



# UNIVERSITY OF THE WESTERN CAPE

## Faculty of Community and Health Sciences

### Psychology Department

**Title: An examination of the Amsterdam Executive Function Inventory (AEFI) in South Africa: A factor analytic study**

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**Plagiarism declaration:**

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## Table of Contents

<b>Abstract.....</b>	<b>vi</b>
<b>Chapter One.....</b>	<b>1</b>
<b>1.1. Introduction.....</b>	<b>1</b>
<b>1.2. Problem Statement .....</b>	<b>2</b>
1.3.1 Aim of the study .....	3
1.3.2. Rationale.....	3
<b>1.3. Conceptual Framework .....</b>	<b>4</b>
<b>1.4. Thesis organisation.....</b>	<b>5</b>
<b>Chapter Two .....</b>	<b>7</b>
<b>Literature review.....</b>	<b>7</b>
The origin and definition of Executive Functioning.....	7
Measures of Executive Functioning and the promising use of self-report instruments...8	
Measures of executive functioning in South Africa .....	9
Conclusion.....	11
<b>Chapter Three .....</b>	<b>12</b>
<b>Methodology.....</b>	<b>12</b>
<b>3.1 Aim.....</b>	<b>12</b>
<b>3.2. Research Objectives .....</b>	<b>12</b>
<b>3.3. Research Design .....</b>	<b>12</b>
<b>3.4. Instrument.....</b>	<b>15</b>
<b>3.5. Sample.....</b>	<b>15</b>
<b>3.6. Data Analysis .....</b>	<b>16</b>
3.6.1. Internal Consistency/ Reliability .....	16
3.6.2. Assumption testing: The assumptions for EFA and CFA respectively are presented below. 16	
3.6.3. Factor Analysis.....	17
Decision making for model fit.....	19
<b>Ethical Considerations .....</b>	<b>20</b>
<b>Chapter Four .....</b>	<b>22</b>
<b>Results .....</b>	<b>22</b>
<b>4.1. Internal consistency.....</b>	<b>22</b>
<b>4.2. Assumption testing: Exploratory Factor Analysis .....</b>	<b>22</b>
4.2.1. Skewness and Kurtosis.....	22
4.2.2. Sampling Adequacy .....	23
4.2.3. Inter-item correlations .....	24
<b>4.3. Assumption testing: Confirmatory Factor Analysis .....</b>	<b>25</b>

<b>4.4. Exploratory Factor Analysis</b> .....	<b>25</b>
4.4.1. Factor Extraction: Principal Axis Factoring (PAF) .....	25
4.4.2. Parallel analysis .....	27
<b>4.5 Confirmatory Factor Analysis</b> .....	<b>29</b>
<b>Chapter Five</b> .....	<b>32</b>
<b>Discussion</b> .....	<b>32</b>
<b>5.1. Objective 1: Internal consistency</b> .....	<b>32</b>
<b>5.2 Objective 2: Assumption testing</b> .....	<b>33</b>
5.2.1. Assumptions for EFA .....	33
5.2.2. Assumptions for CFA .....	33
<b>5.3. Objective 3: Exploratory FA</b> .....	<b>34</b>
<b>5.4. Objective 4:Confirmatory Factor Analysis</b> .....	<b>35</b>
<b>5.5. Conclusion</b> .....	<b>37</b>
<b>Limitations</b> .....	<b>37</b>
<b>Recommendations for future study</b> .....	<b>38</b>
<b>Significance of the study</b> .....	<b>38</b>
<b>References</b> .....	<b>40</b>
<b>Appendix A: 2020 study Participant Information Sheet &amp; Informed consent</b> .....	<b>46</b>
<b>Appendix B: 2020 Ethics Clearance Certificate</b> .....	<b>47</b>
<b>Appendix C: The Amsterdam Executive Functioning Inventory</b> .....	<b>48</b>
<b>Appendix D: Current study Ethical Clearance</b> .....	<b>49</b>
<b>Appendix E: Permission letter to the University of the Witwatersrand</b> .....	<b>50</b>
<b>Appendix F: Data sharing agreement</b> .....	<b>54</b>
<b>Appendix G: Histogram and Q-Q plots of sample data</b> .....	<b>73</b>

## List of Tables

Table 1 .....	20
Table 2 .....	22
Table 3 .....	23
Table 4 .....	23
Table 5 .....	24
Table 6 .....	25
Table 7 .....	26
Table 8 .....	27
Table 9 .....	28
Table 10 .....	29
Table 11 .....	30

## List of Figures

Figure 1: Scree plot of the sample data.....	25
Figure 2: The factors structure of the model (after respecifications).....	31

## Abstract

Executive functioning has a significant role in human behaviour and development. It is important for an individual's everyday functioning and skill set. Thus, over the years executive functioning has become a prominent construct among researchers, practitioners and in literature. This popularity has resulted in challenges establishing comparable estimates of psychometric properties. Executive functioning is typically measured by performance-based measures however, recently there is emerging support for the use of self-report measures. In developing countries such as South Africa, research on executive functioning will receive a substantial injection if self-reports were found to be reliable and valid alternatives to costly and inaccessible performance-based measures. The Amsterdam Executive Function Inventory (AEFI), a measure of executive functioning, has been used recently in South Africa with good reliability and internal stability reported as evidenced by acceptable Cronbach alphas. However, a more systematic exploration of the psychometric properties of the AEFI such as factor structure and validity, remains a focus of further research. The present study attempted to address this gap, by evaluating the factor structure of the AEFI in the South African context, using secondary research. The current study used a data set from a large-scale survey conducted in 2020 with a sample of 1608 South African adult participants between the ages of 18 and 50 years old (Coppin, 2021). The study used a subset of 1315 data points representing students at a South African university who completed the AEFI. A data sharing agreement was compiled and fully executed between the University of the Witwatersrand (WITS) and the University of the Western Cape (UWC). Permission to carry out this research study was obtained from the Bio-Medical Research Ethics committee at the University of the Western Cape. The data set was examined to empirically determine whether it had sufficient internal consistency and if it satisfied the assumptions for Exploratory Factor Analysis (EFA) and Confirmatory factor analysis (CFA) respectively. The results indicated that the data supported factor analysis. Factor analysis was used to examine the factor structure of the AEFI. The results of the EFA proposed a three-factor structure. Furthermore, there was insignificant cross loading of factors, with majority of the items loading on the intended theoretical domains. Unexpectedly, the Attention domain had two items from the Self-Control and Self-Monitoring domain that loaded on it. Results from the CFA yielded positive results, with the model demonstrating good fit on five indices after respecification [ $\chi^2_{56} = 266.86$ ,  $P < .01$ ;  $CMIN/DF = 4.77$ ;  $RMSEA = 0.54$ ;  $CFI = .93$ ;  $SRMR = .055$ ;  $GFI = .97$ ]. The study findings suggest that the AEFI is a valid and reliable self-report measure for use with adults in the South African context.

## Chapter One

### 1.1.Introduction

One of the significant findings in the field of neuropsychology is the role of the frontal lobes and the complexity of cognitive functioning within this region of the brain. Higher-order cognitive skills were shown to originate from within the frontal lobe of the brain, and these high-level cognitive skills are termed, 'executive functions' (Menon & D'Esposito, 2022; Miller et al., 2022). Executive functioning is a phenomenon that encompasses various cognitive functions which are important for everyday functioning and interaction, regulating mental processes and behaviour as well as, goal-orientated behaviour (Finnanger et al., 2022). Moreover, these functions develop with age (Blair, 2017; Veríssimo et al., 2022). However, the exact skills that resort under this umbrella term and the relationships between cognitive mechanisms underpinning it, remains debated (Salehinejad et al., 2021)

Executive functions have shown to be significant in human behaviour (Samuels et al., 2016). High levels of executive functioning are significantly associated with positive developmental outcomes such as, self-efficacy or self-esteem and successful task performance in academics or the workplace (Cortés Pascual et al., 2019; Samuels et al., 2016; Zelazo & Carlson, 2020). Whereas decreased levels of executive functioning were shown to be significantly associated with neurodevelopmental disorders such as Attention-Deficit Hyperactivity Disorders and Autism Spectrum Disorders (Navarro-Soria et al., 2019; Zelazo, 2020; Zelazo & Carlson, 2020). In addition low levels of EF are associated with behavioural problems, aggression, inability to focus, antisocial behaviour, school failure or struggles as well as difficulty with planning and organisation (King et al., 2018; Roselló et al., 2020).

Over the years, research on executive functioning has been extensive as many educators and researchers were intrigued by the importance of executive functions in human behaviour (Baars et al., 2015). Since the 1990s, executive functioning has become a significant part of many neuropsychological assessments and has continued to be (Nyongesa et al., 2019; Sherman et al., 2023). In the late 1990s, neuropsychological testing and measurement was highlighted to be a challenging and exhaustive process, especially in a developing context (Laher & Cockcroft, 2013). Many researchers face numerous difficulties such as, limited funding, lack of access to instrumentation or tests as well as, challenges related to

standardization of existing measures (Laher & Cockcroft, 2017). These challenges still hold true today (Dutt, 2022).

Self-report measures can solve many of the abovementioned instrumentation challenges as they are less demanding on the researcher, are less costly and easier for participants to engage in (Demetriou & Uzun Ozer, 2015). Previously, literature on measures of executive functioning focus on behavioural measures rather than self-report measures. In South Africa, there is a lack of literature on the measurement of executive functioning, as well as the use of self-report measures for this construct in this context. The lack of reporting on the psychometric properties of the instruments lead to a lack of availability of extensive and systematic data of psychometric tests in the local context. Hence, there is a growing need for more information on how these instruments, specifically self-reports, function in a local context.

## **1.2. Problem Statement**

As noted within the literature, measurement of executive functioning is challenging to carry out worldwide and in South Africa for several reasons. Firstly, there is a lack of agreement on the definition of executive functioning, and what core aspects constitute or make up the phenomenon. Secondly, instruments of executive functioning are not readily accessible due to the requirement of payment in foreign currencies for the use of these and the unaffordability of this in a developing context such as South Africa. Thirdly, there is a lack of standardisation of scales of executive functioning in the South African context. Laher and Cockcroft (2013) stipulated that psychometric testing and scales form the basis of neuropsychological evaluations, and that this poses a real challenge to the health services in South Africa as there is a lack of funding for tests and lack of trained practitioners. This poses many challenges for the culture-fair use of instruments in multilingual and multi-cultural contexts, as well as economic disparities. Hence there is a gap in the health care services in a developing context for tests that are affordable and easily used, which investigate neuropsychological functions such as executive functioning. Furthermore, besides the reporting of internal consistency, there is a lack of exploration and reporting of psychometric properties beyond internal consistency which has led to limited information on the in depth reliability, validity or overall factor structure of instruments. This poses significant challenges for the use of instruments investigating executive functioning and investigations and clinical interventions or treatments that may follow.



Coppin (2021) used the AEFI in a SA survey as a measure of EF and reported on its internal consistency. There is a need for more advanced analysis of the resulting data set using data reduction techniques to evaluate the underlying factor structure in the context of a local study. This would address the existing gap of the lack of readily available and cost effective instruments as well as validated and standardised instruments in the local context. Therefore, the current study aimed to examine the factor structure of a self-report measure of executive functioning that has been used with a sample of the South African population. Further, it aimed to provide data on the functioning of the identified self-report measure of executive functioning, especially in a context where neuropsychological testing has many challenges.

### ***1.3.1 Aim of the study***

The aim of the study was to evaluate the construct validity of the Amsterdam Executive Function Inventory (AEFI) in a South African sample.

### ***1.3.2. Rationale***

Executive functioning has a significant role in human behaviour and development. It is an important feature of the identification of cognitive competencies, cognitive decline as well as an identification of possible psychological disorders. Measures of executive functioning are challenging to implement globally, and especially in a diverse context such as South Africa. Understanding executive functioning and being able to measure it is extremely useful for treatment as well as for general insight into an individual's everyday functioning. The National Planning Commission of South Africa identified the need for skilled professionals to use high level skills to enhance research and development, as well as clinical intervention in the National Development Plan 2030 (National Planning Commission, 2012). Similarly, the current study aimed to explore and confirm the factor structure of the Amsterdam Executive Function Inventory (AEFI) through the application of exploratory and confirmatory factor analyses. The validation of the AEFI in South Africa contributed to the body of knowledge on the psychometric properties of the identified scale. Furthermore, the findings have contributed to an empirical basis for the use of the scale in local contexts and enhances research and clinical practice. In addition, it allows for the appropriate use of a valid and reliable instrument measuring executive functioning and in doing so, improves diagnostic and screening in health services. Improving screening in health care services will in turn aid clinical interventions and treatment. In this way, the study contributes to the equitable access to health services such as

screening as contained in the Sustainable Development Goals 2030 adopted by all United Nation countries including South Africa (United Nations, 2015).

### **1.3. Conceptual Framework**

The conceptual framework for the study was two-pronged. The relationship between the two theories was conceptualized as a cascading model. The model for scale construction outlined by DeVellis (2016) formed the broader part of the framework. This model is based on the premise that constructing a scale is a continuous endeavor with various steps needed to develop a reliable, sound and valid scale. It consists of four steps: (1) theoretical foundation, (2) scale construction, (3) structural validation and (4) preparation of manuals (DeVellis, 2016). The theoretical foundation step involves investigating the current definitions, theory, instruments and domains involved in the construct. The scale construction stage involves selecting items, pre-testing of items and a revision of the scale. The structural validation step includes validation of the scale by establishing the psychometric properties. The fourth stage entails writing up of the scale, including the technical details, guidelines for administration, scoring and interpretation (DeVellis, 2016; Munnik & Smith, 2019). This model has been used as a conceptual framework for studies related to scale construction, scale adaptation and scale evaluation including validation studies (DeVellis, 2016; Munnik & Smith, 2019).

The model informed conceptualization and the current study was located within the third step, structural validation. Structural validation involves investigating the instrument purpose and the construct being measured. It investigates this through the evaluation of the reliability and validity of the scale (DeVellis, 2016). DeVellis (2016) noted that in the psychology field, constructs are not directly observable, and thus, test development must have a general philosophical foundation which is then connected to the construct and observable traits or behaviours. A construct being measured must be clearly defined within a scale, and the measure needs to align with the construct fully.

The current study attempted to validate the AEFI constructed by (Van der Elst et al., 2012) within the South African context. The construct, executive functioning, was defined in the development of the AEFI. Thus, the validation must occur in the context of a theoretical definition or model that underpins the scale. The model reported in the construction of executive functioning consist of a three-factor structure namely, attention, self-control and self-monitoring, as well as planning and organization (Van der Elst et al., 2012). The model will be discussed in more detail in subsequent chapters. For the purposes of the conceptual

framework, this tripart model forms the second prong. It provides the criterion reference for the subsequent methodological decisions. The model of internal structure of the AEFI was investigated in this study. The methodology employed had to established whether this model was supported and the scale was appropriate for use as a measure of the construct and whether this instrument was valid in a South African context. This study sought to validate the use of the measure structurally in a South African population, by providing a deeper exploration of the factor structure using factor analysis to validate the construct validity of the scale. The structural validation was done using factor analysis. Thus, the current study constituted further refinement through structural validation of the AEFI as a measure of executive functioning.

In essence the first part of the conceptual framework provides an overarching model. The present study was located within the third step of the model i.e. structural validation. This influenced overall conceptualization of the project aim. The second part of conceptual framework was the theoretical model underpinning the AEFI. The combination of the two models ensure that the study was located within an overarching construction model and that a specific theoretical model was provided for the confirmation of the factor structure. The second part informed the selection of methods, as well as the execution and interpretation of results.

#### **1.4.Thesis organisation**

The present study was conceptualised and executed in partial fulfilment of the degree requirements of the MPsych degree in Clinical Psychology. The thesis weighting is 50% of the final mark. The thesis was written up in an abbreviated monograph format. The thesis was organised into five chapters.

Chapter One introduces the study, and reports the problem statement, the aim and rationale of the study. In addition, it incorporates the theoretical framework and organisation of the thesis.

Chapter Two consists of the literature review of the study. The literature review is an abbreviated literature review and constitutes as an academic rationale of the study by providing the previous research and findings on executive functioning. Varying definitions of functioning was displayed as well as the research that has been conducted on the construct and the various findings. Furthermore, the psychometric measurement of executive functioning worldwide and in the South African context is explored.

Chapter Three reports the methodological decisions and execution of the study. This provides an account of the procedures for the analyses and how rigour and coherence was achieved. In doing so, it also facilitates future replication of the study.

Chapter Four presents the results of the study. First, the chapter looks at characteristics of the sample. Secondly, the internal consistency reliability evaluated through Cronbach alpha is presented. Thirdly, the chapter looks at the assumption testing of the Exploratory Factor analysis describing the findings of: skewness and kurtosis, sampling adequacy as well as inter item correlations. Fourthly, the Exploratory Factor Analysis (EFA) results are presented through reporting of the principal axis factoring (PAF), parallel analysis as well as the factor loadings. Thereafter, the assumptions of the Confirmatory Factor analysis (CFA) are presented. Lastly, the Confirmatory Factor Analysis results are presented, looking at the initial model, the final model as well as a figure demonstrating the factor structure that was found.

Chapter Five consists of the discussion of the findings of the study, which is divided into the four objectives of the study. The results of the study is provided and integrated with findings in existing literature.

The conventions of the American Psychological Association (APA), version 7 was used for the technical aspects. All sources cited have been listed in an alphabetical list included after the fifth chapter. Appendices were included in the order that they appear in the write-up.

## Chapter Two

### Literature review

#### **The origin and definition of Executive Functioning**

Executive functioning, also referred to as executive control or cognitive control, is a neuropsychological construct that has become a widespread research interest among neuropsychologists, researchers and the broader psychological field (Benedek et al., 2014; Li et al., 2021; Nyongesa et al., 2019). Extensive research has been carried out over the last few decades which has contributed to the understanding and measurement of executive functioning in clinical practice. Through neuroimaging and neuropsychological research, executive functioning has been attributed to the frontal lobes of the brain (Salehinejad et al., 2021; Salthouse, 2005). Executive functions are associated with the prefrontal cortex (PFC) of the frontal lobes (Suchy, 2009), although it is debated whether all mechanisms of executive function can be localized to the PFC (Suchy, 2009; Ward, 2015). The PFC of the brain has connections with almost all sensory systems, the cortical and subcortical motor system as well as structures associated with affect and memory (Suchy, 2009). There are also connections between the different regions of the prefrontal cortex, which allows for the coordination of many different mental processes (Ward, 2015). Executive functioning is known to develop throughout childhood and adolescence and have an important role in an individual's ability for cognitive functioning, which enables emotion regulation, behaviour and social engagement (Anderson, 2002). Maturation of these cognitive skills have been shown to develop into early adulthood (Baars et al., 2015).

Executive functions are defined in various ways and there are differences in the aspects researchers consider as falling under the umbrella term of executive functioning (Gallant, 2016; Samuels et al., 2016). Across literature there is a common argument for the non-unitary nature of EF, arguing for the idea that there are different cognitive skills involved (Batista et al., 2017). Universally, executive functions can be characterized as the complex mental processes that an individual uses to enhance his or her performance in any given context where a requirement for many different cognitive processes occurs (Suchy, 2009). These cognitive skills allow for individuals to make decisions and to participate in goal-oriented behaviour (Suchy, 2009; Ward, 2015). There is a lack of consensus on the exact cognitive abilities that make up executive functioning due to it being a multi-faceted construct (Nyongesa et al., 2019). Common cognitive skills identified in literature are: planning, problem-solving, working

memory, inhibitory control, self-monitoring, and attention (Segundo-Marcos et al., 2022). Similarly, literature has clustered these skills into attention/working memory, inhibitory control/shifting as well as verbal initiative/abstract reasoning (Batista et al., 2017).

### **Measures of Executive Functioning and the promising use of self-report instruments**

There are many instruments of executive functioning with differing theoretical and operational definitions of the construct. The assessment of executive functioning is largely done using performance-based measures (Finnanger et al., 2022; Nyongesa et al., 2019). These measures examine an individual's capacity to complete a set of tasks under certain conditions (e.g. completing a motor skill task under a minute). An apparent challenge for these type of measures is that they require accessibility to valid and reliable tests that are costly, in addition, they require trained professionals to administer them (Laher & Cockcroft, 2017). Performance-based measures of executive functioning include examples such as, the Stroop Color-Word Test (SCWT) (Stroop, 1935), The Trail Making Test (TMT) (Reitan, 1956) and the Wisconsin Card Sorting test (WCST) (Grant, & Berg, 1948). Performance-based tests of executive functioning reportedly have a stronger association to cognitive abilities such as intelligence than executive aspects of everyday behaviour (Demetriou et al., 2019). Traditional executive function tests involve many lower-level cognitive abilities such as processing speed as well as higher level executive components. These challenges create difficulty in interpreting the results of EF measures (Anderson, 2002; Van der Elst et al., 2012). The challenge of using performance-based measurements is that the underlying theoretical definitions of the construct are limited. This limitation is often mitigated by using these tests within batteries. For example, some studies administer performance-based tests as a neuropsychological battery such as the Cambridge Neuropsychological Test Automated Battery (CANTAB) and the Delis-Kaplan Executive Function System (D-KEFS) (Nyongesa et al., 2019).

Post 2000, executive functioning has been tested using self-report scales (Baars et al., 2015; Mitchell & Miller, 2008). Researchers justified the use of self-report scales since EF incorporates skills that can be tracked through the cognitive skill of self-perception (Mitchell & Miller, 2008). Self-report questionnaires are widely used by researchers and clinicians in clinical psychology as they assist in the identification of signs and symptoms of psychological disorders and allow for the measurement of an individual's subjective experience of various psychological constructs (Demetriou et al., 2021). Self-report instruments are useful for studies interested in subjective behaviour and self-insight as well as for cognitive skills that are not

measured extensively when using objective cognitive tests (Baars et al., 2015; King et al., 2018). Furthermore, self-report measures of executive functioning have been important to use in contexts where time-efficiency, accessibility and ease of understanding is needed (Van der Elst et al., 2012). Self-report measures are time-efficient, cost-effective, and simple to administer which provides an alternative to performance-based tests (Demetriou et al., 2021). The exploration of self-report measures of executive functioning to determine their reliability and validity of tests was recommended in literature, for future use in mental health services when screening for everyday executive functioning (Van der Elst et al., 2012; van Tetering & Jolles, 2017).

### **Measures of executive functioning in South Africa**

In South Africa, many challenges of psychological testing exist due to a diverse context. South Africa is characterized as multicultural, multilingual and diverse, making standardization of psychological tests difficult, but necessary (Foxcroft, 1997). Due to the lack of resources and accessibility of standardized tests, the application and use of measures that are standardized in this context are minimal (Foxcroft, 1997; Laher & Cockcroft, 2013; Laher & Cockcroft, 2017). As mentioned before, most of the research involving executive functioning or related cognitive skills, made use of standard performance-based tests (Cockcroft et al., 2019; Cook et al., 2019; Milligan & Cockcroft, 2017). Thus, the exploration of self-reports measuring executive functioning remain a focus of further research.

King et al. (2018) reported using the Executive Function Index, a self-report measure of executive functioning, developed by Spinella (2005). It consists of 27 items, and 5 subscales: motivational drive (MD), empathy, impulse control, strategic planning and organization (Britz & van Zyl, 2020). The Executive Function Inventory was reported to be reliable and valid (King et al. (2018). Britz and van Zyl (2020) also reported using the Executive Functioning Index/Inventory in a South African context and it was found to be reliable and valid (subscales internal consistency were as follows: MD ( $\alpha = .52$ ), Organization ( $\alpha = .66$ ) Strategic Planning  $\alpha = .66$ , Impulse Control ( $\alpha = .61$ ) and Empathy ( $\alpha = .65$ ). Britz and van Zyl (2020) referred to this as the Executive Functioning Inventory, although it is used interchangeably with the Executive Function Index and is the same measure. However, both these authors did not report on the psychometric properties supporting these claims. Given its brevity, the recommendation was that the measure should be used in conjunction with other measures (Britz & van Zyl, 2020; King et al., 2018).

The Amsterdam Executive Functioning Inventory (AEFI) which is a self-report measure. The AEFI is an instrument that can be used for not only adults, but adolescents and children, making it a very versatile and useful measure in diverse contexts. It measures three integrated, but separate components of executive functioning: attention, self-control or self-monitoring and planning and initiative. Van der Elst et al. (2012), based the theoretical framework of the AEFI as an extension of the findings reported by Anderson et al. (2001). These components of EF are encompassing of the broad term, and are useful for everyday executive functioning skills, making this measure useful for looking at an individual's level of executive functioning used in their everyday life.

The AEFI has been used with promising results as a stand-alone measure of executive functioning (Coppin, 2021; Khodarahimi, 2018; van Tetering & Jolles, 2017). Baars et al., (2020) conducted an exploration of the factor structure of the revised version of the AEFI (10 items) in an adult population. These authors reported adequate reliability and validity. Khodarahimi (2018) used the AEFI with an adult population and reported that the measure was reliable and valid. These authors did not provide an exact reporting of the psychometric properties obtained in this study.

Coppin (2021) examined the relationship between dispositional mindfulness, everyday creative behavior and executive functioning as measured by the AEFI. This study reported good internal consistency for the overall scale of the AEFI ( $\alpha = .737$ ). Estimates for the subscales were lower: attention ( $\alpha = .671$ ), self-control/monitoring ( $\alpha = .645$ ) and planning and initiative ( $\alpha = .545$ ) (Coppin, 2021). Lower estimates are expected in scales of complex psychological constructs where the subscales have higher levels of covariance (Orçan, 2018). Therefore, the examination of the stability and validity of the instrument through data reduction techniques with specifications to control for the variance, are recommended.

The AEFI was identified as a more suitable alternative than the Executive Function Index/Inventory for research in South Africa due to the limited psychometric properties available and its brevity (Britz & van Zyl, 2020; King et al., 2018). The use of these self-report measures of executive functioning provides promising findings despite the systematic lack of reporting on psychometric properties. Similarly, the examination of underlying factorial models in the local context is critical. Cockcroft et al. (2019) reported that self-report measures of executive functioning were under-used in the South African context.



## **Conclusion**

Executive functioning is an important phenomenon made up of multiple cognitive mechanisms that are significant in individuals' everyday lives. Instruments of executive functioning are wide-ranging, with different measures assessing various cognitive skills, due to the wide-ranging definitions available on the construct. In addition, most neuropsychological assessments are performance-based which can be expensive, require trained professionals to administer and be inaccessible. The use of self-report measures of executive functioning is growing worldwide. Further, self-report measures are useful to administer in a South African context where lack of resources, accessibility and lack of standardized measures are prominent.

Due to the variation of definitions and assessments of executive functioning, the validity of measures of executive functioning is questioned (Salthouse, 2005). A global and local existing challenge is the lack of research on these instruments. More broadly, the lack of exploration of self-report measures of neuropsychological functioning remains a gap in literature. There is a lack of reporting of psychometric properties of measures globally, as well as in the South African context.

Due to the challenges of instrumentation within the South African context, the AEFI has been recommended to address some of these challenges, however, there is a lack of exploration of the psychometric properties beyond internal consistency (Khodarahimi, 2018). The AEFI, a self-report measure of executive functioning was used with a South African sample with good internal consistency, however, the study did not look further at the psychometric properties of the scale. The need for understanding the underlying theoretical models of instruments through data reduction processes is paramount as the use and application of self-report measures in a diverse context would be important for research purposes as well as for diagnostic and screening in health services. Thus, the validation of the AEFI within a South African adult population remains a gap within literature. The present study attempted to test the factor structure of the AEFI to begin addressing the need for more sophisticated and robust data on psychometric properties.

## **Chapter Three**

### **Methodology**

#### **3.1 Aim**

The aim of the study was to evaluate the construct validity of the Amsterdam Executive Function Inventory (AEFI) in a South African sample.

#### **3.2. Research Objectives**

1. To explore the internal consistency of the AEFI
2. To test whether the sample data satisfies the assumptions for factor analysis.
3. To explore the factor structure of the AEFI
4. To confirm the factor structure of the AEFI based on the underpinning theoretical model.

#### **3.3. Research Design**

The study used secondary research and was non-reactive. The study employed archival research which entails using data collected for a different purpose than that of the present study. Fisher and Chaffee (2018) identified the following advantages of archival research. First, it provides access to data that can be challenging to collect through reactive engagement. Executive functioning is usually measured within clinical studies or through data resulting from clinical intervention. In South Africa, there is a lack of use of self-report measures of EF, which has made it difficult to obtain large data sets. Further, studies on EF usually involve a sample of the population with neurological difficulties or other difficulties of interest to the researcher. Assessing EF within healthy adult populations are challenging, due to the use of clinical samples in most studies. The study assessed the AEFI in a healthy adult population.

Second, the data was readily available. In this case, a survey utilizing a self-report measure of EF was conducted on a sample of the South African adult population, and this dataset was cured and stored in an archive at the University of the Witwatersrand for future use. The participants involved in generating the data consented to the data being used for post hoc analysis (Appendix A). This advance directive enabled the availability and usability of the dataset for the analysis proposed in the study. The present study conducted a post-hoc analysis to establish construct validity of the instrument. Hence, the data analysis was a logical extension of the original project. Concerns of intellectual property, access to the data and other

concerns will be addressed in the ethics section. Access to the data set was granted by the University of the Witwatersrand (Wits), the owner and guardian of the data set, on several stipulations for use intended to uphold the ethics requirements and agreements with participants. Thus, there was access to the data set subject to ethical-legal considerations.

Third, archived data sets can provide access to larger data sets than would be procured in the course of executing a single study. The readily available data set was large. As mentioned above, the University of the Witwatersrand (Wits) has a dataset resulting from Coppin (2021). The data set consists of 1682 entries (cases) which constitutes a larger sample than would be reasonably procured in a single study of limited scope in partial fulfilment of the degree requirements.

Fourth, it can be time and cost effective as it reduces the time investment required for data collection and reduces the burden of participation for the participants. In the study, data collection had been completed which saves time and resources. The omission of data collection and use of secondary data is efficient in the context of a coursework programme, without detracting from the learning outcomes of the requirement of the research component. In addition, the original data was collected by the researcher in the present study. Thus, the research student has demonstrated mastery of data collection and has insight into the processes from which the data resulted.

Jones (2010) identified the following disadvantages of archival research: First, there are difficulties around obtaining permission to access the archived data. Often the process for granting access or requesting access is not clear or explicit which could result in delays. In this case, the research student and supervisors have engaged the supervisor of the parent study and guardian of the data set. The researcher making the application was the primary researcher within the parent study. Thus, there is a prior relationship which assisted in the negotiation process and engendered trust. A further mitigating circumstance is that the supervisor of the present study was experienced in such negotiation processes and could guide the application.

Fifth, a lack of understanding the original study that obtained the data often results in appropriate analysis and requires time to become familiar with the limitations of the data set. This disadvantage was mitigated, because the student researcher has a high level of familiarity with the parent study and data set. The student researcher conceptualized, executed and wrote up the parent study and thus has intimate knowledge of the parent study and the extent to which the data can answer the aims and objectives of the present study. Sixth, archival research is

often associated with dated or historical data. The data in this case was collected in 2020 and is thus considered recent as per the recommendation of Booker & Chandola (2022). The analysis was conducted in 2022 which substantially reduced the time laps between data collection and post hoc analysis.

Secondary research was appropriate for the present study. The known disadvantages were easily mitigated which enabled the optimal harnessing of the stated benefits. The present study required a large sample and the data set was appropriate for answering the research questions. To ensure that the data supported the proposed analysis, research objectives and questions were framed to test the assumptions for inferential statistics, and data reduction techniques. Thus, empirical evidence supported the theoretical assumptions and explanations provided.

### **The Parent study.**

As mentioned before, Coppin (2021) explored the relationships between dispositional mindfulness, executive functioning and everyday creative behaviour. The study obtained ethics clearance (MASPR/20/03) through the School of Human Community Development Ethics Committee (Non-Medical) at the University of the Witwatersrand (Appendix B). The study examined whether dispositional mindfulness and executive functioning predict everyday creative behaviour. The sample was recruited through online communication services at the University and on social media platforms. The sample consisted of 2527 participants, of which 1636 completed the questionnaire. After cleaning the dataset of any outliers, the data set consisted of 1608 participants from a South African population between the ages of 18 and 50 years old with access to a computer/device and the internet.

The survey included a short demographic questionnaire, the Mindfulness Attention Awareness Scale (MAAS) (Brown & Ryan, 2003), the Amsterdam Executive Function Inventory (AEFI) (Van der Elst et al., 2012), and the Kaufman Domains of Creativity Scale (KDOCS) (Kaufman, 2012). The data was exported to an Excel spreadsheet where it was cleaned, with outliers and missing information being retracted and variables coded. The analysis was conducted using the IBM SPSS programme, version 26. The cured data set was analyzed using descriptive statistics, measures of central tendency and variability (inclusive of means, standard deviations, ranges, skewness coefficients and kurtosis as well as histograms). Internal consistency of the measures was calculated using Cronbach's Alpha. For a comprehensive write up of the study, refer to Coppin (2021).

### **3.4. Instrument**

The Amsterdam Executive Function Inventory (AEFI) was established in 2011 to evaluate the level of executive functioning in children and adolescents in an efficient and easy to understand manner (Appendix C). The scale is made up of three executive functions which are integrated, although seen as separate skills: attention (which is inclusive of sustained and focused attention), self-control and self-monitoring (inclusive of working memory) as well as planning and initiative (initiating behaviours as well as planning them) (Van der Elst et al., 2012; van Tetering & Jolles, 2017). The AEFI has 13 items, measured on a 3-point Likert-type scale with one (1) indicating not true, two (2) indicating partly true and three (3) indicating true (Baars et al., 2015).

Studies conducted in the Netherlands of adolescents between the ages of 15 to 18 years old, reported that the scale indicated good psychometric properties (Van der Elst et al., 2012; van Tetering & Jolles, 2017). Specifically, internal consistency reliability shown through Cronbach alpha, were all appropriate (Attention = .64, Self-Control = .65 and Planning = .60). Confirmatory Factor Analysis confirmed that the model adequately fitted the data (RMSEA = .06, CFI = .95, NFI = .95) and all items loaded significantly on the a priori expected factors (Van der Elst et al., 2012). In addition, the correlations between the AEFI scale scores were all significantly positive including Attention and Self-Control/Self-Monitoring ( $r = .58$ ), Self-Control/Self-Monitoring, Attention and Planning and Initiative ( $r = .15$ ) and Self-Control and Planning and Initiative ( $r = .10$ ). Therefore, the scale was shown to be reliable and valid in the intended populations.

As noted within the literature review, the scale was used within other studies amongst adult populations (Baars et al., 2015; Khodarahimi, 2018). In addition, within the South African context, the scale was used within Coppin (2021). The instrument was found to have adequate internal consistency reliability. For a full write up of the results of these studies please refer to the unpublished thesis by Coppin (2021).

### **3.5. Sample**

For the purpose this study, a subset of participants was selected from the dataset to reduce variability and increase the likelihood of a normal distribution. The inclusion criteria for the subset were 1) registration as a student, 2) completion of a full AEFI response form and 3) South African nationality. The data set included 1682 local university students of which 1608 completed the AEFI online. Participants ranged between the ages of 18 to 50, with 96.5%

aged between 18 and 36 years old, the mean age was 22.62 (SD = 5.44), the median age was 21 and the mode age was 20. Majority of the participants identified as female (n = 899, 68.4%), while the remainder identified as follows: male (n=388, 30.3%), intersex (n=314, 30.2%) and the remaining seven participants did not identify a gender (n=7, 0.5%).

### **3.6.Data Analysis**

The data was analyzed in SPSS Statistics version 28 (v.28). The analysis was conducted in three stages: First, the internal consistency was calculated. Second, the parameters of the data set were assessed to determine whether the data supported the use of exploratory (EFA) and confirmatory (CFA) Factor Analysis. Third, the respective factor analyses were conducted.

#### **3.6.1. Internal Consistency/ Reliability**

Internal consistency was investigated due to the sample in the study being different from the parent study. It was a more conservative approach to compute internal consistency for this subset given the variation in the larger data set than to adopt the reported internal consistency in Coppin (2021). Cronbach's alpha was computed within the current study. The higher the alpha, the better the internal consistency reliability (Bandalos, 2018) According to Brough (2019), a Cronbach's coefficient above .60 represents adequate reliability. A Cronbach's alpha above .70 indicate desirable/good reliability that suggests that the measure is appropriate for use in psychological research.

#### **3.6.2. Assumption testing: The assumptions for EFA and CFA respectively are presented below.**

##### **3.6.2.1. Exploratory Factor Analysis.**

The following four assumptions were tested to determine whether the data supports EFA: univariate normality, linearity and factorizability and sample size. In order to conduct the factor analysis, the assumptions need to be met. Firstly, univariate normality was tested. According to Watkins (2021) in factor analysis, univariate normality is more important than multivariate normality. Hence, normality was looked at in terms of each individual item rather than the subscale. To look at univariate normality of the items, skewness and kurtosis values for each item of the AEFI were calculated using Kolmogorov-Smirnov and Shapiro-Wilks test of normality (Brough, 2019). Skewness should not exceed 2.0 and kurtosis should not exceed 7.0 for the data to not significantly deviate from normality (Bandalos, 2018).

Secondly, sampling adequacy was evaluated by calculating The Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. These two tests are widely used for assessing the agreeableness of the correlations within the sample and their ability for factoring. To meet the criteria for KMO, you would like the result to be above .60 (Thompson, 2004). Above .60 is 'mediocre', above .70 is 'middling' and above .80 is 'meritorious'. For the Bartlett's test of sphericity, the test needs to be significant, which would mean that the variables are correlated and are not an identity matrix (Bandalos, 2018).

Thirdly, an inter-item, correlation matrix was generated. The inter-item correlations tell us the relationships (linearity) between the items in measuring the construct (Brown & Moore, 2012). Fourth, Principal Axis Factoring (PAF) was performed to assess the suitability of the data for EFA. PAF was performed using orthogonal varimax rotation was used to increase interpretability of factors as recommended by Howard (2016). The PAF is interpreted by assessing the eigenvalues, where eigenvalues should be greater than 1 to retain the factors (Byrne, 2016).

### **3.6.2.2. Confirmatory Factor Analysis**

Zygmunt and Smith (2014) identified that missing data must be attended to as it impacts normality and subsequent factor analyses. As mentioned before, the data set was cured in the process of extracting the subset for analysis and evaluating the overall data set for suitability. The adoption of a completed AEFI protocol as an inclusion criterion ensured that there was no missing data.

Skewness affects tests of means, and kurtosis impacts tests of variances and covariances. The impact of skewness and kurtosis on multivariate tests are also extended to analysis such as CFA. Therefore, the data was tested for multivariate normality using Mardia's (1970, 1974) normalized estimate of multivariate kurtosis coefficient. To establish multivariate normality, the Mardia's coefficient should be less than five ( $<5$ ) as per the recommendations of Bentler (2005).

### **3.6.3. Factor Analysis**

In the third phase of the analysis, Exploratory factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) was conducted.

### **3.6.3.1. Exploratory Factor Analysis (EFA)**

EFA is a data-driven technique that is used as a preliminary exploration of the data (Zygmunt & Smith, & Smith, 2014). It explores the underlying structure of a relatively large set of variables and is important to do when looking at factor structure, when there are no assumptions about how this structure will look (Orçan, 2018). In the present study there was an underlying model which would traditionally not warrant the use of EFA. As a conservative measure, the EFA was conducted prior to the CFA to see the factor structure that emerged naturally from the data. The resultant structure can then be compared to the anticipated theoretical model (Byrne, 2016).

The factors were extracted using Principal Component Analysis as recommended by Field (2018). Identifying the number of factors to extract was based on three strategies: a) the Kaiser rule i.e. the number of eigenvalues that were greater than one (1), b) the magnitude of factors i.e. the percentage of variance that can be explained by the data and c) the factors displayed on the scree plot. Byrne (2016) recommended using several factor retention strategies to assure agreeability.

A parallel analysis was conducted using syntax in SPSS (v28). Horn (1965) parallel analysis was used as a post-estimation command with 1000 repetitions specified, which was run to determine the number of factors using a random data simulation (Cokluk, 2016; Hayton, 2004). A parallel analysis was utilized to create a robust analysis and to confirm the number of factors to extract (Dinno, 2009). As recommended by Henson and Roberts (2006), the factors were interpreted by analyzing the primary loadings, secondary loadings and cross loadings.

Chi-square was used to determine whether the data set and the model differed significantly. As per the recommendation of Kline (1998), Chi-square must be not significant ( $p > 0.05$ ) to proceed with the CFA. It must be noted that Chi Square is particularly sensitive to violations of normal distribution and to sample size (Byrne, 2016; Zygmunt & Smith, 2014). Thus, this statistic was interpreted with caution and not used as an indicator for proceeding with the CFA.

### **3.6.3.2. Confirmatory Factor Analysis (CFA)**

CFA is a theory-driven technique to test theory against the data and verify the theoretical factor structure of the variables (Brown & Moore, 2012). A CFA is typically conducted by specifying a model based on literature, determining model identification, estimating parameters of the model, assessing the model fit and interpreting the results (Orçan, 2018). The conceptual model



underpinning the AEFI scale was used as the reference criterion as the model assessed for fit. A first-order CFA model was used to establish factorial validity of the measure (AEFI) as suggested by Byrne (2016). CFAs are traditionally computed after an EFA has been carried out to ensure that errors and noise are reduced to increase the chances of achieving model fit (Brown & Moore, 2012). The maximum likelihood estimation (MLE) technique was used to assess the AEFI as a first-order CFA model with three factors as per the theoretical model.

### ***Decision making for model fit.***

Five indices were used to establish the adequacy of model fit. Each index has a recommended threshold score that indicates model fit. Below is a brief summary:

1. The Standardized root mean square residual (SRMR). The SRMR must have a value of 0.8 or less to demonstrate an acceptable model (Byrne, 2016). A well-fitting model must have a SRMR value of less than .5 (<0.5) (Byrne, 2016).
2. The Root mean square error of approximation (RMSEA). The RMSEA has values ranging from 0 to 1 (Kline, 1998). Smaller values indicate better model fit (Orçan, 2018). The RMSEA must have a value of 0.06 or less to indicate acceptable model fit (Kline, 1998; Orçan, 2018)
3. The Chi-square/degrees of freedom ratio (CMIN/DF). Values less than 3 indicates an acceptable fit between hypothetical model and sample data (Kline, 1998). A value CMIN/DF <5 indicating a reasonable fit (Marsh, & Hocevar, 1985).
4. The Comparative fit index (CFI). The CFI values range from 0 to 1 (Kline, 2016). Larger values indicate better fit (Field, 2018). Traditionally, a CFI value of .90 or larger was considered to indicate acceptable model fit (Kline, 1998). However, recent studies indicated that a value greater than .90 is needed to ensure that mis-specified models are not deemed acceptable (Byrne, 2016). Thus, a CFI value of .95 or higher is presently accepted as an indicator of good fit (Field, 2018; Kline, 1998).
5. The Goodness of fit index (Bandalos, 2018). Values for this index range between 0 and 1 (McNeish & Wolf, 2021& Wolf). A value of over .9 generally indicates acceptable model fit (Bandalos, 2018).

A conservative approach was adopted to the decision-making about model fit to avoid bias in the interpretation and reporting of model fit indices as recommended by (Orçan, 2018). For the purposes of the present study, model fit was concluded if the values of all five indices satisfied the threshold criterion. Table 1 below illustrates the decision guide and the threshold index scores for acceptable model fit.

**Table 1**  
**Model fit indices**

<b>Indices</b>	<b>Model fit requirement</b>	<b>Decision</b>
<b>The Standardized root mean square residual (SRMR)</b>	<.08 (acceptable model)	Accept
<b>Root-mean-square error of approximation (RMSEA)</b>	</.06 (acceptable model)	Accept
<b>Comparative fit index (CFI)</b>	>.95 (acceptable model)	Accept
<b>Chi-square statistics (CMIN)</b>	<3.0 (acceptable model) <5.0 (reasonable model)	Accept
<b>Goodness of fit index</b>	>.9 (acceptable model)	Accept

\*The decision for any parameter missed or not meeting model fit requirement is reject.

### **Ethical Considerations**

Ethics clearance and permission for this study (BM22/6/19) was obtained from the Bio-Medical Research Ethics Committee (BMREC) at the University of the Western Cape (Appendix D). The study was non-reactive and constituted low risk. The data set is owned by the University of the Witwatersrand where the parent study was conducted in fulfilment of a master's degree. As mentioned before, The University of the Witwatersrand Human Research Ethics Committee granted ethics clearance for the parent study (MASPR/20/03) (Appendix B). Participants provided consent and were informed that responses would be stored for further or future analysis (Appendix A). Thus, Coppin (2021) obtained an advanced directive in which the participants agreed to the use of the data being used in possible future research when signing the informed consent before participating (Appendix A). Permission to use this data was requested to the University of the Witwatersrand to use the data within this research study and to write it up in partial fulfilment of the MPsych degree requirements at UWC (Appendix E). A data sharing agreement between the data provider and the data recipient has been drawn up and executed fully (Appendix F). The signed agreement was a proxy for permission to use the data. The fully executed agreement was submitted to the BMREC at UWC. Data was shared after the University of the Witwatersrand Research Committee granted permission for a post hoc analysis. In compliance with Protection of Personal Information Act (Government, 2013) only a de-identified data set was requested for the purposes of post-hoc analysis. The removal

of identifying information from the dataset ensured that confidentiality of responses and anonymity of participants are maintained. The de-identified data was kept in a safe, secure location in accordance with the data storage requirements at UWC. The data set will not be published in any form to uphold intellectual property rights and the conditions of the DSA. Any disseminations such as publications will be submitted to an identified WITS representative to ensure that there is no misrepresentation of the data. The results of the study were presented at an international conference ([Exploring the use of self-report measures in research on executive functioning](#)). In addition, a draft manuscript is currently under review, and a copy of this was shared with the WITS representative in keeping with the DSA.

## Chapter Four

### Results

The following chapter presents the results of the statistical analyses carried out within the current study. The chapter is structured to reflect the progression of the objectives. The internal consistency results are presented first, followed by the assumption testing. Thereafter, the results of the exploratory factor analysis and the confirmatory analysis respectively.

#### 4.1. Internal consistency

Table 2 below indicates the reliability analysis, which showed a Cronbach's alpha of .74 ( $\alpha = .74$ ), showing good internal consistency estimates. That is the measure remains stable when used in this sample. Similarly, all subscales showed adequate internal consistency, with the planning subscale being the lowest of the subscales.

**Table 2**  
*Reliability analysis*

	<b>N. of items</b>	<b>Cronbach Alpha</b>
Attention	3	.671
Self-control/Self-Monitoring	5	.645
Planning and initiative	5	.545
AEFI	13	.737

#### 4.2. Assumption testing: Exploratory Factor Analysis

##### 4.2.1. Skewness and Kurtosis

Inspection of the histograms and q-q plots demonstrated sufficient normality for the factor analysis to be conducted (Appendix G). Table 3 below contains the skewness and kurtosis values corresponding to each AEFI item in the sample.

**Table 3**  
*Skewness and Kurtosis of the 13 AEFI items*

<b>Item</b>	<b>Skewness</b>	<b>Kurtosis</b>
AEFI1	-.148	-.959
AEFI2	-.419	-1.015
AEFI3	-.336	-1.249
AEFI4	-1.535	1.435
AEFI5	.224	-.970
AEFI6	.043	-1.314
AEFI7	.674	-.638
AEFI8	-.515	-1.173
AEFI9	-.319	-.710
AEFI10	-.265	-.776
AEFI11	-.465	-1.072
AEFI12	-.675	-.970
AEFI13	-.594	-1.112

As seen from the above, the distribution of the items reflect that all skewness values are less than +/-2.0 and all kurtosis values are less than +/-7.0. As per Watkins (2021) the skewness and kurtosis of the distribution met the criteria for factor analysis.

#### **4.2.2. Sampling Adequacy**

Table 4 below summarises the results for Bartlett’s test of sphericity.

**Table 4**  
*Sampling Adequacy: The Kaiser-Meyer-Olkin (KMO) and Bartlett’s test of sphericity*

<b>Test</b>	<b>Factor</b>	<b>Value</b>
<b>The Kaiser-Meyer-Olkin (KMO)</b>	<b>Sampling adequacy</b>	.795
<b>Bartlett’s test</b>	<b>Chi-Square</b>	3785.05
	<b>Df.</b>	78
	<b>Sig</b>	.01

The results of the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicated a value of .795, resembling a “meritorious” index (Pett & Sullivan, 2003). Bartlett’s test indicated that correlations between items tested significant at a 0.01 alpha level. The tests results indicated that inter-item correlations were sufficiently large for factor analysis [ $\chi^2_{(78)} = 3785.05, p < .01$ ].

#### 4.2.3. Inter-item correlations

Table 5 below shows the inter-item correlation matrix of the 13 items of the AEFI.

**Table 5**  
*Inter-item correlation matrix of the 13 items of the AEFI*

	1	2	3	4	5	6	7	8	9	10	11	12
<b>AEFI1</b>	1.000											
<b>AEFI2</b>	.13**	1.000										
<b>AEFI3</b>	.26**	.19**	1.000									
<b>AEFI4</b>	.10**	.17**	.12**	1.000								
<b>AEFI5</b>	.40**	.13**	.28**	.011**	1.000							
<b>AEFI6</b>	.15**	-.05	.08**	-.01	.27**	1.000						
<b>AEFI7</b>	.30**	.15**	.17**	.06*	.50**	.31**	1.000					
<b>AEFI8</b>	.34**	.04	.15**	-.02	.41**	.27**	.377	1.000				
<b>AEFI9</b>	.10**	.27**	.15**	.15**	.13**	.02	.089	.02	1.000			
<b>AEFI10</b>	.04	.24**	.08**	.29**	.04	-.03	.025	-.04	.36**	1.000		
<b>AEFI11</b>	.24**	.20**	.17**	.13**	.26**	.15**	.277	.18**	.10**	.12**	1.000	
<b>AEFI12</b>	.21**	.17**	.14**	.03	.25**	.16**	.296	.18**	.07*	.04	.55**	1.000
<b>AEFI13</b>	.23**	.11**	.29**	.05	.31**	.21**	.296	.22**	.02	-.05	.32	.42**

\*Significant  $p < .05$  two-tailed. \*\* $p < .01$  two-tailed

Looking at the table, most of the correlations were significant at the 0.05 or 0.01 alpha level. It was however noted that items 2, 3, 4 and 10 do not have any correlations above .3. This indicates that there is poor inter-item correlation and could indicate possible issues of measuring the same construct as the other variables (Bandalos, 2018). Despite this, the correlations are sufficient for the factor analysis to be run.

In summary the assumptions for EFA have been met.

### 4.3. Assumption testing: Confirmatory Factor Analysis

Table 6 below presents the results related to the testing of multivariate normality.

**Table 6**

Multivariate normality (Kurtosis Coefficient)

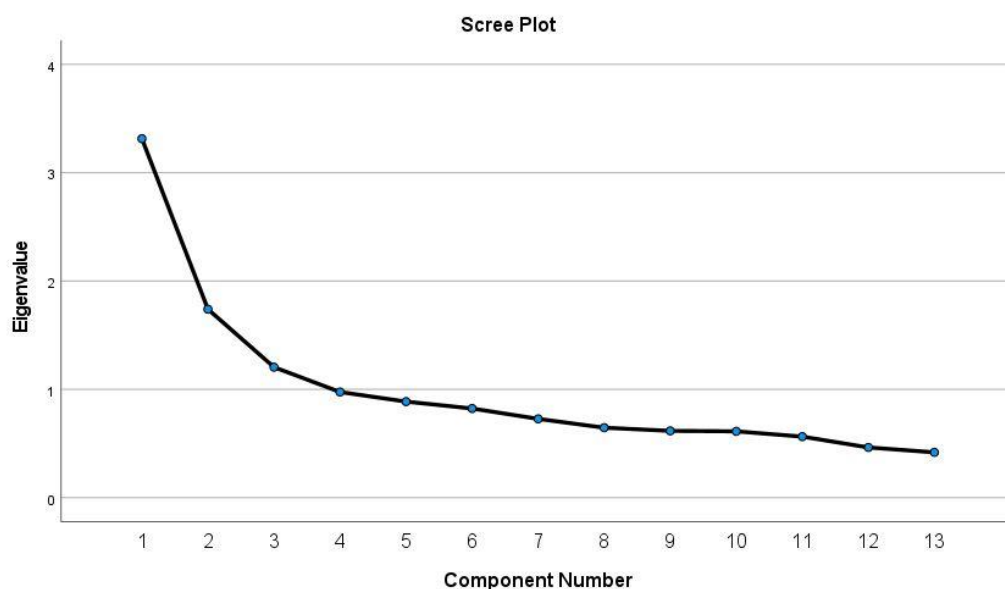
Variable	Min	Max	Skew	c.r.	Kurtosis	c.r.
Multivariate					-1,208	-1,109

From the table above it became evident that the data displayed multivariate normality. As mentioned in the preceding chapter, there was no missing data, the data was found to be continuous and the sample size was adequate. Thus the assumptions for CFA were met.

### 4.4. Exploratory Factor Analysis

#### 4.4.1. Factor Extraction: Principal Axis Factoring (PAF)

The number of factors to extract was based on the Eigenvalues greater than 1, inspection of the scree plot and the parallel analysis. The initial model, as shown in Table 7 below, indicated that 48.395% of the variance are explained with three factors. The Kaiser rule stipulates that eigenvalues must be greater than 1 to retain factors (Byrne et al., 2016). This was further looked at when examining the scree plot of the AEFI which is shown in Figure 1 below.



**Figure 1: Scree plot of the sample data**

Results from the scree plot demonstrated the presence of three factors. A parallel analysis was run to further explore this and the results are represented below in Table 8. The parallel analysis indicates that within the original data, the first three factors have greater eigenvalues than in the random values generated by the parallel analysis. These results further indicate that three factors should be retained. The parallel analysis further extends the results found in the inspection of the model and inspection of the scree plot.

**Table 7**  
Inspection of eigenvalues

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.323	25.563	25.563
2	1.759	13.530	39.093
3	1.209	9.302	48.395
4	.984	7.569	55.963
5	.881	6.780	62.744
6	.806	6.197	68.941
7	.711	5.468	74.410
8	.657	5.055	79.465
9	.623	4.794	84.259
10	.606	4.665	88.924
11	.566	4.356	93.280
12	.449	3.457	96.738
13	.424	3.262	100.000

As seen from the above, it is evident that the first three factors have eigenvalues greater than 1.



#### 4.4.2. Parallel analysis

Table 8 below presents the parallel analysis.

**Table 8**  
Parallel analysis

<b>Factor</b>	<b>Original data</b>	<b>Means</b>	<b>95th Percentile</b>
1.000	3.323	1.15	1.19
2.000	1.759	1.12	1.14
3.000	1.209	1.09	1.11
4.000	.984	1.06	1.08
5.000	.881	1.04	1.06
6.000	.806	1.02	1.04
7.000	.711	.99	1.01
8.000	.657	.97	.99
9.000	.623	.96	.97
10.000	.606	.93	.95
11.000	.566	.91	.93
12.000	.449	.89	.91
13.000	.424	.86	.88

#### *Factor loading*

Loadings are represented in bold where items loaded onto the intended subscale. The items that are italicised represent items that cross-loaded on an unexpected domain. For better interpretability, the theoretical domains of each item are listed in the far-left column for interpretability. Table 9 below indicates the factor loadings of the AEFI resulting from the inter-domain correlation matrix.

**Table 9**  
*Factor loadings of the AEFI*

Theoretical domain		Factor		
		Attention	Self-Control & Self-Monitoring	Planning & initiative
		<b>1</b>	<b>2</b>	<b>3</b>
Attention	AEFI1	<b>.497</b>		
Attention	AEFI5	<b>.718</b>		
Attention	AEFI7	<b>.603</b>	.208	
Planning and Initiative	AEFI2			<b>.442</b>
Planning and Initiative	AEFI3	.301		<b>.227</b>
Planning and Initiative	AEFI4			<b>.393</b>
Planning and Initiative	AEFI9			<b>.530</b>
Planning and Initiative	AEFI10			<b>.631</b>
Self-Control and Self-Monitoring	AEFI6	.399		
Self-Control and Self-Monitoring	AEFI8	.588		
Self-Control and Self-Monitoring	AEFI11	.229	<b>.595</b>	
Self-Control and Self-Monitoring	AEFI12		<b>.825</b>	
Self-Control and Self-Monitoring	AEFI13	.357	<b>.426</b>	

*Extraction Method: Principal Axis Factoring.*  
*Rotation Method: Varimax with Kaiser Normalization.*

- a. Rotation converged in 5 iterations.

Table 9 indicates that the factor loadings of each item of the AEFI on the three subscales: attention self-control and self-monitoring and planning and initiative. Loadings with very low values (lower than .2) were suppressed during the rotation for better interpretation. Results indicate that attention had eight loadings on it, in which three (1,5, 7) were intended loadings, Self-control and self-monitoring domain had four items loading on it, three of which were intended. Further, Planning and Initiative had five items loading on it, which was expected. The structure that emerged was a three-factor solution. The factor loadings provided statistical justification for the extraction of three factors namely, Attention, Planning and initiative, and Self-control and self-monitoring.

#### 4.5 Confirmatory Factor Analysis

Table 10 below reports on the initial model of the AEFI. This indicated mixed results, where the Chi Square was found to not be an exact fit to the theoretical model. Thus, there is concern about continuing with the CFA. As mentioned in Chapter three, Chi Square was not used as a prerequisite. The indices reported in Table 10 will be interpreted cautiously given the significant Chi Square.

**Table 10**  
*Initial model's threshold values for model fit*

Test	Result	Value	Recommendation	Decision
<b>Chi-square</b> ( $\chi^2$ )	687.116 (.000)	Significant		Theoretical model not confirmed
<b>CMIN/DF</b>	11.08	Not an acceptable fit	Reject	
<b>CFI</b>	.79	Not an acceptable fit	Reject	
<b>RMSEA</b>	.088	Not an acceptable fit	Reject	
<b>SRMR</b>	0.76	Acceptable fit	Accept	
<b>GFI</b>	.92	Acceptable fit	Accept	

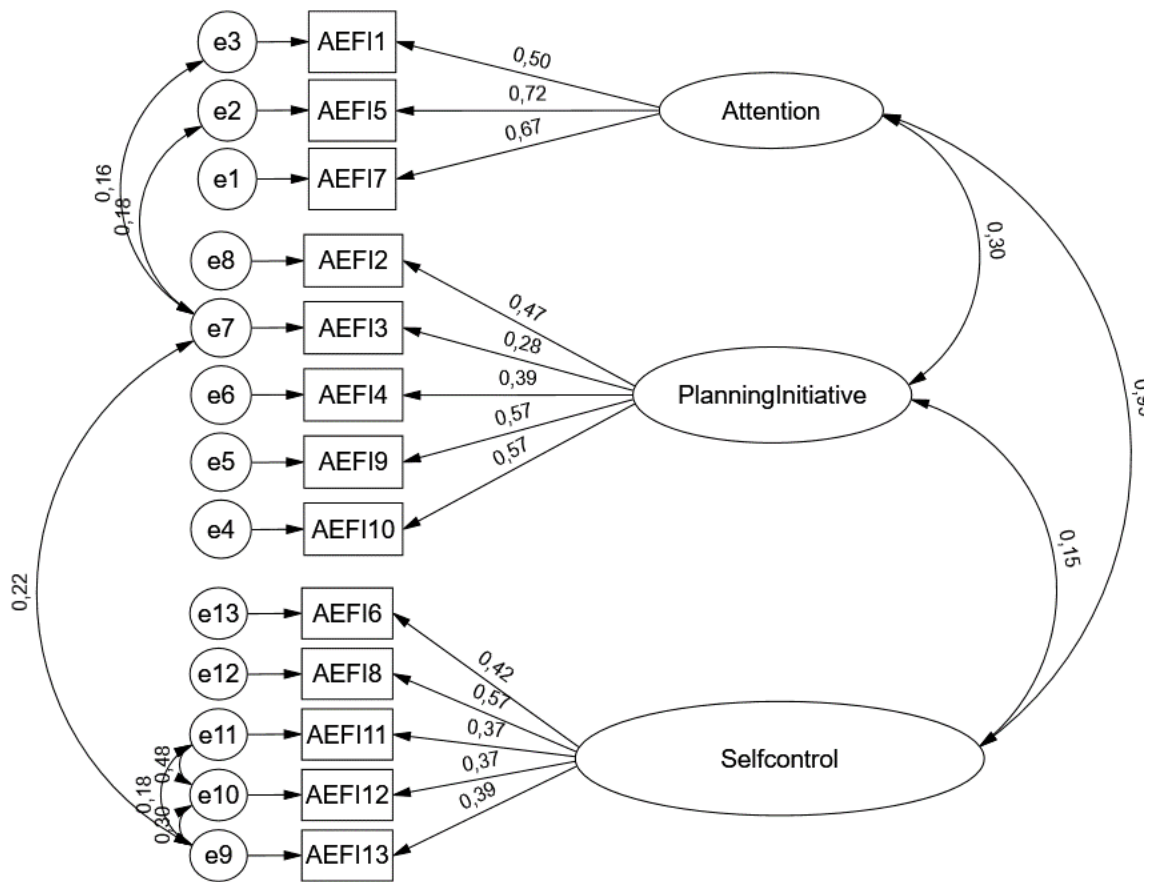
The CMIN/DF far exceeded the threshold score of 3 and the ceiling score of 5. The CFI was smaller than the threshold of .95. The SRMR and GFI showed acceptable model fit. Based on these mixed results, the model was respecified using the modification indices as a guide (Brown, 2015). The model was respecified as the items and what they measure are theoretically similar, and are likely to share variance (Bandalos, 2018). The respecified model is reported in Table 11 below. As shown in Table 11, the Chi square improved substantially ( $\chi^2 = 266.83$ ,  $p < 0.01$ ), although it remained significant.

**Table 11**  
*Model fit of Model 2 (after re-specifications)* (n=315)

<b>Test</b>	<b>Result</b>	<b>Value</b>	<b>Recommendation</b>	<b>Decision</b>
<b>Chi-square (<math>\chi^2</math>)</b>	266.83	Significant		
<b>CMIN/DF</b>	4.765	Reasonable fit	Accept	
<b>CFI</b>	.93	Acceptable model fit	Accept	Theoretical model confirmed
<b>RMSEA</b>	.054	Acceptable model fit	Accept	
<b>SRMR</b>	.055	Acceptable model fit	Accept	
<b>GFI</b>	.97	Acceptable model fit	Accept	

The other model fit indices were much approved. The CMIN (4.8) indicates a reasonable fit, as it is <5. The CFI (.93) indicates acceptable model fit as it exceeds .90. The RMSEA (0.054) demonstrates acceptable model fit as it is smaller than 0.06. The SRMR (0.055) is indicative of an acceptable mode as it is less than 0.8. The GFI (.97) exceeded the threshold value of 0.9 (>0.9). All five indices were met, indicating that the theoretical model is confirmed, and the model is an acceptable fit.

The model reported in Table 11 is further displayed in Figure 2 on the following page.



**Figure 2: The factors structure of the model (after respecifications)**

*The numbers shown in Figure 2 above are standardised beta values*

## Chapter Five

### Discussion

The aim of this study was to evaluate the construct validity of the Amsterdam Executive Function Inventory (AEFI) in an adult sample of the South African population. This chapter will discuss each of the research objectives of the study, while making reference to the relevant literature and the results of the study. Further, conclusions are drawn from the findings of the study. The limitations and significance of the study's findings in a South African context were presented. Recommendations for future studies were made.

#### 5.1. Objective 1: Internal consistency

The results reported a Cronbach's alpha of .74 ( $\alpha = .74$ ) for the overall scale. This suggests that the AEFI was found to be sufficiently reliable in his sample. These findings mirrored the reliability coefficient by (Coppin, 2021) in the parent study ( $\alpha = .74$ ). Furthermore, this is expected to have mirrored other studies using the AEFI in an adult population who found it to be reliable, although the exact internal consistency estimate was not reported (Khodarahimi, 2018). The estimate obtained in this study for the total scale exceeds .7 which suggests that the scale is stable enough to be used in psychological research as per the recommendation of Bandalos (2018).

The individual subscales were all found to be sufficiently reliable. The Attention subscale had a Cronbach's alpha of .671 ( $\alpha = .671$ ) in the present study suggesting that the subscale was had adequate internal consistency. The estimate in the present study was slightly higher to the estimate (Attention:  $\alpha = .64$ ) reported by Coppin (2021). The Self-control/Self-monitoring subscale obtained a Cronbach's alpha of .645 ( $\alpha = .645$ ) suggesting that the subscale was stable. The estimate for Self-Control/Monitoring was relatively similar to that reported by Coppin (2021). The Planning and Initiative subscale had a Cronbach's alpha of .545 ( $\alpha = .545$ ) in the present study suggesting that the subscale was had adequate internal consistency. The estimate in the present study was slightly lower to the estimate (Planning and Initiative  $\alpha = .60$ ) reported by Coppin (2021). Overall, the findings indicated sufficient reliability. The estimates for internal consistency was comparable to estimates reported by (Khodarahimi, 2018; Van der Elst et al., 2012; van Tetering & Jolles, 2017) in different contexts. The findings also indicated that the further removal of any items would not improve the reliability of the scale.

## **5.2 Objective 2: Assumption testing**

The second objective of the study was to test whether the sample data satisfies the assumptions for inferential statistics and for factor analysis. As mentioned before, the assumptions for EFA and CFA were tested separately.

### ***5.2.1. Assumptions for EFA***

In order to look at whether the sample data satisfied the assumptions in the current study, univariate normality was evaluated. The sample data met sufficient conditions for Principle Axis Factoring (PAF). The skewness values and kurtosis values were sufficient and met the criteria outlined by Bandalos (2018). The factor structures that later emerge can be potentially influenced by a univariate magnitude of deviation from a normal distribution (Bandalos, 2018). These results indicated that the data sufficiently met the criteria, thus meeting univariate normality and conditions for a PAF (Watkins, 2021).

In addition to the assumptions being met for inferential statistics, as recommended by Orçan (2018), linearity and factorizability of the data was established through inspection of the inter-item correlation matrix. The inter-item correlation matrix showed that all correlations were significant at the 0.05 or 0.01 level of significance. Items 2,3,4 and 10 showed correlations lower than .3, which could indicate possible difficulties in measuring the same construct. (Bandalos, 2018) The results from the inter-item correlation matrix provided sufficient evidence of linearity and factorizability of the data. Further, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was sufficient and the Bartlett's test of sphericity indicated that the correlations were sufficiently large (Bandalos, 2018). Overall, the results indicated that the data was linear, had univariate normality, adequate sample size, no significant outliers and no multicollinearity was present. Thus the assumptions for EFA were met.

### ***5.2.2. Assumptions for CFA***

To establish the suitability of the data for CFA, multivariate normality was tested using multivariate kurtosis, specifically Mardia's coefficient (Mardia, 1970, 1974). It was important to look at kurtosis estimates as Byrne (2016) emphasized that kurtosis impacts tests of variances and covariances, and therefore impacts CFA, while skewness impacts means. The data displayed multivariate normality due to the sufficient values of Mardia's kurtosis. The kurtosis coefficients together with the no missing data, adequate sample size and continuous data, indicate that the assumptions to run the CFA were met (Byrne et al., 2016).

### 5.3. Objective 3: Exploratory FA

The Principal Axis Factoring (PAF) extracted three factors that accounted for 48.16% of the total variance. Previously, EFA models with good fit have been suggested to account for 75% or more of the variance, however, this is rarely met in research and challenges the practicality of this expectation in applied psychological research (Henson & Roberts, 2006). Within factor analysis studies, there is no set criteria for variance threshold for the factors extracted, and rather the goal is to maximise the variance explained while maintaining a reasonable number of factors (Pett & Sullivan, 2003). The Kaiser rule together with the scree plot and parallel analysis, showed support for a three factor structure. It is important to note that within the parallel data, factor 4 was higher (1.08) while the original model factor 4 was lower (.984), although the parallel data supported a three factor structure. Hence, the extraction of the three factors was statistically justified, and it corresponds with the original AEFI model.

Six items (2,3,4,9, 10 & 11) from the inter-item correlation matrix were shown to have poor inter-item correlations (below .3). The Planning and Initiative domain had five problematic items (2, 3, 4, 9 & 10), while the Self-Control and Self-Monitoring domain had one item (item 11). In addition, three items (3, 4 and 6), one item belonging to each domain, had communalities below .4.

Inspecting the loadings on the intended domains, it was found that majority of the items loaded onto the intended theoretical factors. Factor 1 (Attention) had 8 items loading on it. Item 1, 5 and 7 are items that were intended to load on attention. AEFI5 had the highest loading on attention out of the three intended items. There were two items belonging to the Self-Control and Self-Monitoring domains that loaded onto the Attention domain (items 6 & 8). Looking at the wording of these items, it is reasonable that participants may have misunderstood these items as belonging to attention (e.g. Item 8 reads: "It is difficult for me to sit still"). It is rare for an item to be related to a single construct, and thus cross loadings are expected (Ximenez et al., 2022). As noted earlier in the study, executive functioning is also a construct consisting of cognitive skills that are similar in nature, and due to their relatedness can be interpreted this way by participants (Van der Elst et al., 2012; van Tetering & Jolles, 2017). Unexpectedly, item 3, belonging to planning and initiative also loaded on the attention domain, however, all of the above cross loadings were low cross loadings.

Self-Control and Self-Monitoring (Factor 2) had four items loading on this domain. The AEFI intended to have three items on this domain. The items intended to load on this domain



are items 11, 12 and 13. Item 11 has the highest loading of .825. The item that was cross loading on this factor is item 7, which is intended to load on the attention factor. An important consideration to note is that all items in the self-control and self-monitoring domain were reverse scored. Reverse scoring meant that the items contained negative wording (e.g. “It is difficult for me to sit still” or “I often lose things”). The statistical variance shared with similar items may be accounted for by the negative wording in these items (Kline, 2016).

Planning and Initiative (Factor 3) had five items loading on it: item 2, 3, 4, 9 and 10. These items were intended to load on this factor, and are thus expected. AEFI10 had the highest loading of .631, while the lowest loading was AEFI3 at .227. The factor loadings showed evidence that there was robust statistical justification for the extraction of three factors (Brown & Moore, 2012). These findings correspond with the original AEFI model of 3 factors.

The original study found high correlations between the AEFI scales, particularly the Attention and Self-Control and Self-monitoring scales. The researchers’ noted this as possibly indicating that: the two first order factors are underlined by one a single order factor, or, that the items on the attention and self-control/self-monitoring scales load on a single first-order factors. Despite this, the further analyses showed that this was not the case as the fit of the two alternative models were a worse fit compared to the a priori expected model. These cross-loadings and correlations were found within the current study. The close relations of the three dimensions of executive functioning measured by the AEFI may account for the challenges of the inter-item correlations and factor loadings. In essence, the findings resonate with (Van der Elst et al., 2012) who identified the complexity of executive functions and the relatedness of the constituents o components.

#### **5.4. Objective 4:Confirmatory Factor Analysis**

CFA was conducted in two iterations namely, an initial model and a respecification. In the initial model, Chi square tested significant. This indicates that the data was not an exact fit to the theoretical model ( $\chi^2 = 687.116, p < .01$ ). Chi Square remained significant after model respecification suggesting that the data provided still was not a fit to the theoretical model. Chi-Square is sensitive to normality distributions in large samples and does not necessarily indicate an ineffective model (Brown, 2015; McNeish & Wolf, 2021). Furthermore, Chi-square approximation is dependent on the chi-square distribution. This is challenged when normality is violated, and structural equation modelling (*t*) is often used as an alternative analysis, although large sample sizes impact the sensitivity of Likelihood Ratio Tests such as MLE

(Byrne et al., 2016). It is important to note that within the current study, univariate normality was looked at for the EFA, while multivariate normality was looked at for the CFA. The data was found to be sufficiently normal when calculating both univariate and multivariate normality for the current study, however it is useful to consider the impact of normality on the Chi-Square. Overall, although Chi Square is useful in evaluating model fit, it should not be used as a requirement, but in combination with the evaluation of other indices. Thus, the decision matrix for this study excluded Chi-Square as a prerequisite for model fit. The decision to proceed despite a significant Chi-Square was offset by the more conservative approach to decision-making about model fit.

The initial model in the current study showed mixed results. Three indices of the model (CMIN = 11.083; RMSEA = .088; CFI = .79) did not satisfy the threshold for acceptable fit. The remaining indices did however meet satisfaction (SRMR = 0.76; GFI = 0.92). The GFI value being higher than 0.9 may be due to the large sample size of the data, which increases the GFI in a positive direction. The overall performance of the initial model was not satisfactory. The items within the AEFI and what they measure are theoretically similar, thus they are likely to share variance (Bandalos, 2018). Due to these reasons, the model was respecified using the modification indices as a guide for the covariance terms (Brown, 2015).

The final model was much improved from the initial model. All indices satisfied the threshold requirements as stipulated. Based on this decision matrix, all indices indicated accepted model fit (Byrne, 2016). The results of the current study indicate that the model is a good fit, suggesting that it is a plausible model and the acceptance of the indices support the factor structure of the AEFI in this sample.

The findings of the current study supports the theory of the original study construction of the AEFI and the three clusters they identified (Van der Elst et al., 2012). According to the original study constructing the AEFI, the CFA showed a three-factor model (Attention, Self-Control and Self-Monitoring and Planning). The model adequately fit the data and all items significantly loaded on the a priori expected factors (Van der Elst et al., 2012). These authors reported model fit based on only three indices (RMSEA = .06; CFI = .95; NFI = .95) in the original study. The NFI is the (Non) Normed Fit Index (value between 0 to 1 with closer to 1 indicating better fit) although the present study did not use the NFI as an indices. The present study used five indices (CMIN, RMSEA, CFI, SRMR, GFI), and the findings resonated with literature reporting on scale construction.

## 5.5. Conclusion

The current study aimed to evaluate the construct validity of the AEFI in a South African sample. The sample data sufficiently met the criteria for data reduction techniques and inferential statistics, therefore the analysis could proceed.

The AEFI was found to be a reliable instrument in this sample as evidenced by the internal consistency estimates. The Cronbach alpha ( $\alpha = .74$ ) suggested that the instrument was reliable and stable enough to be used in psychological research.

A three factor structure was supported by both factor analytic techniques. A three factor emerged in the exploratory factor analysis. The three factor structure included Attention, Self-Control/Self-Monitoring, and Planning and Initiative. In other words, the findings supported the original AEFI structure reported by Van der Elst (2012). The Confirmatory Factor Analysis confirmed the three factor structure and found the theoretical model to be a good fit across a robust decision-making strategy involving 5 indices of fit.

The results of the study provided empirical evidence for internal consistency and construct validity as measured by data reduction techniques. The AEFI self-report measure was found to be a valid and reliable self-report measure of executive functioning in an adult population in the South African context. The factor analysis results provided an outcome of step 3 of the study's theoretical framework (De Vellis, 2016). This was done by the findings informing us of the structural validation of the AEFI. In addition, the findings of the CFA provide confirmation that the theoretical model was valid and measures what it intends to measure, further providing validation of the AEFI in a South African context. This shows positive support for the use of this instrument to combat current instrumentation challenges.

## Limitations

- The sample consisted of only university students (mainly female), limiting the findings to a subset of the South African population
- A wide age range was given for participants in the original study, limiting applicability across age groups
- The sample data did not include identification of neurodiversity or suspected challenges, which could have impacted the findings of the study
- The sample was not screened for participants with clinical conditions that affect executive functioning

- The validation process did not account for tools of executive functioning being commonly used in clinical settings

### **Recommendations for future study**

- Further studies should aim to validate the use of the AEFI in diverse adult populations with wider age ranges and across different groups.
- Further studies should evaluate the use of the AEFI on a sample of varying education levels.
- Future studies looking at executive functioning with similar theoretical definitions should consider the use of the AEFI as a feasible measure of EF

### **Significance of the study**

The current study adds significant and positive support for the use of self-report measures of executive functioning in research on EF in South Africa, a developing country. At a theoretical level, the study was located within a two-pronged conceptual framework which strengthened the research. This contributes to the use of theory to frame the conceptualisation of the study.

At a methodological level the study made assumption testing explicit and demonstrated good practice for establishing baseline confidence that the data supports the analyses. Further, it provided a clear and coherent design and methodology for secondary research. This is very useful as it provides evidence of the application of research methodology to secondary research. Furthermore, the ethics requirements were managed comprehensively. A data sharing agreement was drawn up between two policies, allowing for collaboration. This can be used as a template for subsequent studies.

At the level of practice, the findings of the study increases the confidence that the AEFI can be adopted as a valid and reliable instrument for use in the local context. As noted previously in the study, the complexity of executive functioning and its' constituents make instrumentation challenging. Understanding executive functioning and being able to measure it is extremely useful for treatment as well as for general insight into individual's everyday functioning. A posing challenge for researchers and practitioners is that majority of executive functioning measures are performance-based measures rather than self-report. In a developing context, performance based measures have many instrumentation limitations such as being costly or inaccessible, adding to the difficulties faced by practitioners. Self-report measures are

recommended in contexts where time efficiency is needed, as well as ease of understanding and accessibility.

The current study's findings will enhance the ability to conceptualize and execute research in a more cost-effective manner. This expands the limited options that are available and provides optimistic options to combat the current challenges of instrumentation in South Africa. This will further allow for the enhancement of screening for EF as an additional variable in South African health care and clinical settings where services are vast. This aligns with the National Development Plan 2030, outlined by the National Planning Commission of South Africa as well as the Sustainable Development Goals 2030 which both speak to professionals enhancing research and intervention and providing accessible health care services.

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## Appendix A: 2020 study Participant Information Sheet & Informed consent

[formal Departmental letterhead]

Date: 07/07/20

Hello,

My name is Lauren Coppin and I am a student currently completing my Masters in Social and Psychological Research at the University of the Witwatersrand. As part of the requirements for my degree, I am conducting research. My research aims to explore the relationship between dispositional mindfulness (awareness of our emotions thoughts in our present experience), executive functioning (mental thought processes that regulate our behaviour), and everyday creative behaviour. I will be using data obtained from volunteers from the South African population aged between 18 and 50 who have access to a computer/device and the Internet in order to answer the research questions.

If you meet these criteria, I would like to ask you to please consider participating in my study. Participating will require you to access and complete a set of online questionnaires at a convenient time for you. These questionnaires should take approximately 20-30 minutes to complete and you are asked to do this within the next two to three weeks. Once you have answered the questionnaires, you can submit the completed answers online.

Participation is completely voluntary and you will not be advantaged or disadvantaged in any way, whether you choose to complete the questionnaire or not. There are also no direct benefits or foreseeable risks for participating in the study. You will be asked for informed consent to participate in the study and submission of the completed questionnaire will be regarded as consent to participate in the study. No identifying information, such as your name or identity number, will be asked for and you will therefore be completely anonymous. Your responses will remain confidential and your anonymity is guaranteed as no identifying information or IP addresses will be recorded.

You will be able to obtain feedback for the study in the form of a summary of the general results; individual feedback will not be possible as the data is anonymous. With your permission, we would also like to store your responses permanently in anonymous, electronic form to possibly use for future research projects.

This research will help to better understand whether dispositional mindfulness and executive functioning are related to everyday creative behaviour which will contribute to theory and may inform practice. If you have any questions or concerns, please feel free to contact me or my supervisor as per the details below. Ethical queries can also be directed to: The University of the Witwatersrand Human Research Ethics Committee (non-medical): 011-717-1408; [Shaun.Schoeman@wits.ac.za](mailto:Shaun.Schoeman@wits.ac.za).

Yours

sincerely

Lauren Coppin ([laurenbiancacoppin@live.co.za](mailto:laurenbiancacoppin@live.co.za))

Supervisor: Dr N.I (insert email)

I have read the details of this study and consent to participate in the study on a voluntary basis. I also understand that I may withdraw at any point up to submission.

YES	NO
-----	----

## Appendix B: 2020 Ethics Clearance Certificate



**SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT ETHICS COMMITTEE**  
**CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)**

**CLEARANCE CERTIFICATE:**

**PROTOCOL NUMBER: MASPR/20/03**

**PROJECT TITLE:**

Dispositional mindfulness, executive functioning, and everyday creative behaviour

**INVESTIGATOR**

Coppin Lauren (1432157)

**SCHOOL/DEPARTMENT OF INVESTIGATOR**

SHCD/Psychology

**DATE CONSIDERED**

12 June 2020

**DECISION OF THE COMMITTEE**

Approved unconditionally

**RISK LEVEL**

Minimal Risk

**EXPIRY DATE**

31 December 2022

**ISSUE DATE OF CERTIFICATE**

21 June 2020

**CHAIRPERSON**

  
(Dr Sahba Besharati)

cc: Dr Nicky Israel (Supervisor)

**DECLARATION OF INVESTIGATOR**

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

  
Signature

Date

25 / 06 / 2020

**PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES**

## Appendix C: The Amsterdam Executive Functioning Inventory

### The Amsterdam Executive Function Inventory (AEFI)

Please indicate whether each of the following statements is true, partly true, or not true.

		<b>Not true (1)</b>	<b>Partly true (2)</b>	<b>True (3)</b>
1	I am not able to focus on the same topic for a long period of time			
2	I can make fast decisions (e.g. in lessons or at work)			
3	I am well-organised. For example, I am good at planning what I need to do during a day			
4	I am curious, I want to know how things work			
5	I am easily distracted			
6	I often react too fast. I've done or said something before it is my turn			
7	My thoughts easily wander			
8	It is difficult for me to sit still			
9	It is easy for me to come up with a different solution if I get stuck when solving a problem			
10	I am full of new ideas			
11	It takes a lot of effort for me to remember things			
12	I often forget what I have done yesterday			
13	I often lose things			

## Appendix D: Current study Ethical Clearance

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UNIVERSITY of the  
WESTERN CAPE



17 August 2022

Ms L Coppin  
Psychology  
Faculty of Community and Health Sciences

**Ethics Reference Number:** BM22/6/19

**Project Title:** An examination of the Amsterdam Executive Function Inventory (AEFI) In South Africa: A factor analytic study.

**Approval Period:** 29 July 2022 – 29 July 2025

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above-mentioned research project and the requested amendment to the project.

Any further amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

**Please remember to submit a progress report annually by 30 November for the duration of the project.**

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via:

<https://sites.google.com/uwc.ac.za/permissionresearch/home>

*The permission letter must then be submitted to BMREC for record keeping purposes.*

The Committee must be informed of any serious adverse event and/or termination of the study.

A handwritten signature in black ink, appearing to read 'Josias'.

*Ms Patricia Josias  
Research Ethics Committee Officer  
University of the Western Cape*

NHREC Registration Number: BMREC-130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

## **Appendix E: Permission letter to the University of the Witwatersrand**

Dr N. Israel  
Department of Psychology  
University of the Witwatersrand  
29 May 2022

### **Request to use data for secondary analysis: Ms. Lauren Coppin**

Ms. Lauren Coppin was registered for the Master of Arts in Social and Psychological Research in 2020. She completed her research under your supervision successfully in 2021. She was subsequently accepted into the Master's programme in Clinical Psychology at UWC and registered for said degree in 2022. She is required to complete coursework and research. The research component is conducted under the supervision of Ms Emma Wagener and I. The mini-thesis requirement contributes 50% of the credits towards the degree and she is expected to demonstrate that she is able to plan, execute and write a small study.

Ms. Coppin would like to continue the work started under your supervision at WITS and identified a feasible study of appropriate scope for the degree requirements using secondary research and post hoc analysis. She is proposing to conduct an investigation into the factor structure of the Amsterdam Executive Function Inventory (AEFI). For this purpose she requires access to a data set generated by the identified instrument. In this instance, the AEFI was one of the instruments she used in her study at WITS. The proposed post hoc analysis is a logical outflow from the initial study and will make a meaningful contribution to our understanding of the psychometric properties and factor structure of this self-report measure in the South African context.

To this end, we request permission to use the data collected as part of her first masters at WITS and to write up the post hoc analysis in partial fulfilment of the degree requirements at UWC.



The governance structures at UWC around Ethics and Higher degrees would require the following parameters to be in place (or acceptable equivalents) before the proposed study can be accepted in partial fulfilment of the degree requirements.

1. The Ethics clearance and permission for this study will only be granted once there is a formal permission from WITS to use the data with any stipulations as the data set is the intellectual property of the University of the Witwatersrand.
2. In keeping with the Protection of Private Information Act (POPIA), the data management plan must clearly state that only deidentified data will be obtained and that the data set will not be published in any form by the student or supervisors
3. The University of the Witwatersrand must designate a representative who can monitor use of the data and act as a consultant around any data management or subsequent dissemination. This is to ensure that there is no risk of third-party reputational harm and compliance with the data sharing agreement.
4. The student will be required to submit annual progress reports to the Senate Higher degrees and relevant ethics committees for as long as the student is registered.
5. The University of the Witwatersrand must confirm that the original data set included an advance directive that covers the proposed type of post hoc analysis or indicate whether additional follow-up is required for extended consent.

We attach a copy of the abstract and provide the information required by Wits.

We hope that this application will be met with your favourable approval.

Sincerely

A handwritten signature in black ink, appearing to read 'M. Smith', written in a cursive style. Below the signature is a horizontal line.

Prof. Mario R. Smith

Supervisor

[mrsmith@uwc.ac.za](mailto:mrsmith@uwc.ac.za)

Information required by the University of Witwatersrand

a) **Student name:** Ms. Lauren Coppin

b) **Supervisor:** Professor Mario Smith  
**Co-supervisor:** Ms Emma Wagner

c) **Title of new project:** An examination of the Amsterdam Executive Function Inventory (AEFI) in South Africa: A factor analytic study.

e) **Time Frame for data availability:** April 2022 to December 2022

f) **Master's degree:** Master's in Clinical Psychology (MPsych) at University of the Western Cape

g) **Postal addresses:**

Lauren Coppin:

Professor Mario Smith:

Ms Emma Wagner:

h) **Email addresses:**

Lauren Coppin: [laurenbiancacoppin@live.co.za](mailto:laurenbiancacoppin@live.co.za)

Professor Mario Smith: [mrsmith@uwc.ac.za](mailto:mrsmith@uwc.ac.za)

Emma Wagner: [ewagener@uwc.ac.za](mailto:ewagener@uwc.ac.za)

**i) Physical address of UWC research office/entity:**

Prof J. Phillips, Acting Director  
Research Development Office  
The Research Hub  
University of the Western Cape  
Bellville, 7535  
+27+21+9592949/8  
Email: [jphillips@uwc.ac.za](mailto:jphillips@uwc.ac.za)

## **Appendix F: Data sharing agreement**



UNIVERSITY OF THE  
WITWATERSRAND,  
JOHANNESBURG

### **DATA SHARING AGREEMENT**

**between**

**THE UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG**

**and**

**UNIVERSITY OF THE WESTERN CAPE**

EFD  
Wits / UWC DTA DRAFT 1  
10/04/2022

**TABLE OF CONTENTS**

1. PARTIES.....3  
2. DEFINITIONS.....3  
3. GRANT AND TRANSFER .....5  
4. PROVIDER DATA.....5  
5. RECIPIENT'S USE OF DATA.....6  
6. RESULTS .....6  
7. CONFIDENTIAL INFORMATION .....6  
8. PUBLICATION.....6  
9. PUBLICITY .....7  
10. DATA PROTECTION .....7  
11. GENERAL PROVISIONS .....9  
12. MISCELLANEOUS MATTERS .....10

ANNEXURE 1 : Research Programme

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## DATA SHARING AGREEMENT

### 1. PARTIES

This Agreement between:

- 1.1. The University of the Western Cape, (“the Recipient”) acting through Lauren Coppin in collaboration with Mario Smith and Emma Wagener (supervisors), having principal place of business at Robert Sobukwe Road, Bellville, 7535,
- 1.2. University of the Witwatersrand, Johannesburg acting through its Faculty of Humanities, School of Human and Community Development (“the Data Provider”), having a principal place of business at 1 Jan Smuts Avenue, Braamfontein, Johannesburg,

is effective on the 01st day of June 2022 (“Effective Date”).

- 1.3. The Data Provider plans to provide anonymized and de-identified data to the best of our ability to Lauren Coppin (“the Principal Investigator”) for a research project titled, “*An Examination of the Amsterdam Executive Function Inventory (AEFI) in South Africa: A Factor Analytic Study*” as forth set out in Annexure 1 (“Research Program”) attached hereto. The Collaborators are Mario Smith and Emma Wagener (thesis supervisors) from the Department of Psychology, at the Recipient. The Parties hereby agree as follows:

### 2. DEFINITIONS

Unless the context clearly indicates otherwise, the following terms will bear the following meanings:

- 2.1. “Agreement” this agreement together with all annexures and schedules hereto
- 2.2. “Confidential Information” means information that (a) relates to a Party’s past, present or future research, development, business activities, products, services and technical

- knowledge, relating to the Research Program, and  
(b) has been identified in writing as confidential or  
(c) in the case of oral disclosure, is confirmed in  
writing as being confidential within 7 days of such  
disclosure
- 2.3. "Data" means the data and information to be transferred to the Recipient
- 2.4. "Party" shall have the meaning set forth in the introductory paragraph
- 2.5. "Personal Data" includes any subset of health or personal information, including demographic information that identifies an individual, directly or indirectly (or there is a reasonable basis to believe that the information can be used to identify an individual)
- 2.6. "Publication" means any abstracts, reports, external communication, websites, presentations or other peer-reviewed scientific publications that contain information, data or Results that are created using directly or indirectly related to the Data in the performance of the Research Program
- 2.7. "Research Program" means "*An Examination of the Amsterdam Executive Function Inventory (AEFI) in South Africa: A Factor Analytic Study*" and which is further set forth in the recitals.
- 2.8. "Result" "Result" means the information, data, results, intellectual property generated in or arising out of the use of the Data in the performance of the Research Program
- 2.9. "University" the University of the Witwatersrand, Johannesburg, a public higher education institution recognised as

such in terms of the Higher Education Act 101 of 1997

### 3. GRANT AND TRANSFER

- 3.1. **Grant.** Subject to the terms and conditions of this Agreement, the Data Provider grants the Recipient the non-exclusive right to use the Data solely in the Research Program.
- 3.2. **Transfer Term.** The Data Provider will make the Data available to the Recipient during the term of this Agreement, a period from: 01 June 2022 to 31 December 2023 ("Term"). The Term may be extended only by advance written agreement of both parties.
- 3.3. **No Other Rights.** This Agreement does not constitute, grant, nor confer any license under any patents or other proprietary interests of one Party to the other, except as explicitly stated in this Agreement.
- 3.4. **No Cost of Transfer.** Each Party pays all the costs it incurs in the performance of this Agreement. Any given expense or cost can only be committed in writing by the Party responsible for the cost in question. In no case can one Party commit an expense on behalf of another Party without prior written consent.
- 3.5. **Compliance with Applicable Laws.** Each Party shall comply with all applicable national, regional, and local laws and governmental rules, regulations and guidelines, and the University's policies which are applicable to the Data or the use thereof, including without limitation laws, regulations and rules related to the privacy of personal information. As the Party providing the information, that the receiving Party shall agree to be covered by the applicable University policies in order that the University shall discharge its ethical and legal responsibilities.

### 4. PROVIDER DATA

- 4.1. **Ownership.** The Data Provider retains ownership of Data. Data Provider retains all rights to distribute the Data to other commercial or non-commercial entities.
- 4.2. **Authority.** The Data Provider warrants it has the authority to provide Data to the Recipient for use in the Research Program.

EFD  
Wits / UWC DTA DRAFT 1  
10/04/2022



- 4.3. The Data Provider shall endeavour to ensure that the Data is anonymised and that no Personal Data is included.

**5. RECIPIENT'S USE OF DATA**

- 5.1. **Restrictions.** The Recipient will use Data only for the Research Program. If the Recipient seeks to use Data for other purposes In that case, the Recipient will obtain written consent from the Data Provider, either by an amendment to this Agreement or a new agreement, before such use.
- 5.2. **No Further Transfer.** The Recipient will not transfer Data to any third party, except as provided in the Research Program, without prior written consent from the Data Provider.

**6. RESULTS**

- 6.1. The Recipient shall own the Results.
- 6.2. **Reporting.** In consideration of the Data Provider having provided Data, the Recipient will report the Results of the Research Program to the Data Provider, who may use such Results for own research and teaching purposes subject to approval by the Recipient for such use, which approval shall not be unreasonably withheld.

**7. CONFIDENTIAL INFORMATION**

Neither Party shall share any of its Confidential Information with the other Party.

**8. PUBLICATION**

- 8.1. The Recipient will be free to publish and otherwise publicly disclose the Results provided that the Recipient shall provide to the Data Provider a confidential copy of any such proposed publication or disclosure at least thirty (30) days prior to publication. Within that thirty (30) day review period, the Data Provider may require the Recipient to delete any Data from the proposed publication, and, if the proposed publication contains patentable subject matter directly relating to the Data, then at the Data Provider's written request within said thirty (30) day

period, the Principal Investigator will delay publication for up to an additional thirty (30) days to allow for filing of patent application(s). Notwithstanding anything to the contrary herein, the Data Provider agrees to allow the Recipient to publish and disclose sufficient information regarding the Data to enable the complete and accurate publication of the Results.

- 8.2. That the publication and amended data set shall be deposited into a University approved repository, which will respect the restrictions of access agreed in the Research Programme and this Agreement. This version is an archival version, providing proof of the publication and the ability to justify or replicate the research results.

**9. PUBLICITY**

- 9.1. Neither Party will use the name or trademark of the other Party or the names of the other Party's employees, students or agents in any publicity, advertising or announcement related to this Agreement without the prior written consent of the other Party's authorised officials.

**10. DATA PROTECTION**

- 10.1. In performing their obligations under this Agreement, the Parties shall:
- 10.1.1. comply with the provisions of the Data Protection Legislation insofar as it is applicable to this Agreement;
  - 10.1.2. not process Personal Information for any purpose other than to perform its obligations under this Agreement and ensure that such processing will not place the Data Provider or the Recipient as agents of their respective universities in breach of any Data Protection Legislation;
  - 10.1.3. only act on the instructions of the Data Provider in collecting, processing and utilising the Personal Information and for avoidance of doubt, this Agreement will constitute such instructions;
  - 10.1.4. not disclose or otherwise make available the Personal Information to any third party other than authorised Personnel or sub-contractors who require access to such Personal Information strictly in order for the

Recipient and its Collaborators (Supervisors) to carry out its obligations pursuant to this Agreement, and ensure that such Personnel and any other persons that have access to the Personal Information are bound by appropriate and legally binding confidentiality and non-use obligations in relation to the Personal Information.

- 10.2. The Recipient shall be responsible for establishing and maintaining an information security program that is designed to:
  - 10.2.1. ensure the security and confidentiality of the University information, including any back-ups, where applicable, by the use of encryption for such information at transit and rest;
  - 10.2.2. protect against any anticipated threats or hazards;
  - 10.2.3. protect against unauthorised access to, disclosure or use of any University information;
  - 10.2.4. ensure the proper separation of information belonging to the University from any third party information;
  - 10.2.5. where appropriate, ensure the proper disposal of information belonging to the University where appropriate;
  - 10.2.6. preserve the integrity of any information belonging to the University and prevent the corruption, destruction or loss of such information at all times; and
  - 10.2.7. ensure that all sub-contractors of the Recipient if any, comply with the provisions of this clause 10.
- 10.3. The Recipient will report orally and in writing any actual and/or suspected breaches such as security incidents, unauthorised access or disclosure of Confidential and/or Personal of the University immediately upon discovery of the unauthorised disclosure to the University Representative, but in no event more than 2 (two) days after the Recipient reasonably believes there has been such unauthorised use or disclosure.

- 10.4. Where the Recipient, its Principle investigator and Collaborators (including the Recipient's Personnel) are given access (whether direct or remote) to any University Information Technology Systems under or in connection with the Agreement, the Recipient will ensure that the Recipient's Personnel:
  - 10.4.1. comply with any policies, requirements or other instructions of or, where applicable, the University's third party suppliers regarding use of such University Information Technology Systems;
  - 10.4.2. only use the University Information Technology Systems in connection with the proper delivery of the Deliverables and/or Services;
  - 10.4.3. not permit any other individual or entity to access the University Information Technology Systems;
  - 10.4.4. upon the University's request, immediately cease access to and use of any University Information Technology Systems and return all University Information Technology Systems (and associated documentation) to the University; and
  - 10.4.5. not deactivate or disable any Information Technology Systems used by the University or introduce any viruses or other similar code to the same, or otherwise take action that would cause any damage or harm to any Information Technology Systems of the University.

## 11. GENERAL PROVISIONS

- 11.1. **No Warranties.** Except as otherwise provided in this Agreement, Data are provided by the Data Provider AS IS, WITHOUT ANY WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.
- 11.2. **Liability.** In no event shall the Data Provider be liable for any use by the Recipient of Data or Results or for any loss, claim, damage, or liability, of any kind or nature, that may arise from or in connection with this Agreement or the Recipient's use, handling, or storage of Data. The Recipient agrees to indemnify and hold harmless the Data Provider, its trustees, officers, employees, students, volunteers and agents from all liability, loss, or damage they may suffer as a result of claims,

demands, costs or judgments against the Data Provider arising out of the use, handling or storage of Data by the Recipient. The Recipient will ensure that there is no attempt to identify subjects or merge the Data in such a way that subjects Identities become apparent.

- 11.3. **Termination.** Either Party may terminate this Agreement at any time upon thirty (30) calendar days prior written notice, in which case the Recipient will discontinue within thirty (30) calendar days use of the Data and related information. The Recipient agrees, upon the Data Provider's direction, to return or destroy Data. Sections 3.1, 4.1, 4.2, 4, 7, 9.1, 9.2 will survive the termination or expiration of this Agreement.

## 12. MISCELLANEOUS MATTERS

### 12.1. Address for correspondence

12.1.1. Any correspondence (other than a notice contemplated in (12.2) in connection with this Agreement may be addressed:

12.1.1.1. in the case of the Data Provider, to:

Physical Address

Research Development Office  
10<sup>th</sup> Floor, Solomon Mahlangu House  
1 Jan Smuts Avenue  
Braamfontein  
Johannesburg  
Republic of South Africa

Postal Address

10<sup>th</sup> Floor, Solomon Mahlangu House  
Private Bag 3  
Wits 2050  
Republic of South Africa

Electronic mail address: robin.drennan@wits.ac.za and a copy to Nicky.Israel@wits.ac.za

marked for the attention of the Director: Research Development

12.1.1.2. in the case of the Recipient to:

Physical Address

Prof Mario R. Smith  
Department of Psychology,  
Social Sciences Building  
UWC  
Robert Sobukwe Avenue,  
Bellville  
7535

Postal Address

The University of the Western Cape  
Private Bag X 17  
Bellville  
7535

Electronic mail address: mrsmith@uwc.ac.za marked for the attention of Prof Mario Smith

12.1.2. The notice will be deemed to have been duly given:

- 12.1.2.1. seven (7) calendar days after posting, if posted by registered post to the Party's address in terms of this sub-clause;
- 12.1.2.2. on delivery, if delivered to the Party's physical address set out in 12.1.1;
- 12.1.2.3. on despatch, if sent to the Party's then electronic mail address set out in 12.1.1 and confirmed by registered letter posted no later than the next business day;

unless the addressor is aware, at the time the notice would otherwise be deemed to have been given, that the notice is unlikely to have been received by the addressee through no act or omission of the addressee.

12.1.3. A Party may change its address for this purpose to another address in the Republic of South Africa, by notice to the other Party.

12.1.4. Notwithstanding anything to the contrary herein contained a written notice or communication actually received by a Party will be an adequate written notice or communication to it notwithstanding that it was not sent to or delivered at its chosen address in terms of 12.1.1.

12.1.5. All notices and correspondence in connection with this Agreement will be in the English language.

**12.2. Address for Service of Legal Documents**

12.2.1. The Parties choose the following physical addresses at which documents in legal proceedings in connection with this Agreement may be served (i.e. their *domicilia citandi et executandi*):

12.2.1.1. The Data Provider

Office of the Director: Legal Services  
5<sup>th</sup> Floor, Solomon Mahlangu House  
1 Jan Smuts Avenue  
Braamfontein  
Johannesburg

12.2.1.2. The Recipient:

Mr S. Rajie  
Director  
Division Legal Services  
2nd Floor, East Wing, Administrative Building  
University of the Western Cape  
Robert Sobukwe Road  
Bellville, 7535

12.2.2. A Party may change its address for this purpose to another physical address in the Republic of South Africa at which legal process can be served by notice to the other Party.

**12.3. Entire Agreement**

This Agreement contains all the express provisions agreed on by the Parties with regard to the subject matter of the Agreement, and the Parties waive the right to rely on any alleged express provision not contained in the Agreement.

**12.4. No Representations**

No Party may rely on any representation which allegedly induced that Party to enter into this Agreement, unless the representation is recorded in this Agreement.

**12.5. Variation, Cancellation and Waiver**

No addition to or variation of any clause of this Agreement (including this clause 12.5), consensual cancellation or novation of this Agreement and no waiver of any right arising from this Agreement or its breach or termination will be of any force or effect unless reduced to writing and signed by both Parties or their duly authorised representatives.

**12.6. Indulgences**

If either Party at any time breaches any of its obligations under this Agreement, the other Party ("the Aggrieved Party"):

12.6.1. may at any time after that breach exercise any right that became exercisable directly or indirectly as a result of the breach, unless the Aggrieved Party has expressly elected in writing or by clear and unambiguous conduct, amounting to more than mere delay, not to exercise the right. In particular, acceptance of late performance will be provisional only, and the Aggrieved Party may still exercise that right during that period;

12.6.2. will not be estopped (i.e. precluded) from exercising its rights arising out of that breach, despite the fact that it may have elected or agreed on one



or more previous occasions not to exercise the rights arising out of any similar breach or breaches.

**12.7. Applicable Law**

This Agreement will be interpreted and implemented in accordance with the law of the Republic of South Africa.

**12.8. Jurisdiction**

The Parties consent to the jurisdiction of the South Gauteng High Court, Johannesburg.

**12.9. Successors in title**

Without prejudice to any other provision of this Agreement, any successor-in-title, including any executor, heir, liquidator, judicial manager, curator or trustee, of a Party will be bound by this Agreement.

**12.10. Severability**

If any provision of this Agreement is invalid, unenforceable or illegal, the remaining provisions of this Agreement will be deemed to be severable therefrom and will continue in full force and effect unless such invalidity, unenforceability or illegality goes to the root of this Agreement.

**12.11. Counterparts**

This Agreement may be executed in any number of counterparts and by the Parties hereto on separate counterparts, each of which, when executed and delivered, will be an original, and each of the counterparts will together constitute one and the same instrument.

**12.12. Costs**

Each Party will bear its own costs relating to the negotiation, preparation and signature of this Agreement.

**12.13. Integration**

This Agreement, including attached Exhibits, supersedes all prior oral and written proposals and communications, if any, and sets forth the entire Agreement of the parties with respect to the subject matter hereof, and may not be altered or amended except in writing and signed by an authorised representative of each Party.

**12.14. Electronic Copy**

The Parties to this document agree that a copy of the original signature (including an electronic copy) may be used for any and all purposes for which the original signature may have been used. The parties further waive any right to challenge the admissibility or authenticity of this document in a court of law based solely on the absence of an original signature.

The duly authorised party representatives execute this Agreement.

RECIPIENT

DATA PROVIDER



Signature:

Signature:

Name:  
Jose  
Frantz

Name: Lynn Morris

Title: Prof  
DVC:  
Research  
and  
Innovation  
Date:  
8 /7/2022

Title: DVC Research  
Date: Jul 17, 2022

I acknowledge that I have read this Agreement in its entirety and will use reasonable efforts to uphold my obligations and responsibilities under this Agreement.

PRINCIPAL INVESTIGATOR

EFD  
Wits / UWC DTA DRAFT 1  
10/04/2022



Signature:  
Name: Lauren Coppin  
Title: Ms  
Date: 30 June 2022

COLLABORATOR



Signature:  
Name: Mario Smith  
Title: Prof  
Date: 30 June 2022

COLLABORATOR



Signature:  
Name: Emma Wagener  
Title: Ms  
Date: 30 June 2022

## ANNEXURE 1 – Research Program

A significant contribution in the field of neuropsychology was the origination of higher-order cognitive functions to the frontal lobe region of the brain. These cognitive mechanisms, known as executive functions, are important for an individual's everyday functioning and skill set. Thus, over the years, executive functioning has been a prominent construct within literature, among researchers, test developers and practitioners. There is a lack of consensus on the definition of executive functioning that resulted in various theoretical and operational definitions, as well as challenges in establishing comparable estimates of psychometric properties. Executive functioning is typically measured by performance-based measures which requires professionals to administer and is costly. There is emerging support for the use of self-report measures. In developing countries such as South Africa, research on executive functioning will receive a substantial injection if self-reports were found to be reliable and valid alternatives to costly and inaccessible performance-based measures. The Amsterdam Executive Function Inventory (AEFI), a measure of executive functioning, has been used recently in South Africa with reported reliability and internal stability as evidenced by acceptable Chronbach's alphas. However, a more systematic exploration of the psychometric properties of the AEFI such as factor structure and validity, remains a focus of further research. The proposed study will attempt to address this gap, by evaluating the factor structure of the AEFI in the South African context. The proposed study will use secondary research to assess the factor structure of the AEFI. The proposed study will use a data set from a large-scale survey conducted in 2020 with a sample of 1608 South African adult participants between the ages of 18 and 50 years old. The study was conducted in fulfilment of a Master's degree at the University of the Witwatersrand. The data will only consist of the AEFI scores and data analysis will follow three lines. First, the data set will be tested to confirm that the assumptions for inferential statistics and data reduction techniques are met. Second, Exploratory Factor Analysis will be used to determine the factor structure that emerges. Third, Confirmatory Factor Analysis will be conducted to test the theoretical factor structure underpinning the instrument and the overall model fit. A decision matrix will be distilled from literature to guide the decisions about model fit. Permission to carry out this research study will be obtained from the Bio-Medical Research Ethics committee at the University of the Western Cape. Permission to use this data for secondary analysis and to write it up in partial fulfilment of the requirements

of the MPsych degree will be requested Wits. The subsequent analysis and write will comply with POPIA and any additional conditions stipulated by WITS.

Timeframe:

Activity		Person responsible	
		WITS	UWC
Signed Agreement	June 2022	NI Legal services	LC, MS Legal Services
Research Proposal submitted to Higher Degrees	May 2022		LC MS EW
Application for Ethics clearance	July 2022		LC MS EW
Data received from Provider	July 2022	NI	
Checking data set for completeness and accuracy			LC MS EW
Testing the data set for adequacy	August 2022		LC EW
Data analysis	September 2022		LC EW
Draft chapters	August - December 2022		LC
Intention to submit	December 2022		MS EW
Appointment of examiners			
Full draft	January 2023		LC
Editing	February 2023		Designated Editor
Submission for examination	March 2023		MS EW
Processing of results	May 2023		
Completion	June 2023		MS

# Data Sharing Agreement: University of the Witwatersrand, Johannesburg / University of the Western Cape (Nicky Israel)

Final Audit Report

2022-07-17

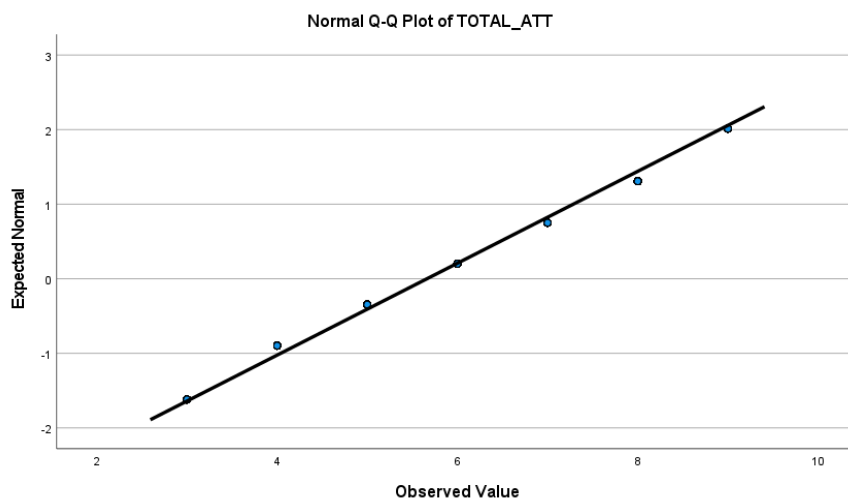
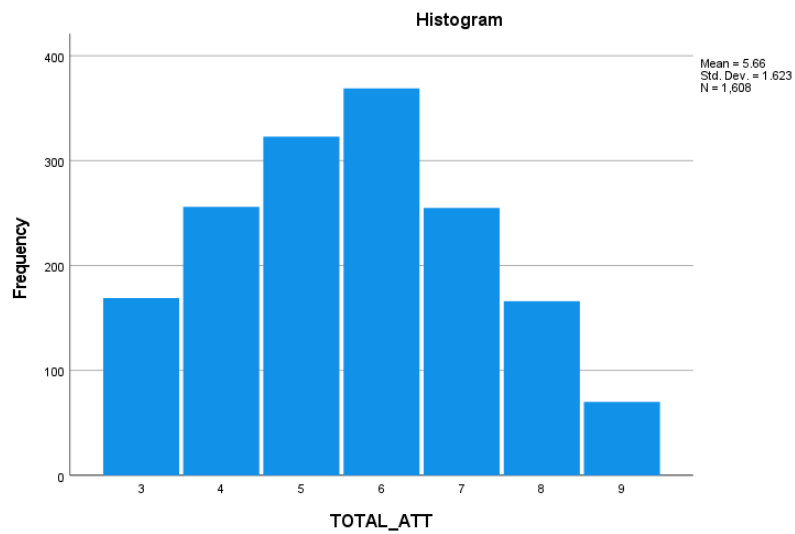
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## "Data Sharing Agreement: University of the Witwatersrand, Johannesburg / University of the Western Cape (Nicky Israel)" History

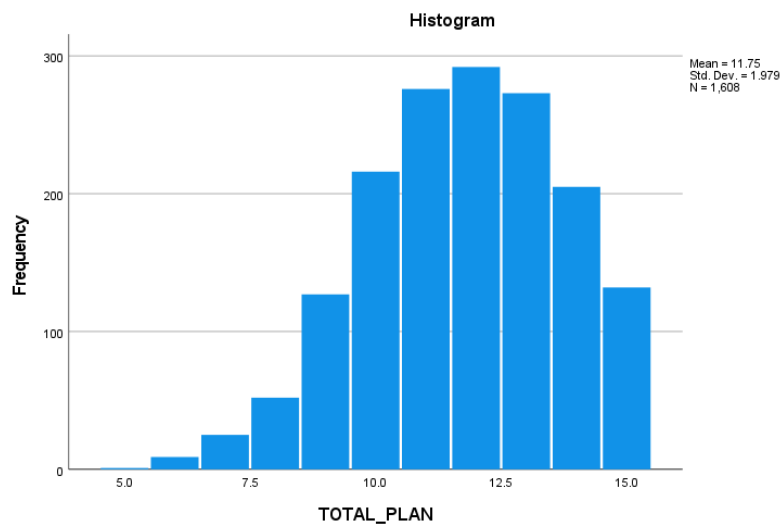
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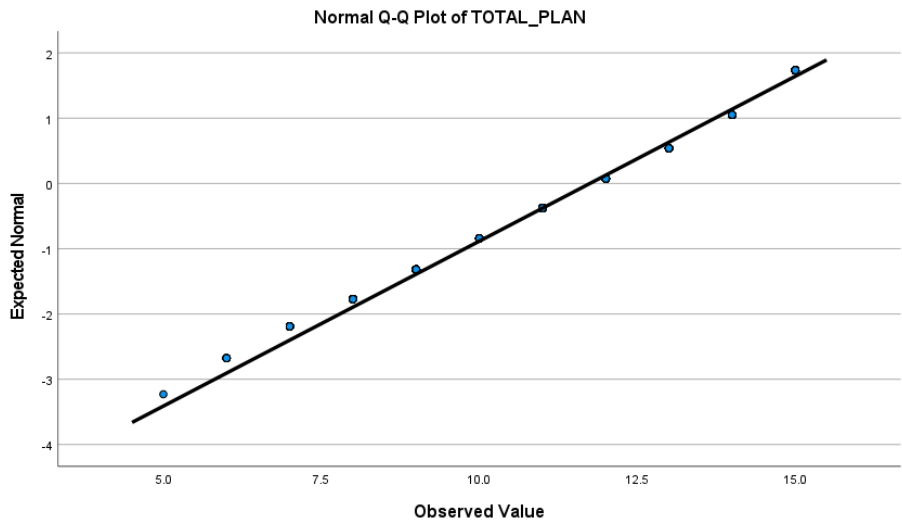
## Appendix G: Histogram and Q-Q plots of sample data

### TOTAL\_ATT

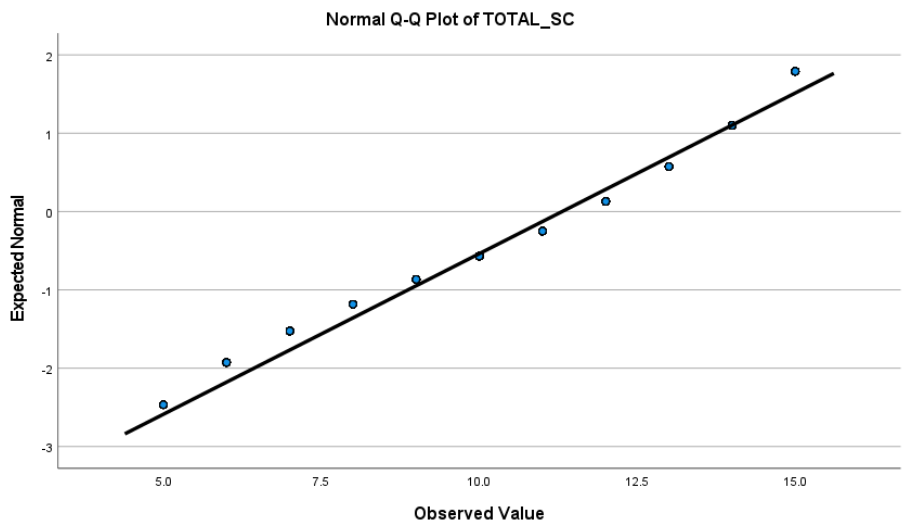
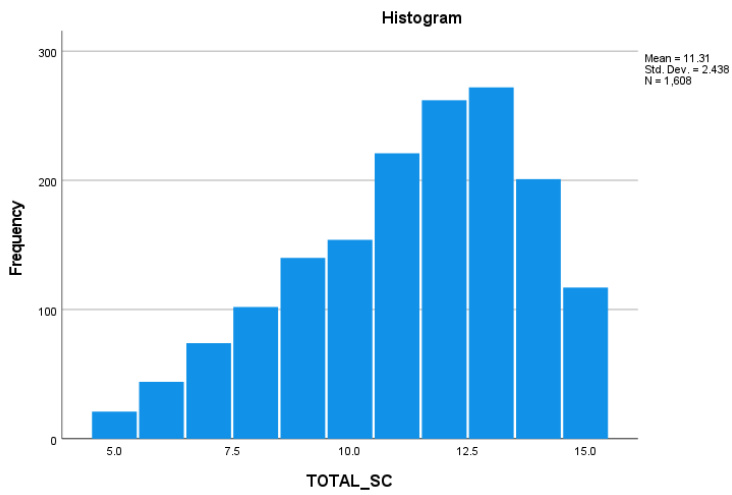


### TOTAL\_PLAN





**TOTAL\_SC**



**AEFI\_TOTAL**



