

AN EXPLORATION OF THE RELATIONSHIP BETWEEN RETAINED PRIMITIVE
REFLEXES AND CONCENTRATION PROBLEMS IN LEARNERS ASSESSED AT
A SELECTED PRIVATE PRACTICE IN WINDHOEK, NAMIBIA

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MAGDALENA G. CALITZ

STUDENT NUMBER: 201212314

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Main Supervisor: Professor M. L. Mostert

Co-Supervisor: Professor A. Möwes

ABSTRACT

In this research a quantitative approach was employed to conduct a correlation study on the possible impact of retained primitive reflexes on concentration problems. Secondary data from existing client documents were used. These comprised the test scores of four of the cognitive processes included in the Cognitive Assessment System (Naglieri & Das, 1997a) – Planning, Attention, Simultaneous and Successive processes. The outcomes of an observation study indicating the presence of four retained primitive reflexes were also included. The sample consisted of 164 Namibian school-aged learners with concentration problems.

No direct correlation between the retained primitive reflexes and concentration problems was found. Correlations between the different retained primitive reflexes were found and supported a gateway effect of earlier primitive reflexes, which led to the retention of those primitive reflexes following the earlier ones. This gateway effect was also found in a study by Taylor, Houghton and Chapman (2004). One of the irregular primitive reflexes (STNR) correlated with simultaneous processing problems, which again correlated with concentration problems. Associations of TLR, ATNR and STNR with concentration problems were also found when using Kruskal-Wallis analyses. More research is needed on the impact of retained primitive reflexes on other neurological soft signs and treatment options to improve those factors that influence concentration problems.

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DEDICATION

This thesis is dedicated to my husband, Ernst Calitz, who stayed married to me through another research process and my son, Ernst Calitz (junior), who acted like a young adult ... Your trust and love will always make me more than I can be.

I, Magdalena Gertruide Calitz, declare hereby that this study is a true reflection of my own research, and that this work or part thereof has not been submitted for a degree in any other institution of higher education.

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Date.....

Magdalena Gertruide Calitz

CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

1.1 INTRODUCTION

This chapter provides a short overview of the orientation of this study and the problem that was addressed, as well as the research questions and hypotheses that led this study; it also addresses the limitations encountered. This study is focused on finding an alternative to the traditional treatment measures of concentration problems by investigating a possible correlation between concentration problems and retained primitive reflexes. Should a correlation be found, the improvement of the identified retained primitive reflexes can provide an alternative treatment of concentration problems, focusing on causal measures and not on treating symptoms.

“What ... is the point of just measuring a child’s intelligence and labelling him with a tag of slowness or subnormality? The point, surely, is to change the child” (Feuerstein as cited in Howard & Coulter, 1996).

1.2 ORIENTATION OF THE STUDY

The development of thinking abilities and the ability to focus attention effectively on a learning task is a hierarchical process. It starts during infancy with involuntary movements, called primitive reflexes. Primitive reflexes are automatic movements that require no thought and are directed from the brainstem. They are used for survival and

development in the womb and during the first year of life (Sensory Development Seminars, 2010). Hereafter these reflexes develop into controlled movement and planned actions and finally into thoughts and higher thinking processes (De Jager, 2009a; De Jager, 2009b; Gajewska, Sobieska, Kaczmarek, Suwalska & Steinborn, 2013; Kokot, 2010a; Leisman, Braun-Benjamin & Melillo, 2014). If the primitive reflexes keep on existing beyond their expected time frame, “they can interfere with social, academic, and motor learning” (Sensory Development Seminars, 2010, p. 2). The continued existence of these reflexes causes problems with the next steps in development, such as effective controlled movements. It thus causes disruptions in the effective development of the brain or in the normal hierarchy of development. The current study aimed to explore the relation between disruptions at the lower parts of the developmental hierarchy, namely the existence of primitive reflexes beyond their expected time frame and the ability to focus attention effectively on a learning task. For the purpose of this study the inability to focus attention effectively on a learning task is referred to as concentration problems and primitive reflexes that exist beyond their expected time frame are referred to as retained primitive reflexes.

1.3 STATEMENT OF THE PROBLEM

A variety of researchers already found links between disruptions in the hierarchy of normal development and disorders and/or learning disabilities, such as Autism, Attention Deficit Disorder and Schizophrenia (Brainhighways, 2009; Kokot, 2005; Rabiner, 2012; Solanki, Swami & Singh, 2012; Westendorp, Hartman, Houwen, Smith

& Visscher, 2011). The researcher found it necessary, though, to extend this research to the Namibian context due to the following:

Concentration problems contribute extensively to general learning problems in schools. Approximately 90% of all learners with learning problems who attend the researcher's psychological practice are reported to experience concentration problems. None of these learners could significantly be helped with medication; therefore, they were visiting this practice for additional assistance in managing and treatment of their concentration problems. According to Kokot (2006), in a study done through the University of South Africa, concentration and task completion are the most frequently experienced barriers to learning in formal schooling. She also states that "Attention Deficit Disorder (inattentive type) is the most frequently diagnosed disorder" (Kokot, 2006, p. 134). As concentration problems constitute such a significant problem in schools in both South Africa and Namibia and medication is not effective in all cases, alternative treatment measures are needed. Halperin, Bédard and Curchack-Lichtin (2012) suggest a neuro-developmental perspective (improving retained primitive reflexes) as an alternative treatment to improve concentration problems. The improvement of retained primitive reflexes as a treatment option for learning difficulties has been used by several institutions, such as Integrated Learning Therapy (Kokot, 2010b) and Mind Moves (De Jager, 2009a) practises in Southern Africa and The Handle Institute (2012) in Seattle, United States of America. A correlation between retained primitive reflexes and concentration problems (when using a psychometric test) has not yet been proven in the Namibian context, though, and no formal research has been done in this area in Namibia.

This shows a need for research in order to develop alternative options in describing concentration problems and related causes, as well as alternative treatment options.

Furthermore, research on a correlation between various retained primitive reflexes and concentration problems is still inconclusive in literature as studies focus on specific reflexes. Konicarova, Bob and Raboch (2013) focused on the relation of the Asymmetrical Tonic Neck Reflex (ATNR) and the Symmetrical Tonic Neck Reflex (STNR) to concentration problems. ATNR's relation to Autism with the Tonic Labyrinth Reflex (TLR) also implicated in learning problems was done by Leisman et al. (2014).

A need thus exists to establish whether a correlation exists between various retained primitive reflexes and concentration problems. Should such a correlation exist, the use of alternative treatment options to improve the learning potential of Namibian learners could be encouraged and further developed.

1.4 RESEARCH QUESTIONS

The above stated problems led to the following research questions:

- Does a correlation exist between various retained primitive reflexes (Moro reflex, TLR, ATNR, and STNR) and concentration problems for Namibian school-aged learners?

- Can certain of the above mentioned retained primitive reflexes predict the existence of concentration problems more significantly than others?

1.5 HYPOTHESES

In reaction to the stated research questions the following alternative hypotheses were stated:

- A positive correlation exists between retained primitive reflexes and concentration problems in Namibian school-aged learners.
- Certain retained primitive reflexes can predict concentration problems better than others.

1.6 SIGNIFICANCE OF THE STUDY

This study is significant in the Namibian situation as it addresses one of the biggest learning difficulties experienced in schools in Namibia – learners’ inability to concentrate. Should some primitive reflexes have better predictive value towards concentration problems; this can improve the focus of possible treatment programs and provide one possible explanation and prediction of the occurrence of concentration problems.

This possible predictive value provides the possibility to develop alternative treatment strategies focused on the causes of concentration problems rather than only on treating symptoms. Although correlation does not necessarily imply a causal relationship (Coolican, 2009), a correlation can still indicate the possibility of improving the one

variable by improving the other. Concentration could thus be improved by treating retained primitive reflexes.

1.7 LIMITATIONS OF THE STUDY

This study was limited to a population of clients to whom the researcher had immediate access and not a population covering the whole of Namibia. Although the majority of clients resided in Windhoek, some came from smaller rural and urban towns. The documents used were from one psychological practice, but included 191 learners who were assessed for both learning problems, including concentration, as well as retained primitive reflexes. The retained primitive reflexes included only four of a variety of primitive reflexes (Kokot, 2010b), namely Moro reflex, Tonic Labyrinth reflex (TLR), Asymmetrical Tonic Neck reflex (ATNR) and Symmetrical Tonic Neck reflex (STNR). These specific primitive reflexes were selected based on practitioner training and risks in assessment strategies. The researcher made use of secondary data. This data was compiled by the researcher herself though.

1.8 RESEARCH ETHICS

This study was based on ethical ground rules in order to protect the subjects, whose data were used, as well as the profession of psychology and the researcher. The study is thus adhering to the following ethical principles to ensure mutual respect and confidence between the investigator and participants and their guardians:

Oral consent was gained from those clients' guardians whose information was included in the sample to be studied. The purpose of this study and the reason why the specific child client's information was included in the study was explained in the interview with the guardians. Guardians were free to, at any time during the research, withdraw their approval of consent. Participants and their guardians had the opportunity to obtain information about the nature, results and conclusions of this research study as was stated in the discussion of consent. All data in this study are based on true data from the used documents. No data were fabricated. Where significant errors in the published data were found, reasonable steps to rectify them were taken. No portion of another author's work was used unless the source was cited, and no previously published data were used as original data collected by the researcher. Research data used to derive conclusions in this study will not be withheld from other competent researchers as long as participants in this study remain anonymous (American Psychiatric Association, 2010). The University of Namibia gave permission for this research study to be conducted and provided ethical clearance. A copy of the research permission letter from the University of Namibia as well as a copy of the ethical clearance certificate are included in Appendices 1 and 2 at the end of this research report.

1.9 CLARIFICATION OF CONCEPTS

Primitive reflexes: Automatic reactions that require no thought and which are controlled from the brainstem. They occur as part of normal development up to 3,5 years of age. They have a developmental, as well as survival, role in development and a specific time frame during which they should be active.

Retained primitive reflexes: Primitive reflexes that remained active beyond their expected time frame.

Concentration problems: Problems with executive functions that control behaviour and the ability to focus on one thing at a time for a prolonged period of time. Concentration problems form part of Attention Deficit Disorder (ADD) and Attention Deficit / Hyperactivity Disorder (ADHD).

Norm referenced test: A standardised test compares and ranks the person who takes the test to others of the same age group.

1.10 STRUCTURE OF THE STUDY

In the first chapter the orientation of the study is discussed; it includes the statement of the problem, hypotheses and questions of the study, significance of the study, limitations of the study, ethical ground rules and the clarification of concepts and terms. The second chapter focuses on the theoretical framework and the literature review. The third chapter discusses the research methodology. The research findings are presented in the fourth chapter. Lastly, the discussion, limitations, recommendations and conclusions are presented in Chapter Five.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter has as its focus the theoretical framework within which primitive reflexes and concentration problems are understood. It discusses how primitive reflexes can contribute to concentration problems. Primitive reflexes and concentration problems are both discussed within a neuro-developmental framework.

The eco-systemic theory, applied by Integrated Learning Therapy, is used to describe the neuro-developmental role of primitive reflexes. This role of primitive reflexes is discussed by explaining the influence of movement on structures of the brain and its effective development. Other contributors to problems with concentration, such as neurophysiology, brain chemicals and other factors like nutrition, allergies and heavy metals are briefly addressed.

The PASS model of intelligence, based on the theory of Luria, is used to explain the neuro-developmental character of concentration problems. Other aspects of concentration problems, such as the neuro-anatomy, neurophysiology and other neuro-developmental factors are also addressed. Finally the impact of concentration problems on the educational environment is discussed.

The focus of this study is on possible neuro-developmental contributors to concentration problems, placing concentration problems and their contributors in a neurological framework. This chapter addresses this framework.

2.2 THEORETICAL FRAMEWORK

The current study is embedded in the eco-systemic theory as explained by Integrated Learning Therapy. This theory forms the conceptual base for primitive reflexes and their possible influence on concentration problems. The theory focuses on the human being as a system. “A system can be described as a number of separate parts that work together in order to get something done” (Kokot, 2010b, p. 24). Apart from describing the human being as a system, this theory also places emphasis on the hierarchical development and interrelations of the different systems within the human being as a system. According to Kandawasvika (2008) developmental patterns already from conception have an influence on the development of coping skills in learning, behaviour and health throughout adult life. Kandawasvika (2008) supported the eco-systemic theory as she stated that the brain develops in a chronological order. Disruptions and immaturities within any of the systems comprising a human-being-as-a-system and in the hierarchical pattern of development are considered as possible contributors to concentration problems. This study conceptualises concentration problems and the contributors thereto, based on an understanding of the human being as a system with a hierarchical pattern of development.

The eco-systemic theory of Integrated Learning Therapy (Kokot, 2010a) recognises the human body-brain-spirit-mind system as an integrated whole. This integrated whole consists of many interrelated systems, such as the nervous system, cognitive system and sensory systems like the vestibular and proprioceptive systems. The eco-systemic theory supports the view that problems with learning or behaviour (such as concentration problems) are rooted in sections of the brain which operate in conjunction with other parts of the system as a whole (Budisavljevic & Ramnani, 2012). Makris et al. (as cited in D'Agati, Casarelli, Pitzianti and Pasini (2010) hypothesised that ADHD occurs due to structural defects in the systems or networks of the brain that influence cognition, affect and motor behaviours. D'Agati et al. (2010) researched the effect of defective systems such as the white matter of the corpus callosum on ADHD. The malfunctioning of systems within the bigger whole of the human-system is influenced by a variety of factors (Kokot, 2010a). These factors include internal factors, such as neuro-developmental, neuro-anatomical, neuro-chemical and neuro-physiological factors, where 'neuro' refers to everything that has to do with nerves and the nervous system (Dictionary.com, n.d.). Neuro-developmental factors refer to the quality of the genetically predetermined sequence of development of the nervous system (Halperin, Bédard, & Curchack-Lichtin, 2012). Neuro-anatomical factors refer the anatomy of the neurological system (Kokot, 2010a; Van der Westhuizen, 2007). Neuro-chemical factors refer to those chemical in the brain that relate to thinking and feeling (Kokot, 2010a; Van der Westhuizen, 2007). Neuro-physiological factors relate to how the anatomy or structure of the neurons and the chemicals in the brain, cause action to happen

(Thompson & Thompson, 2003). Other factors that also influence the human as a system are external factors, such as biochemical factors, nutrition and pollutants. Van der Westhuizen (2007) stated that the term 'eco-systemic' refers to any combination of the above listed internal factors. It refers to the influence that these factors, as a single factor or a combination of factors, has on the functioning of the human mind-body system. Eco-systemic, according to Van der Westhuizen (2007), also incorporates the influence of the external eco-system on the human mind-body system. This external eco-system refers to the external factors as listed above.

The eco-systemic theory focuses on the causes of problematic functioning, such as the experience of concentration problems rather than the treatment of the symptoms of the problem. Any of the internal or external factors, or a combination of these factors, may be responsible for malfunctioning within the individual. For the purpose of this study, the researcher was interested in establishing whether the retained existence of primitive reflexes beyond their time frame, as one of the neuro-developmental factors, could have a disrupting influence on other systems that can influence the cognitive system. The influence of neuro-developmental factors and the role of other internal and external factors on the functioning of the human being as a system are discussed in the literature review.

2.3 LITERATURE REVIEW

2.3.1 The nervous system and structure of the brain

For the purpose of this study the nervous system and structure of the brain need to be explained to some extent. The nervous system comprises the central nervous system (the brain and spinal cord) and the peripheral nervous system (the nerve fibres that bring and spread information to and from outside of the brainstem and spinal cord). The peripheral system thus helps the human being to know what is going on in the outside world and other areas of the human-as-a-system. If, for example, there are disruptions in the brain stem as part of the central nervous system, this can influence the peripheral nervous system and also other systems of the human-as-a-system (Kokot & Van der Westhuizen, n.d.).

The cells in the brain are called neurons. A child is born with nearly all of his/her neurons in place, but these neurons are without connections to one another. The connections of one neuron to another are made through dendrites. Dendrites grow when an electrical impulse is carried through the neuron. A neuron can only carry electricity if it is insulated by a myelin sheath. The myelin sheath is a fatty layer that insulates the neuron in order for it to carry electricity. Synaptic terminals found at the end of neurons relay messages from one neuron to another through neurotransmitters (Demos, 2005; Kokot, 2010a). Neurons thus connect to one another by dendrites that grow from the

cell body of the neuron. These connections form a network of wires which send messages to enable us to move and think. The eco-systemic theory refers to the neuronal network that forms the brain and its interconnections between the body and brain as brain 'wiring'. The nervous system, built up from the neurons maturing and growing, has a genetically predetermined sequence or hierarchy of development which cannot be forced. The quality of this development can be influenced by environmental factors though (Halperin et al., 2012; Kokot, 2010a).

2.3.2 The role of movement in brain development

The eco-systemic theory considers brain 'wiring' and the role of movement in neuro-anatomy as important factors (amongst others) that influence concentration (Kokot, 2010a; Van der Westhuizen, 2007).

During infancy babies move due to reflex reactions. As the baby moves, growth hormones, called Brain Derived Neurotrophic Factors (BDNF), are released where the neuron attaches to a muscle. Levi-Montalcini found chemical markers that explained how BDNF, released at the attachment of neurons to muscles, glide messages across neurons to specific areas in the brain. They stimulate dendrites to grow in specific directions (Ratey & Hagerman, 2008). The BDNF released at the junction with the muscles that are used are sent to the brain, where they stimulate a next neuron to be myelinated. Myelination thus takes place in reaction to reflex reactions (Ratey & Hagerman, 2008). A neuron that is myelinated can carry electricity and can be used to

relay messages. The nervous system of the human baby develops as every next layer of neurons receives a myelin sheath and is able to make connections to the next layer of neurons (Kokot, 2010a).

This study considered the presence or absence of certain primitive reflex reactions and their effect on the wiring of the brain. If enough movement takes place and the baby uses his/her reflex reactions effectively, enough BDNF will be released to grow connections between neurons. As these connections are growing, the involuntary primitive reflexes can render their control to voluntary actions. As an example of this rendering of control, the Symmetrical Tonic Neck Reflex (STNR) prepares an infant to start crawling. After the STNR has been used a significant number of times and enough BDNF were released to make connections to higher levels of the brain, the infant can now go over to a voluntary action, which is crawling (Goddard Blythe, 2009). Significant connections between neurons can thus support effective voluntary movement, which in turn may have an effect on learning and concentration abilities (Kokot, 2010a). Ratey and Hagerman state that there is thus “a direct biological connection between movement and cognitive function” (2008, p. 43). Cotman and Berchtold (2002) also found that the release of BDNF through voluntary exercise maintained brain health and plasticity, which improved concentration abilities. Figure 1 shows where BDNF are released at the synaptic junction to a nerve fibre (Kokot, 2010a).

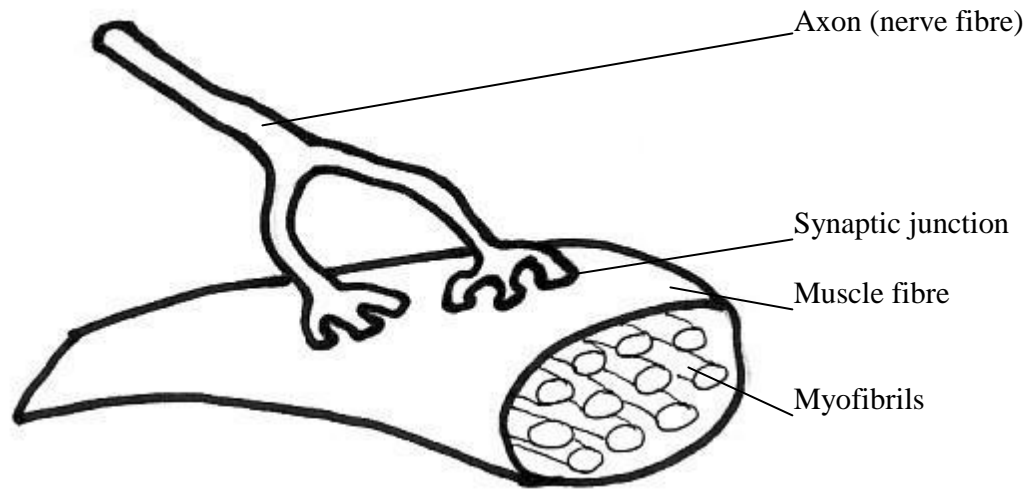


Figure 1: Synaptic junction to a nerve fibre

Movement is thus an integral part of the eco-systemic theory of Integrated Learning Therapy. Movement from primitive reflexes up to controlled movement relates to cognitive functioning and control of behaviour and thinking. Raley and Hagerman (2008) indicate that the motor centre of the human brain also coordinates thoughts, attention, emotions and social skills.

This study focuses on a neuro-developmental understanding of concentration problems. “Neurodevelopment refers to the hierarchical, qualitative changes in ability from the moment of conception until mature adulthood. It considers both the structure (nerves and their myelination) and the function (operation of the sensory-motor system and cognition) of the nervous system” (Kokot, 2010a). This development has to do with the maturation and growth of neurons due to effective movement as discussed previously. Immaturities in specific areas of the neurological hierarchy, which may contribute to

concentration problems, are thus very important to the current study. Retained primitive reflexes, discussed hereafter, are part of these immaturities (Kokot, 2010a) and are the specific focus of this study.

2.3.3 Primitive reflexes

Reflexes in general and specifically primitive reflexes are discussed in this section. The specific primitive reflexes, which were used in this study, are discussed in more detail to explain their relevance to the current research.

2.3.3.1 Definition of reflexes

The physician, Thomas Willis, (as cited in Goddard Blythe, 2009) explained in the 17th century already that impulses in the nerves of the central nervous system could be reflected back to the muscles. He named these impulses motus reflexus and reflexion. A reflex reaction is well explained in the following quote: “Reflex is defined as an involuntary motor response, ... elicited shortly after a stimulus The response to the stimulus is unalterable, it cannot be changed or adapted according to needs or circumstances” (Pedroso, 2008, p. 12).

A reflex is thus a stereotypical and constant type of reaction because the same stimulus always gives the same kind of response. There are simple and more complex reflexes – some only involve the lower parts of the brain (the spinal cord and brainstem) – and others use higher parts of the nervous system, up to the cortex. A reflex reaction takes

place independent of our consciousness. These reactions free the higher levels in the brain from numerous and trivial every-day tasks. Some reflexes can be suppressed or controlled consciously although they are usually controlled independent of will; others cannot be controlled (Goddard Blythe, 2009).

2.3.3.2 Definition of primitive and postural reflexes

There are many kinds of reflex reactions. The following two types of reflexes are of significance in the current study as these have an influence on effective neurological development that support learning (Goddard Blythe, 2000; Goddard Blythe, 2009; The sound learning centre, n.d.): primitive or developmental reflexes and postural reflexes or reactions.

Primitive reflexes develop before birth (thus in utero), are useful during the first year of life and are then inhibited as higher centres in the brain develop due to the release of Brain Derived Neurotrophic Factors (BDNF) (Goddard Blythe, 2009; Ratey & Hagerman, 2008). Primitive reflexes are controlled by the brainstem. They are necessary for survival and development of the human foetus and baby. These reflexes emerge and are integrated or stop working in a specific sequence as the central nervous system matures; a specific primitive reflex is then transformed by higher centres of the brain. Subsequently another reflex appears to do its job and it is then inhibited and/or transformed by a higher centre of development. The primitive reflexes are different from postural reflexes which only emerge after birth and can take up to three and a half years

to develop fully (De Jager, 2009b; Goddard Blythe, 2009). The postural reflexes or reactions are absent in infancy and appear later as the primitive reflexes are disappearing (Pedroso, 2008). As the primitive reflexes are disappearing, controlled movement and cognition are developing and improving. This shows how the brain is developing from the brainstem upwards towards higher centres of the brain (Sangster, n.d.).

2.3.3.3 The role of primitive and postural reflexes in the neurological system

According to Goddard Blythe (2009), primitive and postural reflexes are useful tools to assess the nervous system. They are developmental and hierarchical in nature. There are thus specific times in a normal and healthy nervous system when certain reflexes will be present. They are also specific to the location in the nervous system from where they are controlled. If a specific reflex has not developed according to the expected pattern, it can indicate when and where in the nervous system something has gone wrong. Pedroso (2008) discusses the clinical significance of reflexes by stating how important the changes found in the development of reflexes are in an attempt to describe normality. The normal or abnormal development of primitive reflexes, other postural reactions and upper cerebral functions can thus be a guide for clinicians to make neurological diagnoses. If certain primitive reflexes have not appeared in their specific time frame, a clinician will know where in the brainstem the problem is located, and can also be guided towards the diagnosis of a disorder like cerebral palsy.

In order to explain the specific role of each one of the primitive reflexes, which is the focus of the current study, the hierarchy of development of reflexes is explained. Withdrawal reflexes are the first to appear before birth, at 5 to 7,5 weeks after conception. The withdrawal reflexes are controlled from the spinal cord and help the foetus to move away from intrusion or danger. Hereafter development moves upward to the brainstem from where primitive reflexes are controlled. The primitive reflexes start to appear before birth. The first of these to appear is the Moro reflex which appears already at 9-12 weeks after conception. After the appearance of the Moro reflex, the reflexes relating to grasping and feeding appear; these include the suck-, palmar grasp- and plantar reflexes. After the appearance of the latter reflexes, the babkin and palmomental reflexes are at 13 weeks after conception; tongue movements appear at 14 weeks and are followed by the gag reflex and protrusion and pursing of the lips (Goddard Blythe, 2009). There are many more primitive reflexes (70 in total) but the authors of an article on reflexes in The Learning Clinic (n.d.) state that they only concentrate on those that have a known effect on educational progress. The researcher also focused on those primitive reflexes that are important to The Learning Clinic (n.d.) and Integrated Learning Therapy (Kokot 2010a). These primitive reflexes include the Moro reflex, Tonic Labyrinth Reflex (TLR), Symmetrical Tonic Neck Reflex (STNR) and the Asymmetrical Tonic Neck Reflex (ATNR). The Learning Clinic (n.d.) and Kokot (2010b) also included the Spinal Galant reflex, which was not assessed as part of the current study.

As stated in the discussion on *The role of movement in brain development*, new connections are made in the brain as a result of the movement that occurs when a specific primitive reflex is used. The role of primitive reflexes is thus noticeable by the increase in connections that are being made due to the appearance of that reflex in the developing nervous system. The primitive reflexes are inhibited and replaced by conscious actions as the brain develops further. Each of the primitive reflexes emerges and should be inhibited by a certain time. The postural reflexes appear after the primitive reflexes are suppressed, and need to remain active for the rest of a person's life (Goddard Blythe, 2009). Each following group of reflexes provides a protective layer/zone, which prevents the inappropriate activation of a previous reflex. If there is a gap in development in an outer layer, then certain types or intensity of stimuli can cause a deeper or less mature response or reflex to re-appear (Goddard Blythe, 2009).

The role of primitive reflexes in the neurological system is thus related to the area in the brain that is involved in the control of these reflexes (Goddard Blythe, 2009). According to De Jager (2009b), Goddard Blythe (2009) and Pedroso (2008), primitive reflexes are primarily controlled from the brainstem. If a specific primitive reflex exists beyond its time frame, it can thus indicate specifically where in the brainstem an immaturity exists and thus which type of functioning in such a child is affected. The function that is affected becomes clearer when one understands the different functions of areas in the brainstem. The brainstem includes the medulla, pons and midbrain, and connects the spinal cord to the rest of the brain. The brainstem focuses on functions

necessary for survival and functions outside of conscious control or awareness (Goddard Blythe, 2009). Retained reflexes, controlled from this area, will thus indicate possible problems with functions related to functions of survival. An example of the effect of a retained reflex controlled from the pons is the Moro reflex which is controlled from the lower pons, near the medulla (Futagi, Toribe & Suzuki, 2012). If the Moro reflex is still present in a learner, this learner might experience problems with stress, thus having a tendency to go into survival mode because of trivial stressors. The medulla alerts or calms the brain and sensory system and controls the sleep-wake cycle. Reflexes that are controlled from this area can thus indicate difficulties with calming down the sensory system and with effectively falling asleep. Difficulties with an overstressed sensory system and/or sleeping problems can thus be relieved if the irregularly retained reflexes controlled from the medulla are addressed.

The reticular formation, part of the medulla, is described as the gatekeeper of consciousness. According to Goddard Blythe (2009), it plays an important role in attention by regulating levels of arousal and shutting out distracting information. This is very important in the current study which focuses on the ability to pay attention or to concentrate. If irregularities in the inhibition of primitive reflexes exist, and these reflexes are controlled from the reticular formation in the medulla, it will have an effect on controlling levels of attention or concentration on a task. If a primitive reflex that is controlled from the medulla still exists in a learner, such a learner will experience difficulties shutting out distracting stimuli, and will not be able to focus on the task at

hand. Furthermore, because it is known that primitive reflexes are controlled from the basic survival areas of the brain, irregularities in the development of these will keep the brain focused on these survival actions, instead of freeing it to develop upwards towards the higher thinking areas (Goddard Blythe, 2009). The possible problems of survival actions caused by certain retained primitive reflexes are discussed in the following paragraphs.

The eco-systemic theory focuses on the following retained primitive reflexes' effect on learning: Moro reflex, Tonic Labyrinth Reflex (TLR), Asymmetrical Tonic Neck Reflex (ATNR), Symmetrical Tonic Neck Reflex (STNR), and Spinal Galant Reflex (not included in this study) (Kokot, 2010b). This study only included the first four primitive reflexes. These four primitive reflexes are discussed using their significance for survival and/or development and the effect they can have on behaviour and learning if not inhibited when they should have been. This effect of the uninhibited reflexes on learning relates to the educational impact of the current study.

The first primitive reflex to be discussed is the Moro reflex. Of those focused on in this study, the Moro reflex is the first primitive reflex to appear. It appears at nine weeks after conception and is indicated in figure 2, The Moro Reflex (Marshall & Goddard Blythe, n.d.).



Figure 2: The Moro Reflex (Marshall & Goddard Blythe, n.d.)

Nine weeks after conception is a critical stage in the development of the mechanics of the vestibular system (the balance mechanism in the inner ear) and cerebellum. The Moro reflex forms part of the grasping reflexes (De Jager, 2009b) and is a primitive startle response (Goddard Blythe, 2009).

This reflex is thus elicited in all normal developing infants during the first 12 weeks after birth. When the head is dropped, when a loud sound is made or when something cold touches the abdomen or chest, the infant will extend the upper limbs (Futagi et al., 2012). This response is the early fight or flight reaction and usually disappears by 6 months of age, when it is replaced by a more mature startle response (Futagi et al., 2012; Goddard Blythe, 2009; Sangster, n.d.). The Moro reflex is triggered by unexpected vestibular stimulation amongst other unexpected sensory events and can thus be closely

linked to proper vestibular stimulation and maturation, although it is a multisensory based reflex. It acts as a primitive alarm response to protect the defenceless human baby. The Moro reflex is also used to initiate the first breath after normal birth, as the first action of this reflex is a deep breath. It is associated with the sympathetic division of the autonomic nervous system – the fight or flight action – and is also alerting and summoning assistance (Goddard Blythe, 2009).

According to Goddard Blythe (2009), a retained Moro reflex after 4 to 6 months is an indication of delay in neurological maturation. The persistence of the Moro reflex beyond its preferred time of existence can also delay the initialising of head control, sitting and other movement milestones. The focus on this delay is supported in a study by Taylor, Houghton and Chapman (2004) who found that the Moro reflex delayed the inhibition of reflexes that had to be inhibited after the Moro. Taylor et al. (2004) explain that the Moro reflex serves as a gateway for the subsequent integration of the TLR, ATNR and STNR.’

A retained Moro reflex is associated with hypersensitivity to vestibular stimulation and other unexpected forms of sensory stimuli (Goddard Blythe, 2009; Sensory Development Seminars, 2010). As the Moro reflex is exhibited before a child can consciously filter out unnecessary stimuli or think about an appropriate reaction, the learner acts on a large number of unnecessary stimuli and can easily experience sensory overload. Such a child reacts to much unnecessary information (such as the material of

the clothes s/he is wearing) and thus becomes exhausted – all senses become too tired to process information effectively. The child, therefore, reacts before he/she can think whether the reaction is appropriate – do first, think later. Retention of the Moro reflex can thus result in hypersensitivity – sensitive reactions to certain types of sensory stimuli. According to Goddard Blythe (2009), a retained Moro reflex can also have an effect on physiological and emotional reactions. Even the anticipation of an unpleasant reaction can result in hyper vigilance. Such a child has a lower threshold for a potentially frightening situation and can develop a secondary fear or anticipatory anxiety. The child then manipulates situations as a result of an impaired capacity to regulate levels of arousal in response to specific stimuli. He/she is, for example, inappropriately afraid of water and will thus pretend to be sick and lie to get out of the swimming session at school. Children with a retained Moro reflex regularly have difficulties with social interaction and difficulties with unknown situations. The Moro reflex may also be present in adults with anxiety and panic disorders. Children with a retained Moro reflex usually also suffer from allergies and compromised immune functioning, as well as a leaky gut and food intolerances (Sensory Development Seminars, 2010). The latter is usually the result of a lowered immune system in response to the anxiety and exhaustion (Strydom, 2013) caused by a retained Moro reflex. These children also find it difficult to ignore irrelevant visual stimuli and tend to experience light sensitivity (Goddard Blythe, 2009).

These effects of oversensitivity, heightened reactivity and anxiety relate to those symptoms exhibited by children with concentration problems usually complained about by teachers and parents. A retained Moro reflex may thus contribute to concentration problems.

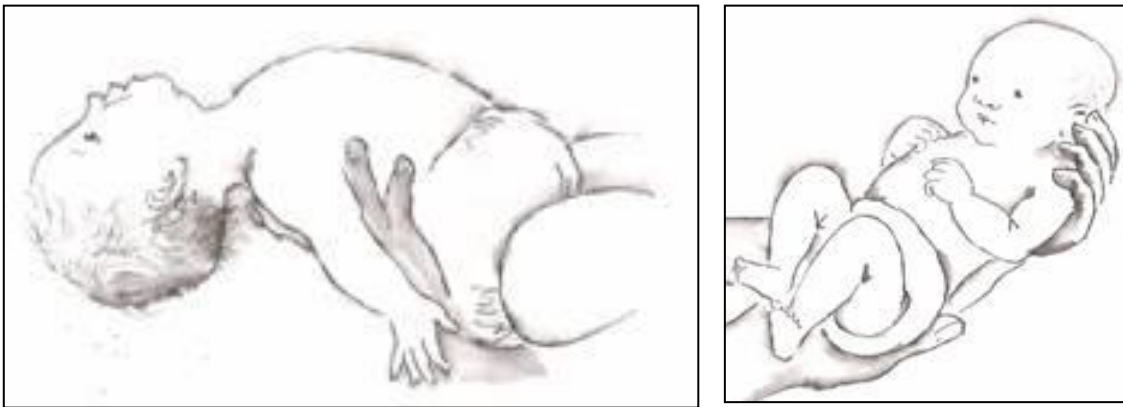


Figure 3: Tonic Labyrinth Reflex (Marshall & Goddard Blythe, n.d.)

The Tonic Labyrinth Reflex (TLR), as indicated in figure 3: Tonic Labyrinth Reflex (Marshall & Goddard Blythe, n.d.), appears after the Moro reflex and is discussed next. The TLR is one of those reflexes that respond directly to the vestibular system. Forward or backward movement of the head stimulates neurons from the vestibular system to the cerebellum, resulting in muscles extending or flexing (Goddard Blythe, 2009; Sensory Development Seminars, 2010).

The TLR is usually present from 30 weeks' gestation in normal infants. If the head is lowered backwards below the level of the spine, the shoulders pull back, arms pull down/back and legs are pulled back/down. According to Goddard Blythe (2009), it mimics a surrender position. If the head is bent forwards, it increases flexor tone, especially at the hips and knees, as well as arms and legs, resulting in the baby curling up into a foetal position. Flexion, as a result of this reflex, assists with the birth process. After birth this reflex assists the new-born baby to adapt to gravity, affecting muscle tone. This reflex is present in early infancy before higher, more advanced systems start to control posture and muscle tone. This reflex is inhibited by a gradual process of several other righting reflexes which emerge over the first few years. The TLR can be present for three to three and a half years (Goddard Blythe, 2009; Sensory Development Seminars, 2010). This reflex also assists the new-born in gaining head control which is needed for the next steps in postural development (De Jager, 2009b). According to Sangster (n.d.), this reflex and its integration assist the youngster to develop from a floppy foetal position to a body with strong muscle tone, which enables the infant to walk upright. Young children learn a wide variety of upright movements, such as walking, running, skipping, climbing and jumping. As each of these is developing, the TLR is further inhibited (Goddard Blythe, 2009). Although this is the case, the TLR may still be seen in normal youngsters before three and a half years of age when balance or posture is placed under stress. If this reflex is still present beyond three and a half years, it is indicative of immaturities in the functioning of the vestibular system and associated pathways, such as proprioceptive feedback. This type of feedback is a variation of touch

inside the joint as it moves. It sends messages about movement to the cerebellum (movement control centre in the brain). If a mismatch occurs from what is measured by the vestibular system and other actions of the body (for example, if the head is turned with a certain speed and the eyes do not measure the same), the child cannot maintain postural stability and control of muscle tone when the head is moved. He or she may fall over – not being able to balance. This can also affect eye movement control which is necessary for stable visual perception (De Jager, 2009b; Goddard Blythe, 2009). A mismatch of information between the vestibular, proprioceptive and visual systems can lead to motion sickness and visual-spatial problems. These problems in integration of sensory perception affect the brain's ability to process information correctly. The latter is needed for cognitive understanding and abstract reasoning controlled by the higher thinking areas in the cortex. Higher nerve centres thus take control over the lower nerve centres that keep primitive reflexes going (Gajewska, Sobieska, Kaczmarek, Suwalska & Steinborn, 2013). This can affect learning and emotional behaviour. If vestibular-related primitive reflexes are retained, they block the working of postural reflexes which support the cerebellum to control posture and motor control (Goddard Blythe, 2009). A child with these retained reflexes might thus find it difficult to control movement and might act in an uncoordinated manner or have poor motor planning – being clumsy and confused in space. A retained TLR also results in poor ability to provide a stable platform for the eyes to focus on. Trying to read for such a child is the same as trying to read in a car while travelling over a bumpy terrain. The eyes are 'jumping all over the place'. A retained TLR thus has a detrimental effect on eye focus and perception of what

is seen, on spatial abilities and muscle tone. It is also related to problems with sequencing and time (Sensory Development Seminars, 2010). It even has an effect on the correct articulation of words (Goddard Blythe, 2009). According to the researcher, this (poor articulation) is because the tongue is also a muscle that needs to be controlled through correct muscle tone. The child thus exhibits weak tongue and mouth muscles, which result in poor articulation of words. Sensory Development Seminars (2010) lists observable social and learning problems associated with a retained TLR as: trouble paying attention when sitting at a desk and/or while reading, dyspraxia, muscle tone problems, poor sense of rhythm and timing, reading and writing difficulties and problems with spatial orientation. This retained reflex thus has a big effect on processing of information and control of actions; these are common difficulties for children with concentration problems. The next reflex to be discussed is the Asymmetrical Tonic Neck Reflex which appears after the TLR, indicated in figure 4: Asymmetrical Tonic Neck Reflex (Parker, 2012).



Figure 4: Asymmetrical Tonic Neck Reflex (Parker, 2012)

According to Goddard Blythe (2009), the ATNR occurs due to rotation of the head and not flexion and extension as with the TLR. The ATNR emerges at 18 weeks' gestation at about the same time as when the mother becomes aware of the movement of the foetus. As the head of the foetus is turned to a specific side, the limbs on the same side are extended in the commonly-known fencing position. In the womb this reflex helps the foetus to move around and explore its little world. It also greatly assists in the birth process.

The ATNR helps to develop differentiated movement on either side of the baby's body and it is training early hand-eye coordination (Goddard Blythe, 2009). Babies cannot see clearly and can only focus on something at about 17cm from their face, focusing on the outline rather than detail. As the arm stretches to the side with the ATNR, the baby follows the hand and vision is stretching too. According to Goddard Blythe (2009), the ATNR plays a central role in developing both central and peripheral vision. The ATNR seems to train the eyes of a human baby to move from peripheral vision to central or focal vision. The ATNR gradually becomes inhibited as the neck muscles grow stronger, head control improves and brain development towards the cortex takes place. Vision develops as the brain is developing upwards towards the cortex. By six months a human baby can already see texture as opposed to the broader vision abilities at two months of age. Movement and sensory experience are trainers in providing the ability to let motor and visual skills work together to make sense of what the baby sees (Goddard Blythe, 2009). The baby, furthermore, learns about texture by putting objects in its mouth. This

is only possible as the ATNR is overridden so the hand can go to the mouth and not away from the head. The action of sucking also helps to override the ATNR when the hands are brought to the midline although the head has been turned to the same side (Goddard Blythe, 2009).

Goddard Blythe (2009) states that the following negative effects if an ATNR is retained beyond four to six months of age: several needed motor skills are underdeveloped, such as rolling over, leopard crawling, upright balance when the head is turned, midline crossing, eye movements, such as eye tracking and visual attention, and hand-eye coordination.

Children with a retained ATNR after 6 months of age also experience impaired motor planning, writing skills and reading. These children tend to turn their books and have a very tight pen grip to keep the fingers closed around the pen or pencil. The physical action of writing does not become automated and the child needs to use extra cognitive effort to control it (Eckersley, 2012; Guy, 2012). Learners with only an ATNR being retained can manage to learn to read, but to write is exhausting as it requires both eye and hand movements which have to be controlled consciously instead of being automated. Guy (2012) has confirmed the negative effect of a retained ATNR on writing. He states that it prevents learners from mastering important learning support skills, such as the fine-motor coordination needed for writing. Reading comprehension is also compromised as the physical actions of reading and writing are not automated and

take up the mental energy needed for the higher cognitive skill of understanding what has been read (Goddard Blythe, 2009). Furthermore, Konicarova and Raboch (2013) relate very specifically retained ATNR and STNR to some neuropsychiatric disorders, such as Attention Deficit and Hyperactivity Disorder (ADHD). Although this is the case, Konicarova and Raboch suggest that these are still preliminary findings.

The problems caused by the ATNR and other retained reflexes result in difficulties in the classroom, such as reading-, writing-, spelling-, sequencing- and memory recall problems. According to the researcher, all this unnecessary cognitive effort on actions that were supposed to be automated, leads to mental exhaustion and lowers the ability to concentrate on a learning task.

The next and final reflex to be discussed is the Symmetrical Tonic Neck Reflex, indicated in figure 5: Symmetrical Tonic Neck Reflex (Marshall & Goddard Blythe, n.d.).

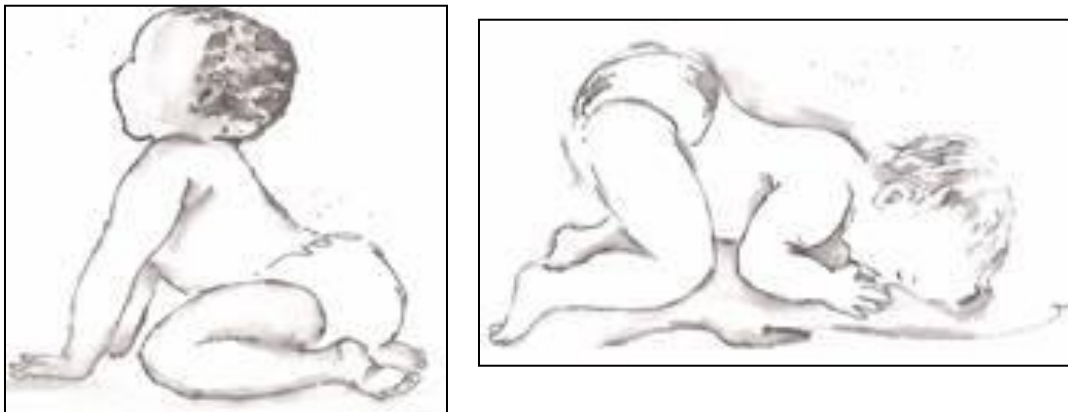


Figure 5: Symmetrical Tonic Neck Reflex (Marshall & Goddard Blythe, n.d.)

The Symmetrical Tonic Neck Reflex (STNR) emerges at 30 weeks' gestation, disappears soon after birth and re-appears at around eight months of age. It should be inhibited by 11 months of age. The STNR assists the infant around eight months of age to start creeping on hands and knees. This reflex helps the baby to extend the upper limbs and flex the lower limbs when the head is picked up and to flex upper limbs and extend lower limbs when the head is dropped down. The STNR, with its opposite movements in upper and lower limbs, helps to inhibit the TLR. The Learning Clinic (n.d.) also states that the STNR is the opposite of the TLR. The STNR also provides a stable position against gravity to support creeping on hands and knees, and should first be inhibited before the baby can start creeping on hands and knees effectively. Another function of the STNR is to assist the baby to stand upright by pulling him-/herself up in a standing position against furniture or anything similar (Goddard Blythe, 2009). Blythe (as cited in Goddard Blythe, 2009) suggests that the STNR also helps to develop visual accommodation. It helps the baby to focus at a near distance when the head is dropped and a far distance when the head is lifted. The action of creeping on hands and knees helps to integrate vision, proprioception and balance in a new orientation towards gravity. Goddard Blythe (2009) states that there is a strong relationship with learning problems later in life and skipping commando style creeping (leopard crawling) and crawling or creeping on hands and knees. This is because of the delay or underdevelopment of functions, such as balance, posture and visual perception. If the STNR is retained beyond its time frame, posture is affected. The upper body is rounded when the head is dropped towards a schoolwork task. It will thus affect stance and gait

in later years, such as during adolescence – the young adolescent can seem to have an unmotivated or ‘sloppy’ attitude. Young children, especially girls with a retained STNR, tend to sit in a W-position on the floor and find it difficult to sit crossed-legs during ‘mat work’ or quiet time. This leads to squirming around during story time on the mat in a pre-school or lower primary grade class (Goddard Blythe, 2009). It is the researcher’s experience that many pre-schoolers and young school-going learners are reported by their teachers as having concentration problems because they cannot sit still on the mat. This could be due to a retained STNR. According to Goddard Blythe (2009), it is also difficult for learners to sit with legs straight and arms bent at a desk. They will tuck their feet underneath their legs to keep the lower body anchored in one position. It is the researcher’s experience that such body position is noted by teachers and therapists as abnormal and is frequently corrected. This can cause a lot of discomfort for the learner with a retained STNR and distract him or her from the learning task at hand. Goddard Blythe (2009) states that children with a retained STNR feel uncomfortable in their own bodies; this makes it difficult for them to sit still, leading to a view that such a child is suffering from attention deficit disorder with hyperactivity. Blythe (as cited in Goddard Blythe, 2009) suggests that a retained STNR retards the skills related to this reflex, such as visual accommodation, at an earlier developmental stage. It takes rapid visual accommodation to copy work from a board or screen in a classroom to a book. Copying to a book in a class is thus impaired in a learner with a retained STNR. According to Goddard Blythe (2009), a retained STNR is also related to poor vertical tracking such as is needed to align columns in Mathematics and Accounting subjects in school.

As concentration problems co-occur with general learning problems (American Psychiatric Association, 2013), those learning problems found because of a retained STNR can lead to the opinion that a child suffers from concentration problems. All the effort taken to be comfortable in a sitting position, difficulties with eye tracking and accommodation and frequent squirming are all distracting the learner from relaxed focus on one learning task at a time. A retained STNR can thus be related to concentration problems.

2.3.3.4 The relevance of irregular primitive reflexes to concentration problems

All four of the primitive reflexes discussed above may have a negative influence on learning and behaviour. It is thus necessary to establish whether this is only a perceived effect or whether the effect of primitive reflexes on concentration problems is a real effect (Coolican, 2009). In order to explain the possible effect of primitive reflexes on concentration problems, the following symptoms related to irregular primitive reflexes, which are also found in children with concentration problems, are noted:

A retained Moro reflex leads to hypersensitivity to vestibular and other unexpected forms of sensory stimuli, sensory overload, as well as psychological and emotional reactions related to the sympathetic system; difficulties with social interaction and unknown situations, anxiety, allergies, leaky gut and food intolerances; difficulties with ignoring irrelevant visual stimuli and light sensitivity (Goddard Blythe, 2009; Sensory Development Seminars, 2010).

A retained TLR leads to problems with posture and muscle tone, resulting in early physical exhaustion and regular movement to counter exhaustion. It also leads to difficulties with eye movement and visual perception, visual-spatial problems, clumsiness and spatial confusion, understanding sequences and adhering to time, processing of information and controlling of actions (De Jager, 2009b; Goddard Blythe, 2009).

A retained ATNR is associated with problems with visual tracking and maintaining visual attention levels. It is also associated with problems with the exhaustion related to the mental effort put into reading and writing that is not automated (Eckersley, 2012; Goddard Blythe, 2009).

A retained STNR is associated with concentration-related tasks, such as learners squirming in their seats at school, sitting on their legs and moving around all the time because of discomfort in their own bodies, poor vertical eye tracking and visual accommodation abilities. The continuous movement caused by a retained STNR can lead to the opinion that a child is hyperactive (Goddard Blythe, 2009).

The HANDLE® institute in the United States focuses on neuro-developmental causes of learning difficulties. Robson (2012), a certified HANDLE® practitioner and instructor, states that irregular, primitive reflexes play a role in an individual's attention priorities. It requires conscious action to control irregular primitive reflexes in order to refrain from

acting and thus look odd to others. “This [conscious action] requires energy that most individuals would prefer to use in other ways” (Robson, 2012, p. 3), such as to calmly focus on a learning task. The next sections focus on an understanding of concentration problems.

2.3.4 Concentration as described by the PASS model of intelligence

The PASS model of intelligence, which is based on the theory of Luria (Kostyanaya & Rossouw, 2013; Reid, Kock & Van der Merwe, 2002) forms the conceptual base for concentration problems as part of cognition. PASS is an acronym for four processes that underlie intelligence. These processes are Planning, Attention, Simultaneous and Successive processes (Naglieri & Das, 1997a). Each of these processes is controlled by a different zone or area in the brain, which develops according to a hierarchical pattern. There are three zones each having specific functions. These three functional zones, also named cortical zones, function as an interrelated system. The effective functioning of the higher cortical zones depends on communication from the lower zone/s (Budisavljevic & Ramnani, 2012). The functioning of each zone and its effect on concentration are described in the following paragraphs. A reference to the relation of the subtests of the Cognitive Assessment System (Naglieri & Das, 1997a) (used in the current study) to the functions of the cortical zones is also made.

The first cortical zone is regulating tone or waking, and is localised in the brain stem which is part of the lower layers of the brain. It wakes up the brain in order for it to

focus its energy on the task at hand. It activates and regulates activity in the cortical or thinking layers of the brain which are part of higher thinking areas and which develop later in the hierarchy of development. The function of the first cortical zone is also to “subordinate the lower structures to the control of the cortex” (Kostyanaya & Rossouw, 2013, p. 51). It is the primary projection area which receives and sends impulses to and from the peripheral nervous system. In this way, the first cortical zone regulates cortical tone and maintains attention (Reid et al., 2002). This zone can be assessed by using the Attention processes of the PASS model in the Cognitive Assessment System (Naglieri & Das, 1997a; Reid et al., 2002) which is the norm referenced test that was used in the current study to assess concentration problems. In literature, the scores achieved on Attention processes are indicated to be effective in the assessment of concentration problems (Naglieri & Das, 1997a; Taddei, Contena, Caria, Venturini & Venditti, 2011).

The second cortical zone is responsible for obtaining, processing and storing of information (Kostyanaya & Rossouw, 2013; Reid, et al., 2002). Simultaneous, as well as successive, processing is associated with the second cortical zone which includes the way information is received and coded or processed. It explains the functions of this zone (Reid et al., 2002). In the case of simultaneous processing, the learner integrates separate stimuli or pieces of information into a single whole or group. It is essential that the learner interrelates the elements into a “perceptual or conceptual whole” (Naglieri & Das, 1997a, p. 4). “These processes have strong visual-spatial and logical-grammatical components” (Naglieri & Das, 1997a, p. 4). The visual-spatial component focuses on the

learner's understanding of the stimuli as a group and his/her ability to form and understand complex visual images. The logical-grammatical component relates to the ability to understand word relationships in order to form meaning. This understanding of parts-into-a-whole, as well as verbal-grammatical activities, happens by either examining stimuli or by the recall of information. The other part of information processing is successive processing. This is a sequential way of thinking or processing of information. One thing follows the next in a "strictly defined order" (Naglieri & Das, 1997a, p. 5). The serial effect of successive processing includes understanding of information in a specific sequence and also the formation of sounds and movement in a specific order. This type of thinking relates one thing to the next as they follow in sequence. The stimuli here are not interrelated as with simultaneous processing. Examples of successive processing include spoken speech, sequential movement and the formation of words and sequences of words, as well as understanding and remembering sentences (Naglieri & Das, 1997a). Simultaneous and successive processing, as assessed by the Cognitive Assessment System, was used in this study as possible contributors to concentration problems.

The third cortical zone includes programming, regulating and directing or verifying mental activity (Das, Naglieri & Kirby as cited in Reid et al., 2002; Kostyanaya & Rossouw, 2013). The third zone is thus responsible for the most complex forms of mental activity and requires many other cortical areas to work together. It is localised in the last part of the cortex to develop, namely the pre-frontal cortex. The subtests of the

Cognitive Assessment System that form the Planning processes are related to the third cortical zone of the PASS model. According to Das (as cited in Reid et al., 2002, p. 249), the three main aspects of Planning processes comprise the “generation, selection and execution of plans”. These main aspects of Planning processes resemble aspects of prefrontal brain function, such as “programming, regulating and verification of human activity” (Reid et al., 2002, p. 249). Planning processes are responsible for actions and thinking patterns which are controlled from the prefrontal cortex and its connections to other areas of the brain that are associated with the control of actions and movement, namely the basal ganglia and the motor cortex. The prefrontal cortex, or third cortical zone, is also involved in executive functions which relate to higher thinking processes (planning, decision making and working memory, amongst others) and control of behaviour (Stuss & Alexander, as cited in Cubillo, Halari, Smith, Taylor & Rubia, 2011; Thompson & Thompson, 2003). Recent literature (Almeida et al., 2010; Cubillo et al., 2011; Depue, Burgess, Bidwell, Willcut & Banich, 2010) states that children who were diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) showed thinner prefrontal cortex areas and abnormalities in these areas. The actions and abilities related to Naglieri and Das’s (1997a) Planning processes are thus implicated in research on underdeveloped brain areas associated with ADHD. Planning processes are used as one of the processes to assess concentration problems in the current study.

As stated above, the three cortical zones have a hierarchical structure and they are based one upon the other – the next one in line develops only after the one before has started to

develop. This developmental pattern in cognition thus follows the same developmental pattern as the structural development of the neurological system, as discussed in the section on *The nervous system and structure of the brain*. The lower layers of the brain are thus the mental building blocks on which the higher cognitive functions rely (Brainhighways, 2009; Kostyanaya & Rossouw, 2013). The Attention processes of the PASS model are represented in the lower layers of the brain (the first cortical zone). There are different types of attention, such as sustained attention and selective attention (Reid et al., 2002). Attention in the PASS theory “is a mental process by which the individual selectively focuses on particular stimuli while inhibiting responses to competing stimuli presented over time” (Naglieri & Das, 1997a, p. 3). The individual is managing his/her attention by being focused and selective, and sustaining this in an effortful manner. Although all these ways of managing attention are higher level complex forms of attention, it (attention) is still being controlled from the lower brain layers (Naglieri & Das, 1997a).

Processing of information as discussed above as both simultaneous and successive processing take place in the upper layer of the brain, called the cortex or neo-cortex, where cognitive processes take place. Both simultaneous and successive processing specifically take place in the visual (occipital lobe), auditory (temporal lobe) and sensory (parietal lobe) areas in the upper layer of the brain. These are thus higher thinking processes, not being part of the lower areas of the brain stem any more (Kostyanaya & Rossouw, 2013). Although both simultaneous and successive processing are localised in

the cortex, these thinking processes are still connected and influenced by the development and operations of the lower areas of the brain. The lower areas (the Attention processes of the PASS model and the influence of the integration of primitive reflexes) are supporting the higher functional areas of the brain. Higher functional areas can thus be influenced by concentration problems (Brainhighways, 2009; Luria as cited in Budisavlejevic & Ramnani, 2012).

2.3.5 A description of concentration problems

This study is not focused only on concentration problems as a diagnosed disorder when using the DSM-5 criteria for Attention-Deficit/Hyperactivity Disorder. The symptoms of concentration problems, as explained by the Planning and Attention subtests of the PASS model of intelligence, are used to form an understanding of concentration problems in the current study. Furthermore, concentration problems in the current study are described by using the behavioural and cognitive immaturities evident in children with immature neurological systems. The complexity of attempting to describe concentration problems is explained by the following quote of Davison (as cited in Van der Westhuizen, 2007, p. 8):

Some researchers suggest that AD/HD (*Attention Deficit with Hyperactivity Disorder*) is a physiological problem of the brain, a malfunction in the central nervous system; others believe it to be a reaction due to an allergy. Yet others claim it exists largely in the eye of the beholder.

People with problems to concentrate on one task at a time, do not look different from others, but if you know what to look for you can clearly identify these learners in classrooms, other educational settings and in the family system (Amen, 2001). It is thus important to know what to look for in order to explain behaviour that inhibits learning and to formulate helping programs accordingly. Other than behaviour related to immature neurological systems and cognitive deficits, according to Attention and Planning subtests, the most recent Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychological Association, 2013) presents criteria according to which an attention deficit disorder can be identified and diagnosed. Although this study is not based on children formally diagnosed with ADHD, according to the Diagnostic and Statistical Manual of Mental Disorders, the criteria listed in the DSM-5 can assist in knowing what to look for (Amen, 2001). The relation between ADHD and concentration lies in the fact that learners with ADHD are also described in terms of symptoms of inattention. Thus, the DSM-5 diagnostic criteria of attention-deficit/hyperactivity disorder are relevant to this study.

2.3.6 DSM-5 diagnostic criteria of attention-deficit/hyperactivity disorder

People with attention deficit disorder show a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development. The learner should either have 6 or more symptoms of inattention for children up to age 16, or five or more for adolescents 17 and older and adults; symptoms of inattention must have

been present for at least 6 months, and should be inappropriate for the child's developmental level. These symptoms include:

Often fails to give close attention to details or makes careless mistakes in schoolwork, at work or with other activities.

Often has trouble keeping attention on tasks or play activities.

Often does not seem to listen when spoken to directly.

Often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (e.g., loses focus, side-tracked).

Often has trouble organising tasks and activities.

Often avoids, dislikes or is reluctant to do tasks that require mental effort over a long period of time (such as schoolwork or homework).

Often loses things necessary for tasks and activities (e.g. school materials, pencils, books, tools, wallets, keys, paperwork, spectacles, mobile telephones).

Is often easily distracted.

Is often forgetful in daily activities.

In addition to the above and related to the hyperactivity-impulsivity type, six or more symptoms of hyperactivity-impulsivity for children up to age 16, or five or more for adolescents 17 and older and adults, should be present. Symptoms of hyperactivity-impulsivity should have been present for at least 6 months to an extent that is disruptive and inappropriate for the child's developmental level:

Often fidgets with or taps hands or feet or squirms in seat.

Often leaves seat in situations when remaining seated is expected.

Often runs about or climbs in situations where it is not appropriate (adolescents or adults may be limited to feeling restless).

Often unable to play or take quietly part in leisure activities.

Is often "on the go" acting as if "driven by a motor".

Often talks excessively.

Often blurts out an answer before a question has been completed.

Often has trouble waiting his/her turn.

Often interrupts or intrudes on others (e.g., butts into conversations or games)

The following conditions should also be met:

Several inattentive or hyperactive-impulsive symptoms were present before the age of 12 years.

Several symptoms are present in two or more settings, (e.g., at home, school or work; with friends or relatives; in other activities).

There is clear evidence that the symptoms interfere with, or reduce the quality of, social, school or work functioning.

The symptoms do not happen only during the course of schizophrenia or another psychotic disorder. The symptoms are not better explained by another mental disorder (e.g. Mood Disorder, Anxiety Disorder, Dissociative Disorder or a Personality Disorder).

Based on the types of symptoms, the following three kinds of attention deficit disorder can occur:

Combined Presentation: if enough symptoms of both criteria for inattention and hyperactivity-impulsivity have been present for the past 6 months

Predominantly Inattentive Presentation: if enough symptoms of inattention, but not hyperactivity-impulsivity, have been present for the past six months

Predominantly Hyperactive-Impulsive Presentation: if enough symptoms of hyperactivity-impulsivity, but not inattention, have been present for the past six months.

Because symptoms can change over time, the presentation may change over time as well (American Psychiatric Association, 2013).

Although the clients who made up the sample of this study were not necessarily formally diagnosed with attention deficit disorder, all of them presented some of these symptoms and were labelled as a learner who is having trouble concentrating predominantly in the educational setting.

All these descriptions of poor concentration abilities are focused on what can be seen or experienced. The neuro-developmental focus and eco-systemic theoretical framework of the current study (Kokot, 2010a) is concerned with the causes of concentration problems and the neurological building blocks that can contribute to this condition. These are attributes that cannot always be seen or experienced in such a clear way. A short discussion of the neuro-anatomy of concentration problems, as well as neuro-

physiological and neuro-developmental views on concentration problems, is thus given in the following sections.

2.3.7 The neuro-anatomy of concentration problems

Children with concentration problems tend to show functional abnormalities in the pathway connecting the frontal lobes with the basal ganglia (group of nuclei below the cortex controlling motor actions and learning, executive functions, behaviours and emotions (Lanciego, Luquin & Obeso, 2012)). These abnormalities include tasks where they have to overcome impulses and focus on one thing at a time (Cubillo, Halari, Ecker, Giampietro, Taylor & Rubia, 2010). Many other studies confirm immaturities and abnormalities in the frontal lobe areas in individuals with poor concentration abilities (Cubillo et al., 2012; Almeida et al., 2010; Depue et al., 2010). Cubillo et al. (2012) found an association with ADHD and connections between the frontal lobes and other cortical systems and connections between the frontal lobes and systems in the lower developmental areas of the brain (sub-cortical systems). These systems influence and/or control cognition and motivation. As the cortical layers are the top layers of the brain and the sub-cortical systems are those layers in the middle and possibly deeper down, ADHD “appear to be multi-systemic” (Cubillo et al., 2012, p. 194).

Several studies found abnormalities, reduced volume and/or thinner cortical thickness in areas, such as the frontal areas of the brain, parieto-temporal areas, the parietal cortex, the basal ganglia, the midbrain and the cerebellum. These areas are associated with

motivation, impulse-control, understanding spoken and written language, working memory and cognitive function, regulation of the focus of attention and internally directed cognition, the normal control of movement, the ability to filter out unimportant information and to pay selective attention (Behrmann, Geng & Shomstein, 2004; Brainhighways, 2009; Coffman, Dum & Strick, 2011; Learning Disabilities, 2013; Leech & Sharp, 2013; Leisman et al., 2014; Thompson & Thompson, 2003).

Concentration problems are thus affected by abnormalities not only in the frontal lobes, but also in areas controlling movement and actions and other cognitive control centres, such as the language oriented parieto-temporal area. As seen here, the neuro-anatomy of concentration problems is truly multi-systemic and is thus affecting different regions of the brain – not only the cortex but also sub-cortical areas (Cubillo et al., 2012). This multi-systemic effect of concentration problems relates to the current study's reasoning that abnormalities in lower layers of the brain (down to the brainstem) could be related to concentration problems.

2.3.8 Neuro-physiological aspects of concentration problems

Neuro-physiological aspects of concentration problems focus on the functioning of the neurological system that influences concentration problems. Cubillo et al. (2012) focus on executive functions as controlled from the frontal brain areas (Best, 2010) when describing some of the neuro-physiological aspects of concentration problems. In an attempt to reduce the complexity of this study, the focus will thus be on executive

functioning only, rather than on all the other functions of affected brain areas as listed in the previous section. According to Cubillo (2012) and Amen (2001), executive functioning is related to the higher thinking strategies of abstract thought and planning. It is also related to motivation and reward, and regulates affect and motivation. Children with concentration problems regularly lack these abilities.

The frontal cortex plays a prominent role in executive functioning, is connected to other areas in the brain and only matures in late adolescence (Best, 2010). The current study is focusing on the effect that immaturities in the bottom layers of the brain have on the top layers. One part of the top layers is the frontal cortex which controls executive functioning. The neuro-developmental aspects influencing concentration problems, address some of the immaturities that affect the neurophysiology of concentration.

2.3.9 Neuro-developmental aspects of concentration problems

Functional and structural immaturities in the lower brain layers contribute to structural and functional immaturities in the upper layers, according to Castellanos et al. and Shaw et al. (as cited in Cubillo et al., 2012). They state that “the structural abnormalities observed in children with ADHD compared to healthy peers in frontal, striatal, parietal and cerebellar regions may be due to a delay in structural maturation” (Castellanos et al, as cited in Cubillo et al., 2012, p. 195). Shaw, Eckstrand, Sharp, Blumenthal, Lerch and Greenstein, et al. (2007) found that cortical thickness over all cortical layers was delayed

with 3 years in children with ADHD and was delayed up to 4 – 5 years in the frontal and temporal regions.

Brainhighways (2009, p. 2) explains concentration problems due to neurodevelopment by stating that

...the lower centres of the brain are supposed to support the higher cognitive functions. When the brain is organised in this way, we can choose what we focus on. In a disorganised brain, we don't always have that option.

If the lower layers are disorganised and immature, as in the case of irregular primitive reflexes, it can be a cause of delay in development in the upper layers. The upper layers control motivation, emotions and behaviour and higher order reasoning (Cubillo et al., 2012). Halperin et al. (2012) also state neurodevelopment as one of the contributing causes to ADHD, together with genetics and the pre-natal environment. “We propose that by the time of birth, or very shortly thereafter, the stage is set for the expression of some form of the ADHD phenotype” (Halperin et al., 2012, p. 534). Thereafter, though, environmental factors keep on influencing neural development (Halperin et al., 2012). As discussed in the current study, a lack of effective movement to integrate primitive reflexes in the baby years can inhibit neurodevelopment. This can thus contribute to delay in development in the upper brain layers with consequent concentration problems.

2.3.10 Concentration problems in the educational environment

According to Wu and Gau (2013), concentration problems are associated with underachievement in school and dysfunctions experienced in the educational setting. Children with concentration problems show problems in all domains of school functioning. This includes performance on academic tasks and also social relations and general school behaviour. The co-morbid conditions associated with concentration problems (such as anxiety) also predict poor attitudes toward schoolwork and poor social interaction. A European study indicated that children with concentration problems performed poorer on on-task behaviour in subjects and settings which required high motivation, information processing and self-regulation. The school subjects included mathematics, languages and sciences. The results of this study showed that low on-task behaviours and low motivation and self-regulation continued despite improved teacher supervision of the children with concentration problems (Imerai, Antrop, Sonuga-Barke, Deboutte, Deschepper, Ball & Roeyers, 2013). Most studies focusing on school outcomes of concentration problems were focused on western populations, but a study by Wu and Gau (2013) included children in an eastern school environment; they found similar trends with those in the western population.

The impact of concentration problems is also apparent in Namibian schools. The National Institute for Educational Development (NIED) (2007) indicates that learners who are intellectually impaired or those with Attention Deficit Disorder (poor concentration) have very different competency profiles when compared to the general

school population. Aro et al. (2011) also indicate that attention-seeking and disruptive behaviour related to attention deficit are some of the main contributors to prevent teachers from teaching effectively in Namibian schools. Concentration problems are some of the causes of emotional, social and behavioural difficulties, low self-esteem, lack of motivation and barriers to learning. The effect of concentration problems is thus very prominent in the educational setting and an important area to address to ensure effective education for all.

2.4 CONCLUSION

Concentration problems are related to the lower areas of the brain, as well as to the upper thinking layers. As the upper thinking layers are of great importance in academic performance, concentration problems contribute greatly to performance in school-related tasks. Research, as discussed above, strongly support the hypothesis of this study that disorganisation in the lower layers of the brain is influencing poor functioning of the upper thinking layers. It is important though to support the latter statement by assessing the correlation of certain irregular primitive reflexes (thus disorganisation in the lower layers of the brain) and concentration problems.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter aims to give an overview of the data collection procedures that were followed in the current study. Firstly, the research design, population and sample are discussed. Thereafter, the research instruments and procedure are discussed and finally the methods used in the analysis of the data are addressed.

3.2 RESEARCH DESIGN

This research is embedded in a quantitative approach as all the data used are in numerical form and based on the results of measurement (Coolican, 2009). The research design, such as the one used in this quantitative approach, is described by Coolican (2009) as the overall composition and plan of the research study and the logical steps that can be selected (Fouché & De Vos, 2002). The specific design of this study is a correlation study that made use of secondary data. Correlation research focuses on the relationship between two or more variables and the extent that they co-vary (Arthur, Waring, Coe & Hedges, 2012). This co-variance was explored in the current study by finding the relationship between irregular primitive reflexes and concentration problems and the extent to which certain reflexes co-vary with concentration problems. As already compiled documented test results on the Cognitive Assessment System (Naglieri & Das, 1997a) and the results of observed irregular primitive reflexes were used, these can be

classified as secondary data. The latter is “an approach where the researcher analyses data which has [sic] already been collected” (Arthur et al., 2012, p. 125).

3.3 POPULATION

The documents from which the data were drawn were compiled from October 2011 to June 2014. The population of this study constitutes 191 learners (69 female and 127 male) who attended a selected private practice in Windhoek, Namibia. The learners' ages ranged from 5 to 17 years. The learners were spread over Namibia, with 162 from Windhoek and 29 from outside of Windhoek, including both urban and rural areas (2 from Keetmanshoop – Southern Namibia, 2 from Stampriet – Southern Namibia, 4 from Mariental – Southern Namibia, 8 from Gobabis – Eastern Namibia, 1 East of Gobabis, 1 from Outjo – Northern Namibia, 2 from Tsumeb – Northern Namibia, 7 from Oshakati – far Northern Namibia).

Documents from these learners contain the results of between one and four processes of the PASS model of intelligence as assessed by using the Cognitive Assessment System (Naglieri & Das, 1997a). The four PASS processes of which the scores were included in the population were the following: Planning-, Attention-, Simultaneous- and Successive processes. An indication of the presence or not of four primitive reflexes that relate to learning also formed part of the documents. The primitive reflexes that were included are: Moro reflex, Tonic Labyrinth Reflex (TLR), Symmetrical Tonic Neck Reflex (STNR) and Asymmetrical Tonic Neck Reflex (ATNR).

3.4 SAMPLE

Purposeful criterion sampling, as part of non-probability sampling, was used to collect data for this study. Non-probability sampling is not based on randomisation. All the members of the population thus did not have an equal chance of being selected. The selection was rather made on the basis of those who were most representative for the issues involved in the research (Strydom & Venter, 2002). For the purpose of the current study concentration levels, as indicated by frontal lobe functioning, as well as effortful focusing on one thing at a time, were the issues of concern. This (frontal lobe functioning and effortful focus on one think at a time) was thus used as the criteria for selection of learners to form the sample. Concentration levels were identified via the Planning and Attention subtests of the Cognitive Assessment System. Results of these two subtests were used to determine whether concentration problems were present or not (Naglieri & Das, 1997a). The researcher, firstly, selected from the available documents those learners who scored below the average (a standard score of lower than 90) in the two mentioned subtests with the purpose of indicating concentration problems. The scores on Simultaneous and Successive processes of the selected learners were also included. Secondly, scores on the four irregular primitive reflexes were included for all the learners with concentration problems included in the sample. A score of 1 was allocated to a learner if a retained primitive reflex was present and 0 if not.

By using the sampling methods as described above, a sample of 164 learners was selected from the population. Of these learners, 124 had lower than average scores on

both Planning and Attention processes, 31 scored lower than average on Planning processes, but not on Attention processes and 9 learners only scored lower than average on the Attention subtests, but not on the Planning subtests. All these were considered to demonstrate concentration problems and were thus included in the sample, leading to the sample size of 164 learners.

In the case of certain descriptive and inferential statistics, the sample was narrowed to learners with lower than average scores on both Planning and Attention processes. A group with scores of average and higher on both Planning and Attention processes, which was not part of the original sample (N 164), was also used in these statistical analyses. Thus for selected data analyses the whole population (N = 191) was used. As stated earlier, scores on the presence or not of all four of the irregular primitive reflexes included in this study were used for all the learners in the sample, as well as the narrowed sample and group with average and better concentration abilities (indicated by both Planning and Attention processes).

3.5 RESEARCH INSTRUMENTS

An overview of the document study is given to guide an understanding of the discussions of the other instruments, which was used to compile the documents.

3.5.1 Document study

As indicated above, this study is based on secondary data, using previously compiled documents. A researcher would often analyse data compiled by someone else when using secondary data (Smith, 2012), but in this study the secondary data were compiled by the researcher herself. According to Smith (2012, p. 125), secondary data come in many forms, like “data generated from systematic reviews, through documentary analysis as well as results from large-scale surveys”. The current study is thus a documentary analysis as stated by Smith (2012) above, although the documents were compiled by the researcher herself. At the time the original data (primary data) were collected, the following procedures were followed: semi-structured interviews were used to identify children with concentration problems on a preliminary basis; observation, based on clearly defined criteria, were used to identify the presence of the four primitive reflexes; a psychometric test, the Cognitive Assessment System (Naglieri & Das, 1997a) was administered to assess the Planning-, Attention-, Simultaneous- and Successive processes.

The results of observations of irregular primitive reflexes and the ranked scores of the psychometric test were included in the documents. In the next section a short description of the instruments that were used to collect the primary data is given. These instruments are semi-structured interviews, observations and the application of a psychometric test.

3.5.1.1 Semi-structured interviews

The interviews used to compile the documents in this study were discussions between the researcher and the parent/s or guardian/s of the children brought for assessment to the researcher's psychological practice. These interviews were not restricted to intake interviews only. Greeff (2002, p. 291) states that "the purpose of the research must guide the researcher to choose the most effective method". This guided the researcher to make use of a semi-structured interview to gain information about the presenting problem and developmental history of the child. The researcher used interviews with leading questions to guide the parent/s or guardian/s to give the information needed. The latter way of conducting an interview is explained by Patton (as cited in Greeff, 2002, p. 297), who states that this type of semi-structured interview is a "general interview guide approach, also known as the guided interview". In this type of interview, a basic checklist is prepared to make sure that all necessary topics are covered (Patton as cited in Greeff, 2002). The checklist used in the current study included information about the learner's current scholastic, behavioural, emotional and other difficulties, which contributed to the need to seek help. Furthermore questions covered the learner's present socio-economic status and factors such as the marital status of the parents, living circumstances and the learner's typical daily program and activities. The learner's developmental history from conception to the present was covered as well as other internal and external factors such as general health, diet and supplements and/or medication and possible allergies. These interviews then led to the choice of

observations and psychometric testing done. The choice of observations and psychometric testing will be discussed in the following sections.

3.5.1.2 Observation to assess primitive reflexes

Angrosino (2012, p. 165) states that “one kind of observation-based research is conducted in *clinical* or *laboratory* settings, which means that researchers set up a situation in which they can control what goes on and they bring carefully selected ... participants into that setting”. The assessment of the presence or not of irregular primitive reflexes was done through observation in a clinical setting where the researcher could control the situation and make use of carefully selected participants (Angrosino, 2012) and procedures. The observation methods employed for the assessment of the presence of each of the primitive reflexes were derived from the “Wired to learn: Ensuring learning readiness in the school beginner” manual (Kokot, 2010b). These observation methods are described in the following paragraphs.

Moro Reflex

Test position: The client lay on his/her back with arms and hands on the floor and legs and feet relaxed. A cushion was placed under the lower back. The researcher held the client’s head about 3 centimetres above the spine.

Procedure: The researcher requested the client to cross his/her arms on his/her chest when the researcher dropped his/her head. The client lay with eyes closed. The researcher dropped the head to below the client’s spine level but not till it touched the floor. The following scores were given for observations:

<u>Score:</u>	<u>Observation:</u>
0:	Immediate cross of arms on chest with no adverse reaction in the rest of the body.
1:	Delayed reaction in arms and/or incomplete hand/arm movement or holding of breath and/or no arm movement, alteration in breathing and visible dislike of testing procedure or movement of the arms outward away from the body, leg extension or distress.

Tonic Labyrinth Reflex (TLR) – Erect test

Test position: The client was standing with feet together, the arms straight but relaxed at the sides of the body and the eyes closed.

Test procedure: The researcher asked the client to slowly tilt the head back into an extended position as if s/he was looking up at the ceiling. After 5 seconds the researcher asked the client to move his/her head slowly forward as if looking at his/her toes and to maintain this position for 5 seconds. This procedure was repeated up to 5 times. The following scores were given for observations:

<u>Score:</u>	<u>Observation:</u>
0:	No response in the rest of the body and no change in tone with the head movement.
1:	Slight alteration of balance as a result of head position or impairment of balance and/or alteration of muscle tone or near loss of balance, alteration of muscle tone and disorientation or loss of balance, massive adjustment

in muscle tone to attempt to stabilise balance and accompanied dizziness or nausea.

Asymmetrical Tonic Neck Reflex (ATNR) – Schilder test

Test position: The researcher asked the client to stand with his/her feet together with arms held out straight in front of him/her at shoulder height, with the hands relaxed at the wrists. The eyes should then be closed.

Test procedure: The researcher stood behind the client and instructed the client to turn his/her head or if the researcher had permission to touch the client, the researcher touched the client's head to help it turn. The client's head was turned through 90 degrees to the one side (looking towards the shoulder) keeping his/her hands straight in front of him/her for 5 seconds. The client's head was then turned forward again and held there for 5 seconds before it was turned through 90 degrees towards the opposite shoulder and held there for 5 seconds before it was turned to the front again. This was repeated up to 5 times. The researcher was observing whether any movement of the arms towards the same side that the head was turning occurred. The following scores were given for observations:

<u>Score:</u>	<u>Observation:</u>
0:	No response in the arms in the same direction together with turning of the head.
1:	Slight movement of the arms in the same direction as the head movement or movement of the arms in the same direction as the head movement,

either 45 degrees, 60 degrees or 90 degrees in any direction of the turning of the head or turning of the whole body in the same direction as the head.

Symmetrical Tonic Neck Reflex (STNR)

Test position: The researcher asked the client to stand in a crawling position or 'table' position.

Test procedure: The client was instructed to maintain the test position but to slowly bend his/her head down as if looking between his/her thighs. S/he needed to hold this position for 5 seconds and then slowly move his/her head upwards as if looking at the ceiling or a point in front higher than his/her head level, but to keep his/her arms straight and his/her body still. This process was repeated up to 5-6 times. It should be observed whether any bending of the arms or raising of the feet as a result of head flexion or movement of the trunk as a result of head extension took place. The following scores were given for observations:

<u>Score:</u>	<u>Observation:</u>
0:	No response.
1:	Tremor in one or both arms or slight hip movement or rotation of the elbows or movement of the elbow and/or hips or arching of the back or definite bending of the arms as a result of head flexion or bending of the arms to the floor or movement of the bottom back onto the ankles.

(Kokot, 2010b)

3.5.1.3 The observation checklist

The observation checklist in this study was compiled by using the results gained through the observations as described above. These were summarised for each client on a simple table. This table resembled the following form:

<u>Name of reflex:</u>	<u>Observation (1/0):</u>
------------------------	---------------------------

Moro	
------	--

TLR	
-----	--

ATNR	
------	--

STNR	
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The results on the outcomes of the observation study, as compiled in feedback reports, were then carried over to an Excel spreadsheet where all document studies were compiled in one document for analysis of data.

3.5.1.4 Psychometric test to assess concentration

According to Coolican (2009, p. 204), a psychometric test is a “test that attempts to quantify psychological constructs: skills, abilities, character, etc”. These constructs are represented with ordinal data, thus as a rank (Coolican, 2009). For the current study a psychometric test, the Cognitive Assessment System (Naglieri & Das, 1997a), was used to assess concentration problems. The four processes, Planning and Attention, as well as Simultaneous and Successive processes, of the Cognitive Assessment System were used.

Standard scores (a score out of 160 in this case) were used to express ranks. The Cognitive Assessment System is used whenever it is needed “to determine an individual’s competence and levels of cognitive functioning” (Naglieri & Das, 1997a, p. 44). The Cognitive Assessment System is generally used to predict achievement, to evaluate individuals with ADHD, to evaluate individuals with learning disabilities, mental retardation, traumatic brain injury, emotional disturbance, planning problems and also those who are gifted (Naglieri & Das, 1997a).

The Cognitive Assessment System (Naglieri & Das, 1997a) provides clear instructions on the application of the test, test procedures and test environment (Naglieri & Das, 1997b). In this study, the client received a Response Book (either for ages 5 – 7 or 8 – 17, depending on the client’s age) in which the Planning and Attention subtests were done by using a red pencil. A copy of the front pages of the Response Books for ages 5 – 7 and 8 – 17 is provided in Appendix 3. The results and time used for each item were recorded by the test administrator on a record form (booklet). For the administration of the Simultaneous and Successive processing, the administrator made use of the stimulus book and her record form to record the responses on the items presented in the stimulus book. A copy of a record form front page can be seen in Appendix 4. The figure memory test, as part of Simultaneous processing, was done by the client in the figure memory response book, from which the administrator recorded the responses on the record form. One of the Attention processes subtests was also presented in the stimulus book.

After all responses had been recorded on the record form, raw scores on Planning, Attention, Simultaneous processing and Successive processing subtests were converted to ratio scores. The totals on all 12 the subtests that made up the 4 processes were then converted to subtest scaled scores, using the client's chronological age. Each cognitive process (Planning, Attention, Simultaneous and Successive) had 3 subtests, of which a sum of the 3 subtest scaled scores was then obtained, as well as a full scale score by calculating the sum of all the subtest scale scores. Hereafter PASS scale standard scores and a percentile rank for each one of the processes, as well as the full scale score, were obtained (Naglieri & Das, 1997b).

The Cognitive Assessment System's discussion of technical properties indicates all reliability coefficients to be consistent "with what is typical for a test of cognitive abilities" (Naglieri & Das, 1997a, p. 44). All full scale and PASS scales have high internal reliability and also high test-retest stability. The Cognitive Assessment System shows to be valid in terms of the content that is measured as well as the constructs that are measured. Criterion-related validity is also discussed in the interpretive handbook of the Cognitive Assessment System and considered to be high (Naglieri & Das, 1997a).

The PASS scale standard scores (a score out of 160) and percentile ranks of each one of the four PASS processes were used in the feedback reports of the clients. These reports were discussed with parents/guardians, and made available to teachers and other educators and therapists who received permission from the parents/guardians of the

clients to read the outcomes of the assessments. The PASS scale standard scores were copied from these reports onto Excel spreadsheets for analysis of the data for the present study.

3.6 PROCEDURE

Clear steps were followed in collecting and analysing the data of the current study and writing the final report. Firstly the University of Namibia and its Ethics Committee gave permission for this research study to be conducted. At the time that the documents were compiled, parents and guardians of learners gave permission that the scores of learners might be used in the current study. Documents of learners that were reported with learning problems, including concentration problems, were selected. Excel spreadsheets, containing the ranked scores on the four PASS processes of all learners and the presence or not of the four primitive reflexes included in the study, were compiled. The sample was compiled from this data and also presented on the excel spreadsheets. The sample, as well as the population, was used in the statistical analyses. The results of the statistical analyses were interpreted and discussed. Conclusions were drawn and recommendations for further research were made.

3.7 ANALYSIS OF DATA

The data analysis in this study was divided into descriptive statistics and inferential statistics. Descriptive statistics described the data used, or summarise it, but did not attempt to draw conclusions or to generalise findings to the population from which the

sample was taken. Inferential statistics was used to test a hypothesis and to draw conclusions about a population outside of the dataset, based on the sample (Taylor, 2014). Both these categories and the specific statistical measures used as part of each are discussed in the following sections.

3.7.1 Descriptive statistics

The first part of the data analysis and data presentation of the current study was based on descriptive statistics. According to William (2006), a researcher can use descriptive statistics to describe the basic features of the collected data. Descriptive statistics is an excellent way to summarise the bigger numbers of data of a population or sample in a manageable way. With this type of statistics the researcher is only attempting to describe what the data show. UNESCO (2014) states that descriptive statistics is the most frequently used statistics in SPSS (Statistical Package for Social Sciences) and is also very user friendly. Frequency distributions are part of descriptive statistics. Frequencies are also easily displayed in graphic form to show results in a clearer way. According to De Vos et al. (2002, p. 226), “The ... most elementary type of summary and display of data collected on one variable that is used very often is the frequency distribution”.

3.7.2 Inferential statistics

According to Taylor (2014), inferential statistics starts with a sample and attempts are made to generalise findings of the sample to a population. In this study, a variety of inferential statistics were applied in an attempt to determine if the information found in

the sample could be generalised to the rest of the population of learners assessed in the multi-disciplinary medical centre. The inferential statistics that was used included Spearman's *rho* as a correlation statistic and the Kruskal-Wallis H test. All statistics used in this study were non-parametric in nature. Non-parametric tests do not rely on information from a normal distribution or bell-curve (Coolican, 2009).

3.7.2.1 Spearman's *rho* for correlation

According to Coolican (2009), a correlation between two variables shows how these two variables co-vary – to which extent one will change in the presence of the other. In the current study the researcher tested the correlation of concentration problems with the presence of irregular primitive reflexes. The analysis of this correlation was done as follows:

The ordinal, non-parametric data from the Cognitive Assessment System scores (a score out of 160) were correlated with a “dichotomous nominal variable” (Coolican, 2009, p. 456). This latter variable was categorical (or dichotomous, indicating 2 categories) with the irregular presence of a primitive reflex assigned a 1 and the well-developed or integrated reflex assigned a 0. Spearman's *rho* for non-parametric data was used to test the correlation between these variables. Each documented case or member of the sample had a measured score on Planning and Attention processes (a ranked score out of 160) and a code, 1 or 0 for the particular reflex, which was correlated.

Planning and Attention processes (used to measure concentration problems) were also correlated with Simultaneous and Successive processes, as well as all of these with all of the irregular primitive reflexes. The correlation of all reflexes with one another was also done.

3.7.2.2 Kruskal-Wallis one-way ANOVA

“Kruskal-Wallis compares between the medians of two or more samples to determine if the samples have come from different populations” (Gaten, 200, p.1). If the distributions in the different groups used in a Kruskal-Wallis test do not have the same shape, the Kruskal-Wallis H test can be used to compare mean ranks and not medians (Laerd Statistics, 2013). The distribution of the irregular primitive reflexes in the different groups of this study might not have the same shape; therefore, mean ranks were compared. Results were presented and discussed based on hypothesis test summary tables as part of the Kruskal-Wallis output in SPSS. In the current study the presence of each one of the irregular primitive reflexes was compared among groups of concentration abilities. The following groups for learners with concentration problems were used: well-below average, below average and low average concentration abilities in the sample (N = 164). These groups were numbered from number one for well-below average to number three for low average in the Kruskal-Wallis calculation. The Kruskal-Wallis was also applied on a group consisting of two subgroups, namely those of the narrowed sample (below average on both Planning and Attention processes) and those with average and above concentration scores on both these processes. These groups were

numbered as number one for the narrowed sample and number two for those with scores of average and above on both Planning and Attention processes in the Kruskal-Wallis calculation. If the distribution of a retained primitive reflex was even over the stated categories, the null-hypothesis could be accepted. There would thus be no significant difference between different levels of concentration problems in the presence of a specific irregular primitive reflex. If the distribution was not even, the null-hypothesis could be rejected, indicating a difference between the groups, and thus an effect of the irregular primitive reflex on concentration. The results from the statistical analysis are discussed in Chapter 4.

3.8 CONCLUSION

This chapter gave an overview of the research process and procedures followed in this study. It also outlined the specific statistical measures used in analysing the data gathered during the process of research. The next chapter discusses the results gained through these statistical measures.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

The results from the statistical analysis described in Chapter 3 are presented in this chapter. The first section covers the descriptive statistics which includes graphic presentations of the demographic information of the sample. Percentages of occurrence of the different irregular primitive reflexes in the sample, a group with below average scores on both Planning and Attention processes and a group with average and higher concentration scores, are also included in the section on descriptive statistics.

The next section covers inferential statistics, where statistical analyses were done in an attempt to determine if the results could be generalised to the population. Spearman's *rho* was used for calculating the correlation between irregular primitive reflexes and concentration problems. Finally, Kruskal-Wallis analyses were used to establish whether there was a difference in occurrence of irregular primitive reflexes in groups with concentration problems and without. The last section of this chapter draws conclusions from the statistical analyses done.

4.2 RESULTS BASED ON DEMOGRAPHIC INFORMATION

The learners in the sample (N = 164) were those who presented lower than average scores (a standard score of below 90) on Planning and/or Attention subtests in the

Cognitive Assessment System. All learners in the sample thus presented with concentration problems. The group did not show a normal distribution over age, gender and demographic area, as the learners were not randomly selected. All learners whose documents were used in this study (those with and without concentration problems) presented with a learning difficulty. The demographic characteristics of the sample are presented in the following bar graphs and short descriptions.

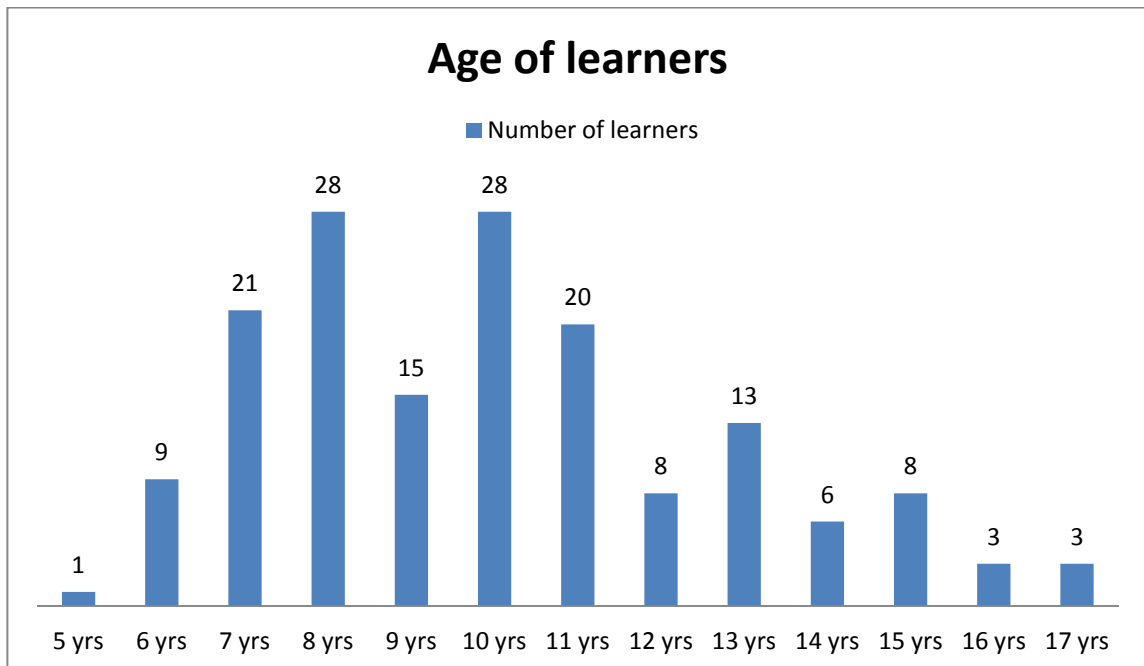


Figure 6: Demographic information: the age of learners (N = 164)

The spread of learners across ages is presented in Figure 6. This figure shows most learners to be in the lower primary group (ages 7 – 10) and the fewest in the pre-primary (ages 5 – 6) and late adolescence (ages 16 – 17) groups. The average age of learners in the sample was 10.5 years.

The sample consisted of 108 males and 56 females, showing that boys were represented nearly twice as often as girls. These learners mostly resided in Windhoek although learners from other towns, both rural and urban, were also represented in the sample.

4.2.1 Frequency results

The percentage of learners in the sample who presented with the four irregular primitive reflexes, as well as any one of the irregular primitive reflexes, is presented in Table 1. This percentage is given separately for each of the primitive reflexes and then also for the group who presented any one of the reflexes.

Table 1: Percentage of occurrence for each of the primitive reflexes and any one of the reflexes

Primitive reflexes	Moro	TLR	ATNR	STNR	Any reflex
Percentage occurrence	41.5%	47.0%	79.3%	37.2%	91.5%

N = 164

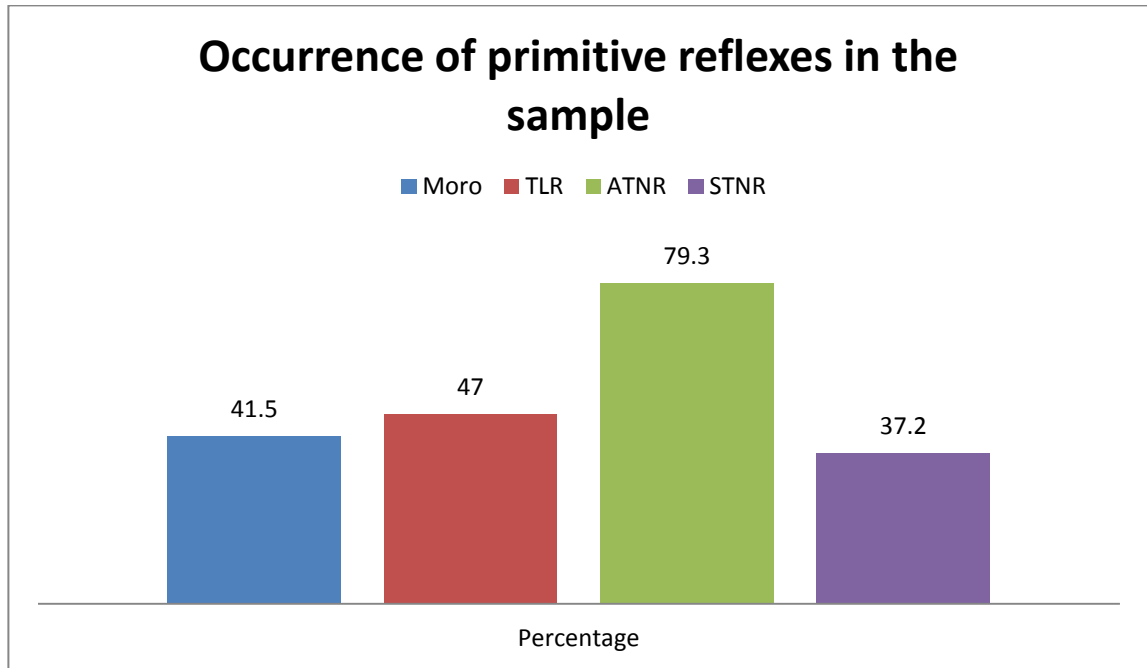


Figure 7: Bar graph of irregular primitive reflexes in sample (N = 164)

Table 1 and Figure 7 show that the Moro reflex, TLR and STNR appeared in less than 50% of the learners with concentration scores lower than average. ATNR was still present in 79.3% of the learners whose concentration scores were lower than the average. ATNR thus appeared more frequently than the other irregular primitive reflexes in the presence of concentration problems. The Moro reflex, TLR and STNR did not seem to be present in learners with concentration problems as often as was the case with ATNR, although they did appear between 37% and 50% of the cases. This is still pointing to a high occurrence, considering that the reflexes were expected to have disappeared altogether.

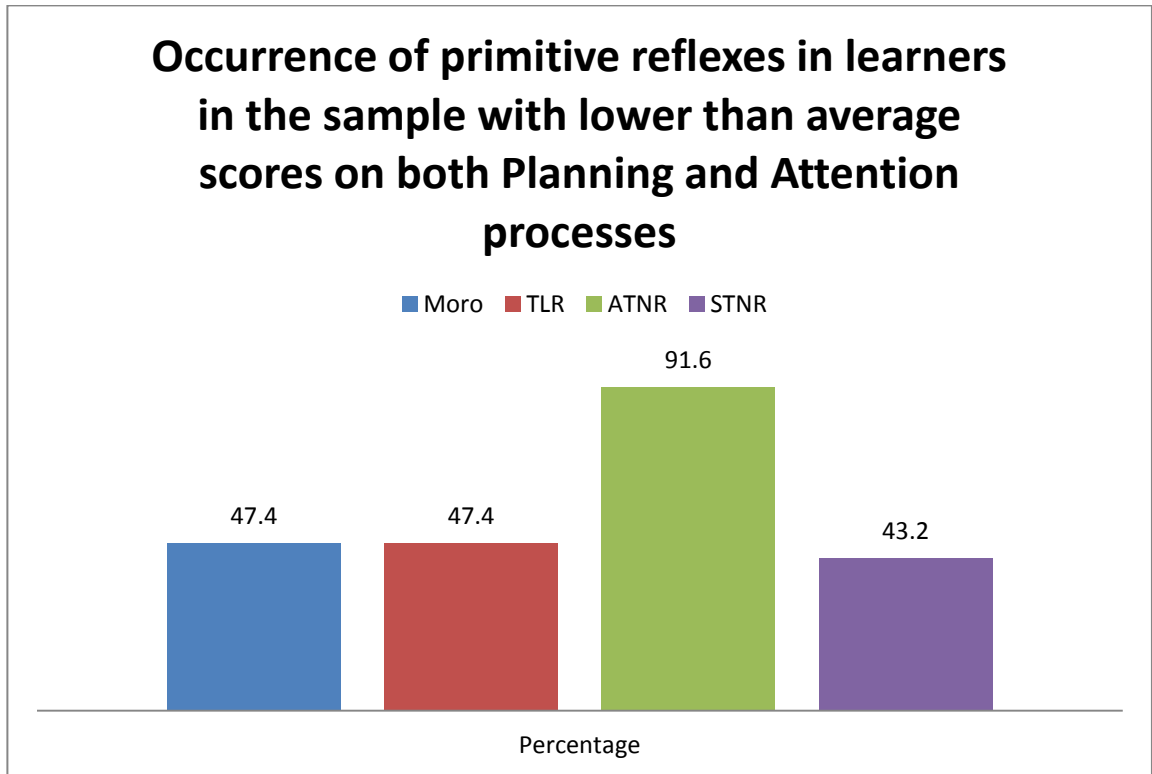


Figure 8: Bar graph of irregular primitive reflexes in sample with both Planning and Attention processes lower than average (N = 95)

Figure 8 shows that the occurrence of all of the primitive reflexes was higher in the case of stronger problems with concentration, namely when learners scored lower than average on both the processes, indicating concentration problems. ATNR occurred in 91.6% of the cases, and the other irregular primitive reflexes all occurred more than 40% of the time. Only the occurrence of TLR did not change much when scores were below 90 in both of the processes.

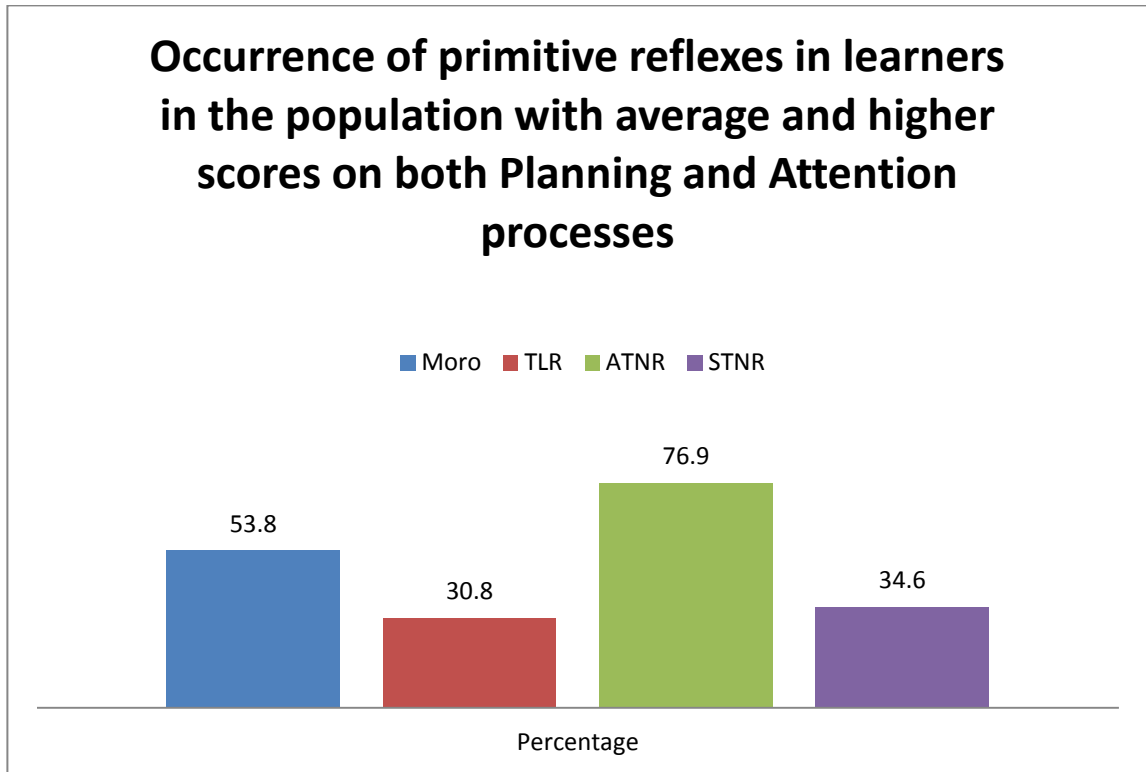


Figure 9: Bar graph of irregular primitive reflexes in population with both Planning and Attention processes average and higher (N = 26)

Figure 9 constitutes learners with average and above scores on concentration abilities as assessed by Planning- and Attention processes of the Cognitive Assessment System (Naglieri & Das, 1997a). It shows a difference in distribution of irregular primitive reflexes from the previous two graphs, which represent learners with concentration problems. Three of the four irregular primitive reflexes occurred less frequently than indicated in the previous tables. The Moro reflex's occurrence increased in this group (presented in Figure 9), indicating that this reflex was not related to poorer concentration abilities, as indicated by the Planning- and Attention processes. The same effect of the

irregular Moro reflex was found in the Taylor et al. (2004, p. 35) study where the Moro reflex did not “relate directly to any of the AD/HD or achievement variables”.

4.3 CORRELATION OF RESULTS USING SPEARMAN’S *RHO*

Spearman’s *rho* for non-parametric data was used in this study to determine whether the presence of each one of the assessed irregular primitive reflexes co-varied with concentration scores. Table 2 shows the results of the correlation of Planning- and Attention processes with each one of the primitive reflexes. It also correlates the presence of any one of the reflexes with Planning- and Attention processes. All learners included in the sample’s scores on Simultaneous- and Successive processes were also included. All of these correlations were done on the sample of learners showing concentration problems, thus lower than average Planning and/or Attention processes (N = 164). Statistical significance is seen when the value of the two-tailed test is less than 0.05 (Coolican, 2009; Mukaka, 2012). The strength of the correlation is shown by the correlation coefficient (r_s). If the correlation coefficient is nearer to 1 or -1, a strong correlation is indicated. A correlation coefficient of 0.2 or -0.2 is strong enough to be considered (Kufs, 2010) although Cann (2003) indicates r_s up to 0.33 as a weak relationship. A negative correlation is indicated by a minus (-) and a positive correlation by no sign.

Table 2: Correlation between Planning-, Attention-, Simultaneous- and Successive processes, each irregular primitive reflex and any reflex present in the sample

Correlations: Spearman's <i>rho</i> (Sample N = 164)										
		Plan- ning	Atten- -tion	Simul- ta- neous	Suc- ces- sive	Moro	TLR	ATN R	STN R	Any reflex
Plan- ning	rs	1.0	0.5**	0.4**	0.3**	0.1	0.1	-0.1	-0.0	-0.1
	Sig. (2- tailed)		0.0	0.0	0.0	0.3	0.2	0.1	0.9	0.4
	N	163.0	162.0	153.0	155.0	163.0	163.0	163.0	163.0	163.0
Atten- -tion	rs	0.5**	1.0	0.2*	-0.1	-0.0	0.1	-0.1	-0.1	0.0
	Sig. (2- tailed)	0.0		0.0	0.3	0.8	0.3	0.1	0.4	0.6
	N	162.0	163.0	153.0	155.0	163.0	163.0	163.0	163.0	163.0
Simul- ta- neous	rs	0.4**	0.2*	1.0	0.5**	0.1	0.1	-0.2	-0.2*	0.0
	Sig. (2- tailed)	0.0	0.0		0.0	0.2	0.3	0.1	0.0	0.7
	N	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0	153.0
Succe- sive	rs	0.3**	-0.1	0.5**	1.0	0.0	0.1	-0.1	0.0	0.0
	Sig. (2- tailed)	0.0	0.3	0.0		0.8	0.2	0.4	0.8	1.0
	N	155.0	155.0	153.0	155.0	155.0	155.0	155.0	155.0	155.0
Moro	rs	0.1	-0.0	0.1	0.0	1.0	0.3**	0.0	0.0	0.3**
	Sig. (2- tailed)	0.3	0.8	0.2	0.8		0.0	0.7	0.6	0.0
	N	163.0	163.0	153.0	155.0	164.0	164.0	164.0	164.0	164.0
TLR	rs	0.1	0.1	0.1	0.1	0.3**	1.0	0.2**	0.2**	0.3**
	Sig. (2- tailed)	0.2	0.3	0.3	0.2	0.0		0.0	0.0	0.0
	N	163.0	163.0	153.0	155.0	164.0	164.0	164.0	164.0	164.0
ATNR	rs	-0.1	-0.1	-0.2	-0.1	0.0	0.2**	1.0	0.2**	0.6**
	Sig. (2- tailed)	0.1	0.1	0.1	0.4	0.7	0.0		0.0	0.0
	N	163.0	163.0	153.0	155.0	164.0	164.0	164.0	164.0	164.0

STNR	R _s	0.0	-0.1	-0.2*	0.0	0.0	0.2**	0.2**	1.0	0.2**
	Sig. (2-tailed)	0.9	0.4	0.0	0.8	0.6	0.0	0.0		0.0
	N	163.0	163.0	153.0	155.0	164.0	164.0	164.0	164.0	164.0
Any Reflex	R _s	-0.1	0.0	0.0	0.0	0.3**	0.3**	0.6**	0.2**	1.0
	Sig. (2-tailed)	0.4	0.6	0.7	1.0	0.0	0.0	0.0	0.0	
	N	163.0	163.0	153.0	155.0	164.0	164.0	164.0	164.0	164.0

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

* . Correlation is significant at the 0.05 level (2-tailed).

(N = 164)

None of the correlations between the Planning and Attention processes and any of the four irregular primitive reflexes were statistically significant. ATNR, STNR and the occurrence of any reflex in Table 2 showed negative correlations with the Planning processes. This indicates that, with an increase in occurrence of these irregular primitive reflexes and the presence of at least one of the reflexes, there was a decrease in concentration. The Moro reflex showed a negative correlation with Attention processes, indicating that focus on one thing at a time decreased as the Moro reflex occurred more frequently. However, it needs to be noted that the strength of these correlations was very low to negligible. In addition to this, none of these correlations were statistically significant ($p > 0.05$), and whatever correlations were found can thus not be generalised to the population. These findings can thus not support the literature that suggests that the presence of irregular primitive reflexes is significantly related to concentration problems. Further research on the correlation between Planning and Attention processes and these irregular primitive reflexes is needed. Although STNR did not correlate

significantly with Attention- and Planning processes, there was a correlation of -0.2 of this reflex with Simultaneous processes. This correlation is relatively low but statistically significant ($p < 0.05$).

Attention and Planning processes showed a correlation of 0.5 with each other. The two criteria for assessing concentration problems thus co-varied in the sample of the current study. Simultaneous processes showed a correlation of 0.4 with Planning processes and a correlation of 0.2 with Attention processes. These inter-correlations of the PASS processes were statistically significant ($p < 0.05$). Inter-correlations of the PASS processes as part of the technical properties of the Cognitive Assessment System (Naglieri & Das, 1997a) also indicated inter-correlations of 0.2 and higher.

The following irregular primitive reflexes showed considerable correlations with one another: the Moro reflex correlated with TLR; TLR further correlated with ATNR and STNR. ATNR also correlated with STNR. All of these correlation coefficients were between 0.2 and 0.3 when rounded and were also statistically significant ($p < 0.05$). The presence of irregular primitive reflexes thus co-varied with one another.

The correlation analyses show that no significant correlation existed between the occurrence of irregular primitive reflexes and concentration problems as assessed with the Planning- and Attention processes of the Cognitive Assessment System in a group of learners who presented lower than average scores on these processes. Correlations did

exist between different irregular primitive reflexes and between irregular primitive reflexes and Simultaneous processes.

4.4 KRUSKAL-WALLIS ONE-WAY ANOVA

The Kruskal-Wallis analysis was used to determine whether two (or more) samples came from different populations (Gaten, 2000). It thus determined whether there were statistically significant differences between two or more groups (Laerd Statistics, 2013) and thus also gave an indication of a possible association between variables. In this case, the variables were learners with concentration problems and the presence of irregular primitive reflexes in these learners. In the current study the presence of each one of the irregular primitive reflexes was analysed across three different groups of learners with concentration problems in the sample (N =164). This was done separately for the Attention and Planning processes. The groups that were used were those with well-below average concentration abilities, those with below average concentration abilities, and those with low average concentration abilities. If the p-value of the Kruskal-Wallis one-way ANOVA (k-samples) was lower than 0.05 ($p < 0.05$), then a significant difference would have been found between these groups in the presence of a specific irregular primitive reflex. This would indicate whether that irregular primitive reflex appeared differently among the different levels of concentration problems. In such a case, the null hypothesis would be rejected. If a specific irregular primitive reflex appeared differently among groups with different levels of concentration problems, that irregular primitive reflex could be associated with concentration problems. The results

from the Kruskal-Wallis analysis on Attention processes are presented in Table 3 and the results from the Kruskal-Wallis analysis on Planning processes in Table 4. A Kruskal-Wallis analysis was also done on another sample (N = 121) which included two groups, namely those with concentration problems (indicated only by scores lower than the average on both Planning and Attention processes) and those with average or higher scores on concentration. The results of these analyses are presented in Table 5.

Table 3: The association between Attention processes and primitive reflexes using Kruskal-Wallis

Hypothesis Test Summary				
	Null hypothesis	Test	Sig.	Decision
1	The distribution of Moro is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.600	Retain the null hypothesis
2	The distribution of TLR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.009	Reject the null hypothesis
3	The distribution of ATNR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.445	Retain the null hypothesis
4	The distribution of STNR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.124	Retain the null hypothesis

Asymptotic significances are displayed. The significance level is .05

N = 164

Results from the Kruskal-Wallis analysis in Table 3 clearly show that in the case of TLR and Attention processes the null hypothesis should be rejected ($p < 0.05$). The alternative

hypothesis is accepted which indicates that in the case of TLR and Attention processes there was a difference between the groups. TLR can thus be associated with concentration problems as assessed by using the Attention processes of the PASS model in the Cognitive Assessment System (Naglieri & Das, 1997a; Reid et al., 2002).

Table 4: The association between Planning processes and primitive reflexes using Kruskal-Wallis

Hypothesis Test Summary

	Null hypothesis	Test	Sig.	Decision
1	The distribution of Moro is the same across categories of Group.	Independent-Samples Kruskal-Wallis test	0.900	Retain the null hypothesis
2	The distribution of TLR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.420	Retain the null hypothesis
3	The distribution of ATNR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.038	Reject the null hypothesis
4	The distribution of STNR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.877	Retain the null hypothesis

Asymptotic significances are displayed. The significance level is .05

N = 164

Results from the Kruskal-Wallis analysis in Table 4 clearly show that in the case of ATNR and Planning processes the null hypothesis should be rejected ($p < 0.05$). The alternative hypothesis is accepted which indicates that in the case of ATNR as assessed by using Planning processes of the PASS model there was a difference between the

groups. ATNR can thus be associated with concentration problems as indicated by Planning processes.

Table 5: Association between irregular primitive reflexes and groups with low and better concentration abilities using Kruskal-Wallis

Hypothesis Test Summary				
	Null hypothesis	Test	Sig.	Decision
1	The distribution of Moro is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.560	Retain the null hypothesis
2	The distribution of TLR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.132	Retain the null hypothesis
3	The distribution of ATNR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.435	Retain the null hypothesis
4	The distribution of STNR is the same across categories of Group.	Independent-samples Kruskal-Wallis test	0.039	Reject the null hypothesis

Asymptotic significances are displayed. The significance level is .05

N = 121

In Table 5 the null hypothesis, indicating that the distribution of STNR was the same across two categories of concentration problems (very poor concentration and average and above concentration), is rejected. The asymptotic significance was 0.039 (< 0.05). STNR could thus be related to concentration problems as it was not evenly distributed between groups with low concentration abilities and those with average and above average scores on both Planning and Attention processes.

4.5 CONCLUSION

In the current study, documents of learners with possible concentration problems were used to determine a relationship between the existence of irregular primitive reflexes and concentration problems. The descriptive techniques indicated ATNR to appear more regularly than the other irregular primitive reflexes in a group of learners with concentration problems. It also indicated a difference in occurrence of the irregular primitive reflexes between groups with poor scores on concentration and those with average and above concentration scores. Although the descriptive techniques showed the above-stated frequencies, none of the irregular primitive reflexes correlated significantly with Planning and Attention subtests which were used to assess concentration problems. It was indicated that, as some irregular primitive reflexes increased in appearance, there was a decrease in concentration. However, these correlations were too weak to be considered important and were also not statistically significant. The irregular primitive reflexes correlated noticeably and in a statistically significant way with one another, though.

The Planning and Attention subtests of the Cognitive Assessment System (Naglieri & Das, 1997a) that were used to assess concentration problems correlated significantly with one another and also with the other PASS processes – Simultaneous- and Successive processing respectively. STNR showed a statistically significant correlation with Simultaneous processes in the sample; this correlated with concentration problems.

The Kruskal-Wallis test for difference between groups indicated an association of TLR, ATNR and STNR with concentration problems.

CHAPTER 5

DISCUSSION

5.1 INTRODUCTION

This chapter presents a discussion of the results presented in Chapter 4 and the hypotheses presented initially. The research questions will be addressed subsequently. This chapter also highlights some of the shortcomings in the study and makes recommendations. Finally, it provides a conclusion on the study.

5.2 INTERPRETATION AND DISCUSSION OF THE STATISTICAL ANALYSES

The eco-systemic theory that underlies this study confirms that a variety of factors can influence concentration problems (Kokot, 2010a; Van der Westhuizen, 2007). According to this theory, the factors that can influence concentration are neurological, neuro-chemical, neuro-physiological, neuro-developmental and external. According to the DSM-5 (American Psychological Association, 2013), other risk factors for concentration problems include temperamental, environmental, genetic and physiological factors. This study explored the significance of the contribution of neuro-developmental factors on concentration problems, as assessed by the Attention and Planning processes of the Cognitive Assessment System (Naglieri & Das, 1997a). The specific neuro-developmental factors that were the focus of this study were the presence

of irregular primitive reflexes. The relation of these to concentration problems was explored.

This study was conducted by using results from documents of a group of learners who presented with learning difficulties or concerns about possible learning difficulties. The whole population thus consisted of learners with possible learning difficulties. Although this was the case, there was a group of learners who presented with concentration problems and a group with average or above-average scores on concentration (as assessed with the Planning- and Attention processes of the PASS model (Naglieri & Das, 1997a)). There were also learners who performed on average, above and below the average on the other PASS processes. As concentration problems were the issue of concern in this study, only those with lower than average scores on subtests indicating concentration problems (Planning and Attention) were included in the sample; however, scores on Simultaneous and Successive processes of those learners included in the sample were also considered.

The average age of the learners in the sample ($N = 164$) was 10.5 years and ranged from pre-school to late adolescence, although the majority of learners were primary school age, 7 – 13 years. This age distribution of learners indicated that most of the learning problems experienced in this population, specifically concentration problems, were salient in the primary school years. The lower representation of older learners in a group with concentration problems is supported by Halperin and Healy (2011). They state that

concentration problems can improve as learners mature, because mental processes that underlie these problems are maturing with the use of directed play and physical exercise. The demographic information that indicated nearly double the number of boys to girls represented in the sample can be explained by indications that boys in general tend to show more learning problems than girls. The ratio is 2:1 to 3:1 boys to girls with learning problems, according to the DSM-5 (American Psychiatric Association, 2013). Attention-Deficit Disorder (ADD) hyperactive/impulsive type is also more prevalent in boys than in girls who might rather present with ADD inattentive type. According to the DSM-5 (American Psychiatric Association, 2013), the ratio of boys to girls is 2:1.

The possible association of irregular primitive reflexes with concentration problems was investigated by using three different procedures. Firstly, the prevalence of irregular primitive reflexes was presented in terms of frequencies; secondly, the correlation between irregular primitive reflexes and concentration problems was investigated by using Spearman's rho for non-parametric data and, lastly, Kruskal-Wallis analyses were used to determine whether irregular primitive reflexes were distributed equally or differently among groups with differing levels of concentration.

The prevalence of the different irregular primitive reflexes presented in the sample showed a high incidence of these reflexes in the presence of learners with concentration problems. As 91.5% of the sample showed that at least one irregular primitive reflex was present, irregular primitive reflexes seemed to be related to the concentration problems

presented by these learners. Giving the expectation that these irregular primitive reflexes should have disappeared at this age level in all of these learners, this is a very high prevalence. ATNR appeared the most frequently (91%) in the presence of concentration problems with Moro; TLR and STNR were also present in more than 37% of the learners. Thus the high prevalence of these irregular primitive reflexes in the case of learners presenting with concentration problems provoked concerns in terms of these problems. Furthermore, the descriptive statistics showed a clear decrease in the prevalence of the irregular primitive reflexes between groups with average and higher concentration abilities (as assessed with Planning and Attention processes) and those with lower than the average scores on both these processes. The prevalence of TLR and STNR showed the most salient decrease in appearance in these groups. In the frequency analyses a very high incidence of ATNR was noted in the group with concentration problems (91.6%), although it seemed to remain also rather high in the group with better concentration abilities (76.9%).

The correlation analyses did not show any of these irregular primitive reflexes to correlate significantly with concentration problems (as assessed by Planning and Attention processes). The correlation of the irregular primitive reflexes incorporated in this study and concentration problems as assessed by Planning and Attention processes can thus not be refuted or supported, based on the outcomes of the Spearman's *rho* correlation analysis. A correlation of irregular primitive reflexes with each other showed a statistical significant correlation between Moro and TLR ($r_s = 0.250$), as well as

between TLR and ATNR ($r_s = 0.210$), TLR and STNR ($r_s = 0.211$) and ATNR and STNR ($r_s = 0.207$). Further analyses showed a statistically significant negative correlation between STNR and Simultaneous processing problems ($r_s = -0.2$) in the sample. This shows that although the presence of irregular primitive reflexes did not impact directly and significantly on the outcomes of concentration problems (Attention and Planning), it correlated with one another and with one of the other processes of the PASS model of intelligence (Simultaneous processing). There was also a statistically significant correlation of Simultaneous processing with both Planning ($r_s = 0.44$) and Attention ($r_s = 0.45$) processes and of Successive processing with Planning processes ($r_s = 0.32$). These latter three correlations indicate that problems with processing abilities (as assessed by Successive and Simultaneous processes) co-varied with problems with concentration. Irregular primitive reflex STNR showed a statistically significant negative correlation ($r_s = -0.2$) with processing abilities (indicated by Simultaneous processes); processing abilities showed a statistically significant positive correlation with concentration abilities ($r_s = 0.44$ with Planning processes and $r_s = 0.2$ with Attention processes). The following thus seems to be the case: a higher occurrence of STNR correlated with poor processing abilities and poor processing abilities correlated with concentration problems. This indicates a relation of STNR with concentration problems. This relation is also visible in the descriptive statistics as discussed previously, where STNR was one of the two irregular primitive reflexes (TLR and STNR) which showed a more salient difference between groups with lower and better concentration abilities.

The Kruskal-Wallis analyses indicated TLR to be associated with concentration problems as assessed by Attention processes (focus on one thing at a time) and ATNR with concentration problems as assessed by Planning processes (frontal lobe function or executive functioning). In the Kruskal-Wallis analyses STNR was the only irregular primitive reflex to be associated with a difference in concentration abilities between groups with poor concentration and those with better concentration (average and above scores on both Planning and Attention processes). In the descriptive statistics, the correlation analyses and Kruskal-Wallis STNR were clearly associated with concentration problems. Although this is the case, there is also an association of TLR and ATNR with certain aspects of concentration problems.

Konicarova et al. (2013) researched the association between perceived symptoms of concentration problems and the presence of irregular ATNR and STNR, and found a link between these irregular primitive reflexes and ADHD symptoms. In the current study this link was also indicated when using a norm-referenced test instead of ADHD symptoms. The findings of the current research are thus in support of the findings of Konicarova et al., at least as far as the relation of STNR with concentration problems is concerned. A retained STNR correlated with poor Simultaneous processing in the current study, which again correlated with concentration problems. There was also a clear association of STNR with concentration problems as indicated by the Kruskal-Wallis test. The descriptive statistics in the current study also showed a high prevalence of ATNR in a group with concentration problems, although the difference of ATNR

between groups with and without concentration problems was not that clear. ATNR did show a difference between groups with varying concentration abilities when the latter was assessed by Planning processes, thus frontal lobe functioning. Other researchers (Konicarova et al., 2013; Solanki et al., 2012) thus found links between some of the irregular primitive reflexes and ADHD symptoms, but the current study found an association of irregular primitive reflexes when using a norm-referenced test. This association was indicated in the case of STNR through its correlation with processing problems which correlated with concentration problems. In the case of irregular TLR, it was associated with focus on one thing at a time and in the case of ATNR, its association was related to the functions of the frontal lobes as aspects of concentration problems.

The findings of the current study also support the study conducted by Taylor et al. (2004). In the Taylor et al. (2004) study the effect of the Moro reflex on concentration problems was suggested to be indirect - "... all the effects for Moro retention were mediated by its relationship with ATNR, STNR, and TLR retention levels" (Taylor et al., 2004, p. 24). Taylor et al. (2004) state that the Moro reflex has a gateway effect on the other primitive reflexes by preventing the other reflexes from becoming inhibited. In the correlation analyses of the current study the Moro reflex also did not show a correlation with concentration problems. In the case of the Moro reflex, the alternative hypothesis that a correlation exists between irregular primitive reflexes and concentration problems is rejected. However, the Moro reflex and TLR correlated

significantly with each other ($r_s = 0.25$) and TLR correlated significantly with the other irregular primitive reflexes assessed here (ATNR $r_s = 0.21$ and STNR $r_s = 0.211$). As the Moro reflex is the first of those assessed in the current study to appear it seems to have a gateway effect on TLR, as this is the only reflex with which the Moro reflex correlates significantly. TLR thus tends to stay active beyond its expected time frame if the Moro reflex is still present. In the hierarchy of development, TLR is the next to appear after the Moro reflex and correlates significantly with the following two reflexes that appear, namely ATNR ($r_s = 0.21$) and STNR ($r_s = 0.211$). The latter two irregular primitive reflexes again correlate significantly with each other ($r_s = 0.207$). It seems that the irregular presence of TLR is then preventing the following ATNR and STNR in the hierarchy of development to stop appearing beyond their time frame. The correlation of the reflexes thus seem to follow a hierarchical pattern which starts with Moro, which correlates with TLR and thereafter TLR, which correlates with the two following ones – ATNR and STNR. STNR is the last one of the assessed reflexes to appear in the hierarchy of development and correlates with concentration problems through its correlation with Simultaneous processing problems.

The inferential statistics in this study thus showed an association of STNR with concentration problems when using both correlation analysis and the Kruskal-Wallis test. ATNR and TLR were associated with certain aspects of concentration problems. It also showed a pattern of correlation in the irregular primitive reflexes that resembled the hierarchical inhibition of these primitive reflexes, ending with the STNR which

correlated with processing problems which again correlated with concentration problems. In the case of the irregular primitive reflexes following the Moro reflex in the hierarchy of development, the alternative hypothesis that a correlation exists between irregular primitive reflexes and concentration problems, is accepted. The above-stated evidence also indicates that STNR, ATNR and TLR can be associated better with concentration problems than with the Moro reflex. The alternative hypothesis that certain irregular primitive reflexes can predict concentration problems more effectively than others is thus accepted.

5.3 ANSWER TO RESEARCH QUESTIONS

The research questions of this study can thus be answered as follows:

The first question was: Does a correlation exist between various irregular primitive reflexes, (Moro reflex, TLR, ATNR, and STNR) and concentration problems for learners in the Namibian context? It is answered as follows:

No statistically significant direct correlation existed between the various irregular primitive reflexes assessed in this study and concentration problems as assessed by the Cognitive Assessment System (Naglieri & Das, 1997) for learners in the Namibian context. Although this is the case, STNR correlated with processing problems which again correlated with concentration problems. Frequency results and Kruskal-Wallis one-way ANOVA analyses also showed evidence of an association between some of the irregular primitive reflexes and concentration problems.

The second question was: Can certain of the above mentioned irregular primitive reflexes predict the existence of concentration problems more significantly than others?

It is answered as follows:

A retained STNR showed the strongest association with concentration problems through its correlation with Simultaneous processing problems and its association with concentration problems as indicated by the Kruskal-Wallis one-way ANOVA. The presence of TLR and ATNR was also associated with certain areas of concentration problems as indicated by the Kruskal-Wallis one-way ANOVA. The Moro reflex was not associated with concentration in the current study.

5.4 SHORTCOMINGS AND RECOMMENDATIONS

5.4.1 Shortcomings

- The most prominent shortcoming of the current study is the composition of the population from which the sample was drawn. The total population consisted of learners with learning problems or difficulties that were referred to one private practice in Windhoek. It was thus not possible to form a control group of learners, who did not have any learning problems, from the population of documents available in order to compare the effect of irregular primitive reflexes.

- It would enrich the study if the difference in the effect of irregular primitive reflexes on a group with learning problems could be compared with the effect of the reflexes on a group without any learning problems.
- Concentration problems were only assessed by using one norm-referenced test. The accuracy of the identification of concentration problems could be improved if more than one norm-referenced test were used. It was not necessary to incorporate other diagnostic criteria related to behaviour and school performance, as it was the goal of this study to correlate irregular primitive reflexes with results from a norm-referenced test.
- Only four irregular primitive reflexes, as part of neurological soft signs, were compared with concentration problems. The study could have been greatly enriched if the researcher expanded the correlation study to other neurological soft signs that form part of the eco-systemic theory. A correlation with the latter and concentration problems on the norm-referenced test used could have given a wider scope of treatment possibilities for concentration problems.

5.4.2 Recommendations

- A wider variety of neurological soft signs can be correlated with concentration problems based on the outcomes of the same or another norm-referenced test or with formally diagnosed ADHD learners.
- The correlation of irregular primitive reflexes with specific types of learning difficulties or disorders can be researched. This can give an indication of which

of the irregular reflexes should be focused on in order to improve specific learning difficulties or disorders.

- The same study can be done by using another norm-referenced test which also assesses concentration problems. The outcomes of the two assessments can be compared and it can be attempted to find similarities and differences between the two studies. This might give an indication whether the assessment of concentration problems by using Planning and Attention subtests of the Cognitive Assessment System correlates with the assessment of concentration by using other norm-referenced tests in the Namibian situation.
- The same type of study can be conducted while also using a control group with no learning problems.
- A study based on the same hypotheses as the current, but enriched as discussed above, can focus on specific treatment programs to be implemented in schools, to address concentration and other learning problems. The impact of such treatment program/s can be researched to provide effective measures to address neuro-developmental contributors to concentration and other learning problems.
- Since an association was found between some of the irregular primitive reflexes and concentration problems, it is recommended that these reflexes should be assessed and treated, in addition to other treatment methods, when learners are referred to a psychologist for concentration problems.

- As it was found that one of the irregular primitive reflexes correlates with processing problems, school-based programs can be employed to address irregular primitive reflexes that are associated with processing problems.

5.5 CONCLUSION

In an attempt to find the relationship between the assessed four irregular primitive reflexes and concentration abilities, the researcher became more aware of the complexity of concentration problems and their contributing factors. It is a complex and also a regularly mis-, as well as over- or under-diagnosed disorder in children (Sciutto & Eisenberg, 2007); however, it was enriching to find that some of the findings in this study support previous findings on this issue. Since the findings in this study are still inconclusive, further research is thus needed. Areas that could be addressed are the effect of other neurological soft signs on concentration abilities and improvement of irregular primitive reflexes, as well as other neurological soft signs as efficient treatment options for concentration abilities in the Namibian school situation.

REFERENCES

- Almeida, L. G., Ricardo-Garcell, J., Prado, H., Barajas, L., Fernández-Bouzas, A., Avila, D., & Martínez, R. B. (2010). Reduced right frontal cortical thickness in children, adolescents and adults with ADHD and its correlation to clinical variables: A cross-sectional study. *Journal of Psychiatric Research*, 44, 1214-1223.
- Amen, D. G. (2001). *Healing ADD: The breakthrough program that allows you to see and heal the 6 types of ADD*. New York, NY: Penguin Group.
- American Psychiatric Association. (2010). *Ethical principles of psychologists and code of conduct*. United States: American Psychiatric Publishing.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). United States: American Psychiatric Publishing.
- Angrosino, M. V. (2012). Observation-based research. In J. Arthur, M. Waring, R. Coe, & L. Hedges, (Eds.), *Research methods and methodologies in education* (pp 165-169). London, UK: Sage Publications.
- Aro, T., Imasiku, M. L., Haihambo, C., Möwes, A., Kariuki, D., & Ahonen, T. (2011). Attention and executive functions. In T. Aro, & T. Ahonen, (Eds.). *Assessment of learning disabilities: cooperation between teachers, psychologists and parents* (Namibian Ed.), Jyväskylä: University of Turku and Niilo Mäki Institute
- Arthur, J., Waring, M., Coe, R., & Hedges, L.V. (2012). *Research methods & methodologies in education*. Los Angeles, Cal.: SAGE.

- Behrmann, M., Geng, J. J., & Shomstein, S. (2004). Parietal cortex and attention. *Current Opinion in Neurobiology*, 14, 212-217.
- Best, J. R. (2010). Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. *Developmental Review*, 30, 331-351.
- Brainhighways. (2009). A lower brain connection. Retrieved on January 8, 2014, from www.brainhighways.com
- Budisavljevic, S. & Ramnani, N. (2012). Cognitive deficits from a cerebellar tumour: A historical case report from Luria's laboratory. *Cortex*, 48, 26-35.
- Cann, A. J. (2003). *Maths from scratch for biologists*. Chichester, UK: John Wiley & Sons Ltd.
- Coffman, K. A., Dum, R. P., & Strick, P. L. (2011). Cerebellar vermis is a target of projections from the motor areas in the cerebral cortex. *PNAS*, 108(38). Retrieved July 01, 2014 from, <http://www.pnas.org/content/108/38/16068.full>
- Coolican, H. (2009). *Research methods and statistics in psychology*. London, UK: Hodder Education.
- Cotman, C. W. & Berchtold, N. C. (2002). Exercise: A behavioural intervention to enhance brain health and plasticity. *TRENDS in Neurosciences*, 25(6), 295-301.

- Cubillo, A., Halari, R., Smith, A., Taylor, E., & Rubia, K. (2011). A review of fronto-striatal and fronto-cortical brain abnormalities in children and adults with Attention Deficit Hyperactivity Disorder (ADHD) and new evidence for dysfunction in adults with ADHD during motivation and attention. *Cortex*, 48, 194-215.
- D'Agati, E., Casarelli, L., Pitzianti, M.B., & Pasini, A. (2010). Overflow movements and white matter abnormalities in ADHD. *Progress in Neuro-pharmacology and Biological Psychiatry*, 34, 441-445.
- De Jager, M. (2009a). *Mind moves: Moves that mend the mind*. Johannesburg, RSA: Mind Moves Institute.
- De Jager, M. (2009b). *Sequence of primitive reflex development*. Johannesburg, RSA: Mind Moves Institute.
- Demos, J. N. (2005). *Getting started with neurofeedback*. New York, NY: W.W. Norton & Company.
- Depue, B. E., Burgess, G. C., Bidwell, L. C., Willcutt, E. G., & Banich, M. T. (2010). Behavioural performance predicts grey matter reductions in the right inferior frontal gyrus in young adults with combined type ADHD. *Neuroimaging*, 182, 231-237.
- De Vos, A. S., Fouché, C. B. & Venter, L. (2002). Quantitative data analysis and interpretation. In De Vos, A. S. (Ed.), *Research at grass roots: For the social sciences and human service professions* (pp. 222-246). Pretoria, RSA: Van Schaik Publishers.

- Dictionary.com. (n.d.). *Neuro*. Retrieved November 1, 2014, from <http://dictionary.reference.com/browse/neuro->
- Eckersley, S. (2012, June). ATNR. *Development*. Retrieved 27 June, 2014, from <http://occupationaltherapyforchildren.over-blog.com/categorie-12494208.html>
- Fouché, C. B. & De Vos, A. S. (2002). Quantitative research designs. In A. S. De Vos, (Ed.), *Research at grass roots: For the social sciences and human service professions* (pp. 278-290). Pretoria, RSA: Van Schaik Publishers.
- Futagi, Y., Toribe, Y., & Suzuki, Y. (2012). The grasp reflex and moro reflex in infants: Hierarchy of primitive reflex responses. *International Journal of Paediatrics*. Retrieved on February 20, 2014, from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3384944/>
- Gajewska, E., Sobieska, M., Kaczmarek, E., Suwalska, A., & Steinborn, B. (2013). Achieving motor development milestones at the age of three months may determine, but does not guarantee, proper further development. *The Scientific World Journal*, 2013. doi: 10.1155/2013/354218
- Gaten, T. (2000). *Kruskal-Wallis non-parametric ANOVA*. University of Leicester, Department of Biology. Retrieved October 18, 2014, from <http://www.le.ac.uk/bl/gat/virtualfc/Stats/kruskal.html>
- Goddard Blythe, S. (2000). Early learning in the balance: Priming the first ABC. *Support For Learning*, 15(4), 154-158. doi: 10.1111/1467-9604.00168
- Goddard Blythe, S. (2009). *Attention, balance, and coordination: The A.B.C. of learning success*. West-Sussex, UK: John Wiley & Sons Ltd.

- Greeff, M. (2002). Information collection: interviewing. In De Vos, A. S. (Ed.), *Research at grass roots: For the social sciences and human service professions* (pp. 291-320). Pretoria, RSA: Van Schaik Publishers.
- Guy, C. (2012). Neuro development approach to the treatment of learning difficulties. *Patoss-dyslexia*. Retrieved September 15, 2014, from <https://www.patoss-dyslexia.org/SupportAdvice/InformationSheets/2012-02-03/NeuroDevelopment-Approach/>
- Halperin, J. M., Bédard, A. V., & Curchack-Lichtin, J. T. (2012). Preventive interventions for ADHD: A neurodevelopmental perspective. *Neurotherapeutics*, 9(3), 531-541. doi: 10.1007/s13311-012-0123-z.
- Halperin, J. M. & Healey, D. M. (2011). The influences of environmental enrichment, cognitive enhancement, and physical exercise on brain development: Can we alter the developmental trajectory of ADHD? *Neuroscience and Behavioural Reviews*, 35, 621-634.
- Howard, S. & Coulter, M. (1996). *Changing children's minds: Feuerstein's revolution in the teaching of intelligence*. Birmingham, UK: Imaginative Minds.
- Kandawasvika, Q. G. (2008). *Neurodevelopmental outcomes at preschool age: A 5 year follow up study of a cohort born to mothers participating in the PMTCT program in Harare, Zimbabwe*. Thesis (M.S.) – University of Oslo, Oslo.

- Imerai, L., Antrop, I., Sonuga-Barke, E., Deboutte, D., Deschepper, E., Bal, S., & Roeyers, H. (2013). The impact of instructional context on classroom on-task behaviour: A matched comparison of children with ADHD and non-ADHD classmates. *Journal of School Psychology, 51*, 487-498.
- Kokot, S. J. (2005). A neurodevelopmental approach for helping gifted learners with diagnosed dyslexia and attention deficit/hyperactivity disorder (AD/HD). *Africa Education Review, 2*(1), 130-146.
- Kokot, S. J. (2006). The nature and incidence of barriers to learning among grade three learners in Tshwane. *Africa Education Review, 3*(1+2), 134-147.
- Kokot, S.J . (2010a). *Short course in neurodevelopment: Recognising and addressing underlying causes of learning and behavioural difficulties*. Wellington: Radford House Publications.
- Kokot, S. J. (2010b). *Wired to learn: Ensuring learning readiness in the school beginner*. Wellington: Radford House Publications.
- Kokot, S., & Van der Westhuizen, B. (n.d.). *ILT 2- Distance component. Module 1: movement and learning*. Wellington: Radford House Publications.
- Konicarova, J., Bob, P., & Raboch, J. (2013). Persisting primitive reflexes in medication-naïve girls with attention-deficit and hyperactivity disorder. *Neuropsychiatric Disease and Treatment, 9*, 1457-1461. doi:10.2147/NDT.S49343
- Kostyanaya, M. I. & Rossouw, P. (2013). Alexander Luria – life, research and contribution to neuroscience. *International Journal of Neuropsychotherapy, 1*(2), 47-55. doi: 10.12744/ijnpt.2013.0047-0055.

- Kufs, C. (2010, November 20). Re: Secrets of good correlations. Retrieved from <https://statswithcats.wordpress.com/2010/11/28/secrets-of-good-correlations/>
- Laerd Statistics. (2013). Kruskal-Wallis H test using SPSS statistics. In *Lund Research Ltd*. Retrieved December 1, 2014, from <https://statistics.laerd.com/spss-tutorials/kruskal-wallis-h-test-using-spss-statistics.php>
- Lanciego, J. L., Luquin, N. & Obeso, J.A. (2012). Functional neuroanatomy of the basal ganglia. *Cold Spring Harbor Perspectives in Medicine*, 1-20 doi: 10.1101/cshperspect.a009621
- Learning Disabilities. (2013, April 25). Re: Brain function of reading, writing and spelling learning disabilities. Message posted to <http://neuroblog588.blogspot.com>
- Leech, R., & Sharp, D. J. (2013). The role of the posterior cingulate cortex in cognition and disease. *Brain: A Journal of Neurology*. doi:10.1093/brain/awt162
- Leisman, G., Braun-Benjamin, O., & Melillo, R. (2014). Cognitive-motor interactions of the basal ganglia in development. *Frontiers in Systems Neuroscience*, 8(16), 1-18. doi: 10.3389/fnsys.2014.00016
- Marshall, S., & Goddard Blythe, S. (n.d.). *Smart Learning Solutions: Remedial teaching with a difference*. Retrieved June 24, 2014, from www.smartlearning.co.nz/SLS_reflexes.html
- Mukaka, M. M. (2012). A guide to appropriate use of correlation coefficient in medical research. *Malawi Medical Journal*, 24(3), 69-71.

- Naglieri, J. A. & Das, J. P. (1997a). *Cognitive assessment system: Interpretive handbook*. Itasca: Riverside Publishing.
- Naglieri, J. A. & Das, J. P. (1997b). *Cognitive assessment system: Administration and scoring manual*. Itasca: Riverside Publishing.
- National Institute for Educational Development. (2007). *Entrepreneurship syllabus: Grades 8-10*. Okahandja: NIED.
- Parker, E. (2012). Baby reflexes: hand-to-mouth is more than it seems! *Conscious baby blog: healthy milestones and emotional development with Eliza Parker*. Retrieved October 24, 2014, from <https://consciousbabyblog.wordpress.com/tag/atnr/>
- Pedroso, F. S. (2008). Reflexes. In M. Haith, & J. B. Benson, (Eds.), *The encyclopedia of infant and Early Childhood Development* (pp. 11-23). Elsevier.
- Rabiner, D. (2012). Study: Promising new neurocognitive intervention for preschoolers with ADHD (TEAMS). Retrieved May 1, 2012, from the Sharpbrains website: <http://www.sharpbrains.com/blog/2012/04/19study-promising-new-neurocognitive-intervention-for-preschoolers-with-ADHD>
- Ratey, J. J., & Hagerman, E. (2008). *Spark: The revolutionary new science of exercise and the brain*. New York, NY: Little, Brown and Company.
- Reid, K. D., Kok, J. C., & Van der Merwe, M. P. (2002). The PASS model for the assessment of cognitive functioning in South African schools: A first probe. *South African Journal of Education*, 22(3), 246-252.

- Robson, M. E. (2012). HANDLE® and reflex integration. Retrieved March 29, 2014 from the Compassionate Therapy and Training Centre website: <http://compassionate-therapy.net.au/resources/hand-and-reflex-integration/eractivity>
- Sangster, S. (n.d.). *Coming to grips with primitive reflexes*. Retrieved June 21, 2014, from www.nma-oz.com
- Sciutto, M. J., & Eisenberg, M. (2007). Evaluating the evidence for and against the overdiagnosis of ADHD. *Journal of Attention Disorders*, 11(2), 106-113.
- Sensory Development Seminars. (2010). Primitive reflexes. Retrieved March 28, 2014, from the Eagle Canyon Wellness website: http://www.eaglecanyonwellness.com/old/docs/Primitive_Reflexes.pdf
- Shaw, P., Eckstrand, K., Sharp, W., Blumenthal, J. Lerch, J.P., Greenstein, D., et al. (2007). Attention-deficit/hyperactivity disorder is characterized by a delay in cortical maturation. *Proceedings of the National Academy of Sciences of the United States of America*, 104(49), 19649-19654.
- Smith, E. (2012). Secondary data. In J. Arthur, M. Waring, R. Coe, & L. Hedges, (Eds.), *Research methods and methodologies in education* (pp. 125-130). London: Sage Publications.
- Solanki, R. K., Swami, M. K. & Singh, P. (2012). An examination of relationship between neurological soft signs and neurocognition. *Asian Journal of Psychiatry*, 5(2012), 43-47.

- Strydom, H. (2002). Information collection: participant observation. In A. S. De Vos, (Ed.), *Research at grass roots: For the social sciences and human service professions* (pp. 278-290). Pretoria, RSA: Van Schaik Publishers.
- Strydom, H., & Venter, L. (2002). Sampling and sampling methods. In De Vos, A.S. (Ed.), *Research at grass roots: For the social sciences and human service professions* (2nd ed.). Pretoria, RSA: Van Schaik Publishers.
- Strydom, M. K. (2013). *Healing begins with sanctification of the heart* (4th ed.). Harare: Eagles' Wings Ministries.
- Taddei, S., Contena, B., Caria, M., Venturini, E., & Venditti, F. (2011). Evaluation of children with Attention Deficit Hyperactivity Disorder and Specific Learning Disability on the WISC and Cognitive Assessment System (CAS). *Social and Behavioral Sciences*, 29, 574-582.
- Taylor, C. (2014). Differences in descriptive and inferential statistics. In *About.com*. Retrieved October 20, 2014, from <http://statistics.about.com/od/Descriptive-Statistics/a/Differences-In-Descriptive-And-Inferential-Statistics.htm>
- Taylor, M., Houghton, S., & Chapman, E. (2004). Primitive reflexes and attention-deficit/hyperactivity disorder: Developmental origins of classroom dysfunction. *International Journal of Special Education*, 19(1), 23-37.
- The HANDLE® Institute. (2012). Attention Deficit Disorder (ADD) with Hyperactivity (ADHD). Retrieved May 25, 2012, from The Handle® Institute website: http://handle.org/issues/add_adhd.html

- The Learning Clinic. (n.d.). *Reflexes*. Retrieved September, 14, 2014, from <http://www.thelearningclinic.ie/index.php/programs/movement-therapy/reflexes/>
- The Sound Learning Centre. (n.d.). *Reflexes*. Retrieved June 20, 2014, from <http://www.thesoundlearningcentre.co.uk/the-cause/reflexes/>
- Thompson, M., & Thompson, L. (2003). *The neurofeedback book: An introduction to basic concepts in applied psychophysiology*. Wheat Ridge: The Association for Applied Psychophysiology and Biofeedback.
- UNESCO. (2014). Descriptive statistics. In *Module B4: Basic Data Analysis Techniques*. Retrieved August 24, 2014, from <http://www4.unescobkk.org/education/efatraining/module-b4/2-descriptive-statistics/>
- Van der Westhuizen, B. (2007). *An ecosystemic approach to address attentional difficulties and heightened motor activity*. Unpublished master's thesis – University of South Africa, Pretoria, SA.
- Westendorp, M., Hartman, E., Houwen, S., Smith, J. & Visscher, C. (2011). The relationship between gross motor skills and academic achievement in children with learning disabilities. *Research in Developmental Disabilities*, 32(2011), 2773-2779.
- William, M. K. (2006). Descriptive statistics. In *Social Research Methods*. Retrieved August 24, 2014, from <http://www.socialresearchmethods.net/k/b/statdesc.php>

Wu, S., & Gau, S. (2013). Correlates for academic performance and school functioning among youths with and without persistent attention-deficit/hyperactivity disorder. *Research in Developmental Disabilities, 34*, 505-515.

APPENDIX 1: Research permission letter

APPENDIX 2: Ethical clearance certificate

**APPENDIX 3: Example of Cognitive Assessment System: Response books
front page (5 – 7 years and 8 – 17 years)**

APPENDIX 4: Example of Cognitive Assessment System: Record form front page

APPENDIX 5: Proof of language editing