Executive functioning, temperament and resilience and depressive symptomatology

among university students

by

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A mini-dissertation submitted in partial fulfilment of the requirements for the degree

MA Clinical Psychology

in the Department of Psychology at the

UNIVERSITY OF PRETORIA

FACULTY OF HUMANITIES

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November 2018

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude and appreciation to the following people without who this journey would not have been possible:

- My supervisor, Prof Cassimjee, for your constant guidance and support. Thank you for pushing me to a point where I could grow and learn. Thank you for believing in me and for encouraging me throughout.

- Ms Denise Jankowitz and Mr Andries Masenge, for your prompt assistance in the analysis of the data.

- Prof Du Toit, at the Physiology department, for giving me access to the computer laboratory for the administration of the online assessments.

- The late Prof Pieter Rossouw and his son Jurie Rossouw, for giving me access to use their assessment instrument to assess resilience, and for their interest in my study.

- My husband, for being my pillar of strength and support. Your unconditional belief, encouragement and patience make all my dreams possible. Thank you for always being my biggest fan. Thank you for being an exceptional father to our daughter during this time. You two are my world.

- My family and friends, for understanding what I have committed to even though it was not always easy. Thank you for the motivational and encouraging talks. Your unconditional love and support has been invaluable throughout this journey.

DECLARATION OF ORIGINALITY

Herewith I declare that this mini-dissertation that is submitted in partial fulfilment of the degree purposes for the degree MA Clinical Psychology at the University of Pretoria, is my own work and has not been submitted previously by me for another degree at another university.

Abstract

With the earlier onset of major depressive disorder that ranges between the ages of 15 and 25 years and high prevalence of depressive symptomatology among university students, studies including a South African university cohort are warranted. Furthermore, there is a need for studies that include non-cognitive aspects when studying executive functioning and depressive symptomatology. Temperament dimensions and resilience are considered to be both putative risk factors and protective factors in the onset and recurrence of depression and have been associated with executive functioning. The primary aim of the current study was to investigate the associations between executive functioning, temperament and resilience, and depressive symptomatology. The secondary aim was to explore the potential predictors (depressive symptomatology, trait-related temperament and state-related resilience) of executive functioning. The methodology employed was quantitative in nature and a correlational design was used. Sampling was based on convenience sampling. A total of 135 participants participated and completed assessment protocols. The comprehensive assessment battery consisted of the University of Pennsylvania Neuropsychological Test Battery, the Beck Depression Inventory-II, the Temperament and Character Inventory–Revised and the Predictive 6-Factor Resilience Scale. Correlational analyses, Wilcoxon Two-Sample Test, the Kruskal-Wallis Test and stepwise regression analysis were used. Results indicated significant correlations between executive functioning and depressive symptomatology, executive functioning and resilience as well as executive functioning and temperament. Significant correlations were also found between depressive symptomatology and resilience, and depressive symptomatology and temperament. Regression analysis found total depressive symptomatology and cognitive-affective features of depression to be predictive of accuracy of performance on certain executive functioning tasks such as mental abstraction. The current study also found novelty-seeking (temperament) to be predictive of

both accuracy and performance speed on executive functioning tests. Regression analysis did not find overall resilience to be a predictor of executive functioning.

In the context of high demand for services at student counselling centres, broader knowledge on the role of depressive symptomatology, temperament and resilience on executive functioning is warranted. An integrated approach to understanding the association between depression and executive functioning, allows for a greater therapeutic focus on individual temperament dispositions and the enhancement of resilience.

Keywords: executive functioning, temperament, resilience, depressive symptomatology, depression

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The following mini-dissertation is an account of research conducted to explore the relationships among executive functioning (EF), temperament, resilience and depressive symptomatology among university students. This chapter presents the background of the research, specifies the problem statement and research question, the aim and objectives of the study and the practical significance of the study. An overview of the research methodology and subsequent chapters is also presented.

1.2 Problem Statement

Depression has been described as a common disorder that is incapacitating and is characterized by repeated or prolonged cycles of depressed mood (Bannour et al., 2013). According to Baune et al. (2010), depression is a psychiatric disorder that is severe and commonly affects millions of people around the world.

In 2011 the Mental Health Information Centre of South Africa reviewed large international studies and concluded that an estimated 10% of the general world population will have some form of depression in any given year (Mental Health Information Centre South Africa, 2011). Worldwide there are an estimated 350 million people with depression (WHO, 2016). In a study of the epidemiology and occurrence of depression in South Africa, Tomlinson, Grimsrud, Stein, Williams, and Myer (2009) found that the lifetime occurrence was 9.8% and the occurrence over a period of 12 months was 4.9%. In the same study, participants with depression reported more than 90% impairment in overall functioning. The impairment in overall functioning refers to psychosocial, cognitive and other aspects that are related depression (Bannour et al., 2013; Fried & Nesse, 2014).

In a systematic review study on the prevalence of depression among university students, it was found that an average of 30.6% of students presented with depressive symptoms, which is much higher than that reported in the general population (Ibrahim, Kelly, Adams, & Glazebrook, 2013). The authors of this study also highlighted significant associations between depression at a young age and poor academic achievement, instability in relationships, thoughts of suicide, suicidal behaviour and overall poor work performance. In a study done by Gress-Smith, Roubinov, Andreotti, Compas, and Luecken (2013) on the prevalence, severity and risk factors for depression, they reported that on average, one third of students presented with mild to severe levels of depressive symptoms.

Multiple factors have been associated with vulnerability, occurrence, recurrence and remission of depression. Some of these factors include EF (Baune et al., 2010; Roca, Vives, López-Navarro, Carcia-Campayo, & Gili, 2015), temperament disposition (Kampman & Poutanen, 2011; Nyman et al., 2011) and resilience profiles (Hochsztein, 2014; Obradović, 2016).

Throughout this study the terms depressive symptomatology and depression are frequently used and should be understood in the light that depressive symptomatology refers to subthreshold depression. The effects and mechanisms of both states of depression, i.e. depression and subthreshold depression, are therefore described and highlighted.

1.3 Research Aims and Question

The primary aim of this study was to explore the associations between EF, temperament, resilience and depressive symptomatology in a group of university students. The secondary aim was to investigate the predictive factors underlying EF performance in this group of university students.

Primary research question: Are there significant associations between EF, temperament, resilience and depressive symptomatology?

Secondary research questions: Does depressive symptomatology predict EF? Do temperament (trait-related) dispositions predict EF? Do resilience (state-related) factors predict EF?

1.4 Objectives of the Study

The objectives of the study were as follows:

- To investigate the relationship among EF, depressive symptomatology, temperament and resilience.
- To determine the predictive factors underlying EF performance.

1.5 Overview of Methodology

The above-mentioned objectives were pursued through employing a correlational research design. The sample was selected by means of convenience sampling. The sample consisted of students registered for studies at the University of Pretoria. Voluntary participation entailed the completion of an assessment battery consisting of a neuropsychological assessment battery to assess EF (University of Pennsylvania Neuropsychological Assessment Battery), a temperament assessment (Temperament and Character Inventory - Revised), a resilience assessment (Predictive 6-Factor Resilience Scale) and the assessment of depressive symptomatology (Beck Depression Inventory-II). Exclusion from the study was based on criteria such as previous or current diagnosis of mental health problems, alcohol or substance abuse and neurological illnesses. Data analysis was done by means of Spearman correlation, Wilcoxon Two-Sample Test, Kruskal Wallis Test and stepwise multiple regression analyses.

1.6 Significance of the Study

With the earlier onset of MDD ranging between the ages of 15 and 25 years (Peterson et al., 2014), as well as a high prevalence of depressive symptomatology among university students (Ibrahim et al., 2013), studies including a South African university cohort are warranted. Snyder (2013) proffered that many studies focusing on EF and depressive symptomatology do not include non-EF aspects of cognitive functioning, and subsequently there is a need for such studies to contribute to a better understanding of the mechanisms and associated features involved in the relationship between EF and depressive symptomatology. Certain temperament dimensions and resilience are further considered to be both putative risk factors and protective factors in the onset and recurrence of depression.

Exploring the predictive features of trait- and state-related features, such as temperament and resilience, allows for a more in-depth understanding of the relationship between EF and depressive symptomatology. Delineation of the predictive potential of the coincident trait-related and state-related psychological attributes may inform pharmacological and therapeutic treatment outcomes and interventions. Specific information on how to address the unique mental health care needs of young adults in a university context who have short-term access to psychological services on campus may, for example, translate into better overall academic outcomes.

1.7 Chapter Overview

Chapter 2 provides an overview of the theoretical point of departure and a review of literature related to EF, temperament, resilience and depressive symptomatology. Chapter 3 focuses on the research methodology that was employed with a specific focus on sampling methods, measurement instruments and data analysis techniques. The findings of the study together with sample composition and statistical techniques, are presented in Chapter 4.

Lastly, Chapter 5 provides a discussion of the main findings in context of relevant literature, the limitations of the study as well as recommendations for future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

It has been found that 1 in every 6 South Africans suffers from depressive disorders (Williams et al., 2013). Mental health disorders such as depression affect not only the psychological and emotional well-being of the individual, but their social and economic states as well (WHO, 2014).

The motivation for this study originated from various international and local studies. Previous research focused on the relationships between EF and depression (Baune et al., 2010; Roca et al., 2015), EF and temperament (Cassimjee & Murphy, 2010; Cassimjee & Murphy, 2013), temperament and depression (Kampman & Poutanen, 2011; Nyman et al., 2011), resilience and depression (Cooper, 2010; Elisei, Sciarma, Verdolini, & Anastasi, 2013), EF and resilience (Hochsztein, 2014; Obradović, 2016) and temperament and resilience (Eley et al., 2013; Williams et al., 2009). Research including a combination of all of these variables (EF, temperament, resilience and depressive symptomatology) is scant.

Chapter 2 provides a review of the literature related to depressive symptomatology and EF. The theoretical point of departure will serve as the foundation for the understanding of various variables that were investigated i.e. EF, temperament, resilience and depressive symptomatology. Furthermore, the trait- and state related features of temperament and resilience will be distinguished.

2.2 Theoretical Point of Departure

The study assumed a neural network approach to depressive symptomatology (Hamilton, Chen, & Gotlib, 2013). When thinking of neural networks in the brain, it is important to note the great interconnectivity of these networks which emphasizes that neural events do not easily occur in isolation (Hamilton et al., 2013). Mayberg (1997, 2003)

conceptualized depression as a multi-dimensional disorder that occurs at system level. According to Mayberg (2003), structural and functional imaging studies found that neural networks in the frontal-striatal-thalamus and the limbic-thalamic-frontal areas play an important role in depression since these networks are involved in mood regulation, cognitive functioning and behavioural output. Temperament and EF have been found to share a common neural foundation (Baune et al., 2010; Spielberg et al., 2011). Furthermore, resilience has been linked to neural circuits such as the reward and fear circuits (Elisei et al., 2013).

A neural network approach further allows for a more robust, precise and logical description of neural network impairments in the presence of depressive profiles (Hamilton et al., 2013).

2.3 Depression

Young adulthood is characterized by increased responsibilities (including academic pressure and stress, social pressure and stress, increased independence and increased autonomy), which often pose difficulties with regards to psychological adjustment (Gress-Smith et al., 2013). These young adults, including university students, have to cope with a multitude of personal and social vicissitudes in their journey to an autonomous personal life (Bayram & Bilgel, 2008; Thurber & Walton, 2012). Young adults' transition from a school to university context is considered one of the most challenging phases of an individual's life and is regarded as an important time for the development of preventative mental health interventions (Bayram & Bilgel, 2008). Risk of the onset of depression seems to increase during the transition from adolescence to young adulthood, and it is during this transition that young adults are faced with multiple challenges, as mentioned previously, which contribute to an increased risk for the onset of depression (Gress-Smith et al., 2013).

Depression can be described as continuous feelings of lowered mood, guilt, hopelessness, helplessness or a decline in self-esteem or self-regard (Parker, 2007). The DSM-5 criteria for major depressive disorder (MDD) confirms the aforementioned by listing symptoms such as depressive mood, loss of interest, not taking pleasure in daily activities and impaired social, occupational and educational functioning (APA, 2013). Depression is often recognized as a chronic disorder due to a high relapse rate (Demeyer, De Lissnyder, Koster, & De Raedt, 2012). *Depressive symptomatology* includes somatic, affective and cognitive features (Sadock, Sadock, & Ruiz, 2015). According to Muñoz, Beardslee, and Leykin (2012), the onset of depression can be delayed and even prevented through early detection and intervention at the level of subthreshold depressive symptoms.

2.4 Depression and Neuropsychological Functioning

The DSM-5 criteria for depression recognizes that individuals suffering from depression may show signs of neuropsychological dysfunction (Keefe et al., 2014). Although depression is primarily defined as a state of mood, cognitive impairment is seen as an integral symptom of the disorder (Bannour et al., 2013). In a study conducted by Baune et al. (2010), cognitive functioning was compared among three groups of participants i.e. healthy control group, currently depressive group and a remission group. As expected it was found that in comparison to the healthy control group, the group that had depression obtained lower scores across the board for cognitive performance (Baune et al., 2010). In comparison to the healthy control group, the currently in remission group showed long lasting cognitive deficits for immediate memory and attention (Baune et al., 2010).

Burton, Vella, Weller, and Twamley (2011) emphasized the manner in which cognitive functioning, especially EF, appears to be impaired easily in the presence of mental illness. In the aforementioned study, a clinical sample was assessed on the following EF subdomains: problem solving, reasoning ability, planning and organizing, cognitive

flexibility, monitoring and adjustment of own performance as well as inhibition of behaviour deemed inappropriate (Burton et al., 2011). The study found that despite some domains of cognitive functioning appeared to be similar in healthy individuals and the clinical sample, impaired domains such as impulse control and decision-making indicated that EF deficits may potentially be cognitive correlates of depressive symptomatology, such as suicidal behaviour. Similarly, another study concluded that cognitive domains, such as attention, EF and memory, appeared to be impaired in the presence of mood disorders such as depression (Beblo, Sinnamon, & Baune, 2011).

Numerous studies focusing on neuropsychological functioning and depression, often make use of adult samples with a focus on later-onset depression and consequently limited research on adolescents and young adults (Baune, Fuhr, Air, & Hering, 2014). In a review study on neuropsychological functioning in adolescents and young adults with MDD, Baune et al. (2014) concluded that adolescents and young adults with depressive symptomatology present with neuropsychological deficits specific to the domains of EF, working memory and psychomotor speed domains. They further emphasize the importance of understanding the nature of neuropsychological functioning within younger groups since early onset depression could have significant long-term effects.

2.4.1 Executive functioning (EF)

Executive functioning (EF) refers to the abilities that equip an individual to function independently, decisively, self-directedly and self-servingly (Lezak, Howieson, Bigler, & Tranel, 2012). According to Lezak et al. (2012) EF is about 'how' and 'whether' a person goes about performing a certain task. EF has been defined as an overarching term encapsulating various cognitive processes such as planning, working memory, attention, impulse control, self-regulation and self-monitoring and is initiated and controlled by the prefrontal areas of the frontal lobes (Goldstein, Naglieri, Princiotta, & Otero, 2014). Suchy

(2016) concurred with and expanded on the aforementioned by defining EF as a multifaceted construct that includes a set of higher order cognitive processes in order to engage in goal-directed and future-orientated behaviour. Complex functions such as the ability to multi-task, problem solve and learn strategically are also within the purview of EF (Lee, 2016).

Although EF is commonly considered synonymous with prefrontal functioning, it is now well understood that the neural architecture of the frontal lobes reflect a richly interconnected network that spans multiple brain regions (Williams, Suchy, & Rau, 2009). Snyder (2013) congruently stated that although EF has been interchangeably used with frontal lobe tasks, and is specifically reliant on the prefrontal cortex, EF employs and connects to wide-ranging neural networks such as the cortical and subcortical areas of the brain.

When studying EF and depression, studies have often focused on EF deficits in the presence of depression. Such studies have found deficits specifically in the EF domains of decision making, concentration, memory and attention, as well as a decline in processing speed where depression is present (Doumas, Smolders, Brunfaut, Bouckaert, & Krampe, 2012; Elderkin-Thompson, Moody, Knowlton, Hellemann, & Kumar, 2010; Marazziti, Consoli, Picchetti, Carlini, & Faravelli, 2010; Rosenberg, Mielke, Xue, & Carlson, 2010). Papazacharias and Nardini (2012) explain that cognitive dysfunction and depression are mainly related due to structural as well as functional changes in areas such as cortical and sub-cortical areas of the brain. These areas are known for the regulation of processing emotional and cognitive information (Papazacharias & Nardine, 2012). In another meta-analysis and review study, it was found that clinically diagnosed patients presented with significant impairments in inhibition irrespective of the measures used (Snyder, 2013). The same study found that planning was the EF domain that appeared to be least affected in the presence of MDD (Snyder, 2013). Processing speed was found to be impaired in the presence

of MDD, and it was reasoned that a decrease in reaction time was due to neuropsychological deficits and not due to psychomotor deficits.

Further support for the active role of EF in depressive episodes focuses on the feature of interference and its impact on recovery from negative moods (Gotlib & Joormann, 2010). If, for example, an individual struggles to shift their attention away from a negative experience or stimulus it may lead to extended focus on this negative information, negative affect and increased depressive symptoms (Letkiewicz et al., 2014).

Deficits in information processing, memory and verbal fluency in the presence of MDD, have been found to be predictors of poor academic performance and poor occupational and daily functioning (Lee, Hermens, Porter, & Redoblado-Hodge, 2012). Lee et al. (2012) proposed that studying, identifying and treating deficits in cognitive functioning could be an important area of focus to improve overall functioning in the presence of MDD.

2.5 Temperament

According to Cloninger (1994) *temperament* can be defined as habits or skills that are based on an individual's perceptions of external stimuli. Temperament is said to be inheritable and refers to an automatic response that is related to procedural memory and learning (Cloninger, 1994). Individual temperament traits have been described as being central to personality and has shown important connotations with developmental psychopathology (Bates & Peterson, 2014).

According to Cloninger's Psychobiological Model of Temperament, temperament can be subdivided into 4 dimensions: novelty seeking (NS), harm avoidance (HA), reward dependence (RD) and persistence (P) (Cloninger, Svrakic, & Przybeck, 1993). These temperament dimensions refer to individual differences in habitual responses that are emotion-based and remain stable from childhood to adulthood (Cloninger, 1994). NS

constitutes impulsiveness, explorative nature, low tolerance and high frustration levels, which may result in explosive behaviour and emotional dysregulation in uncomfortable situations. HA refers to the opposite and is characterized by a pessimistic view about the future, shyness in the presence of strangers and fear of what is not known which leads to behaviour that tries to avoid challenges and unfamiliar situations. RD is described as the fondness of social relationships and the importance of external approval which can make the individual more sensitive to criticism as well as more sentimental. Lastly, P refers to perseverance in achieving one's goals (Mochcovitch, Nardi, & Cardoso, 2012).

Studies on temperament and depression have found that neurotic temperaments, such as high HA and low P, show significant correlations with the onset and presence of depression (Bould et al., 2014; Kampman & Poutenan, 2011; Kampman et al., 2012; Mezulis, Simonson, McCauley, & Vander Stoep, 2011; Panksepp, 2004). In a longitudinal study done by Bould et al. (2014) it was found that temperament could be linked to depression in that negative affect strongly correlated with the diagnosis of depression by the age of 18 years. Although this correlation suggests vulnerability to depression it is important to note that the onset of depression is dependent on the presence of other factors as well (Bould et al., 2014). In contrast to the aforementioned, it has been found that temperament dimensions related to positive affect, being low in HA and high in P, serve a protective role to the onset of depression (Eley et al., 2013).

Temperament has also been studied in relation to EF. In a study done on non-clinical samples, Crocker et al. (2012) found that trait negative affect was related to lower brain activity in regions associated with attentional control which is an executive function. Cassimjee and Murphy (2010), found strong correlations between temperament and character domains and EF, such as performance speed and abstract reasoning in a student sample. With regards to clinical samples, Brunfaut, Claes, Demyttenaere, Gabriel, and Hermans (2009)

found a positive correlation between impaired metacognition, behavioural inhibition, deficits in attentional control, and negative affect within a clinical sample of 30 OCD patients. Similarly, Drechsler, Zulauf Logoz, Walitza, and Steinhausen (2015) found consistent relationships between temperament and EF in clinically diagnosed children with ADHD and non-clinical samples without ADHD.

Latzman, Shishido, Latzman and Clark (2016) highlighted the importance of studying the contributing properties of temperament and EF with regards to anxious and depressive symptomatology. The study emphasizes the moderating role that positive temperament traits play regarding the effect of negative temperament traits and anxious and depressive symptomatology, specifically among young adults with lower levels of EF. Further investigation of neuropsychological functioning in relation to positive and negative temperament traits is encouraged in order to gain a better understanding of the shared and interactive potential these traits show as risk and protective factors for anxious and depressive symptomatology (Latzman et al., 2016).

When relating temperament to specific depressive symptomatology, Paavonen et al. (2014) studied vegetative symptoms of impaired sleep, impaired appetite and inner tension in association with temperament dimensions of NS, HA and RD. It was found that temperament clusters and vegetative symptoms of depression could provide valuable information on the treatment response of antidepressants in MDD (Paavonen et al., 2014).

2.6 Resilience

One of the foundations of psychological health and behavioural medicine is the understanding of risk and resilience to stress (Williams et al., 2009). There is increasing interest in the phenomenon of resilience despite controversies around the definition and

measurement of the situational and cultural limitations of resilience (Russo, Murrough, Han, Charney, & Nestler, 2012).

Resilience is a term that is not easily defined but often understood as an overarching term for concepts associated with patterns of positive adaptation where adversity is present (Masten & Obradović, 2006). Another definition refers to resilience as a positive response to obstacles, a learning opportunity from setbacks as well as a motivation to overcome challenges (Owen, 2012). Similarly, in the context of posttraumatic stress disorder and MDD, resilience has been defined as the capacity of an individual to avoid situations of extreme stress that might compromise psychological and physical well-being (Russo et al., 2012).

From a biological perspective resilience has been linked to the hypothalamic-pituitary-adrenal axis (HPA axis) that plays an important role in the mediation of responses to adverse stimuli or stress and is strongly associated with depression when HPA function is disrupted (Russo et al., 2012). When looking at resilience as a mental construct, it is grounded in neural networks and neurobiological functioning (Russo et al., 2012). From this neurobiological point of view, research has described resilience alongside neuroplasticity and its role in facilitating adaptation (Rossouw & Rossouw, 2016). In their development of the Predictive 6-Factor Resilience Scale, Rossouw and Rossouw (2016) found six distinct neurobiological constituents (tenacity, vision, collaboration, composure, reasoning, momentum and health) that could inform treatment as well as improve resilience overall.

As outlined in the previous paragraphs, it is important that resilience is viewed as state-related rather than trait-related (Rutter, 2012). Rutter (2012) acknowledged that even if it is probable that resilience could be shown in a variety of contexts and settings, it is not to say that this resilience has the same protective features in the presence of all risks. Resilience

can be developed by promoting factors such as a positive outlook, secure and caring network, secure role models, cognitive flexibility, commitment, religious or spiritual support systems, altruism, etc. (Southwick & Charney, 2012). Using these psychosocial factors to develop resilience could be beneficial throughout an individual's life (Southwick & Charney, 2012).

As with temperament, resilience has been studied in relation to depression and EF. Resilience is seen to have an important protective function against depression across the lifespan and is therefore regarded as a valuable intervention tool in clinical, educational and professional settings (Muñoz et al., 2012; Rossouw & Rossouw, 2016). Adversely, low resilience has been associated with ineffective coping abilities when faced with adversity, which is considered a risk factor for the onset of psychopathology (Lee, 2016). Low resilience also implies that extra effort is needed to overcome the negative emotions experienced when faced with adversity (Lee, 2016). With regards to EF, Owen (2012) found that resilience can be linked to EF in that it incorporates functions such as the ability to think in a flexible manner as well as problem-solving ability. Another argument is based on findings indicating the presence of a larger prefrontal cortex in resilient children as opposed to non-resilient children, which highlights the pivotal role of executive functioning in resilience (Shaw, 2016).

Muñoz et al. (2012) emphasized how preventative strategies for the onset of depression should focus on strengthening resilience, not just on an individual level but rather on multiple levels, such as family, caregiver, system and community level. High resilience has been associated with significant resistance to the development of pathology by individuals regardless of high-risk environments (Muñoz et al., 2012).

2.7 Trait-related Temperament and State-related Resilience

For the purposes of this study it is important to note the operationalization of the constructs temperament and resilience.

Chess, Thomas, Birch, and Hertzig (1960) defined temperament as an innate, natural trait that is of biological origin (as cited in Rauch, 2015). Cloninger agrees with this by describing temperament as a biological feature that one is born with and that influences one's behaviour (Cloninger, 1993). Resilience, on the other hand, is a learned trait that refers to an individual's ability to cope and move past challenging experiences and situations (Rauch, 2015). It refers to how easily or quickly an individual can return to their normal level of functioning in the face of adversity (Rauch, 2015). Resilience can be improved in order to assist in controlling one's responses (Casalin, Tang, Vliegen, & Luyten, 2014). Temperament is therefore, according to these researchers, a genetic and stable trait that is concerned with automatic emotional responses to external stimuli, whilst resilience is considered a protective measure against the development of psychopathology and constitutes the ability to revert to a healthy state when presented with hardship or stress (Kim, Lee, & Lee, 2013).

Temperament and resilience are both important contributors to reaction and response which is not predetermined but differs from one individual to another (Kim et al., 2013). According to Goldstein, Faulkner, and Wekerle (2013), temperament is not a form of resilience. Temperament is an individual's inner or natural response (i.e. trait-related) whilst resilience develops from exposure to stress or trauma that an individual is faced with (i.e. state-related) (Nilsson, 2014). Temperament can be seen as a trait that results in a certain reaction, whilst resilience refers to how an individual responds to the stressor (Rauch, 2015). Resilience is conditional, situational and an interactive process in comparison to temperament that is stable and enduring across time (Rutter, 2012).

2.8 Other Features of EF and Depressive Symptomatology

In a study conducted on the relationship between depressive symptoms and impaired cognitive control (EF domain) in a clinical sample, 30 remitted participants were recruited. After the initial assessment, a follow up assessment was conducted to determine whether cognitive control predicts depressive symptoms. The study found that ruminative thinking significantly mediated the relationship between depressive symptoms and cognitive control (Demeyer et al., 2012).

In another study, Wolters Gregório et al. (2015) studied a group of 93 individuals with acquired brain injury together with 58 of their significant others. The study found that the relationships among EF impairment, depressive symptoms and quality of life were mediated by passive coping styles. (Wolters Gregório et al., 2015). Passive coping styles thereby were found to be associated with decreased quality of life as well as an increase in depressive symptomatology.

Lastly, Wante, Mezulis, Van Beveren, and Braet (2016) found that both maladaptive and adaptive emotional regulation play a significant role in mediating the relationship between EF and depressive symptoms in a sample of adolescents.

2.9 Conclusion

With factors such as rumination, coping style and emotional regulation being found to be mediators in the relationship between EF and depressive symptoms (Lee, 2016; Mezulis et al., 2011; Troy & Mauss, 2011), studying the relationship among other associated factors (EF, temperament, resilience and depressive symptomatology) and how they interplay is essential. It can further inform prevention, intervention and treatment strategies. Noting this, it is necessary to investigate trait-related and state-related contributors such as temperament and

resilience when considering the association between EF and depressive symptomatology.

Chapter 3 details the research methodology.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The aims for this study were, firstly, to investigate the associations between EF, temperament, resilience and depressive symptomatology. Secondly, to investigate the potential predictive features of depressive symptomatology on EF, the potential predictive features of temperament (trait-related) on EF and the potential predictive features of resilience (state-related) on EF.

The objectives for the proposed study were as follows:

- To investigate the relationship among EF, depressive symptomatology, temperament and resilience.
- To determine the predictive factors underlying EF performance.

Chapter 3 provides a description of the quantitative approach and correlational design.   Furthermore, the employment of convenience sampling and the recruitment of participants is described. The chapter also outlines and describes the various assessment instruments used to collect data as well as the methods of data analysis employed. Lastly, the chapter discusses various ethical considerations that were taken into account during this investigation.

3.2 Research Design

3.2.1 Correlational design

The methodology employed was quantitative in nature and a correlational design was used.

It is important to note that a correlational design does not attempt to explain the relationship between variables but rather determines whether a relationship exists, and then describes the nature of that relationship (Gravetter & Forzano, 2012).

3.3 Research Methodology

3.3.1 Sampling

Sampling was based on convenience sampling and on participants' availability and willingness to participate (Gravetter & Forzano, 2011).   The proposed sample comprised of students between the ages of 18 and 25 years of age. Students registered for any of the psychology modules at the University of Pretoria were recruited to participate in the study on a voluntary basis.

A total of 135 participants who voluntarily participated in the study and had valid and completed assessment protocols were included in the final data analysis. A larger sample size would have been ideal, but this was not possible mainly due to time and cost constraints.

The inclusion of the designated University of Pretoria psychology student sample was based on the following motivations: firstly, the convenient sample comprising psychology students allowed for the management of practical aspects inherent in utilizing an online assessment platform. Scheduling of group administration of the online neuropsychological assessment was based on shared timetable availability. The link to the online neuropsychological battery, which is on the University of Pennsylvania online platform, had to be managed at specific intervals in order to assure that remote technical support were available across time zones. Secondly, cognitive online assessments linked to platforms had to be conducted in a controlled cognitive laboratory test environment.

3.3.2 Exclusion criteria.

a) Diagnosis of any mental disorders such as major depressive disorder, schizophrenia, bipolar disorder, etc.

b) Other medical or neurological illnesses that may affect cognitive performance on assessments, such as a history of stroke, epilepsy or brain injury with loss of consciousness.

c) Substance abuse within the preceding 3 months.

3.3.3 Participant recruitment

After approval from the Research Committee of the Department of Psychology and the Faculty of Humanities Postgraduate Research and Ethics Committee at the University of Pretoria, module coordinators were approached by the researcher to obtain permission for a detailed information sheet to be uploaded on the university ClickUp system (intranet) in order to recruit volunteer participants. The information sheet provided a brief description of the research together with a detailed description of what participation would entail.

Students who were interested and willing to participate and felt that they met the inclusion criteria, contacted the researcher via e-mail or SMS. Any questions regarding the research were addressed. Potential participants who were comfortable with the assessment process were then provided with possible time slots in which assessments would take place. Each participant could choose one slot. Based on mutual availability a time slot was booked and a reminder with venue information was sent to volunteer participants closer to the date of assessment. Assessment would then proceed as described below. In instances where participants were interested to partake but could not attend one of the given time slots, weekly time tables were sent in order to find a date that would suit both parties.

3.3.4 Administration conditions

The researcher facilitated all sessions. Group sessions comprised of between three and 10 students. The online testing was conducted in a computer laboratory on campus, in a room conducive to optimal testing conditions (i.e. free of distractions and standardised testing protocols applied to all groups). Online assessments were conducted on desktop computers linked to the University of Pennsylvania Computerised Neuropsychological Test Battery (PennCNP) (University of Pennsylvania, 2007). Students were provided with unique

identifiers (numerical codes) that were used to log in to the online assessments. This ensured the confidentiality of test scores. Information provided in the socio-demographic questionnaire was reviewed and clarified at the start of each session in order to ensure that participants met the criteria for participation. The complete assessment battery took 45 – 60 minutes to administer depending on the pace of the participant.

3.4 Research Instruments

3.4.1 Socio demographic questionnaire

After being briefed on the nature and purpose of the study, written informed consent was obtained from all participants (Appendix A). A short socio-demographic questionnaire (Appendix B) was completed to gather basic information on age, gender, ethnicity, degree, first language and clinical and medical information as set out in the exclusion criteria.

3.4.2 Executive functioning.

3.4.2.1 University of Pennsylvania Computerised Neuropsychological Test Battery.

The WebCNP is an online portal that provides access to the Penn's Computerised Neurocognitive Battery which is a computerised online assessment that measures neurocognitive functions such as abstract reasoning, mental flexibility, problem solving, working memory, episodic memory, language, spatial perception, sensorimotor functioning, motor speed and emotion identification (Gur et al., 2010). Access to this battery is granted by the PennCNP team of researchers. The battery has been previously administered to South African university students (Murphy & Cassimjee, 2013). For the purposes of this study the focus was on the EF battery of tests which comprises the following:

Executive Function Domain	PennCNP Subtest(s)
Abstract Reasoning	Penn Abstraction, Inhibition and Working Memory (AIM); Short Raven's Progressive Matrices (sRAVEN); Penn Conditional Exclusion (PCET)
Mental Flexibility	sRAVEN
Problem Solving	sRAVEN
Working Memory	Letter-N-Back (LNB-2); AIM
Attention	LNB-2
Motor Speed	Motor Praxis (MPraxis)

Below is a description of each of the above-mentioned subtests.

3.4.2.1.1 Motor Praxis (MPraxis). The MPraxis subtest was designed to allow the participant to familiarize himself with the computer mouse. It measures sensory-motor ability. The participant is expected to click the mouse once on a continuously shrinking green square that appears on the screen in a different location after each click. It is said that if a participant fails to complete the MPraxis it is unlikely that they will have the ability to complete any of other PennCNP tasks. The participant is presented with the green square 20 times and has five seconds to respond. Should the

participant not provide a response in five seconds the trial will continue with the green box appearing smaller at a dissimilar location on the screen. The number of correct responses and the median response time for correct responses makes up the overall test score.

3.4.2.1.2 Penn Abstraction, Inhibition and Working Memory (AIM). The AIM was developed to measure abstraction and concept-formation. Both these domains of EF are measured with working memory and without working memory. The participant is presented with two separate types of questions which may be practiced before the actual task starts. Firstly, the participant is presented with two sets of stimuli on the top of the page and one stimulus in the middle at the bottom of the page. Participants are expected to decide to which set the bottom stimulus belongs to. A response is entered by clicking on the set that is deemed best suited to the bottom stimulus. The participant immediately receives feedback on whether their response was correct or incorrect. After feedback is presented the task automatically presents the next question. Secondly, the participant is presented with a stimulus flashing at the bottom of the screen after which two sets of stimuli are presented at the top of the page. Working memory is thus measured in this type of trial i.e. the participant's ability to keep the flashing stimulus in mind in order to choose the pair which it belongs to. Feedback is once again given immediately and the programme moves on to the next question. The AIM subtest is made up of 60 questions in total – 30 for each category type. The participant is given 10 seconds to answer each trial. It is expected that both colour and shape are taken into consideration for all stimuli presented. Scores are determined by the number of correct and incorrect responses as well as the median response time for each category.

3.4.2.1.3 Letter N Back (LNB-2). The LNB-2 serves as a measure of attention and working memory. The task requests participants to focus attention to letters that flash on the screen. Letters appear one by one and the participant is expected to press the spacebar based on three different rules. During the first trial, 0-back, the participant is asked to press the spacebar as the letter 'X' is presented on the screen. Secondly, the spacebar must be pressed when the letter on the screen is the same as the letter presented previously in the 1-back trial. Lastly, during 2-back, the participant is expected to press the spacebar when the letter on the screen is the same as the letter before the previous letter that was presented. For each trial the participant has 2.5 seconds to respond. There are practice examples for each of the three scenarios after which the official task begins. The participant's score is based on the total of correct and incorrect responses as well as median reaction time for all correct responses.

3.4.2.1.4 Penn Conditional Exclusion Test (PCET). As a measure of abstraction in EF the PCET is related to the Wisconsin Cart Sorting Test. The participant has to make a decision on what object out of four objects is the odd one out with regards to the remaining three objects. Choosing an object is based on three criteria which change as the participant correctly answers 10 consecutive trials. Criteria for decision making include line thickness, shape and size. The test is scored by taking the number of correct or incorrect responses into account as well as the median response times.

3.4.2.1.5 Short Raven's Progressive Matrices (sRAVEN). The sRaven was designed as a measure of abstraction and mental flexibility. The sRAVEN is made up of multiple choice tasks. The participant is expected to abstract spatial design and numerical associations which range from easy to difficult. The participant is asked to

click on the pattern that is deemed to fit best with the visual analogy of nonrepresentational designs presented on the page. This subtest consists of nine questions and scores are based on the number of correct responses as well as the median reaction times for the number of correct, incorrect and all responses.

3.4.3 Temperament.

3.4.3.1 Temperament and Character Inventory – Revised (TCI-R)

The TCI-R is the revised version of the TCI and is aimed at measuring personality traits associated with temperament and character across 7 domains according to the biopsychosocial model (Cloninger et al., 1993). For non-clinical samples, internal consistencies across domains have been recorded between 0.70 and 0.89 (Cloninger, Thomas, Przybeck, Dragan, & Svrakic, 1994). The TCI has been used in the South African context with samples of a representative age to that of the current study (Du Preez, Cassimjee, Lauritz, Ghazinour, & Richter, 2011). The TCI looks at four temperament dimensions namely novelty seeking (NS), harm avoidance (HA), reward dependence (RD) and persistence (PS) and three character dimensions namely self-directedness (SD), cooperation (CO) and self-transcendence (ST). For the purpose of this study, the temperament dimensions were analysed. NS refers to the activation of behaviour and includes exploratory, impulsive and extravagant behaviour. In contrast, HA refers to the inhibition of behaviour and includes a pessimistic nature, avoidance, fear of uncertainty and worry. RD is described as the maintenance or continuation of behaviours and includes sentimental behaviours, attachment relationships and approval seeking from others (Cloninger et al., 1993).

3.4.4 Resilience

3.4.4.1 Predictive 6-Factor Resilience Scale (PR6)

The PR6 measures resilience and aims to measure protective factors that may diminish risk and adversity (Rossouw & Rossouw, 2016). This assessment taps into vision, composure, tenacity, reasoning, collaboration and health. Vision refers to what drives us or gives us personal sense of direction. It includes what we aspire to be as well as our sense of confidence in achieving our goals. Composure is described as effective emotional regulation during stressful and complex circumstances. Tenacity refers to perseverance when things get difficult. Reasoning plays an essential role in our confidence, problem solving ability and adaptability. Collaboration is the nature of human need for close relationships with others and includes support networks. Lastly, health is considered a foundational domain of resilience. Health refers to our physical health and wellbeing. The PR6 shows good internal consistency with a Cronbach's α of 0.74 (Rossouw & Rossouw, 2016). The PR6's strength lies in its unique development based on a neurobiological approach to conceptualising resilience (Rossouw & Rossouw, 2016). This was the first time that the PR6 was used in a South African study.

3.4.5 Depressive symptomatology.

3.4.5.1 Beck Depression Inventory-2 (BDI-II)

For this study the BDI-II was used to identify the presence of state-based depressive symptomatology (Beck, Steer, & Brown, 1996). The BDI-II has been validated and normed for use in South Africa and is considered reliable for use in this context (Makhubela & Mashegoane, 2016). Two dimensions can be distinguished namely the cognitive-affective dimension and the somatic dimension. The cognitive-affective dimension includes factors such as sadness, past failure, loss of pleasure, feelings of guilt, feelings of punishment, self-

dislike, self-criticalness, suicidal thoughts or wishes, crying, agitation, loss of interest, indecisiveness, feelings of worthlessness and irritability (Beck et al., 1996). The somatic dimension includes factors such as loss of energy, changes in sleeping patterns, loss of appetite, concentration difficulty and tiredness or fatigue (Beck et al., 1996).

3.5 Data Analysis

Preliminary data analyses and descriptive statistics were computed followed by correlational analyses. Correlational analyses were done by means of Spearman correlations in order to investigate the relationships between EF, temperament, resilience and depressive symptomatology. The Wilcoxon Two-Sample Test was used to test for mean differences between categorical variables in the LNB-2 and sRaven tasks. The Kruskal-Wallis, a non-parametric test, is used to conclude whether statistically significant differences exist between a continuous dependent variable and more than two groups of independent variables (McKnight & Najab, 2010). Stepwise regression analysis would further indicate which (and possibly how) independent variables (depressive symptomatology, resilience and temperament) are related to the dependent variable (EF).

3.6 Ethical Considerations

Participants were provided with knowledge on the general purpose of the study in order to make an informed decision regarding voluntary participation. The researcher's contact details were provided so that any queries could be addressed timeously. Participants were assured that study participation was voluntary and that they could choose to withdraw from the study at any time without any consequences. Confidentiality of information was assured since no personal identifiers were used on the online platform and on questionnaires. Data that was collected is being stored in the Department of Psychology for 15 years as per the University of Pretoria policy. Participants were asked to give permission for data to be made available for future research endeavors. There were no foreseeable or anticipated risks

in participating in this study. Should debriefing be required, participants would have been referred to Itsoseng Clinic at the University of Pretoria Mamelodi Campus and/or to the University of Pretoria student counselling centre to receive such services free of charge.

3.7 Conclusion

Chapter 3 outlined the methodology, details on measuring instruments and data analysis and assessment techniques. Chapter 4 provides a detailed account of the results of the data analyses.

CHAPTER 4: RESULTS

4.1 Introduction

The following chapter reports the findings of the statistical analyses. Firstly, the chapter provides descriptive characteristics followed by correlations and results from the inferential analysis.

4.2 Demographic Information

A total of 135 participants were recruited and assessed during a five-month period (November 2017 to March 2018). All participants met the inclusion criteria for partaking in the study.

The mean age of participants was 20.27 years (SD = 1.76). Females were overrepresented in the sample at 87% compared to 13 % males. The majority of participants reported being English speaking (47%), followed by Afrikaans (33%). Table 1 provides a more detailed account of the demographics of the total sample.

Table 1

Demographic Characteristics of the Total Sample

Demographic characteristic	Frequency	Percentage
Gender:		
Female	117	87%
Male	18	13%
Home Language		
Afrikaans	44	33%
English	61	45%
African	28	20%
Other	2	2%
Study Phase		
Postgraduate	24	18%
Undergraduate	111	82%

Note: N = 135

4.3 Descriptive Statistics

      4.3.1 Descriptive statistics for assessment measures. Table 2 to 5 below provides a summary of the descriptive statistics for each of the assessment measures.

Table 2

Descriptive Statistics for EF Assessments

EF Test	N	Mean	SD	Skewness	Kurtosis
MPraxis – Sensory-Motor Abilities					
Reaction time – Trial 1	135	914.13	226.70	-	-
Reaction time – Trial 2	135	668.70	143.01	-	-
AIM – Abstraction and Concept Formation					
Correct responses – trial 1	135	7.24	1.89	-0.34	-0.48
Median response time – trial 1	135	2169	802.63	1.50	3.59
Correct responses – trial 3	135	8.66	1.09	-0.67	0.11
Median response time – trial 3	135	2048	601.72	0.68	0.23
Correct responses – trial 5	135	8.59	1.07	-0.36	-0.70
Median response time – trial 5	135	1920	610.66	1.02	0.66
Total correct responses		24.49	3.16	-0.55	-0.29
Total reaction time		2045	545.32	0.63	0.25
AIM – Abstraction and Concept Formation (Working Memory)					
Correct responses – trial 2	135	7.93	1.23	-0.70	0.76
Median response time – trial 2	135	2487	1011	0.87	0.35
Correct responses – trial 4	135	8.53	1.34	-1.05	1.36
Median response time – trial 4	135	2666	1159	0.95	1.19
Correct responses – trial 6	135	8.04	1.35	-0.47	-0.37
Median response time – trial 6	135	2626	1112	1.16	2.32
Total correct responses	135	24.50	2.96	-0.54	-0.29
Total reaction time	135	1472	375.09	0.65	0.30
LNB-2 – Attention and Working Memory					
True positive responses	135	43.04	3.54	-6.41	56.94
Total reaction time	135	456.47	76.14	1.98	6.02
True positive responses – 0-back	135	14.87	0.90	-10.11	109.65
Total reaction time – 0-back	135	438.97	63.52	2.04	8.68
True positive responses – 1-back	135	14.53	1.17	-4.95	33.67
Total reaction time – 1-back	135	464.56	88.94	1.50	3.15
True positive responses – 2-back	135	13.64	2.06	-2.98	14.21
Total reaction time – 2-back	135	503.98	125.81	2.00	6.95
PCET – Abstraction					
Correct responses	135	38.33	7.45	1.34	2.08
Reaction time	135	1894	506.28	1.48	3.82
Incorrect responses	135	25.47	15.15	0.62	-0.52
Reaction time – incorrect responses	135	2701	903.44	1.06	1.74
Total number of trials	135	63.80	18.30	0.54	-0.04
Categories achieved	135	2.75	0.44	-1.16	-0.67
sRAVEN					
Correct responses	135	46.84	8.10	-	-
Reaction time	135	18814.68	10217.05	-	-
Reaction time – incorrect responses	135	33820.33	29061.47	-	-

Note: SD = standard deviation

Table 3

Descriptive Statistics for TCI-R

Temperament dimension	N	Mean	SD	Skewness	Kurtosis
Novelty seeking	135	2.81	0.47	0.24	-0.26
Harm avoidance	135	3.13	0.75	0.05	-0.51
Reward dependence	135	3.35	0.64	-0.18	-0.30
Persistence	135	3.63	0.62	-0.06	-0.54

Note: SD = standard deviation

Table 4

Descriptive Statistics for PR6

Resilience domain	N	Mean	SD	Skewness	Kurtosis
Tenacity	135	7.63	2.07	-0.69	-0.29
Vision	135	6.81	1.85	-0.32	-0.36
Collaboration	135	5.65	1.88	0.39	0.09
Composure	135	5.71	2.20	0.13	-0.87
Reasoning	135	6.53	1.89	-0.32	-0.35
Momentum	135	6.56	1.96	-0.13	-0.50
Health	135	12.00	3.47	-0.21	-0.30
Total resilience	135	0.64	0.12	0.01	-0.23

Note: SD = standard deviation

Table 5

Descriptive Statistics for BDI-II

BDI-II Subscales and Total Scale	N	Mean	SD	Skewness	Kurtosis
Cognitive-Affective	135	9.65	6.99	0.71	-0.23
Somatic	135	5.19	3.05	0.33	-0.44
Total score	135	15.70	9.92	0.56	-0.41

Note: SD = standard deviation

The mean score for the BDI-II was 15.70 (SD = 9.92). According to Beck et al. (1996) the score of the BDI-II can be interpreted in the following way: Total scores ranging from 0 – 13 are categorised as minimally depressed or non-depressed, total scores ranging from 14 – 19 are categorised as mildly depressed, total scores ranging from 20 – 28 are categorised as moderately depressed and total scores ranging from 29 – 63 are considered to be severely depressed.

Table 6 summarizes the outcome of each of these categories of depression for the current sample.

Table 6

BDI-II Classification of Total Scores for Student Sample

Category	Total Score Range	n	Percentage	Mean	SD
Minimal	0 – 13	64	47%	7.30	3.66
Mild	14 – 19	25	19%	15.96	1.72
Moderate	20 – 28	30	22%	23.63	2.75
Severe	29 - 63	16	12%	34.06	4.06

Note: N = 135, n = number of participants, SD = standard deviation

From Table 6 it is clear that majority of the students who participated in the study fall within the non-depressed (47%) category, with 22% self-reported as moderately depressed. Notably, when collating individuals who indicated mild, moderate and severe symptomatology, 53% of the participants were categorised as such.

It is important to keep in mind that since the BDI-II is a self-report measure, it is subject to response bias (Beck et al., 1996), therefore, scores may be elevated or minimized during the testing situation.

4.4 Reliability

The reliability of an instrument refers to the extent to which a construct is consistently measured (Foxcroft et al., 2004). In relation to the concept of measurement error, instruments are considered reliable when they are relatively free of measurement error (Kaplan & Saccuzzo, 2013).

4.4.1 Internal consistency. Internal consistency is a method that is commonly used to examine reliability. This method inspects the degree to which each item in a scale correlates with the other items in that scale i.e. is the instrument measuring what it should be measuring (Durrheim & Painter, 2006). Internal consistency for this study was investigated by means of Cronbach's alpha.

All three instruments showed good or excellent internal consistency with the TCI showing a Cronbach's α of .79, the PR6 .81 and the BDI-II .90.

4.5 Correlational Analysis

Spearman's correlational analysis was used to investigate relationships between variables. Spearman correlations indicated significant correlations between depressive symptomatology and tests measuring aspects of abstract reasoning, working memory and concept formation. Significant relationships were found between certain temperament

dimensions and depressive symptomatology as well as resilience and depressive symptomatology. The Wilcoxon Two-Sample Test was used to test for mean differences between categorical variables specific to the LNB-2 and sRaven tasks. The test revealed no significant differences for either of the variables. The Kruskal-Wallis Test is a non-parametric test used to determine whether statistically significant differences exist between a continuous dependent variable and more than two groups of independent variables (McKnight & Najab, 2010). For the current study no significant differences were found in the distribution of scores.

4.5.1 Executive functioning and depressive symptomatology

Significant correlations were found between depressive symptomatology and tests measuring aspects of abstract reasoning, working memory and concept formation. A significant positive correlation was found between the second trial of the AIM assessment, which measures abstraction and concept formation with working memory, and depressive symptomatology ($r_s = .19$; $p = .02$). Thus, as depressive symptomatology increased, the ability to mentally abstract and form concepts increased. A significant negative correlation was found for the Cognitive-Affective subscale of the BDI-II and reaction time for correct responses on the PCET subtest for executive functioning ($r_s = -.19$; $p = .02$), thus indicating that performance speed decreased as cognitive-affective features of depressive symptomatology increased and vice versa. The total score for depressive symptomatology was found to be significantly negatively correlated with reaction time for correct responses on the PCET assessment ($r_s = -.17$; $p = .05$). Therefore, as the presence of depressive symptomatology increased, performance speed decreased.

4.5.2 Executive functioning and resilience

A significant negative correlation was found between total resilience and the median response time for correct responses on the AIM assessment of the EF battery ($r_s = -.19$; $p =$

.02). Thus, as resilience increased, response time for correct responses on the AIM assessment decreased and vice versa.

4.5.3 Resilience and depressive symptomatology

The total resilience score was calculated as an average of the seven resilience domains (Rossouw & Rossouw, 2016). Significant negative correlations were found for all seven domains of resilience and depressive symptomatology as well as overall resilience and depressive symptomatology. Table 7 provides a summary of these correlations. As tenacity, vision, collaboration, composure, reasoning, momentum and health increased, depressive symptomatology decreased and vice versa. As overall resilience increased, depressive symptomatology decreased.

From table 7 it is clear that significant negative correlations were further found between total resilience and both cognitive-affective and somatic subscales for depressive symptomatology. As resilience decreased, the presence of depressive symptomatology (including somatic and cognitive-affective features of depressive symptomatology) increased.

Table 7

Significant Correlations between PR6 Domains and BDI Total Scores and Subscales

Resilience Domain	Total BDI	BDI (CogAff)	BDI (Som)
Tenacity	-.59*		
Vision	-.33*		
Collaboration	-.34*		
Composure	-.48*		
Reasoning	-.45*		
Momentum	-.56*		
Health	-.29*		
Total resilience	-.65*	-.57***	-.62***

Note: N = 135; Total BDI = Total score for Beck Depression Inventory-II; BDI (CogAff) =
Total score for the cognitive-affective subscale on the Beck Depression Inventory-II; BDI
(Som) − Total score for the somatic subscale on the Beck Depression Inventory-II; *p < .05?;
**p < .01; ***p < .001.

4.5.4 Executive functioning and temperament

A significant negative correlation was found between NS and total reaction time for correct responses on the PCET assessment of the EF battery ($r_s = -.20$; $p = .02$). Thus, as novelty seeking behaviour increased, quicker reaction time for correct responses on the PCET was observed. .

4.5.5 Temperament and depressive symptomatology

A significant positive relationship was found for HA and depressive symptomatology ($r_s = .60$; $p = < .0001$). Thus, as harm avoidance increased, depressive symptomatology increased. A significant negative correlation was found between persistence and depressive symptomatology ($r_s = -.29$; $p =?< .0007$), i.e. as depressive symptomatology increased, persistence thereby decreased and vice versa. For each of the temperament dimensions certain subscales were also found to be significantly correlated with depressive symptomatology.   Significant negative correlations were found between the total score for persistence and the total score for depressive symptomatology on the BDI-II, the total score for persistence and the total score for the somatic subscale on the BDI-II and the total score for persistence and the total score for the cognitive-affective subscale on the BDI-II. This means that as depressive symptomatology (for the somatic as well as cognitive-affective subscales) increased, persistence decreased and vice versa.

Table 8 provides a summary of the significant Spearman correlations found for each of the temperament dimensions and relevant subscales and total score on the BDI as well as the two subscales on the BDI-II.

Table 8

Significant Correlations between TCI Temperament Dimension Subscales and BDI Total Scores and Subscales

Temperament Dimension	Total BDI	BDI (CogAff)	BDI (Som)
Harm Avoidance (HA)	.60***	.58***	.48***
Anticipatory worry (HA1)	.65***		
Fear of uncertainty (HA2)	.45***		
Shyness (HA3)	.27**		
Fatigability (HA4)	.62***		
Reward Dependence (RD)			
Sentimentality (RD1)	.19*		
Openness to warm communication (RD2)	-.25**		
Attachment (RD3)	-.22**		
Persistence (PS)	-.29**	-.23**	-.28**
Eagerness of effort (PS1)	-.18*		
Work hardened (PS2)	-.35***		
Ambitious (PS3)	-.25**		
Perfectionist (PS4)	-.22*		

Note: $N = 135$; Total BDI = Total score for Beck Depression Inventory-II; BDI (CogAff) = Total score for the cognitive-affective subscale on the Beck Depression Inventory-II; BDI (Som) − Total score for the somatic subscale on the Beck Depression Inventory-II; *$p < .05$; **$p < .01$; ***$p < .0001$.

4.6 Regression Analysis

Stepwise multiple regression analysis was employed to determine significant predictors (temperament, resilience and depressive symptomatology) of EF. This approach was deemed most suitable to the current study since both the dependent and independent variables are continuous. Stepwise multiple regression analysis allows for the investigation of more than one independent variable and its effects on the dependent variable (Pallant, 2011). Stepwise multiple regression analysis entails that variables are entered into the model based on a set of statistical criteria from a list of independent variables (Pallant, 2011). Preliminary analyses were conducted to ensure that there was no violation of the assumptions of normality and multicollinearity. In the regression model where all the independent variables are continuous, all variables are treated as covariates. Table 9 provides a summary of the results of the regression analysis.

Table 9

Stepwise Regression for Predictors of Significant Executive Functioning Outcomes

Dependent Outcome	Predictor	Adj. R^2	F value	p value
AIM – Abstraction and Concept Formation				
Total correct responses	RAV_CR	.15	23.98	<.0001
PCET – Abstraction				
Total correct responses	NS	.03	4.20	.04
	TOT_COGAFF	.06	4.48	.04
Reaction time – correct responses	NS	.06	7.83	.01

Note: RAV_CR = correct responses on sRaven; NS = novelty-seeking; TOT_COGAFF =

total score for the cognitive-affective subscale on the Beck Depression Inventory-II

From Table 9 it is evident that various variables may predict EF with regards to accuracy and performance speed. For the EF domains of abstraction and concept formation, accuracy on the sRaven subtest ($F = 23.98$; $R^2 = .15$; $p < .0001$) was found to predict accuracy on the AIM. Since results on the sRaven are regarded as a non-verbal estimate of general intelligence (Van der Elst et al., 2013), it can be deduced that intelligence may predict performance accuracy. Novelty seeking (temperament) ($F = 4.20$; $R^2 = .06$; $p = .04$) and cognitive-affective features of depression ($F = 4.48$; $R^2 = .03$; $p = .04$) were found to predict accuracy on mental abstraction in the PCET subtest of the EF battery. Novelty seeking ($F = 7.81$; $R^2 = .06$; $p = .01$) was predictive of performance time.

4.7 Conclusion

The chapter presented information on demographic and other variables that were investigated, i.e. EF, temperament, resilience and depressive symptomatology. The following chapter provides a detailed discussion of these results in relation to literature. Chapter 5 also discusses the limitations and recommendations of the current study as well as the practical implication thereof.

CHAPTER 5: DISCUSSION

5.1 Introduction

The aim of the study was to investigate the relationships between EF, temperament, resilience and depressive symptomatology. Significant correlations were found between EF and depressive symptomatology, EF and resilience and EF and temperament. Results also indicate significant correlations between depressive symptomatology and resilience and depressive symptomatology and temperament. Secondly, the study aimed to explore whether depressive symptomatology, trait-related temperament and state-related resilience predicted EF functioning in this cohort. The following chapter outlines the overall results in context of literature relevant to this study. The chapter also presents the strengths and limitations of this study and provide recommendations for future research. The practical implications of this study are further discussed.

5.2 Executive Functioning and Depressive Symptomatology

Significant correlations were found between depressive symptomatology and tests measuring aspects of abstract reasoning, working memory and concept formation. Contrary to what would be expected, this correlation between performance accuracy and depressive symptomatology, was found to be significantly positive. EF and depression have been studied for many years. Many studies have found EF to be compromised in the presence of depression (McClintock et al., 2010; Snyder, 2013). Snyder (2013) found EF deficits in individuals who merely show depressive symptoms and who have not been clinically diagnosed. Depressive symptomatology has been found to be associated with poor self-management, self-organization, self-discipline, self-motivation and self-regulation of emotions (Feldman, Knouse, & Robinson, 2013).

Another unexpected phenomenon was the significant negative correlation that was found for the total score for depressive symptomatology and the cognitive-affective subscale

and reaction time on the PCET subtest. This indicated that reaction time improved in the presence of depressive symptomatology. Research points to decreased processing speed in the presence of depression (Snyder, 2013). It would therefore be expected that reaction time is slower (deteriorates) as the presence of depressive symptomatology increases.

Regression analysis found cognitive-affective features of depression to be predictive of accuracy of performance on certain EF tasks such as mental abstraction. Abstraction refers to the ability to look at specific essential features of an object whilst ignoring less relevant features, and then using this information to represent an entire group of objects (Soderberg, Callahan, Kochersberger, Amit, & Ledgerwood, 2015). Information about the predictive nature of cognitive-affective features of depression allows for targeted intervention.

One reason for the contradictory results obtained in this study could be related to the academic environment. Due to the fact that participants were completing assessments under standardized conditions, it could be possible that they did not take the task lightly and performed as if under academic testing conditions where students deliberately want to perform well. Another factor could be the severity of depression in this particular cohort. Taking into consideration that the sample was not a clinically diagnosed group, with few individuals being identified as severely depressed, results could have been skewed. Temperament and resilience also need to be taken into account as these could provide protective features against diminished EF ability in the presence of depressive symptomatology.

5.3 Executive Functioning and Temperament

The current study indicated a significant negative correlation between NS and performance speed on the PCET assessment of the EF battery. Thus, as novelty seeking behaviour increased, performance speed on the PCET decreased. One of the premises of NS

is impulsiveness (Cloninger et al., 1994). The results therefore concur with what would be expected i.e. that participants are faster due to an impulsive response style. Even though it was not found in this study, it would be expected that accuracy of performance declines as impulsivity increases which could be ascribed to lapses in attention as relating to an impulsive response style (Cassimjee & Murphy, 2010). Contrary to what would be expected, there was no significant correlation found between HA and EF as suggested by previous research (Cassimjee & Murphy, 2010).

5.4 Temperament and Depressive Symptomatology

The results of the current study corroborates previous literature findings (Hansenne et al., 1999; Farmer et al., 2003; Kampman et al., 2012; Mochcovitch et al., 2012). As HA increased, depressive symptomatology was found to increase, thus a significant positive relationship was found for HA and depressive symptomatology. A significant negative correlation was found between PS and depressive symptomatology, indicating that as depressive symptomatology increased, persistence decreased and vice versa. In a study done on the TCI in major depression, Farmer et al. (2003) found that HA scores were significantly influenced by current depression or a history thereof. As in the current study, the aforementioned study found a significant positive relationship between HA and depression.

In a study done by Kampman et al. (2012), HA was found to be a vulnerability factor to the onset of depression. HA was also found to be more or less stable during the acute treatment phase of depression and was not found to be significantly associated with depression severity. The outcome of depression treatment and HA was found to be positively correlated (Kampman et al., 2012). The results from the current study indicate a strong positive correlation between HA and depressive symptomatology which agrees with previous studies where high HA has been found to predict the risk of depression (Cloninger et al., 2012; Eley et al., 2013). Even though the current study did not find significant associations

between other temperament dimensions and depressive symptomatology, research has found NS to be negatively correlated with low mood. RD was found to be unrelated to the state of mood and this result could be explained noting the protective role of RD in the development of depression (Farmer et al., 2003).

5.5 Executive Functioning and Resilience

A significant negative association was found between resilience and the average performance speed on the AIM assessment of the EF battery. Thus, as resilience increased, performance speed on the AIM assessment decreased (improved) and vice versa.

Even though research related specifically to EF performance speed and resilience is scant, research on EF in general and resilience has found that preschool infants who had high levels of emotional reactivity and regulation from a resilience perspective, showed higher EF skills in comparison to their peers with low levels of resilience (Ursache, Blair, Stifter, & The Family Life Project Investigators, 2013). Obradović (2015) highlights how higher EF skills could increase resilience in terms of reactivity to adverse situations by providing young children with the ability to shift their attention away from the negative stimuli, inhibit their reaction towards it and recall positive coping strategies in the face of adversity.

5.6 Resilience and Depressive Symptomatology

Significant negative correlations were found for all seven domains of resilience as well as overall resilience and depressive symptomatology. As tenacity, vision, collaboration, composure, reasoning, momentum, health and overall resilience increased, depressive symptomatology decreased, and vice versa. These results concur with previous studies where lower depression levels have been negatively correlated with resilience (Southwick & Charney, 2012).

In a study by Hjemdal, Vogel, Solem, Hagen, & Stiles (2011), resilience was found to be significantly associated with psychological symptoms such as depression, anxiety, stress and obsessive-compulsive symptoms in older adolescents. The study also found resilience to be a predictor of psychological symptoms of depression, anxiety, stress and obsessive-compulsive symptoms. Overall, higher resilience scores with regards to personal dispositions, social support networks and family unity were found to be consistently and significantly related to depression, anxiety, stress and obsessive-compulsive symptoms (age and gender were controlled for) (Hjemdal et al., 2011). In the aforementioned study the Resilience Scale for Adolescents was used as the measurement instrument for resilience. Interestingly, the current study corroborates the results found by Hjemdal et al. (2011), even though the PR6 is grounded in neuroscience as a theoretical point of departure (Rossouw & Rossouw, 2016).

Resilience has also been researched in the field of medicine. It has been found that resilience has a buffering effect to the occurrence and development of depressive symptomatology among individuals with spinal cord injuries (Catalano, Chan, Wilson, Chiu, & Muller, 2011).

Studying resilience in relation to EF and depressive symptomatology allows for a better and more detailed understanding of the individual presentation of EF and depressive profiles. For example, when looking at the contradictory results found in the current study, where accuracy on certain EF tests was positively correlated with the presence of depressive symptomatology. Resilience could have acted as a protective feature, therefore providing a more in depth understanding of these results.

As mentioned previously, the PR6 was used to measure resilience in the current study. The PR6 is a new instrument and this was the first time that it was used in a South African

study to measure resilience among university students. It is emphasised that in the current study the PR6 showed an internal consistency of .81 and therefore it can be trusted that the instrument measured what it was supposed to measure.

5.7 Predictive Properties of Temperament and Resilience

5.7.1 Temperament as a predictor of executive functioning

The current study found NS to be predictive of both accuracy and performance speed on EF tests. When taking into consideration the subscales that make up the temperament dimension of NS (i.e. exploratory excitability, impulsiveness, extravagance and disorderliness), one could reason that features such as an impulsive or disorderly nature may in fact indicate how such an individual might perform on EF tasks. As previously mentioned, impulsivity has been found to be linked to accuracy and performance speed on EF tasks (Cassimjee & Murphy, 2010).

5.7.2 Resilience as a predictor of executive functioning

The current study regression analysis did not find overall resilience to be a predictor of EF.

Research on resilience as a predictor of EF is limited. However, resilience and EF have been studied in the context of MDD. Southwick & Charney (2012) considered resilience as a multi-faceted protective factor to the onset of MDD. Protective features of resilience are visible in cognitive-behavioural features such as high EF, high coping ability, positive emotionality, optimism that is realistic and cognitive flexibility; emotional regulation; strong social skills and networks; good physical health – including sleep and nutrition and neurobiological features with reference to HPA axis, prefrontal cortical EF and limbic reactivity (Southwick & Charney, 2012). This indicates that high resilience preserves

EF functioning, allows for optimal emotional reactivity and regulation and improves overall well-being.

5.8 Intervention and Prevention Strategies

In a study done be Kress et al. (2015) it was found that university students mainly complain about anxiety, depressed feelings, lowered self-esteem, psychosomatic issues, alcohol and substance abuse and suicidal thoughts or behaviour. These complaints warrant enough reason to make counselling services readily available to students, and to create awareness about the availability of such services. Counselling services should focus on promoting academic success as well as personal development of students.

From a practical point of view, research provides evidence of the value of attending to resilience in order to treat and prevent depression (Southwick & Charney, 2012; Hjemdal et al., 2010). Southwick & Charney (2012) argued that resilience can be improved by means of various strategies and interventions. In turn, this improvement in resilience can be used to prevent and treat depression (Southwick & Charney, 2012). The current study supports this viewpoint by emphasising the significant negative association between resilience and depressive symptomatology i.e. if resilience can be improved, the presence of depressive symptomatology could be reduced. Catalano et al. (2011) agreed with Southwich and Charney (2012) in that resilience can be acquired. The acquisition of resilience is based on resilience based interventions which include the improvement of social skills and the development of effective coping and problem-solving strategies (Catalano et al., 2011). Workshops and campaigns on resilience should be an objective of the student counselling centre. By increasing resilience students may find that they cope better in adverse situations or when faced with difficulties. Krumrei-Mancuso, Newton, Kim, & Wilcox (2013) highlighted how academic performance and life satisfaction can improve through providing students with guidance and support to work towards better attitudes, behaviours and outlooks.

The use of the PR6 in an academic setting could provide valuable information with regards to areas of focus when improving resilience. The PR6 does not only provide information about the overall picture of resilience but it uniquely measures resilience in terms of six domains i.e. vision, composure, tenacity, reasoning, collaboration and health.

The current study contributes to evidence that tailor made programmes to strengthen resilience and accommodate different temperament types of students are of high importance. Such programmes could allow the student counsellors to deal with subclinical depression in an effective manner and this could possibly prevent the conversion of depressive symptomatology to a clinical diagnosis of MDD. By employing such programmes EF could be enhanced (due to the association between EF and depressive symptomatology) and therefore academic performance could improve.

Where students struggle with organisational and attentional aspects of EF related to the study environment, workshops and coaching could provide the opportunities to promote such skills as time structuring, goal setting, planning and the general execution of other academic responsibilities (Krumrei-Mancuso et al., 2013).

As previously mentioned, information on the predictive nature of cognitive-affective features of depression on EF provides the opportunity for targeted intervention practices. Keeping in mind that cognitive-affective features include feelings of sadness, rumination about past failure, loss of pleasure, feelings of guilt, feelings of punishment, self-dislike, self-criticalness, suicidal thoughts or wishes, crying, agitation, loss of interest, indecisiveness, worthlessness and irritability (Beck et al., 1996), Cognitive Behavioural Therapy interventions may prove to be most valuable by addressing negative perceptions and automatic thoughts (Coull & Morris, 2011; Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012).

Based on the sample recruited in this study it might be beneficial to target outreach interventions toward first year or undergraduate students.

5.9 Strengths and Limitations of the Study and Recommendations for Future Research

Given the high prevalence rate of depression among university students the study thereof is warranted (Ibrahim et al., 2013). When taking into consideration the EF demands that are related to adjusting successfully to the academic and social components of university, it is clear to see the value of studying EF, depression and other associated factors among university students (Wingo et al., 2013).

Another strength of the current study is the use of a new resilience measurement instrument such as the PR6. As previously mentioned, the PR6 was theoretically developed based on a neurobiological perspective (Rossouw & Rossouw, 2016). This was the first time that the PR6 was used among university students in South Africa.

One of the limitations of this study is the use of self-report measures. This allows for the possibility of response bias, meaning participants could have exaggerated or underreported symptoms or acted in a manner that they feel would be socially acceptable. Another limitation is the small sample that was recruited due to time and cost constraints. Lastly, the sample was recruited based on registrations for Psychology modules at the University of Pretoria. This limits the generalisability of the results. Future research ought to include larger and broader samples in order to generalize results. As previously mentioned the investigation of predictive properties of temperament and resilience in relation to EF is encouraged to gain a better understanding of the mechanisms involved in EF performance in the presence or absence of depressive symptomatology.

5.10 Conclusion

The study aimed to investigate the relationships between EF, temperament, resilience and depressive symptomatology. Secondly, the study aimed to explore whether depressive symptomatology, trait-related temperament and state-related resilience predicted EF functioning in this cohort.

When taking into consideration the interconnectivity of neural pathways in the brain (Hamilton et al., 2013) as well as the multi-dimensionality of depression (Mayberg, 1997, 2003) it is clear that EF and depressive symptomatology cannot be viewed in isolation. Based on the associations of temperament and resilience with depressive symptomatology and the association of depressive symptomatology with EF, it can be argued that both temperament and resilience could have an indirect effect on EF in the presence or absence of depressive symptomatology.

Although EF is considered to be an overarching term, the current study found that specific EF assessments, i.e. specific EF functions, were predicted by specific variables. This means that EF functions were differentially predicted by specific features of depressive symptomatology and temperament.

In the context of high demand for services at student counselling centres, broader knowledge on the role of depressive symptomatology, temperament and resilience on executive functioning is warranted. An integrated approach to understanding the association between depression and executive functioning, allows for a greater therapeutic focus on individual temperament dispositions and the enhancement of resilience.

Future research on the role of temperament, resilience and depressive symptomatology on EF is recommended in order to facilitate tailor-made prevention and intervention strategies.

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Appendix A: Consent Form

Faculty of Humanities

Department of Psychology

RESEARCH PARTICIPANT CONSENT FORM

STUDY: Executive functioning, temperament and resilience and depressive symptomatology among university students.

This consent form consists of two parts:

- **PART 1:** Overview of and information about the study.
- **PART 2:** Consent form (sign should you choose to participate).

A copy of the information sheet will be made available.

PART 1: Overview of and information about the study.

The purpose of the study

The researcher, affiliated with the University of Pretoria, is conducting a study which attempts to explore the associations between executive functioning, temperament and resilience and depressive symptomatology among university students.

Participation

Individuals who choose to participate in the study will be agreeing to complete a battery of online assessments in order to obtain executive functioning, temperament and resilience profiles. In addition to the online assessments, a basic demographic questionnaire will be completed as well as a questionnaire assessing mood states. This battery of assessments will be completed on a laptop during a time that is agreed upon by you as the participant and the researcher. The total administration time of the complete battery is approximately 60 minutes.

The researcher will assure confidentiality of your personal information as well as assessment results. No identifiable information will be collected. Participants will be assigned a numerical code identifier

to ensure this confidentiality. After the study has been conducted, the data will be kept in a safe location at the University of Pretoria Psychology Department for 15 years for archiving purposes. Should you wish to remain informed on your results, you are welcome to contact the principal research for further information. Whilst data is stored at the University of Pretoria it will be available for future research endeavors.

Since your participation in the study is voluntary, you may withdraw from the study at any point in time without offering an explanation and without any consequences to you. There are no foreseeable or anticipated risks by participating in this study. Should you feel any discomfort you are encouraged to inform the researcher so that the necessary assistance or debrief can be provided. Should debriefing be required, you will be referred to Itsoseng Clinic at the University of Pretoria Mamelodi Campus and/or to the University of Pretoria student counselling centre to receive such services free of charge.

The researcher will be present and willing to assist you during the time that you undertake the assessment.

Any further questions regarding the research study may be directed to the principal researcher.

Regards,

Karlien Swanepoel

karlien.swanepoel@gmail.com

Participant Number		
(To be completed by the researcher)		

STUDY: Executive functioning, temperament and resilience and depressive symptomatology among university students.

PART 2: Consent to participate

I hereby confirm that I have been clearly informed about the nature and the procedures of the abovementioned study. I am aware and give consent that the information and data collected will be used for research purposes and that my confidentiality will be protected. I am aware and agree that the data that is obtained during this investigation will be available to researchers at the University of Pretoria to use in future research studies. I agree that I am willing to participate in the study on a voluntary basis and therefore I may withdraw at any time without any explanation or consequences to me.

Participant signature : …………………………………………

Date: : ………………………………………….

Researcher signature : …………………………………………..

Date: : ………………………………………….

Thank you for you participation!

Appendix B: Socio-demographic Questionnaire

	Participant Number

Faculty of Humanities

Department of Psychology

Participant Number		
(To be completed by the researcher)		

PARTICIPANT SHORT DEMOGRAPHIC QUESTIONNAIRE

FOR PARTICIPATION IN STUDY: Executive functioning, temperament and resilience and depressive symptomatology among university students.

Please complete all sections.

AGE:	
GENDER:	Male: ☐ Female: ☐
RACE/ETHNICITY:	
HOME LANGUAGE:	
STUDY PHASE:	Undergraduate: ☐ Postgraduate: ☐
YEAR OF FIRST REGISTRATION AT A TERTIARY INSTITUTION:	
QUALIFICATION/DEGREES OBTAINED:	
HAVE YOU BEEN DIAGNOSED WITH/ EXPERIENCED ANY OF THE FOLLOWING: 1. Head injury with loss of consciousness for 30 minutes or longer. 2. Neurologic disease (i.e. stroke, epilepsy, seizures).	Yes: ☐ No: ☐ Yes: ☐ No: ☐

3. Diagnosed mental health problems (i.e. depression, anxiety, schizophrenia, etc.).	Yes: ☐ No: ☐
4. Problems with your eyesight.	Yes: ☐ No: ☐ If yes, please specify: ………………………………………….
5. Any other medical condition.	Yes: ☐ No: ☐ If yes, please specify: ………………………………………….
6. Have you abused any substances (i.e. drugs/alcohol) in the last 3 months?	Yes: ☐ No: ☐