

DSM: Diagnostic and Statistical Manual of Mental Disorders

FAA: Frontal alpha asymmetry

HR: Human Resources

ICD: International Classification of Diseases

ISNR: The International Society for Neuroregulation and Research

MBI: Maslach Burnout Inventory

MBI-ES: Maslach Burnout Inventory-Educator Survey

MBI-GS: Maslach Burnout Inventory-General Survey

MBI-HSS: Maslach Burnout Inventory-Human Service Survey

OLBI: Oldenburg Burnout Inventory

qEEG: Quantitative electroencephalogram

REDCap: Research Electronic Data Capture

SPSS: Statistical Package for the Social Sciences

CHAPTER 1: INTRODUCTION AND BACKGROUND TO RESEARCH

1.1 Background: Understanding burnout

The formal introduction of the construct of 'burnout' first emerged in the literature in the late 1960s by author Graham Greene when he described the story of an architect who lost the capacity to find meaning in his occupation and pleasure in his life (Edú-Valsania et al., 2022). Afterwards, the term made its way into the psychological sphere when Freudenberger (1975) conceptualised burnout as a state of extreme fatigue and frustration among volunteers working in a care centre for individuals with mental disorders. The author attempted to theorise about the source of this extreme fatigue by suggesting it originated from excessive demands being placed on these individuals' strength, energy, or resources. Nevertheless, the phenomenon now known as 'burnout' might have a much longer and richer history when considering the extensive neurological and psychoanalytic work on the physical manifestations of chronic stress (see the classical work by Freud, 1905). However, for the purposes of this thesis, burnout will be conceptualised in terms of a more contemporary perspective stemming from the organisational psychology literature.

The next significant development in the burnout field was pioneered by Maslach and Jackson (1981) who introduced a three-component operational definition of burnout captured by the the Maslach Burnout Inventory (MBI). According to these authors, burnout is a psychological syndrome characterised by: (1) exhaustion, (2) depersonalisation or cynicism, and (3) a reduced sense of personal accomplishment or professional efficacy that is considered a prolonged response to chronic occupational stress. From this definition, for the purpose of this study, burnout is considered a syndrome and is thus understood as a set of symptoms that emerge simultaneously and comprise a specific state distinct from others.

Initially, the MBI's three components were labelled as emotional exhaustion, depersonalisation, and a reduced sense of personal accomplishment. The resulting measurement instruments were named the MBI-Human Service Survey (MBI-HSS; Maslach & Jackson, 1981) and the MBI-Educator Survey (MBI-ES; Maslach & Jackson, 1986). These versions of the MBI were thus only suitable for measuring burnout among those in the human services and educational environments. However, answering the call for a burnout measure that can be used in any occupational setting, Maslach et al. (1996) introduced the MBI-General Survey (MBI-GS). The MBI-GS captures equivalent dimensions of burnout, namely exhaustion, cynicism, and a reduced sense of professional efficacy. Fundamentally, the MBI-GS measures the same three components outlined in the previous two editions but without the specific wording applied to those in human services or educational environments (Maslach et al., 1996). Thus, the following sections will provide definitions of these components as it appears in both the original and more recent version of the MBI.

The first component, exhaustion, can be understood as the experience of severe fatigue and feelings of depleted emotional resources (Maslach et al., 2001). Next, the inextricably linked cynicism and depersonalisation elements are marked by uncaring, callous, or detached attitudes towards others (depersonalisation) or one’s work (cynicism; Maslach et al., 2001). Therefore, specifically relevant to academic staff, burnout among this population can present as negative and distant attitudes towards students and colleagues and/or the work itself (Singh & Bush, 1998). The reduced personal accomplishment or professional efficacy component calls attention to symptoms of burnout such as perceived incompetence, reduced satisfaction with occupational success, and the absence of productivity in the workplace (Maslach et al., 2001). Maslach et al. (2001) attempt to explain this component by stating that a work climate characterised by chronic and overwhelming demands can be expected to foster a condition in which employees are likely to negatively self-assess their performance and develop reduced satisfaction with their occupational success.

From these initial studies, burnout gained increasing attention, which led to its inclusion in the 11th Revision of the International Classification of Diseases (ICD-11) by the World Health Organisation (WHO, 2019). Specifically, the WHO (2019) agrees with Maslach and Jackson’s (1981) classification of burnout as a syndrome following persistent occupational stress, characterised by the three dimensions outlined by these authors. Important to note, that according to the ICD-11, burnout is presented under general problems associated with occupational experiences and is not classified as a clinical diagnosis. As such, the viewpoint of the WHO is uncertain as the organisation includes burnout among their list of diseases whilst also denying that it is one (Schaufeli et al., 2020a). Likewise, burnout also lacks conceptualisation as a clinical diagnostic category in the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association [APA], 2013). For this reason, burnout represents a source of significant scientific debate regarding its symptomatic profile and whether it should be considered a clinical diagnosis (Golonka et al., 2019).

For example, according to Rotenstein et al. (2018), the lack of consensus regarding burnout’s symptomatic profile is evident since at least 42 different burnout definitions can be found in the literature. The most notable variations in the definition of burnout are its conceptualisation as a syndrome consisting exclusively of exhaustion (Kristensen et al., 2005; Pines & Aronson, 1988), or rather that it represents a multidimensional construct, as in the previously mentioned MBI (Maslach & Jackson, 1981). In addition, some believe that the symptomatic profile of burnout also includes cognitive impairments, such as memory difficulties, deficits in attention and concentration (Schaufeli et al., 2020b) or simply slowed mental processes (Shirom & Melamed, 2005). Indeed, neuropsychological testing revealed a spectrum of cognitive impairments associated with burnout, most notably in the executive function, attention, and memory domains (Deligkaris et al., 2014). For example, research indicates that burnout adversely affects sustained attention, working memory, inhibition, and cognitive flexibility—key components of executive control (Der Linden et al., 2005; Feuerhahn et al., 2013). The significance of attentional impairment is highlighted by Österberg et al. (2014), who observed diminished performance on cognitive tasks reliant on intact attentional functions among individuals previously diagnosed with work-related stress and exhaustion. Additionally, Jonsdottir et al. (2013) noted that burnout patients exhibited inferior performance on tasks involving learning and episodic memory compared to their healthy counterparts.

Furthermore, Schaufeli et al. (2020b) are also of the opinion that those experiencing burnout also suffer from emotional impairments. Emotional impairment is characterised by heightened emotional responses as well as a sense of being overwhelmed by one's emotions (Schaufeli & De Witte, 2023). Specific symptoms include frustration and anger at work, irritability, overreacting, unexplained sadness, and a lack of emotional control in the workplace (Schaufeli & De Witte, 2023). Given that burnout stems from prolonged occupational stress, the cognitive and emotional deficits observed in affected employees are unsurprising. Chronic stress can exert enduring detrimental effects on the brain. The specific neurological mechanisms underlying these impairments are extensively explored in the subsequent chapter. However, put briefly, glucocorticoids, a class of hormones released in response to stressors, can impact brain regions such as the hippocampus, cingulate cortex, amygdala, and frontal lobes (Herman & Cullinan, 1997). Prolonged stress exposure can result in neuronal damage within these areas or disrupt the neural connections crucial for emotional regulation and cognitive function (Belanoff et al., 2001). Consequently, chronic stress can detrimentally affect both cognition and precipitate various emotional disturbances (Marin et al., 2011).

According to these variations in the definition of burnout, numerous measurement instruments can be employed to capture burnout, all based on differing conceptualisations of the syndrome. These measurement instruments and fundamental burnout conceptualisations will be discussed in detail in the subsequent chapter. However, put briefly, there are currently six popular burnout measures that all differ in their conceptualisation of the condition (see Table 1). For example, as mentioned previously, some capture burnout as the experience of extreme exhaustion alone. However, the vast majority of measures consider burnout to consist of equivalent MBI dimensions of exhaustion and depersonalisation with conflicting views about the inclusion of either only cognitive difficulties, or both cognitive and emotional symptoms, or neither. Therefore, in terms of nosology, burnout remains undefined. Despite over 35 years of ongoing research, no diagnostic category for the syndrome exists (Bianchi et al., 2019; Rotenstein et al., 2018). This impedes interested parties from gaining accurate prevalence data on the condition and, in turn, a clear impression of employees' mental health status (Bianchi et al., 2019).

***Table 1:* Conceptualising burnout according to different measures**

Burnout measure	Definition of burnout
Copenhagen Burnout Inventory (CBI)	Psychological syndrome comprised of physical and psychological exhaustion.
Burnout Measure (BM)	A state of physical, emotional, and mental exhaustion.

Burnout measure	Definition of burnout
MBI	Psychological syndrome characterised by exhaustion, depersonalisation, and a reduced sense of personal accomplishment.
Burnout Assessment Tool (BAT)	A state of severe exhaustion, mental distancing, and cognitive and emotional impairment. • Mental distance: Extreme aversion to work and cynical attitudes. • Exhaustion: Extreme loss of energy. • Cognitive impairment: Memory difficulties and deficits in attention and concentration.
Oldenburg Burnout Inventory (OLBI)	Burnout consists of exhaustion and occupational disengagement. • Exhaustion: The outcome of extreme pressure placed on physical, emotional, and cognitive faculties. • Disengagement: When individuals distance themselves from their work in general, the objects or contents of their job.
Shirom-Melamed Burnout Measure (SMBM)	Critical components include: Cognitive weariness, fatigue, and emotional exhaustion. • Cognitive weariness: Experience of slowed mental processes or diminished mental agility. • Emotional exhaustion: Depletion of the necessary energy required to demonstrate empathy towards colleagues or service recipients. • Physical fatigue: Low energy levels in performing activities of daily living.

Additionally, within the last decade, the debate on whether burnout should be viewed as a syndrome distinct from depression has also been especially prominent (Meier & Kim, 2022). For example, considering the partial overlap of burnout symptomology with that of depression, it has been suggested that burnout is merely a form of depression elicited by occupational stressors (Bianchi et al., 2014; Bianchi et al., 2021). However, researchers also consistently highlight important differences between the symptom profiles of burnout and depression (Ahola & Hakanen, 2007; Hakanen & Schaufeli, 2012). Several researchers also demonstrated differences in the underlying neural correlates of the two conditions that may further support the idea that burnout should be considered a stand-alone syndrome (Brenninkmeijer et al., 2001; Golonka et al., 2019; Luijtelaar et al., 2010; Tement et al., 2016). However, regardless of the ongoing debates on the conceptualisation of burnout and its relation to depression, this phenomenon is still considered a serious problem among various working populations.

Overall, special attention has been given to the high prevalence of burnout among individuals working in healthcare industries (Edú-Valsania et al., 2022). For example, extensive studies have been conducted that highlight the high levels of burnout among physicians (Kumar, 2016; Low et al., 2019), nurses (Adriaenssens et al., 2015; Woo et al., 2020), and paramedics (Reardon et al., 2020). Further vulnerable working populations have also been identified that suffer from high levels of burnout, such as informal caregivers (Gérain & Zech, 2020), parents (Roskam et al., 2021), professional athletes (Gustafsson et al., 2017), catholic clergy (Picornell-Gallar & González-Fraile, 2023), and school teachers (García-Carmona et al., 2019). However, one understudied population that may be at risk for burnout is academic staff (the individuals working as research and teaching staff at higher education institutions), as will be discussed in the next section.

1.2 Burnout among academic staff

Over the preceding years, several research inquiries were aimed at improving our understanding of the occupational environment and well-being of individuals working in the higher educational sector (i.e., academic staff; Brunsting et al., 2014; Skaalvik & Skaalvik, 2010; Zhong et al., 2009). This may be particularly relevant considering the historic rise in international focus on stress among academic staff and associated poor health outcomes (Gmelch et al., 1984; Kyriacou, 1987). As per the WHO (2023), stress can be defined as “a state of worry or mental tension caused by a difficult situation”. Importantly, as previously stated, burnout is commonly understood as the outcome of chronic stress.

More recently, surveys conducted among academic staff across different universities have brought attention to the transformed landscape of academia, indicating that it is no longer perceived as a relatively low-stress work environment (Kinman, 2014). In fact, globally located academic staff reported significant amounts of work-related stress (Kinman, 2001; Watts & Robertson, 2011). In their systematic review, Watts and

Robertson (2011) reported that the most notable factors contributing to stress among this population include pronounced increases in workload because of internationalisation, massification, and rising requirements for both improved research productivity and quality of education (Byrne et al., 2013; Rothmann & Barkhuizen, 2008; Sabagh et al., 2018). The competitive climate of academia, often described as the 'publish or perish' culture, can further contribute to impaired mental health of academic staff (Frith, 2020). The relentless pace of publication output is often referred to as fast science in contrast to slow science where emphasis is placed on quality rather than quantity (Frith, 2020). This phenomenon known as fast science is in the opinion of Frith (2020, p.1) "bad for both science and scientists."

Considering academic staff from South Africa specifically, the South African higher education domain is often faced with substantial challenges that can contribute to experienced stress among staff (Coetzee et al., 2019). Barkhuizen et al. (2013) noted that universities in South Africa encountered massive economic and social changes following the fall of Apartheid. For example, higher education is now more accessible for students from under-resourced socio-economic and academic backgrounds, historically disadvantaged due to Apartheid (Barkhuizen et al., 2013). These students are often not adequately prepared for higher education and can thus contribute to the stress experienced by academic staff by creating additional work burdens (Pienaar & Bester, 2009). Of note, burnout investigations among university students in South Africa have received considerably more attention while much less is known about burnout among academic staff in comparison (e.g., Colby et al., 2018; le Roux et al., 2017; Morgan & de Bruin, 2010; Mostert et al., 2007; Stein & Sibanda, 2016; van der Merwe et al., 2020).

Moreover, post-Apartheid also marked a period in which the government implemented strategies aimed at facilitating a knowledge-based economy (Simons et al., 2019), thereby holding academics responsible for producing knowledge and knowledge producers (Waghid, 2002). As a result, South African academic staff are often burdened with high workloads due to large student numbers and increased pressure for high-quality research and international publications, which mirrors the wider international academic climate (Frith, 2020), but arguably with less access to structural resources (e.g., research funding; Barkhuizen et al., 2013; van Niekerk & Van Gent, 2021). Finally, country-wide student protests, mostly relating to student exclusion according to financial, epistemological, and cultural grounds, dramatically disrupted the working environments of academic staff (Czerniewicz et al., 2019). The significance of these protests is aptly captured by the following quote from Jansen (2017): “Even during the long, dark days of apartheid, no university had ever experienced this level of student protest in terms of scale, scope, intensity, and, in the course of time, violence”. Considering these numerous challenges associated with the higher education sector in general, and specific to contexts like South Africa, academic staff often find themselves in stressful working environments and are thus arguably at risk for burnout (Barkhuizen et al., 2013).

Indeed, abundant research studies support the notion of high burnout rates among globally located academic staff (Adekola, 2012; Byrne et al., 2013; Catano et al., 2010; Khan & Yousaf, 2016; Mark & Smith, 2012; Nazari et al., 2016; Teven, 2007; Tytherleigh et al., 2005; Winefield et al., 2003). Of further relevance is the high burnout rates reported among academic staff in South Africa, as determined by the MBI (Pretorius, 1994; Rothmann & Barkhuizen, 2008), the OLBI (Coetzee et al., 2019) and the BAT (Fynn & van der Walt, 2023). Therefore, a handful of studies have shown that South African academics show high levels of burnout across different conceptualisations of the condition. However, apart from demonstrating high levels of burnout among South African academic staff, these studies did not contribute to our understanding of burnout as a construct, its neural correlates, and its relation with depression.

Nevertheless, stressors associated with the recent coronavirus disease 2019 (COVID-19) pandemic are likely to further increase the risk of burnout among the already vulnerable academic staff population (Gewin, 2021). The pandemic disrupted the activities of most higher educational institutions by forcing a rapid movement to online methods of teaching (Hofer et al., 2021; Robson et al., 2022). Many university lecturers were not familiar with online educational methods which caused considerable challenges when attempting to appropriately engage with students (Littlejohn et al., 2021). In South Africa, university lecturers indicated that their workload increased considerably, and they found the implementation of online education challenging due to a lack of preparedness for online teaching (Banda & Malinga, 2021). Furthermore, in many low- and middle-income countries, as is the case in South Africa, many students and staff were exposed to poor internet connectivity, high costs of data, inadequate technological infrastructure, and disruptions in power supply (Banda & Malinga, 2021; Tadesse & Muluye, 2020). Sequentially, academics were faced with the additional burden of managing these difficulties on top of an already increased workload (Banda & Malinga, 2021) and other COVID-19-related stressors (Dinu et al., 2021). Additionally, Łaskawiec et al. (2022) also highlighted that the stress and trauma of the pandemic are maintained even after the subsequent 'return to normal' as the widespread destabilisation of organisations, institutions, and family structures is continuously experienced.

Therefore, as burnout arguably represents a substantial concern among academics, effective ways of identifying and treating the condition become an important priority. However, when attempting to identify or treat burnout, it is first necessary to understand what exactly constitutes burnout. To this end, as mentioned in the previous section, the uncertainty surrounding the conceptualisation of burnout, its available measures, and its relationship with depression are key factors to address when attempting to understand and identify burnout among academics. Additionally, these points of controversy have serious consequences for the ability to develop effective interventions to combat the adverse effects of the condition. For example, since burnout is still heavily debated as a concept or diagnosis, empirical investigations of interventions for the syndrome are scarce (Ahola et al., 2017; Korczak et al., 2012; Leiter & Maslach, 2014). On this note, examining emerging and innovative strategies to reduce burnout, such as neurofeedback, may be valuable. As a reminder, the current study is not an intervention study but since it is embedded in the larger longitudinal study focused on investigating the efficacy of neurofeedback as a burnout intervention it is important to investigate the neural correlates of burnout, which is presently not yet known in full, as will become apparent in the next section.

1.3 Neurofeedback

The International Society for Neuroregulation and Research (ISNR) defined neurofeedback as follows: "Neurofeedback is a process in which sensors are placed on the scalp and devices are used to monitor and provide moment-to-moment information that is fed back to the individual about his or her physiological brain activity for purposes of improving brain functioning" (ISNR, 2023). Importantly, considering the nature of neurofeedback, this intervention is not dependent on a specific diagnosis but rather aims to correct underlying brain-wave deviations that will ultimately alleviate associated symptoms. Thus, it may be particularly relevant in the context of conflicting opinions on the diagnostic status of burnout, although the efficacy of the intervention itself is still widely debated (Alkoby et al., 2018; Marzbani et al., 2016; Rogala et al., 2016).

For example, the systematic review by Rogala et al. (2016) concluded by stating that the effectiveness of neurofeedback is highly ambiguous, which may result from a limited number and high diversity of the available descriptions of well-controlled neurofeedback studies. The principal aim of this review was to assess the scientific evidence supporting the efficacy of diverse neurofeedback protocols for nonspecific syndromes. The culmination of this review encompassed 25 studies that compared the effectiveness of neurofeedback against control groups comprising healthy participants or, conversely, groups undergoing alternative interventions such as relaxation techniques or yoga. In assessing the efficacy of neurofeedback, the authors examined alterations in EEG activity alongside desired behavioural modifications.

Nevertheless, despite the apparent ambiguity regarding the efficacy of neurofeedback in this rigorous review, numerous other and more recent studies in the field present an alternative perspective. These studies indicate that neurofeedback holds promise as a potentially beneficial intervention for individuals grappling with burnout or other stress-related conditions, such as posttraumatic stress disorder (PTSD). For instance, Campbell et al. (2020) conducted a study utilising an alpha-theta neurofeedback regimen to examine the potential benefits for 12 radiation therapists in terms of behaviour and brain performance. After completing the three-week protocol, participants exhibited a reduction in perceived cognitive workload, quicker response times during task performance, and a decrease in alpha band desynchrony. In essence, this research offers promising behavioural enhancements alongside evidence of neurophysiological changes following neurofeedback, advocating for further exploration of its efficacy in mitigating burnout. Likewise, Choi et al. (2023) conducted a systematic review and meta-analysis to explore the impact of neurofeedback on alleviating symptoms of PTSD. The authors analysed ten studies, comprising 276 participants, that included randomised and non-randomised controlled trials spanning from 1990 to July 2020. The findings of their study revealed a positive influence of neurofeedback on various aspects of PTSD, including arousal levels as well as intrusive, numbing, and suicidal ideations. Consequently, the authors assert that neurofeedback emerges as a promising and efficacious therapeutic avenue for addressing PTSD symptomology.

Neurofeedback applications are implemented by first acquiring brain-based data, which can be performed using different methods; however, the most popular method and the focus of the current study is the quantitative electroencephalogram (qEEG; Enriquez-Geppert et al., 2017). The qEEG method is a more advanced form of EEG analysis that uses computer algorithms to statistically transform, process, and analyse EEG data (Demos, 2005). Transforming EEG data into qEEG parameters enables the investigator to objectively evaluate an individual's EEG features, such as power, coherence, phase, amplitude, and frequency, compared to a normative database (Demos, 2005). In this way, a qEEG analysis can assist the investigator in their understanding of the current brain functioning of a particular individual by recognising how it compares to what is considered healthy or normal (Demos, 2005). This information can then be used to develop a neurofeedback protocol to establish optimal brain functioning by strengthening and/or weakening specific frequency bands' power to ultimately alleviate targeted symptoms (Collura, 2016).

Effective neurofeedback protocols for burnout are thus dependent on knowledge about the biological brain wave characteristic of the syndrome targeted. Of note, the literature on the electrophysiological profile of burnout is severely lacking, evidenced by only three identified studies that have been carried out to date (Golonka et al., 2019; Luijtelaar et al., 2010; Tement et al., 2016). Further, among these studies, there are notable fragmentary findings. The findings from these studies, alongside the interpretation of various electrophysiological observations, will be meticulously examined in the subsequent chapter. However, to provide immediate insight, a concise overview of the results of these three studies will be presented. The first study by Luijtelaar et al. (2010) demonstrated significantly lower alpha peak frequency (APF) and beta power in the burnout group than in controls. Golonka et al. (2019) found significantly reduced alpha power among employees with burnout compared to controls. Lastly, Tement et al. (2016) found that alpha power positively correlated with burnout scores, although this relationship was non-significant. Therefore, in conclusion, burnout currently represents a controversial construct, especially in terms of its conceptualisation, measurement, relationship with depression, and biological characteristics. As such, the rationale for conducting a study focused on academic burnout using psychometric and electrophysiological methods becomes clear, as will be discussed in the following section.

1.4 Study rationale

The emergence of the burnout phenomenon increasingly captured the attention of various researchers hoping to make sense of work-related distress. At present, burnout is considered one of the most crucial psychosocial occupational hazards due to its high personal and organisational costs (Edú-Valsania et al., 2022; Epstein et al., 2020; Grow et al., 2019; Han et al., 2019). In particular, from the introductory discussions, the rationale for specifically looking at burnout among academic staff was presented. This population are often faced with suboptimal working environments that may trigger chronic stress and eventual burnout. More importantly, the South African context introduces additional stressors that may leave academics especially vulnerable to burnout. Burnout thus represents an important area of investigation when attempting to improve the mental health of South African academic staff.

However, even though interest in and formalisation of the term burnout has escalated over the preceding decades, its existence has always coexisted with prominent difficulties in conceptualising, measuring, and developing intervention strategies for the syndrome. Therefore, investigations that aim to clarify these inconsistencies, together with attempts to explore effective strategies to alleviate burnout among academic staff are a critical priority. In this case, one potential intervention for the burnout problem is neurofeedback. The reported success of neurofeedback in the treatment of various stress-related conditions suggests that it may be a viable, medication-free option to alleviate symptoms associated with burnout among academic staff (Campbell et al., 2020; Fedotchev et al., 2021; Kratzke et al., 2021).

Although the preliminary results on the effect of neurofeedback on burnout are promising (Campbell et al., 2020; Fedotchev et al., 2021; Kratzke et al., 2021), the field may benefit even more from the identification of the qEEG correlates of burnout as effective neurofeedback protocols rely on prior knowledge of specific brain wave abnormalities. However, the literature in this regard is severely lacking, in line with the pervasive issue of the difficulties in understanding and conceptualising the condition. Understanding the neural correlates and patterns associated with burnout is thus critical in this regard. In this way, the present study provided further insight into the neurobiological profile of burnout, improving the overall understanding of its neural characteristics and allowing the development of an effective neurofeedback protocol for burnout that may ultimately improve the well-being of academic staff.

At the same time, in order to effectively understand academic burnout, psychometric investigations of the condition are also needed. To illustrate, the discriminant validity of burnout versus depression has been difficult to prove. Indeed, Meier and Kim (2022) mentioned that, even after 35 years of investigation, the question of whether burnout should be seen as a diagnostic entity separate from depression remains unresolved. In terms of the depression-burnout relationship, the current state of research tends to advocate for burnout, defined according to popular instruments such as the MBI, CBI, BM, OLBI, and SMBM, to be considered as part of a depressive disorder (Bianchi et al., 2021; Meier & Kim, 2022; Schonfeld & Bianchi, 2022; Schonfeld et al., 2019a). However, to our knowledge, no study to date has examined whether the overlap of burnout and depression extends to the definition of burnout as conceptualised by the BAT. Therefore, it can be said that such an investigation is warranted, not only to facilitate conceptual coherence but also to advance occupational health more effectively.

Thus, exploring academic burnout in the context of qEEG and psychometric methods constitutes two important areas of investigation within the greater context of understanding academic burnout. In turn, only once an appropriate understanding of burnout has been achieved can the effects of the condition be minimised or prevented among the critical academic staff workforce. Finally, since the current study, as well as the larger longitudinal study in which it is embedded, was and continues to be conducted in South Africa, it will contribute to broadening the existing knowledge about qEEG profiles and the effectiveness of neurofeedback in low and middle-income countries, an area currently understudied (Rubí, 2008). Similarly, psychometric investigation of academic burnout has largely originated in North America, Canada, and Europe, as well as to a lesser extent from South America, Asia, Australia, and New Zealand. The relative absence of these investigations among African samples signals the need for academic burnout exploration in this context to establish the geographical generalisation of previous findings. Based on the rationale and literature presented above, the primary aim and research question were formulated and are presented in the section below.

1.5 Main research aim and question

The primary aim of the study was to explore academic burnout using psychometric and qEEG methods. Likewise, the main research question of this study was: What is the profile of academic burnout according to psychometric and qEEG characteristics? The sub-aims and research questions derived from this primary aim will be described at the end of Chapter 2 after the appropriate literature supporting the relevance of these aims and research questions has been explored.

1.6 Chapter outline

This dissertation consists of six additional chapters. In Chapter 2, the literature providing the foundation of the study is explored. The chapter then ends with a description of the study's various sub-aims, research questions, and hypotheses. Chapters 3 and 4 are concerned with the first component of this dissertation, the psychometric investigations. Chapter 3 provides the reader with the details of the research methodology employed and Chapter 4 outlines the psychometric results obtained from descriptive and correlational statistical analysis. Chapters 5 and 6 involve the qEEG component of the study. Chapter 5 documents the research methods used while Chapter 6 consists of the descriptive qEEG results chapter. In Chapter 7, a summary of the main findings is provided and the study's results are discussed and interpreted within the boarder context of existing literature on the areas of investigation. Finally, the chapter ends with a description of the study's limitations as well as recommendations for practice and future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This narrative literature review has been organised around four areas of interest. Firstly, building on the introductory chapter, burnout's theoretical foundation and its available measurement tools are described, followed by a critical examination of the burnout-depression relationship. The chapter then continues by describing the consequences and treatment of burnout, which subsequently leads to the discussion of one potential intervention for the burnout problem, qEEG-based neurofeedback. Since a general understanding of neurofeedback and qEEG was gained from Chapter 1, this chapter then proceeds to a review of the specific qEEG profiles associated with burnout. Finally, according to the literature presented, the study's sub-aims, accompanying research questions and hypotheses will be outlined.

2.2 Conceptualising burnout

As mentioned in the introduction, the measurement of burnout and its relationship with depression constitute two important domains to explore within the broader area of conceptualising burnout. For this reason, the first section focuses on burnout measures and the conceptualisations of the syndrome on which these measures are built. Thereafter, burnout's relationship with depression will be discussed for the purpose of gaining a deeper understanding of academic burnout.

2.2.1 Measurement of burnout

Due to the lack of established criteria to diagnose burnout, it is primarily measured and identified with numerous self-report measures (van Dam, 2021). However, the conceptualisation of burnout that underlies these various instruments is still vehemently debated (Qiao & Schaufeli, 2011). Most notably, there appear to be conflicting conceptualisations of burnout as either consisting exclusively of exhaustion, as in the CBI (Kristensen et al., 2005) and the BM (Pines & Aronson, 1988), or rather that it represents a multidimensional construct, as in the MBI (Maslach & Jackson, 1981). Nevertheless, research tends to support a multidimensional burnout construct beyond mere exhaustion, as demonstrated in the MBI (Hobfoll & Shirom, 2001; Maslach & Jackson, 1981; Rothmann, 2003; Schaufeli et al., 2009). Although exhaustion is often the most frequently reported symptom of burnout, it cannot give a complete picture of the syndrome as experienced by those suffering from it (Maslach et al., 2001).

Due to the extensive empirical evidence and validity of the MBI’s theoretical underpinnings, it quickly became the golden standard for measuring burnout (Schaufeli et al., 2009). For example, according to de Beer et al. (2020), it appears in approximately 90% of research studies on the topic. However, as research on burnout gained momentum, especially from more recent neuroscientific investigations of burnout, several notable criticisms of the MBI came to light. For instance, Asiwe et al. (2014) argued that the MBI lacks consideration of cognitive impairment, an element repeatedly linked to burnout in prior studies (Deligkaris et al., 2014; Golonka et al., 2017; Golonka et al., 2018; Sokka et al., 2017). For instance, individuals with burnout or chronic work-related stress showed reduced grey matter volumes in the prefrontal cortex (PFC), which is proposed to underlie and support the existence of cognitive impairments in burnout, such as working memory and attentional difficulties, which is not considered in the MBI (Blix et al., 2013; Savic, 2015; Savic et al., 2018). The study samples of these neuroscientific studies consisted of participants who experienced stress or burnout symptoms for at least one year, worked 50% or less than usual for six months or more before study participation, and had an average or higher score on the MBI.

These findings are invaluable when reviewing the various measurement instruments of burnout. For instance, in contrast to the MBI, the BAT (Schaufeli et al., 2020a) includes cognitive impairment as part of burnout syndrome. Specifically, the BAT characterises burnout as a state of severe exhaustion accompanied by mental distancing and a decrease in one’s capacity to regulate cognitive and emotional processes (Schaufeli et al., 2020b). The BAT is thus similar to the MBI in terms of the exhaustion and mental distancing (depersonalisation) components but includes cognitive and emotional impairment as novel components (Redelinghuys & Morgan, 2023). In line with the evidence of cognitive impairment in burnout, studies within the neuroscientific domain also tend to support emotional impairment as part of burnout symptomology. For instance, Jovanovic et al. (2011) demonstrated abnormalities in the functional connectivity between structures of the medial PFC, specifically the anterior cingulate cortex (ACC), and the amygdala in a sample of participants exposed to chronic occupational stress. In support of this finding, Golkar et al. (2014) also revealed reduced functional communication between the ACC and right amygdala among individuals with burnout. For these two studies, chronic occupational stress and burnout also referred to symptom duration of one year or more, a minimum of 50% less work involvement for six months or more before study participation, and average or higher MBI scores. Because emotional regulation relies on functional networks between the PFC and amygdala, these findings may explain the inability to cope with and control negative emotions often described in burnout populations (i.e., emotional impairment; Golkar et al., 2014). Several studies further found reduced grey matter volumes in the ACC in individuals with burnout or chronic work-related stress (Blix et al., 2013; Savic, 2015; Savic et al., 2018). As emotional impairment is a common outcome of ACC pathology, this finding further supports its inclusion in burnout syndrome (Golonka et al., 2017).

The final important criticism of the MBI concerns the inclusion of reduced personal accomplishment. Several researchers argue that this element is a divergent factor, meaning it has a weak association with the depersonalisation and exhaustion components (Bakker et al., 2004) and should more appropriately be viewed as an outcome of burnout rather than one of its chief dimensions (De Beer, 2021; De Beer & Bianchi, 2019; De Beer et al., 2022; Schaufeli et al., 2020a; Worley et al., 2008). On this account, reduced personal accomplishment is not included in the BAT. Similarly, the OLBI regards exhaustion and occupational disengagement as the two fundamental dimensions of burnout (Demerouti et al., 1999). Regardless of some differences in conceptualisation, these two elements are similar to the first two dimensions of the MBI. However, in the OLBI, no dimension is equivalent to aspects of reduced personal accomplishment. Thus, the OLBI may be viewed as superior to the MBI in this regard but is also subjected to the same criticisms associated with a lack of consideration of cognitive and emotional impairment.

Further review of burnout measures showed that reduced personal accomplishment is also not an element captured by the SMBM (Shirom & Melamed, 2005). The conceptualisation of burnout fundamental to this measure is that it includes the components of cognitive weariness, fatigue, and emotional exhaustion (Shirom, 2003). From this description, the SMBM can be praised for its inclusion of a cognitive domain in burnout symptomology along with the absence of any aspects related to personal accomplishments. However, similar to the OLBI and MBI, it can also be criticised for its lack of consideration of emotional impairment that has previously been linked to burnout (Blix et al., 2013; Golkar et al., 2014; Jovanovic et al., 2011; Savic, 2015; Savic et al., 2018).

In summary, it appears that the BAT, with its inclusion of all relevant dimensions of burnout found in the literature, is based on an alternative and more comprehensive conceptualisation of burnout compared to the MBI and other measures, such as the OLBI, CBI, BM, and the SMBM (De Beer et al., 2022; see Table 2). However, despite significant developments in the concept of burnout, a clinical diagnosis or universally confirmed definition is still not evident. To complicate matters further, a significant debate in the field also centres around disagreements about whether burnout constitutes a separate diagnostic label from depression (Bianchi et al., 2015), as will become apparent in the next sections.

Table 2:* *Advantages and disadvantages of different burnout measures

Burnout measure	Advantages and disadvantages
CBI and BM	***Advantages:*** Absence of any aspects related to personal accomplishments. ***Disadvantages:*** Only considers burnout as a syndrome of exhaustion. Research tends to support a multidimensional burnout construct.
MBI	***Advantages:*** Considers burnout as a multidimensional syndrome. ***Disadvantages:*** Problematic inclusion of personal accomplishment and lack of consideration of emotional and cognitive symptoms of burnout.
OLBI	***Advantages:*** Absence of any aspects related to personal accomplishments. ***Disadvantages:*** Lack of consideration of emotional and cognitive symptoms of burnout.
SMBM	***Advantages:*** Inclusion of a cognitive domain in burnout symptomology along with the absence of any aspects related to personal accomplishments ***Disadvantages:*** Lack of consideration of emotional symptoms of burnout.

Burnout measure	Advantages and disadvantages
BAT	***Advantages:*** Inclusion of all relevant dimensions of burnout found in the literature.

2.2.2 Burnout and depression

The connection between depression and burnout dates back to the earliest description of burnout when Freudenberger already noted that an individual with proposed burnout "looks, acts, and seems depressed" (Freudenberger, 1974, p. 161). However, several researchers initially rejected this sort of similarity between depression and burnout by maintaining that, although the two conditions are related, burnout is a different syndrome from depression (Ahola & Hakanen, 2007; Lacovides et al., 2003; Maslach & Schaufeli, 1993; Schaufeli, 2003; Schaufeli & Enzmann, 1998). Nevertheless, the relationship between depression and burnout received significant attention as the focus of several research inquiries in the past decade, indicating that the burnout and depression relation is far from resolved (Bianchi et al., 2015; Bianchi et al., 2021; Koutsimani et al., 2019; Meier & Kim, 2022; Schonfeld et al., 2019a). Thus, the following sections will start with a description of depression followed by an exploration of the current state of evidence on the depression-burnout relationship according to the following fields of debate: (1) Conceptual debates; (2) Symptomatic profiles; (3) Nomological networks; (4) Correlational analyses; and (5) Biological perspective.

2.2.2.1 Depression

The classification and definition of depression used in both clinical and research settings rests on the diagnostic criteria outlined in the DSM (APA, 2013; Ingram & Siegle, 2009). The DSM-5 describes the symptomatic profile of depression according to the following nine symptoms: "Depressed mood, markedly diminished interest or pleasure in all, or almost all, activities, significant weight loss when not dieting or weight gain, or decrease or increase in appetite, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feelings of worthlessness or excessive or inappropriate guilt, diminished ability to think or concentrate, or indecisiveness, recurrent thoughts of death, recurrent suicidal ideation without a specific plan, or a suicide attempt or a specific plan for committing suicide" (APA, 2013, p. 160). To receive a clinical diagnosis of depression, the DSM states that either a depressed mood or anhedonia (loss of pleasure) is required along with any four of the remaining six symptoms, all of which must be present for at least two weeks (APA, 2013).

When considering measures of depression, Nezu et al. (2009) stated that this includes both self-report questionnaires and clinical ratings. Clinical ratings, including the Structured Clinical Interview (First et al., 1997), for example, represent the most favourable method of diagnosing depressive disorders (Ingram & Siegle, 2009). While both clinical ratings and self-report questionnaires are based on specific DSM criteria, the former allows clinicians to restate questions, probe and challenge individuals as well as ask for clarification, all of which may lead to more accurate diagnoses (Ingram & Siegle, 2009). However, due to the resource-intensive nature of clinical ratings, self-report questionnaires are most commonly employed for research purposes (Schonfeld & Bianchi, 2016). Among these self-report questionnaires, popular choices among researchers typically include the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), the second edition of Beck's Depression Inventory (BDI-II; Beck et al., 1996), and the nine-item depressive measure of the Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001). Since an appropriate understanding of both burnout and depression has been established, the literature review now continues to consider the depression-burnout relationship according to the various fields of debate outlined previously, starting with debates grounded in conceptual reasoning.

2.2.2.2 Conceptual debates

It was previously argued that burnout and depression can be separated from one another when considering the scope of burnout to be related to one's occupation and thus, situation-specific, whereas depression is pervasive and not tied to any specific context (Bakker et al., 2000; Freudenberger & Richelson, 1980; Lacovides et al., 2003; Maslach et al., 2001; Plieger et al., 2015; Schaufeli & Taris, 2005; Shirom, 2005). However, this suggestion of a distinction between the two conditions based on scope is somewhat problematic for several reasons. Firstly, a substantial volume of high-quality studies has accumulated over the years that causally connect job stressors to depressive conditions to the same degree as burnout (Bianchi & Brisson, 2017;

Rotenstein et al., 2020; Schonfeld & Bianchi, 2016; Schonfeld & Chang, 2017; Schonfeld et al., 2019b; Verkuilen et al., 2021). Interestingly, researchers have shown that both conditions were also similarly associated with exposure to non-work stressful life events (Schonfeld & Bianchi, 2016; Schonfeld et al., 2019b). To this end, Bianchi et al. (2015) argue that job-relatedness is thus not a sufficient discriminator between the conditions. Secondly, Bianchi et al. (2015) further opposed this scope distinction by reminding the reader that, even if burnout is limited to the occupational context, it does not alter the fundamental features of the condition. Following this logic, it has been suggested that burnout is merely a dimension of depression elicited by occupational stressors and can thus be more aptly seen as workplace depression (Kahn, 2008; Rydmark et al., 2006).

2.2.2.3 Symptomatic profiles

The proximity of burnout symptom descriptions to those of depression resulted in the conclusion that conceptualising burnout as a depressive condition might be a more effective approach (Schonfeld, 1991). However, there has also been disagreement in this domain as other authors promoted the idea that burnout symptomology only intersects with depression to a limited degree (Brenninkmeyer et al., 2001; Lacovides et al., 2003). Indeed, after examining 18 studies on both conditions, Glass and McKnight (1996) contended that depressive and burnout symptoms do not exhibit total isomorphism and, for this reason, are not redundant phenomena. Even so, the similarities in the symptomatic descriptions of the two conditions are undeniable as the clinical picture of burnout has often been recounted in a manner that is indicative of depressive symptoms.

For example, the statement by Maslach and Leiter (1997) that burnout constitutes the lack of positive emotions, along with the presence of negative ones, led some to recognise that this description aligns closely with anhedonia and a depressed mood, the central elements of a depressive disorder (APA, 2013; Pryce et al., 2011). Likewise, Schonfeld and Bianchi (2022) suggested that individuals experiencing depression frequently underestimate their accomplishments, indicating a diminished sense of accomplishment, in line with one of the burnout dimensions captured by the MBI. In fact, perceptions of inadequacy and failure are prevalent attributes among individuals experiencing depression (Beck & Alford, 2009; LeMoult & Gotlib, 2019). On top of this, depersonalisation, another element of MBI-defined burnout, represents the feeling of ‘not caring anymore’, which corresponds to the well-established correlation linking depression to decreased emotional engagement, diminished empathy, and interpersonal detachment (Beck & Alford, 2009; Kupferberg et al., 2016).

Another important point to consider relates to fatigue or exhaustion, the central tenant of the burnout syndrome. The centrality of this component is drawn from the observation that, despite different conceptualisations of burnout found in the literature, exhaustion is common to all of them. Notably, fatigue or exhaustion cannot be used to distinguish burnout from depression. Apart from fatigue constituting one of the nine symptoms of depression, Van Dam et al. (2015) reported that the degree of subjective fatigue among participants suffering from depression is no less than that found among burnout participants. Indeed, the APA (2013) announced that fatigue or insomnia is often the presenting concern among depressed individuals seeking professional care.

Another collection of evidence suggests that as the symptoms of depression increase in severity, a similar linear increase in burnout symptoms is observed as measured by the MBI, CBI, and SMBM (Bianchi et al., 2014; Schonfeld & Bianchi, 2016; Schonfeld & Bianchi, 2022; Wurm et al., 2016). These findings further point to the close association between the symptomatic profiles of burnout and depression. All in all, identifying meaningful differences in the symptomatic profiles of depression and burnout has been challenging. The balance of evidence presented in this section indicates that if burnout were to find its way into the DSM or ICD as a clinical diagnosis, its differential diagnosis versus depression would be extremely difficult if not impossible. This idea speaks directly to the clinical validity and usefulness of burnout as a separate diagnostic entity (Robins & Guze, 1970). Additionally, the suggestion of depression and burnout as representing the same underlying construct is further validated by the reported overlap in nomological networks.

2.2.2.4 Nomological networks

Investigation into the burnout-depression relationship as it relates to a history of depression, personality traits, and cognitive styles questioned the relevance of a distinction between the conditions. For instance, several research studies have shown that burnout is associated with a history of depression and concurrent use of antidepressant medication (Bianchi et al., 2014; Dahlin & Runeson, 2007; Rössler et al., 2015; Rotenstein et al., 2020; Schonfeld & Bianchi, 2016). Put another way, a history of depression typically serves as a risk factor for both burnout and future depressive disorders. In a similar vein, one of the known risk factors for depression is the personality trait neuroticism, which was also found to predict burnout in a similar manner (Ghorpade et al., 2007; Hakulinen et al., 2015; Rotenstein et al., 2020; Swider & Zimmerman, 2010).

Research has also demonstrated parallels in the association between burnout and depression to specific cognitive styles, such as attentional and memory biases (Bianchi, 2016; Bianchi & Laurent, 2015; Bianchi et al., 2020a; Bianchi et al., 2018). To illustrate, in an eye-tracking study, Bianchi and Laurent (2015) observed that depression and burnout both predicted comparable attentional-behavioural modifications, presenting as a heightened focus on dysphoric images and a reduced focus on positive images. In support of this finding, Bianchi et al. (2018) demonstrated that the burnout-depression overlap extends to memory biases as both conditions were linked to an increased recall of negative words, combined with a decreased recall of positive ones.

2.2.2.5 Correlational analysis

The magnitude of correlation has often been the focus of investigation in the debate of whether depression and burnout represent interchangeable or different conditions, evidenced by five systematic reviews and meta-analytic studies performed on the topic to date (Table 3). Importantly, Table 3 also highlights the burnout measurements included in these reviews as these constitute important indicators of the conceptual generalisation of the burnout-depression relationship.

Table 3: List of systematic reviews and meta-analyses on the burnout-depression relationship

Study	Number of studies (participants included)	Burnout measures used
Bianchi et al. (2015)	92 (95 119)	MBI (78%) SMBM (14%) BM (6%) OLBI (2%)
Schonfeld et al. (2019a)	13 (17670)	MBI
Koutsimani et al. (2019)	67 (84169)	MBI (55%) SMBM (15.9%) CBI (5.8%) BM (4.3%) OLBI (4.3%) Other (14.7%)[a]
Bianchi et al. (2021)	14 (12 417)	MBI (71.43%) SMBM (28.57%)
Meier and Kim (2022)	69 (46 191)	CBI (5%) OLBI (5%) SMBM (6.67%) MBI (61.67%) BM (3.33%) Other (5.29%)[b] Unknown (13.04%)[c]

[a]Professional Quality of Life Scale (ProQOL), Parental Burnout measure (PBM), Burnout Scale Inventory (BSI), The Hamburg Burnout Inventory (HBI), and Professional Fulfilment Index (PFI). [b]ProQOL, PBM, and HBI. [c]For nine studies the burnout measures could not be determined as access to these articles was restricted.

From Table 3, it becomes clear that the MBI was by far the most frequently studied instrument. Thus, the following sections will start with a discussion of the depression-burnout relationship in the context of the MBI, after which a description of this relationship will also be discussed based on alternative measures. For the MBI, strong and significant associations were found between its exhaustion dimension and depression while moderately significant correlations were found between its depersonalisation and personal accomplishment components and depression (Bianchi et al., 2015; Bianchi et al., 2021; Schonfeld et al., 2019a). Overall, the conclusion drawn from these studies is that the association between MBI-measured burnout, especially concerning its exhaustion subscale, were problematically strong in terms of discriminant validity (Bianchi et al., 2021; Schonfeld et al., 2019a). This idea is held regardless of lower correlations reported for the other two dimensions. The central concern of the correlation between the MBI exhaustion component and depression is justified as this dimension is commonly seen as the initial stage of burnout (Maslach et al., 2001; Taris et al., 2005), where depersonalisation and diminished personal accomplishment are considered outcomes of exhaustion.

However, in contrast, the systematic review and meta-analysis performed by Koutsimani et al. (2019) found lower (but still significant) associations between components of the MBI and depression compared to the studies cited above. These inconsistencies may stem from the different timeframes applied to the reviews of Bianchi et al. (2015) compared to Koutsimani et al. (2019). In addition, although the review of Sconfeld et al. (2019a) had a similar timeframe to that of Koutsimani et al. (2019), the latter consisted of a substantially larger sample size. Finally, the review of Bianchi et al. (2021) combined MBI and SMBM scale scores, which may be where the inconsistencies arise. However, the most recent review and meta-analysis, the one carried out by Meier and Kim (2022), can potentially settle these variabilities as it included research spanning the full 35 years of burnout investigations. A correlation of 0.55 between the MBI exhaustion component and depression was found, which is very similar to the findings of Koutsimani et al. (2019) and Schonfeld et al. (2019a) but lower than what was found by Bianchi et al. (2021). However, as a reminder, the study of Bianchi et al. (2021) combined elements of the SMBM with that of the exhaustion scale of the MBI, which may explain the inconsistency. Nevertheless, the general conclusion reached by most of these authors looking at the relationship between the MBI and depression was that considerable overlap was evident (Bianchi et al., 2015; Bianchi et al., 2021; Meier & Kim, 2022; Schonfeld et al., 2019a).

From the standpoint of the burnout-depression relationship outside of the MBI context, Bianchi et al. (2015) also summarised the observed correlations between depression and other burnout measures, which is a necessity to determine whether the depression-burnout relationship holds for alternative conceptualisations of burnout. According to Bianchi et al. (2015), burnout, as captured by the BM, correlated highly with depression. A more recent study conducted by Talih et al. (2016) also confirmed the significantly close relation between depression and BM-measured burnout. Significantly strong correlations between SMBM-measured burnout and depressive measures were also demonstrated (Bianchi & Brisson, 2017; Schonfeld & Bianchi, 2016), thereby further supporting the substantial overlap of depression and burnout as it extends to SMBM-conceptualised burnout. Regarding OLBI-measured burnout and depression, Bianchi et al. (2015) observed moderate to strong correlations between depressive measures and the OLBI dimensions of exhaustion and occupational disengagement. The more recent study by Duan-Porter et al. (2018) confirmed this observation by highlighting significant positive correlations between depression and exhaustion and depression and disengagement. Further review of the literature also showed significantly strong correlations between another prominent instrument, the CBI, and depression (Schonfeld & Bianchi, 2022). Finally, Koutsimani et al. (2019) and Meier and Kim (2022) found a meta-analytically pooled significant correlation between all included burnout measures, such as those mentioned above, and depression in the range of 0.50.

Taken together, the systematic reviews and meta-analytic studies of Bianchi et al. (2015), Bianchi et al. (2021), and Schonfeld et al. (2019a) show that the observed correlations between measures of depression and burnout are indicative of a substantial overlap between the conditions that persist despite different operational definitions applied to burnout. Bianchi et al. (2021) explicitly stated that their findings provide a robust foundation of evidence supporting the perspective that burnout significantly overlaps with depression. However, Koutsimani et al. (2019) reached an opposite conclusion by stating that "Burnout and depression are more likely to be two different constructs rather than one" (p.14). The authors elaborated by suggesting that despite a significant correlation between the conditions, the effect size was not high enough to imply that burnout is a form of depression. Interestingly, Meier and Kim (2022) rather endorsed the idea that their results point to considerable overlap between depression and burnout, despite a somewhat lower effect size found than that of Koutsimani et al. (2019).

Therefore, it appears as though a correlation coefficient of around 0.50 has been used to promote the belief that (a) burnout is a separate condition from depression (Koutsimani et al., 2019) and (b) burnout is not a separate condition from depression (Meier & Kim, 2022). However, these contradictory assumptions of the distinctiveness of burnout based on the magnitude of correlations can be clarified when placing effect sizes in context. The study by Wurm et al. (2016), for example, can offer some clarification. These authors revealed a correlation of 0.52 between depression and burnout based on a sample of 5897 physicians. They further found that as the symptoms of burnout intensified, the odds ratio for a depressive disorder increased substantially, from 2.99 (for mild burnout) to 10.14 (for moderate burnout) to 46.84 (for severe burnout) to 92.78 (for extremely high burnout). Consequently, it appears that the conclusion drawn by Meier and Kim (2022), suggesting a substantial overlap between burnout and depression based on an effect size of approximately 0.50, may be more accurate. However, important to note, that although these studies looked at a wide range of burnout measures, no study to date has examined the BAT-burnout-depression relationship, which is based on an alternative conceptualisation of burnout. Additional studies are therefore needed on different populations to elucidate whether the conclusions drawn about the burnout-depression relationship extend to all relevant conceptualisations of burnout.

Nevertheless, even in the face of accumulating evidence pointing to burnout as part of a depressive syndrome, this idea still received significant resistance from some researchers in the field. For instance, according to Maslach and Leiter (2016), one factor to consider when attempting to conclude the depression and burnout overlap is the fact that the strong depression-burnout correlation may merely reflect a methodological artifact. That is, the content overlap between measures of burnout and depression as it relates to fatigue or exhaustion (a symptom of both depression and burnout) may inflate the observed relationship between the two conditions (Maslach & Leiter, 2016). For this reason, several researchers responded to this issue by investigating whether the high correlations between depression and burnout persist even when fatigue-related item overlap has been controlled for. Interestingly, when depressive measures were stripped of fatigue-related items, the correlations between depression and burnout remained essentially unchanged when using the MBI (Bianchi et al., 2021; Schonfeld et al., 2019a), SMBM (Bianchi, 2020; Bianchi et al., 2021; Schonfeld et al., 2019b), or CBI (Schonfeld & Bianchi, 2022). Therefore, Schonfeld, Bianchi, and colleagues effectively disproved the content-overlap hypothesis of Maslach and Leiter (2016). However, all findings relating to the burnout-depression relationship presented thus far were based solely on psychometric results obtained from burnout and depressive measures. Importantly, investigation of the biological characteristics of the two conditions provides yet another avenue for addressing the concerns surrounding the burnout-depression relationship.

2.2.2.6 Biological perspective on the burnout-depression relationship

Because burnout is considered the outcome of chronic occupational stress, the endocrine system, due to its close associations with stress, has previously been the focus of burnout investigations within the biological research field. Such investigations have proved fruitful in the quest to distinguish burnout from depression. To illustrate, studies revealed that individuals with burnout showed substantial alterations in the amount of circulating cortisol, the body's main stress hormone, in a pattern that is distinct from depression (Kakiashvili et al., 2013). More specifically, burnout is linked to hypocortisolism while depression is linked to hypercortisolism (Marchand et al., 2014; Toker et al., 2012). One plausible interpretation of these results lies in the reality that hypocortisolism often appears in the time following chronic stress and associated hypercortisolism. This phenomenon is considered part of the body's response to counteract the detrimental impacts of elevated cortisol levels (Fries et al., 2005).

However, important to consider when reviewing these findings is that depression consists of distinct subtypes, related to different neurobiological profiles (Bianchi et al., 2015). On this account, it was previously shown that hypercortisolism is only present among individuals suffering from melancholic depression, one of the subtypes of the disorder (Gold & Chrousos, 2002; Lamers et al., 2013). On the other hand, hypocortisolism was also previously associated with atypical depression, another alternative depressive subtype (Hellhammer & Hellhammer, 2008; Lamers et al., 2013; Tops et al., 2008). Interestingly, atypical depression exhibits numerous commonalities with burnout, such as its inclination to be persistent and the central presence of fatigue symptoms (APA, 2013; Shirom, 2005; Tops et al., 2007).

Therefore, while the biological perspective implies a certain level of distinction between depression and burnout, the lack of subtyping in depression studies hinders definitive conclusions. Since diverse endocrine profiles can exist in different depressive subtypes, not accounting for the influence of these subtypes stands as a substantial limitation in this area of research. Nevertheless, based on qEEG findings, several researchers also demonstrated differences in the underlying neural correlates of the two conditions (Golonka et al., 2019; Luijtelaar et al., 2010; Tement et al., 2016). For instance, both Luijtelaar et al. (2010) and Golonka et al. (2019) came to the same conclusion regarding the absence of frontal alpha asymmetry (FAA) among those suffering from burnout. FAA is a characteristic qEEG biomarker associated with emotional processing and affective psychopathology, most notably depression (Tomarken et al., 1992). Thus, the lack of similar evidence of FAA in burnt-out samples may support the idea that burnout should be considered a stand-alone syndrome (Brenninkmeijer et al., 2001; Glass & McKnight, 1996). Luijtelaar et al. (2010) went so far as to say that the presence or absence of FAA can be used in the differential diagnosis of depression and burnout.

In addition, alpha power findings among those with burnout can also be interpreted in the same manner as it relates to depression. For example, Golonka et al. (2019) found evidence of significantly lower alpha power among a burnout group of employees compared to healthy controls. In contrast, elevated alpha power has traditionally been associated with depression (Begić et al., 2011; Jaworska et al., 2012). Thus, Golonka et al. (2019) concluded by stating that the difference between depression and burnout may be situated in the level of cortical activity as burnout was linked to cortical hyperactivity, contrasting with the typical cortical hypoactivity observed in depression. Of note, the reader's understanding of these findings necessitates an understanding of the relationship between alpha power and cortical activity. Elevated alpha power is characteristic of relaxed states, particularly when eyes are closed, thus indicating decreased cortical activation.

Moreover, Tement et al. (2016) also provided evidence of a biological distinction between burnout and depression by reporting on differential associations with certain qEEG markers for the two conditions. More specifically, the authors showed that burnout was related to alpha power whereas depression was associated with APF. Clarification on the different qEEG frequencies, including APF will be provided in the subsequent section. Nevertheless, for now, it is important to understand that Tement et al. (2016) concluded by stating that their study results lend some support for the consideration of burnout as a distinct clinical entity. However, among those studies reporting on the qEEG findings in depressed participants, it is unclear whether the influence of different depressive subtypes and associated neurobiological profiles was considered, meaning that caution should be exercised in reviewing these findings.

2.2.2.7 Summary

After 35 years of examination, scholars still lack consensus on the reasons behind the observed overlap between depression and burnout (Meier & Kim, 2022). The central inquiry revolves around whether burnout constitutes a distinct construct or if it is essentially interchangeable with depression. This controversy has been approached using diverse methods, including the assessment of conceptual distinctions, comparisons of symptomatic profiles and nomological networks, correlational analyses, and biological comparisons between the two conditions (see Figure 1 for a summary). Despite some contradictory findings, the balance of psychometric evidence presented in this review of the literature tends to support the belief that burnout is indistinguishable from depression. However, from the biological perspective, the evidence points in the opposite direction as suggestions of burnout's distinctiveness have been made based on qEEG and hormonal findings, although subtyping of depression is needed before drawing definitive conclusions.

Figure 1: Summary of the literature concerning the burnout-depression relationship

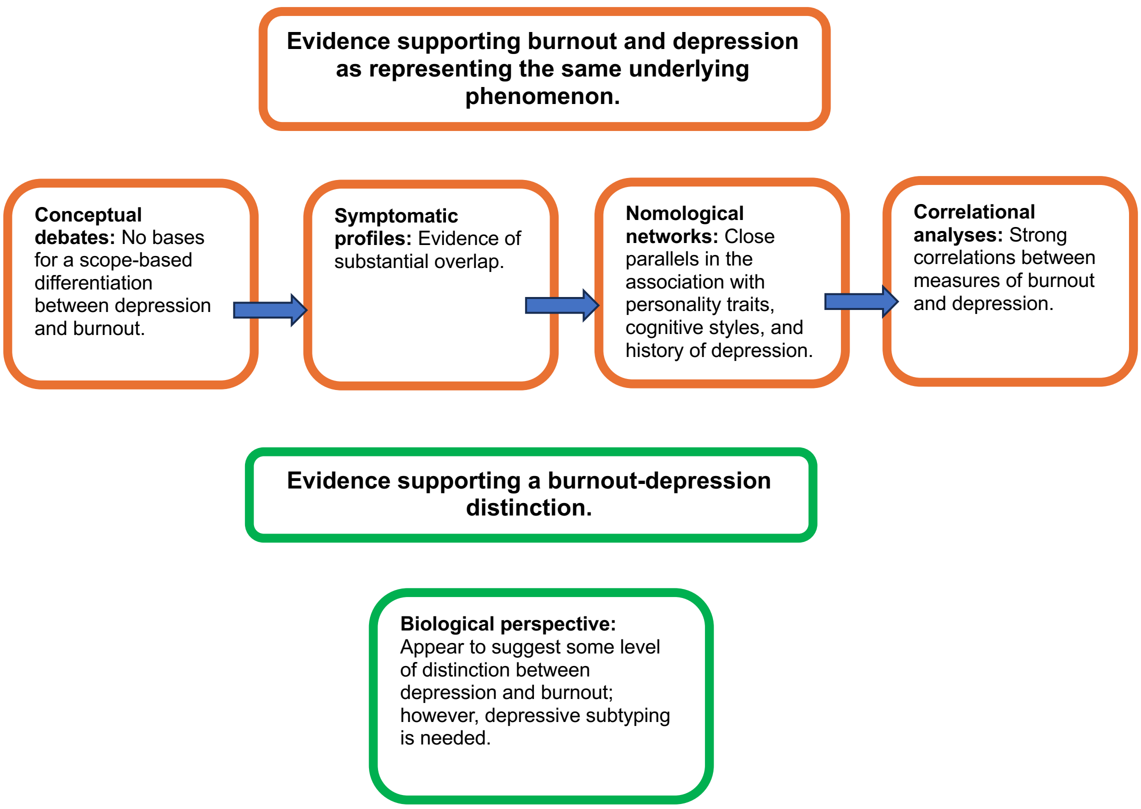


Figure 1: This figure displays a brief summary of the debates on the burnout-depression relationship.

Biological investigations seem to suggest that burnout and depression should be regarded as two different constructs while the psychometric evidence largely favours the idea that the two conditions are representative of the same underlying phenomenon.

However, regardless of the ongoing debates on the conceptualisation and discriminant validity of burnout, this phenomenon is still considered a serious problem among academic staff. In other words, many still attempt to make sense of work-related suffering through the lens of the burnout syndrome. Importantly, the relevance of burnout investigations among academics, despite the controversies attached to the condition, rests in its association with various adverse outcomes (Maslach et al., 2001), which will be discussed next.

2.3 Consequences of burnout

As described previously, the symptoms of burnout are initially psychological in nature but may later also negatively impact employees' physical health, interpersonal relationships, and behaviour (Salvagioni et al., 2017). For example, several studies indicate that burnout is associated with musculoskeletal pain, gastrointestinal alterations, respiratory diseases, hypertension and cardiovascular disorders, higher incidences of infections (Giorgi et al., 2017), and diabetes (Melamed et al., 2006). De Beer et al. (2016) provided evidence for the relationship between burnout and irritable bowel syndrome, hypertension, and diabetes in South Africa. In terms of the interpersonal dimension, disruption of family and social relationships has been reported by those suffering from burnout (Cordes & Dougherty, 1993). Maslach and Jackson (1982) found that individuals demonstrating burnout were likely to express anger during social interactions as well as withdrawal tendencies from their family and friends. In addition, since burnout is understood as involving the development of cynical and detached attitudes at work, these may negatively impact relationships with colleagues (Jackson & Schuler, 1983).

Burnout can also lead to destructive and counterproductive behaviours in employees, including aggressive interactions with colleagues and service recipients (Giorgi et al., 2017), substance and alcohol abuse (Maslach & Leiter, 2016), suicidal behaviours (Bryan et al., 2017), low organisational commitment (Salvagioni et al., 2017), increased absenteeism (Ahola et al., 2017), higher intentions to resign and employee turnover (Han et al., 2016), and reductions in performance (Adriaenssens et al., 2015; Sakakibara et al., 2020). In academic staff in particular, burnout can result in decreased academic output, difficulties in maintaining high academic performance (Coetzee et al., 2019; Ismail et al., 2013; Kratzke et al., 2021), and negative student experiences and performance (Byrne et al., 2013). Consequently, the combination of these physical and behavioural outcomes may translate to a significant reduction in the quality of education and research publications delivered and severe economic losses for higher educational institutions (Ugwu et al., 2017). Burnout among academic staff may also ultimately assert adverse effects on student experience, learning, performance, and attainment, which has further implications for the success of the entire higher educational institution (Gillespie et al., 2001; Maslach & Leiter, 1999).

In light of these problematic consequences of burnout, the importance of appropriate intervention strategies is emphasised. However, as mentioned in the introductory chapter, empirical investigations of interventions for burnout are scarce, difficult to implement, and most show unsuccessful or mixed results (Ahola et al., 2017; Korczak et al., 2012; Leiter & Maslach, 2014). For example, organisation-directed interventions have been recommended to combat burnout symptoms and typically consist of strategies such as reducing work hours and job demands, task restructuring, and increasing job control or participation in decision-making (Wiederhold et al., 2018). However, attempting to re-organise the working environments of higher education institutions can be challenging, time-consuming, and is not often implemented (Ahola et al., 2017). Alternatively, individual-level interventions can also be considered that generally focus on improving coping skills, cognitive behavioural therapy, relaxation and meditation, exercise, and emotional management training (Wiederhold et al., 2018). However, these suggestions can be difficult to incorporate into the already busy schedules of academic staff and, more importantly, do not show promising results. For example, a systematic review by Ahola et al. (2017) indicated that symptoms of burnout were not systematically reduced by individually focused interventions such as those mentioned above. Therefore, exploring alternative interventions to reduce burnout, such as neurofeedback, may be of great value.

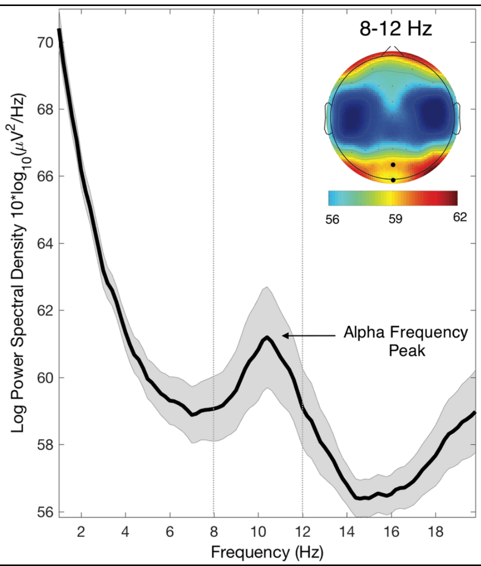
2.4 Neurofeedback

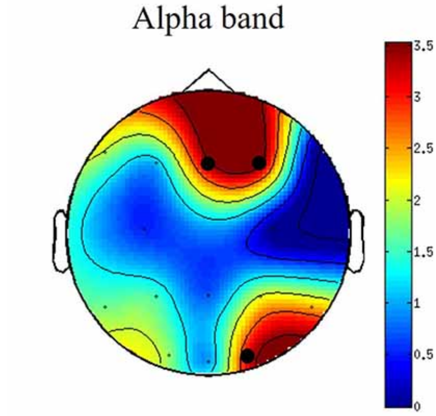
As mentioned in the introduction, neurofeedback is a therapeutic technique that involves real-time monitoring of brain activity to teach self-regulation of brain function (ISNR, 2023). Neurofeedback training has been widely studied and effectively used for the alleviation of symptoms of numerous conditions, including, but not limited to, epilepsy, insomnia, stroke, chronic pain, attention-deficit hyperactivity disorder, depressive disorders, post-traumatic stress disorder, substance abuse, anxiety-related disorders, and used for peak performance training (Hammond, 2011). Specifically aligned with the scope of the present study, the rationale for neurofeedback as a potential intervention for burnout in academic staff is based on voluminous empirical evidence of its efficacy in reducing general stress in a wide range of populations (Bennett et al., 2017; Bennett et al., 2022; Dunham et al., 2019; Hafeez et al., 2019; Hafeez et al., 2021), reducing work-related stress in financial employees (Liu & Cha, 2018), and burnout among surgical residents (Kratzke et al., 2021), radiation therapists (Campbell et al., 2020), and scientists (Fedotchev et al., 2021). However, the efficacy of neurofeedback is still a debated matter and more studies in this area are needed (Rogala et al., 2016). Nevertheless, as highlighted in Chapter 1, the successful implementation of neurofeedback depends on the accurate identification of abnormal brain activity associated with the targeted symptoms. In the case of burnout, three studies were identified that used the qEEG method to elucidate the abnormal brain activity associated with the condition that will be discussed in the sections below.

2.5 qEEG profiles of burnout

The three identified studies on qEEG profiles and burnout focused on the entire range of different frequency bands, measured across all brain areas, that consisted of the following: Delta, theta, alpha, APF, FAA, and beta (see Table 4 for a brief overview).

Table 4: Description of the different qEEG frequency bands

Frequency band	Wave frequency	Description
Delta power	Less than 4 Hz 	• Characteristic of mental states during deep and restorative sleep. • Associated with deep unconsciousness and unawareness.
Theta power	4-8 Hz 	• Represent a daydream-like and very relaxed state of mind. • Associated with mental inefficiency and early sleep stages. • Associated with creativity, insight, meditation, prayer, and spiritual awareness.
Alpha power	8-12 Hz 	• Represent alert-relaxed state or relaxed wakefulness when the brain is in an idle but alert state. • Associated with a relaxed mental state, creativity, and sometimes meditation.
Beta power	15-30 Hz 	• Dominant in periods of mental and intellectual activity (e.g., concentration, judgement, problem-solving). • Associated with states of excitement, tension, or high alertness.
Alpha peak frequency (APF)		• Refers to the specific frequency within the alpha brainwave band that exhibits the highest amplitude or power during an EEG recording. • Represent an index of cognitive preparedness (e.g., executive function).

Frequency band	Wave frequency	Description
Frontal alpha asymmetry (FAA)		• Unequal distribution of alpha power among the left and right frontal electrodes. • Associated with emotional processing and affective psychopathology. • Greater alpha wave activity in the left frontal cortex compared to the right is often associated with positive emotions and approach motivation. • Greater alpha activity in the right frontal cortex compared to the left is linked with negative emotions, withdrawal, and avoidance behaviours.

*Pictures of alpha, beta, theta, and delta waves were sourced from Summer (2023). APF picture was sourced from Ronconi et al. (2018). FAA picture was sourced from Fischer et al. (2018).

The first study that examined qEEG profiles in individuals with burnout was conducted by Luijtelaar et al. (2010), who aimed to establish biological markers for burnout. Their study compared 13 participants with burnout (four females and nine males) and 13 controls (four females and nine males) based on four variables: FAA, APF, and beta as well as alpha power during eyes open and closed. Participants with burnout were identified through a treatment centre for burnout, while the controls consisted of participants from the general population in the Netherlands. The presence of burnout was identified by: A diagnosis of undifferentiated somatoform disorder according to the Structured Clinical Interview for DSM-IV (First et al., 1997); high exhaustion and depersonalisation scores and low personal accomplishment scores according to the Utrecht Burnout Scale (Schaufeli & van Dierendonck, 2000); agreement among interviewer and participant that the symptoms are job-related; and due to the symptoms, the participant worked at least 50% less than usual for a minimum of three months. From the results of their study, Luijtelaar et al. (2010) demonstrated significantly lower APF and beta power in the burnout group than in controls. The authors also revealed no FAA based on the qEEG data of the burnout group.

The following study to consider is that of Golonka et al. (2019), who aimed to investigate possible differences in the qEEG power of specific frequency bands in a burnout group of employees (N=46; 19 men) compared to healthy controls (N=49; 19 men). The study sample consisted of non-specific employees who responded to the study invitation posted on social networks and emailed to private and public organisations. Employees with burnout included those who had high scores on the MBI (Maslach et al., 1996) and reported a stressful working environment according to the Areas of Work Life Survey scale (Leiter & Maslach, 2004). In contrast to the results of Luijtelaar et al. (2010), Golonka et al. (2019) reported no significant differences in APF among the burnout group compared to controls. However, the authors came to the same conclusion regarding the absence of FAA in the burnout group.

Further, the finding of significantly reduced alpha power among employees with burnout during eyes open compared to controls contrasted sharply with those of Luijtelaar et al. (2010), which demonstrated no significant difference in alpha power among the burnout group compared to the control group. Moreover, Golonka et al. (2019) reported no significant beta power differences between the burnout and control groups, which were inconsistent with the findings of Luijtelaar et al. (2010) described above. Finally, only Golonka et al. (2019) examined delta and theta activity and found no significant differences between the burnout group and controls concerning these frequency bands.

The final study on the qEEG profile of burnout was conducted by Tement et al. (2016), involving 117 participants (35.90% males) to compare APF and alpha power between undergraduate and graduate students with burnout and depression. Burnout was measured with the MBI (Maslach et al., 1996). Regarding the study's results, Tement et al. (2016) found no significant correlations between APF and burnout, in line with the findings of Golonka et al. (2019) but inconsistent with the results of Luijtelaar et al. (2010). In addition, although not statistically significant, Tement et al. (2016) showed that alpha power positively correlated with MBI burnout scores, which differed from the finding of Golonka et al. (2019), showing significantly decreased alpha power among the high burnout group.

Therefore, overall, apart from consistent findings regarding no FAA in individuals with burnout, all remaining findings regarding the alpha and beta bands among the three discussed studies were inconsistent. Therefore, it is impossible to draw definite conclusions about the direction and existence of specific brain wave abnormalities in the burnout population, which signals the need for further exploration to establish reliable neurobiological markers of burnout. In addition, since the study by Golonka et al. (2019) was the only study investigating theta and delta power, their findings need to be replicated.

Differences in experimental conditions may partly explain inconsistencies in results, as Luijtelaar et al. (2010) and Golonka et al. (2019) based their findings on eyes-open and closed conditions, with only the latter included in the study by Tement et al. (2016). In this regard, Golonka et al. (2019) supported their consideration of both the eyes-open and closed conditions by referring to the results of Fonseca et al. (2013), who found that the difference between at rest qEEG results in the eyes-open and closed conditions signifies a measure of resting-state arousal. This finding is relevant when investigating burnout as it was previously demonstrated that individuals with burnout showed abnormal arousal patterns, including reduced energy and elevated tension levels (Malkinson et al., 1997). As such, in line with Luijtelaar et al. (2010) and Golonka et al. (2019), the present study considered both the eyes open and closed conditions.

Golonka et al. (2019) suggested that the inconsistent findings among the discussed studies may also be due, in part, to differences in sample characteristics, namely burnout severity. For example, it can be said that the study by Luijtelaar et al. (2010) included participants with more severe burnout as the inclusion criteria not only consisted of high scores on burnout measures but also a diagnosis of undifferentiated somatoform disorder and the requirement that participants worked at least 50% less than usual for a minimum of three months. To compare, the remaining studies were based on relatively healthy students (Tement et al., 2016) and employees (Golonka et al., 2019). Therefore, the severity of burnout symptoms may be displayed as differences in qEEG profiles (Golonka et al., 2019), an area in need of further exploration.

Furthermore, the differences in the qEEG profiles as related to socio-demographic factors, such as gender, are rarely investigated. In one of the few studies looking at potential gender differences, Tement et al. (2016) showed that alpha power positively correlated with burnout among male participants only. These authors further stated that, in females, burnout negatively correlated with alpha power but failed to reach significance. Similarly, Golonka et al. (2019) also demonstrated pronounced gender differences in a study looking at the qEEG profiles of a burnout group of employees compared to a healthy control group. The authors expressed that alpha power showed significant negative correlations with burnout scores only among male participants. The tendency for negative correlations was also present in females, but these were non-significant in most regions. Additional studies are therefore needed to determine the possible differences and mechanisms underlying these potential gender differences in the qEEG profiles of burnout. In addition, considering the moderating role of gender on the outcome of qEEG results, differences in gender distribution of the studies cited above (Golonka et al., 2019; Luijtelaar et al., 2010; Tement et al., 2016) may be another source of conflicting findings. Therefore, considering all the above, it is evident that the samples are not equivalent, and comparisons should be made with caution.

2.6 Literature review summary

The construct of burnout is still a debated matter in terms of conceptualisation, measurement, its relationship with depression, and biological characteristics. There are currently six popular burnout measures and differing underlying conceptualisations. However, based on the state of evidence, especially considering the neuroscientific investigations of burnout, BAT-defined burnout appears to represent the most accurate conceptualisation of the condition. However, as most researchers understand burnout to be what the MBI measures (Hadžibajramović et al., 2020), it becomes important to evaluate the convergence and divergence of the different burnout dimensions outlined by the MBI as opposed to those contained in the BAT. This may ultimately lead to an improved understanding of the burnout concept. In terms of the burnout-depression relationship, it appears as though popular opinion regards these two conditions as manifestations of the same underlying syndrome. However, no consensus has been reached yet and no studies have been conducted that focus on the BAT-defined burnout-depression relationship. Similarly, knowledge of the qEEG correlates of burnout is scarce and inconsistent. The uncertainty surrounding burnout is especially problematic considering the numerous adverse personal and organisational outcomes of the syndrome. Thus, considering the substantial negative impact of burnout on the well-being of academics, there is a need to improve our understanding of the condition, including the convergence and divergence of different measures, its relationship with depression, and biological underpinnings. Following this rationale, the subsequent sections outline the research aims, questions, and hypotheses formulated under the main overarching aim of exploring academic burnout using psychometric and electrophysiological methods.

2.7 Research aims and questions

From the primary research aim outlined above, three sub-aims and accompanying research questions were formulated:

(1) To explore the associations between the most popular burnout measure, the MBI, and the newly developed BAT at both categorical and dimensional levels. The resulting research question was as follows: What is the relationship, at both dimensional and categorical levels, between MBI- and- BAT-measured burnout?

(2) To examine the distinctiveness of burnout versus depression using different analytic techniques. The resulting research questions were: What does categorical analysis show regarding the percentages of individuals suffering from both burnout and depression? How do the BAT and MBI scores compare among academic staff with different levels of depression severity? What is the relationship between both MBI- and- BAT-measured burnout (including subscale dimensions) and depression? How does controlling for content overlap between measures of burnout and depression affect the correlation between both MBI- and- BAT-measured burnout and depression?

(3) To explore the qEEG profiles of burnout to provide the initial data necessary for the development of an appropriate neurofeedback protocol for burnout. The resulting research question was: How do the qEEG profiles of academic staff scoring high on burnout compare to a normative database?

2.8 Research hypotheses

The study hypotheses corresponding to the research questions outlined above consisted of the following:

What is the relationship, at both dimensional and categorical levels, between MBI- and- BAT-measured burnout?

Hypothesis: It was expected that the global BAT and MBI scores would show a strong, significant, and positive correlation as both are measures of the same construct, employing self-report items rated on a Likert scale. However, due to the unique contributions of both measures to the burnout construct, cognitive and emotional impairment for the BAT and personal accomplishment for the MBI, it was expected that these dimensions would represent divergent factors. In other words, the cognitive and emotional impairment dimensions of the BAT would show weaker correlations with the total MBI score compared to the exhaustion and mental distance components. Likewise, the personal accomplishment scale of the MBI would show weaker correlations with total BAT scores compared to the emotional exhaustion and depersonalisation scales. On a categorical level, it was expected that a substantial percentage overlap would be observed among those scoring both high on MBI-emotional exhaustion and depersonalisation and the BAT. However, a smaller percentage overlap between those scoring low on personal accomplishment and high on the BAT was anticipated.

How do the BAT and MBI scores compare among academic staff with different levels of depression severity?

Hypothesis: In line with previous evidence (Bianchi et al., 2014; Schonfeld & Bianchi, 2016; Schonfeld & Bianchi, 2022; Wurm et al., 2016), it was expected that average MBI scores will show a stepwise increase with each increment in depression severity (from minimal to mild to moderate to severe). However, no similar investigations have ever been conducted for the BAT. Nevertheless, since some elements of the BAT (exhaustion and mental distance) are congruent with the MBI, it was anticipated that a dose-dependent association would exist between BAT scores and depressive symptoms, albeit to a lesser extent.

What does categorical analysis show regarding the percentages of individuals suffering from both burnout and depression?

Hypothesis: Due to the considerable symptomatic overlap between depression and burnout, it was expected that a large percentage of participants with high burnout scores would also score in the clinical range on the BDI.

What is the relationship between both MBI- and- BAT-measured burnout (including subscale dimensions) and depression?

Hypothesis: Given the recent comprehensive meta-analyses by Meier and Kim (2022) and Koutsimani et al. (2019), it was expected that MBI scores (including subscale scores) would correlate significantly with depressive scores. Due to substantial content overlap with MBI dimensions, it was expected that the exhaustion and mental distance elements of the BAT would also show similar significant correlations with depression. For the cognitive impairment domain, it was expected that this subscale would also show significant positive correlations with BDI-II scores as this element is captured in the BDI-II as part of the depressive picture. However, as no study to date has investigated the association between the total BAT scores or BAT-measured emotional impairment and depression, a specific hypothesis on the magnitude and significance of these relationships cannot be stated. However, since the two core dimensions of BAT-measured burnout are expected to correlate significantly with depressive scores, it seems likely that the total BAT score would follow this trend. Therefore, overall, it is expected that burnout, as measured by the MBI and BAT, will lack sufficient discriminant validity versus depression on a dimensional level.

How does controlling for content overlap affect the correlation between both MBI- and- BAT-measured burnout and depression?

Hypothesis: Corresponding to previous studies (Bianchi et al., 2021; Schonfeld et al., 2019a), it was expected that the magnitude of the relationship between MBI-measured burnout and depression will remain relatively unchanged in the face of controlling for exhaustion item-level overlap. Due to the similarities between the MBI and BAT dimensions of exhaustion, it was anticipated that a similar finding would apply to the BAT. However, since no such investigation has ever been conducted that further includes the effect of cognitive item overlap between the BAT and measures of depression, a specific hypothesis in this regard could not be stated.

How do the qEEG profiles of academic staff scoring high on burnout compare to a normative database?

Hypothesis: Following prior studies (Golonka et al., 2019; Luijtelaar et al., 2010), it was hypothesised that participants with high levels of burnout will demonstrate deviations in qEEG-derived parameters in the alpha band. In particular, although findings in the literature have been inconclusive, a trend indicating hyperarousal mechanisms characterised by reduced alpha activity in EEG bands (assessed through various metrics such as alpha power and APF) has emerged. Consequently, it was anticipated that individuals in the burnout group would exhibit reduced levels of alpha activity across a range of measures.

2.9 Conclusion

This chapter included a critical discussion of the literature supporting the present study that also led to the formulation of six research questions outlined. The remaining chapters in this dissertation will focus on the methodology, results, and discussion chapters. The research methodology sections are divided according to the two components of this dissertation based on different samples, data collection and statistical analytic techniques. Stage one of the data collection and analysis addressed research questions one to five and involved the investigation of the psychometric profile of academic burnout. Chapter 3 provides an overview of the methodology employed for this psychometric component of the study and Chapter 4 provides the details of the psychometric results. Stage two involved using a sub-test of the original sample to investigate the qEEG profiles of academic burnout (research question six). Thus, Chapters 5 and 6 provide an overview of the qEEG-derived methodology and results, respectively. Chapter 7 ties these two components of the study together in a discussion of the results in comparison with previous studies on the topics of interest.

CHAPTER 3: PSYCHOMETRIC METHODOLOGY

3.1 Introduction

A study's methods are the specified procedures employed for the purpose of identifying, selecting, processing, and analysing the information on a given research topic (Creswell & Guetterman, 2019). This chapter thus allows for an examination of the study's overall validity and reliability, which can influence the reader's confidence in the obtained results. For this reason, this chapter presents a detailed discussion of the research methods used to meet the study's aims pertaining to the psychometric section of this dissertation. The point of departure is a description and justification of the research design selected. The chapter will further describe the study population and sampling strategy, the choice, reliability, and validity of data collection instruments as well as the data collection procedures. Finally, this chapter will also incorporate a discussion of the statistical data analytic techniques used and the ethical considerations applied.

3.2 Research design

The study is nested within a larger project aimed at investigating the effect of a neurofeedback training protocol as an intervention for burnout among academic staff. The specific role of the study in relation to the larger study was to collect the initial (baseline) demographic, burnout, and pre-intervention qEEG data among the identified burnout and control groups. To address the research aims and hypotheses, this study adopted a positivist and quantitative research approach to data collection and analysis. A quantitative research design suited the present study as it aimed to collect quantifiable data that permits statistical description to explain a phenomenon, allow for hypothesis testing, and determine relationships between variables (Creswell & Guetterman, 2019).

More specifically, within the quantitative domain, the study design can further be understood as a descriptive, exploratory, quantitative design, involving both correlational and comparative components. Descriptive research aims to generate a precise and systematic description of a population, situation, or phenomenon, typically in the context of group differences, developmental trends, and relationships among variables (Bryman, 2016). The descriptive nature of the study can thus also be understood as being non-experimental as there was no variable manipulation and no randomisation of participants (Salkind, 2010). Consequently, the current research design did not allow for the establishment of causality between the variables under investigation (Creswell & Guetterman, 2019). However, as the sub-aim of the study relevant to the psychometric component was to examine the co-occurrence of depression and burnout, the establishment of causality was not relevant in this case and a descriptive design was thus most appropriate.

The study's descriptive nature allowed for the ability to make use of naturally occurring phenomena, burnout and depression, to produce insights through a deductive process (Kielhofner, 2006). The comparative component of the descriptive design allowed for participants to be recruited and grouped based on depressive scores. Subsequent comparisons were made based on the burnout scores of different depressive severity groups. The correlational component used within this specific design allowed for the exploration of the degree of association between burnout and depressive variables to gain insight into the burnout-depression as well as the MBI-BAT relationship.

Finally, the current study was also cross-sectional as data collection and analysis occurred during a single period (Creswell & Guetterman, 2019). This design was deemed a good cost-effective approach to data collection (Leedy & Ormond, 2015). However, a cross-sectional study design was not able to permit an examination of how one condition (burnout) may predict another (depression). Nevertheless, longitudinal investigations into the burnout-depression relationship can only be valuable once the distinctiveness of burnout versus depression has been firmly established (Schonfeld & Bianchi, 2016; Schonfeld et al., 2019a)

3.3 Study setting

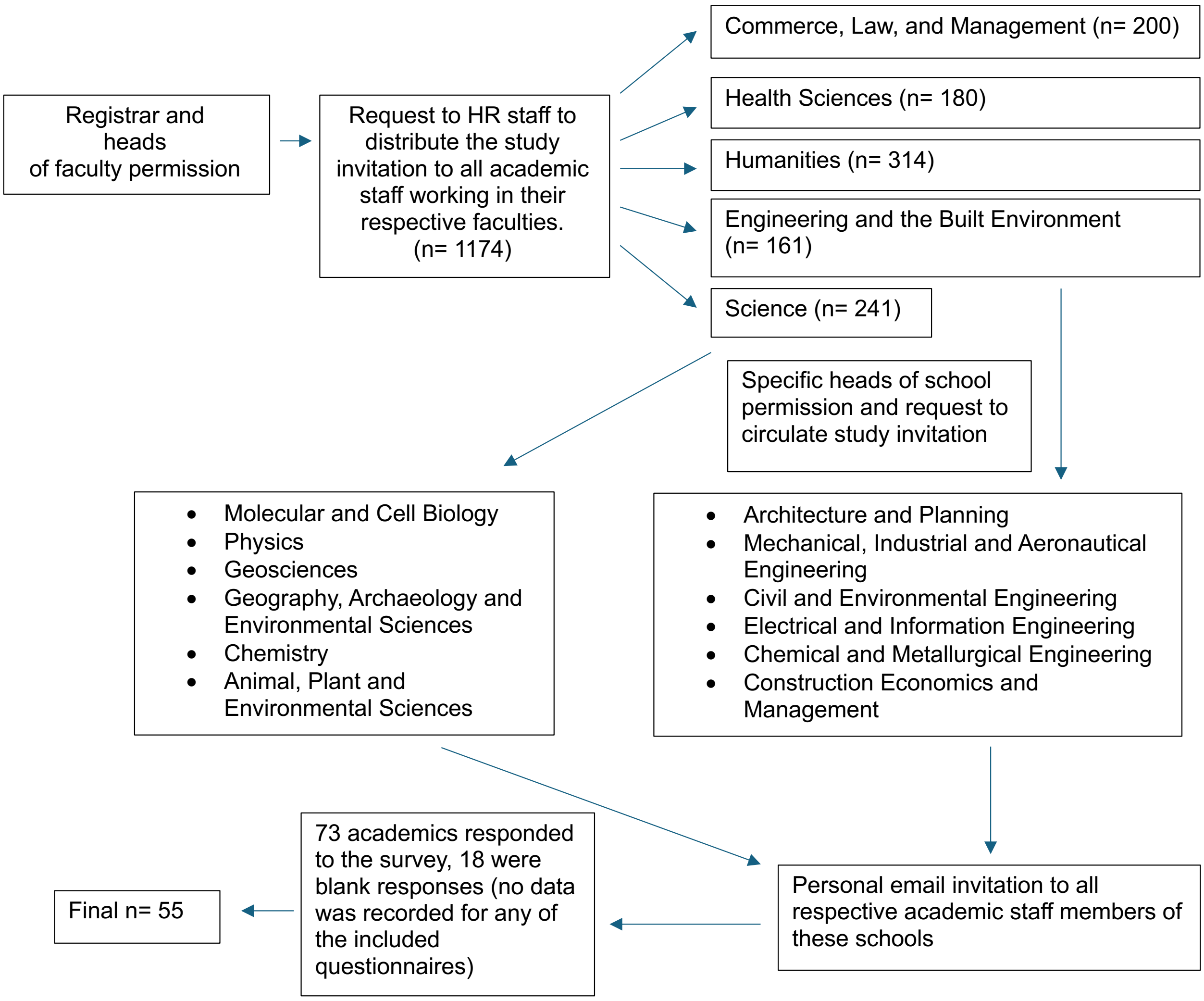
This study focused on academic staff from the University of the Witwatersrand (Wits). Wits is a public university with multiple campuses located in the capital city of Gauteng, Johannesburg, South Africa. The university is structured into the following five Faculties: Science; Commerce, Law, and Management; Humanities; Engineering and the Built Environment; and Health Sciences. As of 2021 (Wits, 2021), the total number of full-time permanent academic staff was reported as 1174 individuals. In terms of the demographic profile of these employees, as of 2021, 51.53% of academic staff are female, 19.25% are Black South Africans, 5.88% are Coloured, 9.88% are Indian, 38.76% are White, 0.17% are Chinese, and 26.06% are classified as international. In addition, 67.54% of Wits academic staff have a PhD level of education, 16.44% hold the title of professor, 17.38% are associate professors, 29.05% are senior lecturers, 35.01% are lecturers, 1.79% are associate lecturers, and 0.34% are termed as other.

3.4 Sample and sampling procedure

The target population of this study consisted of academic staff from Wits. Choosing Wits as the site of the study provided a sample of academic staff within a confined geographic area that was easily accessible thereby facilitating the collection of data. The recruitment of participants was conducted from 23 August to 31 October 2023 and consisted of a two-stage process. For this chapter, the focus is on the first stage of data collection. Therefore, once ethical clearance was obtained, participants were invited across all Wits Faculties using convenience and snowball sampling methods. Convenience sampling, a form of non-probability sampling, involves selecting a sample according to the simplicity of its accessibility (Bryman, 2016). The convenience sampling method thus allowed for the selection of participants who were willing and available to partake in the study. Despite the possible introduction of bias and threats to generalisation associated with convenience sampling (Creswell & Guetterman, 2019), it was nonetheless deemed appropriate because of its affordability and efficiency in providing easy access to the population (Bryman, 2016). Further, an attempt to mitigate sampling bias was made by inviting all Wits academic staff to participate, thereby providing each staff member with an equal opportunity to be included in the study. In addition, participants who have already taken part in the study, or indicated an interest in participating, were encouraged to invite fellow staff who also met the study's inclusion criteria.

Using the convenience sampling method, participants were recruited through the help of the University Registrar and the Human Resources (HR) departments of each Faculty. Once relevant Registrar and Faculty permission was obtained, the HR representative of each Faculty was asked to distribute the study invitation via email to all academic staff of their respective Faculties. To boost participation, permission to circulate the study invite was also obtained from individual heads of schools from the Faculties of Engineering and Science. The schools within these Faculties were chosen due to their proximity to the site of qEEG data collection, which was thought to eliminate non-participation due to travelling or time inconveniences. In addition, to further ensure sufficient participation, individual members of these schools were also contacted directly via an email containing the study invitation (see Figure 2 for an overview of the first stage of recruitment).

Figure 2: Sampling strategy for the first stage of data collection



During this first recruitment process, no specific inclusion and exclusion criteria were applied, except that all included participants were required to be active Wits academic staff members. In addition, due to the nature of the survey, participants were also required to have a stable internet connection and a computer or similar devices to complete the survey. The aim was to include as many academic staff members as possible to ensure a good cross-section of participants in terms of race, gender, age, and severity of burnout. The final sample size consisted of 55 participants, recruited from all Wits Faculties mentioned above. From the information presented in the previous section, the sample size thus represented an estimated response rate of 4.68%. Regarding demographics, among the total sample size, 67.27% of participants identified as female, 63.64% had a PhD level of education, and 69.09% identified as White.

3.5 Data collection tools

A combination of four measures was employed to obtain the data necessary to investigate the hypotheses of the study. These included a demographic questionnaire, the BAT, MBI, and BDI-II. The questionnaires were administered electronically, using the Research Electronic Data Capture (RedCap) online platform, and in English to all the participants. The measures utilised are described in detail below.

3.5.1 Demographic questionnaire

All participants were asked to complete a demographic questionnaire (Appendix A) to collect the following characteristics of the sample: Gender, age, educational level, home language, ethnicity, and questions pertaining to participants' medical and psychiatric histories. All demographic data was used for descriptive purposes only. However, information on the medical histories of participants, including details of medication use, was examined for possible exclusion criteria applied to the qEEG testing sessions, which will be discussed in Chapter 5.

3.5.2 The Burnout Assessment Tool (BAT)

The BAT (Appendix B; Schaufeli et al., 2020b) was utilised to determine the presence and severity of burnout among the participants. As mentioned in the literature review, the BAT is arguably based on an alternative and more comprehensive definition of burnout compared to the MBI and other measures, such as the OLBI, CBI, BM, and

SMBM (De Beer et al., 2022). Following this rationale, the BAT was chosen as the primary measurement of burnout in the current study. The BAT contains two sections: Core symptoms of burnout (23 items) and secondary symptoms of burnout (10 items). The core symptoms of burnout include exhaustion (8 items; e.g., "When I get up in the morning, I lack the energy to start a new day"), mental distance (5 items; e.g., "I feel indifferent about my job"), cognitive impairment (5 items; e.g., "I struggle to think clearly"), and emotional impairment (5 items; e.g., "I feel unable to control my emotions"). The secondary symptoms of burnout include psychological complaints (5 items; e.g., "I have trouble falling or staying asleep") and psychosomatic concerns (5 items; e.g., "I suffer from headaches"; Schaufeli et al., 2020b, p.142). These secondary symptoms are typically used to further differentiate the overall health status of a particular individual being assessed for clinical treatment purposes and were thus not used in the present study for the calculation of the burnout score. Schaufeli et al. (2020a) specifically mentioned that, although these secondary symptoms often co-occur with the experience of burnout, it is not specific to burnout and thus not included in its definition.

All items on both core and secondary symptom scales were presented as statements with subsequent responses based on a five-point rating scale with the following response options: never (1), rarely (2), sometimes (3), often (4), and always (5). According to the BAT, burnout is conceptualised as a syndrome, meaning that the measure provides a composite score encapsulating the experience of the syndrome as a whole, in addition to different subscale scores referring to the experience of each BAT-burnout dimension (Schaufeli & De Witte, 2023). Thus, total BAT scores were used as an indicator of the level of burnout experienced among our sample while subscale scores were used to gain additional insights into the experience of specific burnout symptoms.

Moreover, to proceed with burnout case identification to assign participants to either a high burnout or control group, the cut-off scores included in the BAT manual were utilised (Schaufeli et al., 2020b). The scoring guidelines for determining the degree of burnout are presented in Table 5 below. Cut-off scores are available for the total BAT score as well as subscales scores, which are divided into the categories of low, average, high, and very high (Schaufeli et al., 2020b). As can be seen in Table 5, the interpretation of both total and subscale scores on the BAT relies on averaging. Specifically, the average scores for BAT scales are computed by summing the scores of all items within a given subscale and subsequently dividing this sum by the number of items in that scale. The average scale scores thus range from one to five, corresponding to the scale of response options outlined previously. This same procedure is applied in calculating total BAT scores. As such, the total BAT scores also fall within the range of one to five.

The BAT manual highlights that a score contained in the 'high' category is most likely indicative of burnout while a score in the 'very high' category signals an even higher likelihood of an individual suffering from burnout (Schaufeli et al., 2020b). As such, BAT scores in the 'high' and 'very high' categories were considered indicative of burnout and participants with these scores were thus included in the burnout group eligible for qEEG administration (to be discussed in Chapter 5). As will be elaborated upon in Chapter 5, an exceedingly small number of participants scored in the average and low range of the BAT, which would have defined our control group. Therefore, the decision was made to utilise an established normative database as our control group.

Table 5: Score ranges for the core burnout symptoms of the BAT

	Category	**Score range**
Total score	Low	≤1.60
	Average	1.61–2.40
	High	2.41–3.29
	Very high	>3.30
Exhaustion	Low	≤1.60
	Average	1.61–2.40
	High	2.41–3.29
	Very high	>3.30
Mental distance	Low	≤1.60
	Average	1.61–2.40
	High	2.41–3.29
	Very high	>3.30
Emotional impairment	Low	≤1.60
	Average	1.61–2.40
	High	2.41–3.29
	Very high	>3.30
Cognitive impairment	Low	≤1.60

	Category	Score range
	Average	1.61–2.40
	High	2.41–3.29
	Very high	>3.30

Source: Schaufeli, W.B., De Witte, H., & Desart, S. (2019b). *Manual Burnout Assessment Tool (BAT) - Version 2.0*. KU Leuven, Belgium: Utrecht Unpublished internal report

Regarding the reliability and validity of the BAT, several studies investigated the properties of the instrument in South African samples. For example, De Beer et al. (2022), conducting a validation study using a sample of 1048 South African employees from non-specific occupations aged 18 years or older, concluded that the BAT is a valid and reliable measure in South Africa. The authors further indicated that the BAT demonstrated invariance across ethnicity and gender in South Africa. Additionally, Fynn & van der Walt (2023) confirmed the validity of the BAT and revealed a high internal consistency (Cronbach's alpha of 0.96) among a South African sample of academics. The authors found Cronbach's alpha scores of 0.95 and 0.89 for the core and secondary symptoms subscales, respectively. Likewise, the results of Redelinghuys and Morgan (2023) reinforce the BAT's strong psychometric properties and cross-cultural measurement invariance in South Africa, the Netherlands, Australia, and the United States of America (USA).

3.5.3 Maslach Burnout Inventory- Human Services Survey (MBI-HSS)

To explore the divergence and convergence of the BAT with respect to the most popular burnout measure, the MBI-HSS (Appendix C) was also included in the survey. The MBI-HSS comprises a 22-item survey and asses three dimensions or scales of burnout: Emotional exhaustion, depersonalisation, and a reduced sense of personal accomplishment. Each of the items is in the form of a seven-point Likert scale, starting from never (0), few times a year or less (1), once a month or less (2), a few times per month (3), once per week (4), a few times per week (5), to every day (6; Maslach et al., 1996).

The scoring guidelines provided by Maslach et al. (1996; see Table 6) were used to establish the presence and severity of burnout symptoms for each of the MBI subscales. According to the recommendation of Maslach et al. (2016), scores in each burnout domain (emotional exhaustion, depersonalisation, and reduced personal accomplishment) were interpreted separately as no similar scoring guidelines are available for the total burnout score. MBI subscale scores can be categorised as being either low, moderate, or high. For the emotional exhaustion and depersonalisation subscales, higher scores in these domains are indicative of higher levels of burnout, while low scores on the reduced personal accomplishment subscale are associated with high levels of burnout (Maslach et al., 2016).

Table 6: Classification of burnout according to the MBI

MBI subscale	Low scores	Moderate scores	High scores
Emotional exhaustion	≤18	19-26	≥27
Depersonalisation	≤5	6-9	≥10
Reduced personal accomplishment	≥40	39-34	≤33

Source: Maslach, C., Jackson, S.E., & Leiter, M.P. (1996). *Maslach Burnout Inventory Manual, General Survey, Human Services Survey, Educators Survey and Scoring Guides*. Mind Garden.

The MBI is said to be the most validated assessment available to measure burnout in numerous parts of the world (Van der Walt et al., 2015). According to Maslach et al. (1996), the MBI also showed adequate reliability (Cronbach's alpha of 0.71 to 0.90). Regarding its subscales, the following Cronbach's alpha estimates were found: 0.79 for depersonalisation, 0.90 for exhaustion, and 0.71 for reduced personal accomplishment, indicating good internal reliability (Maslach et al., 2016). Although the MBI was initially developed in the USA for English-fluent individuals (Demerouti et al., 2003), its three-dimensional framework has received tremendous support for its validity and reliability in different countries and languages across a wide range of occupations (Gold et al., 1989; Green & Walkey, 1988; Green et al., 1991; Leiter & Schaufeli, 1996; Pierce & Molloy, 1989; Schutte et al., 2000).

When considering the South African perspective, Rothmann (2003) found the MBI to be a reliable and valid burnout measure in a sample of South African university staff. Further support for the MBI's validity and reliability among South African samples was also provided by numerous additional studies (Jackson & Rothmann, 2005; Rothmann & Barkhuizen, 2008; Storm & Rothmann, 2003). The cross-cultural applicability of the MBI has been validated in South African research studies in terms of differences among several race (Storm & Rothmann, 2003) and language groups (Jackson & Rothmann, 2005).

3.5.4 Beck Depression Inventory- Second Edition (BDI-II)

The BDI-II (Appendix D; Beck et al., 1996) is a self-report instrument consisting of 21 items. It is regarded as one of the most widely used measures of depressive symptoms, experienced over the previous two weeks (Huang & Chen, 2014; Wang & Gorenstein, 2013). This instrument assesses a cluster of depressive symptoms covering affective, somatic, and cognitive aspects of depression, designed in accordance with the depressive episode criteria documented in the DSM-IV (APA, 1994; Beck & Beamesderfer, 1974). Performance on the BDI-II is scored by summing the responses of all 21 items, each based on a four-point rating scale extending from zero to three. Instead of using vague response choices like ‘often’ or ‘sometimes’, the BDI-II utilises highly specific answer options for each item. It assigns higher point values to statements that indicate more severe depressive symptoms. For instance, when measuring suicidal ideation, the point system works as follows: “0= I don’t have any thoughts of killing myself, 1= I have thoughts of killing myself, but I would not carry them out, 2= I would like to kill myself, and 3= I would kill myself if I had the chance” (Williams et al., 2020, p. 8).

The BDI final score ranges from zero to 63, with scores of 0-13 indicating a minimal range of depression, scores ranging between 14-19 are regarded as mild, 20-28 are considered moderate with scores of 29-63 pointing to severe depression (Beck et al., 1996). Based on these guidelines, the sample was divided into different depressive severity groups, including those belonging to the severe, moderate, mild, and minimal depressive symptom groups. This information was then used to compare the burnout scores obtained from the MBI and BAT across these four depressive groups. In addition, accumulated research has shown that depression is best conceived as a dimensional disorder and only those presenting with symptoms at the upper end of this dimension are suited for a clinical diagnosis of depression (Bianchi et al., 2021;

Haslam et al., 2012). Thus, for this study, participants scoring in the severe range of the BDI were considered provisionally depressed.

The BDI-II was proven to be valid and reliable in the general population and among participants from medical or psychiatric backgrounds (Wang & Gorenstein, 2013). Furthermore, the BDI-II has undergone translation from English into numerous languages, including Asian languages (such as Chinese and Japanese), European languages (such as Spanish, German, and French), and African languages (such as Xhosa; Huang & Chen, 2014; Wang & Gorenstein, 2013). This extensive translation effort has significantly contributed to validating its applicability across a diverse array of countries, cultures, and sample profiles, including those from South Africa.

3.6 Research procedure

The link to the study survey containing the demographic questionnaire, the BAT, the MBI, and the BDI was included in the study invitation and emailed to volunteering participants, which was completed anonymously on electronic devices of their choice (e.g., smartphone, iPad, computer, or laptop). A licence to reproduce the MBI survey was purchased once ethical clearance was obtained. The BAT and BDI-II were acquired from freely available internet sources. The study survey was sent to prospective participants on 23 August 2023. The participants were not given a specific time window to complete the survey, thereby allowing them to complete it at a convenient time. However, data collection ended on 31 October 2023 and only those respondents who completed the survey before this time were included.

All survey questionnaires were preceded by an introductory section explaining the purpose of the questionnaires, what they measure, the questionnaire procedure, and clear instructions about how to answer the questions. In addition, participants were also provided with a digitally based information sheet and asked to provide informed consent before the commencement of any data collection activities (see Appendix E). Immediate discontinuation of the survey took place in the event any participant failed to give informed consent. The subsequent administration and item order of the BAT, MBI, and BDI-II was based on published instructions (Beck et al., 1996; Maslach et al., 1996; Schaufeli et al., 2020b) for all participants to avoid order effects and reduce response bias. Participants were allowed to leave certain questions blank if they chose to do so. However, due to the necessity of certain information for the study, all questions on the core symptoms of the BAT, as well as certain demographic data, including gender, age, medical history, and medication use were programmed as required items. Thus, participants could only proceed with the survey once these required fields were completed. The questionnaires were expected to take less than 60 minutes to complete after which participants were thanked for participating. All of the above was hosted and disseminated electronically on the RedCap online platform.

3.7 Data management

From the RedCap platform, participant data were coded using a unique ID for each participant and exported into a password-protected Microsoft Excel spreadsheet. From there, all test scores for the BAT, MBI, and BDI-II were calculated according to the instructions in the relevant manuals. For the BAT, BDI-II, and MBI subscales, measurement scores were summed to obtain total burnout and depressive scores. For the calculation of the overall MBI score, scores on the emotional exhaustion and depersonalisation scales were summed and added to the reverse score of the personal accomplishment subscale. Next, all data were checked for errors and missing values, cleaned, and then imported into the Statistical Package for the Social Sciences (SPSS) version 27 (IBM, 2021).

A total of 73 academic staff responded to the survey, of which 18 were blank responses (no data was recorded for any of the included questionnaires). The remaining 55 entries were considered for further analysis. Among these participants, missing data were identified for job title (n=1), relationship status (n=1), living circumstances (n=1), home language (n=2), BAT (n=3), MBI-emotional exhaustion (n=8), MBI-depersonalisation (n=7), MBI-personal accomplishment (n=8), and BDI (n=12). As the demographic data were used for descriptive purposes only, the missing values were simply omitted from the analysis. Due to the central role of the BAT score in determining levels of burnout in the study, participants with missing values in this case were excluded from further analysis. Missing data relating to MBI and BDI measures were dealt with according to the pairwise deletion technique in SPSS. Following appropriate data preparation and organisation, both descriptive and inferential statistics were used to address the research aims.

3.8 Statistical data analysis

All data were analysed using SPSS version 27 (IBM, 2021). As a first step, descriptive statistics were employed to describe the general demographic, burnout, and depressive characteristics of the study sample. Continuous demographic data (i.e., age) were summarised as measures of central tendency and variability (mean, standard deviation, and range) whereas categorical demographic data (gender, race, home language, job title, and education) were analysed using frequencies and percentages. Regarding the BAT, MBI, and BDI data, all total scores as well as subscale scores of the BAT and MBI were similarly summarised as measures of central tendency and variability.

To address the aim of comparing BAT and MBI scores on a categorical level, the overlap of each MBI subscale with the overall BAT score was investigated using percentage calculations. That is, participants who reported both high scores on MBI subscales and total BAT-burnout scores. To investigate the symptomatic overlap of depression and burnout, the percentage of participants identified as experiencing high BAT-burnout levels while also falling into the severe depressive category was calculated. Similar calculations were performed for the MBI's emotional exhaustion subscale scores. To address the next aim, relating to depressive group comparisons based on burnout scores, the sample was divided into different depressive severity groups, including those belonging to the severe, moderate, mild, and minimal depressive symptom groups. The mean, range, and standard deviation of BAT and MBI scores were then calculated for each category of depression severity (minimal, mild, moderate, and severe). Thereafter, visual inspection and comparison of burnout scores across different depressive groups were performed.

In terms of inferential statistics, correlational analysis was performed to address the remaining aims of the study. The significance of the relationships of interests was drawn from the output gained from SPSS. The significance level for all statistical tests was set at $p<0.05$. The strength of observed correlations was interpreted according to the guidelines outlined by Schober et al. (2018; see Appendix F) that describe correlations obtained from different statistical tests as being negligible, weak, moderate, strong, or very strong. Regarding the direction of correlations, relationships among the study's variables were also described as being either positive or negative.

To choose an appropriate statistical test, all parametric assumptions linked to Pearson's correlational analysis were tested, including the assumptions of normality, interval or ratio scale of measurement, linearity, no significant outliers, and homogeneity of variance. Although the first two assumptions were met in the present study, violations of the latter three were found. Thus, it was decided that non-parametric analysis was more appropriate for the current sample. More specifically, Kendall's tau test was used as it was previously recommended that this test is superior to Spearman's coefficient when dealing with a small data set (Field, 2018). In addition, while Spearman's statistic is the one more widely used among the two coefficients, research showed that Kendall's statistic provides a more accurate estimate of the correlation in the population (Field, 2018). As such, more accurate generalisations from Kendall's statistics, compared to Spearman's, can be drawn.

However, the parametric equivalent of Kendall's statistic was also run, namely Pearson's correlation coefficient, and included for further reference and to confirm whether or not the obtained results were significant using a more rigorous test. The significance and magnitude of the observed correlations between the variables under study proved to be comparable between the tests and Kendall's test was thus used in the reporting of results. All psychometric results were displayed in tables and organised into appropriate graphs and charts to assist readers in their understanding of and ability to use the results of the study. Accompanying the tabulated and graphically displayed results, a descriptive summary provided details of how the results link with the study's aims and hypotheses.

3.9 Ethical considerations

As mentioned previously, this study was embedded within a larger study that investigated the effectiveness of neurofeedback as an intervention for academic staff with high burnout. Ethics approval was obtained by the Human Research Ethics

Committee (Medical; see Appendix G), in which this study was included. The study involved human participants, and as such, ethical considerations were essential to ensure the safety and well-being of the participants. Overall, this study was conducted in a manner that respected the rights and welfare of the participants and adhered to the Code of Ethics for Research on Human Subjects of Wits, which subscribes to the Ethics in Health Research Document (2015). The principal investigator has also completed relevant ethics training as evidenced by the ethical training certificate attached as Appendix H. Specifically, the following ethical considerations were addressed:

Informed consent: Participants received a study information sheet and were asked to provide informed consent before participating. The information sheet provided the appropriate information to ensure participants were informed of the purpose and nature of the study, what was asked of them, how the data would be used, and the potential risks or harms. Participants were also informed that study participation is voluntary; they can withdraw from the study at any point without any consequences, their data will be erased whenever such a request is made, and they have the right to access their data. Participants were allowed to ask questions and given time to consider their participation before consenting.

Confidentiality and anonymity: All participant data was kept confidential and anonymous. Although the study survey asked for participants' email addresses, which can be considered identifiable information, all data was collected and stored with a unique ID code. The participants will also remain anonymous in any reports or publications resulting from the study. Confidentiality was maintained by ensuring that all participant data were only accessible by authorised research team members and stored on a secure, password-protected cloud folder hosted on OneDrive. Participants were informed of the measures taken to ensure anonymity and confidentiality, the limits to confidentiality, and the specific circumstances that will require the investigator to report observed or spoken information to an appropriate authority.

Risk and benefits: Participants were informed of any potential risks associated with the study, and appropriate measures were put in place to minimise any harm that may have arisen. The contact details of Dr Aline Ferreira-Correia, a Clinical Psychologist in the Department of Psychology, Wits were to be provided upon recognition of any distress. Fortunately, no participant reported any distress during the course of data collection. Furthermore, the participants did not receive immediate benefits or compensation due to participation in the study but did not suffer any costs either.

Debriefing: At the end of data collection, participants received the opportunity to ask any questions or voice any concerns that they may have had. The participants were also encouraged to contact the researchers if they had questions or concerns linked to the research project at a later stage. The participants were also informed that a summary of the results and conclusions of the study would be shared with them on request. For this purpose, the contact details of the researchers were provided in the information sheet. However, individual feedback on performance was not available as the collected data was anonymous. Participants were also informed that they could contact the Ethics committee if there were ethical concerns with the research.

Knowledge dissemination and publications: The results of the study were written up as a master's dissertation for degree purposes. The results may also be disseminated through publications and conference papers. Finally, the data from the current study will be incorporated into a subsequent study that will aim to determine the effect of neurofeedback on burnout-related symptoms in tertiary-level educators.

3.10 Conclusion

This chapter outlined the research methodology employed for the psychometric component of this study. A descriptive, exploratory, cross-sectional, quantitative research design was deemed most appropriate for the present study according to the predefined aims and research questions. The participants were selected through a convenient and snowball sampling method and recruited with the assistance of the University Registrar and HR representative of each Faculty. The measurement instruments consisted of four questionnaires. These measures provided quantitative data analysed with the use of both descriptive and inferential statistics (correlational analysis) through SPSS. This chapter also included a discussion of the research procedure employed in this study, including a description of how psychometric data was collected. The chapter then concluded with a description of the ethical considerations that have guided the study. The next chapter presents the results of the statistical analyses undertaken to investigate the psychometric aims of the study.

CHAPTER 4: PSYCHOMETRIC RESULTS

4.1 Introduction

Chapter 4 is organised around the psychometric research aims of the study and reports on the results in terms of descriptive and inferential data analysis. Specifically, in this first results chapter, the psychometric data are described, starting with a description of the demographic profile of the sample. Next, the descriptive statistics derived from the BAT, MBI, and BDI measures are discussed in terms of measures of central tendency, followed by MBI-BAT comparisons, and lastly, burnout-depression comparisons. Finally, the inferential statistics will be discussed, which includes the results of a correlational analysis of the burnout and depressive variables of interest.

4.2 Demographic profile of the sample

As outlined in the methods section, the total sample size for the psychometric analysis was 55. The average age of the participants was 42.69 years (SD = 10.55; range: 28-68 years). A summary of the remaining demographic variables explored in the study is depicted in Table 7 (displaying information on the study sample in terms of self-identified gender, education, job title, relationship status, living circumstances, self-identified race, and home language).

Table 7: Demographic characteristics of the total sample

Variables	N	%
Self-identified Gender		
Male	16	29.09
Female	37	67.27
Prefer not to say	2	3.64
Self-identified Race		
Black	8	14.55
White	38	69.09
Coloured	4	7.27
Indian	4	7.27
*Other**	1	1.82

Home language		
English	37	67.27
Afrikaans	9	16.36
IsiXhosa	2	3.64
Setswana	1	1.82
Both English and Afrikaans	1	1.82
German	1	1.82
Sotho	1	1.82
Italian	1	1.82
Missing value	2	3.64
Education		
Master's degree	20	36.36
PhD	35	63.64
Job title		
Associate Professor	8	14.55
Professor	4	7.27
Postdoctoral fellow	4	7.27
Lecturer	25	45.45
Senior lecturer	13	23.64
Missing value	1	1.82
Relationship		
Yes	43	78.18
No	11	20
Missing value	1	1.82
Living circumstances		
Alone	7	12.73
With a partner only	24	43.64
With a partner and children	16	29.09
With children only	4	7.27
With immediate family	3	5.45
Missing value	1	1.82

** Only one participant responded with the option of 'other' and specified that they consider their race as human.*

The majority of participants identified as female (67.27%) and reported a PhD level of education (63.64%). Almost half of the sample reported the job title lecturer (45.45%). Most participants also indicated that they are in a relationship (78.18%) with most either living with a partner only (43.64%) or with a partner and children (29.09%). Regarding self-identified race and home language, most participants (69.09%) identified as White and more than half of the participants reported English as their home language (67.27%). Therefore, the overall sample represented a relatively homogenous group of academic staff with most being English-speaking, White, and female academics.

4.3 Distribution of burnout scores

Among the total sample of 55 participants, 52 completed the BAT, 48 completed the MBI emotional exhaustion and personal accomplishment subscales, and 49 completed the MBI depersonalisation subscale. Due to the missing values for the different MBI components, average MBI scores could only be calculated for 47 participants. Based on these sample sizes, measures of central tendency were calculated for both the BAT and MBI scores, as outlined in the next sections.

4.3.1 BAT scores

Table 8 shows the general descriptive statistics of the BAT-burnout variables utilised in this study, including an overview of the minimum, maximum, mean and standard deviation of the average BAT and subscales scores.

Table 8: Distribution of average BAT scores

	N	Minimum	Maximum	Mean	SD
BAT total	52	1.00	4.57	2.89	0.67
BAT E	52	1.00	4.88	3.28	0.79
BAT M	52	1.00	5.00	2.57	0.91
BAT EM	52	1.00	4.00	2.61	0.69
BAT C	52	1.00	4.60	2.87	0.76

BAT E: Exhaustion subscale; BAT M: Mental distance subscale; BAT C: Cognitive impairment subscale; BAT EM: Emotional impairment subscale

The average BAT score of the participants was 2.89 (SD = 0.67; range: 1.00-4.57), indicating that participants experienced burnout symptoms rarely to sometimes. A score of 2.89 is also above the cut-off for burnout as it falls in the category of high burnout risk, a positive indicator for burnout. Regarding BAT subscales, an average exhaustion score of 3.28 (SD = 0.67; range: 1.00-4.57) translates to the experience of exhaustion between sometimes and often among the sample. In terms of the remaining components of the BAT, participants reported experiencing mental distance (mean= 2.57; SD= 0.91), emotional impairment (mean= 2.61; SD= 0.69), and cognitive impairment (mean= 2.87; SD= 0.76) between the frequencies of rarely and sometimes. According to relevant cut-off scores, all subscale scores of the study sample can be regarded as high risk and thus above the cut-off for burnout.

4.3.2 MBI scores

Table 9 displays the descriptive statistics calculated for the MBI variables utilised in this study.

Table 9: Distribution of average MBI scores

	N	Minimum	Maximum	Mean	SD
MBI total	47	0.00	4.59	2.34	1.04
MBI EE	48	0.00	52.00	26.71	12.78
MBI DP	49	0.00	20.00	6.71	5.40
MBI PA	48	14.00	48.00	30.00	8.39

MBI EE: Emotional exhaustion subscale; MBI DP: Depersonalisation subscale; MBI PA: Personal accomplishment subscale

Categorisation of the global MBI score is generally not available, as mentioned in the previous chapter. Interpretation of MBI scores will thus only focus on each subscale separately. The participants reported moderate levels of emotional exhaustion on average (mean= 26.71; SD= 12.78). Similar moderate levels of depersonalisation were reported (mean= 6.71; SD= 5.40). Therefore, the participants experienced moderate levels of burnout in the context of these two dimensions and thus below the cut-off for burnout. Personal accomplishment showed an average score of 30 (SD= 8.39), which is below the cut-off for burnout and indicative of high personal accomplishment and thus low levels of burnout in terms of this dimension. Thus, the moderate and low levels of burnout among our sample as indicated by the MBI contrast sharply with the high levels of burnout among our sample as determined by the BAT. Differences in burnout levels are thus evident with the use of different burnout measures.

4.4 Distribution of depressive scores

Among the total sample of 55 participants, 44 completed the BDI. On average, the participants scored mild on depression (mean= 15.07; SD= 10.34; range: 0-45). Thus, the sample scored below the cut-off for a provisional diagnosis of depression. Having described the basic demographic and descriptive data of burnout and depression among the sample, this chapter now turns toward consideration of the specific research questions outlined in the context of psychometric data.

4.5 Categorical BAT and MBI comparisons

Using descriptive statistics, this section serves to address the categorical part of the following research question: What is the relationship, at both dimensional and categorical levels, between MBI- and- BAT-measured burnout? Among the participants who scored very high on the BAT (n=14), 12 of those also completed the MBI's emotional exhaustion subscale. Of these, 11 also scored high on this measure while one participant scored moderate, reflecting a significant overlap of BAT and emotional exhaustion scores. Thus, our initial hypothesis on the BAT-MBI emotional exhaustion overlap was confirmed. Among the participants who scored high on the BAT (n=27), 25 of those also completed the measure of emotional exhaustion. Of these, 13 also received high emotional exhaustion scores, nine scored moderate, and three scored low. Thus, 52% of participants with high BAT scores also showed high emotional exhaustion scores, evidence of a lower symptomatic overlap in this regard.

Among the participants who scored very high on the BAT (n=14), 13 of those also completed the depersonalisation measure. Of these, seven also scored high on depersonalisation, four scored moderate, and two scored low. The 53.85% of participants thus scoring very high on the BAT while also scoring high on depersonalisation reflect a more modest overlap in comparison with the observed overlap described for emotional exhaustion. Among the participants who scored high on the BAT (n=27), 25 of those also completed the depersonalisation measure. Of these, five scored high, seven scored moderate, and 13 scored low. Thus, 20% of participants with high BAT scores also scored high on depersonalisation, representing a weak symptomatic overlap that is also lower than what was found for the BAT-emotional exhaustion relationship. Of note, due to content overlap, a larger depersonalisation-BAT overlap was expected.

Among the participants who scored very high on the BAT (n=14), 13 of those also completed the personal accomplishment measure. Of these, 12 scored high on personal accomplishment while one participant scored moderately on this measure. Among the participants who scored high on the BAT (n=27), 24 of those also completed the personal accomplishment measure. Of these, 17 scored high, six scored moderate, and only one participant scored low. Interestingly, according to Maslach et al. (2001), it is expected that individuals with high levels of burnout will report comparable low levels of personal accomplishment, which was clearly not the case for the present sample. However, considering the absence of any elements associated with personal accomplishment in the BAT, this minimal symptomatic overlap between these two variables was an anticipated finding.

4.6 Categorical burnout and depression comparisons

Also employing descriptive statistics, this section aimed to address the following research question: What does categorical analysis show regarding the percentages of individuals suffering from both burnout and depression? Among the participants who scored very high on the BAT (n=14), 11 of those also completed the BDI. Of these, four also indicated severe depression, two scored moderate, four scored mild and one participant scored in the minimal range. In other words, a total of 36.36% of participants with very high burnout levels also met the diagnostic criteria for a provisional diagnosis of depression. Among the participants who scored high on the BAT (n=27), 23 of those also completed the BDI. Of these, only one participant indicated severe depression, seven scored moderate, four scored mild, and 11 scored in the minimal range. Thus, only 4.35% of participants with high burnout scores can also be regarded as clinically depressed. In contrast, the one participant who scored low on the BAT also scored in the minimal range for depression. Among the 10 participants who scored average on the BAT, nine completed the BDI with all scoring in the minimal range for depression.

Considering the centrality of the emotional exhaustion component of the MBI (Maslach et al., 2016), it is also worth examining the depression-burnout overlap in this context. Among the 24 participants who scored high on emotional exhaustion, 22 also completed the BDI. Five of them scored in the severe range, six scored moderate, five scored mild, and six scored in the minimal range. Thus, 22.73% of participants who scored high on emotional exhaustion met the diagnostic criteria for a provisional diagnosis of depression.

Therefore, the highest percentage of symptomatic overlap between burnout and depression was observed for those scoring very high on the BAT. Importantly, this 36.36% overlap still seems lower than what would be expected if the two conditions represented the same underlying syndrome. Due to the similarities in the description of the symptomatic profiles of burnout and depression, a larger percentage of symptomatic overlap was anticipated, which was not demonstrated among this sample.

4.7 Burnout scores of different depressive groups

This section serves to address the following research question: How do the BAT and MBI scores compare among academic staff with different levels of depression severity? Based on BDI-II scores, the sample was divided into different depressive severity groups, including those belonging to the severe, moderate, mild, and minimal depressive symptom groups. Therefore, further analysis of the depression-burnout overlap can be seen in Tables 10 and 11 which report the mean BAT and MBI scores found among participants contained in these four depressive groups.

Table 10: Average BAT scores of different depressive groups

	N	**Range**	**Mean**	**SD**
Severe	5	3.17-4.26	3.63	0.43
Moderate	9	2.57-3.57	3.10	0.29

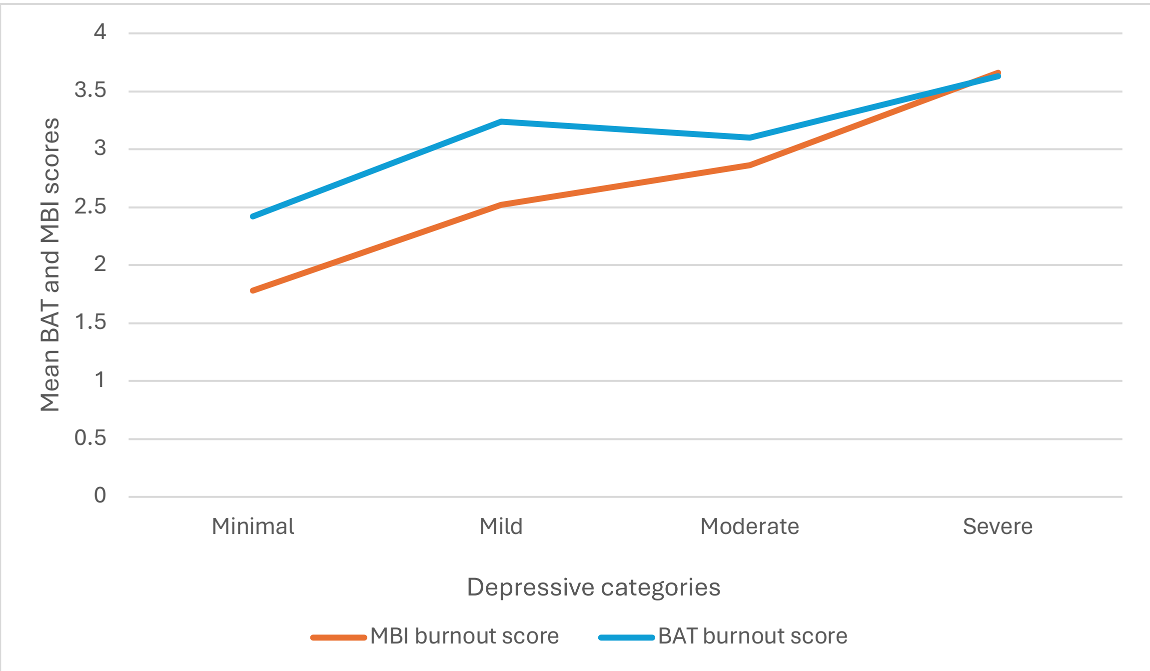
	N	Range	Mean	SD
Mild	18	2.57-3.74	3.24	0.46
Minimal	22	1.00-3.39	2.42	0.56

Table 11: Average MBI scores of different depressive groups

	N	Range	Mean	SD
Severe	5	2.36-4.59	3.66	0.82
Moderate	9	1.64-4.05	2.86	0.70
Mild	8	1.64-3.82	2.52	0.72
Minimal	22	0.00-3.14	1.78	0.89

A review of Tables 10 and 11 shows that burnout scores displayed a stepwise increase in mean from minimal to severe depression in the case of the MBI. This trend was also generally shown for the BAT, although the mean BAT score of the mild depressive group was slightly higher but essentially equivalent compared to the moderate group. Nevertheless, similar to MBI findings, a general increase in BAT scores is observed as one moves from the minimal to severe depressive categories (Figure 3). Therefore, our initial hypothesis regarding the relationship between MBI scores, as well as BAT scores, to the severity of depression was validated.

Figure 3: Line graph plotting mean burnout scores against four categories of depression severity



4.8 Inferential statistics

The next section of data analysis relies on inferential statistics to address the following three research questions: (1) What is the relationship, at both dimensional and categorical levels, between MBI- and- BAT-measured burnout?; (2) What is the relationship between both MBI- and- BAT-measured burnout (including subscale dimensions) and depression?; and (3) How does controlling for content overlap between measures of burnout and depression affect the correlation between both MBI- and- BAT-measured burnout and depression? According to these research questions, Pearson (*r*) and Kendall's tau-b (τb) correlation coefficients were calculated for all variables of interest. Kendall's τb is a nonparametric equivalent to Pearson correlational analysis. Thus, when a particular dataset fails one or more assumptions of Pearson's *r*, a nonparametric alternative should be run instead. The following section briefly describes the testing of assumptions performed to determine which correlational test was most appropriate for the present study.

4.8.1 Testing assumptions

For Pearson's correlation coefficient to be valid, the following parametric assumptions needed to be satisfied: Interval or ratio scale of measurement (i.e., continuous data), linearity, no significant outliers, normal distribution, and homogeneity of variance. Firstly, the assumption of continuous data was consistent with all the relevant variables in this study, as they were derived from several psychometric tests and captured as interval or ratio data. Secondly, to ascertain whether the data met the requirement of normal distribution, various methods were used, including interpretation of the Kolmogorov-Smirnov test and visual examination of normal PP plots. From these illustrations, it was determined that the dataset was approximately normally distributed (for the results of all analyses related to testing of assumptions see Appendix I).

Thirdly, it was necessary to determine whether a linear relationship between the investigated variables exists. To this end, scatterplots for all variables were created followed by a visual examination to determine approximate linearity. It was found that both the BAT-BDI as well as the MBI-BDI relationships violated this assumption. Fourthly, in terms of outliers, the output gained from SPSS indicated several outliers among different variables, which also means that another parametric assumption was violated in this dataset. Finally, for homogeneity of variance, violation of this assumption was also identified among the datasets.

In sum, although the assumptions of normality and interval or ratio (continuous) data were met, violations of linearity, outliers, and homogeneity of variance were encountered. Thus, the non-parametric Kendall's test was deemed most appropriate for this study. However, the parametric equivalent, Pearson's *r*, was also run and the results are included for further reference and to confirm whether the obtained results were significant using a more rigorous test (Appendix J).

4.8.2 Correlational analysis

Having ascertained the parametric nature of the data, the research questions are addressed in order using the relevant statistical analyses. The results of Kendall's τb correlations calculated between all the key variables in the investigation are presented in the table below (see Table 12). In addition, as mentioned, a confirmatory check for parametric analysis was also performed and a similar pattern of results was found regarding the significance and magnitude of observed correlations (see Appendix J). Thus, the subsequent sections will report on Kendall's test only. When considering these results, it is important to remind the reader of the relevant sample sizes for the different variables. Total BAT scores as well as all subscale scores had a sample size of 52, MBI scores had a sample size of 47, and sample sizes of 49 (depersonalisation) and 48 (emotional exhaustion and personal accomplishment) were applied to the MBI subscales. The BDI scores had a sample size of 44.

Table 12: Kendall's correlational analysis of BAT, MBI, and BDI scores

	BAT E	BAT M	BAT EM	BAT C	MBI	MBI EE	MBI DP	MBI PA	BDI	BDI A1	BDI A2
BAT	.72** (.62, .80)	.72** (.62, .80)	.57** (.43, 68)	.58** (.44, 69)	.64** (.51, 75)	.61** (.47, 72)	.47** (.30, 61)	-.49** (-.62, -.33)	.61** (.47, .73)	.59** (.44, .70)	.56** (.41, .69)
BAT E	1.00	.50** (.35, .63)	.38** (.21, .53)	.45** (.29, .59)	.52** (.36, .65)	.59** (.45, .71)	.33** (.15, .49)	-.38** (-.53, -.20)	.54** (.38, .67)	.48** (.31, .62)	.46** (.29, .61)
BAT M		1.00	.45** (.29, .59)	.47** (.31, .60)	.65** (.53, .75)	.57** (.42, .69)	.53** (.37, .65)	-.48** (-.61, -.31)	.50** (.34, .64)	.50** (.34, .64)	.49** (.33, .63)
BAT EM			1.00	.29** (.11, .45)	.40** (.22, .55)	.36** (.17, .51)	.33** (.15, .49)	-.36** (-.52, -.18)	.50** (.34, .64)	.50** (.34, .64)	.50** (.34, .64)
BAT C				1.00	.39** (.21, .54)	.41** (.23, .56)	.35** (.17, .50)	-.28** (-.45, -.09)	.45** (.28, .60)	.42** (.24, .57)	.39** (.21, .55)
MBI					1.00	.81** (.73, .87)	.59** (.45, .71)	-.64** (-.74, -.50)	.57** (.41, .69)	.57** (.41, .69)	.56** (.39, .68)
MBI EE						1.00	.53** (.37, .65)	-.45** (-.59, -.28)	.51** (.35, .65)	.49** (.33, .63)	.49** (.32, .63)
MBI DP							1.00	-.30** (-.47, -.11)	.39** (.20, .55)	.41** (.23, .56)	.41** (.23, .56)
MBI PA								1.00	-.49** (-.63, -.32)	-.48** (-.62, -.31)	-.47** (-.61, -.29)
BDI									1.00	.97** (.95, .98)	.95** (.92, .96)
BDI A1										1.00	.98** (.97, .99)

***. Correlation is significant at the 0.01 level (2-tailed).*

✓95% CIs reported in brackets.

BDI A1 (BDI Adjusted 1): BDI variable where fatigue and energy-related items were excluded; BDI A2 (BDI Adjusted 2): BDI variable the cognitive-related item was excluded; E: Exhaustion; M: Mental distance; C: Cognitive impairment; EM: Emotional impairment; EE: Emotional exhaustion; DP: Depersonalisation; PA: Personal accomplishment.

From the information presented in Table 12, all correlations are marked as being significant at the 0.01 level (2-tailed). This Table also illustrates that all significant correlations were positive, except those relating to the personal accomplishment subscale of the MBI (a lower score in this domain indicates higher burnout levels) for which negative correlations were found for its relationship with all other variables of interest. Regarding specific results, the following sections serve to address the research questions in order.

4.8.2.1 Correlational analysis of BAT and MBI scores

This section addresses the dimensional aspect of the following research question: What is the relationship, at both dimensional and categorical levels, between MBI-and- BAT-measured burnout? Total BAT scores showed a strong, positive correlation with total MBI scores ($\tau = 0.64$, 95% CI [0.51, 0.75], $p < 0.001$), indicating that higher BAT scores were significantly related to higher MBI scores. This finding was in line with the study's hypothesis as it related to the proposed relationship between these measures. A strong, positive correlation was also found between total BAT scores and the emotional exhaustion subscale of the MBI ($\tau = 0.61$, 95% CI [0.47, 0.72], $p < 0.001$) while a moderate positive correlation was found between total BAT scores and the MBI's depersonalisation subscale ($\tau = 0.47$, 95% CI [0.30, 0.61], $p < 0.001$). Regarding personal accomplishment of the MBI, a strong, negative correlation was found between global BAT scores and this variable ($\tau = -0.49$, 95% CI [-0.62, -0.33], $p < 0.001$). These findings mostly align with the study's hypotheses, although the slightly stronger BAT-personal accomplishment relationship compared to the BAT-depersonalisation relationship, was an unexpected finding. It was rather expected that the latter correlation would be stronger due to content similarity compared to the BAT's lack of any elements associated with personal accomplishment. Thus, the strong relationship between these variables found in the present study points to a divergence from previous research.

Additionally, as hypothesised, the exhaustion and mental distance subscales of the BAT showed strong, positive correlations with the global MBI score ($\tau = 0.52$, 95% CI [0.36, 0.65], $p < 0.001$ for exhaustion-MBI and $\tau = 0.65$, 95% CI [0.53, 0.75], $p < 0.001$ for mental distance-MBI). However, the BAT's cognitive and emotional impairment subscales showed weaker correlations with the MBI, which was found to be in the moderate range ($\tau = 0.40$, 95% CI [0.22, 0.55], $p < 0.001$ for emotional impairment-MBI and $\tau = 0.39$, 95% CI [0.21, 0.54], $p < 0.001$ for cognitive impairment-MBI). This finding was also an expected result due to the lack of consideration of emotional and cognitive impairment in the MBI.

4.8.2.2 Correlational analysis of burnout and depressive scores

The next research question was: What is the relationship between both MBI- and-BAT-measured burnout (including subscale dimensions) and depression? When investigating the depression-burnout overlap in the context of the BAT, it was found that total burnout scores showed a strong, positive association with BDI-measured depression (τ = 0.61, 95% CI [0. 47, 0.73], $p < 0.001$). This strong, positive correlation with depression was also demonstrated for the exhaustion (τ = 0.54, 95% CI [0.38, 0.67], $p < 0.001$), mental distance (τ = 0.50, 95% CI [0.34, 0.64)], $p < 0.001$), and emotional impairment subscales (τ = 0.50, 95% CI [0. 34, 0.64], $p < 0.001$). The cognitive impairment subscale also showed a significant positive correlation with depression, although this was moderate in strength (τ = 0.45, 95% CI [0.28, 0.60], $p < 0.001$).

The MBI also showed a strong, positive correlation with depression, which was slightly lower than the observed correlation for the BAT and depression (τ = 0.57, 95% CI [0.41, 0.69], $p < 0.001$). Regarding the subscales of the MBI, emotional exhaustion and personal accomplishment showed strong correlations with depression with the former being positive (τ = 0.51, 95% CI [0.35, 0.65], $p < 0.001$) and the latter negative (τ = -0.49, 95% CI [-0.63, -0.32], $p < 0.001$). The correlation between depersonalisation and depression was regarded as moderate (τ = 0.39, 95% CI [0.20, 0.55], $p < 0.001$). It was hypothesised that burnout, as measured by the MBI and BAT, will lack sufficient discriminant validity versus depression on a dimensional level, which was confirmed in our study. An increase in perceived burnout as measured by the MBI and BAT as well as an increase in all its subscales correlated significantly (and strongly in most cases) with an increase in depressive scores.

The next research question of the study was: How does controlling for content overlap between measures of burnout and depression affect the correlation between both MBI-and- BAT-measured burnout and depression? As was done in previous studies on the topic (Bianchi, 2020; Bianchi et al., 2021; Schonfeld & Bianchi, 2022; Schonfeld et al., 2019a), fatigue and loss of energy-related items were removed from the BDI after which correlational analysis was again performed for the adapted depression variable. In addition, considering the overlap between the BAT's cognitive impairment scale and item number 19 of the BDI (also referring to cognitive difficulties), the relationship between BAT and depressive scores was further examined when this item was also excluded from the BDI. The results showed that the correlation between the total MBI and the adjusted BDI scores (where fatigue and loss of energy-related items were removed) remained unchanged (both correlations were found to equal 0.57), endorsing the study's hypothesis on this aspect.

In terms of the BAT, it was found that controlling for fatigue-related items lowered the magnitude of the burnout-depression relationship slightly ($\tau = 0.59$, 95% CI [0.44, 0.70], $p < 0.001$) while also controlling for cognitive item overlap lowered the coefficient even further ($\tau = 0.56$, 95% CI [0.41, 0.69], $p < 0.001$). Although smaller effect sizes were found when controlling for content overlap, indicating at least partial inflation of the burnout-depression relationship due to content overlap, the final correlation was still strong, significant, and positive. Thus, item-level content overlap is not sufficient to explain the strong correlation found between burnout and depression, representing a novel finding.

4.9 Conclusion

This psychometric results chapter presented the descriptive and inferential statistical results of the first five research questions. In terms of the MBI-BAT relationship, categorical analysis showed a large emotional exhaustion-BAT overlap while the overlap between the BAT and the remaining two components of MBI-measured burnout was considerably lower. On a dimensional level, these two measures correlated strongly and significantly. Regarding the burnout-depression relationship, the categorical analysis revealed a lower percentage overlap than what would be expected if the two conditions represented the same underlying syndrome. However, it was also illustrated that as depressive symptom severity increased, so did burnout scores in a relatively linear manner. In addition, the outcome of correlational analysis revealed a significant and strong relationship between measures of burnout and depression. The idea that these strong correlations were due to content overlap was rejected. The next chapter describes the research methodology employed for the electrophysiological component of this dissertation.

CHAPTER 5: QEEG METHODOLOGY

5.1 Introduction

This chapter includes a discussion of the research methodology employed for to the qEEG component of the present study. It starts by highlighting the research design chosen, followed by an outline of the process that led to the selection of the study sample. Next, the qEEG method of data collection is described, the research procedure, and the data analytic strategies implemented. Finally, this chapter will also incorporate a brief discussion of the ethical considerations applied that were discussed in detail in Chapter 3.

5.2 Research design

In line with the research design of the psychometric component of this study, this was an exploratory, quantitative design, that was cross-section. The exploratory nature of the research design was especially relevant for this qEEG component of the study. An exploratory research design is a type of research methodology that is used when a researcher seeks to explore a new topic or gain preliminary insights into a phenomenon, without the need for a specific hypothesis (George, 2021). The primary goal of exploratory research is to generate ideas, hypotheses, and a deeper understanding of a subject for further investigation. This type of research design is particularly useful in situations where there is little existing knowledge or when the topic is not well-defined (George, 2021). As such, this design was most appropriate for the present study due to the scarcity and inconsistency of knowledge on the qEEG correlates of burnout. This design thus allowed for participants to be recruited and grouped based on burnout scores. Subsequent comparisons were made based on the qEEG profiles of burnout among our sample compared to a normative database.

5.3 Study setting

This was a single-site study conducted at Wits in the Wits Neuroscience Laboratory (Wits NeuRL), Enthomjeni Centre, East campus, 1 Jan Smuts Avenue, Johannesburg, South Africa.

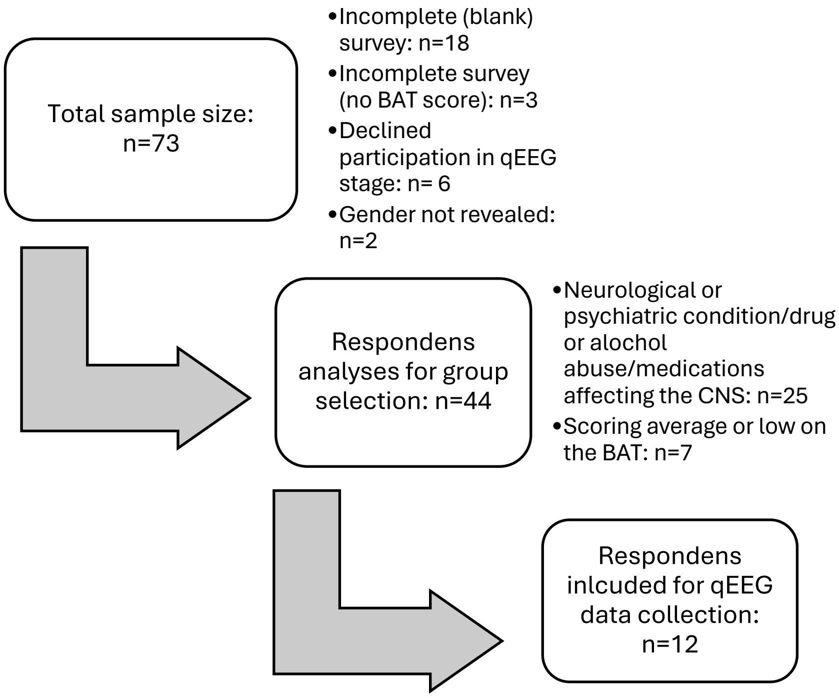
5.4 Sample and sampling procedure

As mentioned in the previous chapter, the sampling strategy for the entire study consisted of a two-stage process. As such, this section focuses on the second stage of recruitment. The second step in the recruitment process consisted of allocating participants to either a high or average burnout group, based on BAT scores. This grouping of participants took place to determine eligibility for participation in the qEEG data collection stage. To be considered eligible for qEEG administration, academic staff were required to meet the following inclusion criteria: (a) no use of medication affecting the central nervous system, (b) no history of neurological or psychiatric conditions (c) no history of drug or alcohol abuse, and (d) completion of at least basic demographic questions and the BAT component of the initial survey. Further inclusion criteria applied to the respective groups were a high score on the BAT for the burnout group and a low or average score on the BAT for the control group.

The exclusion criteria applied during the qEEG recruitment process consisted of the following: (a) history of any neurological or psychiatric conditions that may impact the qEEG recordings, (b) history of substance or alcohol abuse, and (c) incomplete BAT or demographic questionnaire. In addition, participants who preferred not the reveal their gender identification were also excluded as the normative database comparisons rely on the specification of age and gender. Thus, without an appropriately matched control, the relevance of those qEEG data would have been questionable.

As this is a pilot study and because of the resource-intensive nature of qEEG administration, the budget and time constraints of the current study could only allow a maximum sample size of 20 participants selected from the initial participant sample described in Chapter 3. However, the final number of eligible participants occupying the high burnout group was 12. The selection process that led to the inclusion of these 12 academic staff members is displayed in Figure 4 below. Important to note, that although control participants were also recruited for qEEG data collection, the final number of individuals who scored low or average on the BAT was extremely limited. Thus, the decision was made to only include those participants who scored high on the BAT with an established normative database serving as the control group.

Figure 4: Selection process of participants included for qEEG administration



From these 12 participants, it should be noted that visual inspection of the qEEG profiles of the sample led to the identification of one profile that can be classified as a significant outlier at certain electrode sites for the delta, theta, alpha, beta, and high beta bands. For instance, from a visual examination of the qEEG profiles of each participant, it was recognised that deviant values rarely exceeded z-scores of approximately five. In contrast, for the outlier participant, z-scores ranging from 10 to 21.2 were recorded for the Fz and O2 electrodes in all frequency bands except for APF. Similar extreme z-scores were also recorded at the P4 electrode site for the delta and theta bands as well as the F7 and FP1 electrodes for the theta frequency band. Therefore, to avoid skewed results, the values obtained from this participant were excluded and average z-scores were thus calculated based on sample sizes of 11 instead of 12. Further, although it was the initial aim to recruit an equal amount of male and female participants, this was not possible as the respondents were predominantly female. Thus, 63.64% of the final sample included for qEEG analysis identified as female, 63.64% had a PhD level of education, and 63.64% identified as White.

5.5 Data collection tools

The only means of data collection relevant to this component of the study was the administration of qEEGs. Thus, the qEEG method is described in detail below.

5.5.1 Quantitative electroencephalogram (qEEG)

qEEG assessments are conducted the same way as a standard EEG; however, the raw EEG data obtained are statistically transformed and compared to a normative database. The qEEG-Pro normative database used was based on resting-state qEEG data of 1482 and 1231 individuals for the eyes closed and eyes open condition, respectively. These individuals are those who visited the Neurofeedback Institute Netherlands (NIN) between 2004 and 2013. Their ages ranged from four to 82 years. Apart from qEEG administrations, participants also completed an extensive, DSM-based questionnaire. With the use of statistical regression, the variance that explained each participant's psychopathology was removed from the qEEG data and the subsequent normative database was compiled (qEEG Pro, n.d.). While the normative databases cover a wide age range from four to 84 years, the qEEG-Pro software employed in this study specifically compares participants' data with database entries matched based on age and gender.

Continuous qEEG data was obtained from 22 channels (O1, O2, T3, T4, T5, T6, P3, P4, Pz, F3, F4, F7, F8, Fz, Fp1, Fp2, C3, C4, Cz, a ground electrode, and linked mastoid electrodes as reference) using Silver Chloride electrodes manually placed on participants' scalps in accordance with the International 10-20 System of electrode placement (see Figure 5). Each electrode site was prepared using NuPrep gel and Ten20 paste was used to adhere the electrodes to the scalp. Brainwave activity was recorded using 1024 samples per second sampling rate and impedances were kept below 10kΩ.

The equipment and software used for qEEG data analysis included a high-quality qEEG system, which included electrodes, amplifiers, and a data acquisition device to record and digitise EEG signals. The hardware used consisted of Brainmaster Technologies' Discovery 24 Series system (Discovery 24 Series, n.d.). The transformation of EEG data to qEEG variables was facilitated by the qEEG-Pro software (qEEG Pro, n.d.).

Figure 5: Electrode placement and underlying brain structures

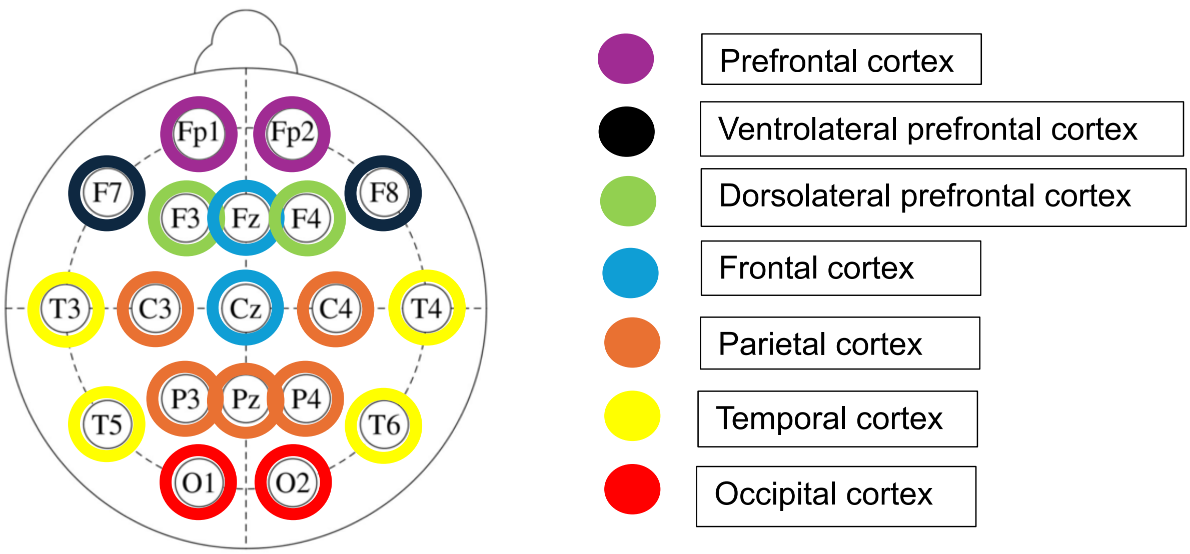


Figure 5: Location of electrodes according to the 10-20 system. Odd numbers indicate electrodes on the left, even numbers represent electrodes on the right, and z involves electrodes placed in the midline.

5.6 Research procedure

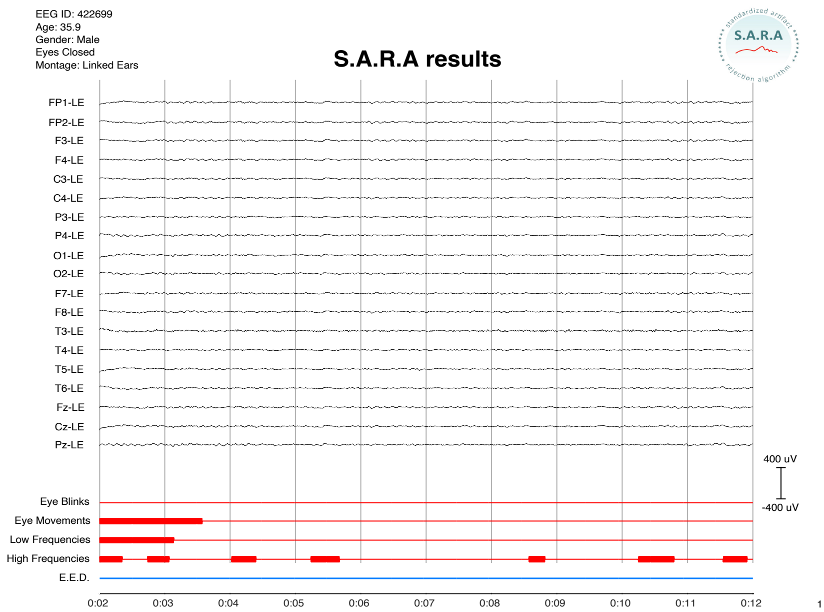
During the completion of the study survey, participants were asked to indicate their willingness to partake in a qEEG testing session if they met the relevant inclusion criteria. If yes, participants were subsequently asked to provide relevant contact information so that the research team could inform them of their eligibility to participate in the qEEG testing stage. Based on BAT scores, participants were assigned to either a high burnout or average burnout group (control group). Participants of both groups were then contacted and asked to schedule a convenient time and date for the qEEG recording session via an online scheduling platform. However, as mentioned previously, only those from the high burnout group were included for analysis in the present study. After obtaining informed consent, the qEEG recordings were then conducted at rest with eyes open and closed at the Wits NeuRL, Enthomjeni Centre, East Campus. Each participant was assessed individually in a quiet and private room in the Wits NeuRL. All participants' assessment conditions were standardised. The administration of participants' qEEGs was done by the same principal researcher of the larger neurofeedback study, Dr Beukes, a Health Professions Council of South Africa (HPCSA) registered EEG Technician (EE0002240) and Research Psychologist (PS 0141828) who is also a Biofeedback International Alliance (BCIA) certified Neurofeedback Practitioner (E6575). The standardised assessment conditions and appropriate training of the assessor ensured a degree of reliability in the results obtained.

Before the start of qEEG recordings, the researchers ensured that the participants were comfortable and relaxed by engaging in general conversation to prevent the undue influence of test-related anxiety on subsequent qEEG recordings. qEEG data was then recorded for approximately 10 minutes for both the eyes closed and open conditions. Participants were asked to remain silent and relaxed but awake with minimal eye and body movements, not to clench their teeth, and not to think of anything in particular. For the eyes-open condition, participants were asked to focus on a relaxing video presented on a laptop screen in front of them. Both the participants and real-time EEG results were continuously observed. Verbal prompts were used when necessary to prevent movement and/or speech while adjustments were made to the electrodes as necessary to ensure high-quality data. The qEEG session lasted approximately 60 minutes for all participants. Participants were thanked for participating and received an opportunity to ask questions or express any concerns.

5.7 Data management

The pre-processing of qEEG data was facilitated by the Standardised Artifact Rejection Algorithm (SARA) from the qEEG-Pro software (qEEG Pro, n.d.). An illustration of this process is depicted in Figure 6 below. From there, the qEEG report of each participant (produced by the qEEG-Pro software) was subsequently stored on a secure, password-protected cloud folder hosted on OneDrive. These files were only accessible to the research team. From the qEEG-Pro reports, participant data were coded using a unique ID for each participant and exported into a password-protected Microsoft Excel spreadsheet.

Figure 6: Example of one EEG segment in a SARA report

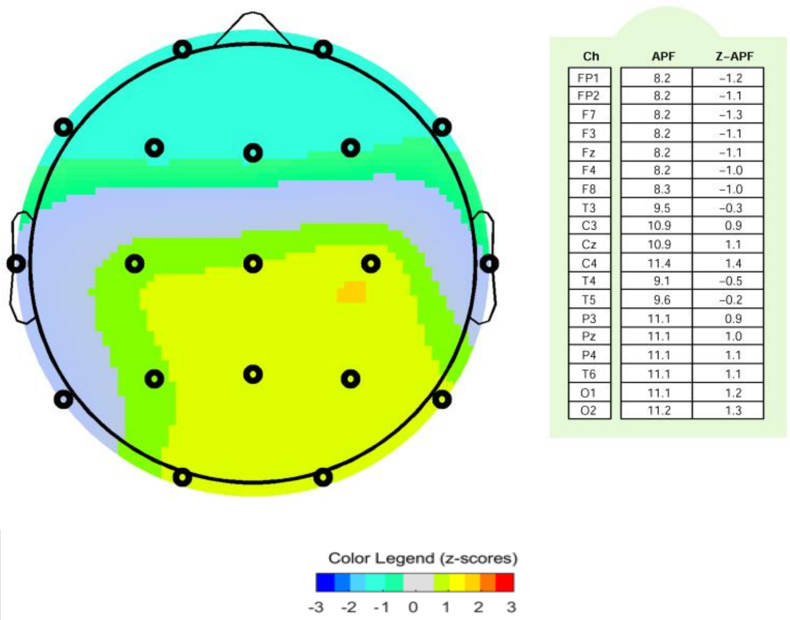


Source: qEEG-Pro Report Service - PLATINUM. (n.d.). BrainMaster Technologies Inc. https://brainmaster.com/product/qeegpro-report-service-platinum/

5.8 Statistical data analysis

To provide an overview of the sample chosen for this stage of data collection, descriptive statistics, based on the demographic profile of the sample, were presented. Thereafter, EEG recordings from each participant were transformed into qEEG metrics using Fast Fourier Transform (facilitated by the qEEG-Pro software) and contained in the subsequent qEEG reports produced by this software. From these reports, relevant data were extracted that included information on APF and mean power measures for delta, theta, alpha, and beta bands for each participant. Importantly, the data contained in the qEEG reports consisted of qEEG metrics (z-scores) compared to an age- and-gender-matched normative database. As was done in previous research on the qEEG profile of burnout (Golonka et al., 2019; Luijtelaar et al., 2010), qEEG correlates for both the eyes closed and open conditions were considered since these conditions produce qEEG profiles differing in topography as well as power levels (Barry et al., 2007). For example, for the eyes-open condition, brain wave activity also reflects cortical processing of visual input, generating differences in activation patterns between eyes-open- and closed conditions (Barry et al., 2007). Figures 7 and 8 illustrate examples of the data extracted for each participant. These examples were obtained from the qEEG Pro manual and thus not representative of the data captured for any of the participants included in the current study.

Figure 7: Example of the z-scored alpha peak analysis



Ch	APF	Z-APF
FP1	8.2	−1.2
FP2	8.2	−1.1
F7	8.2	−1.3
F3	8.2	−1.1
Fz	8.2	−1.1
F4	8.2	−1.0
F8	8.3	−1.0
T3	9.5	−0.3
C3	10.9	0.9
Cz	10.9	1.1
C4	11.4	1.4
T4	9.1	−0.5
T5	9.6	−0.2
P3	11.1	0.9
Pz	11.1	1.0
P4	11.1	1.1
T6	11.1	1.1
O1	11.1	1.2
O2	11.2	1.3

Figure 7: Visual brain map of APF z-scores compared to a normative database with the tabulated results on the right according to the values for each electrode (frontal-parietal, frontal, parietal, temporal, central, and occipital sites). The colour legend and tabulated z-scores show that APF for this individual was within the normative range. Source: qEEG-Pro Report Service - PLATINUM. (n.d.). BrainMaster Technologies Inc. https://brainmaster.com/product/qeegpro-report-service-platinum/

Figure 8: Example of the z-scored delta, theta, alpha, and beta analysis

Tables: Amplitude

Absolute Power (uV^2)

Ch	Delta	Z-Delta	Theta	Z-Theta	Alpha	Z-Alpha	Beta	Z-Beta	Gamma	Z-Gamma
FP1	21.3	-0.4	12.6	1.5	11.5	1.7	4.7	1.5	0.3	-1.2
FP2	20.5	-0.4	11.4	1.3	11.5	1.6	4.7	1.4	0.5	-0.3
F7	14.0	0.4	9.3	2.2	10.2	2.0	4.6	1.9	0.3	-0.8
F3	16.3	0.7	12.5	1.8	14.5	1.6	6.1	1.6	0.3	-0.5
Fz	17.0	0.7	13.8	1.6	15.7	1.5	6.2	1.6	0.3	-0.1
F4	15.3	0.5	11.7	1.7	13.6	1.5	5.5	1.3	0.4	-0.4
F8	9.5	-0.3	7.3	1.6	9.1	1.8	3.9	1.5	0.9	0.7
T3	8.2	1.4	9.2	3.3	13.8	2.0	5.8	1.7	1.5	0.7
C3	12.5	1.3	10.6	1.7	18.1	1.5	7.1	1.7	0.3	-0.2
Cz	16.4	1.3	13.9	1.4	23.4	1.7	8.9	1.7	0.4	0.0
C4	12.7	1.3	10.9	1.7	19.1	1.6	6.5	1.5	0.3	-0.3
T4	6.5	0.8	7.2	2.8	12.1	1.9	3.8	0.9	0.9	0.2
T5	6.3	0.4	8.1	2.0	18.6	1.5	4.5	1.0	0.5	0.3
P3	10.7	0.9	10.7	1.7	27.5	1.4	7.9	1.6	0.4	0.4
Pz	14.9	1.3	13.9	2.0	46.5	1.9	11.3	2.1	0.4	0.4
P4	11.4	1.0	11.0	1.9	30.8	1.6	7.3	1.6	0.3	-0.1
T6	7.2	0.6	8.3	2.1	25.8	1.9	4.6	1.2	0.4	-0.0
O1	8.6	0.3	9.1	1.4	31.5	1.5	7.4	1.4	1.5	1.5
O2	8.8	0.3	8.8	1.3	32.7	1.6	6.1	1.0	0.5	0.1

Figure 8: Table of the z-scores of one individual for the delta, theta, alpha, beta, and gamma frequency bands across all brain regions. Z-scores highlighted in colour represent deviations from a normative database. Source: qEEG-Pro Report Service - PLATINUM. (n.d.). BrainMaster Technologies Inc. https://brainmaster.com/product/qeegpro-report-service-platinum/

From these figures above, z-scores are displayed as either positive or negative values. A positive z-score reflects elevated activity whereas a negative z-score indicates reduced brain wave activity, relative to the normative database. In addition, the qEEG-Pro software also marks certain z-scores in colour (as seen in Figure 8), which means these scores are reflective of a deviation from the norm. In this context, elevated or reduced activity, which is considered deviant compared to the normative database, refers to z-scores of at least two or minus two.

Following examination of the individual qEEG reports generated for each participant, all z-scores across all electrodes for APF, delta, theta, alpha, beta, and high beta power measures (for both eyes open and closed conditions) were extracted and transferred to a password-protected excel spreadsheet. From there, the sample's z-scores were averaged for each frequency band at each electrode placement to compile a composite qEEG profile for the sample. Z-scores were then presented in tables and composite brain map figures. This information was also visually inspected for each participant and summarised as group trends for each frequency band using percentage calculations. In other words, the percentage of participants showing specific deviations in the beta band, for example, was narrated.

Overall, it should be noted that the initial aim was to recruit both a control group and a test group and subsequently compare the qEEG profiles of these groups using inferential statistics, such as Analysis of Variance (ANOVA), as was done in previous studies on the qEEG profile of burnout (Golonka et al., 2019; Luijtelaar et al., 2010). However, once data collection ceased, it was discovered that the number of participants scoring low or average on the BAT and could therefore be considered part of the control group, was only six. Among these participants, only two responded to the invitation to participate in qEEG administration. Therefore, a burnout-control group comparison was not possible and the qEEG profiles of the high burnout group were thus compared to the normative database provided by the qEEG-Pro software.

5.9 Ethical considerations

The ethical considerations taken into account for this component of the study were embedded in those described in the psychometric section. Thus, ethical approval for this section was also obtained by the Human Research Ethics Committee (Medical) and attached as Appendix G. In addition, ethical considerations addressed paralleled those described in the previous chapter and included consideration of informed consent, confidentiality and anonymity, debriefing, knowledge dissemination and publications, and finally, risk and benefits. There were no foreseeable risks associated with the study, as qEEG recordings are considered safe, non-invasive, and risk-free. Any residual conducive paste left in the participants' hair after the qEEG recordings could easily be washed out with water. Nevertheless, participants were informed of any potential risks associated with the study. Fortunately, all participants showed no signs of discomfort during the qEEG protocol.

5.10 Conclusion

This chapter outlined the research methodology of the qEEG component of the study. A descriptive, exploratory, cross-sectional, quantitative research design was chosen to address the predefined study aims. The sample was selected from the pool of participants recruited for the psychometric component of the study who met the specific inclusion and exclusion criteria, which determined eligibility for qEEG administration. Data collection entailed a qEEG testing session. The subsequent qEEG-Pro reports for each participant were then analysed with the use of descriptive statistics. The chapter then concluded with a description of the ethical considerations that have guided the study. The next chapter presents the results of the statistical analyses undertaken to investigate the electrophysiological aims of the study.

CHAPTER 6: QEEG RESULTS

6.1 Introduction

As described in the methods chapter, 11 participants with high levels of BAT-measured burnout were drawn from the total sample of 55 participants to partake in qEEG data collection. These individuals were chosen according to specific predefined inclusion and exclusion criteria and thus represented a group of academic staff with high burnout levels (mean= 3.21; SD= 0.42; range: 2.43-3.7) that had no history of neurological or psychiatric conditions, no history of drug or alcohol abuse, and no reported use of medications affecting the central nervous system. Thus, the following sections will discuss the descriptive analysis of the data obtained from these 11 academic staff members. First off, the demographic profile of the participants will be described followed by a descriptive analysis of the qEEG profile of the sample.

6.2 Demographic profile of the sample

The average age of the participants was 44.67 years (SD= 11.24; range: 32-61 years). Additionally, the Table below further illustrates the distribution of the remaining demographic variables among the sample.

Table 13: Demographic characteristics of the sample

Variables	N	%
Self-identified Gender		
Male	4	36.36
Female	7	63.64
Education		
Master's degree	4	36.36
PhD	7	63.64
Job title		
Associate Professor	3	27.27
Postdoctoral fellow	1	9.09
Lecturer	7	63.64

Relationship		
Yes	10	90.91
No	1	9.09
Living circumstances		
Alone	1	9.09
With a partner only	5	45.45
With a partner and children	5	45.45
Self-identified Race		
Black	2	18.18
White	7	63.64
Coloured	2	18.18
Home language		
English	8	72.73
Afrikaans	1	9.09
IsiXhosa	2	18.18

Most participants identified as female (63.64%), indicated that they are in a relationship (90.91%) and live either with a partner only (45.45%) or with a partner and children (45.45%). Regarding education, the highest level of education for most participants was a PhD (63.64%) degree. Most reported lecturer as their job title (63.64%). No participation from professors (excluding associate professors) or senior lecturers was seen. In terms of self-identified race, most participants were White (63.64%). There was no representation from those identifying as Indian or any other race category not specified by the survey. Finally, most participants' home language was English (72.73%) with the remaining participants reporting either Afrikaans (9.09%) or IsiXhosa (18.18%) as their home language. Thus, no representation of those with home languages other than those above was evident, including those from the larger sample that also reported Setswana, bilingual Afrikaans and English, German, Sotho, and Italian as home languages.

6.3 Descriptive statistics of qEEG results

The main aim of the qEEG component of the study was to compare the qEEG profiles of South African academic staff scoring high on burnout with an age- and gender-matched normative database. Accordingly, for all participants, z-scores for each frequency band on each electrode placement were extracted from the qEEG Pro report. Attempting to establish a qEEG profile for the sample, average z-scores for every frequency band at each electrode placement were calculated and presented in Tables 14 (eyes open condition) and 15 (eyes closed condition). Accompanying these tabulated results are composite brain maps showing the location and visual representation of average z-scores for each frequency band separately.

6.3.1 Eyes open condition

Table 14: Average sample z-scores for the eyes open condition.

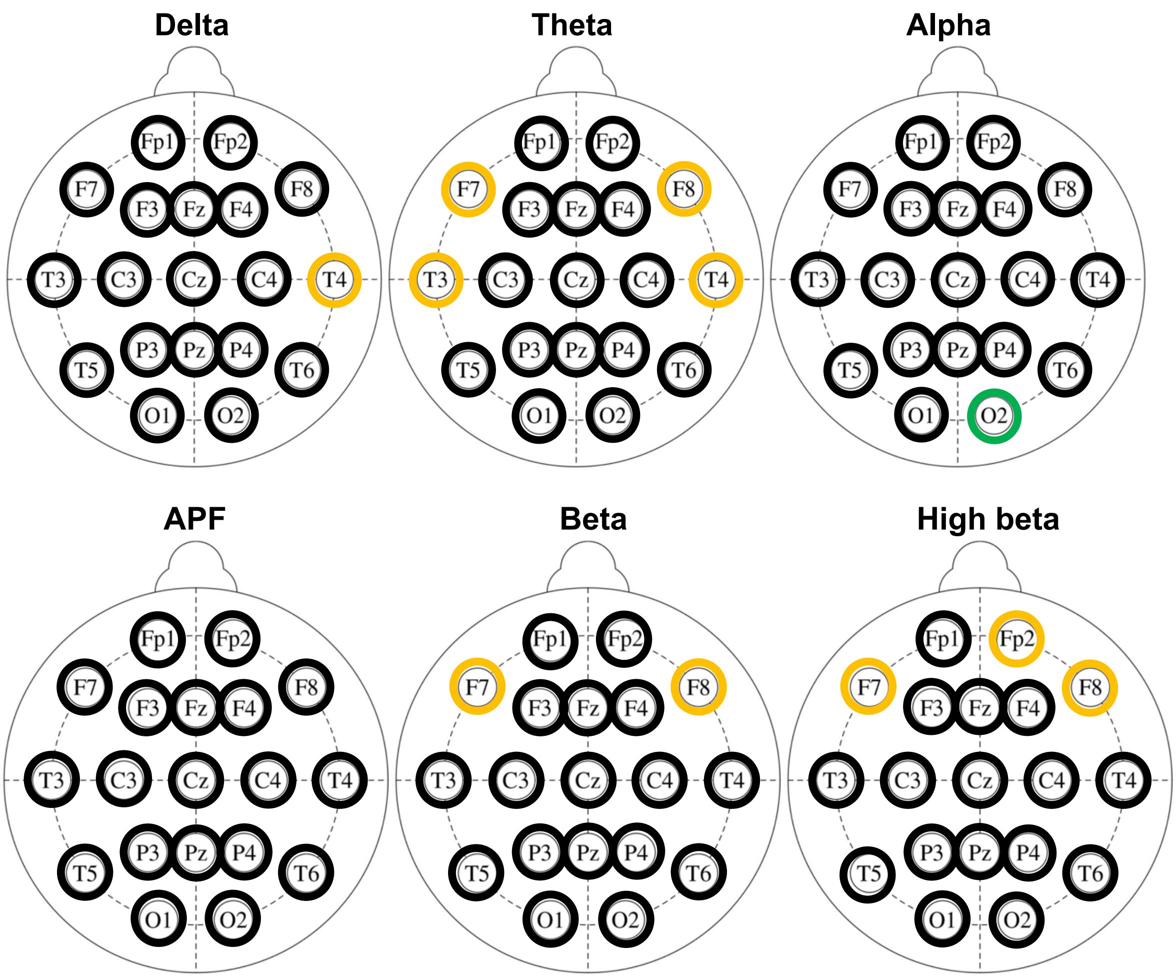
Ch	Delta (SD)	Theta (SD)	Alpha (SD)	APF (SD)	Beta (SD)	hiBeta (SD)
FP1	-0.51 (0.27)	0.28 (0.88)	0.05 (0.67)	-0.10 (1.31)	0.77 (1.22)	0.92 (1.18)
FP2	-0.39 (0.26)	0.32 (0.83)	0.04 (0.65)	0.19 (1.15)	0.83 (1.33)	1.02 (1.75)
F7	0.48 (0.30)	1.18 (0.95)	0.45 (0.88)	-0.24 (1.18)	1.45 (1.82)	1.48 (1.79)
F3	-0.29 (0.64)	0.55 (0.87)	-0.15 (0.71)	-0.84 (0.72)	0.39 (1.06)	0.72 (1.16)
Fz	0.17 (0.99)	0.80 (0.84)	-0.09 (0.66)	0.13 (1.33)	0.32 (0.73)	0.85 (0.91)
F4	0.06 (1.43)	0.52 (1.06)	-0.26 (0.73)	-0.04 (1.02)	0.28 (1.05)	0.76 (1.08)
F8	0.63 (0.51)	1.38 (0.75)	0.40 (0.75)	-0.31 (0.58)	1.18 (1.12)	1.21 (1.28)
T3	0.91 (1.12)	1.12 (1.31)	-0.05 (0.94)	-0.29 (0.81)	0.17 (0.97)	0.45 (0.91)
C3	-0.10 (1.27)	0.14 (1.12)	-0.48 (0.71)	-0.03 (1.23)	0.10 (1.02)	0.76 (1.33)
Cz	-0.24 (1.02)	-0.12 (0.85)	-0.50 (0.66)	-0.13 (0.76)	-0.30 (0.75)	-0.07 (0.87)
C4	-0.01 (1.07)	0.05 (0.95)	-0.53 (0.69)	-0.30 (0.74)	-0.13 (0.92)	0.35 (1.03)
T4	1.01 (0.99)	1.35 (1.18)	-0.01 (0.97)	-0.29 (0.83)	0.28 (0.95)	0.55 (0.88)
T5	-0.07 (1.19)	0.03 (1.19)	-0.73 (0.70)	-0.44 (0.99)	0.05 (1.25)	0.95 (1.48)
P3	-0.13 (1.07)	-0.06 (0.98)	-0.77 (0.54)	-0.42 (1.08)	-0.34 (1.06)	0.25 (1.22)
Pz	-0.08 (1.04)	0.09 (0.95)	-0.59 (0.49)	-0.45 (0.61)	-0.42 (0.83)	-0.21 (0.92)
P4	-0.22 (1.18)	-0.15 (0.98)	-0.81 (0.58)	-0.32 (0.89)	-0.55 (0.83)	0.02 (0.89)
T6	-0.20 (1.56)	-0.05 (1.18)	-0.80 (0.68)	-0.40 (0.76)	-0.06 (1.03)	0.75 (1.45)
O1	-0.41 (1.28)	0.17 (1.21)	-0.95 (0.44)	-0.04 (0.95)	-0.60 (0.78)	0.20 (1.14)
O2	-0.74 (1.35)	-0.29 (1.02)	-1.05 (0.54)	-0.31 (1.30)	-0.87 (0.80)	-0.12 (1.02)

Ch: Channel; FP: Frontal parietal; F: Frontal; C: Central, T: Temporal; P: Parietal; O: Occipital

From Table 14, all z-scores across all frequency bands and electrodes fell within the normative range. This means that no z-scores greater than -2 or 2 were observed. The visual representation of this information is displayed in the composite brain map below (Figure 10). These images should be interpreted according to the colour code displayed in Figure 9 below. Thus, deviations in qEEG parameters (z-scores equal or greater than 2 or -2) are illustrated in red and orange colour fields for those representing positive deviations while the two shades of blue are used to convey negative deviations.

Figure 9: Colour legend (z-scores)

Figure 10: Composite brain maps based on average z-scores (eyes open)



This figure shows that for most electrode sites across all frequency bands, the z-scores fell within the -0.9 to 0.9 range with selective electrodes in the delta (temporal region), theta (frontal and temporal sites), beta (frontal sites), and high beta bands (also frontal regions) demonstrating z-scores in the range of 1 to 1.9, all of which are considered normal relative to the normative database. For the alpha band, at one occipital electrode, average z-scores fell in the -1.9 to -1 range, which is also considered normal.

6.3.2 Eyes closed condition

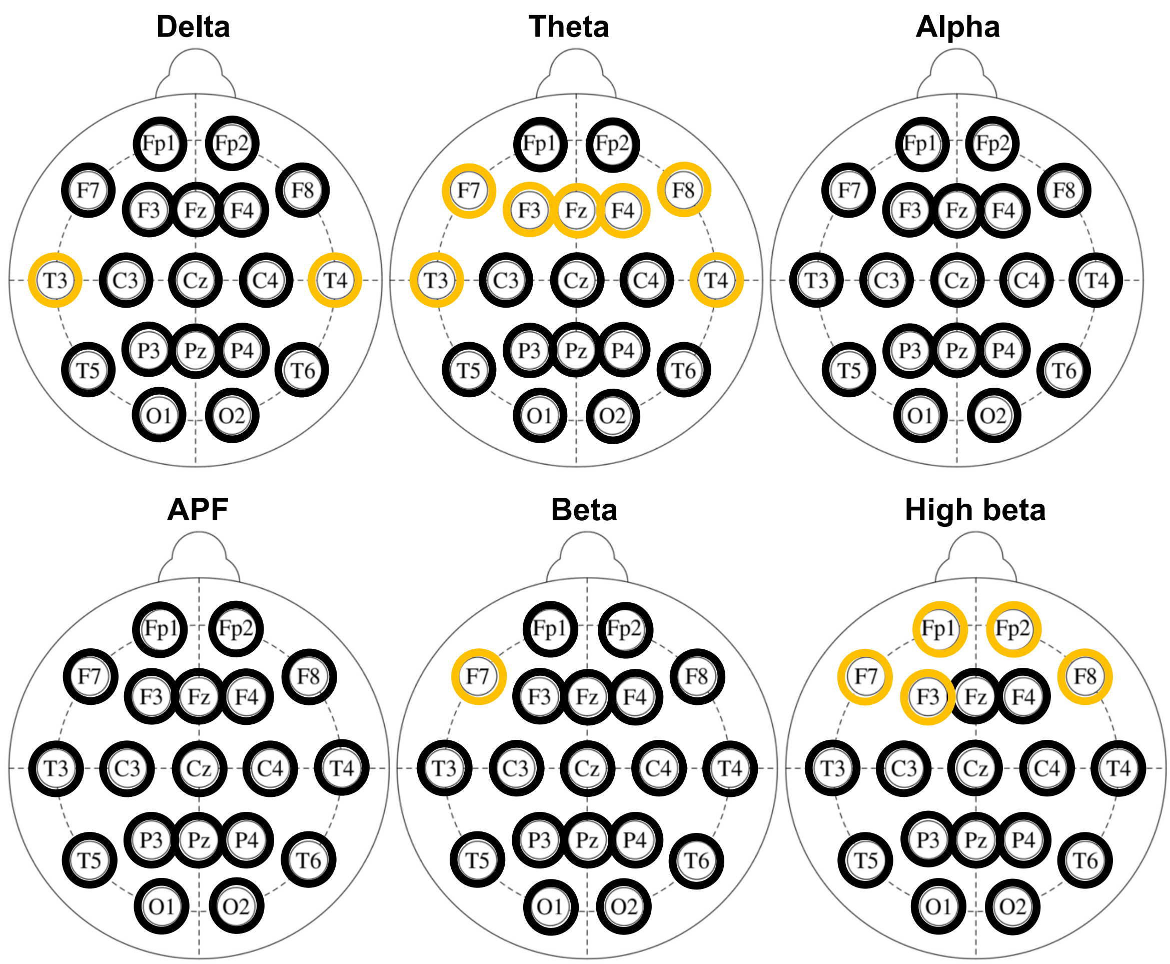
Table 15: Average sample z-scores for the eyes closed condition

Ch	Delta (SD)	Theta (SD)	Alpha (SD)	APF (SD)	Beta (SD)	hiBeta (SD)
FP1	0.09 (0.88)	0.89 (1.15)	0.37 (1.08)	0.82 (1.02)	0.90 (1.05)	1.45 (1.17)
FP2	0.13 (0.88)	0.91 (1.20)	0.37 (1.08)	0.55 (0.97)	0.89 (1.12)	1.55 (1.49)
F7	0.67 (1.05)	1.24 (1.29)	0.51 (1.04)	0.64 (0.67)	1.33 (1.73)	1.61 (1.66)
F3	0.45 (1.62)	1.05 (1.10)	0.26 (1.16)	0.35 (1.22)	0.55 (0.95)	1.03 (1.30)
Fz	0.89 (1.66)	1.17 (1.03)	0.38 (1.29)	0.21 (0.89)	0.45 (0.72)	0.98 (1.06)
F4	0.75 (2.57)	1.03 (1.24)	0.23 (1.10)	0.01 (0.87)	0.30 (0.95)	0.75 (1.19)
F8	0.74 (1.41)	1.29 (1.34)	0.47 (1.01)	0.52 (0.85)	0.89 (1.08)	1.28 (1.06)
T3	1.47 (1.84)	1.31 (1.44)	0.26 (0.95)	0.45 (0.88)	0.25 (0.98)	0.65 (1.17)
C3	0.37 (2.03)	0.63 (1.14)	-0.06 (1.01)	0.02 (0.93)	0.08 (0.74)	0.54 (1.15)
Cz	0.07 (1.76)	0.54 (1.07)	-0.04 (1.02)	0.29 (0.85)	-0.05 (0.64)	0.10 (0.94)
C4	0.18 (1.94)	0.55 (1.11)	-0.10 (1.01)	0.02 (0.86)	-0.03 (0.78)	0.43 (1.14)
T4	1.43 (1.60)	1.20 (1.16)	-0.05 (0.76)	0.05 (1.03)	0.19 (0.78)	0.51 (0.98)
T5	0.39 (1.78)	0.15 (1.13)	-0.86 (0.63)	-0.09 (1.02)	-0.36 (0.83)	0.26 (1.26)
P3	0.05 (1.73)	0.33 (1.05)	-0.38 (0.86)	0.30 (0.82)	-0.23 (0.63)	-0.09 (0.89)
Pz	-0.19 (1.70)	0.25 (1.22)	-0.26 (0.96)	0.33 (1.09)	-0.30 (0.65)	0.02 (0.86)
P4	-0.10 (1.83)	0.24 (1.22)	-0.43 (0.90)	0.11 (1.06)	-0.34 (0.62)	0.09 (0.89)
T6	0.05 (1.89)	0.14 (1.14)	-0.92 (0.65)	0.09 (1.18)	-0.40 (0.59)	0.18 (0.88)
O1	-0.04 (1.89)	0.02 (1.46)	-0.85 (1.00)	0.23 (0.97)	-0.64 (0.61)	-0.11 (0.97)
O2	-0.38 (1.85)	-0.26 (1.38)	-0.84 (1.05)	0.09 (1.05)	-0.80 (0.63)	-0.36 (0.79)

Ch: Channel; FP: Frontal parietal; F: Frontal; C: Central, T: Temporal; P: Parietal; O: Occipital

The power of delta, theta, alpha, APF, beta, and high beta were all within the normative range. Thus, similar to the eyes open condition, the sample did not demonstrate any deviant activity for any of the frequency bands on any of the electrode placements. The composite maps displayed below (Figure 11) show that most average z-scores across the spectrum of frequency bands were within the -0.9 to 0.9 range while certain frontal and temporal electrode sites for the delta, theta, beta, and high beta bands fell within the 1 to 1.9 range. However, as none of the z-score averages exceeded -2 or 2, the results are considered normal relative to a normative database.

Figure 11: Composite brain maps based on average z-scores (eyes closed)



When looking at these results it can be concluded that the sample showed no qEEG deviations on average for either the eyes open or closed conditions. This finding was surprising since all participants showed brainwave activity that deviated from the norm across the spectrum of qEEG frequencies for both eyes open and closed conditions, except one participant who showed no qEEG deviations in the eyes open condition (all z-scores for this participant for the eyes open condition fell into the normative range). The inconsistency may be understood when recognising that qEEG deviations, although occurring in the same frequency band for many participants, did not occur consistently at the same electrode placement for the entire sample or the same experimental conditions (eyes open or closed). In other words, there was considerable individual variability in the presentation of qEEG deviations associated with burnout among our sample. Therefore, to get a clear and accurate picture of the qEEG profiles of burnout identified among our sample, the following sections will additionally describe the existence and directions of specific qEEG deviations found among the sample as group trends in terms of frequency and percentage calculations.

6.4 Group-level percentage deviation calculations

Delta: Nine out of the 11 participants showed deviations in delta power, corresponding to 81.82% of the sample. For five of these participants, delta deviations occurred in both eyes open and closed conditions while four participants had delta deviations only in the eyes closed condition. Regarding direction, six showed positive deviations (increase in delta activity), two showed negative deviations (decrease in delta activity), and one participant had both increased and decreased delta activity at different electrode placements.

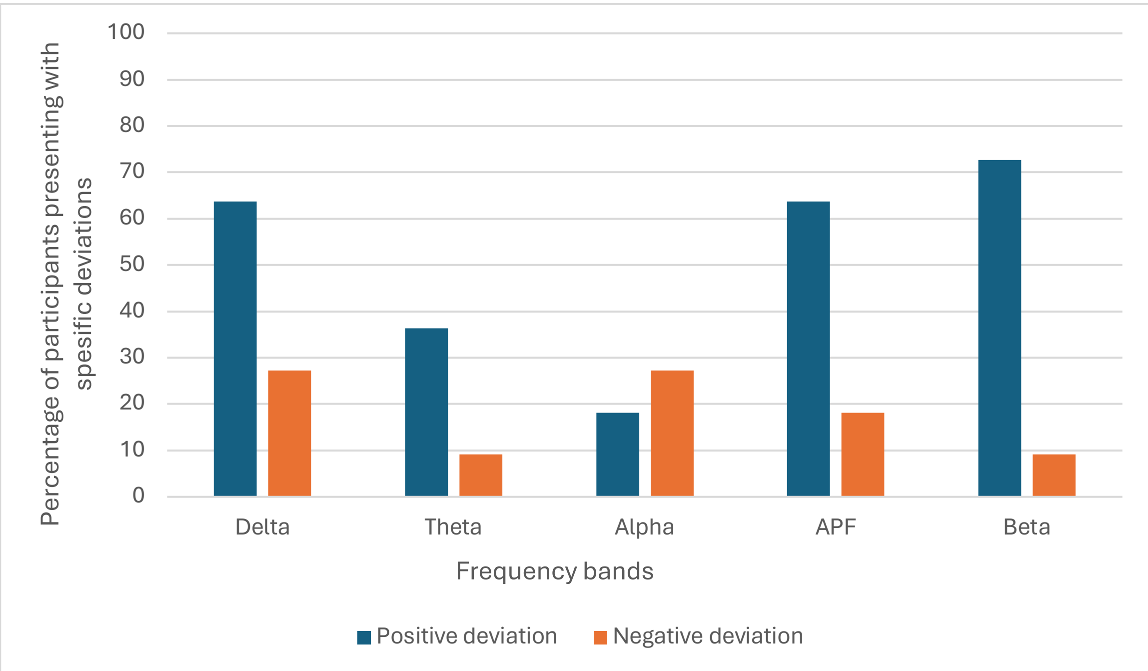
Theta: A total of five participants (45.45%) presented with theta deviations, with all deviations occurring in both eyes open and closed conditions. Most showed elevated theta activity (n=4) with one participant showing reduced activity.

Alpha: For the alpha band, five participants (45.45%) were found to show deviations in this frequency band, all occurring in the eyes closed condition. These deviations were regarded as elevation for two participants, and reduction for three participants. Additionally, eight participants (72.73%) had deviations in APF, occurring in both eyes open and closed conditions for one participant, only in the eyes open condition for five participants, and only in the eyes closed condition for two participants. Most were seen as positive deviations (n=6), one participant showed negative deviation, and one had both positive and negative deviations at different electrode placements.

<u>Beta:</u> Nine participants had deviations in the beta band, corresponding to 81.82% of the sample. Of these, six showed beta deviations and nine showed high beta deviations. Beta band deviations occurred in the eyes open condition (n=4), eyes closed condition (n=2) and in both conditions for the same individual (n=3). Regarding direction, most participants showed elevated beta or high beta activity except one participant who had reduced activity in this frequency band.

All in all, from these frequency calculations, it appears that high beta and delta deviations were the most common finding among the sample with deviations in APF representing a close second. In contrast, alpha and theta deviations were only evident for less than half of the participants. Regarding the direction of deviations, see Figure 12 for a summary of the proportion of participants presenting with specific deviations.

Figure 12: Percentage of participants presenting with positive and negative deviations in the delta, theta, alpha, APF, and beta bands



From Figure 12, the most prevalent deviations for the delta, theta, APF, and beta bands were positive deviations while negative deviations in the alpha band were more common. For instance, 63.64% of participants showed elevated delta activity, 36.36% of the sample had elevated theta activity, 27.27% showed reduced alpha, 63.64% showed elevated APF, and 72.73% showed elevated beta activity. Thus, elevated delta, APF, and beta activity represented a relatively consistent finding as this was reported for more than half of the total sample.

6.5 Conclusion

This section presented the descriptive statistical results on the final research question: How do the qEEG profiles of academic staff with high burnout compare to a normative database? From the computation of sample averages for both the eyes open and closed conditions, across all frequency bands and electrodes, no qEEG deviations among our sample were found. Therefore, these findings do not correspond to the study's hypothesis that predicted the presence of qEEG deviations associated with burnout. More specifically, the expectation of qEEG deviations in the alpha band (Golonka et al., 2019; Luijtelaar et al., 2010) were not found on average among our sample. Interestingly, individual-level results showed significant deviations from the normative database, particularly in the delta, beta, and APF bands. However, when looking at the group averages these results fell away. This large individual variability found in the presentation of qEEG profiles will be discussed in the next chapter.

CHAPTER 7: DISCUSSION

7.1 Introduction

This was a pilot study investigation that used a descriptive, exploratory, and quantitative research design to address the main aim of exploring academic burnout in South Africa with both electrophysiological and psychometric methods. As per this larger aim, the sub-aims of the study included an exploration of the relationship between two burnout measures (the MBI and the BAT) to understand the convergence and divergence of the different dimensions of burnout contained in these measures. Secondly, this study sought to investigate the distinctiveness of burnout versus depression using different analytic approaches. Finally, the study aimed to explore the qEEG profile of burnout among South African academic staff that can be used for the following two purposes: (1) to gain further insight into the qEEG correlates of burnout that will allow for the development of an effective neurofeedback protocol; and (2) to build on the biological investigations of burnout that can potentially be used to evaluate and compare its distinctiveness or similarities versus depression from this perspective.

Following these aims, this chapter will first provide a summary of the main research findings according to the six research questions fundamental to the study. The chapter then continues with a detailed discussion of the study results within the broader context of existing literature pertaining to the areas of investigation. The starting point of the discussion consists of a description of the sample characteristics and the demographic profile of participants. From there, the study results will be discussed in the order of research questions. Accordingly, MBI-BAT comparisons will be discussed first, followed by a focus on the depression-burnout relationship, and ending with a description of the qEEG findings among academic staff with burnout. Thereafter, the study's strengths as well as limitations will be outlined to provide the reader with an appropriate context in which to evaluate the study findings. This chapter will then continue to describe the possible influence of the results on the practice of identifying and understanding work-related suffering. Finally, this chapter will make recommendations for future research that will ultimately serve to strengthen and build on the findings of this study.

7.2 Summary of main research findings

The following paragraphs highlight the results of the six research questions formulated under the primary aim of exploring academic burnout in South Africa with both electrophysiological and psychometric methods. The first research question addressed was: What is the relationship, at both dimensional and categorical levels, between MBI- and- BAT-measured burnout? The BAT and MBI demonstrated adequate convergent validity although the cognitive and emotional impairment subscales of the BAT showed weaker correlations with the MBI, compared to its exhaustion and mental distance scales, confirming the unique contribution of the BAT to the overall burnout construct. In addition, considering the high symptomatic overlap between those scoring very high on the BAT and scoring high on the MBI's emotional exhaustion subscale, it seems likely that these two measures can be seen as almost equivalent when comparing prevalence data obtained from the BAT and MBI. The BAT-depersonalisation and BAT-personal accomplishment overlap was substantially lower.

The second research question consisted of the following: What does categorical analysis show regarding the percentages of individuals suffering from both burnout and depression? Categorical analysis revealed partial distinctiveness of burnout and depression as a maximum of 36.36% overlap was found, although the appropriateness of cut-of scores used to identify cases of burnout can be called into question, which will be discussed in detail in the subsequent sections. Next, how do the BAT and MBI scores compare among academic staff with different levels of depression severity? A general increase in both MBI and BAT test scores was seen from the minimal depression to severe depressive groups, indicating an overlap of burnout and depressive symptomology. The next research question addressed was: What is the relationship between both MBI- and- BAT-measured burnout (including subscale dimensions) and depression? The outcome of the correlational analysis performed on measures of burnout (MBI and BAT) and depression (BDI-II) failed to satisfy the criterion for the discriminant validity of burnout versus depression. An increase in perceived burnout as measured by the MBI and BAT as well as an increase in all its subscales correlated significantly (and strongly in most cases) with an increase in depressive scores. The final research question pertaining to the psychometric analysis of academic burnout was: How does controlling for content overlap between measures of burnout and depression affect the correlation between both MBI- and- BAT-measured burnout and depression? The correlation between the total MBI and the adjusted BDI scores (where fatigue and loss of energy-related items were removed) remained unchanged. For the BAT, although smaller effect sizes were found when controlling for content overlap, indicating at least partial inflation of the burnout-depression relationship, the final correlation was still strong and significant. Thus, item-level content overlap is not sufficient to explain the strong correlations found between burnout and depression.

The final research question dealt with the qEEG profile of academic burnout and consisted of the following: How do the qEEG profiles of academic staff scoring high on burnout compare to a normative database? From the computation of sample averages for both the eyes open and closed conditions, across all frequency bands and electrodes, no qEEG deviations among our sample were found. This finding was surprising considering the substantial proportion of participants presenting with qEEG deviations, particularly in the delta, beta, and APF bands. Thus, it can be concluded that these deviations did not occur consistently at the same electrodes for the total sample or the same experimental conditions (eyes open or closed), pointing to large individual variability among our sample.

7.3 Sample size and demographic characteristics

For the initial psychometric data collection, the study sample was delimited to Wits academic staff with no additional inclusion or exclusion criteria applied. All Wits academic staff were invited to participate and those working in a specific context or academic field were thus not targeted. Academics from all Faculties were represented in the study. The final sample size consisted of 55 participants, representing an approximate response rate of 4.68%, which is considered low (Sheehan, 2001). This low response rate could have been the outcome of factors such as the participant's interest in the topic as well as the considerable length of the survey (Dillman, 2007; Liu & Wronski, 2017; Shannon & Bradshaw, 2002). It was also possible that academic staff merely failed to see or open the invitational email. The low response rate can also be attributed to survey fatigue. To illustrate, de Koning et al. (2021) drew attention to the fact that the COVID-19 pandemic has spurred increased research activity while limiting data collection methods, resulting in a higher prevalence of survey-based studies. Because of this, the authors found that subsequent neurosurgical survey dissemination encountered decreased response rates due to the phenomenon of survey fatigue. As such, the same post-COVID survey fatigue could have been at play among our population and reduced the response rate. Another point to consider is that burnout is characterised by extreme fatigue, which could have reasonably led to a decrease in potential participants' desire or interest in taking the additional time needed to complete the survey.

The low response rate combined with the issues of sample representativeness should be considered when attempting to generalise research findings to the larger population from which the sample was drawn. The overall sample represented a relatively homogenous group of academic staff with most being English-speaking, White, and female academics who were mostly lecturers or senior lecturers with a PhD level of education. As per the statistics of the Wits academic staff population noted in the methods chapter, the present sample contained a relatively larger proportion of females and those identifying as White compared to the demographic profile of the entire population of academics working at Wits. The study sample was thus not adequately representative of the entire population, thereby restricting the ability to safely draw conclusions from the sample about the population.

For the second stage of data collection, 11 eligible participants were drawn from the original sample to partake in qEEG administrations. These participants were those scoring high on BAT-measured burnout, had no history of neurological or psychiatric conditions, no history of drug or alcohol abuse, and reported no use of medications affecting the central nervous system. Similar to the representativeness of the original 55 participants, these academic staff were also mostly female and White, in a higher proportion than what was described for the entire university population. Moreover, the present sample also failed to represent Indian and Chinese staff members. This may also influence the generalisation of research findings from the sample to the population.

Further interpretation of the demographic profile of the present sample can be done in the context of previous systematic reviews and meta-analyses that focused on the psychometric characteristics of burnout. Demographics, as it relates to gender, are especially important to consider as Meier and Kim (2022) reported a stronger depression-burnout correlation linked to a larger number of female participants in their study. The current study sample consisted of 67.27% females, which can be considered comparable to the female representation in previous reviews. For example, Meier and Kim (2022) included an average of 67.55% of females, Schonfeld et al. (2019a) had 65.75% of females, and Bianchi et al. (2021) based their findings on 67% of women. However, the review of Koutsimani et al. (2019) included a slightly lower proportion of women, 59% of their sample was female.

The higher proportion of female respondents among our sample, compared to males, is thus in line with these previous studies as well as general trends in the gender demographics of those who mostly respond to surveys (Curtin et al., 2000; Smith, 2008). The underlying contributors to higher female participation in surveys can potentially be regarded as the outcome of variations in male and female values functioning in a gendered online environment (Smith, 2008). For instance, within the framework of social exchange theory, England (1989) posits that communication inherently carries a gender bias when actors are presumed to base exchange decisions on separative selves. She and others (e.g., Chodorow, 1978) argue that males tend to prioritise separative characteristics, whereas females lean towards connective selves, emphasising traits like empathy and emotional closeness. If this perspective holds true, variations in response rates may stem from gender-specific decision-making and valuation of actions in online settings. Specifically, if participating in a survey aligns more closely with connective selves or is esteemed higher by individuals embodying such characteristics, one would anticipate a greater response rate among females compared to males (Smith, 2008).

Numerous studies have also demonstrated that gender significantly influences behaviour in online environments, correlating with various online activities (Jackson et al., 2001; Ogen & Chung, 2003; Travers, 2003). Specifically, researchers suggest that females are more inclined towards communication and information exchange online, while males tend to focus on seeking information (Jackson et al., 2001). Responding to an email through accessing, completing, and returning an online survey is primarily an act of information exchange rather than information seeking (Smith, 2008). Consequently, it is reasonable to observe a higher response rate among female faculty compared to male faculty. The differing ways in which females and males engage with cyberspace may compound with gender-based value systems in social exchange, potentially leading to a disproportionate number of female participants responding to the web-based survey.

Furthermore, gender was also found to be an important moderating variable when looking at the qEEG profiles of burnout (Golonka et al., 2019; Tement et al., 2016). For this study, the qEEG findings of burnout were based on a sample consisting of 63.64% females. The higher female participation can also be attributed to the factors described above since completion of the study survey was a necessary pre-requisite to qEEG participation. When comparing the findings with that of previous studies it should be noted that female representation in the study of Luijtelaar et al. (2010) was 30.77%, Golonka et al. (2019) included 58.70% of females, and Tement et al.'s (2016) sample comprised 64.10% of females. Thus, the comparison of study results should be approached with caution, especially relating to the study of Luijtelaar et al. (2010) who had considerably lower female participation compared to our study. Nevertheless, taken together, as discussed in the above sections as well, the lack of representativeness of the sample is a limitation of the pilot study and constrains the interpretations of the findings. However, as this was a pilot study investigation, it can be argued that the sample, despite the limitations in size and representativeness, is adequate to inform provisional interpretations of the results below.

7.4 Comparison of the BAT and MBI

Evident in the course of this dissertation is the central role of this study in examining the construct validity of the burnout syndrome among academics. To prove construct validity, both discriminant and convergent validity of measurement scores need to be established (Schaufeli & De Witte, 2023). Therefore, the first part of the study focused on convergent validity. To exhibit convergent validity, "there should be a high correlation between the scores on different measures of the same construct" (Schaufeli & De Witte, 2023, p.7). For this reason, the first sub-aim of the study was to explore the associations between the most popular burnout measure, the MBI, and the newly developed BAT. To gain further insight into the BAT-MBI relationship, categorical analysis based on these measures was also performed. That is, the study sought to examine the proportion of participants that received high scores on both the BAT and MBI subscales to ultimately establish the degree of comparability of prevalence data obtained from these two measures.

The results of the study revealed that there was a strong, positive, and statistically significant relationship between scores on the MBI and BAT, pointing to convergent validity. This finding corresponded to the study's hypothesis in this regard as both instruments seek to measure the same underlying construct (burnout) using self-report items scored on a Likert scale. The strong relationship between the two measures was also expected due to content similarities of the central dimensions of burnout (exhaustion and mental distance or depersonalisation) included in both measures. Sufficient convergent validity of the BAT was also confirmed in previous studies in this area (Oprea et al., 2021; Sakakibara et al., 2020; Schaufeli et al., 2020a). For instance, to explore the convergent validity of the BAT among samples from Flanders and the Netherlands, Schaufeli et al. (2020a) utilised a multi-trait-multi-method approach and included two alternative burnout instruments, the MBI and OLBI. The authors found adequate convergent validity relating to the core dimensions of burnout (mental distance and exhaustion). A similar result was demonstrated by Sakakibara et al. (2020) who sought to validate the BAT's Japanese version among a sample of 982 general employees, younger than 64 years. The authors showed a similar strong, positive, and significant relationship between total MBI and BAT scores. Investigating the relationship between the short version of the BAT and the MBI, Oprea et al. (2021) also demonstrated appropriate convergent validity of the BAT in a sample of 117 Romanian employees.

Moreover, strong significant correlations were also found between total BAT scores and the emotional exhaustion and personal accomplishment dimensions of the MBI. A moderately significant correlation was found between global BAT scores and the MBI's depersonalisation scale. The strength of the association between BAT scores and emotional exhaustion was expected because of content overlap, a finding substantiated in previous studies. For example, Sakakibara et al. (2020) confirmed the significant, strong, and positive correlation between total BAT and emotional exhaustion scores. Only making use of the emotional exhaustion scale of the MBI, Angelini et al. (2021) also reported a strong, significant relationship between BAT and emotional exhaustion scores in a sample of 846 Italian teachers. The outcome of the categorical analysis served to further substantiate the close association of BAT-defined burnout and MBI-defined emotional exhaustion as 91.67% of participants scoring very high on the BAT also scored high on emotional exhaustion.

Further, due to similar content overlap, it was expected that the depersonalisation and BAT scores would also show a comparably significant and strong correlation, which was not found in the study. Nevertheless, previous research also reported lower, but still statistically significant, correlations between depersonalisation and BAT scores, compared to the emotional exhaustion-BAT relationship. For instance, compared to the strong correlation coefficient found between BAT scores and emotional exhaustion, Sakakibara et al. (2020) revealed a more moderate coefficient between depersonalisation and BAT scores. Again, the study's categorical analysis in this regard further supported these observations of lower BAT-depersonalisation overlap as 53.85% of individuals scoring very high on the BAT also scored high on depersonalisation. These results suggest that, when attempting to compare burnout prevalence data, the use of the MBI's emotional exhaustion scale rather than the depersonalisation subscale may provide more reliable results.

Regarding personal accomplishment, a significantly strong and negative correlation was found between total BAT scores and this variable. The strong relationship found between these measures contrasted with the study's hypothesis. A weaker BAT-personal accomplishment relationship was predicted considering the lack of any element associated with personal accomplishment in the BAT (Schaufeli et al., 2020a) as well as previous concern relating to the problematic inclusion of personal accomplishment in the burnout definition (De Beer, 2021; De Beer et al., 2022; De Beer & Bianchi, 2019; Worley et al., 2008). Indeed, in contrast to the study results, Sakakibara et al. (2020) found remarkably weaker correlations between total BAT scores and personal accomplishment. However, despite the strong dimensional BAT-personal accomplishment relationship, the results of categorical analysis tended to align with the dominant notion of personal accomplishment as a divergent element. To illustrate, 92.31% of participants who scored very high on the BAT also scored high on personal accomplishment. These results demonstrated that participants with high levels of BAT-defined burnout reported high levels of personal accomplishment rather than reduced scores in this dimension, which would be expected if reduced personal accomplishment is a common finding among those suffering from burnout. Therefore, these results endorse the idea of personal accomplishment not representing a core element of burnout syndrome.

Additionally, as expected due to content similarities, the exhaustion and mental distance subscales of the BAT showed strong, positive, and significant correlations with the global MBI scores. However, the BAT's cognitive and emotional impairment subscales showed weaker correlations with the MBI, which was found to be in the moderate range. As per the study's hypothesis, this was an expected finding due to the lack of consideration of emotional and cognitive impairment in the MBI. Indeed, Schaufeli et al. (2020a) also reported evidence of divergence in the context of the MBI and BAT, indicative of the unique inputs of each measure to the burnout construct. Similar to the present results, divergent scores on the BAT emerged from its cognitive and emotional impairment scales (Schaufeli et al., 2020a). Angelini et al. (2021) also concluded their correlational study, based on the MBI and BAT, by stating that the two measures demonstrated sufficient convergent validity. However, the lower correlations between the MBI and the BAT's emotional and cognitive impairment elements stand as evidence of differences in the underlying dimensions chosen to represent burnout (Angelini et al., 2021). These findings were also supported by Sakakibara et al. (2020) and Oprea et al. (2021) who stated that the two measures were convergent although not identical, given the differences in the constructs they assess at the subscale level.

Overall, the convergent validity of the burnout syndrome has been confirmed in terms of the MBI and the BAT. However, there is also not a complete overlap between these measures due to the unique contribution of each measure to the burnout construct. For the BAT, this constituted the cognitive and emotional impairment subscales. For the MBI, personal accomplishment has previously been shown to correlate less strongly with the BAT compared to its exhaustion and depersonalisation subscales, indicative of a degree of divergence. However, the present results showed a strong relationship between these elements, representing a departure from previous findings.

Nevertheless, given the small sample size of our study, these findings cannot confidently be used to dispute the longstanding notion of personal accomplishment representing a divergent factor in the burnout syndrome. In fact, categorical analysis revealed high, rather than low levels of personal accomplishment among participants scoring high on the BAT. Therefore, apart from the expected degree of divergence between the measures, the convergent validity of the BAT and MBI was confirmed in this study. These findings also correspond to the proven convergent validity demonstrated for alternative burnout measures not included in our study. For example, satisfactory convergent validity was shown for the MBI and OLBI (Demerouti et al., 2003; Halbesleben & Demerouti, 2005) as well as the SMBM and the MBI (Shirom & Melamed, 2006). However, referring to the criteria for construct validity, while the convergent validity of burnout measures is fairly well established, its discriminant validity versus depression continues to be a challenge, as will be explored in the next section.

7.5 Burnout and depression

Due to the position of burnout as a key variable in the occupational health psychology field, burnout measures are required to demonstrate a valid foundation, and its discriminant validity versus depressive disorders must be firmly established. If not, the construct validity of burnout remains doubtful, which can have severe implications for the overall understanding of work-related suffering. Therefore, the investigation into the burnout-depression overlap has grown remarkably over the preceding decade, evidenced by the five systematic reviews and meta-analyses recently conducted on the topic (Bianchi et al., 2015; Bianchi et al., 2021; Koutsimani et al., 2019; Meier & Kim, 2022; Schonfeld et al., 2019a).

From these studies, accumulated evidence points to burnout representing a depressive phenomenon, although burnout measures tend to capture depressive symptoms in a truncated and meandering way (Bianchi et al., 2021; Schonfeld & Bianchi, 2021). However, such a conclusion on the burnout-depression relationship is not uniformly adopted by all researchers in the field (Brenninkmeyer et al., 2001; Glass & McKnight, 1996; Koutsimani et al., 2019; Lacovides et al., 2003; Maslach & Leiter, 2016). The distinctiveness of burnout as a separate syndrome from depression thus continuous to be a matter of dispute (Bianchi et al., 2015; Maslach & Leiter, 2016; Taris, 2006).

As the interest in clarifying the status of burnout appears to be growing stronger, the present study sought to build on previous research on the burnout-depression relationship, especially as it extends to BAT-defined burnout, an area currently neglected by previous studies. From the literature review, it was seen that the debates on this relationship centred around the following key areas of investigation: Conceptual debates, symptomatic profiles, nomological networks, correlational analyses, and a biological perspective on the depression-burnout relationship. The following sections in this chapter will thus consider each of these domains and illustrate how the present results can be integrated into the conclusions reached. However, it should be noted that analysis of conceptual considerations as well as nomological network investigations were not specifically addressed in this study. Nevertheless, a brief synopsis of the debates in these fields will also be presented in the section conclusion to provide a complete understanding of the burnout-depression relationship.

7.5.1 Symptomatic profiles

The significant association between all relevant dimensions of burnout and depressive scores in the current study confirmed the idea that the clinical picture of burnout has often been described in a manner that is indicative of depressive symptoms. For example, findings from the present study confirmed this direction of thought as the sense of personal accomplishment (one of the MBI's components of burnout) among academic staff showed a strong, significant, and negative correlation with BDI scores. As the degree of depressive symptoms increased, the sense of personal accomplishment significantly decreased. Furthermore, depersonalisation or mental distance (elements of MBI and BAT-defined burnout, respectively), is defined as cynical, indifferent, detached, and uncaring attitudes displayed in the occupational environment (Maslach et al., 2001; Schaufeli et al., 2020a). This symptomatic description of burnout seems to align with the well-established correlation linking depression to decreased emotional engagement, diminished empathy, and social or interpersonal detachment (Beck & Alford, 2009; Kupferberg et al., 2016). Indeed, in the present study, the MBI's depersonalisation scale showed a moderately significant association with depression, which was lower than what was found for personal accomplishment. Nevertheless, the significance of the depersonalisation-depression relationship confirmed the symptomatic overlap of these conditions. Of further interest was the higher correlation found between mental distance (the BAT equivalent of depersonalisation) and depression, for which a strong, positive, significant relation was found. This finding thus further supports the overlap of this burnout dimension with depression.

Furthermore, as mentioned in the literature review, BAT-defined burnout also includes the novel components of cognitive and emotional impairment as part of burnout symptomology. However, these dimensions can also not be used to differentiate the clinical picture of burnout from that of depression. To illustrate, cognitive impairments have long been considered part of depressive conditions (Perini et al., 2019) and are listed in the DSM as one of the nine symptoms defining depression (APA, 2013). Therefore, the significant relationship found between cognitive impairment and depression in this study was unsurprising. As the degree of cognitive impairment among the sample increased, so did depressive scores. In a similar fashion, emotional dysregulation or impairment is an element well-known for its association with depression (Joormann & Gotlib, 2010). Indeed, findings from the present study showed a strong, significant, and positive correlation between BAT-measured emotional impairment and depressive scores.

Apart from the above observations, the most important consideration of symptomatic overlap between burnout and depression may relate to fatigue or exhaustion as this element is arguably the central tenant of the burnout syndrome (Maslach & Leiter, 2017; Schaufeli et al., 2020a). Regarding present findings, measures of exhaustion contained in both the BAT and MBI showed strong, significant, and positive correlations with depression. It can be said that this finding was to be expected as fatigue constitutes one of the nine symptoms of depression and is thus captured in measures of the disorder (APA, 2013). Nonetheless, some argued that fatigue plays a differential role in burnout versus depression according to its more prominent centrality or severity among those suffering from burnout (Maslach et al., 2001). However, Van Dam et al. (2015) reported that the degree of subjective fatigue among participants suffering from depression is no less than that found among burnout participants. Fatigue itself or the features associated with it can thus not be used as a sufficient discriminator between burnout and depression.

To further evaluate the symptomatic overlap of burnout and depression, the present study adopted a categorical approach to uncover the proportion of participants who can be regarded as suffering from both burnout and provisional depression. The results established that a total of 36.36% of participants with very high burnout (as determined by the BAT) also met the diagnostic criteria for a provisional depressive diagnosis. In addition, only 4.35% of participants with high BAT-burnout scores can also be regarded as clinically depressed. For the MBI, the emotional exhaustion scale was used as a proxy for burnout due to the absence of relevant cut-off scores for the total MBI score (Schaufeli et al., 2020b). A total proportion of 22.73% of participants who scored high on emotional exhaustion met the criteria for a provisional diagnosis of depression. Therefore, the findings from this study provided evidence of lower symptomatic overlap than what would be expected if the two conditions reflected the same underlying phenomenon.

When placing the present findings in the context of previous literature, the symptomatic overlap found was slightly lower than what was reported by Ahola et al. (2005) in Finland and Soares et al. (2007) in Sweden. For instance, making use of the MBI, Ahola et al. (2005) revealed that only 53% of employees experiencing burnout met the criteria for a depression diagnosis. Employing the SMBM, Soares et al. (2007) established that only 41% of burnout-out women could also be classified as clinically depressed. These results, along with the current findings, thus provide evidence for at least a partial symptomatic distinction between burnout and depression. To further support this conclusion, the more recent studies of Lu et al. (2015) and Loosely et al. (2019) also reported relatively low symptomatic overlap as the prevalence of depression found among those belonging to a high burnout group (as indicated by the MBI in both cases) were only 38.60 and 40%, respectively. These results thus stand to reinforce the present findings.

However, the findings of the above two studies (Ahola et al., 2005; Soares et al., 2007) received major criticism relating to the use of relatively lower burnout cut-off scores than generally recommended (Bianchi et al., 2014; Bianchi et al., 2015). In other words, these authors used lower burnout cut-off scores than what would be sufficient to indicate clinical levels of condition severity (Bianchi et al., 2014; Bianchi et al., 2015). These studies were thus prone to incorporating numerous false positives amidst those categorised as burned out, potentially implying that the divergence found between burnout and depression was merely artificial. To test this theory, Bianchi et al. (2014) utilised an MBI cut-off score that corresponded to the presence of burnout symptoms a few times a week or more, instead of the commonly used cut-off score translating to symptom frequency of a few times a month. The authors argued that, like depression, burnout is considered to occur on a continuum. Accordingly, to reliably identify an individual as burnout-out, the symptoms of the condition should be severe enough to signify pervasive distress. Interestingly, using this approach, the authors found that 90% of burnout-out French schoolteachers also received a provisional diagnosis of depression. Using the SMBM, Schonfeld and Bianchi (2016) replicated these results while also using cut-off scores reflective of sufficient symptom severity. The authors showed that 86% of burnout-out participants met the criteria for a provisional depressive diagnosis. On this account, it appears that burnout and depression overlap substantially in the symptomatic domain when appropriate case identification procedures are employed.

In support of their argument for appropriate burnout cut-off scores, these researchers (Bianchi et al., 2014; Schonfeld & Bianchi, 2016) further showed that a lower degree of overlap between the conditions is seen as the cut-off used to identify burnout was systematically lowered. There was evidence of such a trend in this study as the prevalence of depression among our sample increased from 4.35% to 36.36% when higher cut-off scores for burnout were used. However, the 36.36% of symptomatic overlap is still far lower than the 86% (Schonfeld & Bianchi, 2016) and 90% (Bianchi et al., 2014) reported previously. Thus, it might be feared that our use of cut-off scores leaves the study vulnerable to including many false positives related to cases of burnout. When looking at the cut-off scores used to designate burnout in the present study, the very high category contained participants with scores of 3.30 or higher (the mean score of this group was 3.63). An average score of 3.63 translates to the experience of burnout symptoms between the frequencies of sometimes and often. This cut-off may be critiqued as the experience of burnout symptoms ‘sometimes’ does not reflect the pervasive nature of the condition that would be better represented by symptoms experienced ‘often’. On this note, there was only one participant in the current study who scored four or above on the BAT (indicative of burnout symptoms experienced often) and who also completed the BDI. Interestingly, this participant also met the criteria for a provisional depressive disorder.

For the MBI, the cut-off scores denoting high emotional exhaustion correspond to experienced symptoms a few times a month, which can also be criticised on the same grounds. Likewise, the previously mentioned studies of Lu et al. (2015) and Loosely et al. (2019), reporting on lower symptomatic overlap (38.60 and 40%, respectively) were also based on the same recommended cut-off scores and can thus also be criticised for the same reason. When using the same cut-off score as recommended by Bianchi et al. (2014), only three participants were identified that scored above the cut-off proposed to be a positive indicator of burnout, one of which failed to complete the BDI. Among the remaining two participants, one scored in the severe depressive range and was thus regarded as provisionally depressed, while the other scored in the moderate category of the BDI. However, since the sample sizes of burnout-out participants, based on the recommendation of Bianchi et al. (2014), were too small to draw any valid conclusions, it is recommended that more studies on this topic be conducted.

The final approach to examining the symptomatic overlap of depression and burnout was to evaluate the trend of burnout scores associated with different depressive groups (minimal, mild, moderate, and severe). In other words, to evaluate whether the likelihood of meeting the diagnostic criteria for depression rises as the symptoms of burnout increase. From the study’s results, MBI-measured burnout displayed a stepwise increase in mean with each category of depression severity (i.e., minimal to mild to moderate to severe), corresponding to previous research in this area (Bianchi et al., 2014; Schonfeld & Bianchi, 2016; Schonfeld & Bianchi, 2022; Wurm et al., 2016). For example, based on three-group comparisons, Schonfeld and Bianchi (2022) showed that the degree of burnout symptoms, as measured by the MBI and CBI, was equivalent to the level of depressive symptoms experienced for each of the categories of low, medium, and high. The authors concluded by suggesting that it is highly unlikely to experience symptoms of burnout without also experiencing the same degree of depressive symptoms. As expected, this tendency of a linear increase in burnout symptoms accompanied by a similar trend of increased depressive symptoms has been replicated across occupational groups, including physicians (Wurm et al., 2016), and teachers (Bianchi et al., 2014; Schonfeld & Bianchi, 2016).

For the BAT, the current study further established the conceptual generalisation of the evidence reported above as BAT scores showed a general increase in severity from minimal to severe depressive groups. However, the mean BAT score of the mild depressive group was slightly higher but essentially equivalent to that found for the moderate depressive group. Nevertheless, a clear increase in BAT scores was observed between those reporting minimal depressive symptoms and those demonstrating severe depression. This suggests that as the severity of depressive symptoms increases, so do BAT burnout scores. This result can thus be interpreted as evidence of a similar, although not perfectly linear, relation between depressive and burnout severity. Further, when considering the finding that all participants who scored below the cut-off for high burnout risk, that is, scoring in the average or low range, all reported minimal levels of depressive symptoms, which further reinforces the picture.

All in all, identifying meaningful differences between the symptomatic profiles of depression and burnout has been a matter of debate (Brenninkmeyer et al., 2001; Glass & McKnight, 1996; Lacovides et al., 2003; Schonfeld, 1991). However, the findings of the present study provided partial evidence of considerable overlap between the conditions in the context of symptomatic profiles. Firstly, the results showed that each dimension of burnout correlated significantly with depression. This finding is in line with previous suggestions that the symptom dimensions chosen to represent the burnout syndrome are also characteristic among those with depression. Secondly, the study results revealed that it is highly unlikely to be experiencing symptoms of burnout without also experiencing the same degree of depressive symptoms. However, on the other hand, the categorical analysis of the present study showed lower symptomatic overlap than what would be expected if burnout and depression constitute the same underlying syndrome. With that being said, the issue of utilising appropriate burnout cut-off scores was also raised which may drastically alter the conclusions drawn from categorical analysis. Future research in this regard is needed, based on larger sample sizes of appropriate burnout case identification to be able to draw more reliable conclusions. Nevertheless, the idea of a substantial burnout-depression overlap is further supported by the reported significant correlations between measures of both conditions.

7.5.2 Correlations

Conclusions drawn based on the overlap or distinctiveness of burnout versus depression have commonly emerged from the evaluation of the strength of the relationship between measures of the two conditions. Considering its popularity, it was unsurprising to learn that most studies focused on the relationship between MBI-measured burnout and depression. In this context, previous reviews and meta-analytic results reported a correlation between the MBI and depression as approximately 0.60 (Bianchi et al., 2015) and 0.47 (Koutsimani et al., 2019). The current results revealed a relatively similar strong, significant, and positive association between MBI and depressive scores, although slightly higher than what was reported by Koutsimani et al. (2019). Moreover, previous studies reported that the MBI's emotional exhaustion scale showed the strongest link to depression (Bianchi et al., 2015; Bianchi et al., 2021; Koutsimani et al., 2019; Schonfeld et al., 2019a), a finding confirmed in the current study. Regarding the strength of this relationship, while certain meta-analytic results indicate a more modest exhaustion-depression correlation around 0.50 (Koutsimani et al., 2019; Meier & Kim, 2022), similar to the present findings, other meta-analytic research (Bianchi et al., 2021; Schonfeld et al., 2019a) suggests that the exhaustion-depression relationship can reach a correlation of 0.70 to 0.80, particularly when measurement error is controlled for.

Further, previous research showed that the other two putative dimensions of MBI-defined burnout (depersonalisation and personal accomplishment) generally showed a weaker association with depression (Bianchi et al., 2015; Bianchi et al., 2021; Koutsimani et al., 2019; Schonfeld et al., 2019a). A finding confirmed among our sample. Importantly, the correlations observed in the present study as it relates to the three domains of the MBI are generally comparable to those reported in previous reviews. For example, the depersonalisation-depression correlation found among our sample is essentially equal to the one found in the review by Schonfeld et al. (2019a), although slightly lower than the one reported by Bianchi et al. (2021). The personal accomplishment-depression correlation found was slightly higher than the effect size reported by Schonfeld et al. (2019a) but almost equivalent to the effect size reported by Bianchi et al. (2021).

The conclusion drawn from most of these studies (Bianchi et al., 2015; Bianchi et al., 2021; Schonfeld et al., 2019a) is that the association between MBI-measured burnout, especially concerning its exhaustion subscale, were strong enough to raise concerns in terms of its discriminant validity. Considering the significantly strong association between the MBI's exhaustion scale and depression among our sample, these suggestions were substantiated by the present research. Therefore, an increase in perceived burnout as measured by the MBI as well as an increase in all its subscales correlated significantly with an increase in depressive scores.

When investigating the depression-burnout overlap in the context of the BAT, it was found that total burnout scores showed a significant, strong, and positive association with BDI-measured depression. This association was also slightly higher than the observed relationship between MBI-measured burnout and depression. A wider search of the literature showed that the high correlations between the MBI and depression are also consistent with the findings concerning the relationship between alternative burnout measures and depression. Although no previous studies were conducted that focused on the BAT-depression relationship, it may be valuable to compare the present finding with previous studies that included burnout measures other than the MBI as some may also capture BAT components. The SMBM, for example, includes cognitive impairment as part of the burnout construct, similar to the BAT. In this case, disattenuated correlation coefficients between the SMBM and depression were found to be as high as 0.84 (Schonfeld & Bianchi, 2016) and 0.90 (Bianchi & Brisson, 2017).

Two systematic reviews and meta-analyses also reported on the relationship between burnout (as measured with various instruments) and depression. On this account, Koutsimani et al. (2019) illustrated that there was a significant association between burnout, as measured by all included instruments, and depression. Interestingly, the authors also reported that for the studies utilising the MBI, a lower correlation was found compared to the one established for all other burnout measures. The correlation between burnout measures other than the MBI and depression is thus basically equal to the BAT-depression relationship found in this study. Regarding the results of the review by Meier and Kim (2022), an effect size of 0.49 was reported for burnout (across all included measures) and depression which aligns closely with the value documented by Koutsimani et al. (2019) but lower than the BAT-depression relationship in this study. Finally, in a systematic review looking at, amongst others, the relationship between depression and burnout among physicians, Ryan et al. (2023) further indicated that burnout (as measured with numerous instruments) displayed a consistently strong and positive correlation with depression.

In sum, most systematic reviews and meta-analytic studies looking at the burnout-depression relationship concluded by stating that the observed correlations between measures of burnout and depression are indicative of a substantial overlap between the conditions (Bianchi et al., 2015; Bianchi et al., 2021; Meier & Kim, 2022; Ryan et al., 2023; Schonfeld et al., 2019a). However, Koutsimani et al. (2019) reached an opposite conclusion by maintaining that, although burnout and depression were significantly related, the correlation was not strong enough to assume burnout forms a dimension of depression. Nevertheless, as mentioned in the literature review, the strength of the relationship between depression and burnout found by these authors can be viewed as evidence of convergence (Meier, 2008; Meier & Kim, 2022; Wurm et al., 2016). For instance, in the psychometric testing literature, correlations of 0.50 and higher are typically construed as evidence of convergent validity (Meier, 2008). Thus, the observed correlations between burnout measures and depression in the present study can also be inferred as representing an overlap between depression and burnout that extends to the BAT.

However, even in the face of accumulating evidence pointing to burnout as part of a depressive syndrome, this idea still received significant resistance from the pioneers in the field. In particular, Maslach and Leiter (2016) promoted the perspective that the strong correlations between depressive and burnout measures partially result from content overlap. Thus, the strong burnout-depression correlation may merely reflect a methodological artifact as content overlap inflates the observed relationship between the two conditions (Maslach & Leiter, 2016). For instance, apart from constituting the central element of burnout, fatigue or exhaustion is also captured in the symptomatic profile of depression (APA, 2013), and thus contained in measures of the disorder.

Fatigue-related item overlap thus arguably conceals the issue of the strength of the association between depressive and burnout measures.

From the perspective of the current study, the results showed that the correlation between the total MBI and the adjusted BDI scores (where fatigue and loss of energy-related items were removed) remained unchanged. In this way, we provided evidence of the lack of relevance of Maslach and Leiter's (2016) suggestion. Of note, previous research on the topic showed similar results. When fatigue-related items were removed from depressive measures, the correlations between burnout and depression remained essentially unchanged when using the MBI (Schonfeld et al., 2019a), SMBM (Bianchi, 2020; Schonfeld et al., 2019a), or CBI (Schonfeld & Bianchi, 2022). In terms of the BAT, it was found that controlling for fatigue-related items lowered the magnitude of the burnout-depression relationship slightly while also controlling for cognitive item overlap lowered the coefficient even further. Although smaller effect sizes were found when controlling for content overlap, indicating at least partial inflation of the burnout-depression relationship, the final correlation was still strong and significant. Thus, instead of viewing the depression-burnout overlap as artificial due to content overlap, the evidence may more accurately be interpreted as burnout falling under the umbrella of depressive disorders (Schonfeld et al., 2017).

These findings can be further supported by the results of Verkuilen et al. (2021) who used a different approach to investigating the content-overlap hypothesis of Maslach and Leiter (2016). The authors performed a correlational analysis of the MBI's exhaustion subscale with, firstly, the cognitive-affective scale of the PHQ-9 and, secondly, its somatic scale. As the fatigue-related items of the PHQ-9 are found in the somatic subscale, it would have been expected that the MBI be more strongly associated with this subscale compared to the affective-cognitive one. However, the authors found that the MBI's exhaustion subscale was strongly associated with both subscales of the PHQ-9, challenging Maslach and Leiter's (2016) argument.

A further interesting finding was that the BAT-MBI correlation was only slightly higher than the BAT-depression correlation. Discriminant validity necessitates that measures of different constructs should not exhibit strong relationships, or at the very least, their associations should not be as strong as those between measures of the same constructs (Spector, 2013). Interestingly, in line with our results, previous studies have revealed that the correlation between performance on depression and burnout measures is approximately equal to the correlation observed between different burnout scales (Bianchi et al., 2016; Hätinen et al., 2004; Lindblom et al., 2006; Verkuilen et al., 2021). Nevertheless, still, other alternative theories for the high correlations found between burnout and depression were put forward, including claims that burnout constitutes a risk factor for depression (Hakanen et al., 2008; Hakanen & Schaufeli, 2012; Leiter & Durup, 1994) or that they represent two highly co-morbid conditions (Koutsimani et al., 2019). For example, Koutsimani et al. (2019) voiced their co-morbidity hypothesis by stating that burnout and depression seemed to represent distinct syndromes, sharing common traits, and likely evolving simultaneously, rather than belonging to the same category with different labels assigned to them. Therefore, the probable high co-morbidity of depression and burnout offers an alternative theory for the high correlations found between these two conditions. The co-morbidity of burnout and depression can also be understood as being similar to the co-morbidity of anxiety and depression, which is an extremely common occurrence (Calkins et al., 2015) although these conditions are captured in the DSM as two separate disorders and also have different pharmacological and psychological interventions for them.

However, these suggestions encountered major objections from other researchers studying burnout. For instance, Schonfeld and Bianchi (2016) maintained that, due to the extreme difficulties in locating a clear difference between depression and burnout from either a symptomatic or etiological perspective, formulating a hypothesis that one condition causes the other becomes dubious. In addition, Schonfeld et al. (2019a) similarly indicated that, before attempting to prove one entity causes the other, the discriminative validity of burnout versus depression should be firmly established, which is currently not the case. The same logic seems to apply to the suggestion of co-morbidity of burnout and depression. Schonfeld et al. (2019a) specified that comorbidity involves at least two nosologically separate, diagnosable entities. As such, evidence pointing to a clear diagnostic distinction between burnout and depression needs to be obtained before one can entertain suggestions of co-morbidity.

7.6 Psychometric section conclusion

On a dimensional level, the psychometric findings of the current study are congruent with an evolving base of evidence calling the depression-burnout separation into question (e.g., Ahola et al., 2014; Bianchi et al., 2020b; Rotenstein et al., 2020; Verkuilen et al., 2021; Wurm et al., 2016). Of note, this study presented the first evidence that the most recent and most comprehensive definition of burnout, the one put forward by Schaufeli et al. (2020a) and captured in the BAT, also demonstrated a similar strong association with depression comparable to the findings based on previously studied instruments (MBI, SMBM, CBI, OLBI, and BM). These findings, in conjunction with studies showing highly parallel nomological networks for depression and burnout (Bianchi et al., 2019), strengthen the perspective that the two conditions are likely to represent one underlying phenomenon. Relatedly, research has also shown that the two conditions are similarly associated with job stressors and stressful life events, thereby disputing the initial scope-based distinction of burnout and depression (the view that burnout is restricted to the work environment while depression is a pervasive disorder). Using different statistical techniques, such as factor analysis, research further supports this conclusion. For instance, although early factor analytic studies concluded that burnout represents a distinct entity (Bakker et al., 2000; Leiter & Durup, 1994), more recent research based on improved methodologies failed to distinguish burnout from depression (Bianchi, 2020; Bianchi et al., 2020b; Schonfeld et al., 2019a). However, the categorical analysis showed some distinctiveness between the two conditions, supported by similar reports in the literature (Ahola et al., 2005; Loosely et al., 2019; Lu et al., 2015; Soares et al., 2007). On the other hand, these results are vulnerable to criticism relating to the use of cut-off scores insufficient to represent the state of burnout.

Taken together, these results, combined with existing evidence, cast significant doubt on the discriminant validity of burnout measures, which has serious implications for its eligibility as a diagnostic entity in the DSM or ICD. As such, Bianchi et al. (2021) came to the firm conclusion that burnout instruments essentially measure certain aspects of what depressive instruments measure. In other words, our findings indicate that burnout likely constitutes a dimension of a depressive condition, particularly in emphasising the significance of physical fatigue. This aligns with the view that burnout resembles a form of depression characterised by atypical symptoms (Bianchi et al., 2014), which includes severe exhaustion (APA, 2013; Gold & Chrousos, 2002). However, it should be noted that we do not advance the view that burnout is identical to depression arising from occupational stressors. Substantial evidence indicates that burnout's core symptoms are significant aspects of depression, although they are not its sole symptoms. Thus, the burnout construct represents a form of depression, yet in a limited capacity (Schonfeld & Bianchi, 2021).

The challenges faced in burnout research for over 35 years (e.g., the inability to reach a consensual diagnosis) can likely be attributed to the origins of the burnout construct (Verkuilen et al., 2021). Early works on burnout, like those by Freudenberger (1974) and Maslach (1976), relied heavily on speculation and anecdotal evidence rather than robust theoretical frameworks and comprehensive investigations (Friberg, 2009; Schaufeli & Enzmann, 1998). When introducing the burnout construct, there was a lack of systematic examination within the existing literature covering stress-related conditions, such as depression. Burnout research evolved separately from studies in psychiatry and psychology that focused on stress-induced conditions like depression. As a result, the pioneers of burnout research largely overlooked the potential overlap between symptoms of depression and burnout (Bianchi et al., 2018; Schonfeld et al., 2019a). In essence, the early approach taken by burnout researchers failed to effectively incorporate existing knowledge and foster a clear understanding of the construct.

Therefore, although the current direction of evidence points to burnout and depression as manifestations of the same underlying syndrome, no consensus has been reached yet. In addition, despite the considerable contribution of our study toward the understanding of burnout from a psychometric perspective, more studies focused on the BAT-burnout relationship and depression are needed. At the same time, apart from psychometric investigations, the study also aimed to examine academic burnout using electrophysiological methods. Knowledge about burnout in this area is also inconsistent and scarce. Therefore, the study also built on the base of knowledge in terms of academic burnout from this angle, as will be discussed in detail in the subsequent sections.

7.7 qEEG discussion

From the analysis of qEEG findings, no group-level deviations in qEEG parameters were found among our sample of South African academic staff compared to a normative database. However, important to note, that individual-level analysis revealed substantial qEEG deviations among our sample in the delta, beta, and APF bands. These deviations were not captured by the computation of average z-scores across the entire sample due to individual variability at specific brain regions. The small sample size of 11 participants could also have contributed to the lack of deviations found for the group as a whole. The existence and direction of specific brain wave abnormalities among burnout-out individuals thus remain unclear as the present findings were inconsistent in most cases with previous research on the topic (Golonka et al., 2019; Luijtelaar et al., 2010; Tement et al., 2016). For instance, to place the current findings within the context of the broader literature on the topic, the results of the current study can be compared to the results of Luijtelaar et al. (2010) and Golonka et al. (2019), both of which also aimed to uncover the qEEG profile of burnout.

The first study that examined qEEG profiles in individuals with burnout was conducted by Luijtelaar et al. (2010), who aimed to establish biological markers for burnout. From the results of their study, Luijtelaar et al. (2010) demonstrated significantly lower APF and beta power in the burnout group than in controls. To compare, among the present sample of South African academics, APF and beta band activity at all electrode placements were considered normal in relation to a normative database. However, a categorical analysis revealed that 63.64% of the sample showed elevated APF and 72.73% showed elevated beta activity, thereby making a strong case for positive beta deviations among those suffering from burnout. Elevated beta activity can be a sign of overall hyperarousal in the central nervous system and is often associated with states of extreme stress or anxiety (Hammond, 2011). As burnout is understood as the outcome of chronic and severe stress, high beta activity among most of our sample seems to be a logical finding.

Thus, evidence of deviations in APF and beta band activity associated with burnout corresponded with the results of Luijtelaar et al. (2010), although the direction of deviations was opposite to what was found by these authors (increased rather than decreased activity). To further reinforce this view, it was found that only two participants among the total sample showed comparably reduced APF. Likewise, only one participant among the total sample showed a similar reduction in beta activity. Therefore, apart from these minority cases, most of the remaining participants did not present with qEEG deviations in a similar pattern as described by Luijtelaar et al. (2010).

The more recent study by Golonka et al. (2019) partially supported our group-level findings by revealing no significant differences in APF and beta power among a burnout and control group. However, as mentioned above, since almost three-quarters of our sample presented with positive beta deviations, more research in this area is needed with larger sample sizes. Moreover, Golonka et al. (2019) also found significantly reduced alpha power among employees with burnout during eyes open compared to controls, inconsistent with the results of Luijtelaar et al. (2010) and the present findings. The study by Luijtelaar et al. (2010) demonstrated no significant difference in alpha power among the burnout group compared to the control group. For the current study, our results supported the conclusion reached by Luijtelaar et al. (2010) as alpha activity of academic staff scoring high on burnout presented in the normative range and were thus not classified as deviant. To further substantiate these findings, in terms of group trends, a small proportion of only 27.27% of participants presented with reduced alpha activity.

Finally, only Golonka et al. (2019) examined delta and theta activity and found no significant differences between the burnout group and controls. These findings were partially consistent with the present results as no average deviation in delta and theta activity was found among our sample. However, individual-level analysis seems to suggest otherwise. For instance, although average z-scores showed delta activity in the normative range, a closer look revealed that 81.82% of participants presented with delta deviations with most of these described as positive deviations (63.64%). The observed high prevalence of delta deviations thus represented a departure from the results of Golonka et al. (2019). Hammond (2011) suggested that the presence of elevated delta activity in the executive regions of the brain has implications for an individual's ability to control cognitive and emotional processes. Positive delta deviations may thus translate to difficulties with concentration, memory, and controlling emotional responses (Hammond, 2011). Since these descriptions align closely with the cognitive and emotional impairment symptoms of burnout captured by the BAT, it seems likely that delta deviations have an important role to play in the experience of burnout. Regarding theta activity, deviations in this frequency band were not common and reported for less than half of the sample, thereby supporting the results of Golonka et al. (2019). Thus, the outcome of the present study suggests that further investigations into the delta activity of burnout may be a worthwhile endeavour, especially because only two participants among the total sample showed delta activity within the normative range.

The final study to consider is that of Tement et al. (2016), looking at APF and alpha power among 117 university students. When considering the results of this study, it is important to recognise that comparisons should be made with caution as these authors employed different data analytic techniques (correlational analysis) compared to the group comparison procedures used in the present study as well as the two previously discussed studies (Golonka et al., 2019; Luijtelaar et al., 2010). Having said that, Tement et al. (2016) found no significant relationship between APF and burnout, which may correspond with the results of Golonka et al. (2019) but likely inconsistent with the results of Luijtelaar et al. (2010), showing significantly reduced APF in the burnout group. Similarly, these results may also be considered consistent with the present results as no average APF deviations were found among our sample. However, as a reminder, although average electrode scores depicted APF within the normative range, a categorical analysis revealed that 63.64% of the sample presented with positive deviations, suggesting a plausible role for APF in burnout. In addition, although not statistically significant, Tement et al. (2016) also showed that alpha power positively correlated with burnout scores, which differed from the finding of Golonka et al. (2019), which showed significantly decreased alpha power among their burnout group. Nevertheless, the lack of a statistically significant relationship between alpha power and burnout is possibly supportive of the findings of Luijtelaar et al. (2010) who reported no significant alpha power differences between a burnout and control group. Similarly, the present findings also showed alpha activity within the normative range.

Therefore, overall, with the addition of the present findings, it appears that there is a marked inconsistency among research studies focused on the qEEG correlates of burnout for the alpha, beta, and delta bands. In this regard, several factors may have contributed to the source of conflicting findings. Firstly, as mentioned above, Tement et al. (2016) used different statistical tests in their study compared to the relatively similar procedures used in the studies conducted by Luijtelaar et al. (2010) and Golonka et al. (2019). For the present study, the data analytic techniques corresponded to the latter two studies. However, instead of comparing a burnout group to a local control group, a normative database was used as a proxy for the control group. As evidence of divergence in qEEG profiles among individuals residing in different geographical locations could not be identified, it was considered plausible that the use of a normative database rather than a local control group would not significantly influence research findings. However, on the other hand, it can also be argued that our use of a normative database instead of a local control group is still problematic when considering the appropriateness of the qEEG norms from the Global North in contexts like South Africa. The wider social and political realities in South Africa might result in higher levels of stress and burnout in general among different samples (e.g. nurses, healthcare workers, and teachers; Jackson & Rothmann, 2005; Khamisa et al., 2017; Peltzer et al., 2003; Zeijlemaker & Moosa, 2019). It is therefore unclear if the baseline scores used in normative databases are at all comparable. Furthermore, while there is a lot of research on the lack of appropriateness of psychological and neuropsychological norms for diverse samples with varying socio-economic backgrounds and education levels in South Africa and similar contexts (Ferrett et al., 2014; Watts & Shuttleworth-Edwards, 2016), very little has been written about the appropriateness of the use of norms for neuroimaging methods, like qEEG.

Furthermore, differences in experimental conditions may also partly explain inconsistencies in results, as the present study as well as those of Luijtelaar et al. (2010) and Golonka et al. (2019) based their findings on eyes-open and closed conditions, with only the latter included in the study by Tement et al. (2016). Golonka et al. (2019) further suggested that the inconsistent findings among the discussed studies may also be due, in part, to differences in sample characteristics, namely burnout severity. For example, it can be said that the study by Luijtelaar et al. (2010) included participants with more severe burnout as the inclusion criteria not only consisted of high scores on burnout measures but also a diagnosis of undifferentiated somatoform disorder and the requirement that participants worked at least 50% less than usual for a minimum of three months. To compare, the present study as well as the other two remaining studies were based on relatively healthy academic staff (the present study), students (Tement et al., 2016) and employees (Golonka et al., 2019). Of note, when using the statement 'relatively healthy' this merely indicates that the inclusion criteria applied to our sample and those mentioned above did not consist of marked functional impairment (such as 50% less work involvement) or a clinical diagnosis of undifferentiated somatoform disorder.

A related difficulty in comparing results arises from the different conceptualisations of burnout on which qEEG findings are based. To illustrate, the present study identified cases of burnout by employing BAT scores. To compare, Golonka et al. (2019) considered the presence of burnout to be those who had high scores on the MBI (Maslach et al., 1996) and reported a stressful working environment according to the Areas of Work Life Survey scale (Leiter & Maslach, 2004). The study by Tement et al. (2019) also used the MBI as the measure of burnout while Luijtelaar et al. (2010) used a translated measure equivalent to the MBI. Considering the strong, positive, and significant correlation between MBI and BAT scores found in this study and supported by previous research (Oprea et al., 2021; Sakakibara et al., 2020; Schaufeli et al., 2020a) it seems plausible that the present results may be considered comparable to these previous studies. Even so, the possible influence of a divergence in burnout's definition in these studies cannot be disregarded. For example, although both the MBI and BAT aim to measure the same underlying phenomenon, it is unsure whether burnout defined according to the MBI versus the BAT will present with different neurobiological profiles.

Moreover, differences in gender distribution of the studies may be another complication for comparison. Female representation in the discussed studies was as follows: 63.64% for the present study, 58.70% for the study by Golonka et al. (2019), 30.77% for the study by Luijtelaar et al. (2010), and 64.10% for the study by Tement et al. (2016). The importance of considering gender distribution as a possible source of conflicting findings lies in the gender-related results of Tement et al. (2016) and Golonka et al. (2019). For example, Tement et al. (2016) showed that alpha power positively correlated with burnout among male participants only. These authors further stated that, in females, burnout negatively correlated with alpha power but failed to reach significance. Similarly, Golonka et al. (2019) also demonstrated pronounced gender differences in the qEEG profiles of their sample. The authors stated that alpha power showed significant negative correlations with burnout scores only among male participants. The tendency for negative correlations was also present in females, but these were non-significant in most regions.

Considering all the above, it is evident that the samples are not equivalent, and comparisons should be made with caution. In addition, the inconsistent conceptualisation used to define burnout also has implications for the investigation of the depression-burnout relationship. As mentioned in the literature review, apart from psychometric analysis, a biological investigation is yet another avenue of investigation into the burnout-depression overlap. The current study can also be used to tap into this biological arena of debate by considering how the qEEG correlates of individuals identified as suffering from burnout compared to the previously studied EEG biomarkers of depression. A comparison of biomarkers can potentially provide valuable information on the biological similarities or distinctions between depression and burnout. For example, if burnout and depression were reflective of the same underlying condition, one would expect that the underlying biological characteristics of the two conditions be comparable.

However, due to the severely limited number of studies investigating the qEEG profile of burnout and subsequent conflicting results, the qEEG profile of burnout remains unclear. This also means that the ability to reliably compare the qEEG characteristics of burnout and depression is problematic. Nevertheless, from the present findings, combined with previous research, two critical commonalities emerged: The experience of burnout appeared not to affect theta and alpha power. For instance, although significant alpha deviations were reported by Golonka et al. (2019), Luijtelaar et al. (2010) found no significant differences between a burnout and a control group, which were corroborated by the present findings. Tement et al. (2016) also found no statistically significant relationship between alpha power and burnout. Regarding theta activity, Golonka et al. (2019) found no significant differences between a burnout and a control group, consistent with the present results. In turn, the insights gained on the qEEG correlates of burnout can potentially be used to establish its biological similarities or distinctiveness when placed in the context of the well-established qEEG biomarkers of depression.

7.7.1 qEEG perspective on the burnout-depression relationship

Several studies have aimed to describe possible qEEG biomarkers of depression using different approaches. For example, several researchers investigated qEEG biomarkers of depression with the use of classification algorithms in an attempt to predict the diagnostic accuracy of certain frequency bands. If a particular frequency band demonstrates strong predictive accuracy, it could signify an essential biomarker. While certain classification algorithms offer insights into specific features, such as increased alpha amplitude predicting depression, others solely identify the significance of features, like how alpha-related activity greatly contributes to accurate classification (de Aguiar Neto & Rosa, 2019).

Concerning alpha activity, conflicting outcomes exist despite some studies highlighting its potential as a reliable discriminator for depression (Dolsen et al., 2017; Hosseinifard et al., 2013; Lee et al., 2018; Mohammadi et al., 2015). Conversely, certain studies contradict this view (Cai et al., 2017; Shen et al., 2017). Delta and theta waves, on the other hand, merit attention (Liu et al., 2017; Mohammadi et al., 2015), yet further research is essential to comprehensively grasp their implications in depression. Theta appears especially promising as a diagnostic tool (Cai et al., 2017; Hosseinifard et al., 2013; Shen et al., 2017), although limited information persists regarding its associated mechanisms.

Another commonly studied biomarker associated with depression is FAA (Tomarken et al., 1992). This metric gauges the relative alpha band activity within the brain's left and right hemispheres, particularly focusing on frontal electrodes. It aligns with the approach-withdraw model (Coan & Allen, 2004; Davidson, 1995), suggesting that left-sided frontal brain activity correlates with approach behaviour, while the right frontal area associates with withdrawal behaviours. Given that alpha activity reflects reduced brain activity, heightened alpha levels on the left side suggest diminished activity and thus, potentially signify a lack of approach behaviour. Both Luijtelaar et al. (2010) and Golonka et al. (2019) came to the same conclusion regarding the absence of FAA among those suffering from burnout. Thus, these findings may further support the idea that burnout should be considered a stand-alone syndrome (Brenninkmeijer et al., 2001; Glass & McKnight, 1996).

However, FAA's suitability for depression diagnostic purposes remains questionable (van der Vinne et al., 2017) due to numerous conflicting findings in the literature, possibly stemming from the unknown influence of gender (Bruder et al., 2017). Some researchers have identified gender impacts on FAA (Jesulola et al., 2017), while others have not (Smith et al., 2018). Furthermore, anxiety can potentially disrupt FAA, posing challenges in diagnosing depression (Nusslock et al., 2018). FAA appears to serve as an effective biomarker for certain symptoms, such as dysphoria and lassitude (Nelson et al., 2018), and in distinguishing pure depression from depression in the context of bipolar disorder (Nusslock et al., 2015). Nevertheless, its limited diagnostic power due to susceptibility to outside factors, particularly anxiety, necessitates further exploration in future studies before considering it for diagnostic prediction. Therefore, considering the inconsistent literature on alpha power and FAA as diagnostic features of depression, it appears that theta activity may represent an important discriminator between depression and burnout. For instance, as mentioned in the previous section, burnout was associated with normal theta activity while depression is characterised by theta deviations.

7.8 qEEG section conclusion

Overall, with the addition of the present findings, it appears that there is a lack of consistency among research focused on the qEEG correlates of burnout for the alpha, beta, and delta bands. Therefore, it is currently impossible to draw definite conclusions about the direction and existence of specific brain wave abnormalities in the burnout population, which signals the need for further exploration to establish reliable neurobiological markers of burnout. Of note, key factors to be considered when attempting to compare research findings on the qEEG correlates of burnout were identified and discussed, including differences in experimental conditions and approach to data analysis, differences in burnout severity and conceptualisation, differences in gender distribution, and the overall general appropriateness of qEEG norms used in the current literature. It was thus evident that the samples among the respective studies were not equivalent, and comparisons should be made with caution. Indeed, the pervasive issue related to the lack of an established and universally agreed-upon definition of burnout will continue to plague future studies aiming the explore the biological characteristics of burnout and restrict the ability to compare results. Biological investigations of burnout will inevitably be based on differing conceptualisations of the condition, which complicates the ability to draw reliable conclusions regarding its biological profile. This highlights the need for burnout researchers to commit to moving towards a unified definition of burnout. In this sense, biological investigations of the condition can be more valuable and effective in understanding the neurobiological profile of burnout and comparing its electrophysiological characteristics to that of depression. Therefore, although an argument can be made for theta activity as a possible discriminator between burnout and depression, the numerous complications linked to biological investigations of burnout suggest that it may be more appropriate to rely on the psychometric results (covering the full spectrum of burnout conceptualisations) that point to burnout and depression as representing a single underlying entity.

7.9 Strengths of the study

The exploration of academic burnout was an area in critical need of investigation as burnout currently represents a highly controversial concept but is nonetheless identified at considerably high levels among South African academic staff. This study was also the first to apply BAT-defined burnout in a psychometric investigation of academic burnout, thereby addressing a critical gap in the literature. Furthermore, the study was the first to examine how not only fatigue-related content overlap influences the strength of the burnout-depression relationship, but also how cognitive content overlap affects this relationship. This analytical approach permitted the assessment of previous suggestions stating that content overlap between measures of burnout and depression is likely the source of the strong relationship found between the two conditions (Maslach & Leiter, 2016). Finally, the study also attempted to address the considerable gap in the literature surrounding the qEEG correlates of burnout as only three previous studies on the topic were identified (Golonka et al., 2019; Luijtelaar et al., 2010; Tement et al., 2016).

All in all, it is the belief that the present findings assisted in the clarification of academic burnout, especially related to its biological characteristics and relationship with depression. By improving the overall understanding of the underlying nature of academic burnout, it is hoped that the current findings can be used to inform potentially effective interventions for addressing symptoms of the condition. However, when attempting to utilise the present findings in developing interventions for burnout, the key limitations of the study should be considered, which will be discussed in the next section.

7.10 Study limitations

Although the study had numerous strengths, it also had several major limitations. Firstly, the study used a convenience sampling strategy and participants thus consisted exclusively of academic staff from Wits. The survey component of the study could have been distributed to a wider sample of academic staff beyond Wits University. However, for feasibility and funding reasons, it was not possible to extend the reach of the qEEG component of the study to include a wider representation of academics across the country. Additionally, limiting the findings to one occupational group potentially threatens the external validity of the study as it relates to individuals with alternative occupations. That said, evidence of close associations between burnout and depression was also reported in previous studies based on a variety of occupational groups (Bianchi et al., 2015; Bianchi et al., 2021; Meier and Kim, 2022; Schonfeld et al., 2019a). For instance, in their systematic review and meta-analysis, Meier and Kim (2022) concluded by stating that the correlation found between measures of burnout and depression is indicative of a substantial overlap between the conditions. Importantly, the authors based their findings on educational employees, athletes, those working in the financial sector, mental health staff, nurses, probation officers, hospice workers, caregivers of dementia patients, and catholic clergy, amongst others. In addition, close associations between depression and burnout were also found among dentist (Ahola et al., 2014) and physician (Wurm et al., 2016) samples. We also note that, from a theoretical perspective, the patterns of burnout-depression correlations are not anticipated to differ considerably according to specific occupational settings (Bianchi & Schonfeld, 2018). Evidence of diverging qEEG profiles as a function of occupational fields could also not be found in the literature.

However, another potential limitation of the study as it relates to demographic factors was that most participants identified as White, female, and English-speaking academics, which were not adequately representative of the entire Wits academic population. As such, generalisation is cautioned. The inclusion of mostly female academics was especially problematic, as it might be feared that the results do not apply to predominantly male samples. Females are known to be at greater risk for both burnout (Artz et al., 2022) and depression (APA, 2013), which could have artificially inflated the association between the two conditions. Nevertheless, it should also be recognised that evidence of similar strong correlations between burnout and depression among samples consisting of larger proportions of men was also reported (Brenninkmeyer et al., 2001; Halpern et al., 2012; Jansson-Fröjmark & Lindblom, 2010; Trockel et al., 2018). However, the limitation of a predominantly female sample was also regarded as problematic in the context of qEEG findings. Previous research provided evidence of differential patterns of qEEG deviations occurring among men and women (Golonka et al., 2019; Tement et al., 2016). Future studies on the qEEG profile of burnout are therefore encouraged to view gender as an important moderating variable and should consider including an equal number of male and female participants. It is also however interesting to consider the sampling bias here and why this particular demographic group mostly responded to the invitation to participate in the study. The reasons behind the higher female participation in our study were explored in previous sections and included the possible influence of gender on behaviour in online environments, such as completing an online survey questionnaire (Smith, 2008).

A further limitation of this study was the low response rate and subsequent small sample size, resulting in issues of generalisation. The sample size of 55 academic staff was smaller than what is generally recommended for survey studies (350 participants) and correlational studies (70 participants; Cohen, 1992). These recommended sample sizes are estimates based on the number of participants required for statistical analysis to yield results that can be better generalised to the population from which the sample was selected (Creswell & Guetterman, 2019). The surveys were sent via the HR department and the low response rate suggests that alternative strategies should be considered when attempting to recruit academic staff. For example, study presentations and in-person study invitations at Faculty or department meetings. Frequent reminders to complete the survey could also be considered.

Of note, the low response rate and small sample size may also have led to an undercoverage bias (Bhandari, 2020) and/or a non-response bias (Stockemer et al., 2019), potentially skewing our results. For example, in the context of the co-morbidity hypothesis (burnout and depression representing two highly co-morbid syndromes), if participants likely to suffer from both burnout and depression mostly responded to the survey, the results would be skewed in favour of a close relationship between the conditions. However, the lack of discriminative validity of burnout versus depression found in the present study is consistent with a vast number of previous studies based on substantially larger sample sizes (Bianchi et al., 2015; Bianchi et al., 2021; Meier and Kim, 2022; Schonfeld et al., 2019a). Skewed results in this case thus seem unlikely. Nevertheless, future studies investigating the relationship between depression and specifically BAT-defined burnout are still needed to be able to draw safer conclusions due to the small sample size of the present study.

Furthermore, because of the small sample size, another key limitation of the study was the lack of inferential statistical tests that could have yielded more valuable information. For example, it would have been preferable to use a statistical test, such as a one-way ANOVA to explore whether there were any meaningful differences in burnout between the different levels of depression severity. In addition, it would also have been preferable to statistically compare the qEEG results of the burnout group with that of a local control group. However, due to the substantial limitation in the number of participants eligible for inclusion in the control group, a normative database was used instead. This normative database was provided by the qEEG-Pro software and derived from individuals residing in the Global North. Although evidence of variabilities in qEEG results according to geographical locations has never been investigated, it remains possible that the use of normative qEEG data from the global North in South African populations may have similar biases as found in neuropsychological testing (Laher & Cockcroft, 2019). Thus, since very little information exists, future studies are urged to make use of a local control group to counteract the need to use normative data.

A further study limitation is arguably related to the choice of research design, that is the use of only quantitative methods. Although a quantitative design was the most appropriate choice based on the study's aims, in retrospect, considering the high level of burnout found among our sample, it would have been valuable to add qualitative open-ended questions to the survey. A mixed-methods design would therefore have allowed us to summarise and understand the factors influencing the high levels of burnout among Wits academic staff that could have inspired changed conditions. As such, future studies on this aspect are needed to gain an improved understanding of the unique contextual factors South African academics are facing.

Moreover, it should also be considered that the degree of depressive symptomatology among the sample of academic staff members could have biased their responses on the MBI and BAT and inflated the correlation between the measures. However, our results, combined with prior research (e.g., Bianchi et al., 2014), seem to contradict this notion. If the level of depression influenced BAT and MBI responses, then it would be anticipated that the BDI would correlate similarly with the different dimensions of these measures. However, this was not observed. The BDI showed a stronger relationship with the emotional exhaustion subscale of the MBI compared to its relationship with depersonalisation and personal accomplishment. This occurred despite mixed scale items in the same instrument with the same response options, which were different from that of the BDI. A similar pattern emerged in the study by Bianchi et al. (2014), for example, using the MBI and PHQ-9 as a measure of depression.

Furthermore, when looking at the symptomatic overlap of depression and burnout, it should be mentioned that the identification of depressed individuals relied on answers to questionnaire items, rendering the diagnoses provisional. Although the BDI is supported by strong psychometric properties and developed under DSM criteria, a structured clinical interview remains the favoured approach for depression diagnosis (Ingram & Siegle, 2009). Nevertheless, Bianchi et al. (2013) compared a group of 46 participants identified as suffering from burnout to a group of 46 individuals professionally diagnosed with depression. The authors found no diagnostically significant difference between these two groups. Simply put, the results of this study showed that individuals with burnout and those with depression reported equivalent symptoms of depression.

Finally, it is worth mentioning our reservations regarding the BAT as a whole. Specifically, we found it perplexing that an average BAT score of 2.41 is categorised as indicating a high level of burnout, as such a score reflects burnout symptoms occurring between the frequencies of rarely and sometimes. We posit that a true indication of high burnout levels would entail symptoms experienced at least ‘often’. This raises concerns about the potential for an inflated identification of burnout within our sample.

7.11 Recommendations for future practices and research directions

The following sections contain recommendations that can be used to inform future research studies and practices within the field of occupational health.

7.11.1 Practical recommendations

In terms of electrophysiological findings, considering the large individual variabilities and inconsistent findings on the qEEG profile of burnout among academic staff, it is recommended that qEEG-based neurofeedback interventions be dependent on individual assessment instead of a common burnout profile. Regarding psychometric results, given the findings of the current study, and in view of the recent direction of research on the depression-burnout relationship (Bianchi et al., 2021; Meier & Kim, 2022; Schonfeld et al., 2019a; Schonfeld & Bianchi, 2022), the prospect of a shift in our understanding of burnout as an element of depression can be anticipated and is our recommendation. In other words, we recommend that occupational health clinicians focus on occupational depressive syndromes instead of burnout to identify and treat suffering academics more effectively.

This shift in the conceptualisation of burnout to occupational depression may ultimately be beneficial for several reasons. For example, various forms of depressive conditions have been extensively studied and are both diagnosable and treatable. In the event burnout signals a depressive syndrome emerging from the occupational context, academics suffering from 'burnout' may be able to benefit from the collection of effective treatment interventions for depression (Schonfeld & Bianchi, 2016). Although studies focusing on burnout interventions do exist (Awa et al., 2010), the calibre and quantity of these studies do not match the standards set by clinical trials designed to assess the effectiveness of interventions for depression (Leiter & Maslach, 2014; Naghieh et al., 2015; Ruotsalainen et al., 2008). In the context of neurofeedback, as mentioned previously, this approach does not rely on specific diagnoses but rather on knowledge of the underlying neural correlates of the condition targeted. Thus, effective neurofeedback protocols for burnout can be developed regardless of whether it is considered a condition in its own right or rather a form of occupational depression.

However, recommending a shift in occupational health research and practice from a focus on burnout to occupational depression might encounter certain criticisms. For example, depression is generally approached in a cause-neutral manner whereas the fundamental aim of developing the burnout phenomenon was to specifically understand work-related suffering (Kristensen et al., 2005; Leiter & Durup, 1994). Thus, we also caution that replacing burnout with occupational depression should not result in the over-individualisation of the problem by disconnecting academics from their occupational environment. Having said that, it should be recognised that depression originating from occupational distress is addressed by a newly developed measure of depression, the Occupational Depression Inventory (ODI; Bianchi & Schonfeld, 2020; Bianchi & Schonfeld, 2021; Bianchi & Schonfeld, 2022). The ODI is based on the DSM criteria for depression (APA, 2013) but also includes causal attributions to an individual's occupation. Thus, it can be used to quantify the degree of job-related depressive symptoms and can also be used to produce a provisional diagnosis of depression.

Taking into account structural and psychometric properties, the ODI is superior to burnout measures (Bianchi & Schonfeld, 2020; Bianchi & Schonfeld, 2021; Bianchi & Schonfeld, 2022). Additionally, Schonfeld and Bianchi (2022) reported that, according to the strong correlations between measures of burnout (MBI and CBI) and the ODI, it essentially measured the core symptoms of burnout while also capturing additional depressive symptoms not included in burnout measures, such as suicidality. On this note, considering the trend of research pointing to burnout as a depressive condition

(Ahola et al., 2014; Bianchi et al., 2020b; Rotenstein et al., 2020; Verkuilen et al., 2021; Wurm et al., 2016), the lack of reference to suicidality in burnout measures can be considered problematic. That is, clinicians and organisations attempting to identify burnout among academics may fail to recognise those with a serious risk of suicide, which may have devastating consequences (Center for Suicide Prevention, 2020; Schonfeld & Bianchi, 2022).

Therefore, the ODI can be regarded as effective in capturing burnout researchers' intention to evaluate work-related suffering while also overcoming the considerable issues associated with the burnout construct and its connected measures. For instance, as mentioned in the introductory chapter, burnout is not yet diagnostically defined. A variety of different definitions of the syndrome can be found in the literature with no consensus reached yet (Bianchi et al., 2019; Rotenstein et al., 2018). In contrast, the ODI is based on the widely employed DSM criteria for a diagnosis of depression. Therefore, with the use of the ODI, prevalence data relating to depression in different occupational environments can be obtained. The ODI is thus superior to burnout measures in this regard as the use of inconsistent burnout conceptualisations and measures prevents reliable prevalence estimations of this condition in different occupational settings (Bianchi et al., 2019; Schwenk & Gold, 2018). In turn, the lack of reliable prevalence data constitutes a significant issue for decision-makers and regulators requiring appropriate information to allocate often limited interventional resources (Bianchi et al., 2019; Rotenstein et al., 2018). In contrast, a focus on occupational depression provides clear and universal diagnostic criteria that can be used to identify work-related suffering among individuals or certain occupational settings where work-related suffering is highly prevalent. Information obtained in this way is needed to make authoritative health policy decisions (Bianchi et al., 2021).

7.11.2 Recommendations for future research

According to the results and limitations of our study, several recommendations for future studies emerged. Firstly, considering the high levels of burnout found in the present sample of Wits academic staff, qualitative studies specifically attempting to uncover the specific stressors contributing to work-related distress among South African academics may offer critical information on this topic. Secondly, concerning the psychometric investigation of academic burnout, our findings in this area provided undeniable evidence of the high probability that burnout may be best understood as a depressive syndrome. However, considering the small sample size of the present study, future studies investigating the relationship between depression and BAT-defined burnout are still needed to be able to draw safer conclusions about the conceptual generalisation of the burnout-depression relationship. Relatedly, categorical symptomatic comparisons, based on larger sample sizes, between depressed participants and those scoring above the recommended cut-off of four for BAT-defined burnout are needed.

Thirdly, more studies on academic burnout from a biological perspective are needed as such studies are currently scarce (Koutsimani et al., 2019). Biological investigations of academic burnout are likely to contribute to the psychometric results that may offer additional clarification of the condition. In addition, when investigating the biological characteristics of academic burnout, it becomes vital to ensure comparable use of burnout conceptualisations. If burnout is to be continuously used to understand work-related suffering, a call should be made to researchers to move towards a universally agreed-upon burnout definition.

For example, as mentioned in the section on qEEG findings of burnout, different criteria applied to identify cases of burnout may have been one source of conflicted findings. Thus, considering the scarcity of studies investigating the qEEG profile of burnout, more research in this regard is needed to gain more reliable data with consistent burnout conceptualisations. Alternatively, it is also recommended that future studies focus on occupational depression among academics, as captured by the previously mentioned ODI, when attempting to generate knowledge about the qEEG profile of burnout. This may ultimately lead to more comparable studies and subsequently more effective advancement of electrophysiological knowledge on academic burnout (or occupational depression). Future studies on the qEEG correlates of burnout or occupational depression conducted in South Africa are also urged to compare findings to that of a South African age- and gender-matched control group rather than a normative database. As mentioned previously, it is currently unknown whether difficulties may arise in using normative data from the Global North for neuroimaging methods. Finally, future research studies are also recommended to directly investigate patterns of theta activity between burnout and depressive groups, and the possible mechanisms underlying it, whilst recognising that different subtypes of depression may present with different neurobiological profiles.

7.12 Chapter conclusion

The present study adopted the most recently developed conceptualisation of burnout using a relatively understudied sample of academic staff to address the main aim of exploring academic burnout in South Africa with both qEEG and psychometric methods. Academic staff, in general, represent an understudied population in the burnout literature, with an additional strength of this study is its placement in the context of the Global South. From the psychometric perspective, the results of the study support the notion that the relationship between burnout and depression is highly complex and multifaceted. As this was a pilot study investigation with a small sample size, only tentative conclusions can be drawn. However, the similarities found among the symptomatic profiles of burnout and depression and the strong significant correlations between measures of both conditions suggest a large degree of symptom overlap. Here, it should be noted that the results of this study do not suggest that the two conditions are identical but rather that burnout, across its varied conceptualisations, only captures certain aspects of depression. The nature of the relationship between burnout and depression merits further investigation to tease out the nuances of the directionality of this relationship, the contextual factors involved, and the implications for any intervention for burnout. The results of this study also highlight the need for a more focused working definition of burnout. A focus on BAT-defined burnout for future studies, as this is arguably the most comprehensive definition of burnout in the literature to date, may prove to be an effective approach.

From an electrophysiological perspective, we also aimed to explore academic burnout in this regard as similar studies in the literature are severely lacking and inconsistent. Overall, with the addition of the present findings, it appears that there is a lack of consistency among research focused on the qEEG correlates of burnout for the alpha, beta, and delta bands. However, although no qEEG deviations were found on average among our sample, the fact that most participants presented with elevated beta and delta activity signifies the need for further exploration in this regard. As elevated beta activity is commonly found among those experiencing extreme stress, it was reasoned that this finding among our group of academic staff scoring high on burnout was a sensible result. For the delta frequency, increased activity is commonly associated with cognitive and emotional difficulties, which are captured in the BAT as symptoms of burnout and, therefore, likely to play a role in burnout symptomology. Nevertheless, the scarce and inconsistent literature on the qEEG correlates of burnout highlights the need for similar future studies. However, we also mentioned that qEEG findings based on different conceptualisations of burnout, as well as the potential high commodity and symptom overlap with depression, will continue to hinder the ability to compare results and move this direction of research forward. Taken together, the results from this pilot study suggest that neurofeedback interventions for those presenting with burnout symptoms be based on individual assessment rather than a common, group-level, burnout profile. In addition, considering the numerous challenges linked to the construct of burnout together with the potential high comorbidity with depression, we believe that a focus on occupational depression, rather than burnout, will be more valuable in understanding work-related suffering among academics.

REFERENCES

Adekola, B. (2012). The Impact of Organizational Commitment on Job Satisfaction: A Study of Employees at Nigerian Universities. *International Journal of Human Resource Studies, 2*(2), 1-17. https://doi.org/10.5296/ijhrs.v2i2.1740

Adriaenssens, J., De Gucht, V., & Maes, S. (2015). Determinants and prevalence of burnout in emergency nurses: A systematic review of 25 years of research. *International Journal of Nursing Studies, 52*(2), 649–661. https://doi.org/10.1016/j.ijnurstu.2014.11.004

Ahola, K., & Hakanen, J. (2007). Job strain, burnout, and depressive symptoms: A prospective study among dentists. *Journal of Affective Disorders, 104*(1), 103-110. https://doi.org/10.1016/j.jad.2007.03.004

Ahola, K., Hakanen, J. J., Perhoniemi, R., & Mutanen, P. (2014). Relationship between burnout and depressive symptoms: A study using the person-centred approach. *Burnout Research, 1*(1), 29–37. https://doi.org/10.1016/j.burn.2014.03.003

Ahola, K., Honkonen, T., Isometsä, E., Kalimo, R., Nykyri, E., Aromaa, A., & Lonnqvist, J. (2005). The relationship between job-related burnout and depressive disorders—Results from the Finnish Health 2000 Study. *Journal of Affective Disorders, 88*(1), 55–62. https://doi.org/10.1016/j.jad.2005.06.004

Ahola, K., Toppinen-Tanner, S., & Seppänen, J. (2017). Interventions to alleviate burnout symptoms and to support return to work among employees with burnout: Systematic review and meta-analysis. *Burnout Research, 4*, 1–11. https://doi.org/10.1016/j.burn.2017.02.001

Alkoby, O., Abu-Rmileh, A., Shriki, O., & Todder, D. (2018). Can we predict who will respond to neurofeedback? A review of the inefficacy problem and existing predictors for successful EEG Neurofeedback Learning. *Neuroscience, 378*, 155–164. https://doi.org/10.1016/j.neuroscience.2016.12.050

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th edition ed.). American Psychiatric Publishing.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th edition ed.). American Psychiatric Publishing.

Angelini, G., Buonomo, I., Benevene, P., Consiglio, P., Romano, L., & Fiorilli, C. (2021). The Burnout Assessment Tool (BAT): A contribution to Italian validation with teachers. *Sustainability, 13*(16), 9065. https://doi.org/10.3390/su13169065

Artz, B., Kaya, I., & Kaya, O. (2022). Gender role perspectives and job burnout. *Review of Economics of the Household, 20*(2), 447–470. https://doi.org/10.1007/s11150-021-09579-2

Asiwe, D. N., Jorgensen, L. I., & Hill, C. (2014). The development and investigation of the Psychometric Properties of a burnout scale within a South African agricultural research institution. *SA Journal of Industrial Psychology, 40*(1), Article 1194. https://doi.org/10.4102/sajip.v40i1.1194

Awa, W. L., Plaumann, M., & Walter, U. (2010). Burnout prevention: A review of intervention programs. *Patient Education and Counseling, 78*(2), 184–190. https://doi.org/10.1016/j.pec.2009.04.008

Bakker, A. B., Demerouti, E., & Verbeke, W. (2004). Using the job demands-resources model to predict burnout and performance. *Human Resource Management, 43*(1), 83–104. https://doi.org/10.1002/hrm.20004

Bakker, A. B., Schaufeli, W. B., Demerouti, E., Janssen, P. P. M., Van Der Hulst, R., & Brouwer, J. (2000). Using equity theory to examine the difference between burnout and depression. *Anxiety, Stress and Coping, 13*(3), 247–268. http://dx.doi.org/10.1080/10615800008549265

Banda, B. C., & Malinga, W. (2021). Coronavirus (COVID-19) and women in higher education in a South African University: Academic and social implications. *African Journal of Gender, Society and Development, 10*(1), 7–34. https://doi.org/10.31920/2634-3622/2021/v10n1a1

Barkhuizen, N., Rothmann, S., & van de Vijver, F. J. (2013). Burnout and work engagement of academics in higher education institutions: Effects of dispositional optimism. *Stress and Health, 30*(4), 322–332. https://doi.org/10.1002/smi.2520

Barry, R. J., Clarke, A. R., Johnstone, S. J., Magee, C. A., & Rushby, J. A. (2007). EEG differences between eyes-closed and eyes-open resting conditions. *Clinical Neurophysiology, 118*(12), 2765–2773. https://doi.org/10.1016/j.clinph.2007.07.028

Beck, A. T., & Alford, B. A. (2009). *Depression: Causes and treatment* (2nd ed.). University of Pennsylvania Press.

Beck, A. T., & Beamesderfer, A. (1974). Assessment of depression: The depression inventory. In P. Pichot & R. Olivier-Martin (Eds.), *Psychological measurements in psychopharmacology*. S. Karger. https://doi.org/10.1159/000395074

Beck, A. T., Steer, R. A., & Brown, G. (1996). *Beck Depression Inventory–II (BDI-II)*. APA PsycTests. https://doi.org/10.1037/t00742-000

Begić, D., Popović-Knapić, V., Grubišin, J., Kosanović-Rajačić, B., Filipčić, I., Telarović, I., & Jakovljević, M. (2011). Quantitative electroencephalography in schizophrenia and depression. *Psychiatria Danubina, 23*(4), 355-362.

Belanoff, J.K., Gross, K., Yager, A., & Schatzberg A. F. (2001). Corticosteroids and cognition. Journal of Psychiatric Research, 35(3), 127-145. https://doi.org/10.1016/s0022-3956(01)00018-8

Bennett, C. N., Gupta, R. K., Prabhakar, P., Christopher, R., Sampath, S., Thennarasu, K., & Rajeswaran, J. (2017). Clinical and biochemical outcomes following EEG neurofeedback training in traumatic brain injury in the context of spontaneous recovery. *Clinical EEG and Neuroscience, 49*(6), 433–440. https://doi.org/10.1177/1550059417744899

Bennett, C. M., Lambie, G. W., Bai, H., & Hundley, G. (2022). Neurofeedback Training to Address College Students' Symptoms of Anxiety and Stress: A Quasi-Experimental Design. *Journal of College Student Psychotherapy, 36*(2), 170-189. https://doi.org/10.1080/87568225.2020.1791777

Bhandari, P. (2020, March 17). *Sampling bias and how to avoid it: Types & examples*. Scribbr. https://www.scribbr.com/methodology/sampling-bias/

Bianchi, R. (2016). Burnout is associated with a depressive cognitive style. *Stress and Health, 35*(5), 642-649. https://doi.org/10.1016/j.paid.2016.01.008

Bianchi, R. (2020). Do burnout and depressive symptoms form a single syndrome? Confirmatory factor analysis and exploratory structural equation modeling bifactor analysis. *Journal of Psychosomatic Research, 131*, Article 109954. https://doi.org/10.1016/j.jpsychores.2020.109954

Bianchi, R., Boffy, C., Hingray, C., Truchot, D., & Laurent, E. (2013). Comparative symptomatology of burnout and depression. *Journal of Health Psychology, 18*(6), 782–787. https://doi.org/10.1177/1359105313481079

Bianchi, R., & Brisson, R. (2017). Burnout and depression: Causal attributions and construct overlap. *Journal of Health Psychology, 24*(11), 1574–1580. https://doi.org/10.1177/1359105317740415

Bianchi, R., & Laurent, E. (2015). Emotional information processing in depression and burnout: An eye-tracking study. *European Archives of Psychiatry and Clinical Neuroscience, 265*(1), 27–34. https://doi.org/10.1007/s00406014-0549-x

Bianchi, R., Laurent, E., Schonfeld, I. S., & Bietti L. M. (2020a). Memory bias toward emotional information in burnout and depression. *Journal of Health Psychology, 25*(10), 1567-1575. https://doi.org/10.1177/135910531876 5621

Bianchi, R., Laurent, E., Schonfeld, I.S., Verkuilen, J., & Berna, C. (2018). Interpretation bias toward ambiguous information in burnout and depression. *Personality and Individual Differences, 135*, 216–221. https://doi.org/10.1016/j.paid.2018.07.028

Bianchi, R., & Schonfeld, I. S. (2018). Burnout-depression overlap: Nomological network examination and factor-analytic approach. *Scandinavian Journal of Psychology, 59*(5), 532-539. https://doi.org/10.1111/sjop.12460

Bianchi, R., & Schonfeld, I. S. (2020). The occupational depression inventory: a new tool for clinicians and epidemiologists. *Journal of Psychosomatic Research, 138,* Article 110249. https://doi.org/10.1016/j.jpsychores.2020.110249

Bianchi, R., & Schonfeld, I. S. (2021). The occupational depression inventory—a solution for estimating the prevalence of job-related distress. *Psychiatry Research, 305*, Article 114181. https://doi.org/10.1016/j.psychres.2021.114181

Bianchi, R., & Schonfeld, I. S. (2022). Is the Occupational Depression Inventory predictive of cognitive performance? A focus on inhibitory control and effortful reasoning. *Personality and Individual Differences, 184*, Article 111213. https://doi.org/10.1016/j.paid.2021.111213

Bianchi, R., Schonfeld, I. S., & Laurent, E. (2014). Is Burnout a depressive disorder? A re-examination with special focus on atypical depression. *International Journal of Stress Management, 21*(4), 307–324. https://doi.org/10.1037/a0037906

Bianchi, R., Schonfeld, I. S., & Laurent, E. (2015). Burnout–Depression Overlap: A Review. *Clinical Psychology Review, 36*, 28-41. https://doi.org/10.1016/j.cpr.2015.01.004

Bianchi, R., Schonfeld, I. S., & Laurent, E. (2019). Burnout: Moving beyond the status quo. *International Journal of Stress Management, 26*(1), 36-45. https://doi.org/10.1037/str0000088

Bianchi, R., Schonfeld, I. S., & Verkuilen, J. (2020b). A five-sample confirmatory factor analytic study of burnout-depression overlap. *Journal of Clinical Psychology, 76*(4), 801-821. https://doi.org/10.1002/jclp.22927

Bianchi, R., Verkuilen, J., Brisson, R., Schonfeld, I. S., & Laurent, E. (2016). Burnout and depression: Label-related stigma, help-seeking, and syndrome overlap. *Psychiatry Research, 245*, 91–98. http://dx.doi.org/10.1016/j.psychres.2016.08.025

Bianchi, R., Verkuilen, J., Schonfeld, I. S., Hakanen, J. J., Jansson-Fröjmark, M., Manzano-García, G., Laurent, E., & Meier, L. L. (2021). Is burnout a depressive condition? A 14-sample meta-analytic and bifactor analytic study. *Clinical Psychological Science, 9*(4), 579–97. https://doi.org/10.1177/2167702620979597

Blix, E., Perski, A., Berglund, H., & Savic, I. (2013). Long-term occupational stress is associated with regional reductions in brain tissue volumes. *PLoS ONE, 8*(6), Article e64065. https://doi.org/10.1371/journal.pone.0064065

Brenninkmeyer, V., Van Yperen, N. W., & Buunk, B. P. (2001). Burnout and depression are not identical twins: Is decline of superiority a distinguishing feature? *Personality and Individual Differences, 30*(5), 873–880. https://doi.org/10.1016/s0191-8869(00)00079-9

Bruder, G. E., Stewart, J. W., & McGrath, P. J. (2017). Right brain, left brain in depressive disorders: Clinical and theoretical implications of behavioural, electrophysiological and neuroimaging findings. *Neuroscience and Biobehavioral Reviews, 78*, 178-191. https://doi.org/10.1016/j.neubiorev.2017.04.021

Brunsting, N. C., Sreckovic, M. A., & Lane, K. L. (2014). Special education teacher burnout: A Synthesis of Research from 1979 to 2013. *Education & Treatment of Children, 37*(4), 681–712. https://doi.org/10.1353/etc.2014.0032

Bryan, C., Goodman, T., Chappelle, W., Thompson, W., & Prince, L. (2017). Occupational stressors, Burnout, and predictors of suicide ideation among U.S. Air Force Remote Warriors. *Military Behavioral Health, 6*(1), 3-12. https://doi.org/10.1080/21635781.2017.1325803

Bryman, A. (2016). *Social Research Methods*. Oxford University Press.

Byrne, M., Chughtai, A., Flood, B., Murphy, E., & Willis, P. (2013). Burnout among accounting and finance academics in Ireland. *International Journal of*

Educational Management, *27*(2), 127–142. https://doi.org/10.1108/09513541311297513

Cai, H., Sha, X., Han, X., Wei, S., & Hu, B. (2017). Pervasive EEG diagnosis of depression using Deep Belief Network with three-electrodes EEG collector. *IEEE International Conference on Bioinformatics and Biomedicine*, 1239–1246. https://doi.org/10.1109/BIBM.2016.7822696.

Calkins, A. W., Rogers, A. H., Campbell, A. A., & Simon, N. M. (2015). Comorbidity of anxiety and depression. In K. J. Ressler, D. S. Pine, & B. O. Rothbaum (Eds.), *Anxiety disorders: Translational perspectives on diagnosis and treatment* (pp. 299–314). Oxford University Press. https://doi.org/10.1093/med/9780199395125.003.0021

Campbell, A. M., Mattoni, M., Yefimov, M. N., Adapa, K., & Mazur, L. M. (2020). Improving cognitive workload in radiation therapists: A pilot EEG Neurofeedback Study. *Frontiers in Psychology, 11,* Article 571739. https://doi.org/10.3389/fpsyg.2020.571739

Catano, V., Francis, L., Haines, T., Kirpalani, H., Shannon, H., Stringer, B., & Lozanzki, L. (2010). Occupational stress in Canadian universities: A national survey. *International Journal of Stress Management,* *17*(3), 232–258. https://doi.org/10.1037/a0018582

Center for Suicide Prevention. (2020). *The workplace and suicide prevention*. https://www.suicideinfo.ca/resource/workplace-suicide-prevention/

Chodorow, N. (1978). *The Reproduction of Mothering*. University of California Press.

Choi, Y.J., Choi, E. J., & Ko, E. (2023). Neurofeedback Effect on Symptoms of Posttraumatic Stress Disorder: A Systematic Review and Meta-Analysis. Applied Psychophysiology and Biofeedback, 48(3), 259-274. https://doi.org/10.1007/s10484-023-09593-3.

Coan, J., & Allen, J. (2004). Frontal EEG asymmetry as a moderator and mediator of emotion. *Biological Psychology,* *67*(2), 7-50. https://doi.org/10.1016/j.biopsycho.2004.03. 002. cited By 668.

Coetzee, N., Maree, D. J. F., & Smit, B. N. (2019). The relationship between chronic fatigue syndrome, burnout, job satisfaction, social support and age among academics at a tertiary institution. *International Journal of Occupational Medicine and Environmental Health,* *32*(1), 75-85. https://doi.org/10.13075/ijomeh.1896.01274

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155

Colby, L., Mareka, M., Pillay, S., Sallie, F., Van Staden, C., Du Plessis, E. D., & Joubert, G. (2018). The association between the levels of burnout and quality of life among fourth-year medical students at the University of the Free State. *South African Journal of Psychiatry, 24*, article 1101. https://doi.org/10.4102/sajpsychiatry.v24i0.1101

Collura, T. F. (2016). Live z-score neurofeedback. *Biofeedback, 44*(4), 212-217. https://doi.org/10.5298/1081-5937-44.4.01

Cordes, C. L., & Dougherty, T. W. (1993). A review and an integration of research on job burnout. *The Academy of Management Review, 18*(4), 621–656. https://doi.org/10.2307/258593

Creswell, J. W., & Guetterman, T. C. (2019). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson.

Curtin, R., Presser, S., & Singer, E. (2000). The effects of response rate changes on the index of consumer sentiment. *Public Opinion Quarterly, 64*(4), 413–428. https://doi.org/10.1086/318638

Czerniewicz, L., Trotter, H., & Haupt, G. (2019). Online teaching in response to student protests and campus shutdowns: Academics' perspectives. *International Journal of Educational Technology in Higher Education, 16*(1), Article 43. https://doi.org/10.1186/s41239-019-0170-1

Dahlin, M., & Runeson, B. (2007). Burnout and psychiatric morbidity among medical students entering clinical training: A three-year prospective questionnaire and interview-based study. *BMC Medical Education, 7*(1), Article 6. https://doi.org/10.1186/1472-6920-7-6

Davidson, R. J. (1995). Cerebral asymmetry, emotion, and affective style. In R. J. Davidson & K. Hugdahl (Eds.), *Brain asymmetry* (pp. 361–387). The MIT Press.

de Aguiar Neto, F. S., & Rosa, J. L. (2019). Depression biomarkers using non-invasive EEG: A Review. *Neuroscience & Biobehavioral Reviews, 105*, 83–93. https://doi.org/10.1016/j.neubiorev.2019.07.021

De Beer, L. T. (2021). Is there utility in specifying professional efficacy as an outcome of burnout in the employee health impairment process. *International Journal of Environmental Research and Public Health, 18*(12), Article 6255. https://doi.org/10.3390/ijerph18126255

De Beer, L. T., & Bianchi, R. (2019). Confirmatory factor analysis of the Maslach burnout inventory: A Bayesian structural equation modeling approach. *European Journal of Psychological Assessment, 35*(2), 217–224. https://doi.org/10.1027/1015-5759/a000392

De Beer, L. T., Pienaar, J., & Rothmann, S. (2016). Job burnout, work engagement and self-reported treatment for health conditions in south Africa: Self-reported health conditions in South Africa. *Stress Health, 32*(1), 36–46. https://doi.org/10.1002/smi.2576

De Beer, L. T., Schaufeli, W. B., & De Witte, H. (2022). The psychometric properties and measurement invariance of the Burnout Assessment Tool (BAT-23) in South Africa. *BMC Public Health, 22*(1), Article 1555. https://doi.org/10.1186/s12889-022-13978-0

de Beer, L. T., Schaufeli, W. B., De Witte, H., Hakanen, J. J., Shimazu, A., Glaser, J., Seubert, C., Bosak, J., Sinval, J., & Rudnev, M. (2020). Measurement invariance of the Burnout Assessment Tool (BAT) across seven cross-national representative samples. *International Journal of Environmental Research and Public Health, 17*(15), 1-14. https://doi.org/10.3390/ijerph17155604

de Koning, R., Egiz, A., Kotecha, J., Ciuculete, A. C., Ooi, S. Z., Bankole, N. D., Erhabor, J., Higginbotham, G., Khan, M., Dalle, D. U., Sichimba, D., Bandyopadhyay, S., & Kanmounye, U. S. (2021). Survey fatigue during the COVID-19 pandemic: An analysis of neurosurgery survey response rates. *Frontiers in Surgery, 8*, article 690680. https://doi.org/10.3389/fsurg.2021.690680

Deligkaris, P., Panagopoulou, E., Montgomery, A. J., & Masoura, E. (2014). Job burnout and cognitive functioning: A systematic review. *Work and Stress, 28*(2), 107-123. https://doi.org/10.1080/02678373.2014.909545

Demerouti, E. (1999). *Oldenburg Burnout Inventory*. APA PsycTests. https://doi.org/10.1037/t01688-000

Demerouti, E., Bakker, A. B., Vardakou, I., & Kantas, A. (2003). The convergent validity of two burnout instruments: A multitrait-multimethod analysis. *European Journal of Psychological Assessment, 19*(1), 12-23. https://doi.org/10.1027//10155759.19.1.12.

Demos, J. N. (2005). *Getting started with neurofeedback*. W.W. Norton & Company.

Department of Health. (2015). *Ethics in Health Research: Principles, Processes and Structures.* https://www.sun.ac.za/english/faculty/healthsciences/rdsd/Documents/Ethics/DoH%202015%20Ethics%20in%20Health%20Research%20-%20Principles,%20Processes%20and%20Structures%202nd%20Ed.pdf

Dillman, D. A. (2007). *Mail and internet surveys: The tailored design method* (2nd ed.). John Wiley & Sons Inc.

Dinu, L. M., Dommett, E. J., Baykoca, A., Mehta, K. J., Everett, S., Foster, J. L. H., & Byrom, N. C. (2021). A case study investigating mental wellbeing of university academics during the covid-19 pandemic. *Education Sciences, 11*(11), Article 702. https://doi.org/10.3390/educsci11110702

Discovery 24 Series. (n.d.). BrainMaster Technologies Inc. *SA Journal of Industrial Psychology, 30*(3), 29–40. https://brainmaster.com/product/discovery-24/

Dolsen, M. R., Cheng, P., Arnedt, J. T., Swanson, L., Casement, M. D., Kim, H. S., Goldschmied, J. R., Hoffmann, R. F., Armitage, R., & Deldin, P. J. (2017). Neurophysiological correlates of suicidal ideation in major depressive disorder: Hyperarousal during sleep. *Journal of Affective Disorders, 212*, 160-166. https://doi.org/10.1016/j.jad.2017.01.025

Duan-Porter, W., Hatch, D., Pendergast, J. F., Freude, G., Rose, U., Burr, H., Muller, G., Martus, P., Pohrt, A., & Potter, G. (2018). 12-Month trajectories of depressive symptoms among nurses: Contribution of personality, job characteristics, coping, and burnout. *Journal of Affective Disorders, 234*, 67-73. https://doi.org/10.1016/j.jad.2018.02.090

Dunham, C. M., Burger, A. L., Hileman, B. M., Chance, E. A., Hutchinson, A. E., Kohli, C. M., DeNiro, L., Tall, J. M., & Lisko, P. (2019). Brainwave self-regulation during Bispectral index neurofeedback in trauma center nurses and physicians after receiving mindfulness instructions. *Frontiers in Psychology, 10*, Article 2153. https://doi.org/10.3389/fpsyg.2019.02153

Edú-Valsania, S., Laguía, A., & Moriano, J. A. (2022). Burnout: A review of theory and measurement. *International Journal of Environmental Research and Public Health, 19*(3), Article 1780. https://doi.org/10.3390/ijerph19031780

England, P. (1989). A Feminist Critique of Rational Choice Theories: Implications for Sociology. *American Sociologist, 20*(1), 14-22. http://www.jstor.org/stable/27698446

Enriquez-Geppert, S., Huster, R. J., & Herrmann, C. S. (2017). EEG-Neurofeedback as a tool to modulate cognition and behavior: A review tutorial. *Frontiers in Human Neuroscience, 11*, Article 51. https://doi.org/10.3389/fnhum.2017.00051

Epstein, E. G., Haizlip, J., Liaschenko, J., Zhao, D., Bennett, R., & Marshall, M. F. (2020). Moral distress, mattering, and secondary traumatic stress in provider Burnout: A call for moral community. *AACN Advanced Critical Care, 31*(2), 146-157. https://doi.org/10.4037/aacnacc2020285

Fedotchev, A. I., Parin, S. B., & Polevaya, S. A. (2021). Adaptive neurostimulation methods in correcting posttraumatic stress disorder and professional burnout syndrome. *Opera Medica et Physiologica, 8*(2), 68-74. https://doi.org/10.24412/250022952021-2-68-74

Ferrett, H. L., Thomas, K. G., Tapert, S. F., Carey, P. D., Conradie, S., Cuzen, N. L., Stein, D. L., & Fein, G. (2014). The cross-cultural utility of foreign-and locally-derived normative data for three WHO-endorsed neuropsychological tests for South African adolescents. *Metabolic brain disease, 29*(2), 395-408. https://doi.org/10.1007/s11011-014-9495-6

Feuerhahn, N., Stamov-Roßnagel, C., Wolfram, M., Bellingrath, S., & Kudielka, B. M. (2013). Emotional exhaustion and cognitive performance in apparently healthy teachers: a longitudinal multi-source study. Stress and Health, 29(4), 297-306. https://doi.org/10.1002/smi.2467

Field, A. (2018). *Discovering statistics using IBM SPSS statistics: North American edition*. SAGE.

First, M. B., Spitzer, P. L., & Gibbon, M. (1997). *Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I)—Clinician Version*. American Psychiatric Publishing.

Fischer, N. L., Peres, R., & Fiorani, M. (2018). Frontal alpha asymmetry and Theta oscillations associated with information sharing intention. *Frontiers in Behavioral Neuroscience, 12*, article 166. https://doi.org/10.3389/fnbeh.2018.00166

Fonseca, L. C., Tedrus, G. M., Bianchini, M. C., & Silva, T. F. (2013). Electroencephalographic alpha reactivity on opening the eyes in children with attention-deficit hyperactivity disorder. *Clinical EEG and Neuroscience, 44*(1), 53-57. https://doi.org/10.1177/1550059412445659

Freud, S. (1905). *Fragment of an analysis of a case of hysteria*. Vintage.

Freudenberger, H. J. (1974). Staff burnout. *Journal of Social Issues, 30*(1), 159-165. https://doi.org/10.1111/j.1540-4560.1974.tb00706.x

Freudenberger, H. J. (1975). The staff burn-out syndrome in alternative institutions. *Psychotherapy: Theory, Research & Practice, 12*(1), 73-82. https://doi.org/10.1037/h0086411

Freudenberger, H. J., & Richelson, G. (1980). *Burnout: How to beat the high cost of success.* Bantam Books.

Friberg, T. (2009). Burnout: From popular culture to psychiatric diagnosis in Sweden. *Culture, Medicine, and Psychiatry, 33*(4), 538-558. https://doi.org/10.1007/s11013-009-9149-z

Fries, E., Hesse, J., Hellhammer, J., & Hellhammer, D. H. (2005). A new view on hypocortisolism. *Psychoneuroendocrinology, 30*(10), 1010-1016. https://doi.org/10.1016/j.psyneuen.2005.04.006

Frith, U. (2020). Fast lane to slow science. *Trends in Cognitive Sciences, 24*(1), 1–2. https://doi.org/10.1016/j.tics.2019.10.007

Fynn, A., & Van der Walt, H. D. (2023). Examining staff burnout during the transition to teaching online due to COVID-19 implications. *SA Journal of Human Resource Management/SA Tydskrif vir Menslikehulpbronbestuur, 21*(0), Article e2062. https://doi.org/10.4102/sajhrm.v21i0.2062

García-Carmona, M., Marín, M. D., & Aguayo, R. (2019). Burnout Syndrome in Secondary School Teachers: A systematic review and meta-analysis. *Social Psychology of Education, 22*(1), 189–208. https://doi.org/10.1007/s11218-018-9471-9

Gérain, P., & Zech, E. (2020). Do informal caregivers experience more burnout? A meta-analytic study. *Psychology, Health & Medicine, 26*(2), 145–161. https://doi.org/10.1080/13548506.2020.1803372

George, T. (2021, December 6). *Exploratory Research | Definition, Guide, & Examples*. Scribbr. https://www.scribbr.com/methodology/exploratory-research/#:~:text=Exploratory%20research%20is%20a%20methodology,can%20be%20quantitative%20as%20well

Gewin, V. (2021). Pandemic burnout is rampant in academia. *Nature, 591*(7850), 489-491. https://doi.org/10.1038/d41586-021-00663-2

Ghorpade, J., Lackritz, J., & Singh, G. (2007). Burnout and personality: Evidence from academia. *Journal of Career Assessment, 15*(2), 240-256. https://doi.org/10.1177/1069072706298156

Gillespie, N. A., Walsh, M., Winefield, A. H., Dua, J., & Stough, C. (2001). Occupational stress in universities: Staff perceptions of the causes, consequences and moderators of stress. *Work & Stress, 15*(1), 53-72. https://doi.org/10.1080/02678370110062449

Giorgi, G., Arcangeli, G., Perminiene, M., Lorini, C., Ariza-Montes, A., Fiz-Perez, J., Di Fabio, A., & Mucci, N. (2017). Work-related stress in the banking sector: A review of incidence, correlated factors, and major consequences. *Frontiers in Psychology, 8*, Article 2166. https://doi.org/10.3389/fpsyg.2017.02166

Glass, D. C., & McKnight, J. D. (1996). Perceived control, depressive symptomatology, and professional burnout: A review of the evidence. *Psychology & Health, 11*(1), 23-48. https://doi.org10.1080/08870449608401975

Gmelch, W. H., Lovrich, N. P., & Wilke, P. K. (1984). Sources of stress in academe: A national perspective. *Research in Higher Education, 20*(4), 477–490. https://doi.org/10.1007/BF00974924

Gold, Y., Bachelor, P. A., & Michael, W. B. (1989). The dimensionality of a modified form of the Maslach Burnout Inventory for university students in a teacher-training program. *Educational and Psychological Measurement, 49*(3), 549-561. https://doi.org/10.1177/0013164489049003005

Gold, P. W., & Chrousos, G. P. (2002). Organization of the stress system and its dysregulation in melancholic and atypical depression: High vs low CRH/NE states. *Molecular Psychiatry, 7*(3), 254-275. https://doi.org/10.1038/sj.mp.4001032

Golkar, A., Johansson, E., Kasahara, M., Osika, W., Perski, A., & Savic, I. (2014). The influence of work-related chronic stress on the regulation of emotion and on functional connectivity in the brain. *PLoS ONE, 9*(9), Article 104550. https://doi.org/10.1371/journal.pone.0104550

Golonka, K., Gawlowska, M., Mojsa-Kaja, J., & Marek, T. (2019). Psychophysiological characteristics of burnout syndrome: Resting-state EEG analysis. *BioMed Research International, 2019*, Article 3764354. https://doi.org/10.1155/2019/3764354

Golonka, K., Mojsa-Kaja, J., Gawlowska, M., & Popiel, K. (2017). Cognitive impairments in occupational burnout – error processing and its indices of reactive and proactive control. *Frontiers in Psychology, 8*(676), 1-13 https://doi.org/10.3389/fpsyg.2017.00676

Golonka, K., Mojsa-Kaja, J., Marek, T., & Gawlowska, M. (2018). Stimulus, response and feedback processing in burnout – an EEG study. *International Journal of Psychophysiology, 134*, 86–94. https://doi.org/10.1016/j.ijpsycho.2018.10.009

Green, D. E., & Walkey, F. H. (1988). A confirmation of the three-factor structure of the Maslach Burnout Inventory. *Educational and Psychological Measurement, 48*(3), 579–585. https://doi.org/10.1177/0013164488483002

Green, D. E., Walkey, F. H., & Taylor, A. J. (1991). The three-factor structure of the Maslach Burnout Inventory: A multicultural, multinational confirmatory study. *Journal of Social Behavior & Personality, 6*(3), 453–472.

Grow, H. M., McPhillips, H. A., & Batra, M. (2019). Understanding physician burnout. *Current Problems in Pediatric and Adolescent Health Care, 49*(11), Article 100656. https://doi.org/10.1016/j.cppeds.2019.100656

Gustafsson, H., DeFreese, J., & Madigan, D. J. (2017). Athlete burnout: Review and recommendations. *Current Opinion in Psychology, 16*, 109–113. https://doi.org/10.1016/j.copsyc.2017.05.002

Hadžibajramović, E., Schaufeli, W., & De Witte, H. (2020). A Rasch analysis of the Burnout Assessment Tool (BAT). *PLoS One, 15*(11), Article e0242241. https://doi.org/10.1371/journal.pone.0242241

Hafeez, Y., Ali, S. S., Hasan, R. A., Adil, S. H., Moinuddin, M., Ebrahim, M., Yusoff, M. S., Amin, H., & Al-Saggaf, U. (2021). Development of enhanced stimulus content to improve the treatment efficacy of EEG–based frontal alpha asymmetry neurofeedback for stress mitigation. *IEEE Access, 9*, 130638-130648. https://doi.org/10.1109/access.2021.3114312

Hafeez, Y., Ali, S. S., Mumtaz, W., Moinuddin, M., Adil, S. H., Al-Saggaf, U. M., Yasin, M. A., & Malik, A. S. (2019). Investigating neurofeedback protocols for stress mitigation: A comparative analysis of different stimulus contents. *IEEE Access, 7*, 141021-141035. https://doi.org/10.1109/access.2019.2944202

Hakanen, J. J., & Schaufeli, W. B. (2012). Do burnout and work engagement predict depressive symptoms and life satisfaction? A three-wave seven-year prospective study. *Journal of Affective Disorders, 141*(2), 415-424. https://doi.org/10.1016/j.jad.2012.02.043

Hakanen, J. J., Schaufeli, W. B., & Ahola, K. (2008). The Job Demands-Resources model: A three-year cross-lagged study of burnout, depression, commitment, and work engagement. *Work & Stress, 22*(3), 224-241. https://doi.org/10.1080/02678370802379432

Hakulinen, C., Elovainio, M., Pulkki-Råback, L., Virtanen, M., Kivimäki, M., & Jokela, M. (2015). Personality and depressive symptoms: Individual participant meta-analysis of 10 cohort studies. *Depression and Anxiety, 32*(7), 461-470. https://doi.org/10.1002/da.22376

Halbesleben, J. R. B., & Demerouti, E. (2005). The construct validity of an alternative measure of burnout: Investigating the English translation of the Oldenburg Burnout Inventory. *Work & Stress, 19*(3), 208-220. https://doi.org/10.1080/02678370500340728

Halpern, J., Maunder, R. G., Schwartz, B., & Gurevich, M. (2012). Identifying, describing, and expressing emotions after critical incidents in paramedics. *Journal of Traumatic Stress, 25*(11), 111-114. http://dx.doi.org/10.1002/jts.21662

Hammond, D. C. (2011). What is neurofeedback: An update. *Journal of Neurotherapy, 15*(4), 305-336. https://doi.org/10.1080/10874208.2011.623090

Han, S. J., Bonn, M. A., & Cho, M. (2016). The relationship between customer incivility, restaurant frontline service employee burnout and turnover intention. International *Journal of Hospitality Management, 52*, 97–106. https://doi.org/10.1016/j.ijhm.2015.10.002

Han, S., Shanafelt, T. D., Sinsky, C. A., Awad, K. M., Dyrbye, L. N., Fiscus, L. C., Trockel, M., & Goh, J. (2019). Estimating the attributable cost of physician burnout in the United States. *Annals of Internal Medicine, 170*(11), Article 784. https://doi.org/10.7326/m18-1422

Haslam, N., Holland, E., & Kuppens, P. (2012). Categories versus dimensions in personality and psychopathology: A quantitative review of taxometric research. *Psychological Medicine, 42*(5), 903–920. https://doi.org/10.1017/s0033291711001966

Hätinen, M., Kinnunen, U., Pekkonen, M., & Aro, A. (2004). Burnout Patterns in Rehabilitation: Short-Term Changes in Job Conditions, Personal Resources, and Health. *Journal of Occupational Health Psychology, 9*(3), 220-237. https://doi.org/10.1037/1076-8998.9.3.220

Hellhammer, D. H., & Hellhammer, J. (2008). *Stress: The brain–body connection*. Karger.

Herman, J. P., & Cullinan, W. E. (1997) Neurocircuitry of Stress: Central Control of the Hypothalamo-Pituitary-Adrenocortical Axis. Trends in Neurosciences, 20(2), 78-84. http://dx.doi.org/10.1016/S0166-2236(96)10069-2

Hobfoll, S. E., & Shirom, A. (2001). Conservation of resources theory: Applications to stress and management in the workplace. In R. T. Golembiewski (Ed.), *Handbook of organizational behavior* (pp. 57–80). Marcel Dekker.

Hofer, S. I., Nistor, N., & Scheibenzuber, C. (2021). Online teaching and learning in higher education: Lessons learned in crisis situations. *Computers in Human Behavior, 121*, 106789. https://doi.org/10.1016/J.CHB.2021.106789

Hosseinifard, B., Moradi, M. H., & Rostami, R. (2013). Classifying depression patients and normal subjects using machine learning techniques and nonlinear features from EEG signal. *Computer Methods and Programs in Biomedicine, 109*(3), 339-345. https://doi.org/10. 1016/j.cmpb.2012.10.008.

Huang, C., & Chen, J. H. (2014). Meta-analysis of the factor structures of the Beck Depression Inventory–II. *Assessment, 22*(4), 459–472. https://doi.org/10.1177/1073191114548873

IBM Corp. (2021). *IBM SPSS Statistics for Mac* (Version 27.0) [Computer software]. IBM Corp.

Ingram, R. E., & Siegle, G. J. (2009). Methodological issues in the study of depression. In I. H. Gotlib & C. L. Hammen (Eds.), *Handbook of depression* (pp. 69–92). The Guilford Press.

International Society for Neuroregulation & Research. ISNR. (2023, April 20). Retrieved April 30, 2023, from https://isnr.org/

Ismail, H. A. K., Coetzee, N., Du Toit, P., Rudolph, E. C., & Joubert, Y. (2013). Towards gaining a competitive advantage: The relationship between burnout, job satisfaction, social support and mindfulness. *Journal of Contemporary Management, 10,* 448–464.

Jackson, L. A., Ervin, K. S., Gardner, P. D., & Schmitt, N. (2001). Gender and the Internet: Women Communicating and Men Searching. *Sex Roles, 44*(5), 363. https://doi.org/10.1023/A:1010937901821

Jackson, L. T. B., & Rothmann, S. (2005). Work-related well- being of educators in a district of the Northwest Province. *Perspectives in Education, 23*(3), 107–122.

Jackson, S. E., & Schuler, R. S. (1983). Preventing employee burnout. *Personnel, 60*(2), 58-68.

Jansen, J. (2017). *As by fire: The end of the south African University*. Tafelberg.

Jansson-Fröjmark, M., & Lindblom, K. (2010). Is there a bidirectional link between insomnia and burnout? A prospective study in the Swedish workforce. *International Journal of Behavioral Medicine, 17*(4), 306-313. http://dx.doi.org/10.1007/s12529-010-9107-8

Jaworska, N., Blier, P., Fusee, W., & Knott, V. (2012). Alpha power, alpha asymmetry and anterior cingulate cortex activity in depressed males and females. *Journal of Psychiatric Research, 46*(11), 1483-1491. https://doi.org/10.1016/j.jpsychires.2012.08.003

Jesulola, E., Sharpley, C. F., & Agnew, L. L. (2017). The effects of gender and depression se- verity on the association between alpha asymmetry and depression across four brain regions. *Behavioural Brain Research, 321*, 232-239. https://doi.org/10.1016/j.bbr.2016.12.035.

Jonsdottir, I. H, Nordlund, A., Ellbin, S., Ljung, T., Glise, K., Währborg, P., & Wallin, A. (2013). Cognitive impairment in patients with stress-related exhaustion. Stress, 16(2), 181-190. https://doi.org/10.3109/10253890.2012.708950.

Joormann, J., & Gotlib, I. H. (2010). Emotion regulation in depression: Relation to cognitive inhibition. *Cognition and Emotion, 24*(2), 281-298. https://doi.org/10.1080/02699930903407948

Jovanovic, H., Perski, A., Berglund, H., & Savic, I. (2011). Chronic stress is linked to 5-HT1A receptor changes and functional disintegration of the Limbic Networks. *NeuroImage, 55*(3), 1178–1188. https://doi.org/10.1016/j.neuroimage.2010.12.060

Kahn, J. P. (2008). Diagnosis and referral of workplace depression. *Journal of Occupational and Environmental Medicine, 50*(4), 396-400. https://doi.org/10.1097/JOM.0b013e31816c0043

Kakiashvili, T., Leszek, J., & Rutkowski, K. (2013). The Medical Perspective on Burnout. *International Journal of Occupational Medicine and Environmental Health, 26*(3), 401-412. https://doi.org/10.2478/s13382-013-0093-3

Khamisa, N., Peltzer, K., Ilic, D., & Oldenburg, B. (2017). Effect of personal and work stress on burnout, job satisfaction and general health of Hospital Nurses in South Africa. *Health SA Gesondheid, 22,* 252-258. https://doi.org/10.4102/hsag.v22i0.1011

Khan, A., & Yousaf, R. B. M. (2016). Psychometric testing of Oldenburg burnout inventory among academic staff in Pakistan. *International Review of Management and Marketing,* *6*(4), 683-687. https://www.econjournals.com/index.php/irmm/article/view/2785

Kielhofner. (2006). *Research in Occupational Therapy* (2nd edition ed.). F.A. Davis Company.

Kinman, G. (2001). Pressure points: A review of research on stressors and strains in UK academics. *Educational Psychology, 21*(4), 473–492. https://doi.org/10.1080/01443410120090849

Kinman, G. (2014). Doing more with less? Work and wellbeing in academics. *Somatechnics, 4*(2), 219-235. https://doi.org/10.3366/soma.2014.0129

Korczak, D., Wastian, M., & Schneider, M. (2012). Therapy of the burnout syndrome. *GMS Health Technology Assessment, 8*, Article 5. https://doi.org/10.3205/hta000103

Koutsimani, P., Montgomery, A., & Georganta, K. (2019). The relationship between burnout, depression, and anxiety: A systematic review and meta-analysis. *Frontiers in Psychology, 10*, Article 284. https://doi.org/10.3389/fpsyg.2019.00284

Kratzke, I. M., Campbell, A., Yefimov, M. N., Mosaly, P. R., Adapa, K., Meltzer-Brody, S., Farrell, T. M., & Mazur, L. M. (2021). Pilot study using neurofeedback as a tool to reduce surgical resident burnout. *Journal of the American College of Surgeons, 232*(1), 74-80. https://doi.org/10.1016/j.jamcollsurg.2020.08.762

Kristensen, T. S., Borritz, M., Villadsen, E., & Christensen, K. B. (2005). The Copenhagen burnout inventory: A new tool for the assessment of burnout. *Work and Stress, 19*(3), 192-207. https://doi.org/10.1080/02678370500297720.

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*(9), 606-613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Kumar, S. (2016). Burnout and doctors: Prevalence, prevention and intervention. *Healthcare, 4*(3), 37-45. https://doi.org/10.3390/healthcare4030037

Kupferberg, A., Bicks, L., & Hasler, G. (2016). Social functioning in major depressive disorder. *Neuroscience and Biobehavioral Reviews, 69*, 313-332. https://doi.org/10.1016/j.neubiorev.2016.07.002

Kyriacou, C. (1987). Teacher stress and burnout: An international review. *Educational Research, 29*(2), 146-152. https://doi.org/10.1080/0013188870290207

Lacovides, A., Fountoulakis, K. N., Kaprinis, S., & Kaprinis, G. (2003). The relationship between job stress, burnout and clinical depression. *Journal of Affective Disorders, 75*(3), 209-221. https://doi.org/10.1016/S0165-0327(02)00101-5

Laher, S, & Cockcroft, K. (2019). *Psychological assessment in South Africa: Research and applications.* Wits University Press.

Lamers, F., Vogelzangs, N., Merikangas, K. R., de Jonge, P., Beekman, A. T. F., & Penninx, B. W. J. H. (2013). Evidence for a differential role of HPA-axis function, inflammation and metabolic syndrome in melancholic versus atypical depression. *Molecular Psychiatry, 18*(6), 692-699. https://doi.org/10.1038/mp.2012.144

Łaskawiec, D., Grajek, M., Szlacheta, P., & Korzonek-Szlacheta, I. (2022). Post-pandemic stress disorder as an effect of the epidemiological situation related to the COVID-19 pandemic. *Healthcare, 10*(6), Article 975. https://doi.org/10.3390/healthcare10060975

Lee, P. F., Kan, D. P. X., Croarkin, P., Phang, C. K., & Doruk, D. (2018). Neurophysiological correlates of depressive symptoms in young adults: a quantitative EEG study. *Journal of Clinical Neuroscience, 47*, 315–322. https://doi.org/10.1016/j.jocn.2017.09.030.

Leedy, P. D. & Ormrod, J. E. (2015). *Practical research: Planning and design* (11th ed.). Pearson.

Leiter, M. P., & Durup, J. (1994). The discriminant validity of burnout and depression: A confirmatory factor analytic study. *Anxiety, Stress, and Coping, 7*(4), 357-373. https://doi.org/10.1080/10615809408249357

Leiter, M. P., & Maslach, C. (2004). Areas of worklife: A structured approach to organizational predictors of job burnout. In P. L. Perrewé & D. C. Ganster (Eds.), *Emotional and physiological processes and positive intervention strategies* (pp. 91–134). Elsevier Science/JAI Press.

Leiter, M. P., & Maslach, C. (2014). Interventions to prevent and alleviate burnout. In M. P. Leiter, A. B. Bakker, & C. Maslach (Eds.), *Burnout at work: A psychological perspective* (pp. 145–167). Psychology Press.

Leiter, M. P., & Schaufeli, W. B. (1996). Consistency of the burnout construct across occupations. *Anxiety, Stress & Coping: An International Journal, 9*(3), 229–243. https://doi.org/10.1080/10615809608249404

LeMoult, J., & Gotlib, I. H. (2019). Depression: A cognitive perspective. *Clinical Psychology Review, 69*, 51-66. https://doi.org/10.1016/j.cpr.2018.06.008

le Roux, L., Steyn, F., & Hall, B. (2017). Burnout and engagement in fourth-year Social Work Students: Why we should be concerned. *Social Work, 54*(2), 179-193. https://doi.org/10.15270/54-2-632

Lindblom, K., Linton, S., Fedeli, C., & Bryngelsson, I.L. (2006). Burnout in the working population: Relations to psychosocial work factors. International *Journal of Behavioral Medicine, 13*(1), 51-59. https://doi.org/10.1207/s15327558ijbm1301_7

Littlejohn, A., Gourlay, L., Kennedy, E., Logan, K., Neumann, T., Oliver, M., Potter, J., & Rode, J. A. (2021). Moving teaching online: Cultural barriers experienced by university teachers during covid-19. *Journal of Interactive Media in Education, 2021*(1), 1-15. https://doi.org/10.5334/jime.631

Liu, C., & Cha, H. (2018). A randomized controlled trial for solving job stress of financial employees based on Neurofeedback Training. *NeuroQuantology, 16*(3), 91-96. https://doi.org/10.14704/nq.2018.16.3.1195

Liu, M., & Wronski, L. (2017). Examining completion rates in web surveys via over 25,000 real-world surveys. *Social Science Computer Review, 36*(1), 116–124. https://doi.org/10.1177/0894439317695581

Liu, M., Zhou, L., Wang, X., Jiang, Y., & Liu, Q. (2017). Deficient manipulation of working memory in remitted depressed individuals: behavioral and electrophysiological evidence. *Clinical Neurophysiology, 128*(7), 1206-1213. https://doi.org/10.1016/j.clinph. 2017.04.011.

Looseley, A., Wainwright, E., Cook, T. M., Bell, V., Hoskins, S., & O'Connor, M. (2019). Stress, burnout, depression and work satisfaction among UK anaesthetic trainees: A quantitative analysis of the Satisfaction and Wellbeing in Anaesthetic Training study. *Anaesthesia, 74*(10), 1231-1239. https://doi.org/10.1111/anae.14681

Low, Z. X., Yeo, K. A., Sharma, V. K., Leung, G. K., McIntyre, R. S., Guerrero, A., Lu, B., Sin Fai Lam, C. C., Tran, B. X., Nguyen, L. H., Ho, C. S., Tam, W. W., & Ho, R. C. (2019). Prevalence of burnout in medical and surgical residents: A meta-analysis. *International Journal of Environmental Research and Public Health, 16*(9), 1479-1501. https://doi.org/10.3390/ijerph16091479

Lu, D. W., Dresden, S., McCloskey, C., Branzetti, J., Gisondi, M.A., & Branzetti, J. (2015). Impact of burnout on self-reported patient care among emergency physicians. *The Western Journal of Emergency Medicine, 16*(7), 996-1001. https://doi.org10.5811/westjem.2015.9.27945

Luijtelaar, G. V., Verbraak, M., Bunt, M. van, Keijsers, G., & Arns, M. (2010). EEG findings in Burnout Patients. *The Journal of Neuropsychiatry and Clinical Neurosciences, 22*(2), 208-217. https://doi.org/10.1176/jnp.2010.22.2.208

Malkinson, R., Kushnir, T., & Weisberg, E. (1997). Stress management and burnout prevention in female blue-collar workers: Theoretical and practical implications. *International Journal of Stress Management, 4*(3), 183-195. https://doi.org/10.1007/bf02765323

Marchand, A., Durand, P., Juster, R. P., & Lupien, S. J. (2014). Workers' psychological distress, depression, and burnout symptoms: Associations with diurnal cortisol profiles. *Scandinavian Journal of Work, Environment & Health, 40*(3), 305-314. https://doi.org/10.5271/sjweh.3417

Marin, M.F., Lord, C., Andrews, J., Juster, R. P., Sindi, S., Arsenault-Lapierre, G., Fiocco, A. J., & Lupien, S. J. (2011). Chronic stress, cognitive functioning and mental health. Neurobiology of Learning and Memory, 96(4), 583-595. https://doi.org/10.1016/j.nlm.2011.02.016.

Mark, G., & Smith, A. P. (2012). Effects of occupational stress, job characteristics, coping, and attributional style on the mental health and job satisfaction of university employees. *Anxiety, Stress & Coping, 25*(1), 63-78. https://doi.org/10.1080/10615806.2010.548088

Marzbani, H., Marateb, H., & Mansourian, M. (2016). Methodological note: Neurofeedback: A comprehensive review on system design, methodology and clinical applications. *Basic and Clinical Neuroscience Journal, 7*(2), 143-158. https://doi.org/10.15412/j.bcn.03070208

Maslach, C. (1976). Burned-out. *Human Relations 9*(5):16-22.

Maslach, C., & Jackson, S. E. (1981). *Maslach burnout inventory. Human services survey*. Consulting Psychologists Press.

Maslach, C., & Jackson, S. (1982). Burnout in Health Professions: A Social Psychological Analysis. In G. S. Sanders, & J. Suls (Eds.), *Social Psychology of Health and Illness* (pp. 227-251). Lawrence Erlbaum Associates.

Maslach, C., Jackson, S. E., & Leiter, M. P. (1996). *Maslach Burnout Inventory Manual* (3rd edition ed.). Consulting Psychologists Press.

Maslach, C., Jackson, S. E., & Leiter, M. P. (2016). *Maslach Burnout Inventory manual* (4th ed.). Consulting Psychologists Press.

Maslach, C., Jackson, S. E., & Schwab, R. L. (1986). Maslach Burnout Inventory-Educators Survey (MBI-ES). In C. Maslach, S. E. Jackson, & M. P. Leiter (Eds.), *MBI Manual* (3rd ed.). Consulting Psychologists Press.

Maslach, C., & Leiter, M. P. (1997). *The truth about burnout*. Jossey Bass.

Maslach, C., & Leiter, M. P. (1999). Teacher burnout: A research agenda. In R. Vandenberghe & A. M. Huberman (Eds.), *Understanding and preventing teacher burnout: A sourcebook of international research and practice* (pp. 295-303). Cambridge University Press. https://doi.org/10.1017/CBO9780511527784.021

Maslach, C., & Leiter, M. P. (2016). Understanding the burnout experience: Recent research and its implications for psychiatry. *World Psychiatry, 15*(2), 103-111. https://doi.org/10.1002/wps.20311

Maslach, C., & Leiter, M. P. (2017). Understanding burnout: New models. In C. L. Cooper & J. C. Quick (Eds.), *The handbook of stress and health: A guide to research and practice* (pp. 36–56). Wiley Blackwell. https://doi.org/10.1002/9781118993811.ch3

Maslach, C., & Schaufeli, W. B. (1993). Historical and conceptual development of burnout. In W. B. Schaufeli, C. Maslach, & T. Marek (Eds.), *Professional burnout: Recent developments in theory and research* (pp. 1–16). Taylor & Francis.

Maslach, C., Schaufeli, W. B., & Leiter, M. P. (2001). Job burnout. *Annual Review of Psychology, 52*, 397–422. https://doi.org/10.1146/annurev.psych.52.1.397

Meier, S. T. (2008). *Measuring change in counselling and psychotherapy*. Guilford Press.

Meier, S. T., & Kim, S. (2022). Meta-regression analyses of relationships between burnout and depression with sampling and measurement methodological moderators. *Journal of Occupational Health Psychology, 27*(2), 195–206. https://doi.org/10.1037/ocp0000273

Melamed, S., Shirom, A., Toker, S., & Shapira, I. (2006). Burnout and risk of type 2 diabetes: A prospective study of apparently healthy employed persons. *Psychosomatic Medicine, 68*(6), 863-869. https://doi.org/10.1097/01.psy.0000242860.24009.f0

Mohammadi, M., Al-Azab, F., Raahemi, B., Richards, G., Jaworska, N., Smith, D., De La Salle, S., Blier, P., & Knott, V. (2015). Data mining EEG signals in depression for their diagnostic value. Clinical decision-making, knowledge support systems, and theory. *BMC Medical Informatics and Decision Making, 15*(1), 1-14. https://doi.org/10.1186/s12911-015- 0227-6.

Morgan, B., & de Bruin, K. (2010). The relationship between the big five personality traits and burnout in South African University Students. *South African Journal of Psychology, 40*(2), 182–191. https://doi.org/10.1177/008124631004000208

Mostert, K., Pienaar, J., Gauche, C., & Jackson, L. (2007). Burnout and engagement in University Students: A psychometric analysis of the MBI-SS and UWES-S. *South African Journal of Higher Education, 21*(1), 147-162. https://doi.org/10.4314/sajhe.v21i1.25608

Naghieh, A., Montgomery, P., Bonell, C. P., Thompson, M., & Aber, J. L. (2015). Organisational interventions for improving wellbeing and reducing work-related stress in teachers. *Cochrane Database of Systematic Reviews*, *8*(4), CD010306. https://doi.org/10.1002/14651858.CD010306.pub2.

Nazari, H., Jariani, M., Beiranvand, S., Saki, M., Aghajeri, N., & Ebrahimzadeh, F. (2016). The prevalence of job stress and its relationship with burnout syndrome among the academic members of Lorestan University of Medical Sciences. *Journal of Caring Sciences, 5*(1), 75-84. https://doi.org/10.15171/jcs.2016.008

Nelson, B. D., Kessel, E. M., Klein, D. N., & Shankman, S. A. (2018). Depression symptom dimensions and asymmetrical frontal cortical activity while anticipating reward. *Psychophysiology* *55*(1), Article e12892. https://doi.org/10.1111/psyp.12892.

Nezu, A. M., Nezu, C. M., Friedman, J., & Lee, M. (2009). Assessment of depression. In I. H. Gotlib & C. L. Hammen (Eds.), *Handbook of depression* (pp. 44–68). The Guilford Press.

Nusslock, R., Shackman, A. J., McMenamin, B. W., Greischar, L. L., Davidson, R. J., & Kovacs, M. (2018). Comorbid anxiety moderates the relationship between depression history and prefrontal EEG asymmetry. *Psychophysiology 55*(1), Article e12953. https://doi.org/10.1111/psyp.12953.

Nusslock, R., Walden, K., & Harmon-Jones, E. (2015). Asymmetrical frontal cortical activity associated with differential risk for mood and anxiety disorder symptoms: an RDoC perspective. *International Journal of Psychophysiology. 98*(2), 249–261. https://doi.org/10.1016/j.ijpsycho.2015.06.004.

Ogan, C. & Chung, D. (2003). Stressed Out! A National Study of Women and Men Journalism and Mass Communication Faculty, Their Uses of Technology, and Levels of Professional and Personal Stress. *Journalism and Mass Communication Educator, 57*(4), 352-368. https://doi.org/10.1177/107769580205700405

Oprea, B., Iliescu, D., & De Witte, H. (2021). Romanian short version of the Burnout Assessment Tool: Psychometric properties. *Evaluation & the Health Professions, 44*(4), 406–415. https://doi.org/10.1177/01632787211048924

Österberg, K., Skogsliden, S., & Karlson, B. (2014). Neuropsychological sequelae of work-stress-related exhaustion. *Stress, 17*(1), 59–69. https://doi.org/10.3109/10253890.2013.862615

Peltzer, K., Mashego, T.-A., & Mabeba, M. (2003). Occupational stress and burnout among South African medical practitioners. *Stress and Health: Journal of the International Society for the Investigation of Stress, 19*(5), 275–280. https://doi.org/10.1002/smi.982

Penz, M., Stalder, T., Kanthak, M., Buske-Kirschbaum, A., & Kirschbaum, C. (2018). Hair cortisol as a biological marker for burnout symptomatology. *Psychoneuroendocrinology, 87*, 218-221. https://doi.org/10.1016/j.psyneuen.2016.07.074

Perini, G., Ramusino, M. C., Sinforiani, E., Bernini, S., Petrachi, R., & Costa, A. (2019). Cognitive impairment in depression: Recent advances and novel treatments. *Neuropsychiatric Disease and Treatment, 15*, 1249-1258. https://doi.org/10.2147/NDT.S199746

Picornell-Gallar, D., & González-Fraile, E. (2023). Burnout syndrome among Catholic Clergy: A Systematic Review. *Journal of Religion and Health*. https://doi.org/10.1007/s10943-023-01883-8

Pienaar, C., & Bester, C. (2009). Addressing career obstacles within a changing higher education environment: Perspectives of academics. *South African Journal of Psychology, 39*(3), 376–385. https://doi.org/10.1177/008124630903900311

Pierce, C. M., & Molloy, G. N. (1989). The construct validity of the Maslach Burnout Inventory: Some data from down under. *Psychological Reports, 65*(3), 1340-1342. https://doi.org/10.2466/pr0.1989.65.3f.1340

Pines, A., & Aronson, E. (1988). *Career burnout: Causes and cures*. Free Press.

Plieger, T., Melchers, M., Montag, C., Meermann, R., & Reuter, M. (2015). Life stress as potential risk factor for depression and Burnout. *Burnout Research, 2*(1), 19-24. https://doi.org/10.1016/j.burn.2015.03.001

Pretorius, T. B. (1994). Using the Maslach Burnout Inventory to assess educators' burnout at a university in South Africa. *Psychological Reports, 75*(2), 771-777.

Pryce, C. R., Azzinnari, D., Spinelli, S., Seifritz, E., Tegethoff, M., & Meinlschmidt, G. (2011). Helplessness: A systematic translational review of theory and evidence for its relevance to understanding and treating depression. *Pharmacology & Therapeutics, 132*(3), 242–267. http://dx.doi.org/10.1016/j.pharmthera.2011.06.006

qEEG-Pro Report Service - PLATINUM. (n.d.). BrainMaster Technologies Inc. https://brainmaster.com/product/qeegpro-report-service-platinum/

Qiao, H., & Schaufeli, W. B. (2011). The convergent validity of four burnout measures in a Chinese sample: A confirmatory factor-analytic approach. *Applied Psychology: An International Review, 60*(1), 87–111. https://doi.org/10.1111/j.1464-0597.2010.00428.x

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*(3), 385-401. https://doi.org/10.1177/014662167700100306

Reardon, M., Abrahams, R., Thyer, L., & Simpson, P. (2020). Review article: Prevalence of burnout in paramedics: A systematic review of prevalence studies. *Emergency Medicine Australasia, 32*(2), 182–189. https://doi.org/10.1111/1742-6723.13478

Redelinghuys, K., & Morgan, B. (2023). Psychometric Properties of the Burnout Assessment Tool across four countries. *BMC Public Health, 23*(1), Article 824. https://doi.org/10.1186/s12889-023-15604-z

Robins, E., & Guze, S. B. (1970). Establishment of diagnostic validity in psychiatric illness: Its application to schizophrenia. *The American Journal of Psychiatry, 126(*7), 983-986. https://doi.org/10.1176/ajp.126.7.983

Robson, L., Gardner, B., & Dommett, E. J. (2022). The post-pandemic lecture: Views from academic staff across the UK. *Education Sciences, 12*(2), Article 123. https://doi.org/10.3390/educsci12020123

Rogala, J., Jurewicz, K., Paluch, K., Kublik, E., Cetnarski, R., & Wróbel, A. (2016). The do's and don'ts of neurofeedback training: A review of the controlled studies using healthy adults. *Frontiers in Human Neuroscience, 10*, article 301. https://doi.org/10.3389/fnhum.2016.00301

Ronconi, L., Busch, N. A., & Melcher, D. (2018). Alpha-band sensory entrainment alters the duration of temporal windows in visual perception. *Scientific Reports, 8*(1), article 11810. https://doi.org/10.1038/s41598-018-29671-5

Roskam, I., Aguiar, J., Akgun, E., Arikan, G., Artavia, M., Avalosse, H., Aunola, K., Bader, B., Bahati, C., Barham, E. J., Besson, E., Beyers, W., Boujut, E., Brianda, M. E., Brytek-Matera, A., Carbonneau, N., César, F., Chen, B., Dorard, G., & Dos Santos Elias, L. E. (2021). Parental Burnout Around the Globe: a 42-Country Study. *Affective Science, 2*(1), 58-79. https://doi.org/10.1007/s42761-020-00028-4.

Rössler, W., Hengartner, M. P., Ajdacic-Gross, V., & Angst, J. (2015). Predictors of burnout: Results from a prospective community study. *European Archives of Psychiatry and Clinical Neuroscience, 265*(1), 19-25. http://dx.doi.org/10.1007/s00406-014-0512-x

Rotenstein, L. S., Torre, M., Ramos, M. A., Rosales, R. C., Guille, C., Sen, S., & Mata, D. A. (2018). Prevalence of burnout among physicians: A systematic review. *Journal of the American Medical Association, 320*(11), 1131-1150. https://doi.org/10.1001/jama.2018.12777

Rotenstein, L. S., Zhao, Z., Mata, D. A., Guille, C., & Sen, S. (2020). Substantial overlap between factors predicting symptoms of depression and burnout among medical interns. *Journal of General Internal Medicine, 36*(1), 240-242. https://doi.org/10.1007/s11606-020-05664-x

Rothmann, S. (2003). Burnout and engagement: A South African perspective. *South African Journal of Industrial Psychology, 29*(4), 16–25. https://doi.org/10.4102/sajip.v29i4.121

Rothmann, S., & Barkhuizen, N. (2008). Burnout of academic staff in South African Higher Education Institutions. *South African Journal of Higher Education, 22*(2), 439-456. https://doi.org/10.4314/sajhe.v22i2.25796

Rubí, M. C. M. (2008). Neurofeedback around the world. *Neurofeedback and Applied Neuroscience, 10*(4), 63-73. http://dx.doi.org/10.1300/J184v10n04_07

Ruotsalainen, J., Serra, C., Marine, A., & Verbeek, J. (2008). Systematic review of interventions for reducing occupational stress in health care workers. *Scandinavian Journal of Work, Environment & Health, 34*(3),169-178. https://doi.org/10.5271/sjweh.1240

Ryan, E., Hore, K., Power, J., & Jackson, T. (2023). The relationship between physician burnout and depression, anxiety, suicidality and substance abuse: A mixed methods systematic review. *Frontiers in Public Health, 11,* Article 1133484. https://doi.org/10.3389/fpubh.2023.1133484

Rydmark, I., Wahlberg, K., Ghatan, P. H., Modell, S., Nygren, Å., & Ingvar, M. (2006). Neuroendocrine, cognitive and structural imaging characteristics of women on long-term sick leave with job stress–induced depression. *Biological Psychiatry, 60*(8), 867–873. https://doi.org/10.1016/j.biopsych.2006.04.029

Sabagh, Z., Hall, N.C., & Saroyan, A. (2018). Antecedents, correlates and consequences of faculty burnout. *Educational Research, 60*(2), 131-156. https://doi.org/10.1080/00131881.2018.1461573

Sakakibara, K., Shimazu, A., Toyama, H., & Schaufeli, W. B. (2020). Validation of the Japanese version of the burnout assessment tool. *Frontiers in Psychology, 11*, 1-15. https://doi.org/10.3389/fpsyg.2020.01819

Salkind, N. J. (2010). *Encyclopaedia of research design* (Vols. 1-0). SAGE Publications.

Salvagioni, D. A., Melanda, F. N., Mesas, A. E., González, A. D., Gabani, F. L., & Andrade, S. M. (2017). Physical, psychological and occupational consequences of job burnout: A systematic review of prospective studies. *PLOS ONE, 12*(10), Article e0185781. https://doi.org/10.1371/journal.pone.0185781

Savic, I. (2015). Structural changes of the brain in relation to occupational stress. *Cerebral Cortex, 25*(6), 1554-1564. https://doi.org/10.1093/cercor/bht348

Savic, I., Perski, A., & Osika, W. (2018). MRI shows that exhaustion syndrome due to chronic occupational stress is associated with partially reversible cerebral changes. *Cerebral Cortex, 28*(3), 894-906. https://doi.org/10.1093/cercor/bhw413

Schaufeli, W. B. (2003). Past performance and future perspectives of burnout research. *South African Journal of Industrial Psychology, 29*(4), 1-15. https://doi.org/10.4102/sajip.v29i4.127

Schaufeli, W. B., Desart, S., & De Witte, H. (2020a). Burnout Assessment Tool (BAT)-development, validity, and reliability. *International Journal of Environmental Research and Public Health, 17*(24), Article 9495. https://doi.org/10.3390/ijerph17249495

Schaufeli, W., & De Witte, H. (2023). Burnout Assessment Tool (BAT). *International Handbook of Behavioral Health Assessment*, 1-24. https://doi.org/10.1007/978-3-030-89738-3_54-1

Schaufeli, W. B., De Witte, H., & Desart, S. (2020b). *Manual Burnout Assessment Tool (BAT) – Version 2.0.* KU Leuven, Belgium: Unpublished internal report.

Schaufeli, W. B., & Enzmann, D. (1998). *The burnout companion to study and practice: A critical analysis.* Taylor & Francis.

Schaufeli, W. B., Leiter, M. P., & Maslach, C. (2009). Burnout: 35 years of research and practice. *Career Development International, 14*(3), 204-220. https://doi.org/10.1108/13620430910966406

Schaufeli, W. B., & Taris, T. W. (2005). The conceptualization and measurement of burnout: Common ground and worlds apart. *Work & Stress, 19*(3), 256-262. https://doi.org/10.1080/02678370500385913

Schaufeli, W. B., & van Dierendonck, D. (2000). *UBOS, Utrechtse Burnout Schaal.* Handleiding, Lisse, Swets Test Publishers.

Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation coefficients: Appropriate use and interpretation. *Anesthesia & Analgesia, 126*(5), 1763–1768. https://doi.org/10.1213/ane.0000000000002864

Schonfeld, I. S. (1991). Burnout in teachers: Is it burnout or is it depression? (Report No. 335329). Washington, DC: Education Resources Information Center.

Schonfeld, I. S., & Bianchi, R. (2016). Burnout and depression: Two entities or one. *Journal of Clinical Psychology, 72*(1), 22–37. https://doi.org/10.1002/jclp.22229

Schonfeld, I. S., & Bianchi, R. (2021). From Burnout to Occupational Depression: Recent developments in research on job-related distress and Occupational Health. *Frontiers in Public Health, 9*, Article 796401. https://doi.org/10.3389/fpubh.2021.796401

Schonfeld, I. S., & Bianchi, R. (2022). Distress in the workplace: Characterizing the relationship of burnout measures to the Occupational Depression Inventory. *International Journal of Stress Management, 29*(3), 253–259. https://doi.org/10.1037/str0000261

Schonfeld, I. S., Bianchi, R., & Luehring-Jones, P. (2017). Consequences of job stress for the psychological well-being of teachers. In T. M. McIntyre, S. E. McIntyre, & D. J. Francis (Eds.), Educator stress - An occupational health perspective (pp. 55–75). Cham, Switzerland: Springer International Publishing.

Schonfeld, I. S., & Chang, C. H. (2017). *Occupational Health Psychology: Work, Stress, and Health*. Springer Publishing Company.

Schonfeld, I. S., Verkuilen, J., & Bianchi, R. (2019a). Inquiry into the correlation between burnout and depression. *Journal of Occupational Health Psychology, 24*(6), 603-616. https://doi.org/10.1037/ocp0000151

Schonfeld, I. S., Verkuilen, J., & Bianchi, R. (2019b). An exploratory structural equation modeling bi-factor analytic approach to uncovering what burnout, depression, and anxiety scales measure. *Psychological Assessment, 31*(8), 1073-1079. https://doi.org/10.1037/pas0000721

Schutte, N., Toppinen, S., Kalimo, R., & Schaufeli, W. (2000). The factorial validity of the Maslach Burnout Inventory—General Survey (MBI—GS) across occupational groups and nations. *Journal of Occupational and Organizational Psychology, 73*(1), 53-66. https://doi.org/10.1348/096317900166877

Schwenk, T. L., & Gold, K. J. (2018). Physician burnout—A serious symptom, but of what? *Journal of the American Medical Association, 320*(11), 1109–1110. https://doi.org/10.1001/jama.2018.11703

Shannon, D. M., & Bradshaw, C. C. (2002). A Comparison of Response Rate, Response Time, and Costs of Mail and Electronic Surveys. *The Journal of Experimental Education, 70*(2), 179-192. https://doi.org/10.1080/00220970209599505

Sheehan, K. B. (2001). E-mail survey response rates: A review. *Journal of Computer-Mediated Communication, 6*(2), 0-0. https://doi.org/10.1111/j.1083-6101.2001.tb00117.x

Shen, J., Zhao, S., Yao, Y., Wang, Y., & Feng, L. (2017). A novel depression detection method based on pervasive EEG and EEG splitting criterion. Proceedings – 2017 IEEE International Conference on Bioinformatics and Biomedicine, BIBM 2017 1879–1886. https://doi.org/10.1109/BIBM.2017.8217946.

Shirom, A. (2003). Job-related burnout: A review. In J. C. Quick & L. E. Tetrick (Eds.), *Handbook of occupational health psychology* (pp. 245–264). American Psychological Association. https://doi.org/10.1037/10474-012

Shirom, A. (2005). Reflections on the study of burnout. *Work and Stress, 19*(3), 263-270. https://doi.org/10.1080/02678370500376649

Shirom, A., & Melamed, S. (2005). Does burnout affect physical health? A review of the evidence. In A.-S. G. Antoniou & C. L. Cooper (Eds.), *Research companion to organizational health psychology* (pp. 599–622). Edward Elgar Publishing. https://doi.org/10.4337/9781845423308.00049

Shirom, A., & Melamed, S. (2006). A comparison of the construct validity of two burnout measures in two groups of professionals. *International Journal of Stress Management, 13*(2), 176–200. https://doi.org/10.1037/1072-5245.13.2.176

Simons, A., Munnik, E., Frantz, J., & Smith, M. (2019). The profile of occupational stress in a sample of health profession academics at a historically disadvantaged university in South Africa. *South African Journal of Higher Education, 33*(3), 132-154. https://doi.org/10.20853/33-3-3199

Singh, S. N., & Bush, R. F. (1998). Research Burnout in Tenured Marketing Professors: An Empirical Investigation. *Journal of Marketing Education 20*(1), 4-15. https://doi.org/10.1177/027347539802000102

Skaalvik, E. M., & Skaalvik, S. (2010). Teacher self-efficacy and teacher burnout: A study of relations. *Teaching and Teacher Education, 26*(4), 1059–1069. https://doi.org/10.1016/j.tate.2009.11.001

Smith, W. G. (2008). Does gender influence online survey participation? A record-linkage analysis of university faculty online survey response behavior. *ERIC Document Reproduction Service No. ED 501717 (2008)*. Online submission.

Smith, E. E., Cavanagh, J. F., & Allen, J. J. B. (2018). Intracranial source activity (eLORETA) related to scalp-level asymmetry scores and depression status. *Psychophysiology 55*(1), Article e13019. https://doi.org/10.1111/psyp.13019.

Soares, J. F., Grossi, G. G., & Sundin, Ö. Ö. (2007). Burnout among women: Associations with demographic/socio-economic, work, lifestyle and health factors. *Archives of Women's Mental Health, 10*(2), 61-71. https://doi.org/10.1007/s00737-007-0170-3

Sokka, L., Leinikka, M., Korpela, J., Henelius, A., Lukander, J., Pakarinen, S., Alho, K., & Huotilainen, M. (2017). Shifting of attentional set is inadequate in severe burnout: Evidence from an event-related potential study. *International Journal of Psychophysiology, 112*, 70–79. https://doi.org/10.1016/j.ijpsycho.2016.12.004

Spector, P. E. (2013). *Survey design and measure development*. In T. D. Little (Ed.), The Oxford handbook of quantitative methods (Vol. 1, pp. 170-188). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199934874.013.0009

Stein, C., & Sibanda, T. (2016). Burnout among paramedic students at a university in Johannesburg, South Africa. *African Journal of Health Professions Education, 8*(2), 193-195. https://doi.org/10.7196/ajhpe.2016.v8i2.626

Stockemer, D., Stockemer, G., & Glaeser. (2019). Quantitative methods for the social sciences (Vol. 50, p. 185). Quantitative methods for the social sciences: Springer International Publishing.

Storm, K. & Rothmann, S. (2003). A psychometric analysis of the Utrecht Work Engagement Scale in the South African Police Service. *South African Journal of Industrial Psychology, 29*(4), 62-70. https://doi.org/10.4102/sajip.v29i4.129

Summer, J. (2023, December 22). *Alpha Waves and Sleep*. Sleep foundation. https://www.sleepfoundation.org/how-sleep-works/alpha-waves-and-sleep

Swider, B. W., & Zimmerman, R. D. (2010). Born to burnout: A meta-analytic path model of personality, job burnout, and work outcomes. *Journal of Vocational Behavior, 76*(3), 487-506. https://doi.org/10.1016/j.jvb.2010.01.003

Tadesse, S., & Muluye, W. (2020). The Impact of COVID-19 Pandemic on Education System in Developing Countries: A Review. *Open Journal of Social Sciences, 8*(10), 159-170. https://doi.org/10.1186/s12991-022-00399-x

Talih, F., Warakian, R., Ajaltouni, J., Shehab, A. A. S., & Tamim, H. (2016). Correlates of depression and burnout among residents in a Lebanese academic medical center: A cross sectional study. *Academic Psychiatry, 40*(1), 38-45. https://doi.org/10.1007/s40596-015-0400-3

Taris, T. W. (2006). Is there a relationship between burnout and objective performance? A critical review of 16 studies. *Work & Stress, 20*(4), 316–334. https://doi.org/10.1080/02678370601065893

Taris, T. W., Le Blanc, P. M., Schaufeli, W. B., & Schreurs, P. J. G. (2005). Are there causal relationships between the dimensions of the Maslach Burnout Inventory? A review and two longitudinal tests. *Work and Stress, 19*(3), 238-255. https://doi.org/10.1080/02678370500270453

Tement, S., Pahor, A., & Jaušovec, N. (2016). EEG alpha frequency correlates of burnout and depression: The role of gender. *Biological Psychology, 114*, 1–12. https://doi.org/10.1016/j.biopsycho.2015.11.005

Tennant, C. (2001). Work-related stress and depressive disorders. *Journal of Psychosomatic Research, 51*(5), 697–704. https://doi.org/10.1016/S0022-3999(01)00255-0

Teven, J. J. (2007). Teacher Temperament: Correlates with Teacher Caring, Burnout, and Organizational Outcomes. *Communication Education, 56*(3), 382-400. https://doi.org/10.1080/03634520701361912

Toker, S., Melamed, S., Berliner, S., Zeltser, D., & Shapira, I. (2012). Burnout and risk of coronary heart disease: A prospective study of 8838 employees. *Psychosomatic Medicine, 74*(8), 840–847. http://dx.doi.org/10.1097/PSY.0b013e31826c3174

Tomarken, A. J., Davidson, R. J., Wheeler, R. E., & Doss, R. C. (1992). Individual differences in anterior brain asymmetry and fundamental dimensions of emotion. *Journal of Personality and Social Psychology, 62*(4), 676-687. https://doi.org/10.1037/0022-3514.62.4.676

Tops, M., Boksem, M. A. S., Wijers, A. A., van Duinen, H., Den Boer, J. A., & Meijman, T. F. (2007). The psychobiology of burnout: Are there two different syndromes? *Neuropsychobiology, 55*(3), 143-150. https://doi.org/10.1159/000106056

Tops, M., Riese, H., Oldehinkel, A. J., Rijsdijk, F. V., & Ormel, J. (2008). Rejection sensitivity relates to hypocortisolism and depressed mood state in young women. *Psychoneuroendocrinology, 33*(5), 551-559. https://doi.org/10.1016/j.psyneuen.2008.01.011

Travers, A. (2003). Parallel subaltern feminist counterpublics in cyberspace. *Sociological Perspectives, 46*(2), 223-237. https://doi.org/10.1525/sop.2003.46.2.223

Trockel, M., Bohman, B., Lesure, E., Hamidi, M. S., Welle, D., Roberts, L., & Shanafelt, T. (2018). A brief instrument to assess both burnout and professional fulfillment in physicians: Reliability and validity, including correlation with self-reported medical errors, in a sample of resident and practicing physicians. *Academic Psychiatry, 42*(1), 11–24. http://dx.doi.org/10.1007/s40596-017-0849-3

Tytherleigh, M. Y., Webb, C., Cooper, C. L., & Ricketts, C. (2005). Occupational stress in UK higher education institutions: A comparative study of all staff categories. *Higher Education Research & Development, 24*(1), 41–61. https://doi.org/10.1080/0729436052000318569

Ugwu, L. I., Enwereuzor, I. K., Fimber, U. S., & Ugwu, D. I. (2017). Nurses' burnout and counterproductive work behavior in a Nigerian sample: The moderating role of emotional intelligence. *International Journal of Africa Nursing Sciences, 7*, 106–113. https://doi.org/10.1016/j.ijans.2017.11.004

University of the Witwatersrand. (2021). *Facts & figures*. https://www.wits.ac.za/media/wits-university/about-wits/documents/WITS%20Facts%20%20Figures%202020-2021%20Revised%20Hi-Res.pdf

van Dam, A. (2021). A clinical perspective on burnout: diagnosis, classification, and treatment of clinical burnout. *European Journal of Work and Organizational Psychology, 30*(5), 732-741. https://doi.org/10.1080/1359432X.2021.1948400

Van Dam, A., Keijsers, G., Verbraak, M., Eling, P., & Becker, E. (2015). Level and appraisal of fatigue are not specific in burnout. *Clinical Psychology & Psychotherapy, 22*(2), 133-141. https://doi.org/10.1002/cpp.1869

Van der Linden, D., Keijsers, G. P. J., Eling, P., & van Schaijk, R. (2005). Work stress and attentional difficulties: An initial study on burnout and cognitive failures. *Work & Stress, 19*(1), 23–36. https://doi.org/10.1080/02678370500065275

Van der Merwe, L. J., Botha, A., & Joubert, G. (2020). Burnout and associated factors in undergraduate medical students at a South African University. *African Journal of Health Professions Education, 12*(2), 62-67. https://doi.org/10.7196/ajhpe.2020.v12i2.1172 van der Vinne, N., Vollebregt, M. A., van Putten, M. J., & Arns, M. (2017). Frontal alpha asymmetry as a diagnostic marker in depression: fact or fiction? A meta-analysis. *NeuroImage: Clinical, 16*, 79–87. https://doi.org/10.1016/j.nicl.2017.07.006.

Van der Walt, N., Scribante, J., & Perrie, H. (2015). Burnout among anaesthetists in South Africa. *Southern African Journal of Anaesthesia and Analgesia, 21*(6), 27-30. https://doi.org/10.1080/22201181.2015.1102798

van Niekerk, R. L., & Van Gent, M. M. (2021). Mental health and well-being of university staff during the coronavirus disease 2019 levels 4 and 5 lockdown in an Eastern Cape university, South Africa. *South African Journal of Psychiatry, 27*, Article 1589. https://doi.org/10.4102/sajpsychiatry.v27i0.1589

Verkuilen, J., Bianchi, R., Schonfeld, I. S., & Laurent, E. (2021). Burnout–Depression Overlap: Exploratory structural equation modeling Bifactor analysis and network analysis. *Assessment, 28*(6), 1583–1600. https://doi.org/10.1177/1073191120911095

Waghid, Y. (2002). Knowledge production and higher education transformation in South Africa: Towards reflexivity in university teaching, research and community service. *Higher Education, 43*, 457-488. https://doi.org/10.1023/A:1015211718131

Wang, Y. P., & Gorenstein, C. (2013). Psychometric properties of the Beck Depression Inventory-II: A comprehensive review. *Revista Brasileira de Psiquiatria, 35*(4), 416–431. https://doi.org/10.1590/1516-4446-2012-1048

Watts, J., & Robertson, N. (2011). Burnout in university teaching staff: A systematic literature review. *Educational Research, 53*(1), 33–50. https://doi.org/10.1080/00131881.2011.552235

Watts, A. D., & Shuttleworth-Edwards, A. B. (2016). Neuropsychology in South Africa: confronting the challenges of specialist practice in a culturally diverse developing country. *The Clinical Neuropsychologist, 30*(8), 1305-1324. https://doi.org/10.1080/13854046.2016.1212098.

Wiederhold, B. K., Cipresso, P., Pizzioli, D., Wiederhold, M., & Riva, G. (2018). Intervention for physician burnout: A systematic review. *Open Medicine, 13*(1), 253–263. https://doi.org/10.1515/med-2018-0039

Williams, Z. J., Everaert, J., & Gotham, K. O. (2020). Measuring depression in autistic adults: Psychometric validation of the Beck Depression Inventory–II. *Assessment, 28*(3), 858–876. https://doi.org/10.1177/1073191120952889

Winefield, A. H., Gillespie, N., Stough, C., Dua, J., Hapuarachchi, J., & Boyd, C. (2003). Occupational stress in Australian University staff: Results from a National Survey. *International Journal of Stress Management, 10*(1), 51–63. https://doi.org/10.1037/1072-5245.10.1.51

Woo, T., Ho, R., Tang, A., & Tam, W. (2020). Global prevalence of burnout symptoms among nurses: A systematic review and meta-analysis. *Journal of Psychiatric Research, 123*, 9–20. https://doi.org/10.1016/j.jpsychires.2019.12.015

World Health Organization, 11th Revision of the International Classification of Diseases (ICD-11) for Mortality and Morbidity Statistics (Version: 04/2019), World Health Organization, 2019, https://icd.who.int/browse11/l-m/en.

World Health Organization. (2023). *Stress*. World Health Organization. https://www.who.int/news-room/questions-and-answers/item/stress

Worley, J. A., Vassar, M., Wheeler, D. L., & Barnes, L. L. B. (2008). Factor structure of scores from the Maslach Burnout Inventory: A review and meta-analysis of 45 exploratory and confirmatory factor-analytic studies. *Educational and Psychological Measurement, 68*(5), 797–823. https://doi.org/10.1177/0013164408315268

Wurm, W., Vogel, K., Holl, A., Ebner, C., Bayer, D., Mörkl, S., Szilagyi, I. S., Hotter, E., Kapfhammer, H. P., & Hofmann, P. (2016). Depression-burnout overlap in physicians. *PLOS ONE, 11*(3), Article e0149913. https://doi.org/10.1371/journal.pone.0149913

Zeijlemaker, C., & Moosa, S. (2019). The prevalence of burnout among registrars in the School of Clinical Medicine at the University of the Witwatersrand, Johannesburg, South Africa. *South African Medical Journal, 109*(9), 668-672. https://hdl.handle.net/10520/EJC-180bab54df

Zhong, J., You, J., Gan, Y., Zhang, Y., Lu, C., & Wang, H. (2009). Job stress, Burnout, depression symptoms, and physical health among Chinese University Teachers. *Psychological Reports, 105*(3), 1248–1254. https://doi.org/10.2466/pr0.105.f.1248-1254

Appendix A: Demographic questionnaire

Please answer the questions below by either filling out the blank spaces or by choosing the correct answer from the lists provided.

1. What gender do you identify with?	◯ Female ◯ Male ◯ Non-binary ◯ Transgender ◯ Prefer not to say ◯ Other
If other, please specify:	____________________
2. What race do you identify with?	◯ Black ◯ White ◯ Coloured ◯ Indian ◯ Asian ◯ Other
If other, please specify:	____________________
3. What is your age?	________________
4. What is your home language?	________________
5. What is your highest level of education)?	◯ Undergraduate degree ◯ Honours degree ◯ Master's degree ◯ PhD
6. What is your current job title or position?	◯ Associate professor ◯ Professor ◯ Postdoctoral fellow ◯ Lecturer
What school/department of the university do you work in (e.g., Department of Psychology)?	____________________
7. Have you ever been diagnosed with any neurological conditions (e.g., neurodevelopmental, or neurocognitive disorders, epilepsy, traumatic brain injury, brain tumour, neurodegenerative diseases, known structural brain defect)?	◯ Yes ◯ No
If yes, please specify:	____________________

8. Have you been diagnosed with any psychiatric conditions (e.g., Major depressive disorder, anxiety disorder)?	◯ Yes ◯ No
If yes, please specify:	________________________________
9. Do you have a history of drug or alcohol abuse?	◯ Yes ◯ No
10. Are you currently on any medication?	◯ Yes ◯ No
If yes, please specify:	________________________________
11. Are you in a relationship?	◯ Yes ◯ No
12. Do you live:	◯ Alone ◯ With a partner only ◯ With a partner and children ◯ With children only ◯ With immediate family (parents/siblings) ◯ With other relatives

Living Standards Measure.

Please answer the below questions according to your current circumstances.

1. I have the following in my household

1.1 TV set	◯ True ◯ False
1.2 Swimming pool	◯ True ◯ False
1.3 DVD player	◯ True ◯ False
1.4 M-Net/DStv subscription	◯ True ◯ False
1.5 Air conditioner	◯ True ◯ False
1.6 Computer / Laptop	◯ True ◯ False
1.7 Vacuum cleaner/floor polisher	◯ True ◯ False

1.8 Dishwashing machine	◯ True ◯ False
1.9 Washing machine	◯ True ◯ False
1.10 Tumble dryer	◯ True ◯ False
1.11 Home telephone (excluding a cell)	◯ True ◯ False
1.12 Deep freezer	◯ True ◯ False
1.13 Fridge/freezer (combination)	◯ True ◯ False
1.14 Electric stove	◯ True ◯ False
1.15 Microwave oven	◯ True ◯ False
1.16 Built-in kitchen sink	◯ True ◯ False
1.17 Home security service	◯ True ◯ False
1.18 Three or more cell phones in household	◯ True ◯ False
1.19 Two cell phones in household	◯ True ◯ False
1.20 Home theatre system	◯ True ◯ False
2. I have the following amenities in my home or on the plot:	
2.1 Tap water in house/on plot	◯ True ◯ False
2.2 Hot running water from a geyser	◯ True ◯ False
2.3 Flush toilet in/outside house	◯ True ◯ False
3. There is a motor vehicle in our household	◯ True ◯ False
4. I am a city dweller	◯ True ◯ False

5. I live in a house, cluster or town house	◯ True ◯ False
6. I live in a rural area outside Gauteng	◯ True ◯ False
7. There are no radios, or only one radio (excluding car radios) in my household	◯ True ◯ False
8. There is no domestic workers or household helpers in household (both live-in & part time)	◯ True ◯ False

Appendix B: Burnout Assessment Tool

	Never	Rarely	Sometimes	Often	Always
Exhaustion					
1. I feel mentally exhausted*	☐	☐	☐	☐	☐
2. Everything I do requires a great deal of effort	☐	☐	☐	☐	☐
3. At the end of the day, I find it hard to recover my energy*	☐	☐	☐	☐	☐
4. I feel physically exhausted*	☐	☐	☐	☐	☐
5. When I get up in the morning, I lack the energy to start a new day	☐	☐	☐	☐	☐
6. I want to be active, but somehow I am unable to manage	☐	☐	☐	☐	☐
7. When I exert myself, I quickly get tired	☐	☐	☐	☐	☐
8. At the end of my day, I feel mentally exhausted and drained	☐	☐	☐	☐	☐
Mental distance					
9. I struggle to find any enthusiasm for my work*	☐	☐	☐	☐	☐
10. I feel a strong aversion towards my job*	☐	☐	☐	☐	☐
11. I feel indifferent about my job	☐	☐	☐	☐	☐
12. I'm cynical about what my work means to others*	☐	☐	☐	☐	☐
Cognitive impairment					
13. I have trouble staying focused*	☐	☐	☐	☐	☐
14. I struggle to think clearly	☐	☐	☐	☐	☐
15. I'm forgetful and distracted	☐	☐	☐	☐	☐
16. I have trouble concentrating*	☐	☐	☐	☐	☐
17. I make mistakes because I have my mind on other things*	☐	☐	☐	☐	☐
Emotional impairment					
18. I feel unable to control my emotions*	☐	☐	☐	☐	☐
19. I do not recognize myself in the way I react emotionally*	☐	☐	☐	☐	☐
20. I become irritable when things don't go my way	☐	☐	☐	☐	☐
21. I get upset or sad without knowing why	☐	☐	☐	☐	☐
22. I may overreact unintentionally*	☐	☐	☐	☐	☐

Note: * Short version.

Appendix C: Maslach Burnout Inventory- Human Services Survey

MBI Human Services Survey

How often:	**0**	**1**	**2**	**3**	**4**	**5**	**6**
	Never	A few times a year or less	Once a month or less	A few times a month	Once a week	A few times a week	Every day

How often 0-6	**Statements:**
1. __________	I feel emotionally drained from my work.
2. __________	I feel used up at the end of the workday.
3. __________	I feel fatigued when I get up in the morning and have to face another day on the job.
4. __________	I can easily understand how my recipients feel about things.
5. __________	I feel I treat some recipients as if they were impersonal objects.
6. __________	Working with people all day is really a strain for me.
7. __________	I deal very effectively with the problems of my recipients.
8. __________	I feel burned out from my work.
9. __________	I feel I'm positively influencing other people's lives through my work.
10. __________	I've become more callous toward people since I took this job.
11. __________	I worry that this job is hardening me emotionally.
12. __________	I feel very energetic.
13. __________	I feel frustrated by my job.
14. __________	I feel I'm working too hard on my job.
15. __________	I don't really care what happens to some recipients.
16. __________	Working with people directly puts too much stress on me.
17. __________	I can easily create a relaxed atmosphere with my recipients.
18. __________	I feel exhilarated after working closely with my recipients.
19. __________	I have accomplished many worthwhile things in this job.
20. __________	I feel like I'm at the end of my rope.
21. __________	In my work, I deal with emotional problems very calmly.
22. __________	I feel recipients blame me for some of their problems.

(Administrative use only)

EE Total score: ________ DP Total score: ________ PA Total score: ________

EE Average score: ______ DP Average score: ______ PA Average score: ______

Appendix D: Beck Depression Inventory- Second Edition

BDI - II

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully. And then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness
   0. I do not feel sad.
   1. I feel sad much of the time.
   2. I am sad all the time.
   3. I am so sad or unhappy that I can't stand it.

2. Pessimism
   0. I am not discouraged about my future.
   1. I feel more discouraged about my future than I used to.
   2. I do not expect things to work out for me.
   3. I feel my future is hopeless and will only get worse.

3. Past Failure
   0. I do not feel like a failure.
   1. I have failed more than I should have.
   2. As I look back, I see a lot of failures.
   3. I feel I am a total failure as a person.

4. Loss of Pleasure
   0. I get as much pleasure as I ever did from the things I enjoy.
   1. I don't enjoy things as much as I used to.
   2. I get very little pleasure from the things I used to enjoy.
   3. I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings
   0. I don't feel particularly guilty.
   1. I feel guilty over many things I have done or should have done.
   2. I feel quite guilty most of the time.
   3. I feel guilty all of the time.

6. Punishment Feelings
   0. I don't feel I am being punished.
   1. I feel I may be punished.
   2. I expect to be punished.
   3. I feel I am being punished.

7. Self-Dislike
   0. I feel the same about myself as ever.
   1. I have lost confidence in myself.
   2. I am disappointed in myself.
   3. I dislike myself.

8. Self-Criticalness
   0. I don't criticize or blame myself more than usual.
   1. I am more critical of myself than I used to be.
   2. I criticize myself for all of my faults.
   3. I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes
   0. I don't have any thoughts of killing myself.
   1. I have thoughts of killing myself, but I would not carry them out.
   2. I would like to kill myself.
   3. I would kill myself if I had the chance.

10. Crying
    0. I don't cry anymore than I used to.
    1. I cry more than I used to.
    2. I cry over every little thing.
    3. I feel like crying, but I can't.

11. Agitation
    0. I am no more restless or wound up than usual.
    1. I feel more restless or wound up than usual.
    2. I am so restless or agitated, it's hard to stay still.
    3. I am so restless or agitated that I have to keep moving or doing something.

12. Loss of Interest
    0. I have not lost interest in other people or activities.
    1. I am less interested in other people or things than before.
    2. I have lost most of my interest in other people or things.
    3. It's hard to get interested in anything.

13. Indecisiveness
    0. I make decisions about as well as ever.
    1. I find it more difficult to make decisions than usual.
    2. I have much greater difficulty in making decisions than I used to.
    3. I have trouble making any decisions.

14. Worthlessness
    0. I do not feel I am worthless.
    1. I don't consider myself as worthwhile and useful as I used to.
    2. I feel more worthless as compared to others.
    3. I feel utterly worthless.

15. Loss of Energy
    0. I have as much energy as ever.
    1. I have less energy than I used to have.
    2. I don't have enough energy to do very much.
    3. I don't have enough energy to do anything.

16. Changes in Sleeping Pattern
- 0. I have not experienced any change in my sleeping.
- 1a I sleep somewhat more than usual.
- 1b I sleep somewhat less than usual.
- 2a I sleep a lot more than usual.
- 2b I sleep a lot less than usual.
- 3a I sleep most of the day.
- 3b I wake up 1-2 hours early and can't get back to sleep.

17. Irritability
- 0. I am not more irritable than usual.
- 1. I am more irritable than usual.
- 2. I am much more irritable than usual.
- 3. I am irritable all the time.

18. Changes in Appetite
- 0. I have not experienced any change in my appetite.
- 1a My appetite is somewhat less than usual.
- 1b My appetite is somewhat greater than usual.
- 2a My appetite is much less than before.
- 2b My appetite is much greater than usual.
- 3a I have no appetite at all.
- 3b I crave food all the time.

19. Concentration Difficulty
- 0. I can concentrate as well as ever.
- 1. I can't concentrate as well as usual.
- 2. It's hard to keep my mind on anything for very long.
- 3. I find I can't concentrate on anything.

20. Tiredness or Fatigue
- 0. I am no more tired or fatigued than usual.
- 1. I get more tired or fatigued more easily than usual.
- 2. I am too tired or fatigued to do a lot of the things I used to do.
- 3. I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex
- 0. I have not noticed any recent change in my interest in sex.
- 1. I am less interested in sex than I used to be.
- 2. I am much less interested in sex now.
- 3. I have lost interest in sex completely.

Total Score: _______

THE PSYCHOLOGICAL CORPORATION
Harcourt Brace & Company

Appendix E: Information sheet and informed consent

STUDY INFORMATION DOCUMENT

Study title: Investigating the effect of Neurofeedback Training on burnout-related symptoms in tertiary-level educators.

Dear Lecturer/Researcher,

I, Dr Johanna Beukes, am doing research on the effect of Neurofeedback Training on burnout- related symptoms in tertiary-level educators. Research is a process used in seeking new knowledge. In this study, I want to investigate whether weekly Neurofeedback Training sessions will have an impact on burnout-related symptoms, specifically focusing on the population of tertiary-level educators.

As a lecturer/researcher, I am inviting you to take part in this research study.

What is involved in the study:
1. To determine the severity of your burnout-related symptoms, and to allocate you to either the test or control group, you will be sent a link to a survey containing the BAT Assessment, the MBI Assessment and the BDI-II Assessment. This is an online, self- report, survey which will take 45 minutes to complete. If you fit the criteria, you will be asked to partake in the study.

2. You will be asked to complete a brief demographic questionnaire that will be sent to you via email before the commencement of the study. This brief questionnaire will collect information on gender, age, education, marital status, and socioeconomic status.

3. Pre- and post-intervention Qualitative Electroencephalographs (qEEGs) will be conducted with both the test and control groups to measure any changes in neural electrical activity (i.e., brainwave activity). A qEEG is conducted in the same way as a standard electroencephalograph (EEG). A qEEG entails placing 22 electrodes on your scalp according to the International 10-20 System of electrode placement using a conductive paste. Neural activity will be measured for 10 minutes with eyes closed and 10 minutes with eyes open. The qEEG will take approximately 45 minutes in total (allowing 25 minutes for electrode placement and removal, as well as 20 minutes for measurement). One qEEG will be taken before the intervention, and another will be taken after the intervention. Please note, the intervention will only take place with the test group. The qEEGs will be conducted in a quiet, private room in the Neuroscience Research Laboratory, Enthomjeni Centre, Wits, East Campus.

4. The intervention will only be conducted with the test group and will consist of 10 weekly sessions of Neurofeedback Training. For each session, electrodes will be placed on the scalp using a conductive paste. A computer program will give you feedback on what your brainwaves are doing in real-time. You will be required to sit and listen to or look at the program's feedback for 30-45 minutes for each session. You will also be asked to wear a watch during the sessions that will measure the sympathetic nervous system response and heart rate. The Neurofeedback Training sessions will also be conducted in a quiet, private room in the Neuroscience Research Laboratory, Enthomjeni Centre, Wits, East Campus.

Risks of being involved in the study: There are no foreseeable risks associated with either the qEEG or the Neurofeedback Training sessions. In the unlikely event that you may experience distress of any kind, you are welcome to consult with Dr Aline Ferreira-Correia, a Clinical Psychologist in the Department of Psychology, School of Human and Community Development, Humanities, University of the Witwatersrand at no cost Dr Aline Ferreira-Correia's email address is Aline.FerreiraCorreia@wits.ac.za and her contact number is 0117174527.

Benefits of being in the study: There are no direct benefits, either monetary or otherwise, for you to partake in this study.

Participation is voluntary: Your participation in this study is completely voluntary and refusal to participate will involve no penalty or loss of benefits to which you (i.e., the participant) are entitled to otherwise. You may discontinue participation at any time without penalty. There will be no requirement to provide a reason for withdrawing and any data collected from you will in default be destroyed unless you specifically consent to its retention after your withdrawal from the study.

Reimbursements for "out-of-pocket" expenses: There will be no payment for participation or any foreseeable costs associated with participation in this research study.

Confidentiality and Anonymity: Normally personal information will be treated in the strictest confidence and will only be available to me, the Principal Investigator (PI), Dr Johanna Beukes. The only exceptions - and all of them are rare - would normally be:

1. Personal information may be disclosed if required by law.
2. The Human Research Ethics Committees of the University may exceptionally require personal data to respond to a formal complaint, or for a compliance audit.

All identifiable information from each participant will be anonymized when capturing the data. No individual participant will thus be identified by name or any other identifiable information in any report or publication arising out of this study. All data collected during this study will be securely retained for two (2) years, if a scientific publication arises from the study and six (6) years, if there is no publication. Thereafter it will be destroyed accordingly.

Outputs: The results of this study will be disseminated through publications and conference papers. Data may be used for subsequent secondary analyses. You (i.e., participants) may request further information about the study and its results, although individual feedback on performance will not be available as the collected data will be anonymous.

Contact details of researcher/s: For further information, to indicate your willingness to participate in this study, or to report any adverse events relevant to this study, please contact me, Dr Johanna Beukes at johanna.beukes2@wits.ac.za.

Contact details of HREC administrator and chair: This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg ("Committee"). The principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research. If you have any concerns over the way the study is being conducted, please contact the Chairperson of this Committee, Dr Clement Penny, by telephone number 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za.

Thank you for reading this Study Information Sheet.

PARTICIPANT CONSENT SHEET

Project Title: Investigating the effect of Neurofeedback Training on burnout-related symptoms in tertiary-level educators.

1. I have been given a Participant Information Document which explains the nature and processes involved in this study, which is attached hereto;
2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given the Principal Investigator's contact details, listed below. If I require further information or become concerned about any aspect of this study, I am free to speak to the Principal Investigator.

Contact details:
Dr Johanna Beukes, Principal Investigator, e-mail at johanna.beukes2@wits.ac.za,

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za, Ms Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za.

Do you consent to participating in this research study?	◯ Yes ◯ No

Appendix F: Guidelines for interpretation of the magnitude of effect sizes

Strength	**Pearson**	**Kendall**
Negligible	0.0 - 0.09	0.0-0.05
Weak	0.1 - 0.39	0.06-0.25
Moderate	0.4 - 0.69	0.26-0.48
Strong	0.7 - 0.89	0.49-0.70
Very strong	0.9 - 1.0	0.71-1.0

Appendix G: Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research and Innovation)

TO: Dr J Beukes, et al
School of Human and Community Development
Department of Psychology
University

E-mail: Johanna.Beukes2@wits.ac.za

CC: Supervisor: Not applicable
<>
and <HREC-Medical Research Office@wits.ac.za>

FROM: Mr Iain Burns
Human Research Ethics Committee (Medical)
Tel: 011 717 1252

E-mail: Iain.Burns@wits.ac.za

DATE: 2023/08/10

REF: R14/49

PROTOCOL NO: **M230406** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)

PROJECT TITLE: *Investigating the effect of neurofeedback training on burnout-related symptomps in tertiary-level educators*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R49 Dr J Beukes, et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M230406

NAME: (Principal Investigator)	Dr J Beukes, et al
DEPARTMENT:	School of Human and Community Development Department of Psychology University
PROJECT TITLE:	*Investigating the effect of neurofeedback training on burnout-related symptomps in tertiary-level educators*
DATE CONSIDERED:	2023/05/05
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Not applicable
APPROVED BY:	Professor P Ruff, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2023/08/10 **EXPIRY DATE:** 2028/08/09

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **April** and therefore reports and re-certification will be due in the month of **April** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

_________________________   ____________________

Signature of Principal Investigator   Date

Appendix H: Ethics training certificate

TRREE

Zertifikat Certificado

Certificat Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants

Clinical Trials Centre
The University of Hong Kong

Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

Natasha Theron

a complété avec succès - has successfully completed

South Africa

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 2023/04/03
CID : jNP1vXAQe

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator

APPROVED BY SIWF FMH ISFM
Programmes de formation continue (2 crédits)
Continuing Education Programs (2 credits)

Foederatio Pharmaceutica Helvetiae

FPH Programmes de formation postgraduée et continue

Programmes de formation continue
Continuing Education Programs

Ce programme est soutenu par - This program is supported by :

European and Developing Countries Clinical Trials Partnership (EDCTP) (www.edctp.org) - Swiss National Science Foundation (www.snf.ch) - Canadian Institutes of Health Research (http://www.cihr-irsc.gc.ca/e/2891.html) - Swiss Academy of Medical Science (SAMS/ASSM/SAMW) (www.samw.ch) - Commission for Research Partnerships with Developing Countries (www.kfpe.ch)

[REV : 20220217]

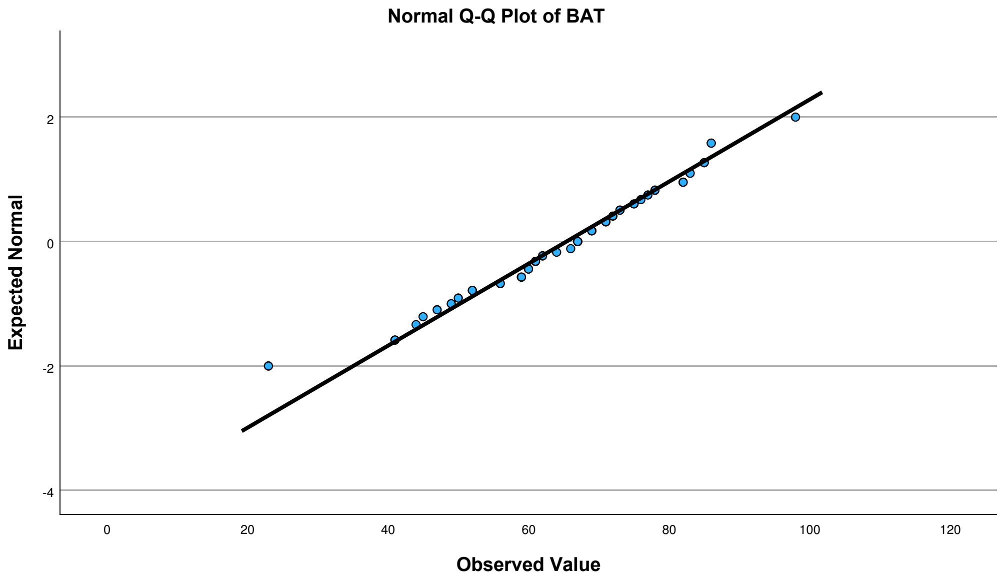
Appendix I: Parametric assumptions testing

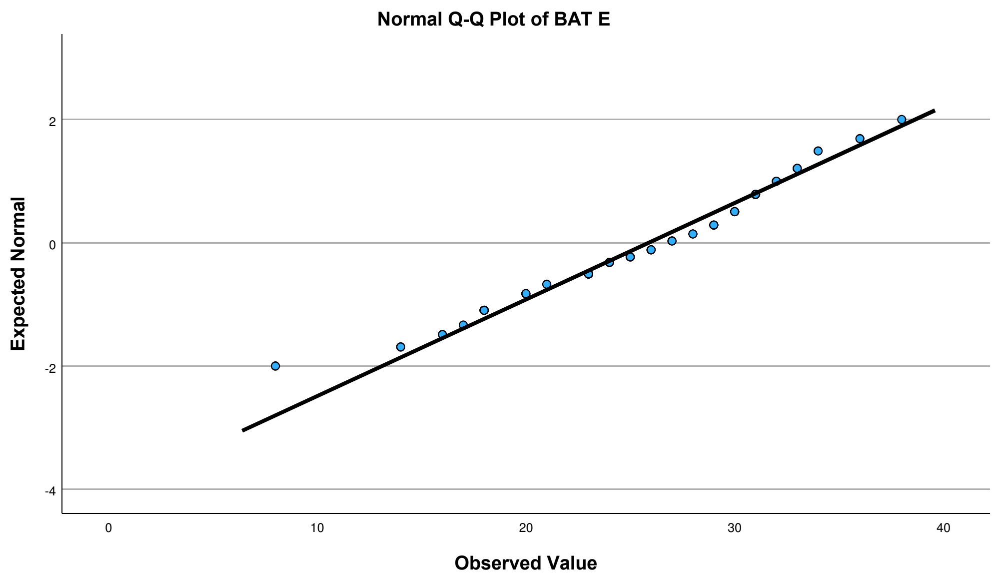
Tests of Normality

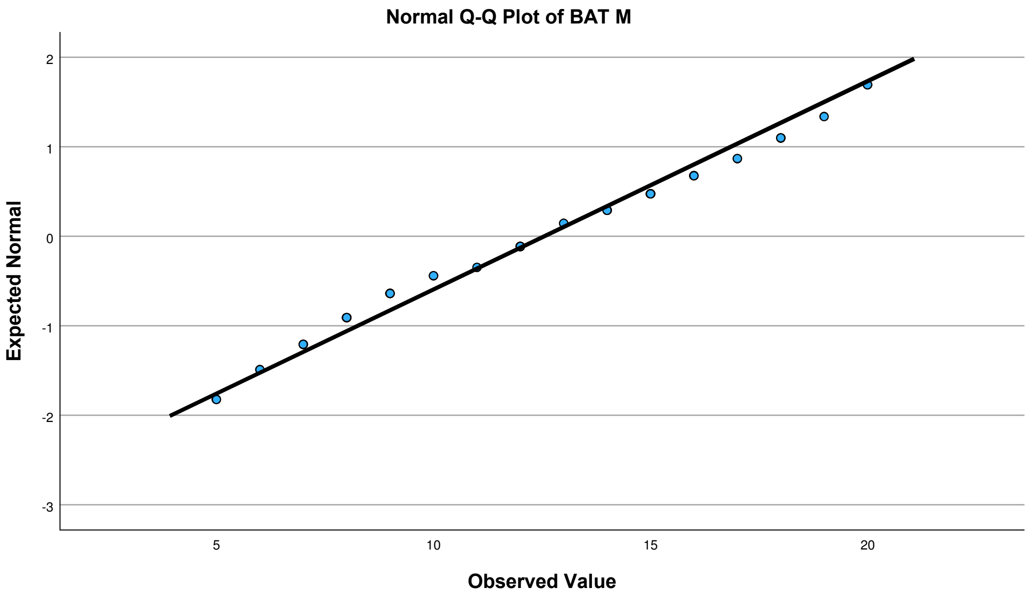
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
BAT	.080	43	.200*	.982	43	.727
BAT E	.106	43	.200*	.972	43	.367
BAT M	.098	43	.200*	.964	43	.189
BAT EM	.130	43	.066	.969	43	.304
BAT C	.095	43	.200*	.984	43	.799
MBI	.059	43	.200*	.992	43	.992
MBI EE	.068	43	.200*	.986	43	.855
MBI DP	.103	43	.200*	.924	43	.007
MBI PA	.091	43	.200*	.971	43	.330
BDI	.110	43	.200*	.939	43	.024

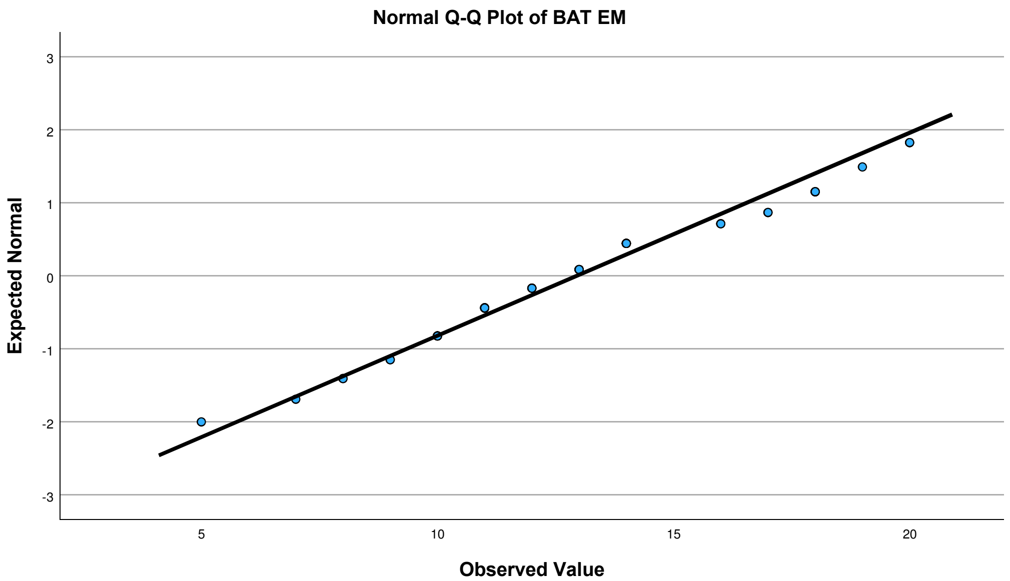
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction




Normal Q-Q Plot of BAT E
Expected Normal
Observed Value
2
0
-2
-4
0
10
20
30
40


Normal Q-Q Plot of BAT M
Expected Normal
Observed Value
2
1
0
-1
-2
-3
5
10
15
20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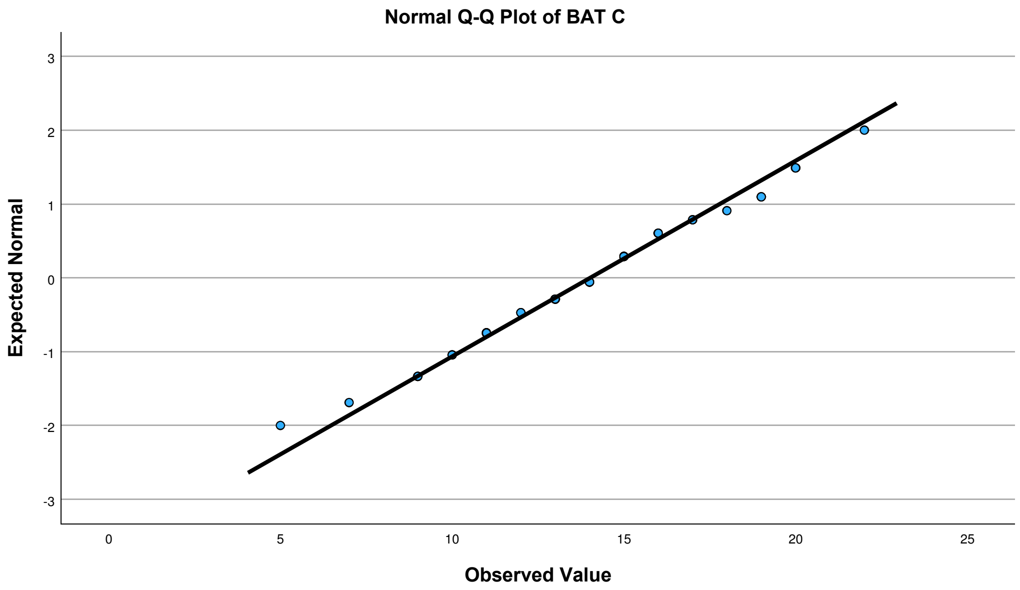
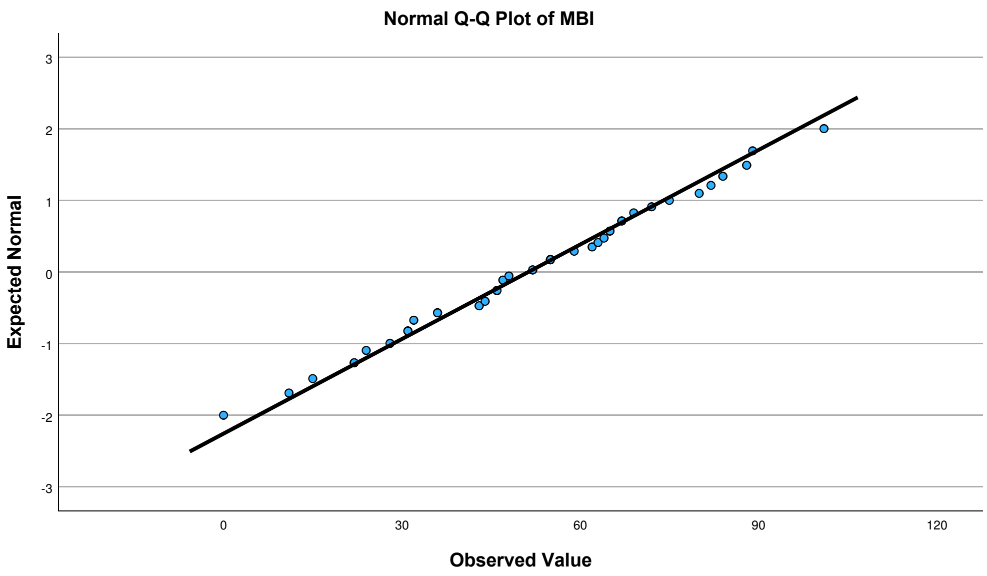
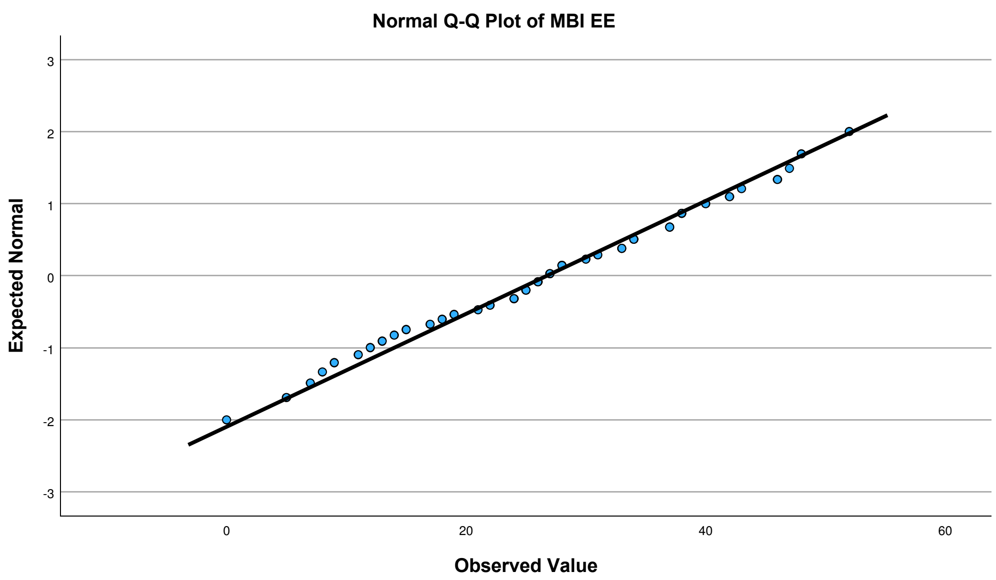
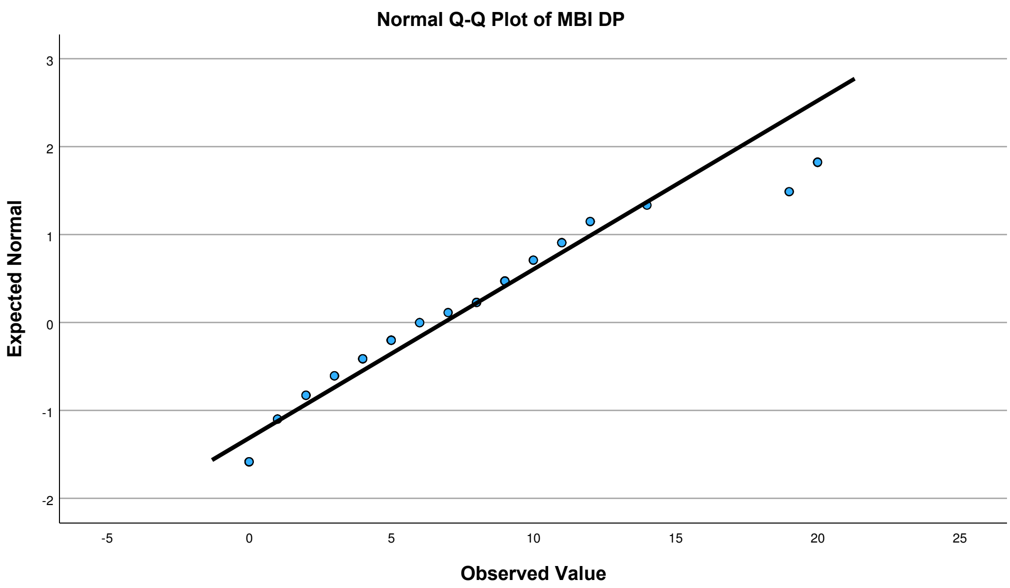
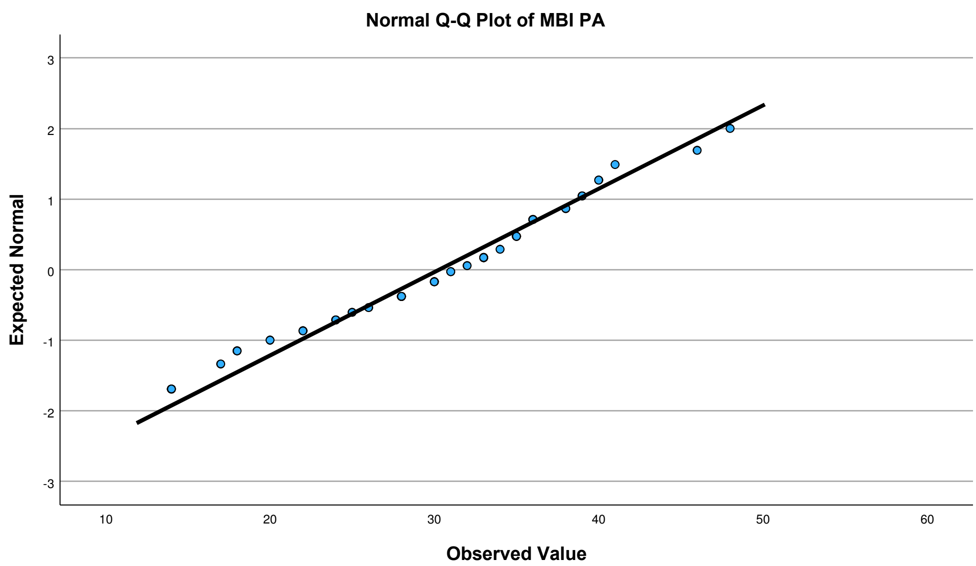
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
5
10
15
20

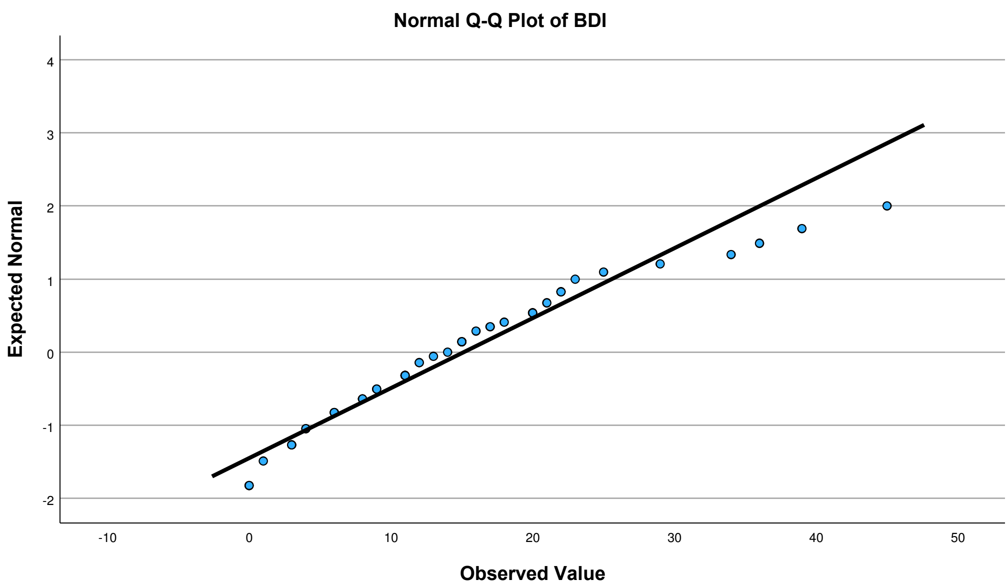

Normal Q-Q Plot of BAT C
Expected Normal
3
2
1
0
-1
-2
-3
0
5
10
15
20
25
Observed Value

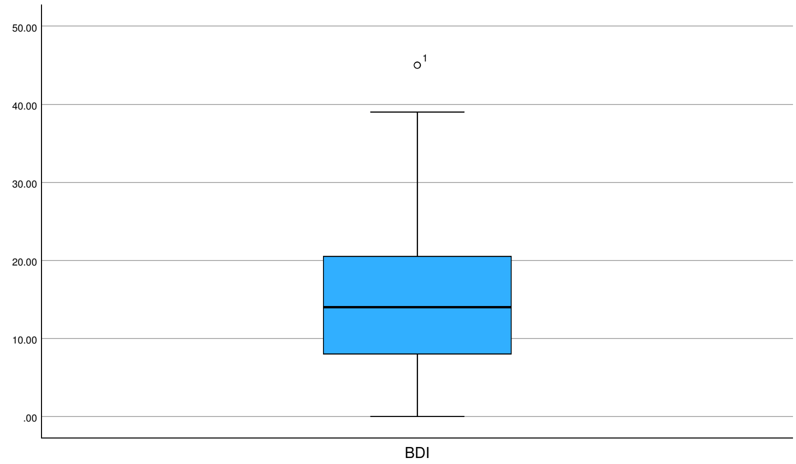

Normal Q-Q Plot of MBI
Expected Normal
3
2
1
0
-1
-2
-3
0
30
60
90
120
Observed Value

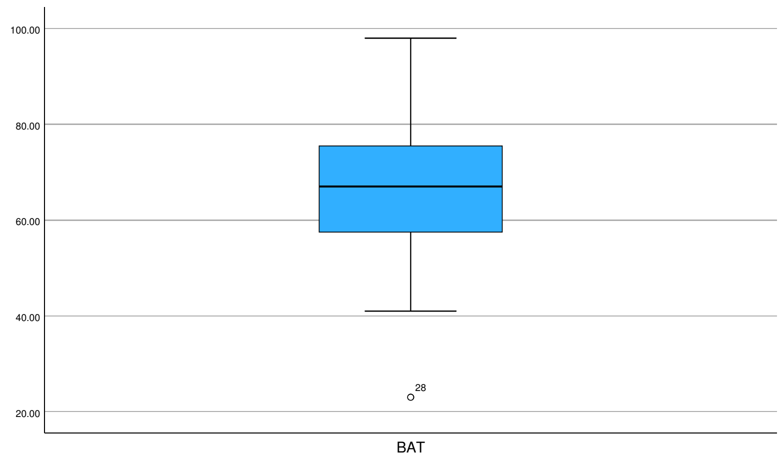

Normal Q-Q Plot of MBI EE
Expected Normal
3
2
1
0
-1
-2
-3
0
20
40
60
Observed Value

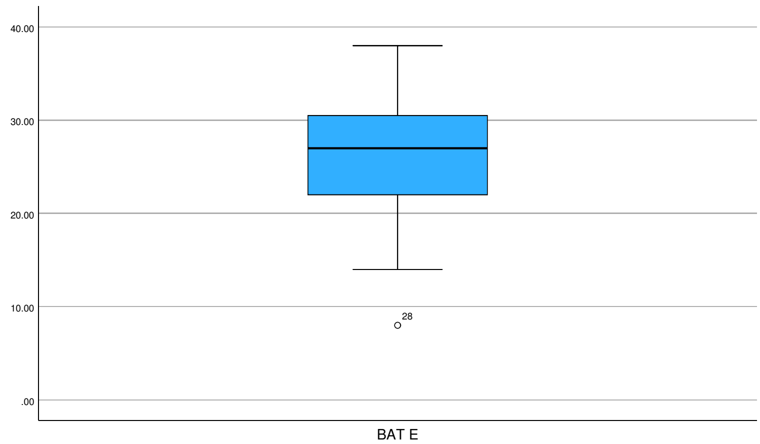

Normal Q-Q Plot of MBI DP
Expected Normal
Observed Value
3
2
1
0
-1
-2
-5
0
5
10
15
20
25

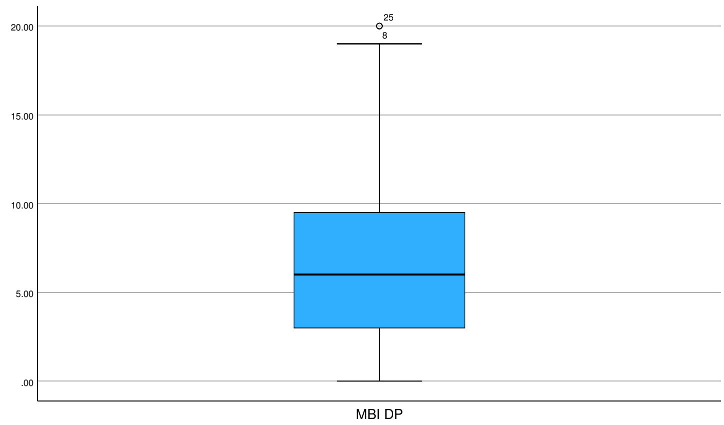

Normal Q-Q Plot of MBI PA
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
10
20
30
40
50
60

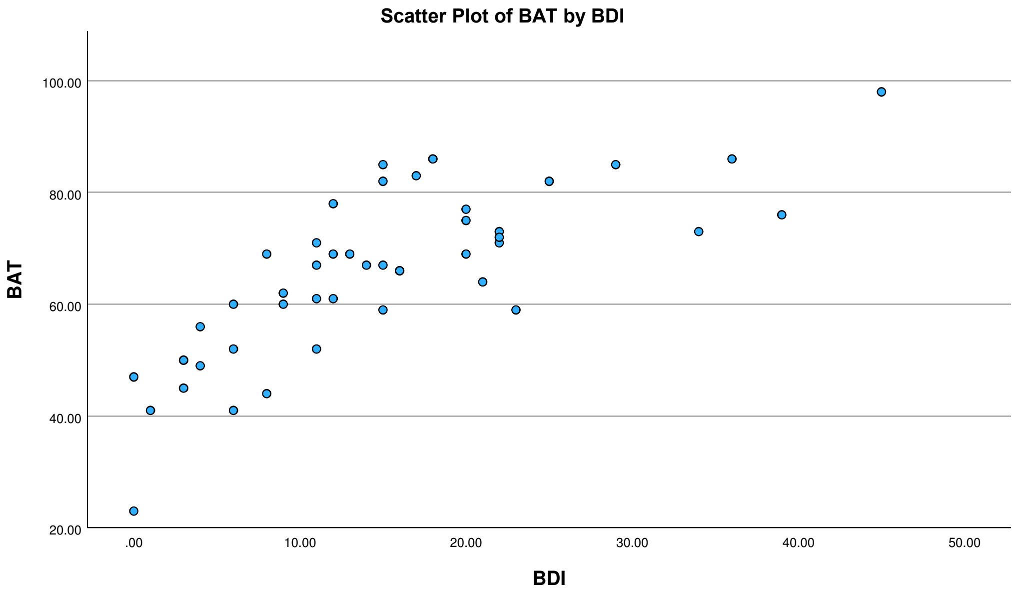

Normal Q-Q Plot of BDI
Expected Normal
Observed Value
4
3
2
1
0
-1
-2
-10
0
10
20
30
40
50

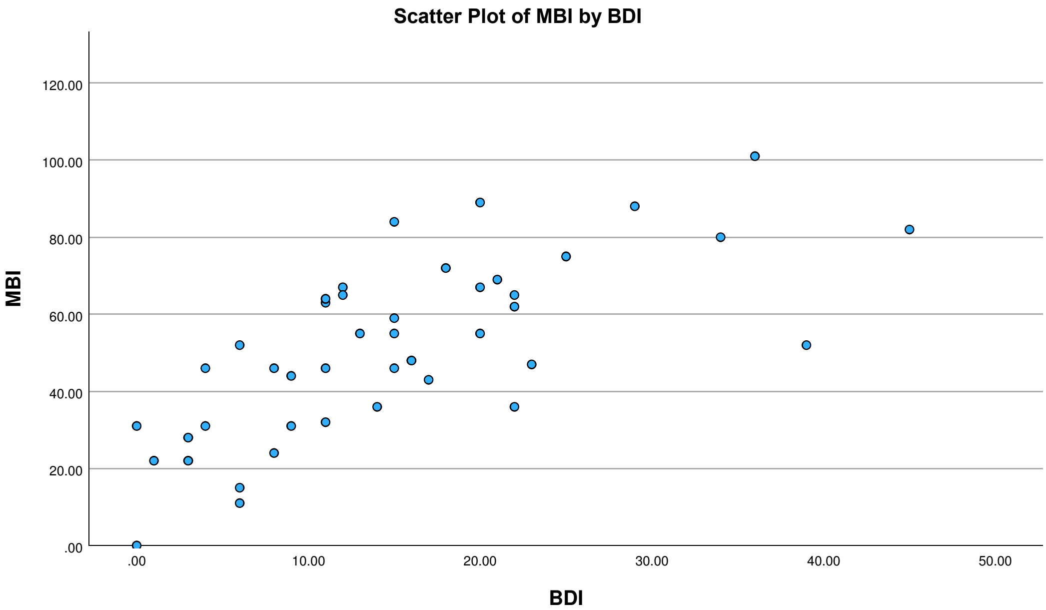

50.00
40.00
30.00
20.00
10.00
.00
1
BDI


100.00
80.00
60.00
40.00
20.00
28
BAT


40.00
30.00
20.00
10.00
.00
28
BAT E


20.00
15.00
10.00
5.00
.00
25
8
MBI DP


Scatter Plot of BAT by BDI
BAT
100.00
80.00
60.00
40.00
20.00
.00
10.00
20.00
30.00
40.00
50.00
BDI

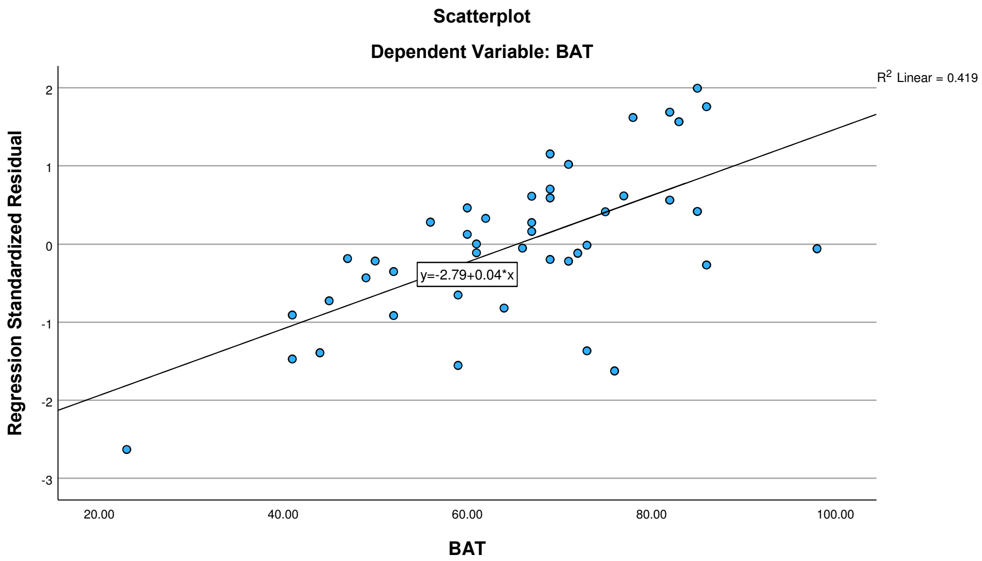

Scatter Plot of MBI by BDI
MBI
120.00
100.00
80.00
60.00
40.00
20.00
.00
10.00
20.00
30.00
40.00
50.00
BDI

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5619.759	1	5619.759	58.319	<.001[b]
	Residual	4047.241	42	96.363		
	Total	9667.000	43			

a. Dependent Variable: BAT

b. Predictors: (Constant), BDI

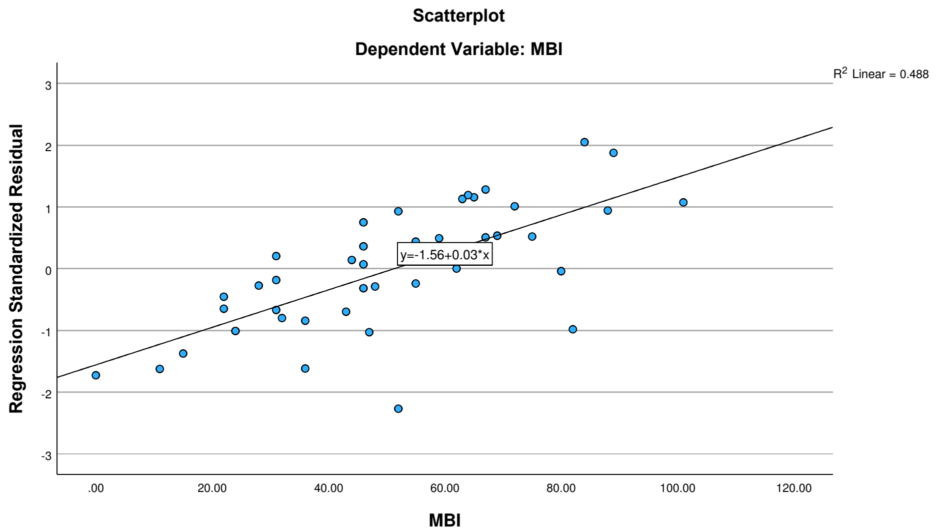


ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11103.396	1	11103.396	43.046	<.001[b]
	Residual	10575.673	41	257.943		
	Total	21679.070	42			

a. Dependent Variable: MBI

b. Predictors: (Constant), BDI



Appendix J: Pearson's correlational analysis of BAT, MBI, and BDI scores

	BAT E	BAT M	BAT EM	BAT C	MBI	MBI EE	MBI DP	MBI PA	BDI	BDI A1	BDI A2
BAT	.91** (.85, .95)	.87** (.79, .93)	.73** (.56, .83)	.82** (.69, .89)	.83** (.71, .89)	.81** (.69, .89)	.57** (.35, .74)	-.62** (-.77, -.41)	.76** (.60, .86)	.73** (.55, .84)	.72** (.53, .83)
BAT E	1.00	.69** (.52, .81)	.55** (.32, .71)	.68** (.49, .80)	.74** (.58, .85)	.78** (.64, .87)	.46** (.20, .66)	-.53** (-.71, -.29)	.70** (.51, .83)	.65** (.45, .79)	.64** (.43, .79)
BAT M		1.00	.57** (.36,.73)	.66** (.47,.79)	.84** (.72,.91)	.76** (.61,.86)	.68** (.49,.81)	-.63** (-.78, -.43)	.68** (.47,.81)	.67** (.47,.81)	.67** (.46,.80)
BAT EM			1.00	.42** (.16, .62)	.57** (.34, .74)	.51** (.27, .69)	.37** (.10, .59)	-.53** (-.71, -.29)	.53** (.27, .71)	.53** (.28, .71)	.54** (.29, .72)
BAT C				1.00	.54** (.29, .71)	.56** (.32, .73)	.39** (.12, .60)	-.37** (-.59, -.09)	.60** (.37, .76)	.56** (.31, .73)	.52** (.27, .71)
MBI					1.00	.94** (.89, .97)	.78** (.64, .87)	-.78** (-.87, -.64)	.72** (.53, .84)	.71** (.53, .84)	.72** (.53, .84)
MBI EE						1.00	.71** (.54, .83)	-.57** (-.74, -.34)	.68** (.47, .81)	.66** (.46, .80)	.66** (.45, .79)
MBI DP							1.00	-.38**(-.60, -.11)	.53** (.28, .72)	.54** (.29, .72)	.55** (.31, .73)
MBI PA								1.00	-.58** (-.75, -.33)	-.57** (-.74, -.32)	-.57** (-.74, -.33)
BDI									1.00	.99** (.99, .99)	.99** (.99, .99)
BDI A1										1.00	.99** (.99, .99)

***. Correlation is significant at the 0.01 level (2-tailed).*

✓95% CIs reported in brackets

BDI A1 (BDI Adjusted 1): BDI variable where fatigue and energy-related items were excluded.

BDI A2 (BDI Adjusted 2): BDI variable the cognitive-related item was excluded.

E: Exhaustion; M: Mental distance; C: Cognitive impairment; EM: Emotional impairment; EE: Emotional exhaustion; DP: Depersonalisation; PA: Personal accomplishment.