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THE CHANGE IN EXECUTIVE FUNCTIONING OF GRADE FOUR LEARNERS ATTENDING AN OCCUPATIONAL THERAPY INTERVENTION AT A LEARNERS-WITH-SPECIAL-EDUCATION-NEEDS SCHOOL

Jean-Marie Cilliers

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Occupational Therapy.

Johannesburg,

September 2025

Declaration

I, Jean-Marie Cilliers declare that this research report is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



(Signature of candidate)

On this 9th (day) of September 2025 in Stellenbosch, Western Cape.

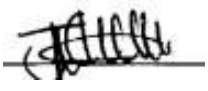
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Dedication

In loving memory of

Luna Cilliers

21 December 2019 – 9 March 2025

My favourite hello and hardest goodbye

and

Martie De Bod

31 January 1951 – 28 March 2023

Abstract

Introduction:

Executive functioning refers to the higher-level cognitive abilities required to plan, organise and direct thoughts and behaviour to achieve chosen goals. As executive functioning underpins the individual's participation in meaningful occupations including education, it is an important treatment focus in paediatric occupational therapy. This is particularly true for children with Attention Deficit and Hyperactivity Disorder (ADHD), learning disorders, Autism Spectrum Disorder (ASD) and more. Various studies have considered the effectiveness of different intervention types to improve executive functioning, but there is still insufficient research in the occupational therapy field.

Methods:

A retrospective quasi-experimental research design was used to evaluate an occupational therapy intervention programme by determining the change in executive functioning in sixteen Grade 4 learners. The learners were attending a Learners with Special Educational Needs (LSEN) school in Gauteng, South Africa and had various diagnoses such as Cerebral Palsy, Specific Learning Disabilities, Autism Spectrum Disorder and physical disabilities. The Mediated Learning Experience approach was used as the basis for developing the intervention programme. Grade 4 learners attended the intervention group once weekly. The Delis Rating Scale of Executive Functioning (D-REF) assessment was used to determine the change in executive functioning of each Grade 4 learner, as well as for different diagnostic groups. The learners' academic results were used to determine the association between the change in executive functioning and change in academic outcomes.

Results:

There were no significant changes in executive functioning scores or academic performance scores from Term 1 to 4. The intervention seems to have addressed severe executive functioning impairments more effectively than only slight executive functioning impairments, with better outcomes in the clinical indices of activity level and impulse control and abstract thought and problem solving. Only slight individual improvement in attention and working memory was indicated. There was no significant change in academic marks of the learners. Learners with an ADHD diagnosis in

conjunction with ASD diagnosis, seemed to have benefitted the most from the intervention.

Conclusion:

While some improvement was found in individual clinical indices for Grade 4 learners who attended the weekly interventions, scores varied. An individualised approach to addressing executive functioning deficits may be indicated.

Acknowledgments

First and foremost, I would like to thank my parents for walking every step of the way with me. Your support and motivation to keep going despite the challenges made all the difference.

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To my supervisors Dr. Denise Franzsen and Dr. Tania Rauch van der Merwe, thank you for your time, dedication and support throughout this process.

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Definition of Terms

Executive functioning: The World Health Organization (2007) regards executive functioning as the higher cognitive functions vital to goal-directed behaviours required by all spheres of life.
Executive functioning is required to support the performance of daily life activities, which allow individuals to engage in meaningful tasks and occupations in all contexts (American Occupational Therapy Association 2020; Wolf et al. 2017).

Attentional control: Attentional control is the ability to choose what one pays attention to as well as which stimuli to disregard, as prioritised to be relevant to one's current goal. Attentional control is vital for one to act and think in accordance with one's objectives and is closely related to executive functioning (Oberauer 2024; Astle and Scerif 2009).

Cognitive flexibility: It is the ability to switch between tasks, mental states and information sets. This allows for taking on different perspectives, adjusting approaches and cognitive constructs and thinking creatively (Garon et al. 2008; Davidson et al. 2006).
**Shifting is used synonymously with cognitive flexibility in some executive functioning theories*

Goal setting: In his model of executive functioning Anderson (2002) conceptualises goal setting as the capacity to develop action plans and strategise to work towards reaching an objective. Initiation, planning, organising and conceptual reasoning are sub-skills of goal setting.

Information processing: The ability to effectively, and with relative ease, process information to complete relevant tasks in a timely manner. Information processing is the fourth domain in Anderson's model of executive functioning (Anderson 2002; Spencer-Smith and Anderson 2009).

Activities of daily living: The World Health Organization (2007) defines activities of daily living as the routine and essential tasks required to manage one's basic needs, such as personal hygiene and feeding. These activities are fundamental for independence and well-being. Examples include bathing, grooming, eating, dressing and toileting.

Instrumental activities of daily living: Tasks and activities of a more complex nature than activities of daily living, related to the ability to live independently within a set community. Activities include food preparation, laundry and housekeeping (*World Health Organization.* 2007).

Acronyms

ADHD	Attention Deficit Hyperactivity Disorder
ASD	Autism Spectrum Disorder
BRIEF®	Behaviour Rating Inventory of Executive Function®
CAS	Cognitive Assessment System
CAPS	Curriculum and Assessment Policy Statement
CFA	Confirmatory Factor Analysis
CP	Cerebral Palsy
DCP	Dyskinetic Cerebral Palsy
D-KEFS	Delis-Kaplan Executive Function System
D-REF	Delis Rating Scale of Executive Functioning
IQ	Intelligence Quotient
LD	Learning Disorders
LSEN	Learners with Special Education Needs
MLE	Mediated Learning Experience
SASAMS	South African Schools Administration and Management System
SCP	Spastic Cerbral Palsy
SD	Standard Deviation
SLD	Specific Learning Disorder
ToM	Theory of Mind

CHAPTER 1: INTRODUCTION

1.1 Introduction

Executive functioning is a neuropsychological concept pertaining to one's ability to set goals, prioritise, plan, organise, initiate, shift mind-sets, connect relevant information sets and self-monitor in order to complete daily tasks (Cox 2007; Dawson and Gaure 2010). The development of executive functioning is a prolonged process, with the frontal lobes being the last brain region to reach maturity (usually by the end of one's twenties). This brain maturation and the corresponding development in executive functioning are synonymous with the refinement of white matter tracts from the frontal lobe to relevant brain regions, as well as ongoing myelination in these regions (Krasenegor et al. 1997). Executive functioning typically develops along a hierarchical trajectory with the presence of 'growth spurts' involving peak times of synaptogenesis and increased myelination with correlating improvements in executive functioning skills (Spencer-Smith and Anderson 2009). These so-called 'growth spurts' take place from birth to two years, seven to nine years and 16 to 19 years of age (Krasenegor et al. 1997).

A conceptualising framework of executive functioning in neuro-typically developing children was proposed by Anderson (2002). Executive functioning is divided into four executive functioning domains, each with its own developmental trajectory, which operate in an integrative manner. The earliest domain of executive functioning to develop is attentional control. This is the capacity to focus and maintain attention over time, as well as the ability to selectively focus one's attention on relevant stimuli. The second domain to develop is cognitive flexibility. This is the ability to learn from and correct mistakes as well as generate alternative strategies to problems and shift from one to another when needed. The third domain of executive functioning is goal setting, and relates to generating new goals. Planning and initiating actions to complete activities in a strategic and organised manner also form part of this domain. The last domain is information processing, reliant on working memory, which is the ability to effectively - and with relative ease - process information to complete relevant tasks in a timely manner (Anderson 2002).

Research shows that executive functioning skills form the basis of success across academic, leisure, social and family activities as they inform the ability to initiate tasks and work towards goals while regulating the behaviour and emotions as required by the task and environment (Dawson and Gaure 2010; Meltzer 2007). Jefferson et al. (2006) found an association between executive functioning deficits and functional difficulties when participating in activities of daily living (ADLs) as well as instrumental activities of daily living (IADLs). Lezak et. al. (2004) add that executive functioning deficits may be apparent in everyday life demonstrated by difficulty attending to the task at hand, impulsivity and a careless nature, disorganisation, poor planning, increased errors without the needed self-correction, poor problem-solving abilities and inappropriate behaviour patterns.

Taking the abovementioned manifestations of executive functioning deficits into account, for learners with special needs, an important treatment focus in occupational therapy should be to address these deficits within the academic setting. This should be the case for learners with a variety of diagnoses such as attention deficit disorder (ADHD), anxiety disorders and learning disabilities (Altarac and Saroha 2007; Faraone et al. 2003). Another study identified the need to treat excutive dysfunction in dyskinetic cerebral palsied (DCP) learners as well as learners with spastic CP (SCP), since both groups demonstrate executive functioning defictes with the DCP learners being more affected. (Laporta-Hoyos et al. 2019).

The importance of addressing executive functioning in the occupation of education is emphasised by research indicating that all domains of executive functioning are important contributors to academic achievement in general as well as in clinical populations listed above (Gerst et al. 2017; Best et al. 2011). Planning has been linked to performance in mathematics (Iseman and Naglieri 2011) and reading comprehension (Haddad et al. 2003). Research also indicates that when planning strategies for engaging in academic activities are taught to children, their academic performance improves (Iseman and Naglieri 2011). Working memory deficits associated with executive functioning has also been shown to predict arithmetic difficulties (Jenks et al. 2007). Dai et al. (2020) added that children with executive functioning deficits may also struggle with other school related requirements such as following instructions and demonstrating appropriate learning related behaviour

such as maintaining the correct postural control in sitting as well as attending to the teacher's explanations and instructions.

The effectiveness of a variety of interventions to improve executive functioning, including that described by Diamond and Ling (2016), indicates that change can be achieved from early childhood to old age. Research points out that intervention for learners in primary school may prevent achievement deficits in occupations such as academics, vocational performance and well-being later in life (Diamond and Lee 2011). Most studies on the effectiveness of executive functioning interventions with primary school learners, however, have considered only a single domain or a component of executive functioning such as self-regulation or working memory (Diamond 2012). A South African study of a remedial programme in addressing planning skills of Grade 4 and 5 learners in Johannesburg, showed significant improvement in these skills (Amod et al. 2017). Other studies showed varied results depending on the severity of the executive functioning deficits, requiring an individualised approach (Paananen et al. 2011).

1.2 Statement of the problem

The global negative effects that executive functioning deficits have on occupational performance are quite often a common denominator across some of the most prevalent diagnoses in learners, whether attending a mainstream or learners-with-special-education-needs (LSEN) school (Khan and Lal 2023; Cramm et al. 2013; Faraone et al. 2003). Executive functioning deficits in these learners have been described as restricting independence as well as engagement in chosen occupations, including primary and secondary academics. Cramm et al. (2013) found that learners with executive functioning deficits increasingly become avoidant of tasks that they deem too difficult and disengage themselves from the student role or become defiant. They concluded that a lack of appropriate executive functioning interventions leads to learners exhibiting either outburst behaviour or disengagement. Learners with executive functioning deficits were found to often 'fall through the cracks'. They also have an increased likelihood of secondary mental health issues such as depression and anxiety, lifelong reduction in income-earning potential and increased likelihood of accessing income support programmes (Crawford 2007).

However, in a qualitative study, the findings indicate that although occupational therapists possess the skills and positioning within the system to identify learners with executive functioning deficits, there is little research on or evidence for the provision of the needed interventions (Cramm et al. 2013). The occupational therapy participants in their study felt that training for the treatment of children was mainly focused on gross motor, fine motor and sensory-based approaches. Thus, the executive functioning deficits in learners concerning participation in occupations are rarely and poorly addressed.

Cramm et al. (2013) also recommend that occupational therapists working with school-aged children address the executive functioning needs of children and integrate intervention for executive functioning into their practice. Effective intervention with school-aged children is needed to mitigate the pervasive effect of executive functioning deficits on occupational performance. The need for addressing executive functioning deficits of learners was identified as a goal for occupational therapy intervention at West Rand School and a class-based intervention programme was then developed by the researcher and was initiated at the start of 2020.

The existing class-based occupational therapy intervention, developed prior to the research study, forms part of the routine therapy intervention provided at West Rand School. The intervention was developed to address executive functioning deficits, but the effect of the programme is unknown.

1.3 Research question

What change occurs in the executive functioning and academic performance of Grade 4 learners at an LSEN school, attending a year-long weekly occupational therapy intervention?

1.4 Aim of the study

This study aimed to determine the change in executive functioning and academic performance of Grade 4 learners with different diagnoses, at a West Rand LSEN school, attending a weekly occupational therapy intervention for one year.

1.5 Objectives

The following objectives ensued from the research question:

- To determine the change in executive functioning, based on the D-REF, for learners in Grade 4 at West Rand LSEN School over four terms, attending a weekly executive functioning occupational therapy intervention.
- To determine the change in executive functioning based on the D-REF scores, of learners in Grade 4 from Term 1-4 for different diagnostic groups.
- To determine the association between the change in academic outcomes and the change in executive functioning from Term 1-4, for Grade 4 learners at West Rand LSEN School, attending a weekly executive functioning occupational therapy intervention.

1.6 Justification for the study

Findings from this study will add to the emergent occupational therapy literature on executive functioning interventions for school-aged learners. Furthermore, it will provide insights into the effect of the current class intervention groups at West Rand School for Grade 4 learners, and whether the intervention should be adjusted or improved for future use. Ultimately having the potential to contribute to evidence-based practice, the study may also highlight the need forthe explicit consideration of executive functioning deficits and their effect on occupational performance, attributing value to a domain of occupational functioning often overlooked by many occupational therapists.

1.7 Outline of the research report

Chapter 1: Introduction

The introduction chapter presents the research question and the background information on executive functioning deficits and the relevance thereof for occupational therapy practice. From the problem statement, the purpose, aim and objectives of the study follow. The justification of the study is included.

Chapter 2: Literature review

The literature review chapter explores the construct of executive functioning and existing models used to conceptualise it. The development of executive functioning

is discussed as well as the role it plays in occupational participation, specifically academic performance. This is followed by a review of existing assessment and treatment practices and studies on the effectiveness thereof. Lastly, executive functioning and different diagnoses as applicable to the sample population of this study are explored.

Chapter 3: Methodology

This chapter evidences the research design, research setting, population and sample size. The inclusion and exclusion criteria are indicated. The three measurement techniques, which include the demographic information, Delis Rating Scale of Executive Functioning (D-REF) and academic records, are explained. The research procedure as well as the intervention process used, are discussed. The methodology chapter, lastly, includes the ethical considerations as well as reliability and validity aspects germane to this study.

Chapter 4: Results

In the fourth chapter the results of 16 participants are presented. This includes the demographic information, the D-REF scores and academic scores. The change in median D-REF scores obtained over four terms is presented according to diagnostic categories. The correlations between the number of participants who improved on D-REF scores as well as academic marks are shown.

Chapter 5: Discussion

In the discussion chapter, demographics as well as the change of executive functioning throughout the intervention and the change in D-REF scores for different diagnostic groups are discussed. The discussion on the correlation between the change in executive functioning scores and academic outcomes over the four terms is explicated.

Chapter 6: Conclusion

The main findings of the study are summarised in the sixth chapter. The conclusion considers the strengths and limitations of the current study as well as the clinical considerations and recommendations. Lastly, recommendations for further research are explored.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Limited literature on executive functioning in the field of occupational therapy is available. For this reason and because executive functioning is a construct straddling various fields, literature on the topic was reviewed in these fields in addition to that of occupational therapy. These fields include neuropsychology, neuroanatomy, and developmental and educational psychology. To ensure a thorough review of literature, no databases were excluded and literature found was reviewed in terms of relevance and quality with all publications being peer-reviewed. Although newer publications were prioritised, much older literature was included such as iconic literature and work from seminal researchers and theorists dating back to the 1970s when the term ‘executive functioning’ was first introduced.

This literature review explores the construct of executive functioning in terms of models used to conceptualise it and defining components thereof. The development of executive functioning is put forward and the role executive functioning plays in occupational participation and, more specifically, academic performance is discussed. This is followed by a review of existing assessment and treatment practices and studies on the effectiveness thereof. Lastly, executive functioning and different diagnoses as applicable to the sample population of this study are discussed.

2.2 Executive functioning

Executive functioning is a complex construct straddling various fields making it troublesome to establish a universal definition. With limited literature available on executive functioning in the field of occupational therapy, literature on the topic was therefore also reviewed in various fields including neuropsychology, neuroanatomy, and developmental and educational psychology to construct a definition most suitable to this study. The World Health Organization (2007) and the Occupational Therapy Practice Framework Domain and Process IV (American Occupational

Therapy Association 2020) describe executive functioning as high-order mental functions vital to complex goal-directed behaviours across all life domains.

In neuropsychology, executive functioning is seen as one's ability to set goals, prioritise, plan, organise, initiate, shift mind-sets, connect relevant information sets and self-monitor in order to complete daily tasks (Dawson and Gaure 2010; Cox 2007). In neuroanatomy, executive functioning is seen as a function of the prefrontal cortex's ability to coordinate the activation and use of various brain regions to accomplish a set task dependent on higher-order thinking and cognitive control (Friedman and Robbins 2022). Neuro-imaging studies have identified specific brain regions that are vital to executive functioning. These include the anterior cingulate, dorsolateral prefrontal cortex, cortex, substantia nigra, orbitofrontal cortex, ventral tegmental area and posterior cingulate (Trutti et al. 2019; Noroozian 2014; Lezak et al. 2004).

2.2.1 Models of executive functioning

A reiterating inference in literature is that the definition of executive functioning has been ever-evolving since the introduction of the term 'executive' in the 1970s. Goldstein and Naglieri (2014) argue that executive functioning is an overarching term for up to 30 different constructs, referencing this as the reason why defining executive functioning is so elusive. Many scholars have attempted to conceptualise the construct with some viewing executive functioning as a unitary concept and others as consisting of various components. Several frameworks and models thus exist.

Barkley's(1997; 2012) model of executive functioning is based on the ability to self-regulate. It states that adequate behavioural inhibition is required to perform the four executive abilities. The first of which is working memory, referring to the ability to remember the relevant information and memories required to perform the current task. The second is the management of emotional responses in order to allow for goal-directed behaviour, and the third is the internalisation of speech to manage actions and synthesize plans needed for problem-solving. The fourth ability, reconstruction, is the analysis of information to govern behavioural responses to meet one's goal.

Behavioural responses are also a central part of the conceptualisation of executive functioning in the model proposed by Lezak (1995). The authors propose four

domains which constitute executive function: a) the formation of a goal, b) planning, c) carrying out goal-directed action and d) effective performance. These are necessary for effective, suitable actions to achieve personal independence and productivity.

Two models, both published in the 2000s, attempt to define executive functioning by delineating the sequential involvement of brain regions in the processing of stimuli or information to guide consequential behavioural responses. These models are Miller and Cohen's (2001) theories on the function of the prefrontal cortex and cognitive control and the Model of Unity and Diversity of Executive Function of Miyake et al. (2000). Miller and Cohen's (2001) model states that the primary function of the prefrontal cortex is that of cognitive control, based on patterns of activity that represent goals and the means to perform a certain task. The bias signals exerting control over input and output neurons in other brain structures mediate the flow of neural activity between systems responsible for the required responses to execute the task. Connectivity between the prefrontal cortex and the sensory and motor cortices as well as the limbic system provides the foundation for these biasing signals. These 'preferencing' signals affect visual processes, responses, memory and emotions and are important when stimuli are ambiguous or when multiple responses are possible. They guide task-appropriate responses and activity despite the competing of stronger more habitual or salient responses that produce incorrect behaviour or task-irrelevant action (Desimone and Duncan 1995).

These findings were supported by Banich (2009) who further refined the functioning of the prefrontal and cingulate cortex in setting goals and achieving task performance in the 'cascade of control' model when performing the Stroop task. The Stroop task presents ambiguous stimuli by requiring the participant to name the colour that a word is typed in, rather than the written name of a colour (i.e. red typed in green font). The role that the dorsolateral prefrontal cortex plays in generating the appropriate attentional guidelines for the task was tested with the activation of the areas of the brain responsible for colour perception as opposed to those responsible for the comprehension of written words. It was found that the mid-dorsolateral prefrontal cortex selected the information relevant to the fulfilment of the pre-set goal. The posterior dorsal anterior cingulate cortex is then responsible for the

response selection, after which the anterior dorsal cingulate cortex evaluates the accuracy of the response.

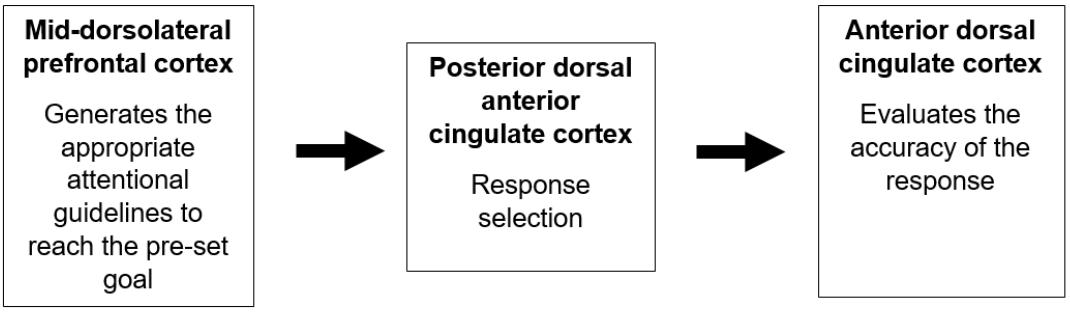


Figure 2.1 Visual representation of neuro-anatomical involvement when performing the Stroop test.

Although laboratory tasks such as the Stroop task provide an opportunity for experimental evidence of the connection between neural structures in executive functioning tasks using functional neuroimaging, it has been shown that individuals with severe executive functioning deficits can still perform within the normal range with laboratory-based assessments (Saver and Damasio 1991). It has also been hypothesized that these laboratory tests assess fundamental cognitive functions such as reasoning, memory and learning, but not the full scope of executive functioning, that coordinates and manages these cognitive resources (Shimamura 2000). Obonsawin et al. (2002) add that many traditional tests of executive functioning, other than assessing cognitive functions, essentially measure intellectual capabilities, bringing the validity of the tests into question. From the abovementioned, the question arises as to whether a model to conceptualise executive functioning can be based on test results that may not be assessing only executive functioning. The ability to perform normally on tests when in fact the person has day-to-day executive functioning difficulties also begs the question of how generalizable these models are to the clinical setting.

In their model of Unity and Diversity of Executive Function, Miyake et al. (2000) propose three components of executive functioning, namely inhibition, working memory and shifting or flexible thinking. Inhibition or inhibitory control refers to capacity to exercise control over one's thoughts, attention and behaviour to respond in the appropriate or required way rather than react using habitual responses or impulses (Diamond 2012). Inhibitory control of attention refers to the ability to attend

to a selected stimulus rather than another, often stronger, more noticeable stimulus (Theeuwes 2010). Self-control within this context is defined as the control over one's behaviour and emotions. One would thus be able to delay gratification and act disciplined and not with a prepotent response (Diamond 2012). Lastly, cognitive inhibition involves the suppression of irrelevant and distracting thoughts or memories, including previously acquired yet no longer relevant information (Anderson and Levy 2009; Postle et al. 2005).

Moving to the second concept of Miyake et al.'s model (2000), cognitive inhibition supports working memory (Diamond 2012), which is the ability to hold relevant information in mind for use in reaching a set goal. Working memory has been defined as verbal or nonverbal (that is visual-spatial) and is the ability to use previously gained experiences and knowledge. This functioning is used for deriving general rules or principles to apply in combination with current knowledge and goals to come to a decision or action (Diamond 2012; Alloway et al. 2006; Huizinga et al. 2006).

The third core element of the model of Unity and Diversity of Executive Function is shifting or cognitive flexibility (Miyake et al. 2000). According to Davidson et. al. (2006) and Garon et al. (2008), this element builds on working memory and inhibition and thus develops later. It is the ability to switch between tasks, mental states and information sets. This allows for taking on different perspectives, adjusting approaches and cognitive constructs and thinking creatively.

2.2.2 Defining components of executive functioning

A fundamental question in the realm of conceptualising executive functioning is whether a single underlying ability underlies all executive functions (unity) or whether components of executive functioning are distinct yet related factors that together make up executive functioning (diversity) (Jurado and Rosselli 2007). The model of Unity and Diversity of Executive Function" by Miyake et al. (2000) has become the prominent and widely accepted theoretical base to explain executive functioning, as well as forming a basis for further research. Miyake et al. (2000) used a confirmatory factor analysis to confirm the three executive functioning components (factors) of working memory, inhibition and shifting (synonymous with cognitive flexibility). While these components are discrete and diverse, they correlate with each other, supporting the idea of unity.

The factors of inhibition, working memory and shifting/cognitive flexibility were also confirmed by Letho et al. (2003) using confirmatory factor analysis for children between the ages of eight and 13 years old. Huizinga et al. (2006) found only partial confirmation for the three-factor model when comparing seven-, 11-, 15- and 21-year-olds developmentally. Cognitive flexibility (shifting) and working memory (but not inhibition) are loaded onto a common variable as factors of executive functioning in further research with adults. Friedman and Miyake (2017) found similar results, leading to their questioning of the model of three factors and whether or not inhibition constitutes a separable component of executive functioning.

A study that made use of functional magnetic resonance imaging (fMRI) confirmed the unity and diversity of executive function. Saylik and Williams (2022) found that certain areas of the brain were consistently activated in all executive functioning tasks. These areas included the left lateral frontal cortices, medial frontal cortices, as well as the inferior and superior parietal lobules supporting the paradigm of executive functioning fundamentally being the ability of the prefrontal cortex to recruit required brain regions responsible for task requirements, so the task can be completed appropriately. These areas were activated regardless of whether they required inhibition, working memory, or shifting of dual-tasking, demonstrating unity of the four abovementioned components.

Saylik et al. (2022) however, also reported that specific frontal sites in the brain were distinctively activated for inhibition (left inferior frontal gyrus) dual-tasking (left postcentral gyrus) and working memory (bilateral middle frontal gyri) providing support for the diversity of these components. It should be noted that the study included dual-tasking (performing two tasks at the same time), which Miyake et al. (2000) in their confirmatory factor analysis (CFA) study found could be a discrete factor of executive functioning.

Jurado and Rosselli (2007) concluded that frontal lobes represent an area of the brain with executive processes that may be diverse but unity is also essential since the entire brain is required for effective executive functioning. The prefrontal cortex might coordinate responses relying on other areas of the brain for input and efficient functioning.

2.3 Age and executive functioning

A limitation of Saylik and Williams' (2022) fMRI study, reported above, was that the participants were between the ages of 18 and 30 years. This corresponds with Best and Miller (2010) arguing that the model of unity and diversity of executive functioning is a suitable framework from which to explain executive functioning, but that the degree of unity and diversity changes between age ranges. There is thus a scarcity of studies comparing the unity and diversity of the components over a person's lifespan. They add that including various age groups requiring different tasks will, however, lead to methodological challenges. These challenges include ceiling effects for older participants, and introducing task impurities when using more complex tasks that may require various executive functions rather than just the one that was intended to be assessed.

2.3.1 Inhibition

Using a review of studies making use of electroencephalogram (EEG), MRI and diffusion tensor imaging (DTI) measuring neural response and activity while participating in tasks requiring inhibition, Best and Miller (2010) suggested a developmental framework of executive functioning. A linear relationship between task performance and brain activity was not found across different age groups. The authors postulated that this non-linear relationship indicated a more efficient use of brain activity as participants matured based on a study by Lamm et al. (2006). In their study Lamm et al. (2006) postulated that increased neural efficiency due to synaptic pruning as aging occurs is the reason for the non-linear relationship between task performance and brain activity. Best and Miller (2010) did, however, conclude that inhibition shows rapid early development, with slower progression through adolescence.

The validity of these findings is however impacted by definitions of inhibition as evidenced by Nigg (2000) who hypothesized that inhibition may have three separate processes of cognitive inhibition, motor inhibition and inference control, adding that each of these may develop at different rates. Diamond (2012) however, suggested that self-control, cognitive control and inhibitory control of attention constitute inhibition. The ambiguity of inhibition as a construct therefore adds to the complexity of determining the developmental tendencies thereof.

2.3.2 Working memory

Deducing the developmental tendencies of working memory had similar challenges to that reported for inhibition since the construct has various definitions. Different studies used different tasks to assess working memory and Best and Miller (2010) bring into question the validity and generalizability of the developmental data available. This is further highlighted by other contradictory studies. Garon et al. (2008) and Gathercole et al. (2004) found support for a linear increase in working memory abilities from the ages of four to 14 years old which levels off between the ages of 14 and 15 years of age. This was the case regardless of the level of complexity of tasks used. Conversely Luciana et al. (2005) using non-verbal tasks found that developmental trajectories depended on the complexity of the tasks used. Conklin et al. (2007) found similar results when using verbal as well as non-verbal tasks. Both studies indicated that, regardless of the content (verbal or non-verbal) to be processed, developmental tendencies were dependent on the degree of difficulty of the processing required by these tasks. Best and Miller (2010), however, despite the differences in studies, concluded that working memory develops significantly during pre-school years, followed by a linear trajectory through adolescence.

2.3.3 Shifting (Cognitive Flexibility)

Shifting was found to improve with age (Garon et al. 2008; Anderson 2002). Both Best and Miller (2010) and Garon et al. (2008) highlighted that inhibition and working memory aids in the process of effective shifting. They added that it then follows that the development of shifting is partially dependent on the development of inhibition and working memory. Synthesizing a developmental trajectory for shifting was again troublesome due to limited reliability and validity of measures used in studies. Davidson et al. (2006) measured response time to indicate the steady development of shifting in their study. Slower responses during adolescence and early adulthood, however, brought an increase of monitoring of one's responses and errors to light. These findings gave valuable insight into the development of meta-cognition, but decreased the validity of the findings of the development of shifting itself.

2.3.4 Framework for the development of executive functioning

Anderson (2002) proposed a domain-specific conceptual model of executive functioning in neuro-typically developing children that have been found to be generalizable to all age groups. The four-factor model includes the domains of a.) cognitive flexibility, b.) goal setting, c.) attentional control and d.) information processing that operates in an integrative manner. Each of these domains has its own developmental trajectory. The earliest domain of executive functioning to develop is attentional control. This is the capacity to maintain focus/attention over time, as well as the ability to selectively center one's attention on relevant stimuli.

The second domain includes the development of cognitive flexibility. This is the ability to learn from and correct mistakes as well as generate alternative strategies to address or solve problems and shift from one to another when needed. The third domain of executive functioning is goal setting and pertains to generating new goals. Planning and initiating actions to complete activities in a strategic and organised manner also form part of this domain. The last domain is information processing, which is the ability to effectively, and with relative ease, process information to complete relevant tasks in a timely manner (Anderson 2002).

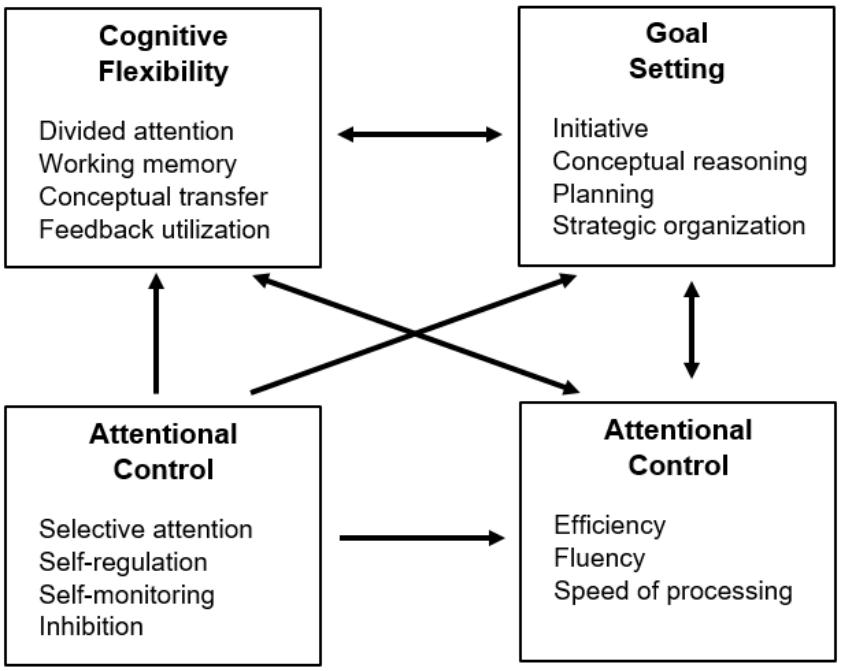


Figure 2.2 Adapted version of Anderson's Framework for the development of executive functioning (Anderson 2002)

2.4 Executive functioning and occupational participation

The World Health Organization (2007) regards executive functioning as vital to goal-directed behaviours required by all domains of life. Executive functioning is required to support the performance of daily life activities, which allow individuals to engage in meaningful tasks and occupations in all contexts (Wolf et al. 2017). Executive functioning is therefore squarely placed in the scope of occupational therapists who consider the ability of a person to engage optimally in their chosen occupations as the basis of their well-being.

Research shows that executive functioning forms the basis of success across activities of daily living (ADLs), academic performance (Neuenschwander et al. 2012), leisure and play (Kelly et al. 2011), social and family activities, as it informs one's ability to initiate tasks and work towards goals while regulating one's behaviour (Jacobson et al. 2011) and emotions as required by the task and environment (Dawson and Gaure 2010).

The negative implications of impaired executive functioning on participation in occupations are illustrated by decreased quality of life, independence levels, number of roles fulfilled and community living (Foster and Hershey 2011; Erez et al. 2009). Connor and Maeir (2011) state that individuals with executive functioning deficits demonstrate poorer participation in community life due to experiencing difficulties with social functioning, employment as well as iADLs. The need to interpret social cues and select, adapt and monitor appropriate responses as well as inhibit inappropriate responses, requires sufficient executive functioning abilities (Connor and Maeir 2011). Intact executive functioning is vital in complex occupations with various and dynamic task demands that may require one to continuously adapt action plans. These occupations include parenting, driving and the management of a household (Stapleton and Connolly 2010).

Executive functioning is also fundamental to the process of acquiring knowledge and learning, planning and decision-making. These abilities allow children to effectively participate in occupations such as play, learning and social interactions (Diamond 2013). Connor & Maeir (2011) add that learners with self-regulation and decision-making difficulties and who struggle to partake in novel and complex tasks subsequently have academic and school performance challenges.

2.5. Executive functioning and academic participation

School-related occupations specifically require sufficient executive functioning skills (Diamond 2013). The coordination and integration of different executive functioning skills underlie the successful execution of various scholastic tasks. These include note-taking, time management, studying, flexible thinking regarding learning material, test-taking and the planning and timeous execution of projects and tasks (Zelazo et al. 2016). Executive functioning has been shown to play a vital role in the effective participation in various classroom-specific activities. These include attending to and following instructions, and adhering to classroom behaviours which in turn enhance effective learning (Duckworth and Seligman 2005).

Historically the intelligence quotient was deemed the most important factor in predicting academic achievement (Vukovic and Lesaux 2013). In the last decade, however, executive functioning has been the most studied variable with regard to academic achievement, effectively replacing intelligence quotient as the focus. It has been found that executive functioning and intelligence quotient (IQ) currently have the same predictive capacity for school performance. Notably, IQ has been shown to be more important for learning and understanding novel aspects, while executive functioning has been shown to be vital in learning that is repetitive in nature and targeted at the development of competencies and skills (Pascual et al. 2019). The significant role that executive functioning plays in achieving success in school has moved some authors to call for the assessment of executive functioning abilities to form part of formal school evaluations, especially in the earlier years of schooling (Visu-Petra et al. 2011).

Inhibition, cognitive flexibility and working memory (Miyake et al. 2000), are deemed to be '*essential ingredients'* for academic achievement (Rose and Rose 2007). Visu-Petra et. al. (2011) conducted a cross-sectional study to investigate the relationship between the three dimensions of executive functioning (working memory, inhibition, and cognitive flexibility) and school performance for grade five and eight learners. School performance comprised of general semester grades, language (Romanian) and mathematics grades. Working memory was shown to correlate with mathematics and general semester grades, while inhibition correlated with general semester grades as well as language grades. Lastly, cognitive flexibility was shown

to correlate with all academic measures used. A cross-cultural study on the relation between academic performance and executive functioning was conducted using the Childhood Executive Functioning Inventory (CHEXI) of Thorell and Nyberg (2008) in China, Sweden, Iran and Spain. The CHEXI has four subscales of inhibition, planning, regulation and working memory which is based on Barkley's (1997) model of executive functioning. Working memory was found to significantly associate with both language and mathematic skills in all four countries. Inhibition was shown to be correlating with language in all countries apart from China, and mathematical skills in all countries except Sweden. Lastly, working memory showed the strongest relation to academic achievement as a whole (Thorell and Nyberg 2008).

A meta-analysis of the connection between academic performance and executive functioning found that working memory is the best predictor of academic achievement. The effect of the components of executive functioning on academic performance is, however, dependent on the subjects studied. An example is that of visuospatial aspects of working memory being especially vital to mathematical abilities. Most executive functioning components are related more to mathematical abilities than language (Visu-Petra et al. 2011). Sesma et al. (2009) and Zelazo and Carlson (2012) indicated that executive functioning is fundamental to the organization and processing of information received as well as the development of language and literacy, with De Abreu et al. (2014) adding that effective learning is heavily reliant on adequate language development. Poor working memory has been shown to hinder normal development of language (Miranda et al. 2011; Bolter et al. 2006). It is worth noting, however, that multiple studies have indicated that the best predictor of academic achievement is inhibition for children up to the age of seven, working memory thereafter and cognitive flexibility after the age of eleven (Isquith et al. 2004; Huizinga et al. 2006; Senn et al. 2004).

2.6 The assessment of executive function

The discourse in the conceptualisation of executive functioning filters through to different approaches to the assessment thereof (Malanchini et al. 2019; Toplak et al. 2013). One view is that of executive functioning as a set of higher cognitive abilities (Miyake et al. 2000). These are most often assessed using standardized tests. These tests are administered in controlled experimental circumstances such

as in locations that are quiet and void of distractions and dissimilar to real-life circumstances. This raises the question as to the usefulness thereof from an occupational therapy perspective as occupational therapists are concerned with occupational performance embedded within the real-life context (Baum et al. 2009) Historically the use of standardized (or performance-based) tests was the gold standard for assessing executive function, however, ecological validity concerns have been raised by many scholars (Barkley and Murphy 2010; Kenworthy et al. 2008; Anderson 2002).

Ecological validity is the degree to which an assessment performed in a highly structured and neutral setting captures the true manifestations of e.g. executive functioning abilities in daily functioning within the appropriate contexts (Wallisch et al. 2018). Challenges of standardized assessments of executive functioning include the necessity of willingness of the child to partake and sufficient attention and engagement. Idiosyncratic factors such as fatigue and mood also affect the performance in these tests and may additionally lead to measurement impurities. Standardized tests for executive functioning are often completed in one session, further exacerbating the effect the abovementioned factors may have on the performance of these tests (Zelazo et al. 2016). Gillen (2013) highlighted the need for ecologically valid assessments in occupational therapy as occupations are complex and play out in unique ways in various real-life contexts.

The second approach to assessment views executive functioning as inseparable from everyday functioning and the particular setting in which activities take place (Mareva 2024). Observer rating scales that may be completed by parents or teachers are seen to have higher ecological validity as they capture information gathered over extended periods and in multiple settings, providing a better idea of typical performance (Doebel and Müller 2023; Holochwost et al. 2022). This is in better keeping with the concerns of occupational therapists such as how executive functioning skills are deployed in various contexts as required by everyday living. The Behavioural Rating Inventory of Executive Functioning (BRIEF®) (Gioia et al. 2002), the Childhood Executive Functioning Inventory (CHEXI) (Thorell and Nyberg 2008) and the most recently developed, Delis Rating Scale of Executive Functioning (D-REF) (Warnick et al. 2015) are assessments most widely used by occupational therapists to assess executive functioning.

2.7 Executive functioning and treatment

The importance of executive functioning skills in academic success brought about the interest in malleability and training as a method to improve developmental and specifically academic outcomes. Various studies indicated a positive effect of executive functioning interventions on academic performance as well as executive functioning skills themselves. Intervention approaches can be categorized into three types: 1) direct approaches, 2) indirect approaches and 3) specific educational practices and designs (Zelazo et al. 2016).

2.7.1 Direct approaches

Interventions for improving working memory have been studied the most extensively. The training of working memory entails the repeated practice of a specific type of working memory with increasing levels of difficulty. It is assumed that these skills will transfer to similar working memory tasks as well as functional tasks with which working memory abilities have been associated, such as academic tasks (Zelazo et al. 2016).

Visual-spatial training using a computer video game with increasingly challenging levels has shown improvement on the specific task as well as tasks closely related to it. This is called ‘near transfer’. Multiple meta-analyses of evaluations of training programs indicated a moderate to large effect on the trained tasks as well as near transfer of the skills (Weicker et al. 2016; Schwaighofer et al. 2015; Melby-Lervåg and Hulme 2013).

Research findings on the ‘far-transfer’ of skills, that is transfer of skills from working memory training to tasks as they unfold in the context of daily living, have been varied. A study with 452 children in Melbourne, Australia, found that visual-spatial working memory computer-based training had a positive effect on visual-spatial working memory skills only, and not on other measures of working memory or academic achievements (Roberts et al. 2016). Some studies with smaller sample sizes, however, yielded positive evidence of the ‘far-transfer’ of visual-spatial memory interventions on academic outcomes (Holmes and Gathercole 2014; Kuhn and Holling 2014). While working memory interventions show promise, much research is still needed to evaluate under which circumstances these interventions could be beneficial and why. There is currently still a paucity of research done with

regard to interventions focussed on cognitive flexibility/shifting and inhibition to directly address executive function.

2.7.2 Indirect approaches

Research indicates that the use of certain activities such as mindfulness practice, aerobic exercises and computerized videogame training, where the primary goal is not to improve executive function, can indirectly address these skills. Mindfulness practices require sustained attention, self-reflection and focus on the in-the-moment experience. Various studies indicated an improvement in executive functioning skills as well as emotional regulation after participation in repeated mindfulness practice (Zeidan et al. 2010; Heerden et al. 2009; Zylowska et al. 2008). Inhibitory control is a key focus of traditional martial arts which encourages and practices discipline and self-control. Learners who took part in Tae-Kwon-Do training showed greater improvement of executive functioning than that of the control group who took part in standard physical education. The learners also showed improvement in mental mathematics (Lakes and Hoyt 2004). Partaking in yoga was also shown to improve executive functioning skills of 10 to13-year-old girls (Manjunath and Telles 2001).

An increasing amount of research literature indicates that aerobic exercise significantly improves the functioning of the pre-frontal cortex (Chaddock et al. 2011; Hillman et al. 2008). Studies on bimanual exercise suggest that it leads to executive functioning improvement (Budde et al. 2008; Uhrich and Swalm 2007) and high-dose aerobic exercise of overweight seven to 11-year-olds indicated an improvement in executive functioning skills as well as mathematical performance (Davis et al. 2011). An improvement in working memory was also brought about by daily fitness training of seven to 9-year-olds (Kamijo et al. 2011). A meta-analysis of 19 studies done by Verburgh et al. (2014) found a moderate effect size of acute exercise on executive functioning skills regardless of age (children, adolescents or young adults) while Best (2010) suggested that exercise that also requires cognitive engagement should have a greater effect on executive function.

After partaking in 12 hours of action video game playing improvement in reading ability was found for children with dyslexia (Franceschini et al. 2013). Visuospatial working memory was also found to have improved after training using CogMed©, a computerized working memory training game that has been the subject of various

research studies. However, these research findings appear to be contradictory (Bergman-Nutley et al. 2011; Holmes et al. 2010; Klingberg et al. 2005) with benefits of CogMed© being mostly domain-specific for visual-spatial memory and not transferable to improvements in verbal working memory (Diamond and Lee 2011; Bergman-Nutley et al. 2011). This was confirmed by a meta-analysis of the effect of videogame playing on cognitive aspects indicated small to medium improvements in motor, auditory and visual processing skills, but none for executive functioning (Powers et al. 2013). Thus, the usefulness of computerized training on executive functioning skills as well as the transferability to the real-life contexts, is not clear and requires more quality research.

2.7.3 Specific educational practices

The third category of executive functioning interventions is specific educational practices. The two sub-clusters of the specific educational practices category are curriculum-based interventions and the mediated learning experience approach.

2.7.3.1 Curriculum-based interventions

Two curriculum-based interventions for preschool and kindergarten learners have been shown to improve executive functioning. 'Tools of the Mind' is a curriculum add-on that was developed based on the theory of Vygotsky (1978), who stated that the development of executive functioning in early childhood is heavily reliant on social pretend play. 'Tools of the Mind' integrates teacher-led scaffolding of academic tasks, visual reminders, structured social pretend play and child-led activities as tactics to improve executive functioning skills in the daily life context. Bordova and Leong (2007) found that skills were not generalized when 'Tools of the Mind' was used as an add-on to the existing curriculum and that it should be integrated into all academic tasks throughout the day.

Findings of the effectiveness of 'Tools of the Mind' were varied with a randomized control trial evaluating 147 preschool children attending subsidized schooling, reporting the program improved executive functioning (Diamond et al. 2007). Wilson and Farran (2012) however, found that the program did not lead to any improvement in executive functions or academic outcomes of 794 preschool children of middle-income class. A 2014 large sample cluster randomized control trail of 729

kindergarten learners in 29 different schools found that the program did improve academic outcomes such as mathematics and reading and attention. The effects on executive function, reasoning skills and attention control were significant in high-poverty schools (Blair and Raver 2014). While 'Tools of the Mind' has been shown to bring about positive change, it is seemingly more effective for learners of lower socio-economic circumstances.

The second curriculum is the Montessori curriculum which does not explicitly mention the improvement of executive functioning as a goal. However, Lillard and Else-Quest (2006) found that learners who attended a school using this curriculum had better executive functioning scores and performed better in mathematics and reading tasks. The Montessori curriculum addresses inattention, impulsivity and self-discipline. The tailoring of tasks by teachers to challenge children's abilities when they are ready, hands-on learning in small groups, cross-age tutoring and child-to-child learning all form part of strategies used in this curriculum (Montessori 1949).

Other in-class interventions studied in relation to executive functioning include the Maltti intervention programme which seeks to combine cognitive behavioural approaches with skills training in a group-based format within the school setting (Paananen et al. 2011). The programme consists of a total of 20 sessions with tasks being verbally initiated and making use of scaffolding and modelling techniques. Paananen et al. (2018) examined the effect of this intervention on the behaviour, attention, executive functioning and improvement of academic skills in Grade 1 to 7 Finnish learners. It was found that only learners with moderate symptoms showed improvement in attention and executive functioning in the classroom setting, and only with the simpler academic tasks. The authors suggested that prolonged individualized interventions for individuals with more severe symptoms may be required.

Miranda et al. (2011) studied the effects of focused psychosocial intervention on the executive functioning of learners with ADHD. The intervention programme involved 27 learners, their teachers and parents during a 10-week period and entailed encouraging inhibitory control and teaching self-instruction skills. These were to be used in conjunction with problem-solving strategies, social skills and anger

management. Intervention modalities used to foster these skills included modelling, dramatization, dialogue and debate. Teachers were also trained to apply these behavioural modification techniques as well as on how to practice and consolidate the use of the self-instruction techniques taught to the children. A significant improvement was seen in especially visuospatial planning and memory. Additionally, parent and teacher ratings indicated improvements in hyperactivity, attention and impulsivity. The authors concluded that the involvement of the parents, who were equipped with behavioural modification strategies, was to be used in the home context to improve attention and obedience of the learners and ensure the carry-over of taught skills to the natural contexts.

2.7.3.2 Mediated Learning Experience

The effect of an in-class Mediated Learning Experience (MLE) approach using a quasi-experimental pre-post-test control group design assessed the development of Grade 4 and 5 learners' planning skills in a private school in South Africa. The planning scale score of the Cognitive Assessment System (CAS) for the pre- and post-test showed significant differences between the control and experimental groups. Individual differences in the level of improvement, however, highlighted the need for independent consideration of learner needs. Different needs pertained to learners with barriers to learning, or those struggling with the output stage. Barriers to learning were reduced organizational abilities and impulsiveness, while difficulties with the output stage were challenges with communication skills. (Amod et al. 2017).

The Mediated Learning Experience is an approach based on the seminal work of Freuerstein et al. (1979) and Structural Cognitive Modifiability (Vygotsky 1978). Freuenstein (1979) made the distinction between client exposure to learning and learning through the assistance of a human mediator. He termed learning with the guidance and purposeful structuring and scaffolding by the human mediator, MLE. It is through the process of MLE that the cognition can be acquired or enhanced (Freuerstein et al. 1988). It is important to note that the mediator can be a teacher, therapist, parent or even a classmate, any person who has a better understanding of a specific topic or has mastered a desired skill. This is similar to the 'Zone of Proximal Development' in the theory of Vygotsky (1978) that introduces the need for mediated strategies such as scaffolding from a more knowledgeable individual to

advance a child's learning from what they can master to what is slightly beyond their current abilities.

The MLE prioritizes the role of the mediator in facilitating learners to reach the correct answer by guiding their thinking process. The approach focuses on the steps taken to reach an answer rather than prioritizing the correct answer. Learners are challenged to communicate their thought processes and reflect on strategies used, ultimately improving metacognitive skills. Metacognition, or the capability to reflect on their own thinking and learning, underlies learners' use of executive functioning processes. More specifically, metacognition, initially conceptualised by Flavell (1977), refers to each learner's comprehension of how she/he learns as well as the strategies that could be used to complete a task. Ultimately, metacognition allows the child to identify which strategies work the best for him/her, as well as the why, where, when, and how application thereof.

Learners with sound metacognitive abilities know to stop and ensure that they understand the situation and all needed information. They may then remind themselves to develop a plan based on the goal of the activity, carry out the plan and then reflect on whether their plan worked or needs to be altered. This may all be done by making use of self-talk. Self-talk refers to the internal dialogue a person may have with themselves to ensure the forming and following of the correct steps. It also includes the evaluation of these steps and is a form of self-management (Meltzer 2007).

There are three essential requirements of interactions for it to be qualified as an MLE. They are intentionality and reciprocity, transcendence and lastly mediation of meaning. Intentionality and reciprocity refer to the mediator interposing him/herself between the child and the source of stimuli to develop or improve a specific skill. This is conversely to a non-mediated task that is supposed to 'teach itself' through direct exposure alone. The Mediated Learning Experience encourages the child to perceive things with clarity and precision as deemed necessary and therefore highlighted by the mediator. A mediator, with the intention to have a particular concept perceived fully, modifies the stimulus, making it more notable and engaging to the learner (Freuerstein et al. 1988).

Another role the mediator fulfils is to aid the learner in distinguishing various situations which require a specific behaviour or cognitive process. This role is called ‘transcendence’. The mediator also links the specific behaviour and cognitive processes used to other situations where these processes may be beneficial or required. It is the transcendence in the nature of the MLE interactions that produces flexibility in the child’s thinking (Freuerstein 1988). The emotional/affective power that will allow the mediational interaction to be deemed useful and worthwhile by the learner is coined as the mediation of meaning, and is another requirement of MLE. Mediation of meaning ensures that the child not only becomes receptive to the stimuli but is also engaged in the mutual reciprocal interaction with it and ultimately understanding the purpose of the activity and behavioural and cognitive processes taught and used (Freuerstein et al.1988).

2.8 Executive functioning and different diagnoses

2.8.1 Cerebral palsy

Cerebral palsy (CP) is a non-progressive neurodevelopmental disability resulting mostly from an insult to the developing brain, whether in the prenatal, perinatal or postnatal period of development. Cerebral palsy has historically mainly been seen as a physical disability due to the conspicuous movement and postural difficulties. The severity and symptoms of CP vary significantly, and the condition is classified according to symptomatic features, which are determined by the type of brain lesion as well as the area of the brain affected. Classifications of CP include dyskinetic, ataxic, spastic, and mixed types. Dyskinesia is characterized by uncontrolled and slowed movements, while individuals with ataxia experience balance and coordination difficulties. People with the spastic CP type are characterized by increased muscle tone and deep tendon reflexes. The last type, mixed CP, is when the clinical picture indicates a combination of the abovementioned motor disturbances. When classified according to the parts of the body that are affected, two categories can be identified, namely unilateral and bilateral. Unilateral refers to when one side of the body is affected, and when both sides of the body are affected, it is classified as bilateral. Unilateral CP includes monoplegia (one limb is affected) and hemiplegia (the two unilateral limbs are affected). Bilateral CP consists of diplegia (all limbs are affected but mostly the lower limbs), tetraplegia (unilateral

limbs and a third limb are affected) and quadriplegia (the trunk and all four limbs are affected) (Graham et al. 2016; Rosenbaum et al. 2007).

It has, however, been evidenced that individuals with CP also experience deficits in cognitive abilities and behavioural and emotional skills (Rosenbaum et al. 2007). Oskoui et al. (2013) adds that CP is often also accompanied by sensory and perceptual disturbances as well as communication and social difficulties. It has been hypothesized that executive functioning deficits are associated with these difficulties, as evidenced in a systematic review, which indicated that children with CP experience significant executive functioning difficulties (Pereira et al. 2018). Using the Behaviour Rating Inventory of Executive Function® (BRIEF®) and the Delis-Kaplan Executive Functioning System (D-KEFS) assessments, Whittingham et al. (2014) found participants with right and left unilateral CP scored significantly lower for executive function than typically developing learners. Verbal self-monitoring was, however, preserved, and the authors argue that this may be due to the brain preserving verbal over other cognitive functions in unilateral CP, as found by Guzetta et al. (2008).

There are three barriers to constructing a conclusive representation of executive functioning in children with CP. Firstly, there is a scarcity of studies that focus on cognitive aspects of CP, and secondly, the classification of CP types is used inconsistently, making comparison and generalizability troublesome. Some studies focus on the region of motor deficits such as unilateral CP (Whittingham et al. 2014; Bodimeade et al. 2013) while other studies focus on the type of motor deficits such as dyskinetic and spastic CP (Laporta-Hayos et al. 2019). Lastly, assessment instruments to evaluate executive functioning in learners with CP are very diverse as indicated in a systematic review with only one assessment tool (D-KEFS) used in more than one study (Pereira et al. 2018) The authors added that none of the studies reviewed specified whether assessments were adapted or modified to accommodate CP learners' physical abilities and co-occurring challenges. This draws parallel to the study by Laporta-Hoyos et al. (2019) where it was argued that the gross motor severity and inaccessibility of tasks for individuals with dyskinetic CP may mask their cognitive abilities.

2.8.2 Specific learning disorders and attention deficit hyperactivity disorders

Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder with the severity of symptoms laying on a continuum. It is characterized by the presence of inattention, impulsiveness and hyperactive behaviour that have an adverse effect on the daily functioning of these individuals. Attention-deficit hyperactivity disorder (ADHD) can be categorized into three sub-categories namely the combined type, inattentive type and hyperactive-impulsive type. Individuals who predominantly indicate attention difficulties fall within the inattentive type while those who evidence mainly impulsivity and hyperactivity fall within the hyperactive-impulsive type. Those who have all the above-mentioned difficulties are classified under the combined type of ADHD. (Von Rhein et al. 2016; American Psychiatric Association 2013)

Specific learning disorder (SLD) is an overarching term referring to neurodevelopmental disorders that are characterized by significant difficulties with performing particular academic skills such as writing, reading and mathematics, despite sufficient intellectual capabilities. Specific learning disorder is mainly categorized into mathematical (dyscalculia), writing (dysgraphia) and reading (dyslexia) related disorders, though written expression, reading comprehension, mathematical reasoning, grammar difficulties and problem-solving are also included under this term (Somale et al. 2016; American Psychiatric Association 2013).

Children with ADHD and SLD have been shown to have significant executive functioning deficits (Faedda et al. 2019; Peng and Fuchs 2016; Schreiber et al. 2014). Many studies have indicated that children with ADHD have inhibitory control impairments (Schreiber et al. 2014; Rajendran et al. 2013; Crosbie et al. 2013) while children with SLD have deficits in working memory, which underpins mathematical and reading abilities (Peng et al. 2018; Moll et al. 2016). These working memory deficits include visuo-spatial working memory linked to mathematical abilities (Caviola et al. 2020) and verbal working memory underlying reading and comprehension abilities (Peng et al. 2018a).

Crisci et. al. (2021) underscored the limited research conducted comparing the executive functioning of typical developing children and children with either ADHD or SLD, or ADHD with comorbid SLD, despite the high prevalence of comorbidity of

ADHD and SLD being well studied (Astle and Fletcher-Watson 2020; Lonergan et al. 2019). In their study comparing the executive functioning of the above-mentioned groups Crisci et al. (2021) showed that all clinical groups had worse executive functioning than their typically developing counterparts. Children with ADHD (without or in combination with SLD) had inferior performance in visuo-spatial working memory tasks while children with SLD performed more poorly in verbal working memory tasks. The authors added that, according to their findings, ADHD with co-morbid SLD does not warrant a separate diagnosis, as they found no definitive proof of a distinctive cognitive profile between this group and those of ADHD or SLD only. This is ambiguous when compared to the study by Fernandez-Andrez et. al. (2021), who found children who have both SLD and ADHD had more severe executive functioning fallouts than their counterparts who had only one of the aforementioned neurodevelopmental disorders. While it is clear that children with ADHD and/or SLD have executive functioning deficits, further research is needed to shed light on their unique cognitive and executive functioning profiles.

2.8.3 Autism spectrum disorder

Autism is a neurodevelopmental disorder marked by challenges in communication and understanding, developing and maintaining social relationships. Other characteristics include the dependency on routines and sameness, limited and often fixated interests and atypical reactivity to sensory input. (Wagner et al. 2018; American Psychiatric Association 2013).

Individuals with autism spectrum disorder fall within different categories based on their intellectual capabilities. The severity of symptoms lies on a spectrum and functional outcomes vary significantly, even for individuals with higher intellectual abilities (Goldberg et al. 2004; Geurts et al. 2004). There is still a limited understanding of the reasons for such heterogeneity in the functioning of individuals with autism spectrum disorder. There is, however, growing support for executive functioning deficits being the source of the variability of symptoms (Pellicano 2012). In late 1990's research, extensive attention was given to executive functioning and the proposal that it formed the underpinnings of autistic behaviours since deficits in specific executive functions have been evidenced to distinguish autism spectrum disorder from other developmental disorders (Hughes et al. 1994; Ozonoff and

Jensen 1999; Boyd et al. 2009). The executive functioning theoretical framework is one of the multiple theories that have been proposed to explain the clinical difficulties of people with ASD. The model is underpinned by observed difficulties in response inhibition, working memory and set shifting/cognitive flexibility, such as insistence on routines and cognitive rigidity (Hill 2004).

In the early 2000s contradicting research findings caused reservations about the validity of the theory that all autistic symptoms are a result of executive dysfunction, since not all persons with autism spectrum disorder have executive functioning difficulties. (Liss et al. 2001). Research has thus moved away from the belief that a solitary neurocognitive, factor such as executive functioning, forms the foundation of ASD symptoms, and several interrelating neurological atypicalities underlie the symptoms experienced (Pellicano 2012; Happe et al. 2006).

Although there is now a general agreement that executive functioning deficits do not explain the complete clinical picture of autism spectrum disorder, it does, however, play a significant role in developmental outcomes and functionality of these individuals. Various meta-analyses indicated impairments in cognitive flexibility, working memory and inhibition in people with ASD. This may then present as difficulties in social competence, school success, behavioural regulation and adaptive behaviour (Wang et al. 2017; Geurts et al. 2014b; Leung and Zakzanis 2014). Theory of Mind (ToM) deficits, which refer to the inability to infer the mental states of others to understand their behaviours, are dependent on the sufficient development of executive functioning and are often synonymous with ASD (Wade et al. 2018). This includes attributing feelings, motivations, beliefs and emotions of others (Senju 2013).

2.9 Conclusion

Executive functioning refers to the higher-level cognitive functions connected with complex goal-directed behaviours across all life domains. It is required to perform daily occupations and activities including academic participation. The negative effects of executive functioning deficits are often a common occurrence in the most prevalent diagnoses of learners in LSEN as well as mainstream schools. These include learners with CP, SLD, ADHD and ASD.

A discourse in the conceptualization of executive functioning exists as it bestrides multiple disciplines and this filters through to different approaches to the assessment thereof. Due to their ecological validity, observer rating scales, such as the D-REF, are often used to assess executive functioning.

Intervention approaches shown to be effective can be categorized into direct approaches, indirect approaches and specific educational practices and designs, with special education practices including curriculum-based interventions and the MLE approach. There is, however, limited research that considers both the behavioural and emotional components of executive functioning of learners in primary school. This study therefore considers the change in these components and executive functioning as well as academic achievement in Grade 4 learners at a LSEN school, attending an occupational therapy intervention for executive functioning.

CHAPTER 3: METHODOLOGY

3.1 Introduction

In this chapter, the research design chosen is indicated and discussed. The research setting, population and sample size are outlined and the inclusion and exclusion criteria are indicated. The three measurement techniques, which were the demographic information (Appendix A), the Delis Rating Scale of Executive Functioning (D-REF) (Appendix B) and academic records (Appendix C) are discussed. The research procedure including data collection, management and analysis as well as the intervention process is outlined. Lastly, the validity, reliability and ethical considerations relevant to the current study are addressed.

3.2 Research design

A retrospective quasi-experimental research design was used to evaluate a pre-existing intervention programme by determining the change in executive functioning in Grade 4 learners at four points in time. Based on data collected retrospectively, the change in executive functioning and academic performance was explored at aggregate and individual levels, by repeatedly measuring the same variables in the same way, for the same participants, at each point of data collection to enhance casual inference. A quasi-experimental research design was used to determine whether a causal relationship between variables existed, but where it was not possible to use random assignment of learners to a treatment and control group, as all Grade 4 learners routinely partake in the intervention programme (White and Sabarwal 2014).

This study included Grade 4 learners who attended a weekly occupational therapy intervention for one academic year. The intervention programme was developed and implemented prior to the research study, and forms part of the general therapeutic interventions provided at West Rand School. The research used the collection of quantitative data in the form of outcome measures provided by the teachers to counter any potential bias by including measurement techniques which were standardised and objective. The D-REF was completed for each learner by his/her teacher over the four terms during the year in which the intervention was in process,

as suggested for programme evaluation to determine change of either a whole programme or components of the programme (Posavac and Carey 2015). Changes related to behavioural and emotional regulation, as well as cognitive functioning were considered. This included the assessment of attention and working memory, impulse control index, abstract thinking and problem-solving, and compliance and anger management. Change in the academic performance of the learners over the year was included and correlated with the change described above. Each learner was their own control as each of the learners' scores was compared to their own scores to determine change.

3.3 Research setting

The research was conducted at the West Rand School in Krugersdorp. The school is an LSEN school, and the learners are multi-cultured and multi-racial with various home languages. The learners follow the Curriculum and Assessment Policy Statement (CAPS) curriculum in either Afrikaans or English. As part of the normal occupational therapy services at the school, a weekly executive functioning group intervention was presented to the Grade 4 class. The researcher was employed by Gauteng Department of Education and working at the school at the time of the interventions and data-collection. None of the learners received any other occupational therapy than the weekly occupational therapy group intervention, whether from an occupational therapist based at the school or private occupational therapists. The learners thus had the same amount of occupational therapy input.

3.4 Population, sampling and sample size

In Grade 4, there were 17 learners in the Afrikaans and English classes combined with ages varying from 9 to 11 years at the time that the intervention took place. Learners had a variety of physical and cognitive disabilities including CP, SLD, ASD and ADHD. Total or whole population sampling was used for this study which is a type of purposive sampling technique that allows the entire population to be examined. This method is used when a small sample size is available since this provides the possibility to obtain a detailed insight into the phenomenon being studied, especially when each learner can be assessed more than once. By including the whole population in the study, the risk of excluding potential insights

into the phenomenon, was minimized. Practically, the class-group intervention forms part of the occupational therapy intervention protocol where learners receive individual occupational therapy until end of their Grade 3 year, and then receive occupational therapy intervention on a class-group basis, with addressing executive functioning difficulties as the therapy goal. Intervention with these learners is appropriate since they fall within the second growth spurt associated with executive functioning (Krasenegor et al. 1997).

3.4.1 Inclusion criteria

- Grade 4 learners at West Rand School

3.4.2 Exclusion criteria

- Learners receiving other occupational therapy input (i.e. private occupational therapy.)
- Learners who attended less than 80% of the class groups. (Whether due to absenteeism from school or only being accepted to the school later in the year.)

3.4.3 Sample size

At the time of the study there were a total of 17 learners in Grade 4, with nine (n≈9) being in the Afrikaans class and eight (n≈8) in the English class. One learner (in the Afrikaans class) only started attending the school at the end of the first term. She was excluded from the study as she attended less than 80% of the class group intervention sessions. Thus, a total of 16 learners were included in the study, with an even spread of learners from the Afrikaans and English classes.

3.5 Measurement techniques

3.5.1 Demographic information

Demographics are distinct characteristics of a population such as gender and ethnicity. The demographic information (Appendix A) of each learner was obtained by the researcher from their learner files and captured on an Excel spreadsheet. Demographic information captured included gender, diagnosis and language of instruction (which Grade 4 class they were in).

3.5.2 Delis Rating Scale of Executive Functioning

The D-REF is an online questionnaire using the Q-global scoring. The test allows for reporting the frequency of observed behaviours that identify executive functioning problems in children and adolescents aged 5-18. The D-REF assessment (Appendix B) is not to be used as a diagnostic tool, but is used to report behavioural aspects that indicate executive functioning deficits. This assessment can be completed by teachers, parents and/or the individuals themselves. In this study, the teacher completed the assessment for each learner. Learners did not complete the self-rating tests as a Grade 4 level of reading is required and the self-rating form is for ages 11 years to 18 years and 11 months.

Each form includes 36 items that fall within one of the three core index domains: behavioural functioning, emotional functioning and executive function. The core index T-scores have a mean of 50 and an SD of 10. The scores for each of the domains are derived from the items within each domain. The behavioural functioning index measures the child's ability to meet the demands of the environment by regulating his or her behaviour, while the emotional functioning index measures the ability of the child to regulate his or her emotions to meet the environmental demands. The executive functioning index measures the higher cognitive skills that are required to successfully and appropriately adapt and function within a given environment. The total composite score is determined using the abovementioned three indexes and thus measures the child's ability to plan, execute as well as regulate behavioural, emotional and cognitive functions.

Clinical index scores are derived to facilitate interpretation based on diagnostic criteria for childhood disorders. The clinical index scores are thus more specific than the items within the core index. There are four clinical indexes on the teacher rating forms, which are attention and working memory, activity level and impulse control, compliance and anger management and abstract thinking and problem-solving. Attention and working memory measure difficulties with inattention, working memory, disorganization and multi-tasking ability. Activity level and impulse control measures symptoms of impulsivity, hyperactivity and deficient self-monitoring. The clinical index of compliance and anger management assesses sensitivity to criticism, frustration tolerance, rule-breaking behaviour and mood lability. Lastly, abstract thinking and

problem-solving examine difficulties with problem-solving or decision-making and cognitive inflexibility.

The D-REF makes use of T-scores for the total composite, core index and clinical index scores. As the D-REF measures dysfunction or difficulties, T-scores below 55 are considered within normal limits and scores from 55 to 59 are borderline elevated. Scores of 60 to 70 are indicative of mild levels of executive dysfunction and T-scores above 70 indicate severe difficulties in executive functioning behaviours. Obtained scores can be compared to general population norms or sex-adjusted norms (Warnick et al. 2015).

The normative data of the D-REF are based on national samples representative of the United States population ages five to 18 years. The sample included 1,062 individuals (parent, N = 500; teacher, N = 342; self, N = 220). Six age bands were collected in years: 5–6, 7–8, 9–10, 11–12, 13–14, and 15–18 and used in the normative sample. (D-REF, 2012, p. 45). The Teacher Rating Form has good to very good internal consistency for the core index scores with reliability coefficients ranging from 0.80 to 0.99 across the age bands. The Total Composite Score for the Teacher Rating Form has the highest reliability coefficients across the age bands ranging from 0.93 to 0.99. The Teacher Rating Form clinical indexes are in the moderate to very good range with reliability coefficients across the age bands ranging from 0.76 to0 97. It can thus be concluded that the use of the D-REF Teacher Rating Form is a reliable and valid method to measure the executive functioning of learners.

3.5.3 Academic records

Academic results (Appendix B) were obtained from each learner's quarterly academic report card generated by the South African Schools Administration and Management System (SASAMS). The SASAMS is an online system used by schools to upload and update information of each learner, including academic results. Teachers are responsible for uploading the relevant data which is then double-checked by the relevant head of department. The SASAMS system does not allow for any missing data. The school follows the CAPS curriculum and tests, projects and examinations are therefore subject to the standards set out by this policy. Academic records should thus be reliable and valid.

3.6 Research procedure

Once ethical clearance for the study was obtained from the Human Ethics Research Committee at the University of the Witwatersrand (M211051) (Appendix D) permission was requested and obtained from the principal of the school (Appendix E).

The research procedure for the study is outlined in Figure 3.1

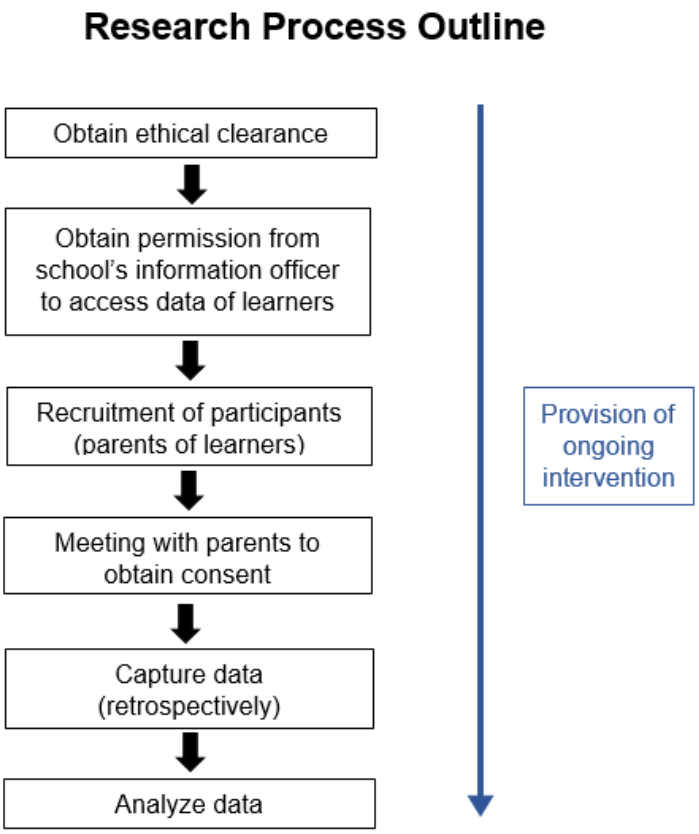


Figure 3.1: Research procedure

After ethical clearance was obtained, the parents/guardians of each Grade 4 learner were telephonically contacted and requested to attend a meeting at the school on a set date. The parents/guardians were informed that the meeting was an information session with the goal of requesting informed consent for a postgraduate research study. At the meeting, the researcher introduced herself and parents/guardians were given a chance to do the same. The information regarding the study was presented, as well as the focus and aim of the executive functioning groups. The information

sheet (Appendix F) as well as the written consent form (Appendix F) were given to the parents/guardians to read and were available in Afrikaans and English. A multilingual class assistant was present to assist with any translations needed. The researcher assisted with any research terminology that parents/guardians may have been unsure of. Ethical aspects were explained, and it was especially made clear that they were not obliged to consent, that they may retract consent at any time and that their decision to consent or not would have no impact on the treatment of their children. All parents/guardians consented.

3.6.1 Data collection

The study involved recording the data on the D-REF and the academic results of the learners, retrospectively. Demographic data from the records of the Grade 4 learners was captured using an Excel spreadsheet and included, home language, diagnosis and gender. The D-REF scores were captured using the Q-global platform and interpretation reports were generated based on T-scores. T-scores were transferred to the data capture Excel spreadsheet for clinical and core index scores categories. Academic results for each term obtained for each subject were captured on the same spreadsheet. The abovementioned data was captured and organized for each learner using their allocated code as part of a de-identification process.

3.6.2 Data management

To ensure that no files get misplaced and that no confidential information was accessed, no files, documents or tests were removed from the school. The researcher obtained only essential data and captured it immediately on a laptop using Excel spreadsheets. To comply with the POPI Act (section 7), in addition to the usual informed consent obtained from parents, all information was stored on a password-protected laptop. As mentioned previously, a de-identification process was used where a code was allocated to each participant. Relevant information was captured using this code.

A double data-capturing method was used to minimise possible human error. As there was only one researcher, the researcher captured the relevant data on two different days on separate documents. The data on the documents were then compared to find and investigate any discrepancies. No discrepancies were found,

and no missing data was experienced as the D-REF was completed online and could only be submitted when all data had been supplied. The SASAMS system also did not allow for missing data and was also completed (by the teacher) online. All data will be stored securely for three years if published, and five years if not, after which it will be destroyed on all platforms (external hard drive and laptop).

3.6.3 Data analysis

Relevant demographic data such as gender and diagnoses were analysed using descriptive statistics. The data (D-REF as well as academic results) were analysed for each participant over four terms as well as for the group of participants using T scores. All analysis of data is presented in Table 3.1.

T-scores are used to analyse the D-REF level of impairment in executive function. A T-score of 54 is considered the cut-off for normal function with a standard deviation of 10 points. Normal scores are in the range of 40 to 60. A score above 60 is reflective of borderline modest difficulties and a score above 70 suggests more significant concerns. Most low scores on clinical scales (below 40) are not interpreted any differently from scores between 40-50, and do not suggest a particular strength, but merely suggest the absence of a problem (Warnick et al. 2015).

Table 3.1 Data Analysis

	Type of data	Data source	Descriptive statistics used	Statistic tests
Demographics	Nominal Nominal	Gender Diagnosis	Frequencies	
Objective 1 To determine the change in executive functioning based on the D-REF, for learners in Grade 4 at West Rand LSEN School over four terms	Ordinal	D-REF scores over 4 terms	Frequencies Median scores	
		Change in D-REF Scores	T scores differences over 4 terms	Wilcoxon test (within participant change)
		Level of impairment for D-REF	T score frequency	

		Difference between mild/ moderate and severe impairment	Percentage	
Objective 2 To consider the change in executive functioning based, D-REF scores, of learners in Grade 4 from Term1-4 for different diagnostic groups	Ordinal	Change in D-REF scores for diagnostic categories	T Scores differences over 4 terms	
Objective 3 To determine association between the change in academic outcomes and the change in executive functioning from Term 1-4, for Grade 4 learners at West Rand LSEN School	Ordinal	Difference between academic results	T score differences over 4 terms and for Term 1-4	Spearman's correlation of change in D-REF scores and academic results from Term 1-4
		Difference between test scores	T scores differences over 4 terms and for Term 1-	

The significance value for the Wilcoxon test was set at $p \leq 0.05$. The correlations were interpreted according to the following criteria:

- to 0.8: Very strong correlation
- 0.8 to 0.6: Strong correlation
- 0.6 to 0.4: Moderate correlation
- 0.4 to 0.2: Weak correlation
- 0.2 to 0.0: Very weak correlation

3.6.4 Intervention Approach

A personalised approach for addressing the executive functioning difficulties of Grade 4 learners at West Rand School was developed for use as a guideline for the weekly executive functioning group interventions (Appendix G). The seminal works of

three psychologists, Freuerstein (1979; 1988), Vygotsky (1978) and Flavel (1977), form the basis of the intervention approach.

The researcher took on the role of the mediator during executive functioning groups presented to the Grade 4 learners weekly. As part of the MLE the researcher (mediator) followed the following principles.

- **Intentionality and reciprocity** (Freuerstein et al.1988). The learners were encouraged to consider relevant factors of the tasks with clarity and precision, as required to successfully complete the task. The mediator thus highlighted the salient aspects of task parameters, strategies or skills that may be useful in the completion of the task

- **Transcendence** (Freuerstein et al. 1988). The situation/type of task requiring a specific strategy or skills was made distinguishable from other situations, while simultaneously linking it to situations where the strategy or skill can also be used in future situations.

- **Mediation of meaning** (Freuerstein et al. 1988). The engagement of learners in class discussions and reciprocal problem solving were encouraged. It was also ensured that they understand the purpose of the activity and how they would benefit from it.

- **Respect for each other's attributes** was fostered as learners were facilitated to understand their strengths and weaknesses and to maximize their positive attributes (Schunk 2001). The learners were guided to identify which strategies worked best for each of them by the mediator making use of verbal cues and feedback. This contributed to the development of their metacognition (Flavell 1977) as well as their understanding of the why, where, when, and how application thereof to achieve transcendence (Freuerstein et al. 1988).

- **Self-talk and self-management** were modelled by the mediator and verbal cues were given to facilitate the use thereof by the learners. Learners were encouraged to stop(focus), develop a plan based on the goal of the activity, carry out the plan and then reflect on whether their plan worked or needed to be altered (Meltzer 2007). Verbal cues and guidance was gradually decreased as learners became more competent (Dawson and Gaure 2010).

3.7 Validity and Reliability

The validity and reliability aspects germane to this study as well as the measurement techniques used for data collection are discussed below.

3.7.1 Validity and reliability of measurement techniques

The measurement techniques, which include the Delis Rating Scale of Executive Function (D-REF) and academic results, are discussed in terms of their reliability and validity.

3.7.1.1 Delis Rating of Executive Functions (D-REF)

The D-REF assessment is not to be used as a diagnostic tool but is used to report behavioural aspects that identify executive functioning deficits. As indicated in section 3.5.2 the D-REF is a valid and reliable assessment with strong psychometric properties. The D-REF is an appropriate measure to use in conjunction with other measures of executive functioning, and it can be used to develop individualised interventions based on the identified problem areas. The length of the forms is convenient and user-friendly, and the interpretation of obtained T-scores is consistent with other scales of this type. The core and clinical indices are adequate to good (Warnick et al. 2015). More detailed descriptions of the D-REF's validity and reliability can be found in section 3.5.2.

3.7.1.2 Academic results

As mentioned in section 3.3.3, academic report cards are generated by SASAMS which is an electronic tool to ensure valid and reliable results. The marks the learners obtained for projects, tests and examinations are loaded into the system by the teacher. The South African Schools Administration and Management System does not allow for missing data and eliminates possible calculation errors. The school follows the CAPS, and all assessment methods are governed by this policy. Academic records are thus deemed reliable and valid.

3.7.2 Rigor of the study

To ensure the construct validity of the research process, multiple sources of evidence were used, and the best measurement techniques were used to study the phenomenon. The D-REF, as well as academic records were used as objective

sources of evidence. Generation of data took place four times a year (once a term) for both the D-REF results and quarterly academic records of the 16 participants. This then yielded 64 data points for the D-REF and 64 for academic records. The inclusion and exclusion criteria of the study were strictly adhered to.

The double data-capturing method was used to minimise human error when filling in the relevant data into the Excel database. No missing data were encountered as indicated in section 3.6.2. A detailed account of the research procedure as well as the intervention used is included in the research report for future researchers to access should they want to recreate the study (Yin 2014).

3.8 Ethical Considerations

3.8.1. Beneficence and non-maleficence

This principle highlights the obligation of minimising possible harm and maximizing the benefits, as research should be to “improve the human condition” (National Department of Health 2015, p14). No deliberate harm was caused to the participants or stakeholders during this research. The risk for causing harm was minimal for this research as the children were not directly involved and only their data (D-REF results, academic records and relevant demographic information) was accessed.

3.8.2 Distributive justice (equality)

This means that there should be a just balance of risk versus benefits for all involved in the research process. It also means that there should be a realistic likelihood that the population of the study would benefit from the research done, either immediately or in future (National Department of Health 2015). The participants (Grade 4 learners) did not benefit from the research outcomes directly, but the research results contribute to evidence-based treatment of executive functioning for future Grade 4 learners and inform the broader occupational therapy community working with those needing executive functioning interventions.

3.8.3 Respect for persons (dignity and autonomy)

Autonomy speaks to the ability to be deliberate about your decision (such as to consent or not) and act on the decision. The principle also includes treating research participants with dignity and being primarily concerned for their well-being and safety

(National Department of Health 2015) In order to honour autonomy, information about the research was communicated to the participants (or in this case, the parents of the Grade 4 learners) in a way and language that was accessible and understandable. This was to ensure that they were sufficiently informed to enable them to make an informed decision. The parents were not coerced in any way and their choice to consent/not consent was self-determined. All parents involved were older than 18 years of age.

3.8.4 Informed consent

For data collection to take place, access was needed to the learners' demographic information as well as assessment results of the D-REF and academic records. As the learners were too young to legally consent, their parents' or legal guardians' consent was required (Wasunna et al. 2014). The parents/guardians were provided with an information sheet and were asked to sign the consent form (should they consent) after they had had time to read the information sheet and ask any questions they had. A copy, an information sheet with all relevant information regarding the study, as well as the process of informed consent, was given to the parent/guardian. The contact information of the researcher was on the information sheet and clearly visible. Learners were informed about the research and their information being accessed and gave verbal accents.

In compliance with the Declaration of Helsinki, the parents/guardians were adequately informed about (see Appendix F):

- the aim, methods, possible risk factors and possible benefits of the study and participation in the study.
- the need for informed consent from the parent/guardian for the researcher to access relevant data and documentation.
- the freedom to decline to participate in the study, and that this will not negatively influence the treatment of their child.
- the right to withdraw from the study at any time and for any reason with no negative effect on themselves or their child.

3.8.5 Upholding confidentiality and anonymity

To ensure that all information remained confidential no names were used. Each participant was allocated a code and relevant information was captured on an Excel spreadsheet using this code. The researcher only had access to the personal information of the participants that was needed to complete the current study.

Three lists were generated and stored separately:

1. Codes with corresponding names and demographic information
2. Codes with corresponding Q-REF and academic scores
3. Participants (represented by codes) divided into three diagnosis groups (CP, SLD and ADHD, ASD)

Due to the retrospective nature of data collection, the researcher was able to access all relevant D-REF assessments and academic results of each participant at the same time. It was thus possible to code all assessments of a participant simultaneously. The list with the participant names and corresponding codes and diagnoses was kept separate from all other data that was available to the researcher only and was kept on a password-secured laptop. The list was not accessed during the data analysis stage of this study.

CHAPTER 4: RESULTS

4.1 Introduction

In this chapter, the results for a total number of 16 participants are presented. The results include the demographic information, the Delis Rating of Executive Functioning (D-REF) scores, the level of impairment for core index domain and clinical index scores over four terms. The change in median scores for the core index and clinical index scores over four terms and the change in T-scores for both the clinical index and core index over four terms are presented according to diagnostic categories. The results chapter further includes the average academic marks for each participant over the four terms. Lastly, the correlations between the number of participants who improved on D-REF scores as well as academic marks are discussed.

4.2 Demographics

Most learners (63%) were male and 37% were female. A quarter of the learners (25%) had specific learning disabilities, which included ADD, dyslexia and alexia. Learners with CP made up 37.5% of which half had ataxic CP and half had diplegic CP. Two learners (12.5%) had both ADHD and ASD while only one learner (6.25%) had ASD only. Learners with other diagnoses, including Spina Bifida, Congenital Myopathy and hearing loss, made up 18.75% of the population.

Table 4.1 Gender and diagnostic categories of participants (N=16)

		N	Percentage
Gender	Male	10	63.00
	Female	6	37.00
Diagnostic Category	CP Diplegia	3	18.75
	CP Ataxia	3	18.75
	SLD (Dyslexia, ADD, Alexia)	4	25.00
	ASD	1	6.25
	Both ADHD and ASD	2	12.50
	Other	3	18.75

Learners were divided into two groups: An Afrikaans and an English class with eight (n≈8) learners in each class. The home language of eight learners (50%) was Afrikaans. Three (18.75%) learners' home language was English, and another three (18.75%) was Setswana. One (6.35%) learner's home language was Tsonga and one (6,25%) isiZulu.

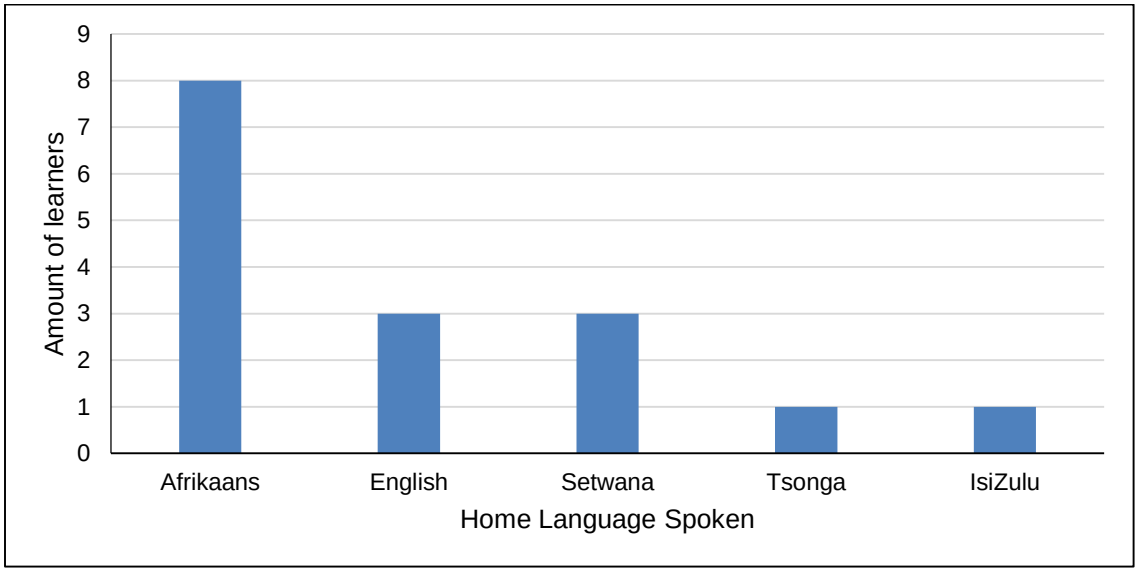


Figure 4.1 Home language of learners

4.3 Delis Rating Scale of Executive Functioning- level and change of executive functioning over four terms

4.3.1 Core Index Domains

4.3.1.1 Median D-REF core index domain scores

The median D-REF core index domain scores showed improvement from Term 1 to Term 2 for all core index domains (Figure 4.2). While behavioural functioning, emotional functioning and the total composite score continued to improve from Term 2 to Term 3, the executive functioning score returned to the Term 1 level.

Behavioural functioning and the total composite score showed an increase in Term 4 with a slight improvement in executive functioning. Emotional functioning remained the same. (Figure 4.2). Most of for the domains fell into borderline elevated

except emotional functioning, which fell into the normal range throughout the four terms. Behavioural function was in a normal range in Term 3, with executive functioning achieving a normal range in Term 2.

No significant differences were noted in the D-REF scores when these were analyzed for differences from term to term, irrespective of the change was positive or negative.

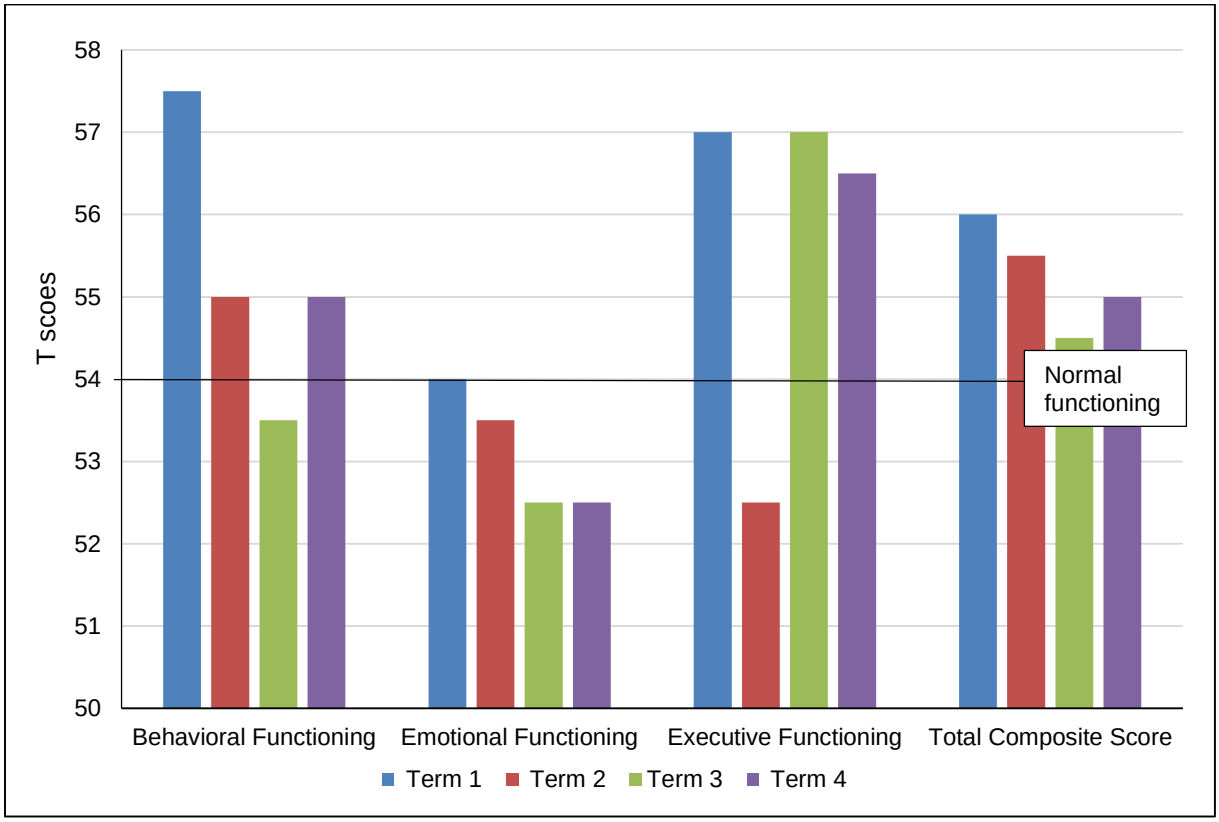


Figure 4.2 Median T scores for core index domains on the Delis Rating of Executive Functions (D-REF) over four terms (N=16)

4.3.1.2 Change in Core Index Domains and Clinical Index Scores

No significant changes in any of the scores on the Core Index Domains on the DREF were seen between the four different terms or overall, from Term 1 to Term 4 (Table 4.2). Executive functioning indicated the greatest change from Term 1 to Term 2 with an improvement of 4.5 points, but this change was not maintained in Term 3 and Term 4.

Table 4.2 Change in median scores for the core index domains and the clinical index scores on the Delis Rating of Executive Functions (D-REF) over four terms (N=16)

Core Index Domains	Change in median score		p-value
Behavioural Functioning	Term 1 to Term 2	-2.5	0.743
	Term 2 to Term 3	-1.5	0.120
	Term 3 to Term 4	1.5	0.599
	Term 1 to Term 4	2.5	0.266
Emotional Functioning	Term 1 to Term 2	-0.5	0.233
	Term 2 to Term 3	-1	0.129
	Term 3 to Term 4	0	0.423
	Term 1 to Term 4	-1.5	0.273
Executive Functioning	Term 1 to Term 2	-4.5	0.241
	Term 2 to Term 3	4.5	0.229
	Term 3 to Term 4	-1	0.492
	Term 1 to Term 4	1.5	0.678
Total Composite Score	Term 1 to Term 2	-0.5	0.890
	Term 2 to Term 3	-1	0.934
	Term 3 to Term 4	0.5	0.714
	Term 1 to Term 4	2	0.541

4.3.1.3 D-REF core index domain – normal to severe level of impairment

Frequencies for the level of impairment on the D-REF identified as normal/borderline or as mild to severe for the core index domains were determined. Table 4.3 indicates these frequencies with a lower percentage of learners with mild to severe behavioural functioning and executive functioning in Term 2. The percentage of learners with normal to borderline impairment of behavioural functioning increased from 50% to 56.2%, as the percentage of learners with moderate to severe impairments decreased from 50% to 43.8% from Term 1 to Term 4.

There was an increase in learners with mild to severe impairment in Emotional functioning in Term 2. The percentage of learners with normal to borderline impairment of emotional functioning decreased from 68.8% to 62.6% from Term 1 to Term 4.

Mild to severe impairment had a lower percentage of learners for executive functioning, in Terms 2 and Term 3. The percentage increased again in Term 4. For executive functioning, which was the focus of the intervention, the frequency of learners with normal to borderline impairment increased (56.2% to 62.5%) from Term 1 to Term 4.

For the Total Composite Score when all domains were considered, there was no improvement in the percentage of learners with normal /borderline scores and those with mildly to moderately and severely elevated scores. The percentage of learners with normal to borderline impairment for the total composite score remained unchanged (62.6%) over all four terms.

Table 4.3 Level of impairment for core index domains on the Delis Rating of Executive Functions (D-REF) over four terms (N=16)

Domain		Total% normal/border-line	Total% Mild/ Severe
	n (%)		
Behavioural Functioning	Term 1	50%	50%
	Term 2	56.2%	43.8%
	Term 3	62.4%	37.6%
	Term 4	56.2%	43.8%
Emotional Functioning	Term 1	68.8%	31.2%
	Term 2	62.4%	37.4%
	Term 3	68.8%	31.2%
	Term 4	62.6%	37.4%
Executive Functioning	Term 1	56.2%	43.7%
	Term 2	68.8%	31.2%
	Term 3	68.8%	31.2%
	Term 4	62.5%	37.5%
Total Composite Score	Term 1	62.6%	37.4%
	Term 2	62.6%	37.4%
	Term 3	62.6%	37.4%
	Term 4	62.6%	37.4%

4.3.1.4. Change in mild/moderate and severe impairment scores – core index domains

Figure 4.3 indicates that for both behavioural and emotional functioning in the core index domains, the percentage of learners with severe impairment and learners with mild to moderate impairment fluctuated over all four terms with similar percentages. The percentage of learners with severe executive impairment decreased from Term 1 through Term 4, with an increase in the percentage of learners with mild to moderate executive functioning over this time. The percentage of learners (25%) with a total composite score indicating mild/moderate impairment and those with severe impairment (13%) remained unchanged from Term 2 through to Term 4.

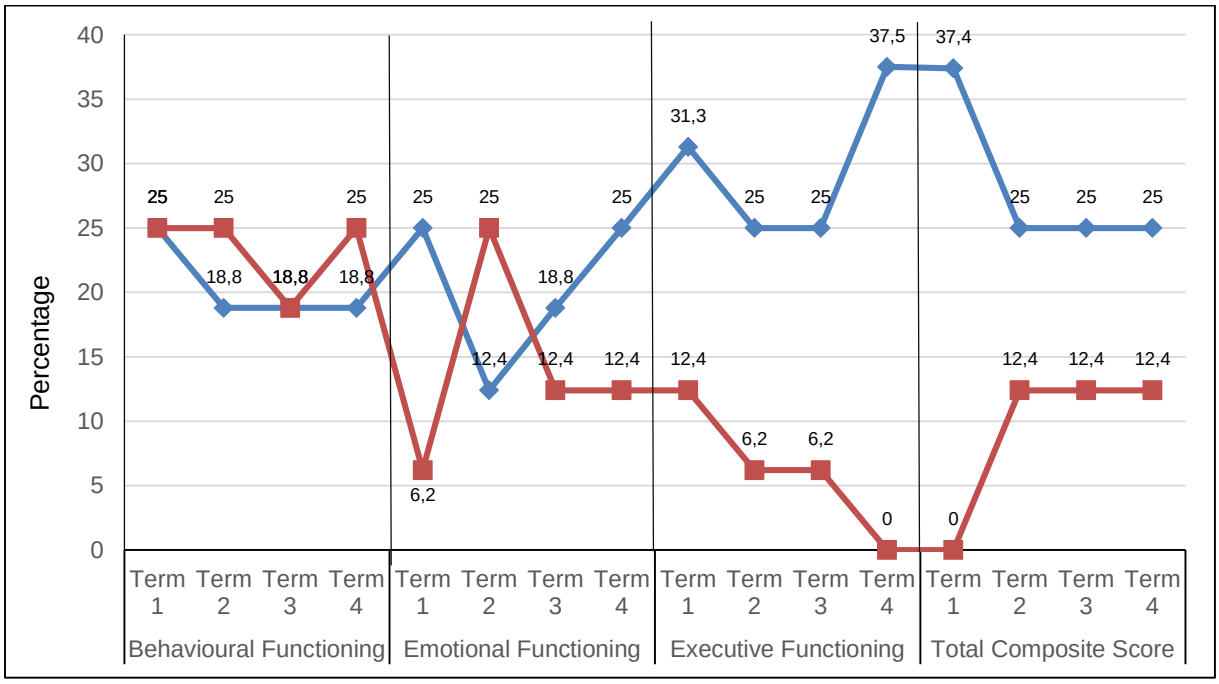


Figure 4.3 Change in Core Index Domains on the Delis Rating of Executive Functions (D-REF) Scores for participants with mild and moderate impairment and severe impairment

4.3.2 Clinical Index Scores

4.3.2.1 Median D-REF clinical index scores

The clinical index scores were highest for the learners for attention and working memory, which improved slightly in Term 2 but were elevated in Terms 3 and 4 (Figure 4.4).

Activity levels and impulse control improved consistently from Term 1 to Term 3, with an increase in scores in Term 4. Compliance and anger management, and abstract thought and problem solving were, for the most part, in the normal range with higher scores in Term 2, with improvement or maintenance of the score in Term 3 respectively. Both these clinical index scores indicated impairment in Term 4.

Abstract thought and problem-solving fell into the normal range (%) with an increase in scores in Terms 2 and 3 and was slightly elevated in Term 4.

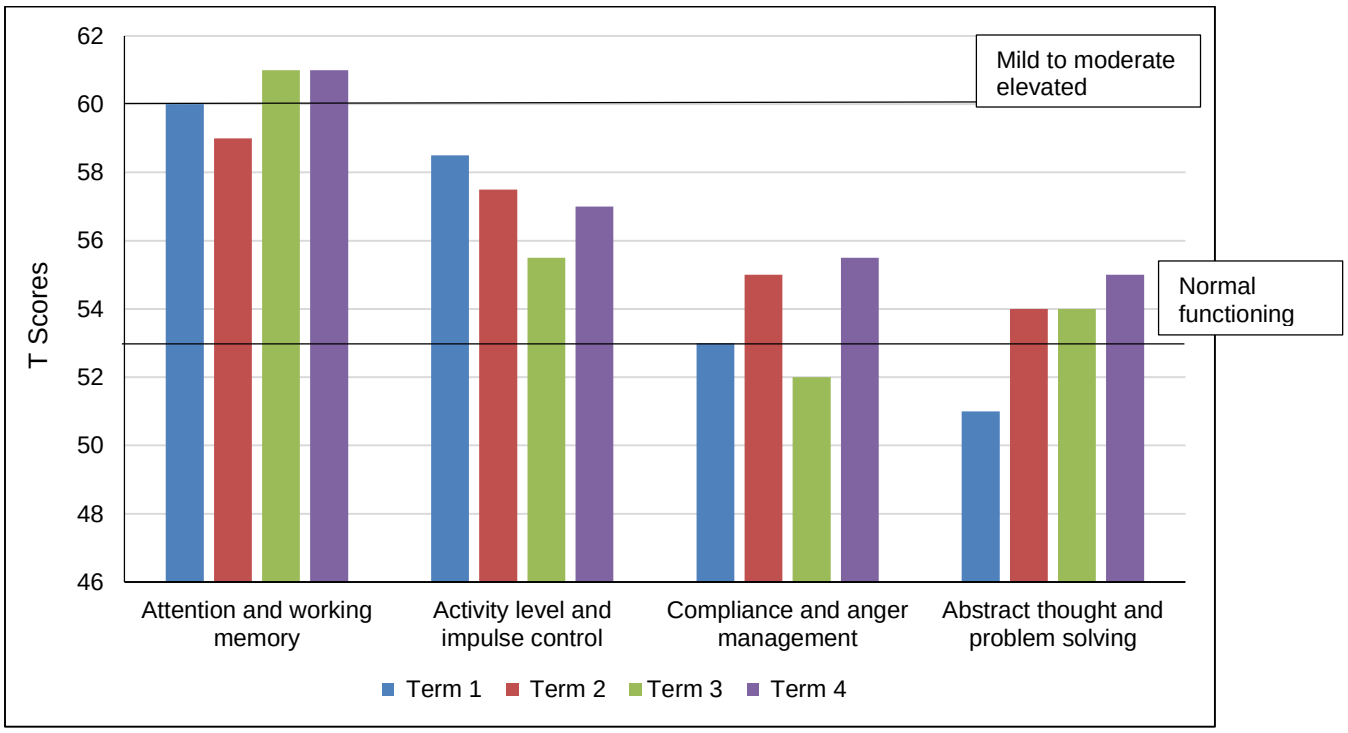


Figure 4.4 Median T scores for clinical index on the Delis Rating of Executive Functions (D-REF) over four terms (N=16)

4.3.2.2 D-REF clinical index – normal to severe level of impairment

Table 4.4 indicates the percentage of learners' level of impairment as either normal/borderline or mild to severe for the clinical index on the D-REF. Fewer learners in Term 4 had mildly to moderately and severely elevated impairment for activity level and impulse control.

There was a similar finding for attention and working memory from Term 1 to Term 3 and for abstract thought and problem-solving from Term 1 to Term 2. The percentage of learners with normal to borderline impairment of attention and working memory, changed between all terms but remained the same (50%) overall when comparing Terms 1 and Term 4.

Table 4.4 Level of impairment for the clinical index scores on the Delis Rating of Executive Functions (D-REF) over four terms (N=16)

Clinical Index Score Type		Total% normal/border-line	Total% Mild/ Severe
Attention and working memory	Term 1	50.0%	50.0%
	Term 2	56.2%	43.8%
	Term 3	33.8%	56.2%
	Term 4	50%	50.%
Activity level and impulse control	Term 1	50.0%	50.0%
	Term 2	56.2%	43.8%
	Term 3	62.6%	37.4%
	Term 4	68.8%	31.2%
Compliance and anger management	Term 1	75.0%	25%%
	Term 2	68.8%	31.2%
	Term 3	68.8%	31.2%
	Term 4	75.0%	25.0%
Abstract thought and problem solving	Term 1	62.6%	37.4%
	Term 2	81.2%	18.6%
	Term 3	75.0%	25.0%
	Term 4	75.0%	25.0%

Changes for compliance and anger management showed little change over the four terms. The percentage of learners with normal or borderline impairment of activity level and impulse control, steadily increased each term from Term 1 through 4. This corresponds with the decrease in learners with severe impairment for this clinical index throughout the four terms. There is no change of the percentage of learners with no to borderline impairment of compliance and anger management (75%) when comparing Term 1 and Term 4.

Abstract thought and problem solving had the highest percentage of learners in the normal/borderline elevated scores, indicating less impairment in these categories. The greatest increase in the percentage of learners with no to borderline impairment of abstract thought and problem-solving took place from Term 1 to Term 2 (62.6% to 81.2%). The percentage of learners with no to borderline impairment of abstract thought and problem solving increased from 62.6% in Term 1 to 75.0% in Term 4.

4.3.2.3 Change in Core Index Domains and Clinical Index Scores

No significant changes in any of the scores on the Clinical Index Scores on the D-REF were seen between the four different terms or overall, from Term 1 to Term 4. (Table 4.5). Abstract thought and problem-solving indicated the greatest change from Term 1 to Term 4 with an improvement of 4 points.

Table 4.5 Change in median scores for the clinical index scores on the Delis Rating of Executive Functions (D-REF) over four terms (N=16)

Clinical Indexes of D-REF	Change in median scores		p-value
Attention and working memory	Term 1 to Term 2	-1	0.501
	Term 2 to Term 3	1	0.786
	Term 3 to Term 4	0	0.172
	Term 1 to Term 4	1	0.599
Activity level and impulse control	Term 1 to Term 2	-1	0.380
	Term 2 to Term 3	-2	0.064
	Term 3 to Term 4	0	0.903
	Term 1 to Term 4	-1.5	0.267
Compliance and anger management	Term 1 to Term 2	2	0.109
	Term 2 to Term 3	-3	0.128
	Term 3 to Term 4	3.5	0.240
	Term 1 to Term 4	2.5	0.357
Abstract thought and problem solving	Term 1 to Term 2	3	0.204
	Term 2 to Term 3	0	0.00
	Term 3 to Term 4	1	0.599
	Term 1 to Term 4	4	0.375

4.3.2.4 Change in mild/moderate and severe impairment scores

In Figure 4.5 it can be seen the percentage of learners with severe impairment in the clinical index of attention and working memory remained the same for Term 1 through Term 3 and decreased in Term 4. The percentage of learners with mild to moderate impairment with attention and working memory decreased the greatest from Term 1 to 2 but showed an overall increase between Term 1 and Term 4.

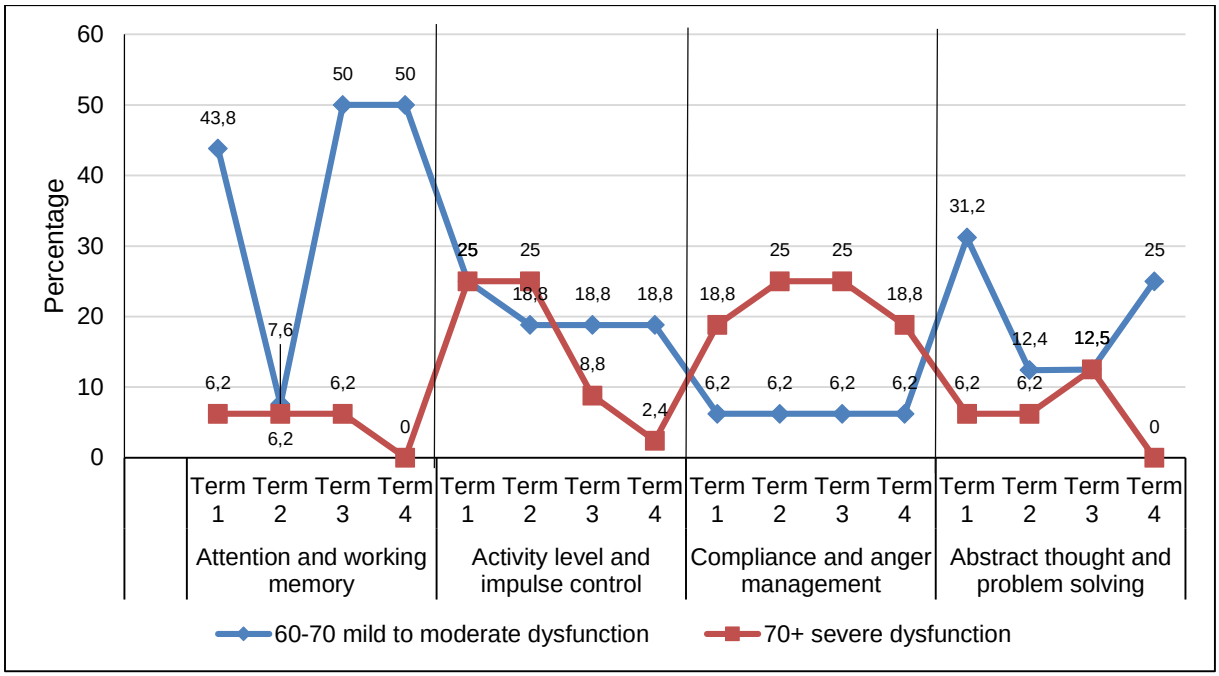


Figure 4.5 Change in the clinical index scores on the Delis Rating of Executive Functions (D-REF) for participants with mild and moderated impairment and severe impairment.

For the clinical index of activity level and impulse control a decrease in the percentage of learners with severe impairment can be seen when comparing Term 1 to Term 4. The percentage learners with severe impairment for compliance and anger management increased from Term 1 to Term 2 and remained the same for Term 3. It however decreased for Term 4 to the level of Term 1. The percentage of learners with a mild to moderate impairment in the clinical index of activity level and compliance and compliance and anger management decreased somewhat and remained the same respectively from Term 1 to Term 4.

The percentage of learners with severe impairment with abstract thought and problem solving decreased when comparing Term 1 to Term 4. The percentage learners with a mild to moderate impairment in abstract thought and problem solving showed an overall decrease from Term 1 to Term 4. Overall, for all clinical index scores the percentage of learners with severe impairments was lower in Term 4.

4.4 Change in the Delis Rating of Executive Functions (D-REF) for diagnostic categories

When the core index domains for the D-REF were analysed according to diagnostic categories, although improvement fluctuated overall, the learners with SLD

Dyslexia, ADHD/ASD, Congenital Myopathy and two learners with CP Ataxia were those that improved or maintained their score over the four terms. One learner with CP Diplegia improved or maintained their scores but only learners with ADHD/ASD improved consistently over all core index domains, other than emotional functioning remaining the same. Learners with ADD in conjunction with ASD, SLD Alexia and two learners CP Diplegia showed deterioration, no or minimal improvement across all domains (Table 4.6).

Table 4.6 Change in T scores for the core index on the Delis Rating of Executive Functions (D-REF) from Term 1-4 according to diagnostic categories (N=16)

Behavioural Functioning	Emotional Functioning	Executive Functioning	Total Composite Score	**Total Change**	**Diagnostic categories**
Term 1-4					
0	4	3	3	10	ADD
-6	0	-9	-4	-19	ADHD/ASD
-4	-8	-3	-4	-19	ADHD/ASD
0	10	3	3	16	ASD
3	-2	-1	0	0	Congenital Myopathy
-12	-3	10	-2	-7	CP Ataxia
-1	3	-4	-1	-3	CP Ataxia
0	3	-2	0	1	CP Ataxia
4	0	7	4	15	CP Diplegia
8	-2	10	6	22	CP Diplegia
-2	0	0	-1	-3	CP Diplegia
-4	14	-2	3	11	Hearing Loss/MID
1	7	-2	2	8	SLD Alexia
-7	-2	2	-2	-9	SLD Dyslexia
0	-7	5	0	-2	SLD Dyslexia
-2	12	-9	1	2	Spina Bifida

Key

	Lower score
	Higher score

When the clinical index scores for the D-REF were analysed according to diagnostic categories, learners had varying changes in scores. The learners with ADHD/ASD and Spina Bifida had improvement in three to four scores over the four terms. Learners with ADD, ASD, CP Ataxia and CP Diplegia showed deterioration, no or minimal improvement across all scores (Table 4.7).

Table 4.7 Change in T scores for the clinical index scores on the Delis Rating of Executive Functions (D-REF) from Term 1-4 according to diagnostic categories (N=16)

Attention and working memory	Activity level and impulse control	Compliance and anger management	Abstract thought and problem solving	**Total Change**	**Diagnostic categories**
Term 1-4					
6	2	8	2	18	ADD
-6	-9	3	-12	-24	ADHD/ASD
-2	-4	-8	-3	-17	ADHD/ASD
4	-1	6	2	11	ASD
2	8	-4	-2	4	Congenital Myopathy
15	-14	0	4	5	CP Ataxia
2	-5	3	2	2	CP Ataxia
-4	0	5	0	1	CP Ataxia
12	0	0	-5	7	CP Diplegia
10	5	-5	6	16	CP Diplegia
-4	3	-9	4	-6	CP Diplegia
-2	-3	11	0	6	Hearing Loss/MID
-6	-2	6	2	0	SLD Alexia
0	-4	-1	8	3	SLD Dyslexia
1	2	-2	10	11	SLD Dyslexia
-12	-3	11	-8	-12	Spina Bifida

Key

	Lower score
	Higher score

4.5 Academic Records

4.5.1 Academic marks over four terms

The mean scores for the academic marks in percentages are presented in Figure 4.6. In Term 1, the subject with the lowest mean is Mathematics (60.62%). The subject with the highest mean percentage is Life Skills (74.19%). More learners had a decrease in their marks compared to those that improved over the 4 terms.

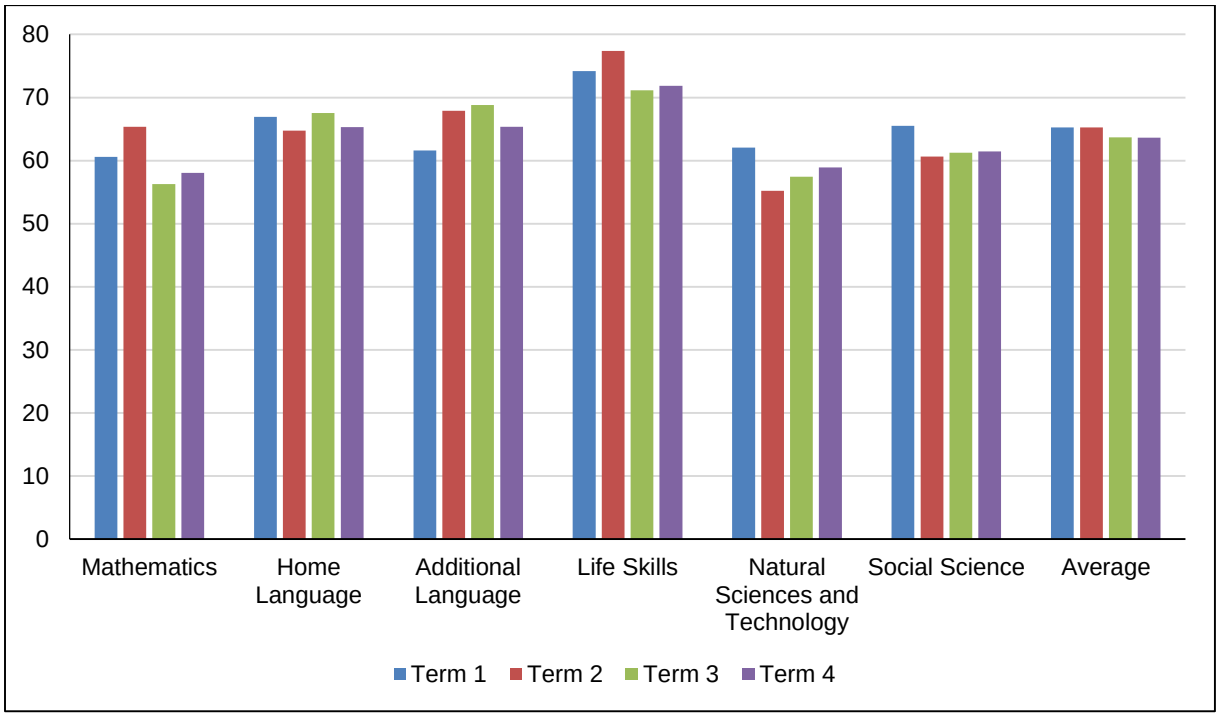


Figure 4.6 – Mean academic marks for participants in each Term and overall (Term 1-4)

4.5.2 Change in academic marks

A significant number of learners improved in their additional language marks between Term 1 and Term 2 (p=0.047) and overall, in the year (Term1 to Term 4: p=0.0021) For all other subjects the marks were lower overall in the year (Term1 to Term 4), but this was not statistically significant (Table 4.8).

Table 4.8 Change in academic marks over 4 terms

Subject	Term 1-2	Term 2-3	Term 3-4	Term 1-4
Mathematics	4.77	-9.12	1.81	-2.54
Home Language	-2.18	2.81	-2.25	-1.62
Additional Language	6.25	0.94	-3.44	3.75
Life Skills	3.19	-6.25	0.75	-2.31
Natural Sciences and Technology	-6.88	2.25	1.5	-3.13
Social Science	-4.88	0.63	0.18	-4.07
Average	0	-1.57	-0.06	-1.63

Key

	Improved marks
	Decreased marks

While the marks for Natural Sciences and Technology dropped significantly from Term 1 - 2 (p=0.001), the marks for Mathematics and Life Skills between Term 2 and Term 3 were significantly lower (p= p=0.029 and p=0.002 respectively)

For the overall academic results from Term 1 to Term 4 significantly more learners had a decrease in their overall mean score when compared to the number that showed improvement (p=0.041).

4.5.3 Correlations between change in Delis Rating of Executive Functions (D-REF) scores and academic marks

Moderate to strong negative correlations between the change from Term 1 to Term 4 were found in some D-REF scores and academic marks (Table 4.9). This indicates a correlation between negative changes in D-REF scores, indicating improvement in executive functions, and academic achievement, indicating improvement in mean academic scores.

Change in Mathematic scores correlated strongly with change in executive functioning and attention/working memory, moderately with change in composite functioning, as well as change in abstract thinking and problem-solving scores on the D-REF. There was a moderate correlation between the change in emotional functioning and Life Skills marks, while the change in abstract thinking and problem-solving scores had a moderate correlation with the change in Social Sciences marks. For the overall mean change in marks from Term 1 to Term 4, only changes in abstract thinking and problem-solving scores correlated strongly.

Table 4.9 Correlations between D-REF scores and academic marks

	Matha-maticcs	**Home Language**	**Additional Language**	**Life Skills**	**Natural science**	**Social science**	**Mean academic score**
Core Index Domains							
Behavioural Functioning	-0.32	0.09	-0.39	0.07	-0.04	0.02	-0.27
Emotional Functioning	0.23	0.12	-0.05	**-0.43**	-0.01	-0.21	-0.21
Executive Functioning	**-0.77**	0.18	-0.12	0.35	0.07	-0.09	-0.32
Composite Scores	**-0.45**	0.33	-0.18	-0.14	-0.01	-0.20	-0.38
Clinical Index Scores							

Attention/ Working memory	**-0.90**	0.11	0.05	0.37	0.24	0.05	-0.25
Activity Level and Impulse control	-0.18	0.17	-0.32	0.10	-0.09	-0.07	-0.19
Compliance and Anger management	0.11	0.05	0.07	-0.34	0.18	-0.06	-0.06
Abstract thinking and Problem solving	**-0.46**	-0.20	-0.10	-0.03	0.02	**-0.55**	**-0.65**

4.6 Conclusion: Summary of results

When the D-REF clinical index and core index scores were analyzed, no significant differences were noted from term to term. When the core index domains and clinical index domains were analyzed according to diagnostic categories, learners had varying scores. Learners with ADHD/ASD however, showed the most improvement in both indices. Moderate to strong negative correlations between the change from Term 1 to Term 4 were found in some D-REF scores and academic marks which indicates a correlation between negative change in D-REF scores, and thus improvement in executive functions, and academic achievement.

CHAPTER 5: DISCUSSION

5.1 Introduction

This discussion considers a sample of 16 Grade 4 learners who attended a weekly occupational therapy intervention programme to address executive functioning deficits over the span of four school terms. Demographics are discussed, as well as the change of executive functioning throughout the intervention. The change in scores from the D-REF of learners from different diagnostic groups, as well as the correlation of the change in executive functioning scores and academic outcomes are also discussed.

5.2 Demographics

There is a paucity of literature regarding the statistics and demographics of LSEN schools in South Africa. These schools are not always comparable as they cater for the needs of the learners in the surrounding areas as determined by the Department of Education and District Based Support Team (DBST). Learners with Special Educational Needs schools therefore have distinct and non-comparable learner demographics (Directorate Inclusive Education 2014).

The most common diagnosis for the learners in the study was CP (37%) since West Rand School was originally founded by community members for learners with CP. However, learners with a wide variety of diagnoses were included in the study as the school later started to accept learners with other diagnoses, including physical and specific learning disorders. Although there is a separate LSEN school for learners with ASD in the same area, learners with ASD who have a co-morbid physical diagnosis or those able to follow the CAPS curriculum are placed in West Rand School by the DBST. Many learners at West Rand School are from a low socio-economic status and are exempted from paying school fees and receive food parcels.

There was an even spread of learners from the English and Afrikaans classes, with eight (n≈8) learners from each class. All learners in the Afrikaans class were educated in their home language. Only three of the eight learners in the English class were educated in their home language as the other five learners' home language

was a range of other indigenous South African languages. Thus, five of the 16 learners (31%) included in the study were being educated and assessed in a language other than their home language even though policy indicates they should receive instruction for the lower grades in their home language (Veriava et al. 2017). The higher percentage of males in the study was congruent with literature that indicates a higher incidence of learning disabilities and CP in males (Romeo et al. 2023; Padhy et al. 2016).

5.3 Change in executive functioning

The first objective of this study was to determine the change in executive functioning of the learners receiving the weekly intervention. Executive functioning deficits are often a common denominator in diagnoses creating barriers to learning for school-going children, whether attending a mainstream or LSEN school (Khan and Lal 2023; Cramm et al. 2013; Faraone et al. 2003). This study indicated between 50% to 31% of participants had executive functioning deficits ranging from mild to severe at the start of the study (Table 4.3).

The median D-REF core index domain scores indicated an improvement from Term 1 to Term 2 for all core index domains, with executive functioning achieving a normal range in the second term. The executive functioning score, however, returned to the level of Term 1 in Term 3 (Figure 4.2). However, no significant differences were noted in the D-REF scores when these were analyzed for differences from term to term. It should be noted that for all indices a minimum of 50% of the learners fell into the normal and borderline range from Term 1 through to Term 4, except for attention and working memory decreasing to 33% with a corresponding increase of the percentage of learners in the mild to severe impairment in Term 3.

The third term of 2021 was, however, a term filled with adversity for learners due to the adjustment of the school environment and implementation of rotational timetabling following an increase in COVID-19 infections. The Department of Basic Education indicated a loss of between 22% and 50% of contact time in Term 3 of 2021, with rotational timetabling being a significant causal factor (Department of Basic Education 2022). Multiple studies indicated a trend of worsening overall mental health due to the pandemic (Samji et al. 2022). A study showed that the anxiety levels of students were high as they had to face many uncertainties, fears

and a changed school environment as well as an increased workload due to lost teaching time (Haffejee, et al. 2024). The negative effect of stress and anxiety on executive functioning is well documented (Ursache and Raver 2014; Visu-Petra et al. 2013; Salthouse 2012). The loss of school contact time, less intervention sessions received by the learners and the psychological effect of the pandemic could all have contributed to the D-REF scores for executive functioning impairments increasing (Figure 4.2).

Although the percentage of learners with mild to severe executive functioning impairment fluctuated through the four terms, it showed an overall decrease from Term 1 (43,7%) to Term 4 (37.5%) (Table 4.2). As the year progressed the percentage of learners with severe impairment in executive functioning decreased to 0 at the end of the intervention in Term 4 (Figure 4.3). It thus appears that the intervention has addressed more severe problems and that those learners with severe executive functioning impairment have benefitted the most. This corresponds to a principle that has been found to apply to executive functioning interventions by Diamond (2012), that the children with the most severe executive functioning impairments benefit the most from any intervention targeting executive functioning.

Another principle, as suggested by Diamond (2012), is that learners' executive functioning should continuously be challenged throughout interventions to ensure its improvement Learners must be required to aim to master a skill that is just beyond what they are able to do. This is known as working in the 'zone of proximal development' according to the theory of Vygotsky (1978). Working in the 'zone of proximal development' of each learner was challenging, as the executive functioning abilities of the learners varied significantly. To ensure that all learners were able to participate and complete the tasks, activities were simplified. This may have led to learners with greater executive functioning to not be challenged sufficiently to bring about significant improvement.

The group setting, however, allowed for learners with strengths in specific executive functions to mediate to classmates with weaknesses in these areas. These learners could, at times, also explain certain strategies and concepts to peers better than the mediator could. This was also the case in the South African study of Amod et. al.

(2017) on the remedial intervention programme in the development of planning skills for learners in Grades 4 and 5. Tzuriel (2013) also found peer mediation to be beneficial in bringing about cognitive modifiability in the paediatric population.

For the clinical index scores, there was no overall change in the percentage of learners with mild to severe deficits for attention and working memory from Term 1 to Term 4 (50%) as seen in Table 4.4., however the percentage of learners with severe deficits decreased from 5% to 0 (Figure 4.5). The intervention thus seems to have improved the deficits of learners with severe impairments to mild/moderate impairments, but did not have an effect on the overall percentage (50%) of total learners that had deficits.

The percentage of learners with activity level and impulse control impairments decreased from Term 1 to Term 4 with a resulting increase of percentage of learners with no to borderline impairments (Table 4.4). There was a greater decrease of percentage of learners with severe impairments than those with mild or moderate impairments (Figure 4.5). The intervention thus seems to have addressed activity level and impulse control to a greater extent in learners who had severe impairments.

The improvement in both the attention and working memory (for the learners with severe impairments) and the activity level and impulse control indices may be attributed to the MLE principles applied during the intervention process. These include the mediator highlighting the most salient aspects that needed to be considered and therefore directing the learners' attention. The MLE principle of transcendence was applied by linking the current task requirements to previously gained knowledge and skills. Working memory was practised by holding this knowledge in mind, as indicated to do so by the mediator, in order to complete the task. Self-talk and self-management were modelled by the mediator, and verbal cues were given to facilitate the use thereof by the learners. Learners were encouraged to stop (focus), to develop a plan based on the goal of the activity, carry out the plan and then reflect whether their plan worked or needed to be altered. This requires the use of inhibitory control/impulse control with self-talk especially requiring cognitive inhibition. In turn this may have contributed to the improvement

of working memory as cognitive inhibition has been found to support working memory (Diamond 2012).

There was no overall change of learners with compliance and anger management impairments when comparing Term 1 and Term 4 (Table 4.4). The percentage of learners with mild or moderate impairments remained consistent over the four terms. There was an increase in learners with severe impairments from Term 1 to Term 2, which returned to Term 1's values by Term 4 (Figure 4.5). The MLE intervention approach did not directly target anger management, and the emotionally strenuous circumstances of the post-pandemic times may have contributed to compliance and anger management difficulties.

There was an overall decrease in the percentage of learners with abstract thought and problem-solving deficits when comparing Term 1 to Term 4 (Table 4.4). There was a decrease of learners with mild/moderate deficits as well as learners with severe deficits, with no learners having severe deficits with abstract thought and problem solving by the end of Term 4 (Figure 4.5). This is consistent with expectations that the cognitive nature of the MLE approach developed with the use of self-talk, self-monitoring, planning of tasks and verbalisation of strategies would improve abstract thought (Miranda et al. 2011) and problem-solving abilities.

Considering the abovementioned together, the intervention seems to have addressed severe impairments most effectively, with better outcomes in the clinical indices of activity level and impulse control, and abstract thought and problem-solving. The intervention did not effectively address compliance and anger management. Only a slight individual improvement in attention and working memory is indicated. This makes an improvement in academic performance unlikely as working memory has been shown to be the best predictor of academic achievement in a meta-analysis by Visu-Petra et al. (2011).

5.4 Executive functioning and diagnoses

The second objective of the study was to determine the change in executive functioning based on the D-REF scores of the Grade 4 learners from Term 1 to Term 4 for different diagnostic groups. Learners with various diagnoses were included in this study. These diagnoses included ADHD/ASD, SLD, ASD only, various subtypes of CP and other physical diagnoses.

When the core as well as clinical index scores for the D-REF were analysed according to diagnostic categories, varying changes in scores were found. Only learners with ADHD/ASD improved consistently across all core index domains. Learners with CP Ataxia and one learner with CP Diplegia improved or maintained their score (Table 4.6). The learners with ADHD/ASD had improvements in three to four scores over the four terms with other learners showing deterioration or minimal improvement across all scores (Table 4.7).

It is interesting to note that the learners with comorbid ASD and ADHD showed overall improvement but learners with ASD only or ADD only showed deterioration or no improvement. Fernandez-Andrez et. al. (2021) have found learners with comorbid neurodevelopmental disorders to have more executive functioning impairments than their counterparts with only one neurodevelopmental disorder. This may further indicate that the intervention was of more benefit for those learners with the more severe impairments.

Attention Deficit Hyperactivity Disorder (ADHD) is characterized by impulsiveness, hyperactive behaviour and inattention that may have a significantly negative effect on daily functioning. (Von Rhein et al. 2016; American Psychiatric Association 2013). School-related difficulties arise due to these learners having challenges with inhibitory control, selective attention (Diamond 2013) and on-task behaviour (Rapport et al. 2013). The weekly intervention placed much focus on the mediation of self-regulation, on-task thought and behaviour, facilitating a learner to focus on the relevant information as well as impulse control. This is similar to the MLE methodology of intervention used by Amod et. al (2017), finding this to be an effective intervention strategy, rendering improved executive functioning and academic performance. More detailed information on the learner with ADD could shed some light as to why this learner did not show improvement in executive functioning scores and how a more individualised approach may be of more benefit.

From observations during intervention sessions, the learner with ASD experienced great difficulty with self-talk without broadcasting thoughts. As broadcasting of thoughts may hinder the concentration of learners in his class, he was encouraged to make use of internal dialogue, but found this extremely challenging. The relationship between executive functioning and language has been well established

in the literature for both typically developing learners (Kuhn et al. 2014) and learners with language impairments (Marini et al. 2020; Vissers et al. 2015) and ASD (Akbar et al. 2013). Language is utilized while executing tasks that require executive functioning (Winsler et al. 2009). The use of inner speech is theorized to ensure on-task thought processes, interpreting instructions and monitoring of progress throughout the execution of tasks. This corresponds with Vygotsky's theory that language is a tool used by children to self-regulate (Vygotsky 1962). Taking the abovementioned into consideration, language and internal dialogue may be a latent variable when assessing as well as treating executive functioning for learners with ASD, as well as other diagnoses.

Cerebral palsy is a neurodevelopmental disability caused mostly by an insult to the developing brain. Symptomatic features as determined by the type and area of brain lesions are used to classify the conditions of CP such as ataxia and spastic diplegia. (Graham et al. 2016; Rosenbaum et al. 2007). Although not the case with all individuals with CP, they often experience cognitive difficulties (Rosenbaum et al. 2007) as well as significant executive functioning impairments (Pereira et al. 2018). This may be dependent on the region of the brain in which the lesion is located. Spastic CP such as diplegia is a result of damage to the motor cortex in the frontal lobe, which is located close to some areas of cognitive functions as well as executive functions. While the information is not available for the three learners with CP diplegia, it is plausible that two learners may have additional cognitive and/or executive functioning deficits due to damage to adjacent areas of the motor cortex, while the brain lesion of the one learner with CP diplegia that showed improvement in core and clinical index scores could be contained to the motor cortex only. Consequently, the improved clinical and core index scores of learners with CP ataxia may have been possible due to the brain lesion resulting in ataxic CP (cerebellum) being located at a distance from the brain regions responsible for cognitive and executive functions.

5.5 Executive functioning and academics

The third objective was to determine the association between the change in academic outcomes and the change in executive functioning from Term 1 to Term 4, for Grade 4 learners who attended a weekly executive functioning occupational

therapy intervention. The mean scores for the academic marks in percentages for all subjects except additional language decreased from Term 1 to Term 4 (Figure 4.6). For the overall academic results from Term 1 to Term 4 significantly (p=0.041) more learners had a decrease in their overall mean score when compared to the number that showed improvement (Table 4.8). The intervention, therefore, did not have an overall positive effect on the academic performance of the learners. Many variables could have played a role in these findings.

The loss of contact time during the third Term of 2021 due to a rise in COVID-19 infections was found to have resulted in a loss of between 22% and 50% academic or teaching time (Department of Basic Education 2022). While some schools made use of online teaching strategies to try and accommodate for lost teaching time, many of the learners of West Rand School did not have internet access. Online learning has been found to require high levels of self-motivation and considerable involvement of parents for younger learners (Alharthi 2022). The parental availability as well as their education levels have an impact on the effectiveness of online learning (Nayir and Sari 2021). The parents may thus not have had the required education or skills to assist their children in the time of digital learning. Haffejee et. al. (2024) found this to be the case for many parents in Gauteng of low to middle socio-economic status. As part of the Assessment for Learning (AfL) approach implemented by the Department of Basic Education, academic assessment methods and weighting thereof were adapted, which could have affected the validity thereof and the academic results (Department of Basic Education 2022).

As stated previously, the years 2020 and 2021 were especially filled with adversity for learners due to the COVID-19 pandemic, with a systemic review finding that multiple studies indicated a trend of worsening overall mental health during this time (Samji et al. 2022). It is widely known that the mental health of learners affects their academic performance. Taking the turmoil that the COVID-19 pandemic caused into account, the question of how much the turmoil of the year and the year before had an adverse effect on the academic performance of the learners, arises.

Diamond (2012) found that the transfer effect of executive functioning intervention is limited and that the generalisation of skills is narrowly applied. Although a principle of the MLE is transcendence and relates to facilitating the learners' ability to

generalise strategies taught to other situations, an essential issue in studies about the effectiveness of executive functioning intervention is the generalisation across settings and tasks (Paananen et al. 2011). Findings of the transferability of working memory skills developed during executive functioning interventions to academic tasks vary (Roberts et. al. 2016; Holmes and Gathercole 2014; Kuhn and Holling 2014). There is currently a paucity of studies focusing on the transferability of cognitive flexibility and inhibition to academic tasks. The integration of various executive functioning skills underpins the successful execution of scholastic tasks such as test-taking, flexible thinking and studying. This brings to question whether the learners have learnt the executive functioning skills but were still unable to integrate the skills in an academic setting. This draws parallels to the recommendation that executive functioning interventions should be developed for and delivered in the school setting (Evans et al. 2014; DuPaul et al. 2012). Miranda et. al. (2011) have found success in employing this strategy in conjunction with empowering teachers and parents to implement techniques to foster inhibitory control and self-induction of learners in other settings and throughout the day. This led to greater outcomes and transferability of executive functioning skills. Due to school closures and less intervention time, the time to practice transferability was limited. Ideally, principles used in the MLE approach should have been taught to all teachers and parents as in the study by Miranda et. al. (2011). Time constraints and socio-economic factors for families, however, impact the practicability of such opportunities.

As in the current study, the study of Amod et. al. (2017) on a remedial intervention program in the development of planning skills of Grades 4 and 5 learners resulted in varied scores. They argued that the information gathered could yield useful information regarding the type of input learners require from executive functioning interventions. They added that learners who are impulsive and do not work systematically would be expected to require different interventions than learners who have difficulties in the output phase, such as communication abilities. Given that 31% of learners were taught and assessed in a second or third language, as their home language is a native South African language, they may have been at a disadvantage in academic performance. This could be further exacerbated by the difference in assessment methods from informal to formal examination

circumstances, from grade 3 to 4, where sufficient understanding and interpretation of language used in test-paper questions is required. The output phase of assessments may have been affected by the language requirements to correctly answer questions, but moreover, for the learners making use of assistive technologies such as speech-to-text and text-to-speech resources due to SLD or physical disabilities. While these accommodations are meant to improve the learners' ability to access the curriculum and assessment processes, no data is available on the effectiveness and ease of use for the participants in the current study. The existence of so many extraneous variables highlights the importance of individual consideration of the needs that executive functioning interventions should meet for each learner.

A significant number of learners improved in their additional language marks over the year ($p=0.0021$) (Table 4.7). Sesma et al. (2009) and Zelazo and Carlson (2012) indicated that executive functioning is fundamental to the organization and processing of information received as well as the development of language and literacy, with Abreu et. al. (2014) adding that effective learning is heavily reliant on adequate language development. Though the overall academic performance did not improve following the executive functioning interventions, the additional language scores did show improvement and may add to pedagogical consideration for future executive functioning and academic improvements.

CHAPTER 6: CONCLUSION

6.1 Introduction

In this chapter, the main findings of the study are summarised. The strengths and limitations of the current study are considered. Lastly, clinical considerations and recommendations, as well as recommendations for further research, are discussed.

6.2 Main findings

Executive functions are vital to the successful participation in academic, social and leisure activities amongst others, and ultimately underlies independence (Cramm et al. 2013; Dawson and Gaure 2010). Executive functioning deficits are often a common occurrence for some of the most prevalent diagnoses found in childhood, such as ADHD, anxiety disorders and learning disabilities (Khan and Lal 2023; Cramm et al. 2013; Faraone et al. 2003).

The intervention seems to have addressed severe impairments most effectively, with better outcomes in the clinical indices of activity level and impulse control and abstract thought and problem solving. When the core, as well as clinical index scores for the D-REF, were analysed according to diagnostic categories, varying changes in scores were found. Only learners with ADHD/ASD improved consistently across all core index domains. An individual approach may be indicated to ensure that the tasks are appropriate and lead to executive functioning development.

6.3 Strengths and limitations of the Study

The main findings of the study should be interpreted taking the strengths and limitations of the study into account.

6.3.1 Strengths

Findings from this study add to the emergent occupational therapy literature on executive functioning interventions for school-aged learners. It provides insights on the effect of the current class intervention groups at West Rand School for Grade 4 learners, and on possible adjustments to improve the effectiveness thereof. The study highlights the need for the consideration of executive functioning deficits and

their effect on occupational performance, which is a domain of occupational functioning often overlooked by many occupational therapists.

6.3.2 Limitations

The occurrence of the COVID-19 pandemic before and over the course of the research brought about variables that may have had an impact on results and the generalisability thereof in other circumstances. The pandemic led to loss of contact time and many extra mental health-related challenges. Mental well-being is well known to have a significant effect on academic performance but also affects executive functioning itself. The loss of school contact time led to the number of intervention sessions being less than initially intended. Although there is no set amount of sessions to complete, more input may have had a greater chance of bringing about executive functioning development. The class-based interventions could not be caught up with learners who were absent, however, as part of the exclusion criteria one learner was excluded as she/he attended less than 80% of the class groups. Valuable academic time was also lost and assessment tasks had to be adjusted. This could have led to poorer academic results than what would be the case under typical circumstances.

The total sample size was sufficient, but a larger sample size for each diagnostic group would have been a better representation of the executive functioning profiles and development thereof, as some diagnostic groups had only one learner. The results are thus less likely to be transferable for all learners with the same diagnosis.

Although observer rating scales have good ecological validity, some discrepancies may have occurred in the completion of the D-REF assessments. Each class had one teacher who taught all subjects. While this provided the teachers sufficient opportunity to observe relevant behaviours, this could have allowed for rater subjectivity and adversely affected the validity of the assessment.

6.4 Clinical implications of the study and clinical recommendations

It appeared that the intervention is the most beneficial for learners with more severe executive functioning difficulties as well as learners with ADHD with co-morbid ASD. Although there are some opportunities for mediated learning to take place in a group, it is recommended that an individualised approach is used to ensure that the

tasks are set at a ‘just-right’ challenge and can be adapted to ensure optimal development of executive functioning of the learner. Ideally, the approach and how to apply it in the classroom setting, as well as at home, should be taught to parents and teachers. This will allow for more opportunities to develop executive functioning skills and also apply them to real-life contexts such as homework tasks, class participation and completing chores at home.

6.5 Recommendations for further research

Studies with a larger sample size per diagnosis would give more reliable and transferable results of the change of executive functioning for each diagnosis. Further studies are required to identify the effect of the group size versus individual intervention approaches on the outcomes intervention. Additionally, research is needed on the effectiveness of empowering parents and teachers to develop executive functions at home and in class.

6.6 Final reflections and closure

With the importance of executive functioning in the optimal participation in occupations such as academics established, and the ambiguity of which intervention approaches address executive functioning deficits best, this study aimed to determine the change in executive functioning and academic performance of Grade 4 learners with different diagnoses. These learners were attending an LSEN school and receiving weekly occupational therapy input in the form of class-based executive functioning interventions.

While some limitations, such as sample size for each diagnostic groups as well as the occurrence of the COVID-19 pandemic bringing about extraneous variables exist, the findings of this study add to the limited occupational therapy literature in executive functioning interventions in the school-based setting. The findings also contribute to the evidence-based practice standard of occupational therapy. Insight was also gained on the potential for the Mediated Learning Experience being utilised to address executive functioning deficits. When analysing the findings, the need for an individualised approach was highlighted. This is in line with the client-centred approach being a key aspect of the occupational therapy practice philosophy.

REFERENCES

Akbar, M., R. Loomis, and R. Paul. 2013. “The Interplay of Language on Executive Functions in Children with ASD.” *Research in Autism Spectrum Disorder* 7: 494–501.

Alharthi, M. 2022. “Parental Involvement in Children’s Online Education during COVID-19; a Phenomenological Study in Saudi Arabia.” *Early Childhood Education Journal* 55: 1–15.

Alloway, T.P., S.E. Gathercole, and S.J. Pickering. 2006. “Verbal and Visuospatial Short-Term and Working Memory in Children: Are They Separable? Tracy Packiam Alloway 1, Susan Elizabeth Gathercole, Susan J Pickering.” *Child Development* 77 (6): 1698–716.

Altarac, M., and E. Saroha. 2007. “Lifetime Prevalence of Learning Disability among US Children.” *Pediatrics* 119 (1): 77–83.

American Occupational Therapy Association. 2020. “Occupational Therapy Practice Framework: Domain and Process (4th Ed.).” *American Journal of Occupational Therapy* 74 (2).

American Psychiatric Association. 2013. *Diagnostic Manual and Statistical Manual of Mental Disorders: DSM-5*. American Psychiatric Association.

Amod, Z, D Haefield, and J Seabi. 2017. “Assessing a Remedial Intervention Programme in Developing the Planning Skills of Grade 4 and 5 Learners.” *International Journal of Disability, Development and Education* 65 (4): 428–41.

Anderson, M.C., and B.J. Levy. 2009. “Suppressing Unwanted Memories.” *Current Directions in Psychological Science* 18 (4): 189–94.

Anderson, P.J. 2002. “Assessment and Development of Executive Function (EF) during Childhood.” *Child Neuropsychology* 8 (2): 71–82.

Astle, D.E., and S. Fletcher-Watson. 2020. “Beyond the Core Deficit Hypothesis in Developmental Disorders.” *Current Directions in Psychological Science* 29 (5): 431–37.

Astle, D.E., and G. Scerif. 2009. “Using Developmental Cognitive Neuroscience to Study Behavioral and Attentional Control.” *Developmental Psychobiology* 51 (2): 107–18.

Banich, M.T. 2009. “Executive Function: The Search for an Integrated Account.” *Current Directions in Psychological Science* 18 (2): 89–4.

Barkley, R.A. 1997. “Behavioural Inhibition, Sustained Attention, and Executive Functions: Constrctiong a Unifying Theory ADHD.” *Psychological Bulletin* 121 (1): 65–94.

Barkley, R.A. 2012. *Executive Functions - What They Are, How They Work, and Why They Evolved.* Gillford Press.

Barkley, R.A., and K.R. Murphy. 2010. “Impairment in Occupational Functioning and Adult ADHD: The Predictive Utility of Executive Function (EF) Ratings versus EF Tests.” *Archives of Clinical Neuropsychology* 25 (3): 157–73.

Baum, C., E. Foster, and T. Wolf. 2009. “Addressing Performance and Participation in Occupational Therapy: The Importance of Cognition.” *British Journal of Occupational Therapy* 72 (4): 43–152.

Bergman-Nutley, S, S Soderqvist, S Bryde, L.B. Thorell, K Humphreys, and T Klingberg. 2011. “Gains in Fluid Intelligence after Training Non-Verbal Reasoning in 4-Year-Old Children: A Controlled, Randomized Study.” *Developmental Science* 14 (3): 591–601.

Best, J., P. Miller, and J.A. Naglieri. 2011. “Relations between Executive Function and Academic Achievment from Ages 5 to 17 in a Large, Representative National Sample. Best, J; Miller, P; Naglieri, J.” *Learning and Individual Differences* 21 (4): 327–36.

Best, J.R. 2010. “Effects of Physical Activity on Children’s Executive Function: Contributions of Experimental Research on Aerobic Exercise.” *Developmental Review* 30 (4): 331–51.

Best, J.R., and P.H. Miller. 2010. “A Developmental Perspective on Executive Function.” *Child Development* 81 (6): 1641–60.

Blair, C., and C.C. Raver. 2014. “Closing the Achievement Gap Through Modification of Neurocognitive and Neuroendocrine Function: Results From a Cluster Randomized Controlled Trial of an Innovative Approach to the Education of Children in Kindergarten.” *PLos One* 9 (11). https://doi.org/10.1371/journal.pone.0112393.

Bodimeade, H.L., K.O.H Whittingham, O Lloyd, and R.N Boyd. 2013. “Executive Function in Children and Adolescents with Unilateral Cerebral Palsy.” *Developmental Medicine & Child Neurology* 55: 926–33.

Bodrova, E, and D.J. Leong. 2007. *Tools of the Mind: The Vygotskian Approach to Early Childhood Education.* 2nd ed. Merrill/Prentice Hall.

Bolter, N., J. Johnson, and J. Pascual-Leone. 2006. “Processing Limitations in Children with Specific Language Impairment: The Role of Executive Function.” *Child Development* 77 (6): 1822–41.

Boyd, B.A., M. McBee, T. Holtzclaw, G.T. Baranek, and J.W. Bodfish. 2009. “Relationships among Repetitive Behaviours, Sensory Features and Executive Functions in High Functioning Autism.” *Research in Autism Spectrum Disorder* 3 (4): 959–66.

Budde, H., C. Voelcker-Rehage, S. Pietrabyk-Kendziorra, P. Ribeiro, and G. Tidow. 2008. “Acute Coordinative Exercise Improves Attentional Performance in Adolescents.” *Neuroscience Letters* 441 (2): 219–23.

Caviola, S., L.J. Colling, I.C. Mammarella, and D. Szucsi. 2020. “Predictors of Mathematics in Primary School: Magnitude Comparrison, Verbal and Spatial Working Measures.” *Developmental Science* 23 (6).

Chaddock, L, M.B. Pontifex, C.H. Hillman, and A.F. Kramer. 2011. “A Review of the Relation of Aerobic Fitness and Physical Activity to Brain Structure and Function in Children.” *Journal of the International Neuropsychological Society* 17 (6): 975–85.

Conklin, H.M., M. Luciana, C.J. Hooper, and R.S. Yarger. 2007. “Working Memory Performance in Typically Developing Children and Adolescents: Behavioral Evidence of Protracted Frontal Lobe Development Heather M Conklin 1, Monica Luciana, Catalina J Hooper, Rebecca S Yarger.” *Developmental Neuropsychology* 31 (1): 103–28.

Connor, L.T., and A. Maeir. 2011. “Putting Executive Performance in a Theoretical Context.” *Occupation, Participation and Health* 31 (1).

Cox, A. 2007. *No Mind Left behind: Understanding and Fostering Executive Control - The Eight Essential Brain Skills Every Child Needs to Thrive*. Penguin.

Cramm, Heidi, Terry Krupa, Cheryl Missiuna, Rosemary M. Lysaght, and Kevin C.H. Parker. 2013. “Broadening the Occupational Therapy Toolkit: An Executive Functioning Lens for Occupational Therapy With Children and Youth.” *The American Journal of Occupational Therapy* 67 (6): 139–47.

Crawford, C. 2007. *Learning Disabilities in Canada: Economic Costs to Individuals to Families and Societies.Ce*. The Roeher Institute. https://www.ldac-acta.ca/downloads/pdf/research/5B%20-Economic%20Costs%20of%20LD%20-%20Jan%202002%20RJune_2007.pdf.

Crisci, G., S. Caviola, R. Cardillo, and I.C. Mammarella. 2021. “Executive Fundctions in Neurodevelopmental Disorders: Comorbidity Overlaps Between Attention Deficit and Hyper Activity Disorder and Specific Learning Disorders.” *Fronteirs in Human Neuroscience* 15: 1–14.

Crosbie, J., P. Arnold, A. Paterson, J. Swanson, A. Depuis, and X. Li. 2013. “Response Inhibition and ADHD Traits: Correlates and Heritability in a Community Sample.” *Journal of Abnormal Child Psycholgy* 41: 497–507.

Dai, D., T.A. Wouldes, G. Brown, et al. 2020. “Relationships between Intelligence, Executive Function and Academic Achievement in Children Born Very Preterm.” *Early Human Development* 148. https://doi.org/10.1016/j.earlhumdev.2020.105122.

Davidson, M.C., L.C. Anderon, A. Diamond, and D. Amso. 2006. “Development of Cognitive Control and Executive Functions from 4 to 13 Years: Evidence from Manipulations of Memory, Inhibition, and Task Switching.” *Neuropsychologia* 44 (11): 2037–78.

Davis, C.L., P.D. Tomporowski, J.E. McDowell, et al. 2011. “Exercise Improves Executive Function and Achievement and Alters Brain Activation in Overweight Children: A Randomized, Controlled Trial.” *Health Psychology* 30 (1): 91–98.

Dawson, P, and R Gaure. 2010. *Executive Skills in Children and Adolescents: A Practical Guide to Assessment and Intervention*. 2nd ed. Gillford Press.

De Abreu, M.J., N. Abreu, C. Nikaedo, et al. 2014. “Executive Functioning and Reading Achievement in School: A Study of Brazilian Children Assessed by Their Teachers as ‘Poor Readers.’” *Frontiers in Psycology* 5 (550).

Department of Basic Education. 2022. *National Assembly*. https://pmg.org.za/files/RNW2243-220613.docx.

Desimone, R., and J. Duncan. 1995. “Neural Mechanisms of Selective Visual Attention.” *Annual Review of Neuroscience* 18 (1): 193–222.

Diamond, A. 2012. “Activities and Programs That Improve Children’s Executive Functions.” *Current Directions in Psychological Science* 21 (5): 335–41.

Diamond, A. 2013. “Executive Functions.” *Annual Review of Psychology* 64: 135–68.

Diamond, A, W.S. Barnett, J. Thomas, and S. Munro. 2007. “Preschool Program Improves Cognitive Control.” *Science* 318 (5855): 1387–88.

Diamond, A, and K Lee. 2011. “Intervention Shown to Aid Executive Function Development in Children 4-12 Years Old.” Unpublished manuscript.

Diamond, A, and D.S. Ling. 2016. “Conclusions about Interventions, Programs, and Approaches for Improving Executive Functions That Appear Justified and Those That, despite Much Hype, Do Not.” *Developmental Cognitive Neuroscience* 18: 34–48.

Directorate Inclusive Education. 2014. “GUIDELINES TO ENSURE QUALITY EDUCATION AND SUPPORT IN SPECIAL SCHOOLS AND SPECIAL SCHOOL RESOURCE CENTRES.” Department of Basic Education Rebublic of South Africa.

Doebel, S., and U. Müller. 2023. “The Future of Research on Executive Function and Its Development: An Introduction to the Special Issue.” *Journal of Cognition and Development* 24 (2): 161–71.

Duckworth, A.L., and M.E.P. Seligman. 2005. “Self-Discipline Outdoes IQ in Predicting Academic Performance of Adolescents.” *Psychological Science* 16 (12): 939–44.

DuPaul, G.J., T.L. Eckert, and B. Vilandro. 2012. “The Effects of School-Based Interventions for Attention Deficit Hyperactivity Disorder: A Meta-Analysis.” *School Psychology Review* 41 (4): 387–412.

Erez, A.B., E. Rothschild, N. Katz, M. Tuchner, and A. Hartman-maeir. 2009. “Executive Functioning, Awareness, and Participation in Daily Life After Mild Traumatic Brain Injury: A Preliminary Study Asnat Bar-Haim ; Ettie Rothschild; Noomi Katz; Maya Tuchner; Adina Hartman-Maeir.” *The American Journal of Occupational Therapy* 63 (5): 634–40.

Evans, S.W., J. Owens, and N. Bunford. 2014. “Evidence-Based Psychococial Treatments for Children and Adolescents with Attention-Deficit/Hyperactivity Disorder.” *Journal of Clincal Child & Adolescen Psychology* 43 (4): 527–51.

Faedda, N., M. Romani, S. Rossetti, M. Viglaite, L. Pezzuti, and F. Cardona. 2019. “Intellectual Functioning and Executive Functions in Children and Adolescents with Attention Deficit Hyperactivity Disorder (ADHD) and Specific Lerning Disorders (SLD).” *Scandanavian Journal of Psycology* 60: 440–46.

Faraone, S.V., J. Sergeant, C. Gillburg, and J Biederman. 2003. “The Worldwide Prevelance of ADHD: Is It and American Condition?” *World Psychiatry* 2 (2): 104–13.

Fernandez-Andrez, M.L., P. Tejero, and X. Velez-Calvo. 2021. “Viual Attention, Orthographic Word Recognition and Executive Functioning in Children with ADHD, Dyslexia or ADHD + Dyslexia.” *Journal of Attention Disorders* 25 (7): 942–53.

Flavell, J.H. 1977. *Cognitive Development*. Prentice-Hall.

Foster, E.R., and T. Hershey. 2011. “Everyday Executive Function Is Associated With Activity Participation in Parkinson Disease Without Dementia.” *Occupation, Participation and Health* 31 (1): 16–22.

Franceschini, S., S. Gori, M. Ruffino, S. Viola, M. Molteni, and A. Facoetti. 2013. “Action Video Games Make Dyslexic Children Read Better.” *Current Biology* 23 (6): 462–66.

Freuerstein, R., Y. Rand, M. Hoffman, and R. Miller. 1979. “Cognitive Modifiability in Retarded Adolescents: Effects of Instrumental Enrichment.” *American Journal of Mental Deficiency* 83 (6): 539–50.

Freuerstein, R., Y. Rand, and J.E. Rynders. 1988. *Don’t Accept Me as I Am: Helping “Retarded” People to Excel*. Plenum Press.

Friedman, N.P., and A. Miyake. 2017. “Unity and Diversity of Executive Functions: Individual Differences as a Window on Cognitive Structure.” *Cortex* 10 (86): 186–204.

Friedman, N.P., and T.W. Robbins. 2022. “The Role of Prefrontal Cortex in Cognitive Control and Executive Function.” *Neuropsychopharmacology* 47 (1): 72–89.

Garon, N., S.E. Bryson, and I.M. Smith. 2008. “Executive Function in Preschoolers: A Review Using an Integrative Framework.” *Psychological Bulletin* 134 (1): 31–60.

Gathercole, S.E., S.J. Pickering, B. Ambridge, and H. Wearing. 2004. “The Structure of Working Memory from 4 to 15 Years of Age.” *Developmental Psychology* 40 (2): 177–90.

Gerst, E., J. Fletcher, P. Cirino, and H. Yoshida. 2017. “Cognitive and Behavioural Rating Measures of Executive Function as Predictors of Academic Outcomes in Children Gerst, E; Fletcher, J; Cirino, P; Yoshida, H.” *Child Neuropsychology* 23 (4): 381–407.

Geurts, H.M., J. Sinzig, R. Booth, and F. Happe. 2014a. “Neuropsychological Heterogeneity in Executive Functioning in Autism Spectrum Disorders.” *International Journal of Developmental Disabilities* 60 (3): 155–62.

Geurts, H.M., S. Verte, J. Oosterlaan, H. Roeyers, and J.A. Sergeant. 2004. “How Specific Are Executive Function Deficits in Attention Deficit Hyperactivity Disorder and Autism?” *Journal of Child Psycology and Psychiatry* 45 (4): 836–54.

Gillen, G. 2013. “A Fork in the Road: An Occupational Hazard?” *The American Journal of Occupational Therapy* 67 (6): 641–52.

Gioia, G.A., P.K. Isquith, P.D. Retzlaff, and K.A. Espy. 2002. “Confirmatory Factor Analysis of the Behavior Rating Inventory of Executive Function (BRIEF) in a Clinical Sample.” *Child Neuropsychology* 8 (4): 249–57.

Goldberg, M.C., S.H. Mostofsky, L.E. Cutting, E.M. Mahone, B.C. Astor, and M.B. Denckla. 2004. “Subtle Executive Impairment in Children with Autism and Children with ADHD.” *Journal of Autism and Developmental Disorders* 35 (3): 279–93.

Goldstein, S, and J.A. Naglieri. 2014. *Handbook of Executive Functioning.* Oxford University Press.

Graham, H.K., P Rosenbaum, P.B. Dan, J.P. Lin, D.L. Damiano, and J.G. Becher. 2016. “Cerebral Palsy.” *Nature Reviews Disease Primers* 2 (1).

Guzzetta, A, C Pecini, and L Biagi. 2008. “Language Organization in Left Perinatal Stroke.” *Neuropediatrics* 39: 157–63.

Haddad, F., Y. Garcia, J. Naglieri, M. Grimditch, A. McAndrews, and J. Eubanks. 2003. “Planning Facilitation and Reading Comprehension: Instructional Relevance of the Pass Theory.” *Journal of Psychoeducational Assessment* 21: 282–89.

Haffejee, S., T.M. Simelane, and A. Mwanda. 2024. “South African COVID-19 School Closures: Impact on Children and Families.” *South African Journal of Childhood Education* 14 (1).

Happe, F., A. Ronald, and R. Plomin. 2006. “Time to Give up on a Single Explination for Autism.” *Nature Neuroscience* 9 (10): 1218–20.

Heerden, A., N. Van Broeck, and P. Philippot. 2009. “The Effects of Mindfulness on Executive Processes and Autobiographical Memory Specificity.” *Behaviour Research and Therapy* 47 (5): 403–9.

Hill, E.L. 2004. “Executive Function in Autism.” *Trends on Cognitive Science* 8 (1): 26–32.

Hillman, C.H., K.I. Erickson, and A.F. Kramer. 2008. “Be Smart, Exercise Your Heart: Exercise Effects on Brain and Cognition.” *Nature Reviews. Neuroscience* 9 (1): 58–65.

Holmes, J, and S.E. Gathercole. 2014. “Taking Working Memory Training From the Laboratory Into Schools.” *Educational Psychology* 34 (4): 440–50.

Holmes, J, S.E. Gathercole, M Place, D.L. Dunning, K.A. Hilton, and J.G. Elliot. 2010. “Working Memory Deficits Can Be Overcome: Impacts of Training and Medication on Working Memory in Children with ADHD.” *Applied Cognitive Psychology* 24 (6): 827–36.

Holochwost, S.J., D. Winebrake, E.D. Brown, K.R. Happeney, N.J. Wagner, and W.R. Mills-Koonce. 2022. “, S. J., Winebrake, D., Brown, E. D., Happaney, K. R., Wagner, N. J., & Mills-Koonce, W. R. (2022). An Ecological Systems Perspective on Individual Differences in Children’s Performance on Measures of Executive Function. Journal of Cognition and Development, 24(2), 223–240.” *Journal of Cognition and Development* 24 (2): 223–40.

Hughes, C., J. Russel, and T.W. Robbins. 1994. “Evidence for Executive Dysfunction in Autism.” *Neuropsychologia* 32 (4): 477–92.

Huizinga, M., C.V. Dolan, and M.W. Van der Molen. 2006. “Age-Related Change in Executive Function: Developmental Trends and a Latent Variable Analysis.” *Neuropsychologia* 44 (11): 2017–36.

Iseman, E., and J.A. Naglieri. 2011. “A Cognitive Strategy Instruction to Improve Math Calculation for Children with ADHD and LD: A Randomized Controlled Study.” *Journal for Learning Disabilities* 44 (2): 184–95.

Isquith, P.K., G.A. Gioia, and K.A. Espy. 2004. “Executive Function in Preschool Children: Examination through Everyday Behavior.” *Developmental Neuropsychology* 26 (1): 403–22.

Jacobson, L.A., A.P. Williford, and R.C. Pianta. 2011. “The Role of Executive Function in Children’s Competent Adjustment to Middle School.” *Child Neuropsychology* 17 (3): 255–80.

Jefferson, A.L., R. Paul, A. Ozonoff, and R.A. Cohen. 2006. “Evaluating Elements of Executive Functioning as Predictors of Instrumental Activities of Daily Living (IADLs).” *Archives of Clinical Neuropsychology* 21 (4): 311–20.

Jenks, K., J. De Moor, and E. Lieshout. 2007. “The Affect of Cerebral Palsy on Arithmetic Accuracy Is Mediated by Working Memory, Intelligence, Early Numeracy and Instruction Time.” *Developmental Neuropsychology* 32: 861–79.

Jurado, M., and M. Rosselli. 2007. “The Elusive Nature of Executive Functions: A Review of Our Current Understanding.” *Neuropsychological Review* 17 (3): 213–33.

Kamijo, K., M.B. Pontifex, K.C. O’Leary, et al. 2011. “The Effects of an Afterschool Physical Activity Program on Working Memory in Preadolescent Children.” *Developmental Science* 14 (5): 1046–58.

Kelly, R., C. Dissanayake, E. Ihsen, and S. Hammond. 2011. “The Relationship between Symbolic Play and Executive Function in Young Children.” *Australasian Journal of Early Childhood* 36 (2): 21–27.

Kenworthy, L., B.E. Yerys, L.G. Anthony, and G.L. Wallace. 2008. “Understanding Executive Control in Autism Spectrum Disorders in the Lab and in the Real World.” *Neuropsychological Review* 18 (4): 320–38.

Khan, K., and P. Lal. 2023. “Executive Dysfunctions in Different Learning Disabilities: A Review.” *Journal of Indian Association for Child and Adoloscent Mental Health* 19 (2): 126–42.

Klingberg, T, E Fernell, P.J. Olesen, et al. 2005. “Computerized Training of Working Memory in Children with ADHD - a Randomized, Controlled Trial.” *Journal of the American Academy of Child and Adolescent Psychiatry* 44 (2): 177–86.

Krasenegor, N., G. Lyon, and P. Coldman-Rakic. 1997. *Development of the Prefrontal Cortex*. Paul Brooks.

Kuhn, J.-T., and H. Holling. 2014. “Number Sense or Working Memory? The Effect of Two Computer-Based Trainings on Mathematical Skills in Elementary School.” *Advances in Cognitive Psychology* 10 (2): 59–67.

Kuhn, L.J., M.T. Willoughby, M.P. Wilbourn, L. Vernon-Feagans, and C.B. Blair. 2014. “Early Communicative Gestures Prospectively Predict Language Development and Executive Function in Early Childhood.” *Child Development* 85: 1898–914.

Lakes, K.D., and W.T. Hoyt. 2004. “Promoting Self-Regulation through School-Based Martial Arts Training.” *Journal of Applied Developmental Psychology* 25 (3): 283–302.

Lamm, C., P.D. Zelazo, and M.D. Lewis. 2006. “Neural Correlates of Cognitive Control in Childhood and Adolescence: Disentangling the Contributions of Age and Executive Function Author Links Open Overlay Panel.” *Neuropsychologia* 44 (11): 2139–48.

Laporta-Hoyos, O, J Ballester-Plane, D Leiva, et al. 2019. “Executive Function and General Intellectual Functioning in Dyskinetic Cerebral Palsy: Comparison with Spastic Cerebral Palsy and Typically Developing Controls.” *The Journal of the European Peadiatric Neurology Society* 23: 546–59.

Letho, J.E., P. Juujärvi, L. Kooistra, and L. Pulkkinen. 2003. “Dimensions of Executive Functioning: Evidence from Children Juhani E. , Petri , Libbe Kooistra, Lea Pulkkinen.” *British Journal of Developmental Psychology* 21 (1): 59–80.

Leung, R.C., and K.K. Zakzanis. 2014. “Brief Report: Cognitive Flexibility in Autism Spectrum Disorders: A Quantitative Review.” *Journal and Autism and Developmental Disorder* 44 (10): 2628–45.

Lezak, M. D. 1995. *Neuropsychological Assessment*. 3rd ed. Oxford University Press.

Lezak, M. D., D.B. Howieson, and D.W. Loring. 2004. *Neuropsychological Assessment*. 4th ed. Oxford University Press.

Lillard, A., and N. Else-Quest. 2006. “The Early Years. Evaluating Montessori Education.” *Science* 313 (5795): 1893–94.

Liss, M., D. Fein, and D. Allen. 2001. “Executive Functioning in High Functioning Children with Autism.” *Journal of Child Psycology and Psychiatry and Allied Disciplines* 42 (2): 261–70.

Lonergan, A., C. Doyle, C. Cassidy, S. MacSweeney Mahon, R.A. Roche, and I. Buran. 2019. “A Meta-Analysis of Executive Functioning in Dyslexia with Consideration of the Impact of Comorbid ADHD.” *The Journal of Cognitive Psychology* 31 (7): 725–49.

Luciana, M., H.M. Conklin, C.J. Hooper, and R.S. Yarger. 2005. “The Development of Nonverbal Working Memory and Executive Control Processes in Adolescents.” *Child Development* 76 (3): 697–712.

Malanchini, M., L.E. Engelbregth, A.D. Grotzinger, K.P. Harden, and E.M. Tucker-Drob. 2019. “‘Same but Different’: Associations between Multiple Aspects of Self-Regulation, Cognition, and Academic Abilities.” *Journal of Personality and Social Psychology* 117 (6): 1164–88.

Manjunath, N.K., and S. Telles. 2001. “Improved Performance in the Tower of London Test Following Yoga.” *Indian Journal of Physiology and Pharmacology* 45 (3): 351–54.

Mareva, S. 2024. “Mapping Neurodevelopmental Diversity in Executive Function.” *Cortex* 172: 204–21.
Marini, A., B. Piccolo, L. Taverna, M. Berginc, and M. Ozbič. 2020. “The Complex Relation between Executive Functions and Language in Preschoolers with Developmental Language Disorders.” *International Journal of Environmental Research and Public Health* 17: 1772.
Melby-Lervåg, M., and C. Hulme. 2013. “Is Working Memory Training Effective? A Meta-Analytic Review.” *Developmental Psychology* 49 (2): 270–91.
Meltzer, L. 2007. *Executive Function in Education: From Theory to Practice*. Guilford Press.
Miller, E.K., and J.D. Cohen. 2001. “An Integrative Theory of Prefrontal Cortex Function.” *Annual Review of Neuroscience* 24 (1): 167–202.
Miranda, A, M.J. Precentacion, R. Siegenthaler, and P. Jara. 2011. “Effects of a Psychological Intervention on the Executive Functioning in Children With ADHD.” *The Journal of Leraning Disabilities* 20 (10): 1–14.
Miyake, A., N.P. Friedman, M.J. Emerson, A.H. Witzki, A. Howerter, and T.D. Wager. 2000. “The Unity and Diversity of Executive Functions and Their Contributions to Complex ‘frontal Lobe’ Tasks: A Latent Variable Analysis.” *Cognitive Psychology* 41 (1): 49–100.
Moll, K., S.M. Gobel, D. Gooch, K. Landerl, and M.J. Snowling. 2016. “Cognitive Risk Factors for Specific Learning Disorder: Processing Speed, Temporal Processing and Working Memory.” *Journal for Learning Disabilities* 49 (3): 272–81.
Montessori, M. 1949. *Absorbent Mind*. Oxford University Press.
National Department of Health. 2015. *Ethics in Health Research Principles, Processes and Structures*. National Department of Health.
Nayir, F., and T. Sari. 2021. “Indentifying Parents’home Schooling Experience during COVID-19 Period.” *Asian Journal of Distance Education* 16 (1): 156170.
Neuenschwander, R., M. Röthlisberger, P. Cimeli, and C.M. Roebers. 2012. “How Do Different Aspects of Self-Regulation Predict Successful Adaptation to School?” *Journal of Experimental Child Psychology* 113 (3): 353–71.
Nigg, J.T. 2000. “On Inhibition/Disinhibition in Developmental Psychopathology: Views from Cognitive and Personality Psychology and a Working Inhibition Taxonomy.” *Psychological Bulletin* 126 (2): 220–46.
Noroozian, M. 2014. “The Role of the Cerebellum in Cognition: Beyound Coordination in the Central Nervous System.” *Nueroligic Clinics* 32 (4): 1081–104.
Oberauer, K. 2024. *The Meaning of Attention Control*. 131 (6): 1509–26.
Obonsawin, M.C., J.R. Crawford, J. Page, P. Chalmers, R. Cochrane, and G. Low. 2002. “Performance on Tests of Frontal Lobe Function Reflect General Intellectual Ability.” *Neuropsychologia* 40 (7): 970–77.
Oskoui, M, F Coutinho, J Dykeman, N Jette, and T Pringsheim. 2013. “An Update on the Prevelance of Cerabral Palsy: A Systematic Review and Meta-Analysis.” *Developmental Medicine & Child Neurology* 55: 509–19.
Ozonoff, S., and J. Jensen. 1999. “Brief Report: Specific Executive Function Profiles in Three Neurodevelopmental Disorders.” *Journal of Autism and Developmental Disorders* 29 (2): 171–77.
Paananen, M., T. Aro, V. Narhi, and M. Aro. 2018. “Group-Based Intervention on Attention and Executive Functions in the School Context.” *Educational Pychology* 38 (7): 859–76.
Paananen, M., J. Heinonen, J. Knoll, U. Leppänen, and V. Närhi. 2011. “Maltti – Group Based Intervention of Deficits in Attention and Executive Functions.” *Niilo Mäki Instituutti*.
Padhy, S.K., S. Goel, S.S. Das, S. Sarkar, V. Sharma, and M. Panigrahi. 2016. “Prevalence and Patterns of Learning Disabilities in School Children.” *The Indian Journal of Pediatrics* 83 (1): 300–306.

Pascual, A.C., N.M. Muñoz, and A.Q. Robres. 2019. “The Relationship Between Executive Functions and Academic Performance in Primary Education: Review and Meta-Analysis.” *Frontiers in Psycology* 10 (1582).

Pellicano, E. 2012. “The Development of Executive Function in Autsim.” *Autsim Reaserach and Treatment* 2012.

Peng, P., and D. Fuchs. 2016. “A Meta-Analysis of Working Memory Deficits in Children with Learning Difficulties: Is There a Difference between Verbal Doain and Numerical Domain?” *Journal of Learning Disabilities* 49: 3–20.

Peng, P., C. Wang, and J. Namkung. 2018. “Understanding the Cognition Relatied to Mathematics Difficulties: A Meta-Analysis on the Cognitive Deficits Profiles and the Bottle Neck Theory.” *Review of Educational Research* 88 (3): 434–76.

Peng, P., C. Wang, W. Wang, M. Barnes, S Li, and H.L. Swanson. 2018a. “A Meta-Analysis on the Relation between Reading and Working Memory.” *Pyschological Bulliten* 144 (1): 48–76.

Pereira, A., S. Lopes, P. Magalhaes, A. Sampaio, and E. Chaleta. 2018. “How Executive Functions Are Evaluated in Children and Adolescents with Cerebral Palsy: A Systematic Review.” *Frontiers in Psycology* 9 (21): 2–12.

Posavac, E., and R. Carey. 2015. *Program Evaluation: Methods and Case Studies*. Routledge.

Postle, B.R., L. Brush, and A.M. Nick. 2005. “Prefrontal Cortex and the Mediation of Proactive Interference in Working Memory January 2005Cognitive Affective & Behavioral Neuroscience 4(4):600-8.” *Cognitive Affective & Behavioral Neuroscience* 4 (4): 600–608.

Powers, K.L., P.J. Brooks, N.J. Aldrich, M.A. Palladino, and L Alfieri. 2013. “Effects of VideoGame Play on Information Processing: A Meta-Analytic Investigation.” *Psychonomic Bulletin and Review* 20 (6): 1055–79.

Rajendran, K., J.W. Trampush, D. Rindskopf, D.J. Marks, S. O’Neill, and J.M. Helperin. 2013. “Association between Variation in Neuropsychological Development and Trajectory of ADHD Severity in Early Childhood.” *American Journal of Psychiatry* 170: 1205–11.

Rapport, M.D., S.A. Orban, M.J. Kofler, and L.M. Friedman. 2013. “Do Programs Designed to Train Working Memory, Other Executive Functions and Attention Benefit Children with ADHD. A Meta-Analystic Review of Cognitive, Academic and Behavioural Outcomes.” *Clinical Psychology Review* 33 (8): 1237–52.

Roberts, G., J. Quach, M. Spencer-Smith, et al. 2016. “Academic Outcomes 2 Years After Working Memory Training for Children With Low Working Memory: A Randomized Clinical Trial.” *JAMA Pediatrics* 170 (5).

Romeo, D.M., I. Venezia, E. Pede, and C. Brogna. 2023. “Cerebral Palsy and Sex Differences in Children: A Narrative Review of the Literature.” *Journal of Neuroscience Research* 101 (5): 783–95.

Rose, D., and K. Rose. 2007. “Deficits in Executive Function Processes: A Curriculum-Based Intervention.” In *Executive Function in Education: From Theory to Practice.* Guilford Publications.

Rosenbaum, P, N Paneth, A Leviton, M Goldstein, and B Martin. 2007. “A Report: The Definition and Classification of Cerebral Palsy.” *Developmental Medicine & Child Neurology* 49: 8–14.

Salthouse, T.A. 2012. “How General Are the Effects of Trait Anxiety and Depressive Symptoms on Cognitive Functioning?” *Emotion* 12 (5): 1075.

Samji, H., J. Wu, A. Ladak, C. Vossen, E. Stewart, and N. Dove. 2022. “Mental Health Impacts of the COVID-19 Pandemic on Children and Youth – A Systematic Review.” *Child and Adolescent Mental Health* 27 (2): 173–89.

Saver, J.L., and A.R. Damasio. 1991. “Preserved Access and Processing of Social Knowledge in a Patient with Acquired Sociopathy Due to Ventromedial Frontal Damage.” *Neuropsychologia* 29 (12): 1241–49.

Saylik, R., A.L. Williams, R.A. Murphy, and A.J. Szameitat. 2022. “Characterising the Unity and Diversity of Executive Functions in a Within-Subject fMRI Study.” *Scientific Reports* 12 (1).

Schreiber, J.E., K.I Possin, J.M. Girard, and C. Rey-Cassirly. 2014. “Executive Functioning in Children with Attention Deficit/Hyper Activity Disorder: The NIH EXAMINER Battery.” *Journal of International Neuropsychology Society* 20: 41–51.

Schunk, B.Z. 2001. *Self- Regulated Learning and Academic Achievement: Theoretitical Perspectives*. Vol. 2. Erlbaum.

Schwaighofer, M., F. Fischer, and M. Bühner. 2015. “Does Working Memory Training Transfer? A Meta-Analysis Including Training Conditions as Moderators.” *Educational Psychologist* 50 (2): 138–66.

Senju, A. 2013. “Atypical Development of Spontaneous Social Cognition in Autism Spectrum Disorders.” *Brain Development* 35 (2): 96–101.

Senn, T.E., K.A. Espy, and P.M. Kaufmann. 2004. “Using Path Analysis to Understand Executive Organization in Preschool Children.” *Developmental Neuropsychology* 26 (1): 445–64.

Sesma, H.W., E.M. Mahone, T. Levine, S.H. Eason, and L.E. Cutting. 2009. “The Contribution of Executive Skills to Reading Comprehension.” *Child Neuropsychology* 15: 232–46.

Shimamura, A.P. 2000. “The Role of the Prefrontal Cortex in Dynamic Filtering.” *Psychobiology* 28 (2): 207–18.

Somale, A., S.W. Kondekar, S. Rathi, and N. Iyer. 2016. “Neurodevelopmental Comorbidity Profile in Specific Learning Disorders.” *International Journal of Contemporary Pediatrics* 3: 355–61.

Spencer-Smith, M., and V. Anderson. 2009. “Healthy and Abnormal Development of the Prefrontal Cortex.” *Developmental Neurorehabilitation* 12 (5): 279–97.

Stapleton, T., and D. Connolly. 2010. “Occupational Therapy Practice in Predriving Assessment Post Stroke in the Irish Context: Findings From a Nominal Group Technique Meeting.” *Topics in Stroke Rehabilitation* 17 (1): 58–68.

Theeuwes. 2010. “Top-down and Bottom-up Control of Visual Selection.” *Acta Psychologica* 135 (2): 77–99.

Thorell, L.B., and L. Nyberg. 2008. “The Childhood Executive Functioning Inventory (CHEXI): A New Rating Instrument for Parents and Teachers.” *Developmental Neuropsychology* 33 (4): 536–52.

Toplak, M.E., R.F. West, and K.E. Stanovich. 2013. “Practitioner Review: Do Performance-Based Measures and Ratings of Executive Function Assess the Same Construct?” *Journal of Child Psycology and Psychiatry* 54 (2): 131–43.

Trutti, A.C., M.J. Mulder, B.F. Hommel, and U Birte. 2019. “Functional Neuroanatomical Review of the Ventral Tegmental Area.” *NeuroImage* 191 (1): 258–68.

Tzuriel, Z. 2013. “Mediated Learning Experience and Cognitive Modifiability.” *Journal of Cognitive Education and Psychology* 12 (1): 59–80.

Uhrich, T.A., and R.L. Swalm. 2007. “A Pilot Study of a Possible Effect from a Motor Task on Reading Performance. Perceptual and Motor Skills.” *APA PsycInfo* 104 (3): 1035–41.

Ursache, A., and C.C. Raver. 2014. “Trait and State Anxiety: Relations to Executive Functioning in an at-Risk Sample.” *Cognition and Emotion* 28 (5): 845–55.

Verburgh, L., M. Königs, E.J. Scherder, and J. Oosterlaan. 2014. “Physical Exercise and Executive Functions in Preadolescent Children, Adolescents, and Young Adults: A MetaAnalysis.” *British Journal of Sports Medicine* 48 (12): 973–79.

Veriava, F., A. Thom, and T.F. Hodgson. 2017. *Basic Education Rights Handbook–Education Rights in South Africa.* Section27.

Vissers, C., S. Koolen, D. Hermans, A. Scheper, and H. Knoors. 2015. “Executive Functioning in Preschoolers with Specific Language Impairment.” *Frontiers in Psycology* 6: 1574.

Visu-Petra, L., V. Cheie, O. Benga, and M. Miclea. 2011. “Cognitive Control Goes to School: The Impact of Executive Functions on Academic Performance.” *Procedia Social and Behavioral Sciences* 11: 240–44.

Visu-Petra, L., M. Miclea, and G. Visu-Petra. 2013. “Individual Differences in Anxiety and Executive Functioning: A Multidimentional View.” *International Journal of Psychology* 48 (4): 649–59.

Von Rhein, D., M. Oldehinkel, C.F. Beckmann, J. Oosterlaan, D. Heslenveld, and C. Hartman. 2016. “Abarrant Local Striatal Functional Concentivity in Attention Defecit/Hyperactivity Disorder.” *Journal of Child Psycology and Psychiatry* 57: 697–705.

Vukovic, R.K., and N.K. Lesaux. 2013. “The Language of Mathematics: Investigating the Ways Language Counts for Children’s Mathematical Development.” *Journal of Experimental Child Psychology* 115 (2): 227–44.

Vygotsky, L.S. 1962. *Thought and Language.* MIT Press.

Vygotsky, L.S. 1978. *Mind in Society: The Development of Higher Psychological Processes.* Harvard University Press.

Wade, M., H. Prime, J.M. Jenkins, K.O. Yeates, T. Williams, and K. Lee. 2018. “On the Relation of Theory of Mind and Executive Functioning: A Developmental Cognitive Neuroscience Perspective.” *Psychonomic Bulletin & Review* 25 (6): 2119–40.

Wagner, R.E., Y. Zhang, T. Grey, et al. 2018. “Autism-Related Variation in Reciprocal Social Behaviour: A Longitudinal Study.” *Child Development* 90 (2): 441–51.

Wallisch, A., L.M. Little, E. Dean, and W. Dunn. 2018. “Executive Function Measures for Children: A Scoping Review of Ecological Validity.” *Occupation, Participation and Health* 38 (1): 6–14.

Wang, Y., Y-b. Zhang, L-i. Liu, J-f. Cui, J. Wang, and D.H.K. Shum. 2017. “A Meta-Analysis of Working Memory Impairments in Autsism Spectrum Disorders.” *Neuropsychological Review* 27 (1): 46–61.

Warnick, B., M. Drake, and S. Vidrine. 2015. “Test Review: Delis Rating of Executive Function (D-REF).” *Journal of Psychoeducational Assessment* 33 (6): 597–601. https://doi.org/10.1177/0734282914564346.

Wasunna, C., P. Tegli, and P. Ndebele. 2014. *Research Ethics in Africa: A Resource for Research Ethics Committees*. SUN Press.

Weicker, J., A. Villringer, and A. Thöne-Otto. 2016. “Can Impaired Working Memory Functioning Be Improved By Training? A Meta-Analysis With a Special Focus on Brain Injured Patients.” *Neuropsychology* 30 (2): 190–212.

White, H., and S. Sabarwal. 2014. “Quasi-Experimental Design and Methods.” UNICEF.

Whittingham, K.O.H, H.L. Bodimeade, O Lloyd, and R.N Boyd. 2014. “Everyday Psychological Functioning in Children with Unilateral Cerebral Palsy: Does Executive Functioning Play a Role?” *Developmental Medicine & Child Neurology* 56: 572–79.

Wilson, S., and D. Farran. 2012. “Experimental Evaluation of the Tools of the Mind Curriculum.” Paper presented at the Society for Research on Educational Effectiveness Spring 2012 Conference, Washington D.C.

Winsler, A., A. Fernyhough, and I. Montero. 2009. *Private Speech, Executive Functioning, and the Development of Verbal Self-Regulation.* Cambridge University Press.

Wolf, C., T. Baum, A. Wong, and A Heinemann. 2017. “Validation and Clinical Utility of the Executive Function Performance Test in Persons with Traumatic Brain Injury.” *Neuropsychological Rehabilitation* 27 (5): 603–17.

World Health Organization. International Classification of Functioning, Disability, and Health: Children & Youth Version: ICF-CY. 2007. World Health Organization.

Yin, R. 2014. *Case Study Research Design And Methods*. Vol. 5. SAGE.

Zeidan, F., S.K. Johnson, B.J. Diamond, Z. David, and P. Goolkasian. 2010. “Mindfulness Meditation Improves Cognition: Evidence of Brief Mental Training.” *Consciousness and Cognition: An International Journal* 19 (2): 597–605.

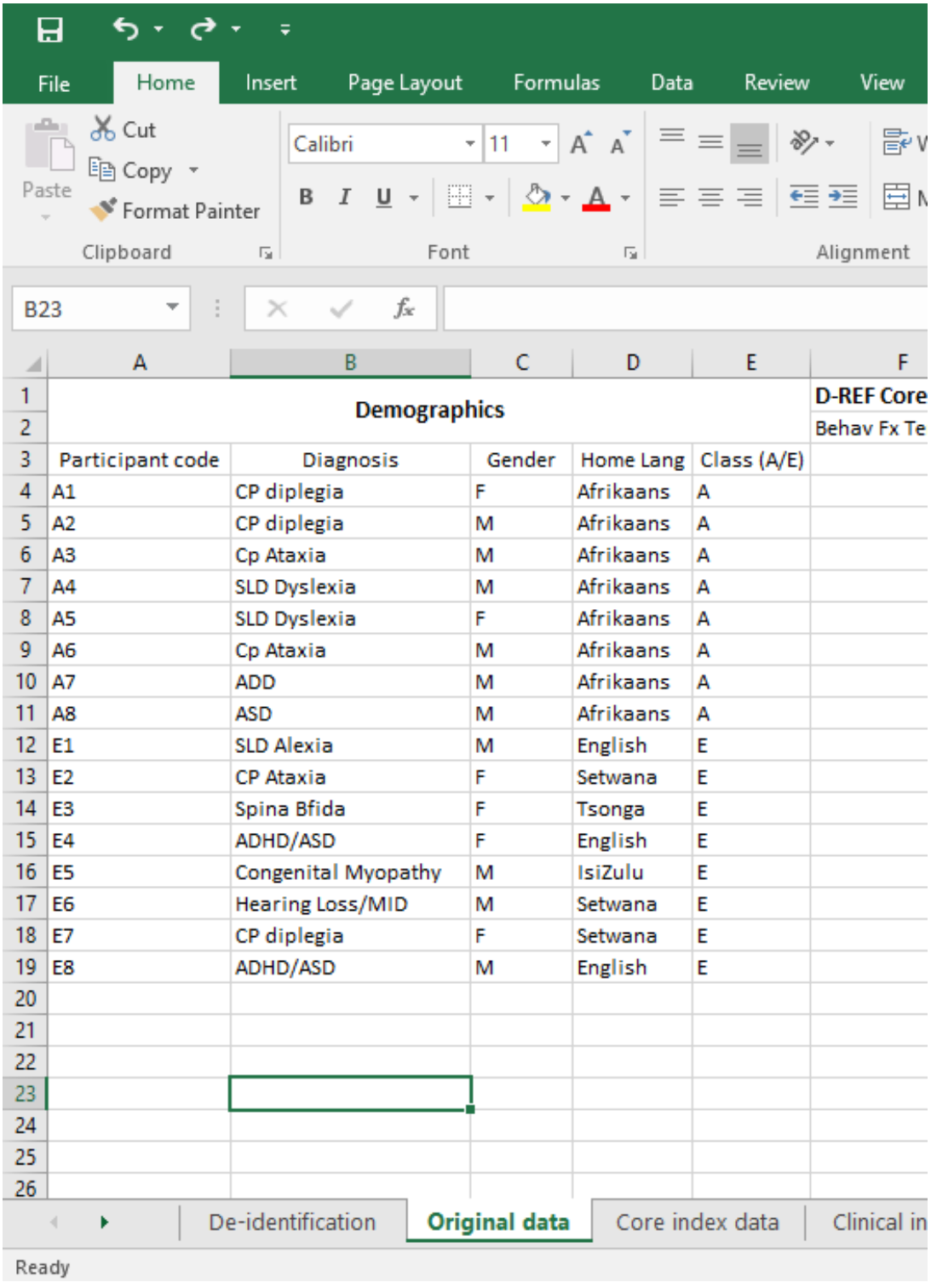
Zelazo, P.D., C.B. Blair, and M.T. Willoughby. 2016. *Executive Function: Implications for Education*. National Center for Education Research, Institute of Education Sciences, U.S. Department of Education. http://ies.ed.gov/.

Zelazo, P.D., and S.M. Carlson. 2012. “Hot and Cool Executive Function in Childhood and Adolescence: Development and Plasticity.” *Child Development Perspectives* 6 (4): 354–60.

Zylowska, L., D.L. Ackerman, M.H. Yang, et al. 2008. “Mindfulness Meditation Training in Adults and Adolescents With ADHD: A Feasibility Study.” *Journal of Attention Disorders* 11 (6): 737–46.

APPENDIX A - DEMOGRAPHIC INFORMATION

As captured on Excel



	A	B	C	D	E	F
1		Demographics				D-REF Core
2						Behav Fx Te
3	Participant code	Diagnosis	Gender	Home Lang	Class (A/E)	
4	A1	CP diplegia	F	Afrikaans	A	
5	A2	CP diplegia	M	Afrikaans	A	
6	A3	Cp Ataxia	M	Afrikaans	A	
7	A4	SLD Dyslexia	M	Afrikaans	A	
8	A5	SLD Dyslexia	F	Afrikaans	A	
9	A6	Cp Ataxia	M	Afrikaans	A	
10	A7	ADD	M	Afrikaans	A	
11	A8	ASD	M	Afrikaans	A	
12	E1	SLD Alexia	M	English	E	
13	E2	CP Ataxia	F	Setwana	E	
14	E3	Spina Bfida	F	Tsonga	E	
15	E4	ADHD/ASD	F	English	E	
16	E5	Congenital Myopathy	M	IsiZulu	E	
17	E6	Hearing Loss/MID	M	Setwana	E	
18	E7	CP diplegia	F	Setwana	E	
19	E8	ADHD/ASD	M	English	E	
20						
21						
22						
23						
24						
25						
26						

APPENDIX B - DELIS RATING OF EXECUTIVE FUNCTIONS

Teacher
RATING FORM

D-REF Delis Rating of Executive Functions

Date of Rating: _____

Teacher's Name: _____

Classroom/ Subject: _____

Time Rater Has Known Child: _____

Referral Agent: _____

Child's Name: _____

Child's Date of Birth: _____

Child's Gender: ☐ M ☐ F

School: _____

Grade: _____

The Delis Rating of Executive Functions examines behaviors and feelings in children and adolescents. A teacher's view of a child's behavior is particularly helpful for understanding the child. This questionnaire asks you to report how often you observe a particular behavior in the child. You will need to answer each question. Select Seldom/Never if you feel it does not apply to the child.

The Delis Rating of Executive Functions consists of two parts. The first section asks you to report on how often you notice the child behaving in certain ways. The second section asks you to note the five behaviors that you feel are most problematic for the child. Please read the instructions for each section carefully before responding.

To complete this form, make sure the child's information is completed, that all 36 items are completed, and to select only five problem behaviors from the list of stresses.

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2 3 4 5 6 7 8 9 10 11 12 A B C D E

Product Number 015001192X

The following statements describe behaviors and feelings of children and adolescents. Please read each statement carefully and decide which frequency applies to the child within the past 6 months.

Remember to give your own opinion of the child's behavior and select the frequency that you feel best applies. If you change your mind, mark through the answer you want to change and circle the new one.

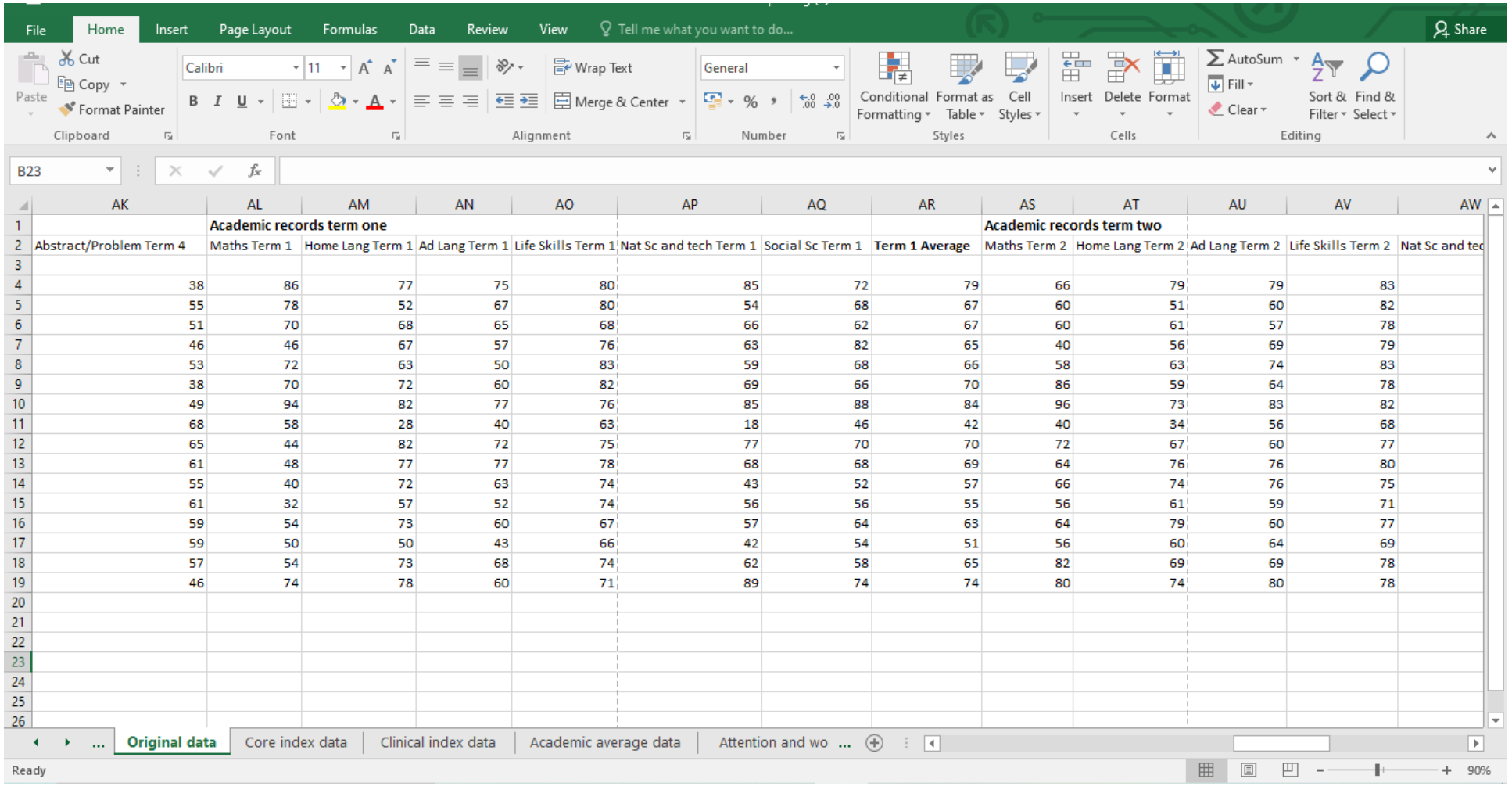
Circle **S/N** for Seldom/Never if the behavior occurs **less than once every 3 months or never.**
Circle **M** for Monthly if the behavior occurs **at least once every 1–3 months** (and less than once a week).
Circle **W** for Weekly if the behavior occurs **at least once a week** (and less than once a day).
Circle **D** for Daily if the behavior occurs **at least once a day**.

PART 1	Rating (circle one)			
Item	Seldom/ Never	Monthly	Weekly	Daily
1. Acts too silly or childish.	S/N	M	W	D
2. Is off-task when he/she is supposed to do class work.	S/N	M	W	D
3. Little setbacks make him/her very upset.	S/N	M	W	D
4. Does the first thing that comes to his/her mind.	S/N	M	W	D
5. Loses track of what he/she is doing due to noises or other things going on.	S/N	M	W	D
6. Switches from happy to sad or mad quickly.	S/N	M	W	D
7. Forgets what he/she is supposed to do.	S/N	M	W	D
8. Shows outbursts of anger.	S/N	M	W	D
9. Behavior is often out of control.	S/N	M	W	D
10. Is very messy.	S/N	M	W	D
11. Resists doing what adults tell him/her to do.	S/N	M	W	D
12. Says things before thinking.	S/N	M	W	D
13. Is quick to argue with others.	S/N	M	W	D
14. Is constantly moving and cannot sit still for long when required.	S/N	M	W	D
15. Cannot do two or more tasks at the same time.	S/N	M	W	D
16. Moods change quickly for no reason.	S/N	M	W	D
17. Touches or plays with things that he/she was told not to touch or play with.	S/N	M	W	D
18. Has difficulty shifting from one task to another.	S/N	M	W	D
19. Is easily upset when corrected by an adult.	S/N	M	W	D
20. Often breaks rules at school.	S/N	M	W	D
21. Does not start class work without extra prompting.	S/N	M	W	D
22. Has trouble making decisions.	S/N	M	W	D
23. Makes mistakes because he/she is in a hurry to complete a task.	S/N	M	W	D
24. Has trouble coming up with his/her own ideas when writing papers for school.	S/N	M	W	D
25. Will miss the main point or moral of a story.	S/N	M	W	D
26. Is very loud.	S/N	M	W	D
27. Has trouble completing tasks like homework or class projects.	S/N	M	W	D
28. Only puts forth effort on things he/she likes to do.	S/N	M	W	D
29. Starts projects without having any idea or plan of what he/she should do.	S/N	M	W	D
30. Loses things easily.	S/N	M	W	D
31. Often loses track of time.	S/N	M	W	D
32. Focuses on small details and fails to understand the main points.	S/N	M	W	D
33. Has trouble following directions.	S/N	M	W	D
34. Keeps trying to solve problems the same way even if that way does not work.	S/N	M	W	D
35. Lets mind wander if an adult does not keep him/her on task.	S/N	M	W	D
36. Misinterprets social situations.	S/N	M	W	D

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Product Number 015001192X

Child's Name :

APPENDIX C - ACADEMIC RECORDS



	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
1		Academic records term one							Academic records term two				
2	Abstract/Problem Term 4	Maths Term 1	Home Lang Term 1	Ad Lang Term 1	Life Skills Term 1	Nat Sc and tech Term 1	Social Sc Term 1	Term 1 Average	Maths Term 2	Home Lang Term 2	Ad Lang Term 2	Life Skills Term 2	Nat Sc and tec
3													
4	38	86	77	75	80	85	72	79	66	79	79	83	
5	55	78	52	67	80	54	68	67	60	51	60	82	
6	51	70	68	65	68	66	62	67	60	61	57	78	
7	46	46	67	57	76	63	82	65	40	56	69	79	
8	53	72	63	50	83	59	68	66	58	63	74	83	
9	38	70	72	60	82	69	66	70	86	59	64	78	
10	49	94	82	77	76	85	88	84	96	73	83	82	
11	68	58	28	40	63	18	46	42	40	34	56	68	
12	65	44	82	72	75	77	70	70	72	67	60	77	
13	61	48	77	77	78	68	68	69	64	76	76	80	
14	55	40	72	63	74	43	52	57	66	74	76	75	
15	61	32	57	52	74	56	56	55	56	61	59	71	
16	59	54	73	60	67	57	64	63	64	79	60	77	
17	59	50	50	43	66	42	54	51	56	60	64	69	
18	57	54	73	68	74	62	58	65	82	69	69	78	
19	46	74	78	60	71	89	74	74	80	74	80	78	
20													
21													
22													
23													
24													
25													
26													

APPENDIX D - ETHICAL CLEARANCE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Miss Jean-Marie Cilliers

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M211051

NAME: (Principal Investigator)	Miss Jean-Marie Cilliers
DEPARTMENT:	Occupational Therapy Learners with Special Educational Needs School Gauteng West
PROJECT TITLE:	The change in executive functioning of grade four learners attending an occupational therapy intervention at a learners with special education needs school
DATE CONSIDERED:	29/10/2021
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the University Registrar's office <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Dr T. Rauch Van der Merwe and Mr D. Franzsen
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	06/05/2022

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions.Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. I **agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **October** and will therefore be due in the month of **October** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX E - PERMISSION FOR STUDY

West Rand School
Wesrandse Skool
PBO No. 930 003667

Johan Jonker Drive
Wentworth Park
KRUGERSDORP 1739

Private Bag X2026
KRUGERSDORP 1740 • Tel: 011 668 8200
E-mail: principal@westrandschool.co.za

To Whom it may concern 2022-04-25

I, Mrs. Leonore Coetzer, Acting Principal of West Rand School, herewith grant permission to Ms. Jean-Marie Cilliers to access the information needed for her study: *The change in executive functioning of grade four learners attending an occupational therapy intervention at an LSEN school.*

As requested she may access the following information:

- Contact information of relevant parents/guardians to obtain the needed consent.
- Demographic information such as date of birth and diagnosis
- Delis Rating scale of Executive Functioning (D-REF) scores for all four terms of 2021
- Academic records for all four terms of 2021
- The session notes made by the therapists presenting the intervention groups.



Leonore Coetzer

Acting Principal

Request to access data at school



LETTER TO PRINCIPAL OF WEST RAND SCHOOL

Dear Mrs. Coetzer

My name is Jean-Marie Cilliers and I am a Masters student in occupational therapy at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, with the aim of investigating the effect of a weekly Grade four occupational therapy intervention on their executive functioning skills and academic performance under the supervision of Dr. Tania Rauch Van der Merwe and Dr. Denise Franzsen.

The research title is; *The change in executive functioning of Grade four learners attending an occupational therapy intervention at a LSEN school*

This study has been approved by the Health Research Ethics at the University of Witwatersrand and will be conducted according to the ethical guidelines and principles of the Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research and International Declaration of Helsinki. Permission has also been obtained from the Department of Education of Gauteng.

I herewith seek permission to access the contact information of the parents/guardians of all the Grade four learners. This is to invite them to a meeting where all relevant information regarding the study will be communicated and consent (or refusal) obtained.

Should the parents/guardians consent, the following data will be collected for each child:

- Demographic information such as name (which will be coded as part of de-identification procedures,) date of birth, home language, gender and diagnosis.
- Delis Rating scale of Executive Functioning (D-REF) scores for all four terms of 2021
- Academic records for all four terms of 2021

- The session notes made by the therapists presenting the intervention groups (myself) after each weekly therapy session.

The data collection will not affect the children or their parents/guardians in any way. The data collection will also not affect the staff or management of the school or disrupt the 'normal school day.'

Please feel free to contact myself or my supervisors should you have any questions or concerns.

I Thank you for your favourable consideration.

Kind regards
Jean-Marie Cilliers (Principal researcher)

Contact information

Jean-Marie Cilliers (Principal researcher)082 732 9390 or
jeanmariec6gmail.com,

Dr. Tania Rauch van der Merwe (Supervisor)011 717 3701
tania.vandermerwe@wits.ac.

Dr. Denise Franzsen (Supervisor)011 717 3701
denise.franzsen@wits.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand
011 717 2301 Clement.Penny@wits.ac.za

APPENDIX F - INFORMATION LETTERS AND CONSENT FORMS



PARTICIPANT INFORMATION SHEET

For parents/guardians

Title of research study:

The change in executive functioning of Grade four learners attending an occupational therapy intervention at a LSEN school

Introduction

Your child is invited to take part in the abovementioned research study. Please take some time to read the information presented below. Please ask the researcher any and all questions that you may have about the study.

This study has been approved by the Health Research Ethics at the University of Witwatersrand and will be conducted according to the ethical guidelines and principles of the Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical. Guidelines for Research and International Declaration of Helsinki. Permission has also been obtained from the Department of Education of Gauteng.

What is this research study about?

An intervention programme has been developed by the researcher, that is also an occupational therapist at the school, Jean-Marie Cilliers. The purpose of this intervention is to improve the executive functioning skills of the Grade four learners. Executive functioning skills include the ability to solve practical problems, work in an organised manner and to focus on the most pertinent information. All Grade four learners have been receiving the intervention as a class group since the beginning of the year. An assessment of their

executive functioning is completed by their teacher every term. The learners are not directly involved in the assessment. The name of the assessment is the Delis-Rating Scale of Executive Functioning (D-REF.)

The therapist (and researcher) wishes to determine whether the weekly class intervention is making a positive difference in the executive functioning and academic performance of each learner. For this purpose, the researcher needs access to the learners D-REF results as well as their academic results.

What is important for you to know?

Your consent as parent/guardian is needed for the researcher to include the data (D-REF as well as academic results) of your child in the study. Consenting to the inclusion of your child's data in this study will have no negative impact on your child's schooling or therapeutic intervention. If you choose not to consent, there will also be no negative impact on your child's schooling or therapeutic treatment. Allowing your child to be a part of the research study is entirely voluntary and you are also free to withdraw your child from the study with no negative consequences to you or your child.

How will confidentiality be upheld?

A de-identification process will be used, where your child is assigned a number such as A1. All information about your child will be captured using A1 instead of his/her name. No personal information will be communicated to any person that is not part of the study. All information will be stored on the researcher's laptop that is password protected.

Are there any risks or benefits or costs involved in taking part in this study?

There are no risks or costs associated with participating in the study for you or your child. Neither you, nor your child will be paid to be part of this study.

Should you have any questions or concerns, please feel free to ask or raise them.

Principal researcher: Jean-Marie Cilliers

Contact details of principal investigator: 082 732 9390 or jeanmariec6@gmail.comSupervisors: Dr. T. Rauch Van der Merwe and Dr. D. Franzsen.

DEELNEMER INLIGTINGSBLAD

Vir ouers/voogde

Titel van navorsingstudie:

Die verandering in uitvoerende funksie van Graad vier-leerders wat 'n arbeidsterapie intervensie bywoon by 'n LSOB skool.

Inleiding

U kind is uitgenooi om deel te neem aan die bogenoemde navordingstudie. U word vriendelik versoek om die onderstaande inligting, rakende die studie, deur te lees. Neem asseblief die vrymoedigheid om enige vrae wat u omtrent hierdie studie sou hê, aan die navorser te vra..

Hierdie navorsingstudie is goedgekeur deur die Gesondheidsnavorsingetiek van die Unversiteit van Witwatersrand en sal uitgevoer word volgens die etiese riglyne en beginsels van die Riglyne vir Goeie Kliniese Praktyk en die Mediese Navorsingsraad (MNR) se Etiese Riglyne vir Navorsing en die Internasionale Verklaring van Helsinki. Toestemming tot hierdie studie is ook verleen deur die Gautengse Onderwysdepartement.

Waaroor handel hierdie studie?

'n Intervensieprogram is deur die navorser, Jean-Marie Cilliers, 'n arbeidsterapeut by die skool, ontwikkel. Die doel van die intervensie is om die uitvoerende funksievaardighede van die graad vier leerders te verbeter. Uitvoerende funksie-vaardighede sluit in die vermoë om praktiese probleme op te los, op 'n geörganiseerde wyse te werk en om te fokus op die mees belangrike inligting. Alle graad vier-leerders ontvang reeds hierdie intervensie as 'n klasgroep sedert die begin van die jaar. 'n Assessering van hulle uitvoerende funksies word

kwartaalliks deur hulle onderwysers voltooi. Die leerders is nie direk betrokke by die assessering nie. Die naam van die assessering wat gebruik word is “The Delis-Rating Scale of Executive Functioning (D-REF.)”.

Die terapeut (en navorser) se doel is om te bepaal of die weeklikse intevensie ‘n positiewe verandering in die uitvoerende funksie en akademiese prestasie van elke leerder tot gevolg het. Vir hierdie doel sal die navorser toegang moet hê tot die leerders se D-REF uitslae sowel as hulle akademiese resultate.

Wat is belangrik vir u om te weet?

Die navorser het u as ouer/voog se toestemming nodig om toegang tot die data (D-REF sowel as akademiese resultate) van u kind te verkry. Toestemming tot die insluiting van u kind se data in die studie, sal geen negatiewe impak op u kind se skoolopleiding of terapeutiese intervensie hê nie. U is vry om u toestemming te weerhou, sonder enige negatiewe gevolge. Die toelating van u kind tot deelname aan die studie, is geheel en al vrywillig en u is ook vry om u kind te onttrek van die studie met geen negatiewe gevolge vir u of u kind.

Hoe sal vertroulikheid verseker word?

‘n De-identifikasie proses sal gebruik word, waarin u kind ‘n kode sal ontvang. Alle inligting omtrent u kind sal sal volgens hierdie kode, en nie sy/haar naam nie, genoteer word. Geen persoonlike inligting sal gekommunikeer word aan enige persoon wat nie deel vorm van hierdie studie nie. Alle inligting sal slegs op die navorser se skootrekenaar gestoor word, onder ‘n spesiale wagwoord.

Is daar enige risiko’s of voordele of kostes verbonde met die deelname aan die studie?

Daar is geen risiko’s of voordele of kostes verbonde met die deelname aan hierdie studie vir u of u kind nie. Nie u, of u kind, sal betaal word om deel te neem aan die studie nie.

Indien u enige vrae of bekommernisse het, neem asseblief die vrymoedigheid om dit aan die navorser te noem.

Hoofnavorser: Jean-Marie Cilliers

Kontakbesonderhede van hoofnavorser: 082 732 9390 or jeanmariec6@gmail.comToesighouers: Dr. T. Rauch Van der Merwe en Dr. D. Franzsen.

PARTICIPANT INFORMATION SHEET

For learners

Title of research study:

The change in executive functioning of Grade four learners who attend occupational therapy intervention at a LSEN school.

To be read to learners

You know that I see you every week to do some occupational therapy work since the beginning of the year. This is to help you with things like solving problems, concentrating better and working nicely and organised. I have to do a project and want to see whether our occupational therapy sessions are helping you get better with these things and helping you to do better on your report cards.

I need to look at your report cards and also some information that your teacher will give to me to see whether our occupational therapy sessions are working, but I must first ask whether that is okay with you. Your parents/guardians have told me that it is okay, but is important that you are also okay with it. You are allowed to say no.

No one will know your names. When I work with your information you will have a secret name like A1. There are no risks in being part of the study. Nothing bad will happen because you said yes, but also no one will be mad if you say no. You will not have to pay to be part of the study, but you will also not get money for it.

Do you have any questions or things that worry you about the study?

DEELNEMER INLIGTINGSBLAD

Vir Leerders

Titel van Navorsingstudie:

Die verandering in Uitvoerende Funksie van Graad vier leerderswat 'n arbeidsterapie-intervensie bywoon by a LSOB skool

Wat vir leerder gelees moet word

Soos julle weet, sien ek julle elke week, reeds van die begin van die jaar af, vir arbeidsterapie werk. Dit is om jou te help met dinge soos om probleme op te los, om beter te konsentreer en om goed en georganiseerd te werk. Ek moet 'n projek doen en wil uitvind of ons arbeidsterapiesessies jou help om beter te raak met hierdie dinge en of dit jou help om beter te doen op julle rapportkaarte.

Hiervoor moet ek na julle rapportkaarte kyk en ook na inligting wat julle meneer vir my sal gee, om uit te vind of ons arbeidsterapiesessise wel werk. Ek wil eers vir julle vra of dit reg is met julle. Julle ouers/voogde het reeds gesê dat dit reg is, maar dit is belangrik dat julle ook ook reg is daarmee. Jy mag ook nee sê.

Niemand sal julle name weet nie. Wanneer ek met jou inligting werk, sal jy 'n geheime naam, 'n skuilnaam, hê, soos A1. Daar is niks gevaarlik wat kan gebeur nie. Geen slegte ding sal gebeur as jy ja sê nie, maar niemand sal kwaad wees vir jou as jy nee sê nie. Jy hoef niks te betaal om deel te neem nie, maar jy sal ook nie geld kry daarvoor nie.

Het jy enige vrae of is daar iets waaroor jy bekommerd is oor die studie?

WITS UNIVERSITY

PARTICIPANT CONSENT SHEET

The change in executive functioning of Grade four learners attending an occupationaltherapy intervention at a LSEN school

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

Contact details:

Jean-Marie Cilliers, Principal Investigator, telephone no. 082 732 9390, or by e-mail atjeanmariec6gmail.com,

T. Rauch van der Merwe or D. Franzsen, Supervisors, on telephone no. 011 717 3701, or by e-mail at tania.vandermerwe@wits.ac.za or denise.franzsen@wits.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Name of Parent/Guardian:_____

Name of child: _____

Date: _____

Place: _____

Signature or mark _____

Witnessed by:

Name of Witness: _____
Signature: _____
Date: _____

WITS UNIVERSITY

PARTICIPANT ASSENT SHEET FOR MINORS

The change in executive functioning of Grade four learners attending an occupationaltherapy intervention at a LSEN school

1. I have been given a Participant Information Sheet for Minors, which explains what this study is about;
2. The study was explained to me and I understand what will happen if I take part;
3. I was given time to ask any questions I wanted to and was happy with the answers I was given;
4. I understand that I will not get any benefits from the study, should I agree to take part. I also understand that I will not be paid or get money to take part in the study; taking part will not cost me anything either;
5. I have been given contact details, repeated below, should I want more information later, or have any cause for concern over anything which is done to me during the study; and
6. I understand that even if I agree to take part in the study, I can change my mind later and stop being a part of the study
7. My parent(s) or guardian(s) know that I have been invited to take part in the study. They agree that I may do so, but the decision to take part is also mine.

Contact details:

Jean-Marie Cilliers, Principal Investigator, telephone no. 082 732 9390, or by e-mail atjeanmariec6gmail.com,

T. Rauch van der Merwe or D. Franzsen, Supervisors, on telephone no. 011 717 3701, or by e-mail at tania.vandermerwe@wits.ac.za or denise.franzsen@wits.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Name of Child: _____

Date: _____

Place: _____

Signature or mark _____

Name of Parent or Guardian: _____

Witnessed by:

Name of Witness: _____

Signature: _____

Date: _____

WITS UNIVERSITY

DEELNEMER VRYWARINGS-/TOESTEMMINGSDOKUMENT

8. 'n Deelnemer Informasie Dokument wat die aard en die prosses van die studie verduidelik, is aan my verskaf en is hieraan vasgeheg;
9. Ek is tyd gegun om die dokument te lees, of dit is vir my gelees, in 'n taal wat ek verstaan;
10. Ek is 'n kans gegun om enige vrae te vra, en is tevrede met die antwoorde wat ek gekry het.
11. I glo dat ek die rede vir die uitvoering van die huidige studie, sowel die verwagte uitkomstes daarvan, ten volle verstaan;
12. Ek verstaan dat nie ek of my kind enige direkte voordeel of betaling sal ontvang, sou ons toestemming gee om aan die huidige studie deel te neem nie. Deelname aan die studie sal ook niks vir my of my kind kos nie;
13. Ek verstaan dat selfs as ek inisiëel toestemming gee, ek my kind sonder rede of verduideliking uit die studie kan onttrek. Sou ek so besluit, sal al die data van my kind wat vir die doel van die studie ingesamel is, onmiddelik vernietig word, tensy ek toestemming gee dat dit gehou mag word.
14. Ek het 'n verskeidenheid van kontak besonderhede ontvang, soos gelys hieronder. Indien ek enige verdere inligting benodig, of as ek oor enige aspekte van die studie bekommerd raak, is ek welkom om enige van die gelyste kontakpersone te kontak.

Kontak besonderhede:

Jean-Marie Cilliers, Hoof navorser, op telefoonnommer: 082 732 9390, of te e-pos byjeanmariec6gmail.com,

T. Rauch van der Merwe of D. Franzsen, Toesighouers/mentors, op telefoonnommer. 011 717 3701, of te e-pos by tania.vandermerwe@wits.ac.za of denise.franzsen@wits.ac.za

Professor CB Penny, Voorsitter van die Menslike Navorsings Etiek Kommittee (Medies) van die Universiteit van Witwatersrand, telefoonnommer. 011 717 2301, of te e-pos by Clement.Penny@wits.ac.za.

Ms. Z Ndlovu of Mr Rhulani Mkansi, Sekretaris van die Kommittee, telefoonnommers.: 011 717 2700 of 1234, of te e-pos by: Zanele.Ndlovu@wits.ac.za of Rhulani.Mkansi@wits.ac.za

Naam van ouer/Voog: _____

Naam van kind: _____

Datum: _____

Plek: _____

Handtekening of merk _____

Getuig deur:

Naam van getuie: _____

Handtekening:_____

Datum: _____

DEELNEMER INSTEMMINGSDOKUMENT VIR MINDERJARIGES

Die verandering in kognitiewe uitvoerende funksies van Graad vier leerders by 'n LSENskool wat 'n arbeidsterapie intervensie ontvang

8. Ek het 'n Deelnemers Informasie Dokument vir minderjariges ontvang. Dit verduidelik waaroor die studie gaan.
9. Die studie is aan my verduidelik en ek verstaan wat sal gebeur sou ok deelneem daaraan.
10. Ek het kans gekry om die vrae te vra wat ek wou vra, en ek is gelukkig met die antwoorde wat ek gekry het.
11. Ek verstaan date k nie enige voordele of geld sal kry as ek aan die studie sou deelneem nie. Om aan die studied eel te neem sal ook nie vir my iets kos nie.
12. Ek het kontakbesonderhede gekry, wat onder op die bladsy staan. As ek enige vrae het, of as ek bekommerd raak oor enige iets wat tydens die studie gebeur, is ek welkom om hulle te kontak.
13. Ek verstaan dat selfs as ek nou instem om deel te neem aan die studie, ek op enige stadium kan besluit date k nie meer deel wil wees van die studie nie.
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Ms. Z Ndlovu of Mr Rhulani Mkansi, Sekretaris van die Kommittee, telefoonnommers.: 011 717 2700 of 1234, of te e-pos by: Zanele.Ndlovu@wits.ac.za of Rhulani.Mkansi@wits.ac.za

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APPENDIX G - INTERVENTION

TREATMENT OUTLINE FOR ADDRESSING THE EXECUTIVE FUNCTIONING DIFFICULTIES OF GRADE FOUR LEARNERS AT WEST RAND SCHOOL

Developed: J. Cilliers

(Occupational Therapist; OT0097950)

A personalized approach for addressing the executive functioning difficulties of grade four learners at West Rand School was developed by an occupational therapist for use as a guide for weekly occupational interventions. Two constructs found in literature form the basis of the intervention approach. These are the Mediated Learning Experience (MLE) and the development of Metacognitive Skills.

1. *MEDIATED LEARNING EXPERIENCE*

Mediated Learning Experience is an approach based on the work of Freuerstein et al. on Structural Cognitive Modifiability (Freuerstein, Rand, & Hoffman, 1979). Freuenstein made the distinction between client exposure to learning and learning through the assistance of a human mediator, which he termed MLE. It is through the process of MLE that the cognition can be acquired or enhanced (Freuerstein, Rand, & Rynders, 1988). It is important to note that the mediator can be a teacher, therapist, parent or even class mate, any person who has a better understanding of a specific topic or has mastered a desired skill.

There are three requirements of interactions in order for it to be qualified as a MLE:

1. Intentionality and Reciprocity

   Intentionality refers to the mediator interposing him/herself between the child and the source of stimuli with the goal of developing or improving a specific skill. This is conversely to a non-mediated task that is supposed to 'teach itself' through direct exposure alone. MLE encourages the child to perceive things withclarity and precision as deemed necessary and thus highlighted by the mediator. A mediator with the intention to have a particular concept perceived fully,

modifies the stimulus, making it more notable and engaging to the learner. (Freuerstein, Rand, & Rynders, 1988)

2. Transcendence

   MLE interactions are never limited to the immediate need that elicited the relevant behaviour or action. The roll of the mediator is to make the situation requiring a specific behaviour or action distinguishable from other situations, while linking it to other situations where this behaviour or action may be needed. It is the transcendence in the nature of the MLE interactions that produces flexibility in the child's thinking. (Freuerstein, Rand, & Rynders, 1988)

3. Mediation of Meaning

   Mediation of meaning represents the affective or emotional power that will make the mediational interaction overcome resistance on the part of the learner. Mediated meaning assures that the child does not only become receptive to the stimuli but is also engaged in the mutual reciprocal interaction with it and ultimately understanding the purpose of the activity. (Freuerstein, Rand, & Rynders, 1988)

2. *THE DEVELOPMENT OF METACOGNITION*

Metacognition, or the ability to reflect on their own thinking and learning, underlies students' use of executive functioning processes. More specifically, metacognition, as defined originally by Flavell (1979) refers to each learner's comprehension of how she/he learns as well as the strategies that could be used to complete a tasks (Flavell, 1977).

To build learners' motivation and persistence, learners require the knowledge and sound understanding of their own attributes. They need to understand their strengths and weaknesses, and apply their executive functioning process to manage those attributesthat may be maladaptive (weaknesses) and maximize the positive attributes (Corno, 2001). Ultimately metacognition allows the child to identify which strategies work the best for him/her, as well as the why, where, when, and how application thereof.

Learners with sound metacognitive abilities, know to stop and ensure that they understand the situation and all needed information. They may then remind themselves

to develop a plan based on the goal of the activity, carry out the plan and then reflect whether their plan worked or need to be altered. This may all be done making use of

self-talk. Self-talk refers to the internal dialogue a person may have with themselves to ensure the forming and following of the correct steps as well as the evaluation of these steps, and is a form of self-management (Gaskins & Pressley, 2007)

2.1 Developing Metacognitive skills

2.1.1 Explaining Strategies/Teaching the skill

There are various executive functioning skills, and educational strategies will, differ depending on the skill being taught, the context in which it will be used, and developmental level of the child. The skills and strategies taught will also differ depending on the goal or desired actions and behaviour. A general process for teaching children executive skills is outlined in Table 1. Initially mediators model the desired behaviour and skills, essentially acting as the learner's external frontal lobes. In so doing, they perform the following functions:

- Supply a plan, an organizational scheme, and a specific set of directions.
- Monitor performance.
- Provide encouragement, motivation, and feedback regarding the success of the approach.
- They model problem solving when something doesn't work.
- They determine when the task is completed (Dawson & Guare, 2010).

Table 1: Teaching Children Executive skills (Dawson & Guare, 2010)

Step 1:	Determine the problem behaviours.
Step 2:	Set a goal.
Step 3:	Establish a procedure or set of steps to reach the goal.
Step 4:	Supervise the child following the procedure. *Child is observed and prompt given as needed to improve performance*
Step 5:	Evaluate the process and make changes if necessary

	Mediator identifies where the process can be improved. Include more/less cues or a more refined breakdown of the task. (See Scaffolding later) Involve learner in the evaluation process.
Step 6:	Fade the supervision

2.1.2 Scaffolding

Scaffolding refers to teachers/facilitators simplifying tasks by breaking them down into smaller and manageable steps to assist the learner to better comprehend them, and reduce frustration, while providing cues as to what strategies to use and how to approach the steps. As the learner becomes more proficient in performing the steps of the task, the teacher/facilitator 'backs off' by providing less cues and guidance, allowing the learner to control his/her own thinking and behaviour, and work more independently (Wood, Bruner, & Ross, 1976)

2.1.3 Self-monitoring

Self-monitoring is a metacognitive strategy, that provides students with control over learning. It is an internal cognitive process in which individuals record information regarding their own behaviour and the outcomes thereof in order to adjust it if needed. It entails checking, verifying and correcting one's performance in a learning task. The modelling of self-talk forms part of teaching the self-monitoring skill (Meichenbaum, 1977).

Practical guidelines for presenting activities during group intervention sessions

1. Encourage the chid to perceive things with clarity and precision by highlighting the salient aspects of a task, strategy or skill. Modify the relevant stimulus, making it more notable and engaging to the learner.
   → Verbal cues, class discussion, sharing of ideas.
2. Make the situation/type of task requiring a specific strategy or skills distinguishable from other situations, while linking it to situations where the

strategy or skill can also be used.

→ Discussion at end of session regarding where 'what we have learnt' can also be used

3. Ensure the engagement of learners in the mutual reciprocal interaction and that they understand the purpose of the activity.

   → Clearly communicate the goal of the group session and what skills will be addressed. Involve all by ensuring active participation in class discussions and communicating with all learners throughout the sessions.

4. Assist learners in discovering their strengths and weaknesses as well as how to apply executive functioning skills to manage their weaknesses and maximize their strengths.

   → Verbalise strengths and weaknesses (and allow for learner to identify what they find difficult and what they find easy.) Problem solve with the learner to find strategies and develop skills to optimise strengths and manage weaknesses.

5. Expose the learners to multiple strategies and skills (and allow for sharing of these ideas between learners) and assist learners to identify which strategies work well for them, as well as why, where, when, and how to apply each strategy
6. Model the use of self-talk as a mode of self-monitoring during participation in tasks. Include

   a.) Stop and ensure I understand what is expected;

   b.) Do I have all the information?

   c.) What is my plan – based on the goal of the activity;d.) Execute the plan;

   e.) Evaluate effectiveness of plan and make corrections if needed

7. When teaching specific executive functioning skills/strategies (such as forworking memory) model the desired actions:

   a.) Supply a plan, an organizational scheme, and a specific set ofdirections.

   b.) Monitor performance.

   c.) Provide encouragement, motivation, and feedback regarding thesuccess of the approach.

   d.) Model problem solving when something doesn't work.

e.) Determine (and indicate) when the task is completed (assist inevaluating the learners' performance in the task.)

Make use of scaffolding by breaking tasks and strategies down into smaller and more manageable steps. Provide less cues as the learner becomes moreindependent in managing the steps

APPENDIX H - TURNITIN REPORT

2507481 J Cilliers Research

by Jean-Marie Cilliers

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Submission ID: 2627785773
File name: 2090_Jean-Marie_Cilliers_2507481_J_Cilliers_Research_53322_1778705404.docx (526.25K)
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