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EVALUATION OF MEASURES OF SENSORY PROCESSING AND INATTENTION IN A SAMPLE OF SOUTH AFRICAN PRESCHOOL LEARNERS

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

Johannesburg, 2015

Declaration

I Yael Chemel declare that this dissertation is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Yael Chemel

25 February 2015

Abstract

The purpose of this study was to determine what percentage of 100 preschool children between the ages of 4 years to 6 years 11 months attending seven private mainstream schools were identified by teachers and parents with inattention and sensory modulation disorder (SMD). A cross section quantitative descriptive design was used as observational data was obtained on the entire sample of the preschools, at one point in time only, by the child's parents and teachers. Parents of the participants scored the Sensory Profile and the teachers scored the School Companion and Attention Deficit Disorders Evaluation Scale-(ADDES-3) inattention subtest based on their functioning and behaviour at home and at school.

Participants were assessed in the classroom and at home and results showed that parents and teachers scored them as having more definite dysfunction than expected compared to a normal distribution. Teachers also scored the participants below average for inattention. Parents indicated less dysfunction than teachers with weak relationship between the School Companion and Sensory Profile indicating that the context in which the participants were observed is important and they may have problems other than SMD and inattention. The School Companion had a moderate positive correlation with the ADDES-3. For the 43% of participants attending therapy there was a low association in the identification of SMD and inattention and attendance at therapy.

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Operational Definitions

Sensory Integration - "the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment. The spatial and temporal aspects of inputs from different sensory modalities are interpreted, associated, and unified" [1]

Sensory processing "is the normal neurological process of organising sensations which we use in everyday life. We use our sensations to survive, satisfy our desires, to learn and to function smoothly" [2]

Sensory modulation "Sensory modulation refers to an individual's ability to respond adaptively to situations over a broad range of intensity and duration. Sensory modulation provides a foundation to perform in day to day occupation. It allows an individual to maintain an optimal level of arousal, attention and activity to meet the demands and expectations of the environment rather than underreacting or overreacting to them" [3]

Abbreviations

ADDES-3: The Attention Deficit disorders evaluation scale-(3rd edition).

ADHD: Attention deficit hyperactivity disorder

CNS: Central nervous system

DCD: developmental coordination disorder

SC: School Companion

SFA: School Function Assessment

SIAS: The National Strategy on Screening, Identification, Assessment and Support

SMD: Sensory modulation disorder

SP: Sensory Profile

CHAPTER 1: INTRODUCTION

Young children with poor sensory processing disorder, amongst other difficulties, typically display delays in their ability to perform age appropriate fine and gross motor skills, incoordination and poor balance [4]. In addition, other observable behaviours linked with poor sensory processing may include tactile defensiveness, distractibility, and dysfunction in language and visual perceptual skills [4].

Performance can be related to deficits in sensory modulation in various different sensory modalities such as visual, tactile, auditory or vestibular processing. [3] Sensory modulation dysfunction, especially the categories of sensory-seeking and over-responsivity, affects the children's performance in schools because of the way in which it presents. These children often display excessive movement such as shaking their feet, rocking on their chair, rolling on the floor, excessive fidgeting and manipulation of things [3]. Sensory integration dysfunction, and specifically sensory modulation dysfunction, may also cause hyperactivity, an inability to suppress irrelevant stimulation and therefore an inability to concentrate on important information, and incapability to participate in class work [3]. This can be associated with attention problems, such as the inability to sit quietly at a school desk and complete a required task. These children may have difficulty focusing for long periods, are easily distracted, and have problems understanding and following directions.

Although the sensory processing problems are milder in children without developmental disorders, these observable difficulties still affect their ability to participate at school and partake in schoolwork [5]. Behaviour resulting from sensory modulation deficits is often noticed in a classroom environment by teachers or facilitators [3] [6]. These children also demonstrate responsiveness patterns to sensory stimuli that are maladaptive, which interfere and disrupt their participation in required tasks at home and at school such as play and leisure and daily care activities [5].

The assessment of the performance of preschool children affected by sensory modulation and related attention problems relies on the availability of reliable and valid assessment tools [7]. Both sensory modulation and attention are assessed behaviourally through the use of survey instruments such as the Sensory Profile and the The Attention Deficit

disorders evaluation scale-(3rd edition) (ADDES-3). Results from these assessments are used to identify over-responsive and/or under-responsive behaviours, their effect on learning as well as the ability to focus attention.

The assessments are filled out by the teacher or parent to identify the behaviours in response to sensory stimuli and inattention. Thus, disruptive behaviours in children are currently assessed using observational rating scales relying on the perspective of teachers, parents or diagnostic observers [7]. There is evidence that teacher and parent ratings can be at risk of potential threats to validity.

One of these threats is sources of 'rater' bias. Behaviour rating scales are significantly subjective, and the rater is only able to make a judgement about the child's behaviour in relation to the behaviour of their peers and with whom the rater has similar contact. Parents will use their other children or relatives as a point of reference and teachers will use other children in their classroom [7]. As a result of this, the reference group which a child is compared to may influence the outcome of these assessments on which referral for therapy may be based [7]. Another major disadvantage of parent and teacher self-report questionnaires is the subjective nature of the information which should be used with other components like direct observation [8].

1.1 Problem statement

Sensory modulation, within the South African context, is currently assessed using the Sensory Profile School Companion, here on referred to as the School Companion and the Sensory Profile (Parent/Caregiver Checklist) here on referred to as the Sensory Profile, as well as observations made by the therapist during the assessment process. Attention can be assessed with a number of different observation scales including the ADDES-3, by the teacher or allied health professionals.

Behaviour rating assessments do have the advantage of providing an inexpensive way in which to assess certain difficulties such as Attention deficit hyperactivity disorder (ADHD) and sensory processing. Teacher ratings are particularly important as they summarise accumulated observations and perceptions about a child's behaviour that impact the child's learning at school. Literature indicates mixed findings exist in terms of the strength of the relationship between different assessments as well as the compatibility between

observers that fill out rating scales [7]. However there is general consensus that a discrepancy in the results does not mean that there are flaws within the rating scales but rather is a question of the practical use of the information given on these checklists [7].

The National Strategy on Screening, Identification, Assessment and Support (SIAS) (2008) published by the SA national Department of Education states that barriers to learning should be identified by teachers and screening processes at the schools [9]. While teacher rating scales are useful for the identification of aspects of behaviour and attention in the classroom it is not known if the use of existing report scales for sensory processing and attention would be useful for the identification of problems when used in South African classrooms.

Within the South African private mainstream preschools, a large proportion of children are being referred for occupational therapy assessments based on sensory modulation dysfunction and inattention in the classroom, as well as multiple children are in speech therapy and physiotherapy for other possible reasons. One then stands to question the percentage of children identified with sensory modulation disorder within a mainstream private school as opposed to a normal distribution. It is unclear whether these children are being identified correctly as having sensory modulation disorder (SMD) or if they are being compared to an unfair point of reference. It is also not known how the behavioural observations in relation to sensory modulation are associated with a child's ability to pay attention in the classroom; if there is convergent validity of the School Companion completed by teachers and the Sensory Profile completed by parents, when they are observed in different contexts. Since further assessment of the child would be needed, the prescription of therapy may be based on the results of these Sensory profiles or attention scales. It is therefore important to determine what differences exist between the perceptions of the teachers and the parents in relation to their child's behaviour related to sensory modulation and how this relates to the child's ability to attend in class.

1.2 Purpose of the study

The purpose of the study is twofold. In the past years there has been a dramatic increase in the number of children referred for occupational therapy for reasons such as sensory processing dysfunction. Dysfunction in sensory processing may be observed both at home

and in the school environment and therefore children may be referred by either parent or teacher. These difficulties are evaluated by observable behaviours that can be related to sensory dysfunction or other diagnoses such as attention problems. The purpose of this study is therefore to establish how many children are being identified, by parents and teachers, with sensory modulation dysfunction and the pattern of dysfunction that these children exhibit in South Africa. Secondly, to determine which of these behaviours are associated with inattention in the classroom as well as referral to therapy. Since it is important that intervention for both attention disorders and SMD start as early as possible the study will be completed on children at a preschool level.

The second purpose is to determine if the correct children are being identified with SMD and referred for therapy and if there is convergent validity of the sensory profile and school companion when filled out by parents and teachers of children when observed in different contexts.

1.3 Research Question

What is the percentage and patterns of behaviour that is observed by parents and teachers related to SMD of preschool children between the age of 4 years to 6 years 11 months, and which of these behaviours are associated with inattention in the classroom and referral to therapy?

1.4 Aim of the study

The aim of the study is to explore the behavioural observations made in relation to SMD, by parents and teachers of preschool children between the ages of 4 years to 6 years 11 months and the association of these with the children's ability to attend in the classroom.

1.4.1 Objectives of the study

The objectives of this study are:

- To determine the percentage of preschool children between the ages of 4 years to 6 years 11 months attending private mainstream schools that teachers identify with observable behaviours related to inattention and SMD in the classroom.

- To determine the percentage of the same preschool children between the ages of 4 years to 6 years 11 months that parents identify with observable behaviours related to SMD at home.
- To determine the convergent validity of the School Companion and Sensory Profile with the ADDES-3 inattention subtest.
- To determine the internal constancy of the School Companion and Sensory Profile for preschool children between the ages of 4 years to 6 years 11 months.
- To explore the attendance at various therapies and the results on the School Companion and Sensory Profile and ADDES-3 in preschool children between the ages of 4 years to 6 years 11 months.

1.5 Justification of the study

A large percentage of preschool children in private mainstream preschools attend therapy and particularly occupational therapy. It is very expensive for children to attend therapy and therefore imperative that the correct children are being identified with SMD and referred for therapy. It is important to understand what parents and teachers are identifying as reasons for referral and why the referral rate is so high.

CHAPTER 2: LITERATURE REVIEW

This review of the literature will consider theories of sensory processing and SMD, attention and inattention, as well as conditions associated with inattention and SMD. This review will analyse possible associations found within the literature between SMD and inattention, and the effect that both conditions have on occupational performance in the classroom and at home. The way in which both attention and sensory modulation are assessed will be identified and the attributes and validity of multi-informant questionnaires and how this relates to sensory modulation and attention will be discussed.

2.1 Sensory processing

"Sensory processing is the normal neurological process of organising sensations which we use in everyday life. We use our sensations to survive, satisfy our desires, to learn and to function smoothly [2]." Sensory information is received through the vestibular, proprioceptive, tactile, visual, auditory, olfactory and gustatory systems. Once received, these sensations are processed by the brain and are used to plan and organise movement and behavioural responses, which in turn enables us to learn, play and interact appropriately [11]. Each sensory system has two functional components that affect an individual's interaction with their environment: sensory modulation and sensory discrimination.

2.1.1 Sensory modulation

Recent neuroscience literature emphasises the modulation of input as a critical function of the central nervous system (CNS) [12]. Sensory modulation refers to the ability of the CNS to respond, regulate and monitor information in order to generate adaptive responses to situations over a broad range of intensity and duration [12] [13]. Modulation occurs by the body's ability to regulate habituation and sensitisation responses. Habituation occurs when sensory stimulation is recognised as familiar and non-harmful by the CNS, and intern decreases transmission among the cells. If the CNS recognizes sensations as unfamiliar or potentially damaging, sensitisation occurs. The CNS then generates a heightened response [12] [14]. Sensory modulation provides a foundation for performance in day to day occupation. It allows the maintenance of an optimal level of arousal, attention and activity

in order to meet the environmental expectations and demands rather than underreacting or overreacting to them [3] [15].

2.1.1.1 Sensory modulation disorder (SMD)

"Sensory modulation disorder is a problem in the capacity to regulate and organize the degree, intensity, and nature of response to sensory input in a graded and adaptive manner [16]. This disorder disrupts a person's ability to achieve and maintain an optimal range of performance and to adapt to challenges in daily life." [16]pg2 In addition, it has been suggested by researchers with widespread clinical and theoretical experience in the area of sensory processing that poor modulation may also be exhibited and observed by behaviours such as distractibility, anxiety, increased activity level, impulsiveness, disorganization, and poor self-regulation [13]. Amongst children in America, prevalence estimates of SPD based on clinical experience have ranged from 5% to 16% for children without disabilities [17] [18].

Despite the high prevalence reported SMD remains a controversial diagnosis even though current empirical research studies have recently been published on the validity of SMD and the mechanisms underlying the disorder [19] [20]. Some experts reinforce that SPD may be merely a symptom of another diagnosis such as autism, or attention-deficit hyperactivity disorder while others insist it is a separate condition that should be labelled a disorder when it interferes with daily life. The American Academy of Pediatrics (AAF) published a statement online in May 2012 that recommended that pediatricians not use SPD as an independent diagnosis. When these symptoms present themselves health care providers should consider other diagnoses such as autism spectrum disorders, attention deficit/hyperactivity disorder, developmental coordination disorder and anxiety disorder [21]. This statement was then followed by the decision not to include the SPD in the DSM-V.

Three types of SMD are identified in the literature: hyper-responsive, hypo-responsive, and fluctuating responsivity, which is a combination of both hyper-responsive and hypo-responsive [22].

The way in which sensory modulation is categorised has changed significantly over the years. Cermak and Royeen (1989) hypothesize that sensory responsivity lies within a continuum with hypo-responsivity at one end and hyper-responsivity at the other end and an optimal level of orientation and arousal lies somewhere in the middle [23]. In this model, dysfunction occurs when the fluctuations of an individual are extreme or when an individual tends to function primarily at one extreme. The child who tends to function at the extreme of under-responsivity fails to register sensory input and fails to notice sensory input that would arouse and illicit the attention of other people. At opposite extremes of the continuum, the child who over-responds to sensory input presents with sensory defensiveness [23]. This child is overwhelmed and overstressed by ordinary sensory stimuli [2] [13].

However, other experts in the field of sensory integration believe that the continuum model did not explain the complex behaviours that a child may exhibit when faced with difficulties in sensory modulation. Therefore to address this Royeen and Lane hypothesised that the sensory modulation model was more circular than linear, as a more sensitive child may become overloaded to the point of shut down and therefore look like an under-responsive child [2] [13]. This concept was confirmed by Kimball (1993) who described a concept of physiological shut down. She felt that over-responsive children use a protective mechanism against severe overload where they appear to stop responding to stimuli in the environment [11].

Dunn, in her model of sensory processing, takes into account the potential roles of various neural processes in terms of thresholds for responding generating patterns of under-responsiveness and over-responsiveness [14] [2]. This model proposes an interaction between neurological thresholds and behavioural responses [22]. Sensory processing is based on a continuum from high thresholds or low thresholds. Sensory modulation disorder (SMD) occurs at either end of the continuum, both when thresholds are too high or too low. When the thresholds are too high, children may not respond quickly enough to the incoming stimuli, thus appearing lethargic and they may take a longer time to respond. When their thresholds are too low, children react too quickly and appear to be over-excitable or hyperactive [22] [12].

Dunn proposed that a child may respond with behavioural responses in accordance with their threshold or act to counteract their high thresholds or low thresholds. [14] The behavioural patterns observed in relation to these thresholds at the end of the continuum can be considered maladaptive and can result in unsuccessful occupational performance. These behaviours at the low end of the continuum can result in children being so goal directed that their behaviour becomes ritualistic which interferes with their performance [12] [14]. At the other end of the continuum, children are so disinterested in goal directed behaviour that they miss the experience of routines and performance [14] [2] [11]. Each child has a range of thresholds which may differ for different sensory input and contexts.

Another construct proposed by Dunn is relation of behaviour based on thresholds to self-regulation, which is also on a continuum. At one end of the continuum is passive behaviour where the child remains in the presence of the sensation even if it is uncomfortable. At the other end of the continuum, children use an active strategy to adjust the amount of sensory input they receive. The self-regulation strategies used by children also affect their performance of tasks [2] [14].

Dunn further described four patterns of sensory processing based on behaviour and response to thresholds based on the intersection of the threshold and self-regulation continua which were placed perpendicular to one another to create quadrants. The four patterns are sensation seeking, with a high threshold and an active self-regulation, low registration where a high threshold is accompanied by passive self-regulation, sensory sensitivity which has a low thresholds and passive self-regulation and sensory avoidance with a low threshold and active self-regulation [14] [2] [11].

Children with high thresholds require increased stimuli to elicit a response and fall into the ‘low registration’ quadrant. If they act actively against their threshold they fall into the sensory seeking quadrant. Those who act passively fall into the low registration quadrant and tend to appear uninterested and can have a dull and flat affect. These children often have low energy levels and act as if they are tired all the time. These children need a lot of stimulation just to achieve ordinary alertness and arousal levels [14] [12].

Children identified with sensation seeking behaviour are continuously involved and actively engaged with the environment. They try to increase the sensory input of every experience

in daily life such as fidgeting, making noises while working or chew on things, detracting from focusing on their task. It is hypothesised that these children have inadequate neural activation (just as do poor registration children) however, they are actively driven to meet their high thresholds and increase input at every opportunity to meet these thresholds [12] [14].

A low threshold would be considered when a child would require very little stimulation to activate them. If they act passively in accordance with their thresholds they are 'sensory sensitive' and if they actively counter their thresholds 'sensory avoidant' [2] [14] [11]. Children who have sensitivity to stimuli appear distractible and present with hyperactivity. They have a pattern of directing their attention to the latest and most obvious stimulus, which prevents them from accomplishing what is expected of them [14]. Over-aroused and unable to screen the irrelevant from the relevant, the child may seek to defend himself from these stimuli and may act in an irritated or threatened manner. It can be hypothesised that children who have sensitivity to stimuli have nervous systems that are over reactive which means they are aware of every sensation or stimulus around them, and they are unable to habituate the responses [14].

Children who are sensation avoiders often engage in disruptive behaviours. It is hypothesized that meeting thresholds occurs too often, and this is uncomfortable or frightening to the child. As a result of this, the child tends to keep these events at bay as a coping strategy. Children do this by either actively withdrawing or engaging in an emotional outburst that enables them to get out of the threatening situation. From a behavioural perspective, controlling and stubborn behaviour is common. Children who avoid sensation are resistant to change because this may represent new opportunities to be presented with new, potentially harmful, stimuli [14].

Recent research has moved from identifying SMD though behavioural observation to including the measurement of neurophysiological responses as it has been shown that children SMD may have different neurophysiological responses to sensory stimuli compared to typical children [24] [25].

2.1.1.2 Neurophysiological evidence

The research on neurophysiological responses related to SMD has been based the autonomic nervous system (ANS). This system uses sensory modulation, motor, visceral, and neuro-endocrine functions to regulate an individual's ability to adapt to changes in the environment. This is done through the parasympathetic (PNS) and sympathetic branches (SNS) of the ANS. Both these subdivisions work together to the presence of demands from the internal and external environment to promote adaptation and self-regulation [24].

Immediate phasic responses are controlled by the SNS. When the body elicits a sympathetic response fight or flight reactions are observed. The parasympathetic nervous system controls the visceral and the neuro-endocrine systems which is used to maintain a balance in self-regulation and plays a role in recovery from a stressor or challenge [24].

The Polyvagal theory which relates autonomic function to behaviour and the importance of autonomic function in the regulation of emotional and social behaviour has the potential relationship of ANS activity to behavioural adaptability [24].

When this theory is applied to children with SMD it suggests that these children may have abnormal ANS activity that underlying factor of their sensory dysfunction, and, therefore, the response to challenges and stimuli in the environment is unsuccessful and ineffectual strategies for maintaining behavioural regulation [24].

Very limited research has been done to establish the effect of the ANS activity in SMD with McIntosh et al (1999) and Miller et al (1999) showing children with SMD show unique SNS activity, during the administration of sensory stimulation when measuring electro-dermal reactivity [20] [26]. The research connected to the role of the PNS in children with SMD has focused on children with a specific diagnosis. A study on boys with fragile X syndrome by Boccia and Roberts (2000) found that those who are hyper-responsive to sensation have a depressed PNS [27].

Schaaf et al (2010), when investigating the role of PNS activity on children with SMD in five sensory domains, found that children with severe SMD tend to have low baseline PNS activity, compared to typical children, with lower baseline vagal tone, indicating the level of PNS activity. Their study showed that since children with SMD appear to be unable to

elicit PNS responses to cope with the typical levels of stimuli in the environment they demonstrate ineffectual and atypical behavioural responses to sensory stimuli. It is hypothesized that PNS responses during sensory challenge are disordered and therefore the PNS is not able to adapt to help regulate responses to stimuli. During sensory challenge the PNS is disorganized, resulting in atypical behavioural responses that interfere with the children's participation in daily tasks [24].

Research in neurophysiology related to sensory modulation is limited and requires further research so as to be used as a primary diagnosis tool. Currently, sensory modulation is assessed by self-report and observations, and is primarily diagnosed by an occupational therapist. In order to assess atypical sensory modulation various surveys can be used. Besides the *Sensory Profile* questionnaires, standardized tests include the *DeGangi Berk Test of Sensory Integration* (TSI; DeGangi & Berk, 1983), the *Infant/Toddler Symptom Checklist* (I/TSC; DeGangi, Poisson, Sickel, & Wiener, 1995), the *Sensory Integration and Praxis Test* (SIPT; Ayres, 1989), and the *Sensory Processing Measure* (SPM; Miller-Kuhaneck, Henry, & Glennon, 2007; Parham & Ecker, 2007) [28]. There tools are only surveys, and are subjective reports on a child's behaviour by a mother or teacher and thus is debate may stem from the result or 'diagnosis' made.

It is evident that there has been a vast amount of research done on sensory modulation, classification and patterns of dysfunction. However the research discussed on a sound method for diagnosis remains limited. Perhaps the fact that there is no universally accepted framework for diagnosis is why the controversy surrounding sensory modulation as a diagnosis remains [21].

2.2 Attention and Inattention

All teachers have experiences with teaching children who have difficulty paying attention, are hyperactive or demonstrate impulsive behaviour. The DSM IV criteria define attention as "the capability or process of selecting out of the totality of available sensory or affective stimuli, those most appropriate or desirable for focus at a given time" [3]. Since the 1950's an internal mechanism of attention has been understood to determine the significance of a stimulus which make affect both the conscious experience and behavior profoundly [29].

This capacity to select and give priority to one stimulus over other stimuli has formed the basis for a number of scientific concepts defined by metaphors to provide adequate explanations of attention.

2.2.1 Theories or metaphors of attention

There are many theories of attention. The theories of exogenous and endogenous attention describe "goal-driven, endogenous" attention, under the control of the individual. Endogenous attention is controlled mostly by the frontal cortex and basal ganglia and is seen as an executive function [30] related to other aspects like working memory [31]. The "stimulus-driven attention or exogenous" attention occurs in a pre-conscious, or non-volitional way as a result of the properties of the stimuli themselves, like motion or a sudden loud noise [32]. These aspects of attention occur in the parietal and temporal cortices, as well as the brainstem [30]. This theory of attention is considered in conjunction with a number of other theories which state that all stimuli are analysed but only important ones are attended to. Neisser (1967), on the other hand, suggested that attention is influenced by experience [33] [34] [35].

Although the type of control on attention varies in these theories they do not present different concepts and all present a set of phenomena in that they accept

"Attention involves some form of stimulus selection; attention enhances processes in the area that is the focus of attention; and attention facilitates access to awareness. [36]"

In the original work on attention in the 1890's by James [37] supported this comment as he suggested that by controlling attention to the individual can choose what information will be processed and which will be blocked out as is not relevant to the present task [38]. He believes that control of attention allows one to behave efficiently and effectively at a task, however paying attention to one aspect means that the individual may not processing other aspects as capacity to attend to more than the important task is limited [38]. It is how and when attention functions can be divided that has been the focus of more current research and metaphors have been developed into newer models or types of attention.

2.2.2 Types of attention

Paying attention is not only a process. Attention is defined as a set of processes organised into a system that serves a number of different functions, including focus, shift, sustain and encode. Sohlberg and Mateer proposed a clinical hierarchical model of attention and defined a number of types of attention which are also applied to learning [39].

2.2.2.1 Focused attention:

Focused attention is the ability to concentrate on one stimulus to the exclusion of other stimuli in the enviornment. This allows for a separate response to specific visual, auditory or tactile stimuli. Focused attention supports active focus without being distracted by other incoming stimuli [38].

2.2.2.2 Sustained attention

Sustained attention is the ability to maintain consistent attention and complete a task even when there are distractions [39].

2.2.2.3 Selective attention

Selective attention requires focus on just one source of information and not processing other sources. Failure to selectively attend causes distraction. One of the models compares attention to a spotlight. The beam stands for the focus of attention where cognitive processors are most effective. Information that falls outside of the spotlight beam is processed superficially, if at all [38]. The disadvantage of the spotlight model is that the beam of attention cannot be split or reduced in intensity for attention on more than one task and therefore the limited resource model is the metaphor used to explain graded attention to different tasks.

The theory of limited resources also assumes that there is limited attention available and that optimal performance occurs when attention is focused on specific task relevant information at the expense of less relevant information. This attention is voluntarily allocated to the task at the expense of other tasks and the amount of attention exerted can be controlled and depends on the demands of the task. More attention given to a task can enhance performance [36].

2.2.2.4 Alternating attention

Alternating attention allows back and forth between two different tasks so focus is shifted between the tasks that may have different cognitive requirements [36]. This includes attention shifting where one source of information is attended to at any point in time, and attention may switch back and forth between multiple sources [38].

2.2.2.5 Divided attention

This requires the greatest amount of attention and is the ability performance of two attention-demanding tasks simultaneously that are in competition for attention. The tasks have to be prioritised and the brain areas used for the prioritisation include the prefrontal cortex and the anterior cingulate cortex. The tasks often include a mix of motor and cognitive skills [40].

Therefore, attention is most efficient when a person is focussing on a specific environmental event [3] and deficits in attention occur when there are problems in sustaining focus on, or disengaging from the event. According to the limited resources theory this may occur when there is overload on the system, and selection of the information becomes difficult. It is theorised that inattention can involve difficulty or sensitivity in filtering, leading to interference by extraneous information [38].

Thus the child with attention difficulties can often attend to specific stimuli but have trouble disengaging or resisting responses to competing stimuli. Extraneous or competing information may come in external distractions or any sensory form including visual, auditory, tactile and vestibular distractions [3] resulting in overload of the system. Once there are not enough resources for the attention the task requires, decreased performance should be expected.

Under load can also affect selective attention based on the processing load model, which considers the cognitive and perceptual mechanisms that affect attention: The ability to perceive or ignore stimuli whether they are related to the task or not forms the perceptual while the cognitive mechanisms is related to processing of the stimuli. Children are more inclined to process both relevant and irrelevant stimuli especially if there are not many

task-related stimuli present. Non-task related stimuli will be perceived as relevant if the task has a paucity of information to engage attention fully [41].

2.2.3 Processes of attention

2.2.2.3 Overt and covert attention

Attention can be considered as overt when sense organs are directed to the stimulus and covert when focused on one of more than possible stimuli. Recent studies suggest that overt and covert attention may not be separate and that covert attention is a mechanism used to scan quickly for interesting details allowing attention in one location while scanning or looking in another direction [42]. Adequate attention is characterised by the ability to initiate and sustain focus, shift the focus of attention when appropriate and inhibit the inappropriate incoming input [38]. Thus, attention problems are observed as behaviours indicating the inability to sustain focus or disengage from other aspects in the environment [3].

2.2.4 Attention and attention difficulties in children

In typically developing children attention demonstrates rapid, steady development from 3 to 6 years old. This includes the ability to shift attention more fluently and inhibit motor responses so as to respond appropriately [43]. The brain's attentional systems are found within catecholamine neurotransmitters within the prefrontal, striatal, and associated subcortical systems [43]. These systems are said to have a rapid maturational process during the infancy and preschool years [43]. During the preschool years, when children are challenged with more occasions where they have to focus on tasks that are intrinsically not interesting to them, a higher-level control of attention becomes needed. Therefore the ability to plan ahead and engage in complex tasks further develops and supports the sustaining of attention when more external demands are placed on the child [44].

In the preschool years Barkley suggested that the development of attention is dependent on inhibition control or the ability to wait to respond. He suggested that these aspects develop much earlier than other executive functions and are crucial for the development of these other functions. As more control is gained over inhibitions, impulsive behaviour is limited [45]. Welsh believes that by about age of 4 years, children are able to show improvement in withholding their response and shifting to more appropriate responses.

These improvements are accompanied by enhanced attention and self-control demanded in a preschool classroom [46]. Children in a mainstream classroom are asked to sit still, listen to the instructions of their teacher, play with other children and play quietly. Children with a difficulty in inhibition control will have difficulty living up to these expectations.

These difficulties often occur as a consequence to the common behaviours that children with attention difficulties exhibit. Such behaviours are defined by the DSM-IV criteria as difficulty sustaining attention to tasks and play activities. Inattention is seen when the child is spoken to directly and appears not to listen or does not complete tasks they are instructed to do and since they are often distracted by external stimuli they may be forgetful in daily activities [3]. Children with difficulties in attention may be hard to manage, unpredictable, refuse to share and often break rules [47]. They have a declining ability to persist in tasks that have little intrinsic appeal or minimal consequences for incompletion [48].

Literature indicates that a number of childhood disorders are associated with inattention and SMD such as Attention-Deficit-Hyperactivity-Disorder (ADHD), obsessive compulsive disorder (OCD), developmental coordination disorder (DCD) and anxiety disorders. In addition, it has been shown that attentional difficulties are numerous and may not be as a result of a core feature of a disorder such as in the case of ADHD, but rather as a manifestation or symptom of another disorder such as sensory processing disorders and psychiatric disorders [10].

Attention deficit disorder is classified as a behavioural disorder and multiple studies suggest that it should be assessed by practitioners through the use of rating scales. In general, teacher rating scales are the most commonly used in diagnosis of attention disorders. Teacher rating scales have shown to be good at differentiating those children with ADHD from those without.

Despite the many benefits described, several weaknesses exist when using an ADHD scale as do when using any rating scale. Some of the weaknesses include source effect which is characteristics of the rater which may stem from cultural differences or be caused by individual biases. Another weakness may reflect the accuracy of wording and context such

as ambiguity on ADHD rating scales. Most of the ADHD rating scales are based on the DSM criteria for ADHD, which may pose problems with the scale as certain items may not be appropriate to the rater's context [7]. Firstly, some items are more appropriate for home and some for the classroom. Secondly, items may be too general and may not relate to ADHD specifically such as the phrase 'often does not seem to listen when spoken to,' which may reflect different aetiologies.

It is vital to remember that when assessing attention in preschool children, many of the behaviours associated with inattention such as fleeting attention, distractibility, difficulty sitting still and playing quietly, are developmentally appropriate for the preschool period [47]. It is thus important to consider that when one is assessing attention verse inattention it should be assessed in multiple contexts and relative to one's peers and developmental level [47].

2.3 The relationship between attention difficulties and sensory modulation disorder and associated disorders

The behavioural dysfunction found in children with attention-deficit/hyperactivity disorder and developmental coordination disorders as well as obsessive compulsive and anxiety based disorders present with similar symptoms to those described in children with SMD. To date there has not been enough research to allow for sensory processing to be included in the DSM V as a standalone diagnosis, although children are often treated for this condition in occupational therapy [49]. A number of studies have been done to differentiate between the various disorders and SMD. Because comorbid conditions commonly occur with sensory processing issues it is possible for a child to present with both and be considered too have a dual diagnosis.

2.3.1 Attention-Deficit-Hyperactivity-Disorder

Attention-Deficit-Hyperactivity-Disorder (ADHD) is characterised by "developmentally inappropriate impulsivity, inattention, and hyperactivity, which can create varying degrees of difficulty in daily functioning," [3] which is often caused by the sensorimotor and academic difficulties that prevent appropriate academic functioning in the classroom. Brown described characteristics of ADHD as affecting the child's ability to start a task and maintain organisation as well as focusing on the task and avoiding distractions. Other

aspects affected are alertness and processing speed, the ability to sustain and shift focus, as well as short-term working memory and accessing recall, withstand the motivation to complete work appropriately, and the management of emotions. Students with ADHD may exhibit hyperactivity or and may be observed as unable to sit still or follow even the most basic directions. A popular theory by Barkley suggest that the core feature of ADHD is as a result of poor inhibitory control which will consequently cause poor secondary executive functions such as memory, self-regulation and attention, [47] rather than a problem with attention per se [19]. And thus extreme disinhibition in a multiple of contexts, relative to one's peers may suggest a diagnosis of ADHD [47].

Solanto (2013) found that both inhibition and motivational processers were both contributors to ADHD but were still separate processers [50] [51] and Sergeant (2000) concluded that from a neurophysiological perspective both these processes are likely to contribute to ADHD [50] [19] [52] . It is thus evident that these theories still face challenges within ADHD literature and require more research within the subtypes of ADHD and how they relate to behaviour and performance.

A vast amount of literature exists attempting to identify the nature of the cognitive impairments associated with ADHD; however no conclusive evidence has evolved. There are developing viewpoints that suggest that instead of it directly affecting attention and its processes such as sustained, maintenance or division of attention, rather the executive function in control of attention is affected. Other theories in explaining ADHD suggest a difficulty with delay aversion and a poor arousal system [53].

These children may encounter problems with attentional capacity, hyperactivity and impulse control. These difficulties hinder their ability to acquire important skills such as focusing on their teacher, interacting with peers, and learning the basis of mathematics, language and reading skills [50]. In studies that sought to compare children with ADHD to a control group without it, it was found that pre-schoolers with ADHD were shown to experience problems with general cognitive development including concept development, memory and reasoning which affect academic skills [50]. Although SMD and ADHD are separate conditions that are often difficult to distinguish as children with either of them have more attention, sensory and emotional difficulties than typical children [54].

Research has documented a high degree of symptom overlap between SMD and ADHD. As a result of this it is difficult to distinguish between the disorders given the overlap in distractible and hyperactive behaviours. Fisher and Bundy believe that children who are hyper-responsive to sensory stimuli often have are not able or struggle to "screening out" irrelevant stimuli, causing them to be highly distractible. In her research that identifies the impact of sensory processing on young children, Dunn provided initial evidence that; children who are hyper-responsive to stimuli show signs of inattention and distractibility as these children have low stimulus thresholds and thus constantly direct their attention from one stimulus to the next, regardless of its relevance to the task at hand [55].

Given that overt symptoms of SMD often overlap with symptoms of ADHD, it would be difficult to demonstrate the difference in symptomology of these conditions at a behavioural level of analysis [55].

Current research suggests that the central deficit among children with SMD is a failure to habituate to repeated sensory stimulation. In contrast, children with ADHD are expected to possess a central deficit in response inhibition [55].

However as the current assessment tool of both SMD and ADHD is through the use of a subjective behavioural rating scale such as the sensory profile or the Conner's rating scale, parents and teachers filling out the scales may not be able to distinguish the dysfunctions. This difficulty may cause confusion between parents and teachers as to where the main difficulty lies and the consequence of intervention.

2.2.2 Developmental coordination disorder

Other children that have difficulty with attention have been described in the literature as those with Developmental Coordination Disorder (DCD). Researchers recognised that children with DCD often have associated problems in attention, learning, emotional adjustment and language [56]. Dewey, Kaplan, Crawford, and Wilson, in a research that was conducted with 78 children with motor deficits compared to 51 children without motor deficits, found that when compared to the comparison group, children with DCD

had noticeably poorer performance on attention tasks and learning tasks such as spelling, reading, and writing [56].

It is well recognised in ADHD literature that children with ADHD often have accompanied motor deficits. Pitcher, Piek and Hay (2003) found a high percentage of movement problems in all subtypes of ADHD children. Motor performance was found to be in the lower 15th percentile. It is hypothesised that DCDC is not necessarily a comorbid diagnosis for children with ADHD, but the poor motor performance in ADHD children can be a direct result of the inattentive or hyperactive/impulsive symptoms [57].

Coordinated movement depends on integrating sensory information and SMD may be seen in some children with DCD or as it is referred to in some countries, developmental dyspraxia [58]. There is an overlap of symptoms between DCD and sensory motor processing dysfunction as both present with a delay of motor milestones, and fine and gross motor coordination problems.

2.2.3 Other disorders

Symptomology of certain psychiatric disorders are defined by a decrease in attention and may have coinciding symptoms that may imitate characteristics of ADHD, such as, multiplex developmental disorder, bipolar disorder, depression, anxiety disorders and manic depressive illness. Certain depressive symptoms, in children with major depressive disorder, may be particularly disruptive of cognitive functioning. For instance, prolonged difficulties with concentration, anhedonia and psychomotor retardation could affect intellectual and academic achievement [59].

Attentional problems that often characterize depressive episodes disrupt the process of mastering new, unfamiliar, and complex academic skills [3]. A study discussed by Alon Avisar, which attempted to identified behavioural and personality characteristics that is associated with selective attention, determined that an inverse relationship between anxiety and performance in more complex tasks exists. High-anxiety participants' performance was more affected by distracting stimuli than low-anxiety participants [60]. In addition, Ben Sasson et al stated that there is no research confirming differential etiologies

of anxiety disorders versus sensory over-responsivity. The onset and course of both disorders may be influenced by maturational and environmental [61].

A recent study has indicated that stress and anxiety problems are closely linked to sensory processing, particularly sensory sensitivity and low thresholds. The threshold means that the child may be more aware of possible threats in the environment and react to these [62]. Problems with sensory modulation can therefore make the environment uncomfortable enough for a child to result in a generalized anxiety response [63].

The symptoms and behaviour described in SMD and other conditions in which inattention is seen makes it difficult to distinguish the primary cause of dysfunction and whether SMD underlies the behaviours reported or whether the child has one of the conditions described above.

There is a vast amount of literature that has supported the theory that poor sensory responsivity affects performance [12] [65] and results in behaviour such as inattention in the classroom environment. It is known that classrooms are typically complex sensory environments. With the arrival of interactive learning styles which has undoubtedly enhanced involvement of children in tasks and activities, an adverse consequence has been amplified sensory difficulties in the classroom. This can affect the child's ability to attend in the classroom and this inattention can be related to deficits in sensory processing in various different sensory modalities like visual, tactile, auditory or vestibular processing [3].

If one had to take each child according to Dunn's sensory profile patterns, one would notice limited concentration in varying ways. For a child that is a sensory seeker, the interest and pleasure that accompanies sensory events might also lead to difficulties with task completion. These children become distracted with each new sensory experience and lose the ability to maintain on track and focus on daily life tasks [66].

In addition to added visual stimuli, disproportionate noise in the classroom is believed to negatively affect the attention and behaviour of many children. [67] In addition to this, academic material is usually taught mainly through verbal instruction, given by the teacher in a brief and quick manner [67]. If a child is unable to resist responses to competing stimuli it follows that other noises in the classroom would distract the child and he/she would therefore

not be able to follow instructions appropriately or would be distracted by other visual input especially in the with conflicting background noise. These difficulties may be identified as inattentiveness and attention difficulties.

However, an inability or dysfunction in attention may not be attributed solely to these sensory difficulties. There is an association between the diagnostic groups described above and difficulties processing and integrating sensory information [10].

The close relationship between conditions with attention deficits and SMD mean that these aspects have to be assessed thoroughly. The assessment of the behaviours of these components in preschool children should be completed with reliable and valid assessment tools [7].

2.4 Assessment of Sensory Modulation and Attention

Disruptive behaviours in children are currently assessed by using observational rating scales relying on the perspective of teachers, parents or diagnostic observers [7]. There are many advantages and concerns when using these questionnaires. Mixed findings exist as to the strength of the relationship between different assessments as well as the compatibility between observers that fill out rating scales [7].

The most useful element to the use of questionnaires is the ability for professionals to collect information about a child that they would otherwise not have access to. Informants may consider responses at their own pace and professionals may be more efficient with collecting information since clients may complete questionnaires in their own time. [28] Behaviour ratings do have the advantage of providing an inexpensive way in which to assess certain difficulties such as ADHD and sensory processing. Teacher ratings are particularly important as they summarise accumulated observations and perceptions about a child's behaviour that impact the child's learning at school [7] .

Concerns include error due to biased responses or misunderstood items. There is evidence that teacher and parent ratings can be at risk for potential threats to validity. One of these threats is sources of rater bias. Behaviour rating scales are significantly subjective, and the rater is only able to make a judgement about the child's behaviour in relation to the behaviour of their peers with whom the rater has similar contact. Parents will use their

other children or relatives as a point of reference and teachers will use other children in their classroom. As a result of this the reference group in which a child is compared to may influence the results [7]. When serving children, it may be an adult's responsibility to complete the questionnaire and DePaul (2003) reminds readers that this type of indirect report is a measurement of the reporters' perceptions about the subject's behaviour, not the behaviour itself [28].

2.4.1 Validity of multiple informants

In practice one may hypothesize that questionnaires with strong statistical properties produce matching results between informants for the same child. In practice, if the information from each reporter across roles and setting were identical, then utilizing multiple reporters would be unnecessary [7] [28]. A research done by De Los Reyes and Kazdin determined that when assessing inattention and hyperactivity informant agreement is "moderate" at best [7] [68]. Kerr also found a mother's rating of a 3 year olds externalising behaviour to be uncorrelated with teacher ratings [7] [69]. However, there is general consensus that discrepancies in the results do not mean that there are flaws within the rating scales but rather is a question of a theoretical or practical issue [7].

Typically, studies conclude that each source provides unique information that would have been missed if only one rater had completed a questionnaire, strengthening the use of a multi-informant approach. [28] As one research group succinctly put it,

"to treat one source of information arbitrarily as the ideal informant increases the risk of obtaining the right answer to the wrong question [28] [70]."

Goodman et al. (2000) also found better sensitivity when integrating the all informants scores rather than using results from one reporter in isolation while Kohen et al (1997), hypothesized that differing information maybe as a result of different past and current experiences of each observer with the child and the fact that the child's behavioural issues may differ across contexts or be difficult to observe in some settings [28]. With precursors and consequences unique to each adult, the child may perform markedly differently in the contexts of home and school [28] [71].

To make the use of multiple informant questionnaires a valid tool in practice, results should contain discriminant and convergent validity rather than uniform consensus [28]. Consensus should be different to accuracy as Kenny (1991) made the point that with low or moderate consensus one may surmise that all informants provide partial accuracy. High consensus does not guarantee accuracy since multiple people could strongly agree on a wrong answer. When faced with information that is unique and possibly opposing, an evaluator may be tempted to choose one reporter over another rather than analyse the information between multiple sources [28].

2.4.2 Findings between multiple informants

Across the research parents and teachers typically have statistically low significant relationships when comparing questionnaires about the same child, however some variations do occur. It appears that there is a higher agreement between parents and teachers when externalized behaviours are assessed, rather than internalized behaviours [28] [72] [73] [74]. Research exploring other categories such as verbal behaviour, general health [72] bullying, or truancy [74] followed the trend of easily observed behaviours tending to have higher agreement between reporters. Mixed results presented when assessing attention on a child [28].

This trend appears to be as a result of multiple Factors that can contribute to the way a teacher or parent completes a questionnaire. Researchers have studied three large categories including the characteristics of the child, the characteristics of the child's family and the characteristics of the informants.

The impact of child characteristics on raters' responses is mixed. In the meta-analysis by Achenbach et al. (1987), the gender of the child did not produce significant differences but the type of issues and age did. De Los Reyes & Kazdin (2005) found that child variables such as age, gender, or ethnicity may influence the questionnaire responses [68]. It was found that mixed ethnicity between a child and his teacher may cause rater bias amongst teachers. There is evidence to suggest that in America White teachers have rated Black children as exhibiting more ADHD behaviours. [28] Howeve,r this is not the case in more recent research. Hosterman, DuPaul and Jitendra did not find teacher bias amongst Black and Hispanic teachers in America, when their ratings were compared to observations [28].

Another study found that informants agreed more on girls and children with better academic performance [75].

Scoring patterns may be due to characteristics of the reporter or due to specific experiences of the reporter with the child. Raters may interpret the same act differently or be impacted by internal Factors such as current mood or initial impression of the child [28].

Although not identified as a major area of research, the context in which a child is perceived does play an important role in the outcome of the scoring. Achenbach (1987) found that children who were scored in the same setting had fewer differences associated with informant role such as two different teachers as opposed to mother [28].. De Los Reyes & Kazdin, 2005 believe that the child may act a certain way due to the setting and thus a reporter will only be able to score based on the way they see the child in one setting highlighting the differences between informant role and context [68].

Dunn et al developed the Ecology of Human Performance model that serves as a framework for considering the effect of context. Their model states that "a person does not exist in a vacuum; the, physical environment as well as social, cultural, and temporal Factors all influence behaviour. Taken together, those Factors that operate external to the person are identified as *context."* Context influences behaviour and performance in many ways; Dunn (1997) states that disciplines that address human behaviour must consider the effect of these contextual features on target behaviours [11]. As with this study, where participants were assessed in two different settings or contexts, clinicians are faced with the task of putting together all the information obtained from numerous informants, such as parents and teachers, from different contexts, as well as their own clinical observations and impressions, and making a judgment based on this information [11].

The relationship between the parent and the teacher filling out the different questionnaires raises questions of construct validity of the questionnaires and their relationship with each other. What will the typical response pattern be within a South African private mainstream preschool environment? And what is the relationship between concentration and sensory

modulation perceived as? These questions will be explored in more detail in the results and discussion of this research.

2.5.3 Assessment of Sensory Modulation

Currently, sensory modulation is assessed by self-report and observations, and is primarily diagnosed by an occupational therapist using these tools. When Dunn [14] [12]developed the Sensory Profile and the School Companion she based the classification of the scores used to interpret dysfunction on a normal distribution. Typical performance in terms of the scores which are provided accordingly in the manual lie between 1 and -1 SD. A child scoring in this range demonstrates with typical sensory processing abilities. Children scoring between 1 and 2 SD or -1 and -2 SD are considered to have questionable sensory processing ability and are seen as having a probably difference more or much less than others. Children scoring above 2 SD or below -2 SD have a definite difference in the sensory processing abilities either much more or much less than others and form 4% of the sample assessed to validate the test.

The mean raw scores for each section, factor and quadrant are presented in the manual for the sample of children used to validate the test in United States of America for children aged 3 years to 10 years. Studies in Australia by Brown et al [76] [77] evaluated various aspects of the Sensory Profile and School Companion scores to those published by Dunn for children in these countries. The mean scores were slightly lower or similar to those for American children.

In her model, and the Sensory profile that is based on her model, Dunn focused on the children that that presented with difficulties ‘more than others.’ Dunn later acknowledged that problems could exist on either side of the population curve and later added ‘less than others [14].’ However the items on the Sensory profile do not really address the ‘less than others’ side of the scale. Thus these children are included in the ‘typical’ population.

2.5.3.1 Sensory Profile parent questionnaire

The Sensory profile created by Dunn is used most frequently within the South African setting. The Sensory Profile allows professionals a standardised method to quantify the sensory processing abilities of children 3 to 10 years old. The Sensory Profile is an observation based questionnaire designed for parents to contribute to a complete assessment of a child’s

sensory performance when joined with other evaluations, observations, and reports. The Sensory Profile supports a “family-centered care philosophy” by involving the caregivers in the data gathering process. It has both a caregiver and teacher rating scale which allows for contextual based observations. Parents complete the 125-question profile, reporting the frequency with which they have observed their child responding to different sensory experiences [14].

The items are grouped by sensory processing, modulation, and behavioural and emotional responses.The classification system of Typical Performance, Probable Difference, or Definite Difference describes the child’s sensory processing abilities for each section and Factor scores. This allows professionals to quickly determine if a child’s performance on any section or Factor groupings is of concern and requires a more in depth assessment. The research on the Sensory Profile took place from 1993 to 1999. During this process content validity was established during development of the Sensory Profile. This was done by establishing that the test was a representation of the full range of children’s sensory processing behaviors and that each item was placed fittingly within sections. Results indicated that 63% of the items were placed correctly in categories by 80% of the therapists. For the rest of the items, new categories were developed. To establish the convergent and discriminant validity of the *Sensory Profile*, a number of scores obtained on the Sensory Profile were compared with different functional tasks measured by the School Function Assessment [14].

2.5.3.2 Sensory Profile School Companion

The School Companion was developed and published in 2006 by Dunn, based on the same scoring principles of the Sensory Profile. The school companion evaluates a child’s sensory processing skills and how this will affect classroom behaviour and task performance. This standardised and theoretically-based assessment obtains the teacher’s perspective of a child's interaction in the school setting. The School Companion is a 62-item teacher questionnaire; items describe a student’s response to common sensory experiences in the school context. The School Companion uses the same 5-point Likert scale and scoring procedures as the Sensory Profile and provides the same four quadrant scores (registration, seeking, sensitivity, and avoiding), four school Factor scores (School Factors 1, 2, 3, and 4) and section scores for four sensory groups and one behaviour group are also recorded. Cronbach’s a coefficient for the School Companion correlations range from .83 to .95, and these are in the adequate

internal consistency range. Test–retest reliability reported by Dunn was 0.80 to 0.95, reflecting good stability [12].

The sensory processing measure can also be used to identify the frequency of behaviours in response to sensory stimuli.

Currently, therapists rely on qualitative techniques to assess sensory modulation as quantitative measures are still considered poorly anchored for gauging sensory processing in children. As a result of this there are inherent limitations about making judgements regarding involvement of sensory processing, as it is based on behaviours and rating scales [12]. In addition to this Dunn, herself, mentions that 4 year olds need to be treated and assessed differently as their modulation is still developing [14]. It is assumed that most teachers are not aware of this as thus the sensory profile of a 4 year old should be interpreted with care.

2.5.2 Assessment of Attention and Attention Deficit Disorder

The Connors teachers' rating scale is a commonly used measure of behavioural problems associated with ADHD and was initially created for behavioural change for pharmacological studies [78]. This scale is both a teacher and parent rating scale that can be completed in 10 minutes. Both forms include questions that address conduct problems, learning problems, psychosomatic, impulsivity and hyperactivity, anxiety and social competence [43]. This assessment was not used for this research as the Conner's teachers rating scale is used for children from the age of 6.

This research uses the Attention deficit disorder evaluation scale (ADDES-3) due to the choice of questions and time frame in which the teacher is asked to observe behaviour. The Attention Deficit Disorders Evaluation scale-third edition (ADDES-3) empowers, teachers and other medical personal to evaluate and diagnose attention-deficit/hyperactivity disorder and observable behaviour in children [79]. The ADDES-3 school version consists of two subscales: inattentiveness and hyperactive-impulsive subscale, which are based on the recognised subtypes of ADHD. The ADDES-3 uses frequency referenced quantifiers. Each item is rated on a six point scale from zero. On administration of the test four types of scores are obtained: a frequency rating for individual item (reflecting the frequency and severity of the behaviour), a subscale standard score, a quotient and a percentile rank (to establish a consistent basis for comparing children) [79].

The ADDES-3 school version was standardised on a total of 3903 students including identified ADHD students. The standardisation process took place on children 4 years through 18 years of age. Separate norms are provided for males and females whens coring the test. Internal consistency for the ADDES-3 was .99 for the total scale. Test retest reliability was greater than .87 for each of the subscales. As measures of concurrent validity the ADDES-3 was compared to the Connor's teacher rating scale-revised: Long form and the ADD-H comprehensive Teacher's rating Scale-Second Edition [79].

Various but limited researches have used the ADDES as a measure for inattention and hyperactivity. A study done by Swartwood, J et al. investigate EEG differences in ADHD-combined type during baseline and cognitive tasks in 2003 and Williams J, investigated Symptom differences in children with absence seizures versus inattention in 2002. To date there have been no studies done with the current edition of the ADDES-3.

CHAPTER 3: METHODOLOGY

A cross sectional design is a type of observational study that involves analysis of data collected at one point in time. This study used a cross section quantitative descriptive design as observational data was obtained on the entire sample of the preschools, at one point in time only, by the child's parents and teachers.

An analytical aspect was included in the study and descriptive statistics were used to describe the basic features of the data in a study as well as inferential statistics for inferring what some of the data may mean. The attendance at therapy was analysed further in terms of the definite, probable and typical scores on the tests used in this project. Comparison of results of the test and scores indicated by the parents and teachers were analysed with simple descriptive summaries and participants were not randomly chosen to partake in this research [80].

3.1 Participants

3.1.1 Sample

A convenience sample of a 100 preschool children between the ages of 4 years and 6 years 11 months old was recruited from mainstream pre-schools in Johannesburg within the Northern and North Eastern suburbs. All the schools were known to the therapist and make referrals for occupational therapy to the various practices in the area. The intention was to use seven schools; however, the researcher was only able to attain the target population size after seven schools were approached. All the schools involved drew on a population from only the middle and upper income economic strata.

All learners of the pre-schools were given the opportunity to be included in this study as consent forms were sent home to all learners regardless of gender, diagnosis, therapies received, religion, culture and socioeconomic status. The first 100 participants who returned their consent forms were then given the opportunity to be involved in the study. During the process of consent one participant dropped out before the questionnaires were

handed out. The sample for this study then included the subset of subjects (n = 100) of whom both parents and teachers completed their respective questionnaires.

Teachers usually had contact with learners five days a week and had known them for more than 3 months. All parent questionnaire forms were filled out by a mother or father rather than a guardian.

3.1.1.1 Inclusion/Exclusion Criteria

The sample included both male and female learners between the ages of 4 years and 6 years 11 months old. All learners who have received any type of therapy, such as physiotherapy, occupational therapy, speech therapy and play therapy were included in the research. Those learners who did not return the informed consent were not included in the research, as well as those who did not return both sets of questionnaires.

3.1.1.2 Sample size

Using Cochran's sample size formula for continuous data it was established that for the approximately 400 children in Grade 0, Grade 00 and Grade 000 in the seven preschools. A sample of 100 children was therefore needed for the sample size to be set at an acceptable error at 5% for this population [81].

3.2 Instrumentation

3.2.1 Parents

Each participant's parent/caregiver was asked to fill out the Sensory Profile which provides a standardized method for professionals to measure the sensory processing abilities of children. Included with the sensory profile caregiver questionnaire was a short demographic questionnaire (Appendix E), completed by each parent so as to obtain information such as the child's age, previous therapy attended and the parent's contact information (Appendix F).

3.2.1.1 Sensory profile (Appendix A)

The Sensory Profile is a 125-question profile that caregivers complete, reporting the frequency with which their child responds to various daily sensory experiences. Caregivers complete the form by indicating the frequency of the child's responses (always, frequently,

occasionally, seldom, or never) researchers of the sensory profile defined a classification system by determining cut scores for each of the section and raw score totals. The classification system describes the child's sensory processing abilities for each section and Factor as either [14]:

- Typical performance
- Probable Difference
- Definite Difference

This classification system helps professionals determine whether a child's performance on any of the section or Factor groupings is of concern [14].

The sensory profile was first compiled as part of research to test the application of sensory integration theory within the classroom. In these studies, researchers used the sensory profile to determine which sensory difficulties a child was having, so that intervention could be aimed at the child's specific and identified needs. Although the findings were informative for practice, therapists expressed an interest in discovering more about the sensory profile as a measure for such purposes [14].

The research on the sensory profile was done between 1993 and 1999 and included more than 1200 children with and without disabilities between the ages of 3 and 14 years.

Researchers completed a literature review of sensory histories to determine which behaviors characterize unusual responses to sensory experiences in daily life. This was done in order to develop the items in the sensory profile. The original profile contained 99 items and later more items were added for a total of 125 items [14].

Through the development of the sensory profile it now contains 3 main item categories, further divided into subsections:

- Sensory processing contains 6 item categories that reflect particular types of sensory processing.
- Modulation contains 5 item categories that reflect various combinations of modulation of input.

- Behavioural and emotional responses contain three item categories that reflect emotional and behavioral responses that might be indicative of a child's sensory processing abilities.

Validity refers to the evidence that establishes the extent to which a test measures what it was designed to measure. Multiple types of validity have been established for the Sensory Profile, such as content validity, convergent validity, discriminant validity and construct validity [14].

During the development of the sensory profile content validity was established by determining that the test sampled the full range of sensory processing behaviours and that the items were placed appropriately within sections. Dunn (1999) applied three distinct approaches to increase the content validity of the Sensory Profile. A literature review was used to identify potential test items that would be relevant based on current research and evidence. Another source included experts in the field providing their insights about the items and the overall structure of the measure. And finally a category analysis of the items was completed via a national study with 150+ therapists. The therapists' input guided the development and assignment of items to categories [14].

A test has construct validity if it actually measures the underlying construct that it implies to measure. One way that this is done is to show convergent and discriminant validity [14].

For convergent and discriminant validity, Dunn (1999) compared the results on the Sensory Profile with scores obtained on the School Function Assessment (SFA). The SFA is used to measure a student's performance of functional tasks that support his or her participation in the academic and social aspects of a Pre-school program. The instrument is a judgment-based (questionnaire) assessment that is completed by one or more school professionals who know the student well and have observed his or her typical performance on the school-related tasks and activities being assessed. The SFA is comprised of 3 parts: participation in school activity settings, task support that is currently given to the child and activity performance of various school related tasks. Convergent findings include overall similarities between results from both assessments. Learners who required higher level of assistance and adaptations also had statistically different sensory processing patterns. Additional convergent findings report similarities between sensory processing difficulties in

areas such as fine-motor/perceptual responses, most behaviours and emotional responses, low endurance and tone, and sedentary responses correlated with scores on the SFA. [14] Discriminant validity is demonstrated when a test has low to moderate correlations with variables that measure different but related constructs. The discriminant patterns indicated low correlations between scores on the SFA and sensory processing as the sensory profile is addressing more global sensory processing and not related to specific tasks on the SGA such as manipulating small object in an art class [14].

Dunn (2006) also explored the convergent and discriminant validity between the quadrant scores for the Sensory Profile and the School Companion of children without disabilities. The low to moderate correlations between reporters follow the patterns reported across the literature of some similar and some unique information from each source and provide high discriminant validity for both tests [14].

Test reliability is an indication of the degree to which a test is precise and offers stable score. The reliability of the sensory profile was estimated using internal consistency and Cronbach's Alpha for each section of the profile. The values of alpha for the various sections ranged from 0.47 to 0.91 (poor to good) [14].

3.2.2 Teacher

The teachers involved in the research were asked to fill out 2 standardised assessments on each child.

3.2.2.1 School Companion (Appendix B)

The School Companion is a standardised teacher reported scale which uses a 5 point Likert scale. The School Companion is based on the scoring of the Sensory Profile. The School Companion evaluates how a child's sensory processing skills affect classroom behaviour and performance. This standardised and theoretically-based assessment obtains the teacher's perspective of a child's interaction in the school setting. This assessment has 62-items; in which the listed items describe a learner's response to common sensory experiences in the school context [12].

After the Sensory Profile was published, therapists indicated that they needed a measure to explore how a child's sensory processing abilities affect his participation in the

classroom. Therapists would often give the sensory profile to teachers to complete. However, the sensory profile is standardised with caregivers and not teachers. Teachers also did not observe many of the items in the sensory profile, so they could not respond to all items. In response, the research was initiated for the development of the School Companion [12].

The research of the school companion took place from September 2005 to March 2006 with more than 700 children between the ages of 3 years and 11 years 11 months with and without disabilities. The research testing included a pilot study, standardisation of the instrument and Factor analysis [12].

The pilot study was done when 12 teachers with varying levels of experience were asked to fill out the sensory profile caregiver questionnaire. Each teacher completed as many items as possible and identified items which they were not able to rate. The teachers were not able to rate 49 out of the 125 items. Therefore additional items were written in relevant to learner's behaviours and activities in school. The items were reviewed by teachers and therapists to ensure that the items were sensory based and behaviours observable in the classroom. Statistical analysis was then performed to help ensure that the test was useful as a school-based measure [12].

The School Companion yields three types of scores: quadrant scores, school Factor scores and section scores and it follows the same classification system as the sensory profile caregiver questionnaire.

The validation process for the School Companion has not yet been completed with the publication of this test. Content validity was been established during the development of the test by conducting an exploratory study, interviewing teachers and school-based occupational therapists and collecting data for a pilot studies [12].

Dunn compared teacher ratings on the research version to the parent ratings on the Sensory Profile. Twelve teachers and 12 parents were included. Findings from the two measures were compared in order to determine if there would be some consistency in the reporting about the learner's sensory processing. It was expected that there would be small to moderate correlations between the ratings because the home and school are two

different contexts. The findings indicate that over half of the correlations between all quadrants scores were significant and moderate between the total sensory processing scores [12].

Two statistical methods were used to determine the reliability of the School companion: internal consistency and test retest stability.

Internal consistency was evaluated for each quadrant, school Factor and section grouping of the School companion. Cronbach's Alpha was used to calculate the internal consistency and ranged from 0.83 to 0.95 indicating a high degree of internal consistency [12].

Obtaining a teacher's rating of the same learner over two separate times provides information on the stability of ratings over time. Test/retest coefficients are at their highest when a learner's target sensory processing ability is relatively stable across time and the respondent rates the child under similar circumstances on both occasions. Test/retest reliability was confirmed on the School companion when teachers were asked to rate the same child one to 21 days after completing it the first time. Test/retest reliability was calculated using the Pearson product moment correlation coefficient and they ranged from 0.80 to 0.95 and reflect good to excellent stability [12].

3.2.2.2 Attention Deficit Disorders Evaluation-third edition (ADDES-3) (Appendix C)

The Attention Deficit Disorders Evaluation scale-third edition (ADDES-3) is a standardised six point scale which uses frequency-referenced quantifiers in order to enable teachers to evaluate and diagnose attention-deficit/hyperactivity disorder in children and youth from input provided by observation of the learners' behaviour. The scale was designed to provide a means for objective reporting on the part of a teacher who has observational opportunities. The ADDES-3 school version consists of two subscales: inattentiveness and hyperactive-impulsive subscale, which are based on the recognised subtypes of ADHD. For the purpose of this research, the inattentiveness subscale was used in isolation so as to determine the level of attention of each child [79].

The ADDES-3 was standardised on 3903 learners between the ages of 4 and 18 years. The sample included 1031 males and 1872 females. The standardisation process took place in America and the sample closely resembled the characteristics of the United States. To

ensure the integrity of the content validity the author created items from the literature with specific attention given to the DSM-IV. In order to determine the appropriateness of the items, the author asked diagnosticians and educators to supply indicators of behaviours associated with ADHD which they had observed. Over a seven month period 82 diagnosticians responded to the request. Following this a pool of 88 of the most representative indicators were created. These items were then sent back to the diagnosticians and educators and were asked to eliminate any of the items found to be inappropriate for a representation of ADHD and modify any words which could be said in a clearer or more useful manner. This reduced the number of items to 68 [79].

These 68 items were then field tested on 152 schools in Missouri from 12 school districts. Teachers were asked to select four learners from each class to be rated. Each teacher conducted two evaluations of learners using the ADDES-2. Based on item analysis, the items were reconsidered and reduced to 60 items [79].

The ADDES-3 was designed to provide a measure for inattentiveness and hyperactive-impulsive behaviour. Four types of validity were established: content, construct, concurrent and criterion-related validity.

Content validity of the ADDES-3 was established during the initial instrument development with meticulous review by diagnosticians and educators who supplied the information necessary for the creation of the final list of the most educationally relevant indicators of behaviour typically demonstrated by learners with ADHD [79].

Three aspects of construct validity were investigated for the ADDES-3: Factor analysis, Subscale interrelationships, and Item validity.

Concurrent validity refers to how accurately a person's current performance is reflected by the individual's performance on the criterion measure at the same time. Both subscales of the ADDES-3 were compared to the two subscales within the ADD-H Comprehensive teachers rating scale- second edition (ACTeRS) and eight subscales of the Conner's Teacher rating scale-revised. When the ADDES-3 inattentive subscale was compared to the Attention subscale of the ACTErRS the correlation was 0.8. All comparisons to the CTRS-R

yielded coefficients ranging from 0.68 to 0.92. These correlations were all statistically significant at levels which exceeded the minimum levels of acceptability [79].

In order to measure criterion related validity, the ADDES-3 was used to rate 78 randomly chosen males and females from the represented age groups of 4 to 18 years. These learners were compared to corresponding males and females identified with ADHD who were receiving program services from school districts participating in the standardisation process. The subscales scores were significantly different for learners with ADHD. These results indicated the ADDES-3 is an effective tool for the identification of learners with ADHD [79].

In order to establish test retest reliability, 855 learners randomly selected from the standardisation process were rated 30 days from their last rating. Test retest reliability proved to be very strong with a coefficient of 0.91 [79].

Inter-rater reliability was established when pairs of raters with equal knowledge of the participants rated 455 learners randomly selected. The coefficients ranged from 0.75 to 0.85. All inter-rater reliability coefficients were significant and indicated substantial reliability [79].

Internal consistency estimates reliability from a single rating with the instrument and applies most directly to the homogeneity of the characteristics which measure the same trait. The coefficient alpha formula was used and all exceeded 0.97, which demonstrates the strong internal consistency of this scale [79].

3.3 Procedure

Permission from the principal from each school in order to involve the teachers and learners in the research was required before the study began. Once consent was obtained by the principal of each Pre-school, an informed consent form was provided to and signed by the teachers who chose to participate in the research. The form explained the purpose of the research and that any information given to the researcher was confidential. Furthermore, their participation was voluntary and they were able to discontinue participation in the study without negative consequences. All schools and teachers approached willingly agreed to participate in the research.

The teachers then offered each the parents of each learner the opportunity to participate in the study. Parents who returned a form of intent to participate, which explained the purpose of the study, the ability to remove their child and that the information received would remain confidential, were given the Sensory Profile and demographic questionnaire in an envelope and asked to return it to the teacher once completed. Teachers were asked to remind parents to return the forms as the researcher had no contact with the parents.The Sensory Profile was sent home so as to ascertain sensory modulation scores.
The teacher was asked to complete the School Companion and ADDES 3 given to them in an envelope for each child participating so as to obtain a score of attention and modulation. Once the parent and teacher had completed the forms, the researcher collected both envelopes. Once all the forms were collected, the forms were scored and analysed.

The time between distribution of consent forms and data collection varied widely due to school holidays, and other logistical Factors.

3.4 Scoring the Sensory Profiles and Attention Deficit Disorders Evaluation -third edition

Scoring was done after a group of envelopes were collected from the various schools. Scoring for the sensory profiles was done as per instructions in the manuals on an Excel spreadsheet designed for the purpose of this Research. Raw scores of the profiles were converted to -2SD indicative of a definite difference or *much less than most*, a score of -1SD as a probable difference or *less than most* and a score of 0 as *typical*. Scores of 1SD and 2SD were used for a probable difference or *more than most* and a definite difference or *much more than most* respectively.

The ADDES-3 raw scores were converted to standard scores and z scores.

3.5 Data analysis

Demographic data was analysed using descriptive statistics.

The main area of interest of the research were the scores that each parent/caregiver and teacher determined for each child. Therefore data was analysed for each parent/caregiver and teacher, rather than each child, as they were the primary population. Therefore the

findings for all the participants were considered jointly to obtain a profile for each parent and teacher, for each section of the sensory profiles.

When analysing the Sensory Profile and School Companion, the scoring sections of the profiles were used; those being Section Summary, Quadrant Summary and Factor Summary. Different items make up each summary. There are a total of 27 items in the Sensory Profile Parent Questionnaire and 13 items in the Teacher Companion. The mean scores for both the School Companion and Sensory Profile were compared to the mean scores in the manuals for these tests published for typical children in United States America. Further analysis of the quadrant, Factor and section scores of the School Companion and Sensory Profile were completed using a non-parametric chi squared test to determine the percentage of participants in the typical, probable and definite difference categories in comparison to a normal distribution. The sensory profiles were compared using the frequency of the scores; the mean summary scores of ±2SD indicative of a definite difference much less or much more than most, a score of ±1SD as a probable difference of less or more than most and a score of 0 as typical.

The z scores on the ADDES-3 test and the scores for the definite differences ±2 and probable differences ±1 and typical 0 were correlated to determine if the scores for inattention were associated with the sections on the Sensory Profiles. The scores in the definite difference, probable difference and typical scores were also correlated to determine convergent validity.

Additional analyses took into account attendance in therapy which was correlated with the scores on the School Companion and Sensory Profile. The significant difference in the scores on the three tests was also established for those participants who did and did not attend therapy.

Table 3, 1: Summary of Data Analysis

Aspect to be analysed	**Statistics used**	**Reason for selection**
Demographics	Descriptive statistics – gender percentages for three age groups 4 years -5 years 5 years -6 tears	

	6 years - 6 years 6 months Kruskal – Wallis ANOVA was used to compare the three groups	Non parametric test used to compare if the gender distribution in the groups were not significantly different .
School Companion (SC)	Chi squared test was used to compared the mean scores for the quadrants, factors and sections to the mean scores for typical children in the USA Chi squared test was used to determine the significant difference between the percentage of children falling into the typical, probable difference, and definite difference categories in the sample and that expected on a normal Gaussian curve.	Non parametric statistic used as data was not normally distributed Non parametric stats used on the percentages represented in each category
Sensory Profile (SP)	Chi squared test was used to the significant difference between the mean scores for the factors and sections to the mean scores for typical children in the USA Chi squared test was used to determine the significant difference between the percentage of children falling into the typical, probable difference, and definite difference categories in the sample and that expected	Non parametric statistic used as data was not normally distributed Non parametric stats used on the percentages represented in each category

	on a normal Gaussian curve.	
ADDES-3	Chi squared test was used to determine the significant difference between the percentage of children falling into each SD from the mean in the sample and that expected on a normal Gaussian curve.	Non parametric stats used on the percentages represented in each category
Convergent Validity (SP, SC and ADDES-3)	Descriptive statistics using percentages and Spearman's correlation coefficient was used to compare the quadrants. Factors and sections of the School Companion and the Sensory Profile scores and the ADDES-3 using the z scores.	Non parametric statistics were used as the data was not normally distributed.
Internal consistency	Cronbach's alpha was established for this sample for the School Companion, Sensory Profile and the ADDES-3	
Attendance at Therapy	Spearman's correlation coefficient was used to determine the correlation between the z scores for the School Companion, Sensory Profile and the ADDES-3 and attendance at therapy A mann Whitney U test was used to determine the significant difference in z scores on the School Companion, Sensory Profile and the ADDES-3 for participants attending and not attending therapy	Non parametric statistics were used as the data was not normally distributed. Non parametric statistics were used as the data was not normally distributed.

3.6 Ethical considerations

Ethical clearance was obtained from the Human Ethics Research Committee (Appendix D). Written permission was obtained from the participating schools (Appendix E), and consent was obtained from teachers (Appendix F) through completing the teacher questionnaire as outlined in the information sheet. Information sheets were provided to all parents and signed parental consent from each participating child was also obtained (Appendix G). The schools and parents/caregivers were informed that participation was voluntary and they could withdraw permission at any time without consequence. According to University policy under-aged children should give assent to participate in research. This procedure was not done as the children were observed in their natural environment and were not asked to behave or act differently. In addition to this it was their teachers' and parents' perspectives on the child's functioning and behaviour that is being analysed rather than the child. Feedback on the results of the research was given on request and parents were informed if their child presented with a problem on the assessment so they could follow up with further assessment if the child was not already in therapy.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter presents the results of the demographics, therapy attended, sensory profiles completed by the parents and teachers as well as the ADDES-3 scores for 100 children. These children between the ages of 4 years to 6 years 11 months were attending private mainstream preschools in the northern suburbs of Johannesburg. These preschools cater for children who have no to mild support needs. The study was cross-sectional so there was no drop out from the study.

4.2 Demographics

4.2.1 Demographic information

The sample included 100 participants, 48 Female (48%) and 52 male (52%). The age of the participants ranged from 4 years (48 months) to 6 years 11 months (83 months), with a mean age of 5 years and 1.55 months (54.77 months) (SD =7.18 months). There were more participants in the 4-5 year age range than the 5-6 and 6 years 11 months age range with a similar number of males and females in all age groups. The Sensory Profiles and ADDES-3 are considered gender free tests so analysis according to gender was not considered. There were no significant differences for gender in any age group so the groups were comparable for this variable.

Table 4, 1: Demographics of the sample: age and therapies received (n=100)

		Female n=48	**Male n=52**	**p value**
Age groups	4-5 years	21%	22%	0.93
	5-6 years	17%	16%	0.93
	6-6 years 11 months	10%	14%	0.76
	Total	48%	52%	0.68

Significance p≥0.05*
Significance p≥ 0.00**

An ANOVA was used to compare the findings of each age group: 4 years old, 5 years old. 6 years old. There was only a significant difference between the groups on three of the 29

items of the School Companion: avoiding, Factor 3 and Factor 4 and therefore the decision was made to combine all the age groups for analysis.

4.2.2 Therapy attended

The therapies attended by the participants indicated that 43% were receiving one or multiple therapies which included either occupational therapy, physiotherapy, speech therapy or play therapy. Twenty eight participants were attending one therapy with most attending speech therapy, while 14% of participants attended two or more therapies. Just less than half of the participants (49%) were receiving no therapies and 8% did not indicate if they were receiving therapies and thus were marked as unknown (table 4.2).

Table 4, 2: Therapies attended (n=100)

		n=100
Therapies	Occupational therapy	4
	Physiotherapy	9
	Play therapy	4
	Speech therapy	11
	Occupational therapy and physiotherapy	3
	Occupational therapy and speech therapy	4
	Occupational therapy and play therapy	1
	Occupational therapy , physiotherapy and speech therapy	2
	Physiotherapy and play therapy	2
	Physiotherapy and speech therapy	2
	None	49
	Unknown	8

4.3 Inattention and Sensory Modulation Disorder

The first objective of the study was to determine the percentage of preschool children between the ages of 4 years to 6 years 11 months that teachers identify with observable behaviours related to inattention and SMD in the classroom The School Companion

completed by the teachers was analysed according to the quadrants, School Factors and the School summary.

4.3.1 School Companion

4.3.1.1 Quadrants of the School Companion

Quadrant scores reflect patterns of low or high thresholds to sensory input. The mean quadrant scores for the School Companion in this study were compared to the mean quadrant scores for typical children in America published in the School Companion manual. The scores were lower for all quadrants for the sample in this study indicating that the teachers identified more dysfunction in the participants. There was however no significant difference between the means for the groups when they were compared using a Chi squared test (p=0.56) and the mean score for the sample in this study fell into the typical range (Figure 4.1).

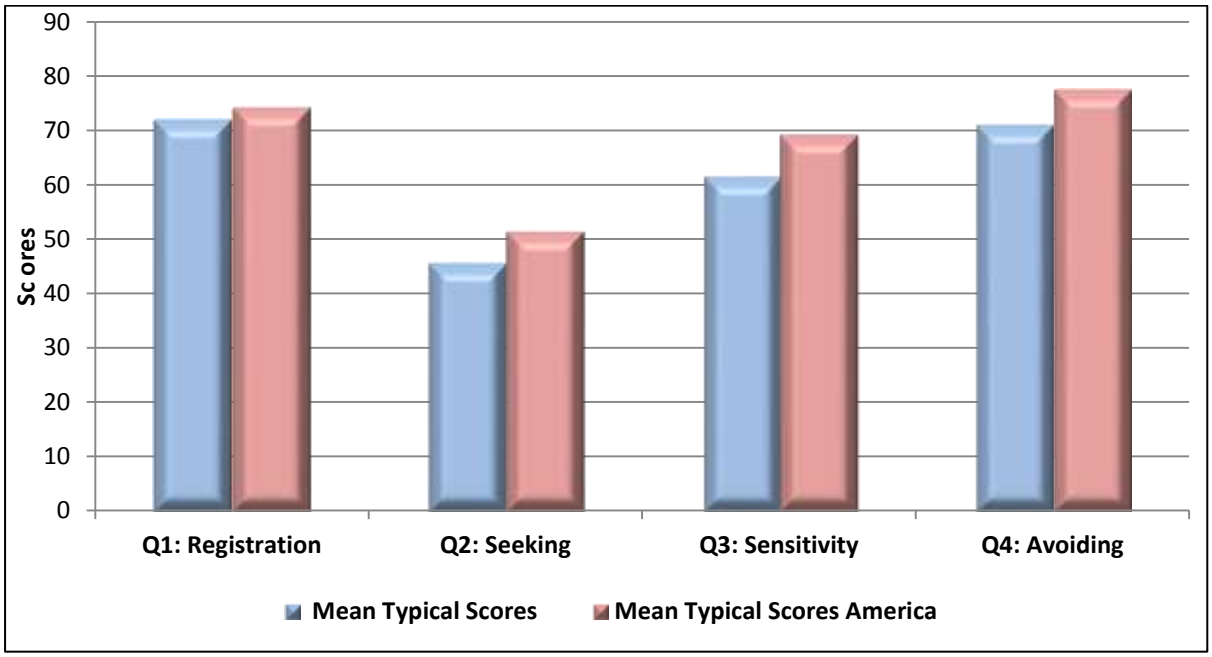


Figure 4.1: Mean scores for typical children in this study (n=100) quadrants compared to mean scores for typical children published in the School Companion manual for an American sample (p=0.56)

To determine whether the lower scores in this study identified participants with a definite or probable difference, the quadrant scores were analysed and plotted according to the normal distribution as described in the manual. The scores were analysed according to the normal distribution; with a score of -2SD indicative of a definite difference or much less

than most, a score of -1SD as a probable difference or less than most and a score of 0 as typical. Scores of 1SD and 2SD were used for a probable difference or more than most and a definite difference or much more than most respectively. The scores on each item were analysed using a Chi Squared test to determine the percentage of participants in the typical, probable and definite difference categories in comparison to a normal distribution curve. The percentage for the typical category was expected to be 68.2%. The probable difference scores for -1 SD and 1 SD at an expected 13.6% definite difference where the 2.1% for -2SD and 2SD respectively were compared to the percentages found in this study.

The quadrant scores are used to interpret dysfunction in a child and the need for therapy. Participants were identified as falling into a definite difference category only if they had definite difference (*Much more* or *less than most*) scores in two or more quadrants. Those with one definite difference score and at least one probable difference score or two probable difference scores (*More* or *less than most*) were placed in a probable difference category and those with only one scores that was not typical or all t*ypical* scores were placed in the typical category.(Figure 4.2)

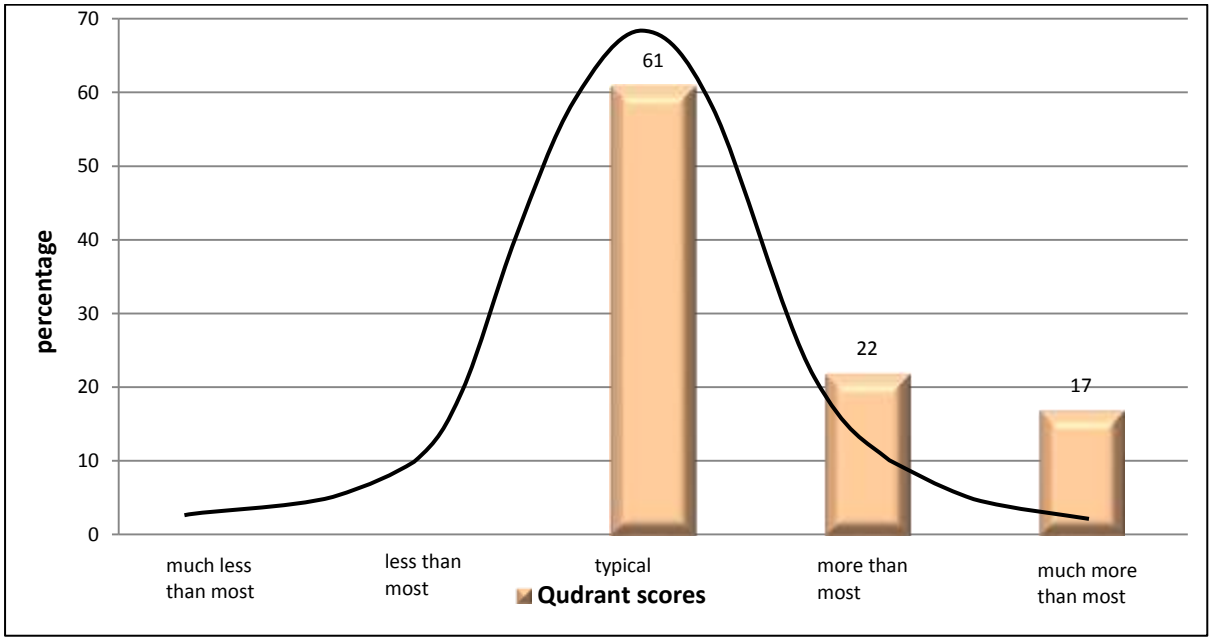


Figure 4.2: Distribution of Quadrant scores for the School Companion compared to a normal distribution (n=100)

No partcpants were scored in the *less than most* and *much less than most* catagores. While the percentage of participants that fell into the *typical* and *more than most* catagories were acceptable, the percentage of participants that fell into the *definite difference much more than most* category was significantly higher than expected for all the quanrants. All quadrants showed a significant difference from the expected scores because of this. When the different quadrants were considered it can be seen that dysfunction in Q1: Registration occurred most frequently followed by Q4: avoiding. (Table 4.3)

Table 4.3: Distribution of quadrant scores for the School Companion compared to a normal distribution (n=100)

	Quadrants					
	Definite Difference less than others %	**Probable Difference less than others %**	**Typical Performance %**	**Probable Difference more than others %**	**Definite Difference more than others %**	*p value*
	-2SD	-1SD	0	1SD	2SD	
Normal Distribution	**2.1**	**13.6**	**68.2**	**13.6**	**2.1**	
Q1: Registration		3	56	22	19	0.000**
Q2: Seeking			71	18	11	0.015*
Q3: Sensitivity			68	19	13	0.004*
Q4: Avoiding		6	54	23	16	0.000**

Significance p≥0.05*
Significance p≥ 0.00**

4.3.1.2 Factor scores of the School Companion

Factor scores reflect how the students learn. The scores on each factor were analysed using a Chi Squared test to determine to determine the percentage of participants in the typical, probable and definite difference categories in comparison to a normal distribution curve. When the Factors scores were considered, using a similar trend was found with the participants in this study scoring lower in their mean scores than typical scores published in the manual for American children.

The greatest difference from the American mean scores was for “Factor 1: external support” and encompasses sensory seeking and registration patterns indicating greater dysfunction for this Factor in the sample in this study. The results for the two samples were not significantly different (p=0.35).

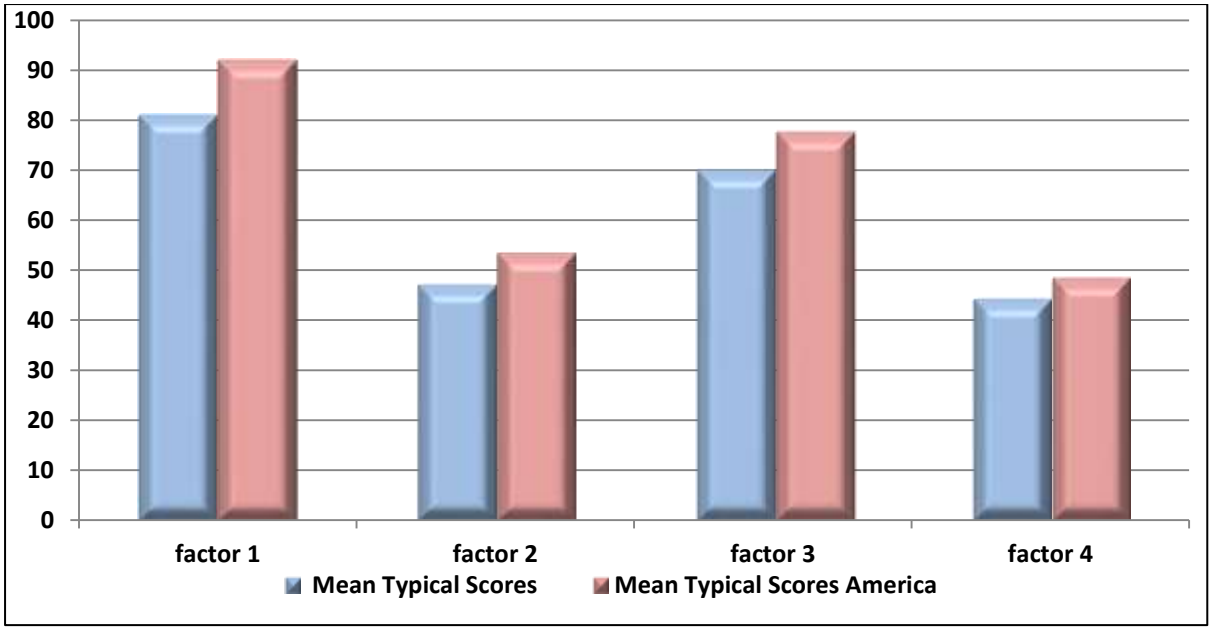


Figure 4.3 Mean Factor scores for typical children in this study (n=100) Factors compared to a mean scores for typical children published in the School Companion manual for an American sample. (p=0.35)

Table 4.4: Distribution of Factor scores for the School Companion compared to a normal distribution (n=100)

Sensory Profile School Companion Factor scores	**Typical Performance %**	**Probable Difference more or less than others %**	**Definite Difference more or less than others %**	**p-value**
	0	-1 SD and 1SD	-2 SD and 2SD	
Normal Distribution	**68.2%**	**27.2%**	**4.2%**	
School Factor summary percentage				
Factor 1 external support and encompasses sensory seeking and registration patterns	65	17	18	0.000**
Factor 2 awareness and attention within the learning environment and includes sensory seeking and sensitivity patterns	69	24	7	0.018*
Factor 3 tolerance for sensory input is influenced by avoiding and sensitivity patterns	57	25	18	0.000**
Factor 4 availability for learning is comprised of avoiding and registration patterns	70	18	12	0.009*
Mean percentage	65.25%	22 %	13.75%	

Significance p≥0.05*

Significance p≥ 0.00**

When the Factors' scores were considered in comparison to a normal distribution Factor 1: *external support* and encompasses sensory seeking and registration patterns and Factor 3: *tolerance for sensory input is influenced by avoiding and sensitivity patterns* showed significance difference had the highest percentage for the participants with a definite difference. (Figure 4.3)

Factor 2: *awareness and attention within the learning environment* and includes sensory seeking and sensitivity patterns, had the lowest percentage for a definite difference for the participants in this study (Table 4.4)

4.3.1.3 Section scores of the School Companion

The section scores allow for identification of the deficits in the participants sensory processing pattern. For the School, summary mean scores obtained for the typical participants in this sample were compared to the typical mean scores published in the manual.

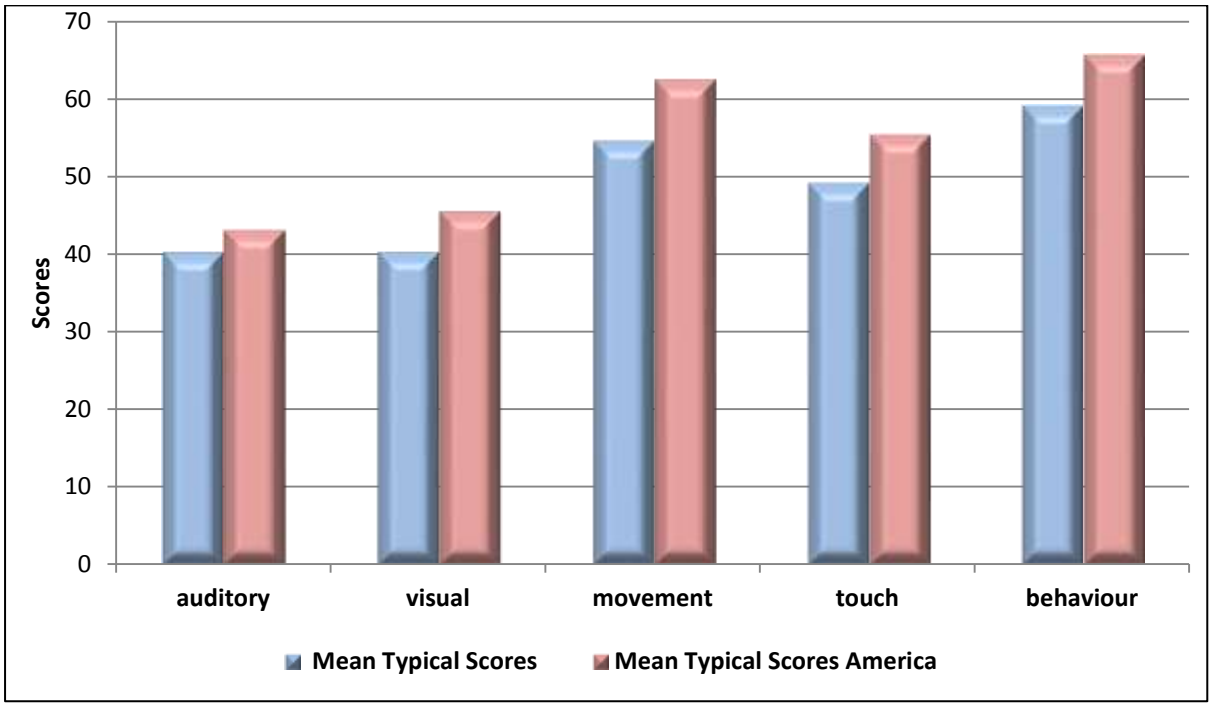


Figure 4.4 Mean section scores for this study (n=100) compared the typical scores for the typical mean scores in the School Companion manual for an American sample. (p=0.054)

Figure 4.1 indicates lower mean scores for all items of the School summary for this study, particularly movement and behaviour indicating the teachers observed more dysfunction in the participants in this study. The difference between the scores was not significantly different (p = 0.54) Figure 4.4.

Table 4.5 indicates that significant differences were found for the expected distribution of scores and those observed by the teachers on the School Companion. All scores in the summary section had percentages of participants lower than expected for typical scores and higher for definite differences indicating a significantly higher percentage of dysfunction for the sample in these items. Under the School summary visual and auditory processing, were the items identified as the lowest percentage of participants with a definite difference to most, with movement and touch also showing the greatest identified dysfunction.

Table 4.5: Distribution of section scores for the School Companion compared to a normal distribution (n=100)

Sensory Profile School Companion	**Typical Performance %**	**Probable Difference more or less than others %**	**Definite Difference more or less than others %**	**p-value**
	0	-1 SD and 1SD	-2 SD and 2SD	
Normal Distribution	**68.2%**	**27.2%**	**4.2%**	
Section summary percentage				
Auditory	62	28	10	0.000**
Visual	64	28	9	0.000**
Movement	50	24	26	0.000**
Touch	50	27	23	0.000**
Behaviour	58	30	12	0.000**
Mean percentage	56.8%	27.4%	16%	

Significance p≥0.05*
Significance p≥ 0.00**

4.3.2 The Attention Deficit Disorders Evaluation Scale-(3rd edition)

The teachers were asked to assess each participant on the ADDES -3 in terms of their attention in the classroom. Table 4.4 indicates that significant differences were found for the expected distribution of scores and those observed by the teachers on the ADDES 3 (Table 4.6).

Table 4.6: Distribution of quadrant scores for the Attention Deficit Disorders Evaluation Scale compared to a normal distribution (n=100)

	Definitely Below average %	**Below Average %**	**Typical Performance %**	**Above average %**	**Definitely above average %**	**p value**
	-2SD	**-1SD**	**0**	**1SD**	**2SD**	
Normal Distribution	**2.1%**	**13.6%**	**68.2%**	**13.6%**	**2.1%**	
ADDES						
z scores	7%	27%	60%	6%		

Typical performance and *probable above average* were lower than expected and *below average* and *definitely below average* were both higher than expected. None of the participants fell within the *definitely above average* range and thus the percentage of participants in this range was less than expected.

4.3.3 Sensory Profile

The second objective of the study was to determine the percentage of the same preschool children that parents identify with observable behaviours related to SMD at home. The Sensory Profile was analysed according to Sensory Processing, Sensory Modulation, Behaviour and emotional responses, Factors and Quadrants. These were compared to a normal distribution curve percentages for -2 SD to indicate definite difference less than most to + 2SD to indicate definite difference more than most.

4.3.3.1 Quadrants of the Sensory Profile

No mean scores for quadrants were available for comparison so the quadrants of the Sensory Profile reported by the parents were considered again. The participants were identified as falling into a definite difference category only if they had definite difference (*Much more* or *less than most*) scores in two or more quadrants. Those with one definite difference score and at least one probable difference scoreor two probable difference scores (*More* or *less than most*) were placed in a probable difference category and those with only one scores that was not typical or all typical.

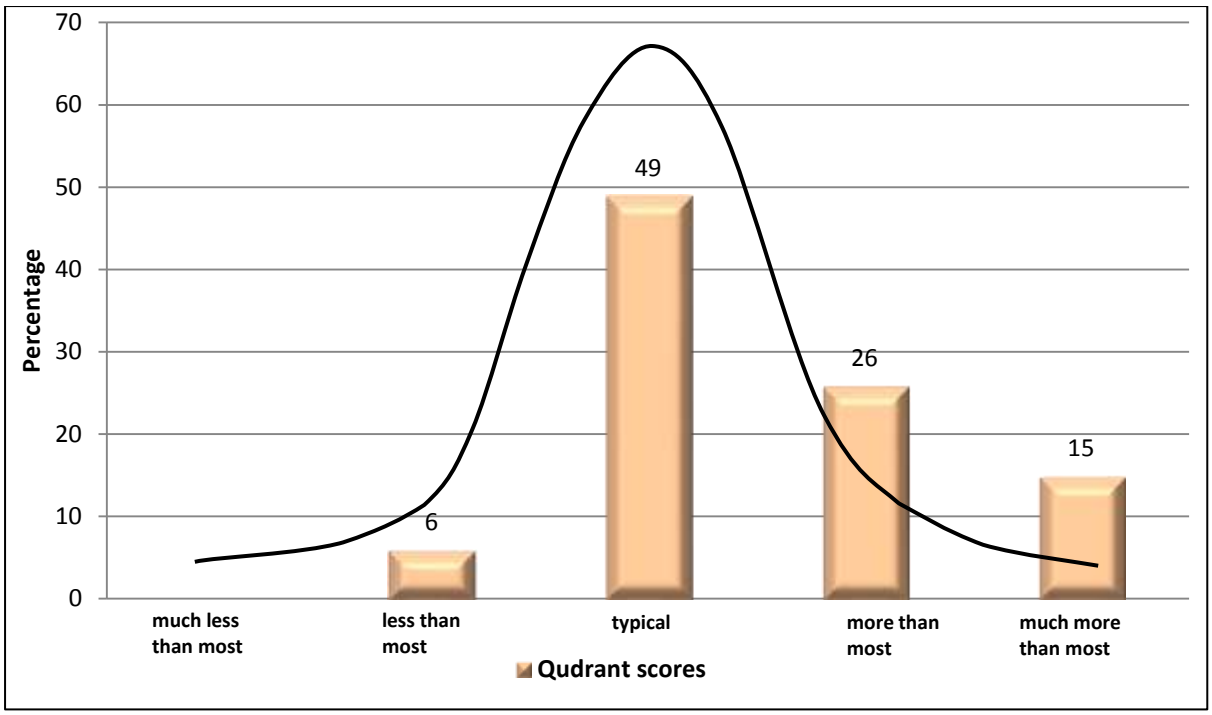


Figure 4.5: Distribution of Quadrant scores for the Sensory Profile compared to a normal distribution (n=100)

The percentage of participants that fell into the typical category was much less than expected, with a significant number being idenfified as having probabale difference *-more than most* and definite difference *much more than most* categories for all the quanrants.

Table 4.7 Distribution of quadrant scores for the Sensory Profile compared to a normal distribution (n=100)

	Quadrants					
	Definite Difference less than others %	**Probable Difference less than others %**	**Typical Performance %**	**Probable Difference more than others %**	**Definite Difference more than others %**	*p value*
	-2SD	-1SD	0	1SD	2SD	
Normal Distribution	**2.1**	**13.6**	**68.2**	**13.6**	**2.1**	
	-2SD	-1SD	0	1SD	2SD	
Q1: Low registration		12	49	16	23	0.000**
Q2: Sensation Seeking			58	27	15	0.000**
Q3: Sensory Sensitivity		13	54	23	10	0.003*
Q4: Sensation Avoiding	1	10	59	20	10	0.015*

All quadrants showed a significant difference from the expected scores because of this. When the different quadrants were considered it can be seen that dysfunction in Q1: Low Registration had the highest percentage. (Table 4.7)

4.3.3.2 Factor scores of the Sensory Profile

Factor scores reflect the registration patterns of the participants. When the Factors scores were considered a similar trend was found with the participants in this study scoring lower in their mean scores than typical scores published in the manual for American children.

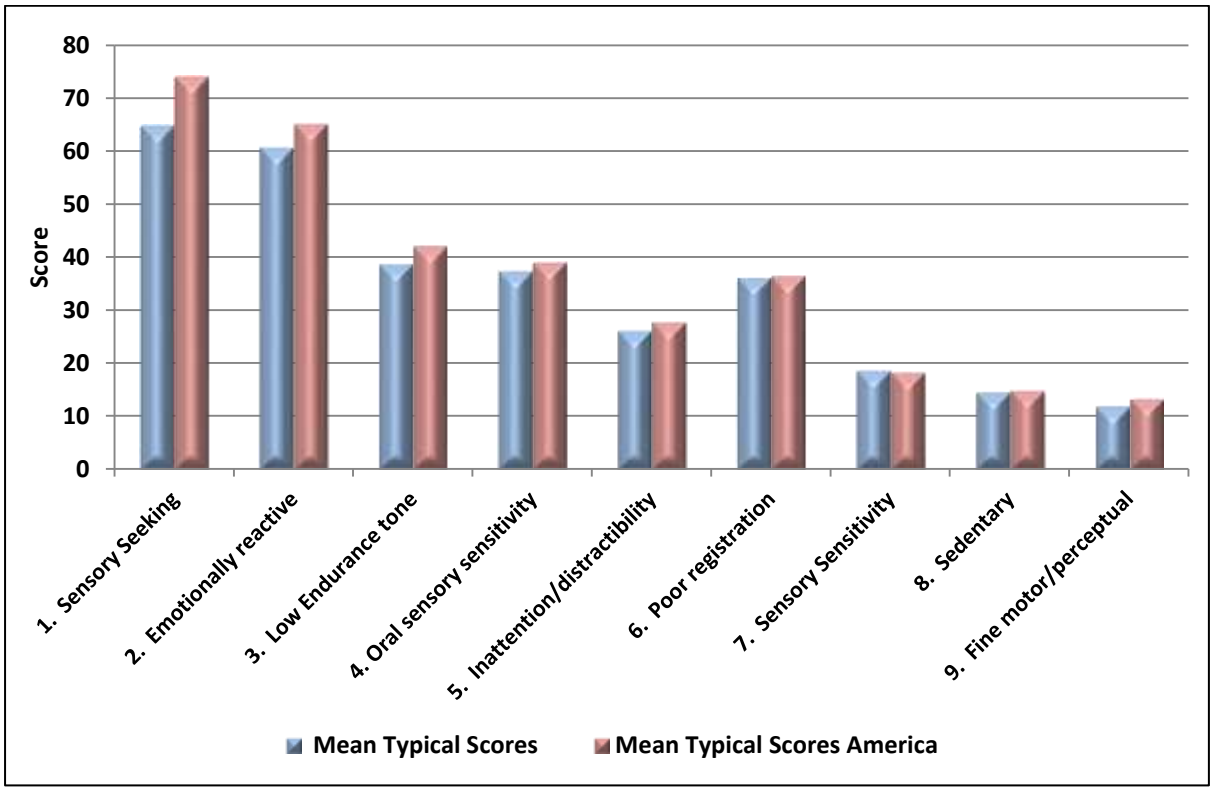


Figure 4.6 Mean Factor scores for typical children in this study (n=100) Factors compared to a mean scores for typical children published in the Sensory Profile manual for an American sample. (p=0.97)

The greatest difference from the American mean scores was for "Factor 1: sensory seeking" and "Factor 2: emotionally reactive" with no difference seen for "Factor 6: poor registration", indicating greater dysfunction for some Factors in the sample in this study. The results for the two samples were not significantly different (p=0.97).

Table 4.8 indicates a significant difference between the percentage of children expected to present with typical or probable or definite differences according to a normal distribution and the Factor scores on the Sensory Profile for the participants in this study. Only the score for "Factor: 6 poor registration" was not significantly different.

Table 4.8: Distribution of scores for the Factors in the Sensory Profile Parent Questionnaire compared to a normal distribution (n=100)

	Typical Performance %	**Probable Difference more or less than others %**	**Definite Difference more or less than others %**	**p-value**
	0	**-1 SD and 1SD**	**-2 SD and 2SD**	
Normal Distribution	**68.2%**	**27.2%**	**4.2%**	
Factor Scores				
1 Sensory seeking	62	21	16	0.000**
2 Emotionally reactive	69	10	13	0.005*
3 Low endurance	73	3	22	0.000**
4 Oral sensory sensitivity	82	6	12	0.000**
5 Inattention/distractibility	70	10	15	0.001*
6 Poor registration	78	16	6	0.127
7 Sensory sensitivity	87	7	6	0.001*
8 Sedentary	87	5	8	0.000**
9 Fine motor/perceptual	91	1	8	0.000**
Mean percentage				

Significance p≥0.05*
Significance p≥ 0.00**

4.3.1.3 Section scores of the Sensory Profile

The section scores allow for identification of the deficits in the participants' sensory processing pattern. For the mean scores obtained for the typical participants in this sample were compared to the typical mean scores published in the manual and no difference was found for Visual affecting emotional and activity level and threshold for responses. All the other section scores were lower for the sample in this study (Figure 4.7). The scores for the sample for this study were lower for the other items, than expected although this was not significantly different when compared to the typical scores in the manual, for some "processing modulation and behaviour" and "emotional responses" sections. These were therefore considered compared to a normal distribution to establish where the dented differences occurred.

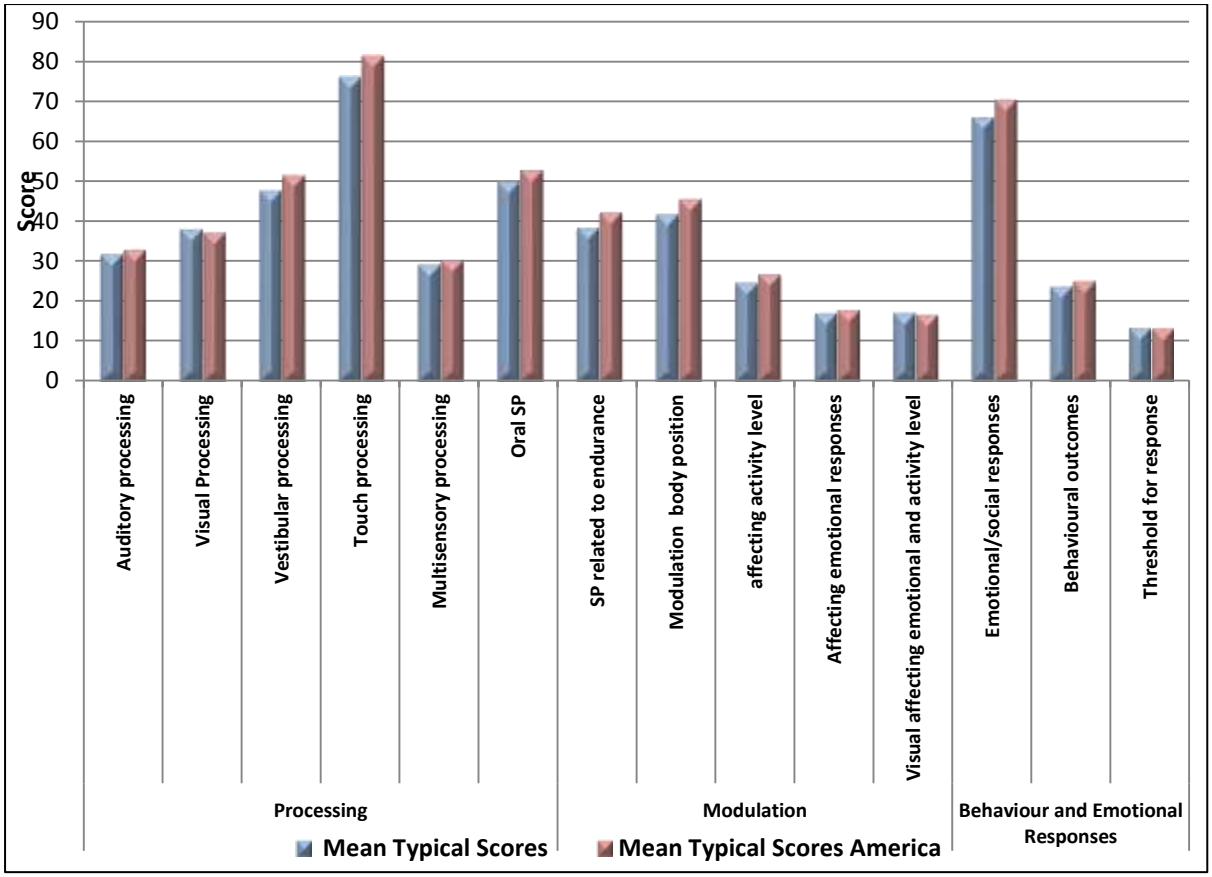


Figure 4.7: Typical mean section scores for this study(n=100) compared the typical scores in an Australian study and the typical mean scores in the Sensory Profile manual for an American sample. (p=0.99)

Most items where significant differences were found indicated that more participants than expected fell into the typical category. For the items: "Vestibular processing" under sensory processing, "Sensory processing related to endurance" under sensory modulation, "Emotional/social responses" under behaviour and "emotional responses and Sensory seeking" under Factors the numbers of typical responses were fewer than expected. For these items a greater percentage of participants can be considered as being dysfunctional.

A significantly higher percentage of participants fell into the definite difference much more than most for all items with the exception of "Sensory processing: Visual processing", "Sensory Modulation: Affecting activity level", and "Visual affecting emotional and activity level". No unexpected percentages of participants were found with a definite difference in the "behaviour and emotional responses".

Table 4.9 Distribution of section scores for the Sensory Profile compared to a normal distribution (n=100)

	Typical Performance %	**Probable Difference more or less than others %**	**Definite Difference more or less than others %**	**p-value**
	0	**-1 SD and 1SD**	**-2 SD and 2SD**	
Normal Distribution	**68.2%**	**27.2%**	**4.2%**	
Sensory processing				
Auditory processing	70	18	12	0.009*
Visual processing	90	9	1	0.012*
Tactile processing	73	18	9	0.035*
Vestibular processing	58	28	14	0.000**
Multisensory processing	75	16	9	0.043*
Oral Sensory processing	75	10	15	0.001*
Mean percentage	73.5%	16.5%	10%	
Sensory Modulation				
Sensory processing related to endurance	63	14	23	0.000**
Modulation body position	74	15	11	0.020*
Affecting activity level	70	27	3	0.030*
Affecting emotional responses	73	14	13	0.008*
Visual affecting emotional and activity level	86	13	1	0.085
Mean percentage	73.2%	16.6%	10.2%	
Behaviour and emotional responses				
Emotional/social responses	65	21	14	0.001*
Behavioural outcomes	72	14	14	0.005*
Threshold for response	83	11	6	0.553
Mean percentage	73.3%	15.3%	11.3%	

Significance p≥0.05*
Significance p≥ 0.00**

4.4 Convergent validity of the results from the Sensory Profile and the School Companion

Some items on the sensory profiles, the Sensory Profile and the School Companion, were similar and these were correlated to establish how the assessments of the sensory processing of the participants was similar amongst the teachers and the parents.

4.4.1 Quadrant summary

For the quadrant summary the Sensory Profile and School Companion sections *sensory seeking and seeking*, *low registration and registration*, *sensory sensitive and* sensitivity, and *sensory avoidant* and *avoiding* were compared.

The parents indicated a high percentage of participants 'at risk' in the ±1 probable difference category for sensory sensitivity and a high percentage of participants with a definite difference for low registration (Figure 4.8).

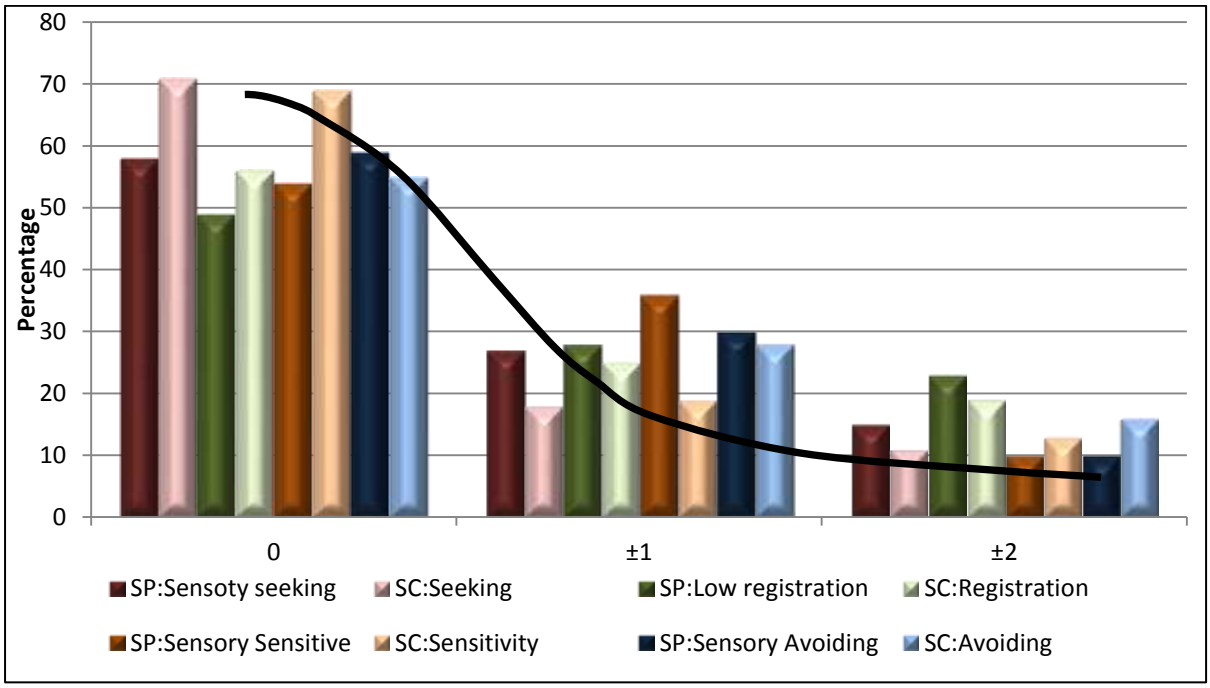


Figure 4.8: Comparison of quadrant scores on the Sensory Profile Parent Questionnaire (SP) and the Sensory Profile School Companion (SC) (n=100)

The teachers also indicated a high percentage for definite difference *low registration* but this was less than the parents' scores on the Sensory Profile. The percentage of definite difference scores for *sensory avoiding* was higher on the School Companion.

There was only a statistically weak significant association between the teachers for low registration scored by the parents and registration scored by the teachers with the teachers scoring this aspect higher indicating more difficulties in this section (Table 4.10).

Table 4.10: Association of quadrant on the Sensory Profile and the School Companion (n=100)

Sensory Profile Parent Questionnaire	**Sensory Profile School Companion**	**R**
Mean (SD)		
Low registration	Registration	
0.50(0.97)	0.57 (0.73)	0.38*
Sensory Sensitive	Sensitivity	
0.30 (0.82)	0.45 (0.71)	0.05
Sensory Avoiding	Avoiding	
0.28 (0.82)	0.50 (0.82)	0.23
Sensory seeking	Seeking	
0.57 (0.74)	0.40 (0.68)	0.15

Significance p≥0.05*

When participants with a definite difference in the quadrants score (those with a definite difference in at least two quadrants) was compared for the Sensory Profile and the School Companion only two participants were identified by both tests as having SMD. All other participants were identified only on one or other of the Sensory Profiles as having two definite differences – 17% by a teacher and a different 15% by a parent.

4.4.2 Factor summary

Figure 4.4 indicates that the on the School Companion teachers indicated a higher frequency of definite difficulties with Factor 1; *external support and encompasses sensory seeking and registration patterns* and Factor 3: *tolerance for sensory input and is influenced by avoiding and sensitivity patterns* than parents indicated on the Sensory Profile with poor registration, sensory sensitive and sensory avoidant.

The parents also indicated a higher percentage of participants with a definite difference on inattention and distractibility and sensory avoidant as well as sensory seeking.

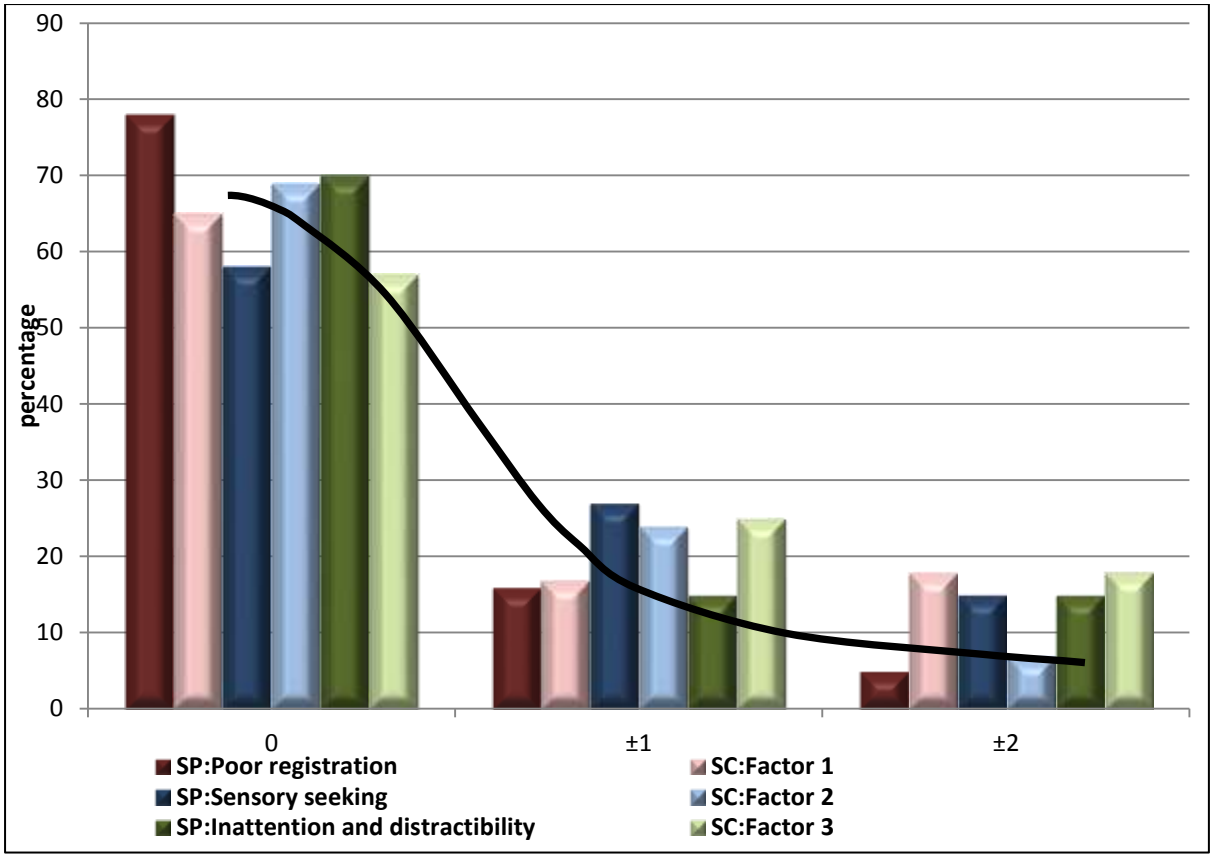


Figure 4.9 Comparison of Factor scores on the Sensory Profile (SP) and the Sensory Profile School Companion (SC) (n=100)

The teachers scored more participants with definite differences but the parents scored a lower percentage of participants than expected in the typical range for *sensory avoidant* with a higher percentage being 'at risk'. A higher percentage than expected of the poor registration scores fell into the *typical* category as parents found no difficulties in this area (Figure 4.9)

Table 4.11 indicated a significant weak association between Factor 1: *external support and encompasses sensory seeking and registration patterns* scored by the teachers and inattention a/distractibility scored by the parents.

Table 4.11: Comparison of Factor scores on the Sensory Profile and the School Companion (n=100)

Sensory Profile Parent Questionnaire	**Sensory Profile School Companion**	**R**
Mean (SD)		

Inattention and distractibility	Factor1	
0.42(0.73)	0.54 (0.78)	0.39*
Inattention and distractibility	Factor 3	
0.42(0.73)	0.61 (0.77)	0.31
Low registration	Factor 4	
0.50 (0.98)	0.42 (0.69)	0.45*
Low Endurance	Factor 4	
0.51 (0.87)	0.42 (0.69)	0.45*

Significance p≥0.05*

There was a significant moderate association for Factor 4: *availability for learning is comprised of avoiding and registration patterns* on the Sensory Profile School Companion and low registration and poor endurance on the Sensory Profile Parent questionnaire. No other correlations were found for the Factor scores.

4.4.3 Section scores -Sensory Processing

The sensory profiles were compared using the rate of the scores and the mean summary scores of ±2SD indicative of definite differences of *much less or much more than most*, a score of ±1SD as a probable difference of *less or more than most* and a score of 0 as *typical*. Since most probable and different differences were on the *more than most* positive side, the frequencies for probable and definite differences were combined.

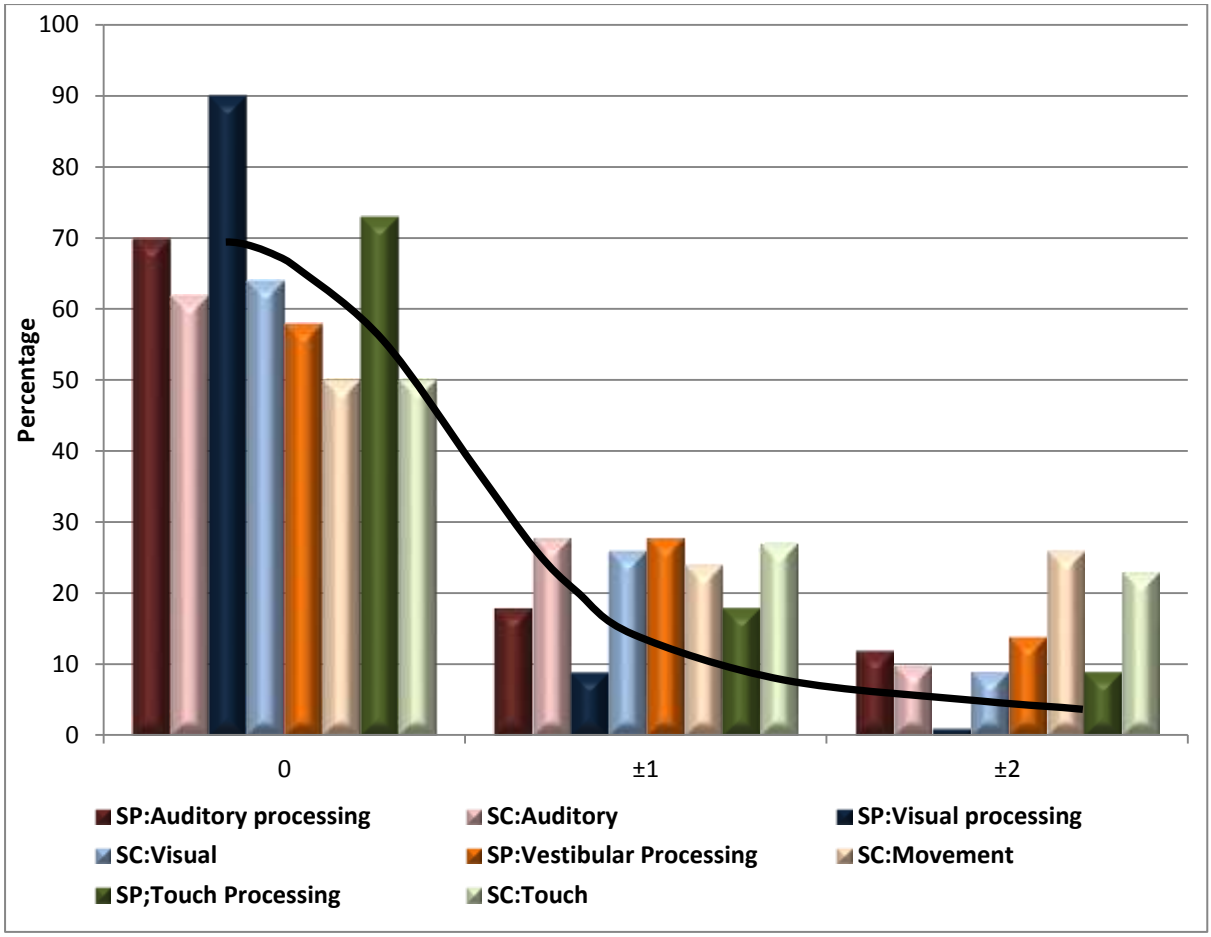


Figure 4.10 Comparison of sensory processing on the Sensory Profile (SP) and the School Companion (SC) (n=100)

Figure 4.10 indicates that the on the Sensory Profile School Companion teachers indicated less definite difficulties with auditory than parents indicated on the Sensory Profile Parent Questionnaire with auditory processing.

The association of the section scores in Table 4.12 indicated only auditory processing and auditory. No correlations were found between the scores for visual processing and visual, vestibular processing and movement and touch processing and touch when the Sensory Profile and the School Companion were compared (Table 4.12) For all these other components in sensory processing, the teachers scored more participants with definite differences, particularly for vestibular processing and movement and touch processing and touch. More than expected of the visual processing score fell into the *typical* category as parents found no difficulties in this area and teachers scored more participants 'at risk' in the probable difference category (Figure 4.8).

Table 4.12: Association of sensory processing section scores on the Sensory Profile and the School Companion (n=100)

Sensory Profile Parent Questionnaire	**Sensory Profile School Companion**	**R**
Mean (SD)		
Auditory processing	Auditory	
0.42(0.69)	0.36 (0.74)	0.44*
Visual Processing	Visual	
0.11 (0.34)	0.43 (0.67)	-0.03
Vestibular processing	Movement	
0.5 (0.72)	0.76 (0.84)	0.23
Touch processing	Touch	
0.36 (0.64)	0.73(0.81)	0.03

Significance p≥0.05*
Significance p≥0.001**

4.4.4 Section Scores Emotional/social and behaviour

When emotional/social and behavioural items on the School Companion and the Sensory Profile were compared, both teachers and parents indicated a typical response for the participants, with the teachers placing a higher amount of children 'at risk' in the ±1 category (Figure 4.10).

Associations of the values obtained on the sensory profiles completed by the parents and teachers indicated there was no convergent validity between the behaviour sections found when parents and teachers assessed the participants. The highest associations are in Table 4.13.

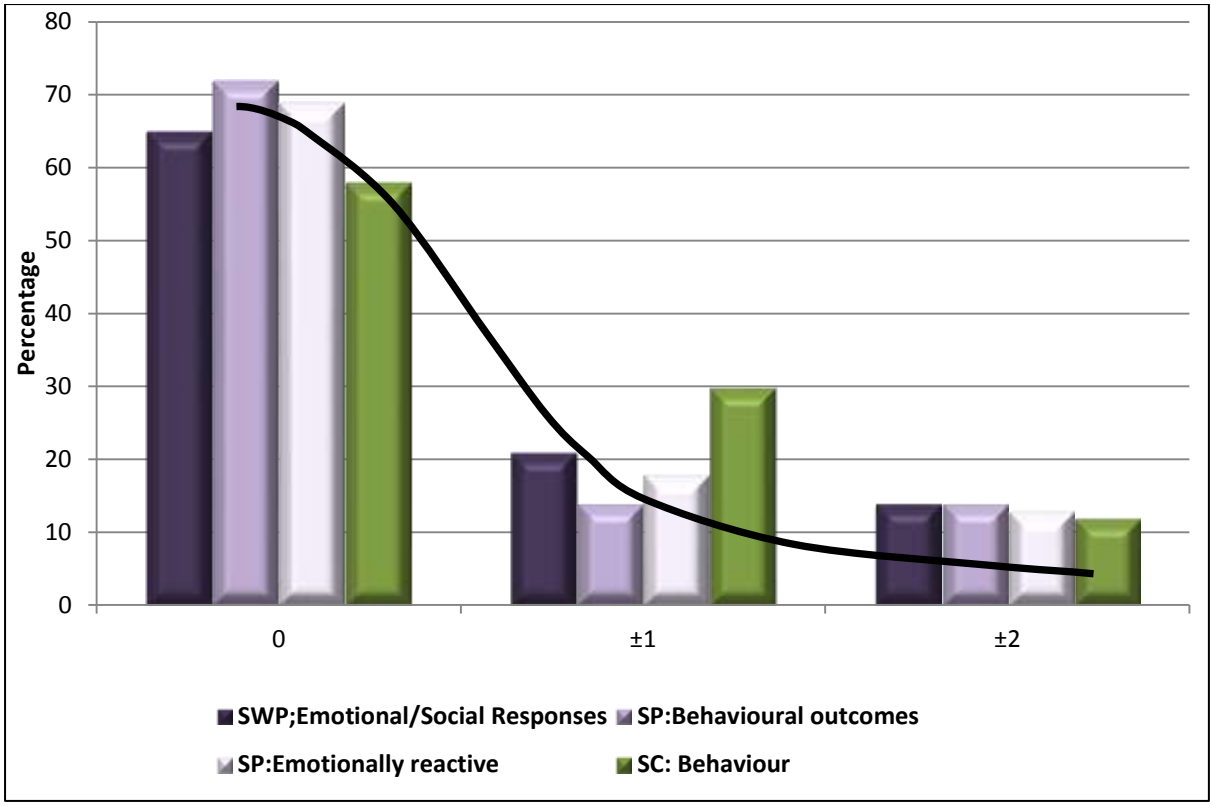


Figure 4.10 Comparison of emotional/social and behaviour on the Sensory Profile (SP) and the School Companion (SC) (n=100)

Table 4.13: Correlation of emotional/social and behaviour scores on the Sensory Profile and the School Companion (n=100)

Sensory Profile Parent Questionnaire	**Sensory Profile School Companion**	**R**
Mean (SD)		
Social/emotional Responses	Behaviour	
0.49 (0. 73)	0.54 (0.70)	0.36*
Behavioural Outcomes	Behaviour	
0.42 (0.72)	0.54 (0.70)	0.16
Emotionally reactive	Behaviour	
0.40 (0.69)	0.54 (0.70)	0.25

Significance p≥ 0.05*
Significance p≥0.001**

4.5 Convergent validity between the Sensory Profile and the School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition)

The z scores on the ADDES-3 test and the scores for the definite differences ±2 and probable differences ±1 and typical 0 were correlated to determine if the scores for inattention the convergent validity of the tests and whether there was an association with the sections on the Sensory Profiles. Since the sensory profiles do not have a total score, only sections could be compared.

Table 4.14 Association between the School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition) (n=100)

Sensory Profile School Companion	**R**
Auditory	0.66**
Visual	0.60*
Movement	0.60*
Touch	0.57*
Registration	0.68*
Seeking	0.52*
Factor 1: external support and encompasses sensory seeking and registration patterns	0.66*

Significant p≥ 0.05

With the exception of auditory processing on the Sensory Profile, only sections on the School Companion had a moderate correlation with the scores on the ADDES-3. These included the processing scores for auditory, visual, movement, touch as well as the summary scores for registration and seeking. The only Factor scores that had a moderate correlation was Factor 1: *external support and encompasses sensory seeking and registration patterns.* All other correlations were low and below 0.04.

Therefore it was the teachers who associated inattention measured on the ADDES-3 with sensory processing and modulation behaviour problems in the participants.

4.6 Internal consistency of the Sensory Profile and the School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition)

The fourth objective was to determine an aspect of reliability of the Sensory Profile and the School Companion. This was accessed by determining the internal consistency of the test for the South African sample. The Cronbach's alpha for each item indicated the tests are reliable for this homogeneous sample varied for the different sections of the sensory profiles and only the section scores for the Sensory Profile fell below the accepted 0.07 level. [14] The Cronbach's alpha for the ADDES -3 was 0.50.

Table 4.15: Cronbach's alpha for the School Companion and the Sensory Profile (n=100)

Sensory Profile School Companion	**Alpha score**
Section scores	0.88
Factor scores	0.78
Sensory Profile Parent Questionnaire	
Section scores	0.68
Factor scores	0.72
Attention Deficit Disorders Evaluation **Scale-(3rd edition)**	0.50

4.7 Attendance at therapy and the scores on the Sensory Profile and the School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition)

4.7.1 Association between the scores on the Sensory Profile and the School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition) and attendance at therapy including number of therapies attended

The association between the participants who attended therapy and their scores on the Sensory Profile and the School Companion and the ADDES-3 were determined. The number of therapies each participant attended was considered. All the correlations were low but those above 0.02 are presented in Table 4.16 and there were no correlation between the ADDES-3 scores and the number of therapies attended.

Table 4.16 Association between attendance at therapy and the Sensory Profile and the School Companion (n=100)

Sensory Profile Parent Questionnaire	
	R
Sensory processing	
Visual Processing	-0.22
Sensory Modulation	
Sensory processing related to endurance	0.33*
Affecting activity level	0.23
Behaviour and emotional responses	
Emotional/social responses	0.28
Emotionally reactive	0.26
Factor Scores	
Low endurance	0.35*
Sedentary	0.22
Fine motor/perceptual	0.20
Quadrant scores	
Low registration	0.35*
Sensory avoidant	0.22
Sensory Profile School Companion	
Factor 4: availability for learning and is comprised of avoiding and registration patterns	0.32*
Attention Deficit Disorders Evaluation Scale-(3rd edition)	
z scores	0.05

Significance p≥0.05

The negative association for visual processing indicates that participants with fewer difficulties on this item are attending therapy. Regression analysis indicated that some associations are significant at the 0.05 level.

4.7.2 Comparison between the scores on the Sensory Profile and the School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition) and attendance at therapy

The scores of participants attending and not attending therapy were compared for differences. There were significant differences between the participants who did and did not attend therapy for similar items on the Sensory Profile and the School Companion and the ADDES-3.

Table 4.17 Comparison of attendance at therapy and the Sensory Profile, the School Companion (n=100)

	Attends therapy	**Does not attend therapy**	
	Mean (SD)		**p value**
Sensory Profile Parent Questionnaire			
Sensory Processing			
Visual Processing	0.02(0.15)	0.17(0.42)	0.02*
Sensory Modulation			
Sensory processing related to endurance	0.90(0.92)	0.36(0.69)	0.00**
Behaviour and emotional responses			
Emotional/social responses	0.69(0.83)	0.33(0.60)	0.01**
Factor Scores			
Low endurance	0.82(0.93)	0.29(0.63)	0.00**
Quadrant scores			
Low registration	0.93(0.96)	0.17(0.86)	0.00**
Sensory avoidant	0.46(0.79)	0.14(0.81)	
Sensory Profile School Companion			
Factor 4: availability for learning and is comprised of avoiding and registration patterns	0.58(0.76)	0.29(0.62)	0.04*
Attention Deficit Disorders Evaluation Scale-(3rd edition)			
z scores	0.32(0.74)	0.29(0.69)	0.56

Significance p≤ 0.05*
Significance p≤ 0.01**

These appear to be the concerns for which participants are referred to therapy and except for Factor 4: *availability for learning and is comprised of avoiding and registration patterns* difficulties identified by teachers the differences were found for scores on the Sensory Profile completed by the parents. All of the scores except those for visual processing and inattention on the ADDES-3, show that the group attending therapy has been identified with more dysfunction. The ADDES-3 scores showed no significant difference between those who do and do not attend therapy.

4.8 Summary

In total 100 children participated, 48 Female (48%) and 52 male (52%). The age of the participants ranged from 4 years (48 months) to 6 years 11 months (83 months), with a mean age of 5 years and 1.55 months. The therapies attended by the participants indicated that 43% were receiving one or multiple therapies which included occupational therapy, physiotherapy, speech therapy or play therapy. Twenty eight participants were attending one therapy with most attending speech therapy, while 14% of participants attended two or more therapies. Just less than half of the participants (49%) were receiving no therapies.

On the School Companion participants' mean scores, although in the typical range, were all lower than those provided in the test manual. The distribution of scores differed from the normal distribution significantly. The quadrant scores the percentage of participants that fell into the typical and more than most catagories were acceptable, the percentage of participants that fell into -2SD *much more than most* category was significantly higher than expected for all the quadrants. The quadrants with a significantly lower percentage of typical scores were "Q1: low registration" and "Q4: sensation avoiding".

In the Factor scores only Factor 3: *tolerance for sensory* input is influenced by avoiding and sensitivity patterns, showed a significant difference with a lower percentage for the typical scores for this sample of participants. All the school Factors indicated a higher percentage of participants with a definite difference. Teachers indicated a higher frequency of definite difficulties with Factor 1; *external support and encompasses sensory seeking and registration patterns* and Factor 3: *tolerance for sensory input and is influenced by avoiding and sensitivity patterns* than parents indicated on the Sensory Profile with poor registration, sensory sensitive and sensory avoidant. The parents indicated a higher percentage of participants with a definite difference on inattention and distractibility and sensory avoidant as well as sensory seeking. Under the section scores, visual and auditory processing were the items identified as the lowest percentage of participants with a definite difference to most, with movement and touch showing the greatest identified dysfunction.

On the ADDES -3 in terms of their attention in the classroom significant differences were found for the expected distribution of scores and those observed by the teachers on the ADDES 3. Typical performance and probable above average performance were lower than expected and below average and definitely below average were both higher than expected.

For the Sensory Profile items where significant differences were found, compared to a normal expected distribution, showed more participants than expected fell into the typical category except for the quadrant scores where low registration showed the greatest deficit. For the Factors and mean scores items did not differ from the typical mean scores reported in the manual and a significantly higher percentage of participants were scored in the typical range. In the Factors *sensory seeking*, *inattention /distractibility* and *low endurance* showed a significantly higher percentage of definite difference scores. A similar result was found for the section scores, *vestibular processing* under sensory processing, *sensory processing related to endurance* under sensory modulation, *emotional/social responses* under behaviour and emotional responses For these items a greater percentage of participants can be considered as being 'dysfunctional'. A higher percentage of participants fell into the typical scores for sensory processing: *visual processing*, *sensory modulation*: *affecting activity level*, and *visual affecting emotional and activity level* and *behaviour and emotional responses: Threshold for response* where no significant differences from those in the expected normal distribution were found in the section scores.

When the profiles were compared to determine convergent validity, the quadrant summary of the Sensory Profile and School Companion sections sensory seeking and seeking, low registration and registration, sensory sensitive and sensitivity, and sensory avoidant and avoiding were correlated. The registration scores by teachers and parents in this study was the only quadrant with a high correlation. There were, however, low correlations for sensory sensitive and avoidant with teachers indicating more dysfunction in avoidant behaviour at school.

When the Factor scores for the School Companion and the Sensory Profile were correlated, only three low to moderate correlations were found SP Factor 5: Inattention and

distractibility showed a weak significant correlation with SC Factor 1 external support and encompasses sensory seeking and registration patterns and Factor 3: *tolerance for sensory input is influenced by avoiding and sensitivity patterns*. There were significant correlations between Sensory Profile Factor 6: low registration and Factor 3: *low endurance* and Factor 4: *availability for learning is comprised of avoiding and registration patterns*. The only weak significant correlation between the parents' and teachers' sensory profiles was for auditory processing and auditory. When emotional/social and behavioural items on the School Companion and the Sensory Profile were correlated no association was found except for social/emotional responses in the Sensory Profile and behaviour in the School Companion. Both teachers and parents indicated a typical response for the participants with the teachers placing a higher frequency of children 'at risk' category.

The z scores on the ADDES-3 test and the scores were correlated to determine if the scores for inattention were associated with the sections on the Sensory Profiles. With the exception of auditory processing the scores on the Sensory Profile did not correlate with the scores on the ADDES-3. Most of the section scores on the School Companion had a moderate significant correlation with the scores on the ADDES-3.

There were significant weak correlations between a number of sections and Factor scores on the Sensory Profile and the number of therapies attended. These results were supported by comparing the participants attending and not attending therapy. The significant difference between the groups for all the items on the Sensory Profile were found with a higher percentage of dysfunction in the group attending therapy related to definite dysfunction identified by parents in the section and Factor scores. The only weak significant correlation found between the School Companion and the number of therapies attended for Factor 4: *availability for learning and is comprised of avoiding and registration patterns*. This Factor was also found to have a significant difference for those attending and not attending therapy.

CHAPTER 5: DISCUSSION

In this chapter the results obtained from this study are discussed, and analysed in context of previous research. The demographics of the sample, as well as the scores obtained on the School Companion, the ADDES 3 inattention scale, the Sensory Profile will be discussed and the convergent validity considered. The relationship between therapy received and the results of the teachers and parents assessments is also examined. The implications for clinical practice and further research are also discussed.

5.1 Demographic information and therapy attended

In total of 100 participants, with a similar number of males and females were recruited into the study. Their ages ranged from 4 years (48 months) to 6 years 11 months (83 months). (Table 4.1) The sample was considered to be representative of an average Grade 0, Grade 00 and Grade 000 classrooms in independent mainstream schools. A variety of seven pre-schools were used, including those whose pupils typically proceed to a private primary school environment. None of the schools used were specifically aimed at children with difficulties and no remedial schools were used. The participants were selected randomly from each class of the participating schools to avoid bias.

Since these schools are all independent and in affluent areas (the school fee cost to the parents is between R3800 to R4500 a month), it can be assumed that the participants come from families with a middle to high socioeconomic status. Therefore, parents appear to be able to afford assessments and various therapies for the participants as 43% were receiving one or multiple therapies. (Table 4. 2) The majority of participants (28%) were attending speech therapy, with 14% of participants attending occupational therapy and 18% physiotherapy. The number of participants attending multiple therapies was also 14%.

Literature indicates that in a typical sample of children, the prevalence of disabilities requiring therapy should be lower. For speech and language therapy in particular, a systemic review of the literature revealed that speech and language delays including:

speech and/or language, language only, speech only, expression with comprehension, expression only and comprehension only should be considered when determining the prevalence of dysfunction. The review indicated that median prevalence of 5.95% of delay across these subdivisions for speech and language delays in children aged up to 16 years in a general population was found [82]. It is of concern therefore that so many participants in this study have been identified with problems severe enough to warrant attendance at speech and language therapy.

A similar finding for learning disabilities, whether they involve motor dysfunction requiring physiotherapy or perceptual dysfunction and/or SMD requiring occupational therapy, indicates a prevalence of between 5% and 10%. Prevalence estimates among children with SMD, within the United States of America, fall within this range amongst parents' perception [17] [83]. Prevalence in South Africa has not yet been established but the number of participants in this study attending both occupational therapy and physiotherapy was more than 10%.

Developmental coordination disorder appears to be the most consistent reason for referral amongst teachers to physiotherapy. According to the "American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM IV–TR) (2000) the prevalence of DCD is only around 6% of the United States of America population." Many authors agree with this statistic and indeed quote it [84] [85] while others report between 5 and 15%.

The results in this study indicate that the percentage of participants attending mainstream private preschools receiving therapy is considerably above the expected prevalence figures; with nearly 50% of children receiving one or multiple therapies. Prevalence figures are usually reported across multiple socioeconomic, cultural and racial groups in other countries and since research indicates that children from high socioeconomic backgrounds are less likely to have learning and speech and language dysfunction and face fewer barriers to learning, these results are unexpected [86]. No prevalence figures have yet been established for learning disabilities and SMD in South Africa so these results cannot in compared to other studies.

In addition to this, therapists in South Africa admit children to therapy who score between -1 and -2 SD most assessments used interpret these scores as the children being at risk and needing to be monitored only. This may account for the higher percentage of children in physiotherapy and occupational therapy as they should only be in therapy at -1.5 or -2 SD. In addition to the reason described above, the environmental expectations both at home and at school may be too high and thus these children are being placed in therapy for difficulties that are not appropriate, according to their developmental age.

5.2 Sensory Modulation Disorder and Inattention

The first two objectives of the study was to determine the percentage of preschool children between the ages of 4 years to 6 years 11 months that teachers and parents identify with observable behaviours related to SMD and inattention in the classroom and at home. The teachers also completed the ADDES-3 on the participants in the classroom to assess inattention.

The evaluation of the participants by the teachers and parents placed the sample in a typical range for SMD although these mean scores for the sample in this study was lower for most aspects than those reported by Dunn in the test manuals [14]. A higher percentage of participants were identified with definite dysfunction than expected according to the normal distribution for the School Companion, the ADDES-3 and the Sensory profile. Although the probable difference and definite difference categories for *less than most* and *more than most* were combined in the results, except for the quadrant scores, most dysfunction was identified in the *much more than most* category. In practice, test results usually end up on the *more than other*s side of the continuum. Yet when assessing children, therapist needs to be open to the possibilities of other patterns and be willing to think through how the *less than others* pattern might be affecting a child's participation. It often occurs that when a parent scores their child as 'never' for all items in a quadrant, the quadrant may come out as *less than most* as this is unrealistic for a child. The fact that this occurred so infrequently in the assessment proves the unlikely nature of the scores.

5.2.1 Assessment by teachers

In recent years occupational therapy has progressively moved into mainstream private schools. According to Vincent, Stewart and Harrison, collaboration between health professionals and teachers is necessary to improve the quality of work, outcomes of tasks and ability of the learners [87]. In order to effectively address the needs of learners collaboration between different disciplines is imperative [88]. Since learners spend most of the school day in the classroom, teachers are able to identify learners who require special attention. According to the manual for the School Companion, teachers may now contribute to a child's sensory processing evaluation along with parents who complete the Sensory Profile parent and teacher report [12].

The teachers scored the participants on the School Companion and these scores were analysed according to quadrants, Factors, as well as section sensory processing scores. In this study, the teachers rated all the mean scores for the School Companion for the participants lower than those of the typical mean scores for children in America published in the manual for the tests, as well as lower than scores published on Australian and New Zealand children (Table 4.1) [76] [77]. The lower scores in this study appear to confirm that for this sample, attending private preschools, teachers are identifying more sensory processing problems than teachers in other countries in studies where the participants were more heterogeneous in terms of culture, age and socioeconomic status.

When the results were compared to a normal distribution (Table 4.3) the teachers scored a lower percentage of participants on the School Companion with expected typical performance and higher percentage of participants than expected with definite difference relating to dysfunction than the expected 5% to 10% indicated as dysfunctional quadrant scores which identify the low and high thresholds for sensory input. The percentage of participants that fell into the much more than most category was significantly higher than expected for all the quadrants (14.75%). The quadrants with the higher percentages of dysfunction were Q1: low registration and Q4: sensation avoiding. Thus the high identification of sensory dysfunction amongst teachers is evident.

There are two possible explenations for the outcome of the higher than expected scores of the quadrants. Two approaches to classroom learning and teaching styles has been

identified in the literature. A child-centred approach emphasises the importance of empowering children to acquire knowledge through self-initiated relationships with other children and objects in their environment. Children are able to choose the activities that they want to participate in and the teacher plays the role of facilitator, preparing the environment so that children can learn through active exploration. The second approach is the academic approach which emphasises a much more directive role for the teacher. In this approach the teacher structures learning by giving pre planned tasks. Children have very little choice about how they spend their time and what they do in the classroom. They are assumed to attain knowledge most efficiently through the formal introduction of concepts and skills [89] [90] [91].

The child-centred curriculum emphasises the importance of creating a 'play like, as opposed to a business like,' atmosphere for learning [89]. As opposed to this more academic programs tend to rely on prepared material such as worksheets and paper-and-pencil tasks that only allow for one "right" answer [91]. Most of the private preschools in South Africa follow an academic approach to teaching. Within a typical grade 0 private mainstream classroom environment, the children are expected to sit at individual desks and have homework files which contain worksheets that are done in the classroom and sent home for homework. All private mainstream preschools begin grade 0, and even grade 00, children with learning letters and their sounds. The majority of large private mainstream preschools require children to wear a uniform from grade 000. The grade 000 and grade 00 classes are required to complete one craft activity a morning that is sent home every day. One of the schools used in this research only allow 40 minutes once a day of outside time in a 5 hour school day. The rest of the day is filled with academic work, and there are no added classes such as sport or music and movement classes. Therefore the children are not able to get the breaks and movement that they require which could be considered as a form of sensory deprivation and may result in the behaviour observed by the teachers.

This may result in under-responsive students with high thresholds getting up and moving around, constantly fidgeting in their desks, approaching the teacher constantly, all in an effort to provide themselves with the opportunity to move. This may be misinterpreted as sensation seeking behaviours rather than a developmental appropriate need for

movement although in this study the teachers reported higher percentages of typical behaviour for this quadrant than expected.

However the participants in this study appeared to use more passive self-regulation and showed signs such as 'becoming distracted, not able to follow instructions, miss oral directions [12].' These observations may be misinterpreted as low registration rather than fatigue and under stimulation. Registration items measure the student's awareness of all types of sensation available to them for example missing oral directions, or has trouble keeping materials organised for use during the day. Behaviour consistent with this quadrant represent high neurological thresholds and students with a definite difference in this quadrant tend to miss sensory input in the classroom [12]. They can come across as disinterested, have a flat affect and can have low energy and appear tired all the time. It is hypothesised that students have inadequate neural activation to support the sustained performace necessary to function in the classroom and therefore may miss important cues to support ongoing responsivity [12].

In practice, the low registration quadrant does not occur often and thus it is unexpected that this quadrant would have a higher percentage of definite dysfunction, more so than the other quadrants in this study. Since students with low registration are not aware of their bodies and may have low muscle-tone, decreased endurance, and delayed motor skills. The observations related to this quadrant can be confused with other difficulties such as DCD. The observations a teacher would make are related to maintaining posture for a long time. This results in considerable fatigue for these children so they may be seen flexed low over their desks or even fall off their chairs. They often complain that their hands get tired when they are writing [56]. Maintain a seated position on the floor is also difficult as these children tire quickly when trying to maintain their sitting balance so they may try to use external support by leaning against the wall or onto other children. The students may appear to avoid some activities, especially if they involve physical activity or may appear disinterested in them. For a child with DCD, skills are very difficult and require more effort [56]. Therefore it is possible that the teachers are observing these difficulties in these children but are attributing it to a sensory cause rather than a postural/coordination cause.

Another reason for the high percentage of low registration sores may be participants with over-responsivity and low threshold that may result in withdrawal or shutting down due to sensory demands in the classroom.

Some participants with low thresholds were reported as using more active self-regulation in the sensory avoiding quadrant, where typical scores were lower than expected and 16% were indicated as having a definite difference. The students try to limit their sensory experiences and withdraw in crowded rooms or move away from sensory input [12].

In a research done to determine the coping abilities for children with SMD, it was determined that children with any of the subtypes appear to do well in some aspect of activities, and children with SOR (sensory sensitivity) appeared to manage well in school as the school environment tends to be more predictable for a child [92]. It is hypothesised by Miller, et al., (2007) that school is an area that might be expected to present challenges for a child with sensory sensitivity; however, Kane (2013) found that children with sensory sensitivity appear not to have as many difficulties with occupational performance in school compared to children with difficulties in other quadrants [92]. This finding was supported by this study where sensory sensitivity was the quadrant with appropriate amount of typical cases matching the expected percentage in the normal distribution and a lower percentage in the definite differences category when compared to the other quadrants.

Since Factor 3*: tolerance for sensory input is influenced by avoiding and sensitivity patterns* had the lowest typical percentage and a high percentage for definite difference

For the Factor scores on the School Companion, the percentage of participants with definite differences was significantly higher (13.75%) than the expected normal distribution of scores (Table 4.4). The highest definite differences were found Factor 3: *tolerance for sensory input is influenced by avoiding and sensitivity patterns*, which had the lowest percentage for typical scores. When a student falls within Factor 3, the student's sensory patterns are low threshold patterns and suggest that they notice input very quickly. From a sensory processing point of view, school Factor 3 includes avoiding and sensitivity patterns. If the predominant feature is avoiding, the child is more likely to move away from stimuli as they may get overloaded very quickly in a typical classroom. This, interferes with their ability to complete work independently and follow instructions as well

as their cooperation and socialisation with other students. From the teacher's point of view, these students may seem less tolerant, overly reactive, and picky [14].

Factor 1: *external support and encompasses sensory seeking and registration patterns* also had a high percentage for definite difference for the participants in this study. This Factor encompass registration patterns and participants are observed as requiring a lot more sensory input to activate their high thresholds in order to be prepared for learning [12]. Students, whose registration quadrant score is the predominant feature, need to get additional guidance from the teacher to get their sensory needs met so that they can participate in the learning process [12].

When scoring the quadrants, the highest percentage of dysfunction fell in the registration quadrant and the avoiding quadrant, which both Factor 1 and Factor 3 make up. It would therefore follow that the school Factors that contain registration and avoiding patterns would have the highest percentage of dysfunction. It is interesting to note that even though School Factor 4 was not the Factor with the highest percentage of dysfunction.

According to the section scores, significant differences were found when the scores for the participants were compared to the expected normal distribution of scores (Table 4.5). The scores were higher for definite differences indicating a significantly higher percentage of dysfunction for the sample in these items with a mean of 16% of participants having dysfunction for the section scores. Visual and auditory processing showed the least dysfunction identified by the teachers with movement and behaviour showing the greatest identified dysfunction.

It is not a surprise that the movement aspect of the section scores were identified as having the greatest identified dysfunction. Children are expected to sit for extended periods of time, beyond their developmental ability and therefore may compensate by 'getting up and moving around the classroom,' they 'can't sit still', 'fidget often' and 'rest their head on their hands on desk or table during seated work'. The expectation is for them to sit for long periods so teachers may perceive their need to move or fatigue as dysfunction.

The scores that are indicated in this research identified behaviour as the highest dysfunction compared to a typical sample and more than an American, or Australian sample [76]. The majority of the behaviour section scores especially the movement section were made up of items that relate to the registration quadrant (3 out of 15) and the sensory avoiding quadrant (8 out of 15). As there was a higher percentage of definite dysfunction seen in this section the dysfunction in the quadrants is congruent with the observed behaviours.

Inattention has been linked to low registration in particular and can be a feature of SMD. When the teachers assessed the participants for inattention in the classroom using the ADDES -3 the results showed a different trend from that seen of the School Companion. Although significant differences were found for the ADDES-3 when compared to a normal distributuion (Table 4.6), a greater percentage of participants than expected were identified 'at risk' of attention problems with the scores between -1 and -2 SD . The precentage of participnts identified as 'dysfunctional' with scores between -2 and -3 SD was only slightly higher than the expected percentage on the normal distruibution for attention. This percentage was lower than the percentage identified with definite dysfunction on the School Companion. It appears that the teachers identified more children with definite problems on the School Companion needing therapy where on the ADDES-3 they were 'at risk' and only need monitoring and their problems are not as severe.

This is unexpected as low registration and sensory avoiding were the quadrants that had the highest percentage of dysfunction and impact on attention in the classroom. This difference may be as a result of the nature of the test and the nature of the questions. During analysis it was noticed that different teachers from the same school and different schools would mark different items as not developmentally appropriate for age such as 'fails to perform assignments independently,' or ' 'fails to demonstrate short term memory skills.' Each teacher had a different idea of developmentally appropriate norms. The teachers also struggled to fill out the items as they struggled to differentiate between the severities of the dysfunction.

The tests appear to be measuring the same items with regards to attention, however the two scales are not picking up the same level of dysfunction due to the reasons discussed above resulting in a moderate convergent validity. (Table 4.14)

Both assessments have been shown to be valid and reliable tests in international studies [12] , so either children in South Africans differ significantly from children in other studies or the teachers are setting expectations too high. The reason for the results found may therefore be attributed to the teachers' expectations of the participants in the classroom. The level of work and curriculum may be pitched at a developmentally higher level, within private schools, than what is developmentally achievable from children at these ages. Therefore, when teachers rate their behaviour compared to the expectations; these children appear to have dysfunction, as they are not able to cope with the environment [91] [90]. An environment that follows an academic approach to teaching, is rich in oral and demonstrated instructions, possibly far beyond the visual and auditory expectations of preschool children, and has structured activities and time at a desk with few opportunities for movement and tactile exploration. Even with play, there are extended periods of controlled play and exploration and focus on direct academic achievement rather than indirect academic achievement through play.

The impact this can have on a child has been debated for many years. As far back as a research done in 1990, it was argued that didactic style teaching can create unjustified stress for children as a short-term consequence with motivation, intellectual, and social behaviour as long-term effects, [89] as well as anxiety about achievement and stress behaviours being common. These consequences can be misinterpreted as behavioural outcomes of sensory modulation.

Rater bias also needs to be questioned. Behaviour rating scales are significantly subjective, and the rater is only able to make a judgement about the child's behaviour in relation to the behaviour of their peers and with whom the rater has similar contact. In this case teachers will use other children in their classroom. As a result of this, the reference group to which a child is compared may influence the results. Teachers may be holding the 'above average child' as a standard of normal measurement of development and function

and thus the expectation of the behaviour of all the children in the classroom is pitched at an unreachable level [7].

Some behaviours found in this study may be as a result of SMD, but since only two children out of one hundred were identified by both the teachers and parents as having definite dysfunction in two quadrants or more it seems the behaviours being recorded for the other children may be related to the context of the classroom and the stress and anxiety of expectations being too high in the classroom as the demands on their abilities is above their developmental age. Thus the context in which he children are observed, the structure of the activities and the sensory environment appear to play a large role in the results found in this study.

5.2.2 Assessment by parents

The scores for the preschool children that parents identify with observable behaviours related to SMD at home were analysed using the Sensory Profile according to quadrants, Factors and sensory processing, as well as section scores for sensory modulation, behaviour and emotional responses. When the Sensory Profile mean scores for the participants were compared to the mean scores in the manual, they were all lower for the quadrant scores but some Factor and section scores were equivalent to those reported by Dunn for the sensory profile [14]. When the quadrants of the sensory profile reported by the parents were considered, the percentage of participants in the typical category was lower than expected for all four quadrants (Table 4.7).

A few of the participants scored in the *probably less* and *definitely less than most* categories, although a higher than expected percentage of participants had dysfunction that was *more than most* especially for Q1: Low registration and Q2: Sensation Seeking. This finding is of concern, as parents are identifying approximately 20% more participants than expected with probable or definite differences in terms of high threshold for sensory input and a greater percentage of children with definite differences than the teachers for low registration. Again, the high percentage of participants with low registration scores was unexpected, as literature reports a higher incidence of over-responsivity which is thought to be more easily identifiable [93]. Sensory under-responsivity is more difficult to recognize and may go unnoticed longer [94] [92]. Thus children with low registration, who can be

described as unmotivated, lethargic, inattentive, apathetic, and self-absorbed, do not have disruptive behaviour. With these behaviours being less obvious, it may be that the prevalence of SUR is more difficult to recognize and therefore, under-reported [92].

In contrast to SUR behaviours, children in the sensation seeking quadrant are described as very active, seeking extreme amounts of sensory input [14] [94]. This subtype of SMD may be under-reported as well as these children may be labelled as ADHD given their level of activity. However, in a study done to determine the impact of sensory modulation on coping, parents of children with SMD reported a similar profile to that found in this study with higher incidences of sensation seeking (63%) and low registration (57%) than low threshold over responsivity (48%) on the short sensory profile [92].

These results aligned with the findings of this study and may have occurred for a few possible reasons. Both quadrants represent high threshold responses for sensory input. Poor registration represents children with passive self-regulation who have low energy levels and act as if they are tired all the time [14], whereas children who are sensation seekers use active self-regulation and appear excitable, continuously active and engaged in their environment. It is possible that after a very busy, academic and pressurising morning at school where they are required to remain seated for the majority of the day, these children are responding in two possible ways. They may have a lot of energy and are able to move and be constantly on the go at home as the environment is less structured, and allows for free time and child centred activity. A child with seeking preferences may maintain self-control during the school day but exhibit more seeking behaviours when at home [95]. Conversely other children may be totally exhausted from their school day and have low energy levels at home and will prefer to partake in more sedentary activities. Thus the behaviour that parents are identifying as a dysfunction is as a result of the context of their morning at school.

In contrast to the quadrant scores, the parents scored more than expected of the participants into the typical category with fewer in the probable difference category for the Factor and section scores. (Table 4.8 and Table 4.9) This is unexpected, as this does not tie up with the poor typical scores of the quadrants.

When compared to the mean scores (Figure 4.6) in the manual and the normal distribution (Table 4.8), the scores for the Factor scores all except Factor 6 *(Poor registration)* were lower than the typical scores reported in the test manual. A number of Factors however were scored significantly higher on the typical percentages when compared to the normal distribution showing the participants in this study were scored as typical for Factor 4 (*oral sensory)*, Factor 7 (*sensory sensitivity)*, Factor 8 (*sedentary)* and Factor 9 (*fine motor/perceptual).*

The remaining Factors that showed significant difference from the expected normal distribution had the high percentages of definite dysfunction. The highest above 20% were for Sensory processing related to Factor 3: *low endurance,* Factor 1: *sensory seeking* and Factor 5: *inattention/distractibility* where 15 % or more of the participants were identified as having a definite difference.

Low scores on Factor 3: *low endurance /tone* and Factor 6: *low registration* are indicants of the quadrant poor registration. It was therefore expected that Factor 3 would present as having a high percentage of dysfunction, but not that Factor 6 would have a higher than expected typical percentage. These children act in accordance with the quadrant poor registration as they have a flat or dull affect and appear disinterested in activities. [14] These children often prefer sedentary tasks such as watching TV or playing on an iPad or computer. Perhaps this is what they are offered at home in high socioeconomic circumstances, rather than being encouraged to play outside. This creates a vicious cycle of no movement therefore little tone and endurance develops.

Low scores on Factor 1: *sensory seeking* are indicators of the sensation seeking quadrant. Thus the fact that Factor 1 is high is not surprising as the sensation seeking quadrant indicated a particularly high percentage of dysfunction. These children add sensory input to every experience at home: they fidget; they appear to be reckless and lack consideration to safety while playing [14].

Although not indicated in the manual Factor 5: *inattention/distractibility* relates to all quadrants. More difficulties in sensory modulation are more likely to restrict the individual's ability to focus and pay attention to activities. Because the way these learners

experience sensations in their environment their difficulties distract them and they thus present with high scores [65].

In the scores for the sections on sensory processing, modulation and behaviour and emotional responses all the mean scores for this sample fell below those reported in the test manual except visual processing, visual processing, affecting activity level, visual affecting emotional and activity level and threshold for response. The scores in a study of typical Australian children found that the mean scores for these terms were the same as or slightly higher than the mean scores for the participants in this study, indicating small differences between different samples internationally (Figure 4.7). Bigger differences were seen however for the mean scores on all other items in the section scores between the participants in this study and those reported in the test manual. This supports the significantly higher percentage of participants that fell into the definite difference much more when the scores were compared to a normal distribution. The significant difference indicated significantly more typical scores for visual and sensory modulation affecting activity level. In this study these were all items that scored a higher percentage for typical responses and low percentages for definite difference or dysfunction and so appeared to represent more uncommon behaviours than common behaviours when scoring the sensory profile.

It had been expected that sensory modulation affecting activity level would have more definite difference scores in relation to the scores in the poor registration quadrant; however, it is noted in the manual that that this section also may be an indicator of sensation-avoiding which had a lower percentage of participants with definite difference scores. When this is the case, modulation of input-affecting activity level indicates that a child spends most of the time at home in sedentary play, and prefers sedentary play options so as to create a context that keeps him away from unwanted stimuli.

When analysing the visual scores, it is evident that the typical scores were much higher than expected and the definite difference scores were lower than expected. In an article analysing items on the first version of the sensory profile, Dunn hypothesised that vision is the aspect of sensory processing that is not well understood. It is possible that the items in this section are not clearly articulated thus the outliers of scores.

All the other items, with the exception of visual affecting emotional and threshold for response, had significantly higher percentages of participants scored with definite difference with percentages above 14% for vestibular processing, oral sensory processing sensory processing related to endurance and social emotional responses and behavioural outcomes.

It is apparent that the parents in this research have scored the participants lower than expected in the typical category for the quadrant scores and higher than expected in the definite dysfunction category. Similar results were seen for specific terms on the Factor and section scores which support the dysfunction reported for the quadrant scores. The scores are also not in agreement with the research that Dunn has done on the sensory profile. [14] Several possibilities exist that may account for the discrepancies. Firstly, it is possible that the effect of rater bias has affected the results of the research where parents are comparing their child to other children in the family or those of their friends and expecting a high level of performance of their children compared to their deemed level of typical. Rater bias may also exist as in South African private mainstream schools, it is very common that there is a sensory integration trained occupational therapist that works on the premises. It is probable that there is a high identification of sensory modulation problems by teachers as therapy and therapists are readily available, and parents and teachers are aware of the impact of SMD on learning thus the identification and referral for therapy is higher than expected.

Even though the sensory profile is a reliable and valid assessment tool the scores are very different when comparing to children in other countries such as America Australia [76] [77]. It is possible that there is a problem with the homogenous sample and the sensory profile may not be appropriate within the specific South African context of this study or may provide different results. It may be a matter of lifestyle as South African children in high socioeconomic situations may play substantially less outside, have less access to outside play areas in town house complexes, have less access to parks and gross motor activities

5.3 Comparison of the Sensory Profile, the School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition)

The third objective of this research was to determine the convergent validity of the School Companion and Sensory Profile (Parent/Caregiver Checklist) and the ADDES-3 inattention subtest.

5.3.1. Comparison of the Sensory Profile, the School Companion

Paediatric multi-informant questionnaires offer breadth and depth in the evaluation process by gathering information from multiple people about one child, as well as different contexts in which they function in [7]. The evaluation of the impact of sensory experiences on children and their ability to function should be contextually relevant and is an important part of an occupational therapy assessment. [96] In the Ecology of Human Performance model, the effect of context on sensory processing is explained. Context influences behaviour and performance in many ways; Dunn (1997) states that disciplines that address human behaviour must consider the effect of these contextual features on target behaviours [11].

Some items on the sensory profiles, the Sensory Profile and the School Companion, were similar and these were compared to establish how the assessments of sensory processing of the participants differed between the teachers and the parents, with the aim of determining if there was consistency about the participants sensory processing from the two sources.The differing, or unique, information from parents and teachers about the same child contributes to multi-informant questionnaires' discriminant validity [28]. Most studies on the topic of multiple informant questionnaires conclude that each source

provides unique information that would have been missed if only one rater completed a questionnaire. Kohen et al (1997) hypothesized that this unique information is due to different past and current experiences of each observer with the child and the child's behavioural issues may differ across contexts or be difficult to observe in some settings [97].

With this in mind, the child may perform very differently in the contexts of home and school [71]. These results of similar, but not identical, reports indicate it is best practice to integrate the information provided by parents and teachers on the Sensory Profile and the School Companion rather than choosing one informant over the other [28]. Clinical decision-making and the accuracy of clinical judgment will be influenced by how clinicians handle such inconsistencies [98].

For the quadrant summary the Sensory Profile and School Companion sections *sensory seeking and seeking*, *low registration and registration*, *sensory sensitive and sensitivity,* and *sensory avoidant and avoiding* were correlated. (Table 4.11) Previous research determined the convergent validity of the School Companion and the Sensory Profile. It was expected that there would be weak to moderate correlations because home and school are two different contexts. A study by Clark (2008) found a significant relationship between parent and teacher reports on avoiding, sensitivity, and registration quadrants. There was not a significant relationship between seeking scores at home and school [28].

It was hypothesised that perhaps parents see their children in many unstructured activities while school settings are much more structured and therefore the students have more opportunity to demonstrate more sensory seeking behaviours at home and are less likely to demonstrate these behaviours during a structured school day. The registration scores by teachers and parents in this study were the only quadrant with a moderate correlation (Table 4.10). Parents in this study did indicate a higher frequency of dysfunction in *sensory seeking* and the low correlation found supports the findings in the previous study.

There were, however, low correlations for *sensory sensitive and avoidant* with teachers indicating more dysfunction in avoidant behaviour at school (Table 4.10). The difference with regards to avoiding may be as a result of two potential reasons. The first possible reason is that a parent may quickly learn what constitutes a good day and recreates it each

day for their child in order to prevent meeting thresholds too often and therefore create situations to limit sensory input to familiar events that are easy for their nervous system to interpret [14]. The classroom is a less individualised environment and a teacher will not be able to adjust every task or maintain routines for a sensory avoidant child and therefore these behaviours may be more apparent.

Furthermore, as discussed above, South African private mainstream schools follow an academic approach which supports a much more directive role for the teacher where the teacher structures the learning process by giving tasks in a careful pre-planned sequence. Children have very limited choice about how they spend their time and what activities they participate in in the classroom. [89] Therefore, when the teachers present structured tasks that they are required to complete, these children may withdraw from activities or have emotional outbursts allowing the teacher to notice their avoidant behaviour. It is possible that the avoidant behaviour is as a result of anxiety or stress over the task that is required of them, as it perceived as too difficult. And they therefore 'withdraw from activities,' are 'frustrated easily' and are stubborn or uncooperative.

Parents and teachers are reporting different dysfunction in the quadrants and on further analysis it was clear that with the exception of two participants, when 17% to 15% of participants with definite differences in two or more quadrants were identified, different participants were being identified by teachers and parents as 'dysfunctional'. It appears in the different contexts in this study that the majority of participants are demonstrating behaviour that can be considered as 'dysfunctional' either at home or at school and not in both It is possible that the behaviour that is seen is not as a result of underlying SMD but rather related to other reasons such as other conditions or context-related sensory environments and stress.

When the Factor scores for the School Companion and the Sensory Profile were correlated (Table 4.12) only three low to moderate correlations were found Sensory Profile Factor 5: *Inattention and distractibility* showed a weak significant correlation with School Companion Factor 1: *external support and encompasses sensory seeking and registration patterns* and Factor 3: *tolerance for sensory input is influenced by avoiding and sensitivity*

patterns. Parents identified more dysfunction with inattention /distractibility than the teachers did with the Factors on the School Companion.

School Factor 1 follows high threshold patterns and represents the students need for external support. From the teacher's point of view, these students need the teacher's attention to get them engaged in learning effectively. School Factor 3 is a low threshold pattern in which students become overloaded very quickly which interferes with their ability to get instructions, complete independent work, or cooperate with other students. Both these Factors represent children who struggle to pay attention and become distracted within the school environment [14]. Therefore the weak, but significant, correlation is important as Factor 5 of inattention and distractibility connects with both Factors 1 and 3 of the school companion.

There were significant correlations between Sensory Profile for Factor 6: *low registration* and Factor 3: *low endurance* and Factor 4: *availability for learning is comprised of avoiding and registration patterns.* (Table 4.12) Teachers indicated the participants showed more dysfunction in their availably to learn. School Factor 4 includes avoiding and registration patterns. Both of these patterns involve disengagement on the student's part. As mentioned previously, low registration and endurance/tone are often linked and misinterpreted as each other due to the observations noticed by the rater. This correlation is therefore important, as both parent and teacher are identifying the same difficulties.

The only weak significant correlation between the parents' and teachers' sensory profiles was for auditory processing and auditory.(Table 4.13) teachers indicated less definite difficulties with auditory than parents, indicating that parents are picking up more difficulties with regards to auditory processing. However, when the sensory profile was revised it was found that only 60% of the auditory items were found to be uncommon with children without disabilities i.e.: 40% of items in auditory processing occur commonly and were marked as frequently or always occurring with children without disabilities. This may explain the high percentage of auditory processing difficulties marked by parents as the profile is not able to discriminate these items from children who have SMD [96].

No correlations were found between the scores for visual processing and visual, vestibular processing and movement and touch processing and touch. For all these components in

sensory processing the teachers scored more participants with definite differences, particularly for vestibular processing and movement and touch processing and touch. This indicates that the teachers are identifying more difficulties than parents with regards to section summary items. This is in contradiction to the research done by Clark (2008), where she used the common scores of the profiles to compare teacher and parent scores. Her research revealed a high correlation between movement, touch, auditory and behaviour, however visual processing did not show a significant correlation [28]. This again may be related to the identification of different participant's difficulties by the teachers and parents with definite differences in this study indicating the behaviour is as a result of the context rather than due to SMD.

When emotional/social and behavioural items on the School Companion and the Sensory Profile were correlated no association was found except for Social/emotional Responses in the Sensory Profile and behaviour in the School Companion (Table 4.13). Both teachers and parents indicated a typical response for the participants with the teachers placing a higher frequency of children 'at risk' category. This appears to align with the research done that parents and teachers do not agree on a majority of the areas for behaviour and teachers reported a four times higher frequency of problems with behaviour than parents [28].

When the convergent validity of the two tests was considered overall, the lack of association and the low and moderate correlations between parents and teachers reflect the findings of Cohen et al. (2003), who also found a low to moderate correlation between parents and teachers when asked about behaviours related to sensory/perceptual issues, and social behaviours [64]. The resulting differences between the parent and teacher scores indicate the importance of using both the School Companion and the Sensory Profile to obtain a clear picture of the child's performance in different contexts and that teachers and parents have a unique view and one should not be substituted for another [68]. The reasonably high correlations between the sensory profiles completed in similar contexts and the low correlations between the sensory profiles completed in different contexts was evidence that behaviour varies across different circumstances. Thus the informants' reports should not be interpreted as invalid or untrustworthy [98].

5.3.2 Association between School Companion and the Attention Deficit Disorders Evaluation Scale-(3rd edition)

The characteristics of sensory modulation disorder (SMD) and ADHD appear to have almost identical definitions and there appear to be many similarities between these disorders. Both include difficulties with maintaining attention, remaining seated or still and both lack focussing ability [10] and it has been noted that a high percentage of children with ADHD are said to have an accompanying sensory disorder [19]. When related back to the theories of ADHD, children with SMD demonstrate executive inhibition problems similar to those children with ADHD. Even though symptoms of sensory processing disorders can be similar with features in other conditions, particularly ADHD [19], a difference between ADHD and sensory processing disorders has been suggested from the results of research and specific sensory profiles for each.

The z scores on the ADDES-3 test and the scores were correlated to determine if the scores for inattention were associated with the sections on the Sensory Profiles (table 4.14). With the exception of auditory processing, the scores on the Sensory Profile Parent Questionnaire did not associate with the scores on the ADDES-3. The ADDES-3 is a teacher questionnaire with the questions contextually based within the classroom. Due to the difference in ways that children behave at home and at school it would be expected that these tests would not associate as both tests are not measuring a consistent construct. Therefore it was the teachers who associated inattention measures on the ADDES-3 with sensory processing and modulation problems in the participants.

Most of the section scores on the School Companion had a moderate positive relationship with the scores on the ADDES-3. These included the processing scores for auditory, visual, movement, touch. The quadrant scores for registration and seeking also had a moderate positive relationship with the ADDES scores indicating that the teachers found an association between inattention and sensory modulation in the participants. The scores for inattention placed them 'at risk' rather than in the 'definitely dysfunctional' category.

This is supported by the literature in a study done to standardise the Leiter International Performance Scale—Revised [99]*:* Fifty-six percent of those children who had symptoms of impaired attention (*n* =131) also revealed symptoms of compromised sensory processing

(*n* = 74) confirmed the correlation between attention and sensory processing, thereby supporting the findings of this study [99]. Sensory modulation has been shown to affect the child's ability to attend in the classroom and this inattention can be related to deficits sensory modalities like visual, tactile, auditory or vestibular processing [8]. When a child exhibits poor registration, they can also exhibit poor attention as they do not respond when called, may become unfocused during activities, and have difficult time completing tasks in a timely manner [66].

The only Factor scores that had a moderate positive relationship to the ADDES-3 scores was Factor 1: *external support and encompasses sensory seeking and registration patterns.* Teachers are relating the need for external assistance and attention as well as passive disinterested behaviour with inattention in the classroom rather than the behaviour in Factor 4 which represents the awareness and attention within the learning environment [12].

All other associations were weak and not significant. Behaviour did not correlate with inattention which, contradict the findings of Abikoff, Courtney, Pelham, & Koplewicz (1993) who found that teachers' reports about students were more biased if the child had behavioural issues compared to those with just attention problems [28]. Teachers in this study were able to identify attention issues unrelated to behaviour and appear not to be biased in this way indicating inattention may be due to other reasons.

5.4 Attendance at therapy

The concern about the identification of a high percentage of participants by both teachers and parents with definite dysfunction is related to the participant's attendance at therapy so the last objective of the study was to explore the attendance at therapy and the results on the School Companion and Parent Questionnaire. There were significant weak correlations between a number of section and Factor scores on the Sensory Profile and the number of therapies attended. These results were supported by comparing the participants attending and not attending therapy (Table 4.16 and Table 17). The significant difference between the groups for all the items on the Sensory Profile were found with a higher percentage of dysfunction in the group attending therapy related to definite dysfunction identified by parents in the section and Factor scores. The correlations were

found for sensory processing related to endurance, emotional/social responses, low registration, and low endurance. A negative correlation indicates that more participants identified with visual processing problems were not attending therapy than attending therapy again confirming the problems with assessment on this item.

It appears that participants are being referred for therapy for low registration and low tone based on the section and Factor scores rather than quadrant scores. When a child is referred for therapy the sensory profile is used to determine the sensory processing within the home environment. Once scored, all aspects of the profile are analysed specifically if the quadrant scores are supported by the Factor and section scores. If these sections all contribute to dysfunction the decision is made to do therapy. Thus, since referral to therapy is associated with section and Factor scores, it is possible the participants do not present with SMD but rather one of the associated conditions such as DCD which has similar symptoms. The observations a parent would make are related to maintaining posture for a long time which is often fatiguing for these children so they may appear to be slumped, falling often and involvement in sedentary activities.

The only weak significant correlation found between the School Companion and the number of therapies attended for Factor 4: *availability for learning and is comprised of avoiding and registration patterns.* This Factor was also found to have a significant difference for those attending and not attending therapy. This could present as a learning disability in class and result in referral. Even though teachers identified other aspects that required intervention children are not receiving therapy for them, such as Factor 1 and Factor 3. Again the referral to therapy may be based on other learning problems rather than SMD. Ultimately, the decision to place a child in therapy is up to the parent or guardian of the child.

Thus, when the overall scores were considered, only participants that had high definite difference Factor or section scores in the sensory profile parent questionnaire and Factor 4 in the school companion were seen in therapy. The results of the study do not account for the higher percentage of participants attending therapy. Of the 15% of participants identified with definite differences in two quadrants or more on the Sensory Profile Parent

Questionnaire, 5% were attending occupational therapy and 5% attending other therapies, some in conjunction with occupational therapy. 10% were not attending any therapy.

Teachers identified substantially more difficulties than parents, but the participants are not in therapy for these reasons. Of the 17% of participants identified with definite differences in two quadrants or more on the School Companion 3% were attending occupational therapy and 9% were attending other therapies in conjunction with occupational therapy. Eight percent were not attending therapy. The two participants identified by both teachers and parents with at least two definite differences in their quadrant scores were not attending therapy. Attendance at therapy is not related to identification of SMD or behaviour related to these problems and the high percentage of children attending therapy.

It is clear that the reason a child is in therapy based on a parents' perspective is not for SMD or attention as there was no correlation between the z scores of the ADDES and those participants attending (Table 4.17). It is possible that a teacher may have referred for SMD but the parent has not followed through on the referral as they are not seeing sensory modulation problems at home. It appears that parents are over-identifying other problems such as low endurance and that this is the reason for therapy. It is also probable that there is not a clear understanding of SMD and the effect on learning and the benefit of therapy for this.

5.5 Reliability of the Sensory profiles

The reliability in terms of internal consistency for both the Sensory Profile and the School Companion were in acceptable levels above 0.6 for all sections and Factors (table 4.15). The scores for the sensory profiles indicate that it can be accepted that the tests are reliable when used with the sample in this study.

Dunn indicated Chronbach alpha scores for the Sensory Profile Parent Questionnaire from 0.47 to 0.90 and the School Companion from 0.60 to 0.90. The scores for this study did not fall as low and were also higher than those reported by Brown et al [76], probably due to the more homogeneous sample in this study.

The coefficient alpha formula was used for internal consistency of the ADDES-3and all exceeded 0.97, which demonstrates the strong internal consistency of this scale. The internal consistency of this research for the ADDES-3 was 0.50. The scores for this study fell much below that of the ADDES-3 and indicate a poor internal consistency in this sample. Teachers expressed difficulties when using this assessment and were not always clear on how to fill it out. This may have affected the internal consistency of this scale.

5.6 Limitations of the study

Parental consent was required which may cause a bias in the final sample. Some parents declined to participate, saying that their children had received therapy and therefore been assessed for concentration and sensory modulation. Other parents were worried that feedback on their children's results, would confirm the presence of sensory modulation difficulties and therefore did not want their child in the study.

The question of why the learners were attending therapy was asked in the demographic form; however, many parents did not complete this, thus this information was missing during analysis. This information was not analysed according to SMD or another reason. It also would have been useful to understand who initiated the referral process.

During the research process it was noted that teachers struggled to determine the frequency of behaviours asked on the ADDES-3 and each teacher felt differently about when certain scores were developmentally appropriate and therefore differed when excluding items by giving the child a '0', thus lowering the score. The teachers involved in the research did not feel that this tool was an effective tool and it may have affected the results of the items that did not correlate as well as the strength of the correlation.

The teachers were asked to fill out 2 tests which took 20 minutes per child in total. The time was an issue for some teachers as they had a lot of children that participated in the research, which distracted them from other work. It wold have been useful if the researcher new the number of years of experience and qualification of the teachers as this may have impacted how the tests were scored.

The small sample size is a limitation in interpreting and proposing these results to the South African population. Therefore these results should be interpreted with caution.

5.7 Implications for practice

Kohen et al., (1997) hypothesized that differing information may be as a result of different past and current experiences of each observer with the child and the fact that the child's behavioural issues may differ across contexts or be difficult to observe in some settings [28] [97].With precursors and consequences unique to each adult, the child may perform markedly differently in the contexts of home and school.

Despite the difference of opinion and scores by teachers and parents clinicians are faced with the task of mixing information obtained from teachers and parents from different contexts, as well as their own clinical observations and impressions, and making clinical judgments based on this information.

It is also essential that when a therapist receives the sensory profiles from the parents and teacher they analyse each item, Factor, section and quadrant score and not make an assumption of SMD based on quadrants. The decision to start therapy cannot only be based on the Sensory Profiles and that all tests to determine reasons for behaviour need to be considered as well as the level of dysfunction.

'At risk' children should be supported by teachers in the classroom and sensory adaptations would be the role of the occupational therapists, including determining the amount of movement and play allowed.

CHAPTER 6 CONCLUSION

The purpose of this study was to determine the percentage of preschool children between the ages of 4 years to 6 years 11 months that teachers and parents identify with observable behaviours related to inattention and SMD as well as the the association of SMD to attention. The relationship between these findings and attendance at therapy was also considered.

The participants were recruited from various private mainstream preschools in an area of Johannesburg. The tools used was the Sensory Profile, School Companion and ADDES-3

The findings of this study indicate that both teachers and parents are identifying many sensory modulation difficulties in preschool children, with a higher percentage of participants being identified with dysfunction when compared to a normal distribution and to the results for the sample of children presented in the manuals for the Sensory Profiles.

Most South African private mainstream schools follow an academic approach which supports a much more directive role for the teacher where the teacher structures the learning process by giving tasks in a careful pre-planned sequence. The classroom provides few choices for children in terms of how they spend their time. It is often presumed by teachers that they gain knowledge most efficiently by the use of formal instruction methods that to introduce concepts and skills. It is hypothesised that the pressure placed on these children during the school day and the academic expectation is beyond the developmentally appropriate ability of these children. Teachers are therefore identifying and observing what they would deem 'Sensory modulation difficulties,' but may be compensation techniques for a child to get through their day. Parents are identifying 20% percent more participants with SMD based on the finding of the quadrant scores. This finding is of concern and was reasoned that that after a very busy, academic and pressurising morning at school where children are required to remain seated for the majority of the day, these children with seeking preferences may maintain self-control during the school day but exhibit more seeking behaviours when at home [95]. Conversely, other children may be totally exhausted from their school day and have low energy levels at home and will prefer to partake in more sedentary activities.

When the convergent validity of the School Companion was examined it was determined that teachers are picking up many more definite difficulties than parents for the same sample. These difficulties were identified for the different children of the sample which indicates that the context in which these children are observed in is important as they may have other problems and not SMD.

These differences between the parent and teacher scores indicate the importance of using both the School Companion and the Sensory Profile to obtain a clear picture of the child's performance in different contexts and that each informant has a unique view and one could not be substituted for another [68].

Most of the section scores on the School Companion had a moderate positive relationship with the scores on the ADDES-3 indicating that the teachers found an association between inattention and sensory modulation in the participants. The scores for inattention placed them 'at risk' rather than in the 'definitely dysfunctional' category. It is therefore emphasised again that inattention was probably not related to SMD as it did not correlate with appropriate quadrant scores.

There were significant weak relationships between a number of section and Factor scores on the Sensory Profile and the number of therapies attended. The correlations were found for sensory processing related to endurance, emotional/social responses, low registration and low endurance. It appears that participants are being referred for therapy for low registration and low tone based on the section and Factor scores rather than quadrant scores. Thus, since referral to therapy is associated with section and Factor scores it is possible the participants do not present with SMD but rather one of the associated conditions such as DCD which has similar symptoms.

The only weak relationship found between the School Companion and the number of therapies attended for Factor 4. This Factor was also found to have a significant difference for those attending and not attending therapy. This could present as a learning disability in class and result in referral. Again the referral to therapy may be based on other learning problems rather than SMD. The results of the study do not account for the higher percentage of participants attending therapy.

In conclusion teachers identified substantially more difficulties than parents but the participants are not in therapy for those reasons. Attendance at therapy is not related to identification of SMD or behaviour related to these problems and the high percentage of children attending therapy.

6.1 Recommendations

From the findings of this research, future research should focus on a well-designed, comprehensive prevalence study that should be conducted in South Africa in order to establish the true prevalence of SMD in this country.

It is also important that both sensory profiles should be normed on the South African population so as to understand how the South African teachers and parents perceive SMD.

In addition to this further qualitative research should be done to establish the demands and academic expectations of the children in South African private preschools and the effect that it has on them.

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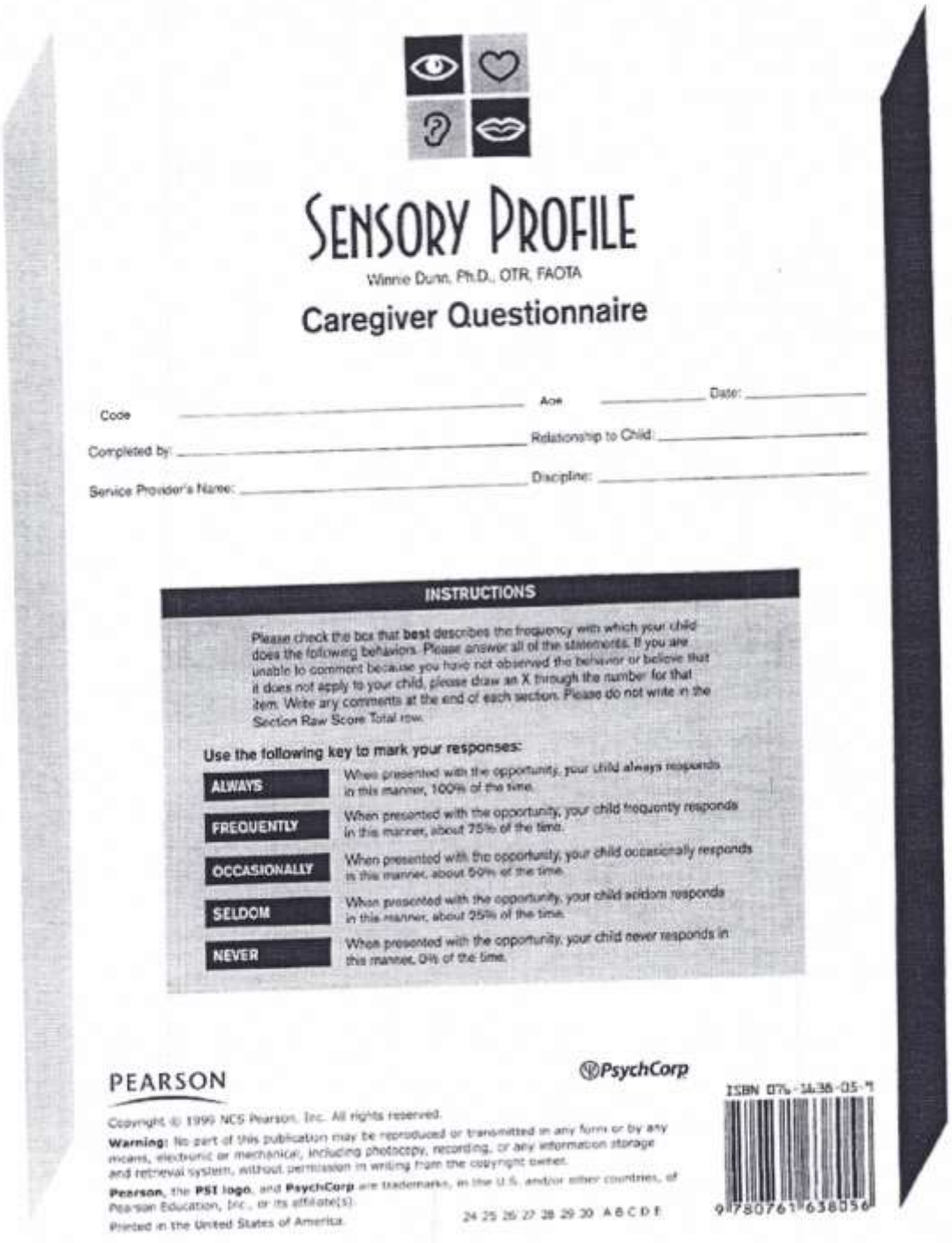
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APPENDIX A



SENSORY PROFILE

Winnie Dunn, Ph.D., OTR, FAOTA

Caregiver Questionnaire

Code _____ Age _____ Date: _____

Completed by: _____ Relationship to Child: _____

Service Provider's Name: _____ Discipline: _____

INSTRUCTIONS

Please check the box that **best** describes the frequency with which your child does the following behaviors. Please answer all of the statements. If you are unable to comment because you have not observed the behavior or believe that it does not apply to your child, please draw an X through the number for that item. Write any comments at the end of each section. Please do not write in the Section Raw Score Total row.

Use the following key to mark your responses:

ALWAYS	When presented with the opportunity, your child always responds in this manner, 100% of the time.
FREQUENTLY	When presented with the opportunity, your child frequently responds in this manner, about 75% of the time.
OCCASIONALLY	When presented with the opportunity, your child occasionally responds in this manner, about 50% of the time.
SELDOM	When presented with the opportunity, your child seldom responds in this manner, about 25% of the time.
NEVER	When presented with the opportunity, your child never responds in this manner, 0% of the time.

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APPENDIX B



SENSORY PROFILE®

SCHOOL COMPANION

Winnie Dunn, PhD, OTR, FAOTA

Teacher Questionnaire

Code _____ _____ Date: _____

_____ _____

How frequently do you have contact with the student? ☐ 1 day/week ☐ 2 days/week ☐ 3–4 days/week ☐ Daily

How long have you had this level of contact with the student? _____ Years _____ Months

_____ _____

Describe any challenges the student is experiencing in the classroom: _____

_____

_____

INSTRUCTIONS

Please check the box that **best** describes the frequency with which this student performs the following behaviors. Please respond to all of the statements. If you are unable to respond to an item because you have not had an opportunity to observe this behavior, cross through the item number and explain at the end of the section why you were unable to respond to the item. Write any additional comments at the end of each section.

Use the following key to mark your responses:

ALMOST ALWAYS	When presented with the opportunity, this student almost always responds in this manner, or 90% or more of the time.
FREQUENTLY	When presented with the opportunity, this student frequently responds in this manner, or 75% of the time.
OCCASIONALLY	When presented with the opportunity, this student occasionally responds in this manner, or 50% of the time.
SELDOM	When presented with the opportunity, this student seldom responds in this manner, or 25% of the time.
ALMOST NEVER	When presented with the opportunity, this student almost never responds in this manner, or 10% or less of the time.

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Environmental Sensations

Quadrant	Item	A. Auditory	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
—	1	Misses oral directions in class more than other students					
—	2	Appears to not hear what you say (e.g., does not tune in to what you say, appears to ignore you)					
—	3	Seems oblivious within an active environment (i.e., unaware of activity)					
S	4	Hums, whistles, sings, or makes other noises throughout the day					
@	5	Is distracted or has trouble functioning if there is a lot of noise in the area					
@	6	Tells others to be quiet					
@	7	Becomes distressed during assemblies, lunch, or other large gatherings					
@	8	Is overly bothered by loud or unexpected noises (e.g., fire alarm, books slamming to the floor, doors slamming, announcements, bells)					
@	9	Has difficulty participating in group activities where there is a lot of talking					
|	10	Holds hands over ears to protect them from sound					
		Auditory Section Raw Score Total					

Comments

Quadrant	Item	B. Visual	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
—	11	Misses written or demonstrated directions more than other students					
—	12	Has trouble keeping materials and supplies organized for use during the day					
—	13	Leaves items blank on a busy worksheet even when he or she knows the answers					
—	14	Doesn't watch during instruction, but follows through with activities					
S	15	Adds more details to drawing and coloring than other students					
S	16	Watches other students when they move around the room					
@	17	Notices even small changes in the room or desk organization					
@	18	Comments on small details in objects or pictures that others haven't noticed					
@	19	Looks away from tasks to notice all other activity in the room					
@	20	Startles at unexpected movements near desk or around room (e.g., another student getting up quickly, objects falling off desk)					
|	21	Avoids eye contact					
		Visual Section Raw Score Total					

Comments

Body Sensations

Quadrant	Item	C. Movement	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
—	22	Is clumsy and awkward in movements (e.g., runs into desks and furniture when moving about)					
—	23	Slouches, slumps, or sprawls in chair					
—	24	Rests head in hands on desk or table during class time and seatwork					
—	25	Runs or bumps into things (e.g., walls, doors, equipment, other people)					
∿	26	Seeks all kinds of movement, which interferes with daily routines (e.g., can't sit still, fidgets)					
∿	27	Is "on the go"					
∿	28	Fidgets during activities (e.g., moves around, taps on desk)					
∿	29	Gets up and moves around more than other students					
∿	30	Seems to find excessive reasons for approaching the teacher					
|	31	Stands or sits at the side of the playground during recess					
|	32	Withdraws from activities					
|	33	Is slow to participate in physically active tasks or activities					
|	34	Intentionally withdraws from active environments or situations (e.g., retreats to a quiet area in the classroom)					
|	35	Refuses to participate in team games (e.g., soccer or basketball)					
		Movement Section Raw Score Total					

Comments

Quadrant	Item	D. Touch	ALMOST ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	ALMOST NEVER
—	36	Does not steady objects when working (e.g., does not hold paper down when writing)					
—	37	Comes too close into other people's personal space when talking					
—	38	Doesn't seem to notice when face and hands remain soiled					
∿	39	Touches people and objects to the point of irritating them					
∿	40	Plays or "fiddles" with objects or school supplies (e.g., pencils, notebooks, folders)					
∿	41	Displays unusual need to touch certain toys, surfaces, or textures (i.e., constantly touching objects)					
◎	42	Is fidgety or disruptive when standing in line or close to other people (e.g., getting on the bus, sitting in an assembly)					
◎	43	Wants to wipe hands quickly or often during messy tasks					
◎	44	Is easily upset by minor injuries (e.g., bumps, scrapes, cuts)					
◎	45	Uses only fingertips to work on projects that require manipulation					
|	46	Flinches when you get in close proximity or touch his or her body					
|	47	Refuses to participate in activities that are messy (e.g., art projects, using glue or paint)					
		Touch Section Raw Score Total					

Comments

APPENDIX C

Code _____

THE ATTENTION DEFICIT DISORDERS EVALUATION SCALE-(3RD EDITION) (ADDES-3)

TO RATER: Rate every item using the quantifiers (0-5) provided. Every item must be rated. **Do not leave any boxes blank**

NOT DEVELOPMENTALLY APPROPRIATEFOR AGE	NOT OBSERVED	ONE TO SEVERAL TIMES PER MONTH	ONE TO SEVERAL TIMES PER Week	ONE TO SEVERAL TIMES PER Day	ONE TO SEVERAL TIMES PER Hour
0	1	2	3	4	5

1. rushes through assignments with little or no regard for accuracy or quality of work
2. rushes through assignments with little or no regard for accuracy or quality of work
3. Is easily distracted by other activities in the classroom, other students, the teacher, etc.
4. Does not listen to what other students are saying
5. does not hear all what is said (e.g., misses word endings, misses key words such as 'do not')
6. Does not direct attention or fails to maintain attention to important sounds in the immediate environment (e.g. teacher directions, public address system, etc.)
7. Is unsuccessful in activities requiring listening (e.g., games, following oral directions, etc.)
8. Needs oral questions and directions frequently repeated (e.g. student says, 'I don't understand,' needs constant reminders, etc.)
9. Attends more successfully when close to the source of the sound (e.g. when seated close to the teacher, etc.)
10. Requires eye contact in order to listen successfully (e.g., one to one situation, etc.)

11. Fails to demonstrate short term memory skills (e.g. does not remember two or three step directions, does not remember materials needed for a task, etc.)

☐ 12. Fails to remember sequences (e.g. events in a daily routine, days of the week, months of the year, etc.)

☐ 13. Has difficulty concentrating (e.g. staying on an assigned task, following a conversation, etc.)

☐ 14. Loses place when reading (e.g. leaves out words, lines, or sentences when reading, etc.)

☐ 15. Omits, adds, substitutes or reverses letters, words or sounds when reading

☐ 16. Fails to copy letters, words, sentences and numbers from a textbook, chalkboard, etc.

☐ 17. Omits, adds or substitutes words when writing

☐ 18. Fails to complete homework assignments and return them to school

☐ 19. Does not perform or complete classroom assignments during class time (e.g., does not perform the assignment or does not use the time provided, will go on to another assignment before completing the first, etc.)

☐ 20. Is disorganised to the point of not having necessary materials, losing materials, failing to find completed assignments, failing to follow the steps of the assignment in order, etc.

☐ 21. Completes assignments with little or no regard to neatness (e.g. rushes through tasks, does not care to do well, etc.)

☐ 22. Fails to perform assignments independently (e.g. continually asks for assistance or reassurance, does not begin work on, or complete assignments without assistance, etc.)

☐ 23. Does not prepare for school assignments (e.g. does not study for tests or quizzes, does not read assigned material, etc.)

☐ 24. Does not remain on task (e.g. is more interested in other activities, e.g. sits and does nothing, etc.)

☐

25. Does not perform academically at his/her ability level (i.e. performs below ability level or at a failing level)

☐ 26. Does not listen or follow verbal directions

☐ 27. Fails to make appropriate use of study time (e.g. does not read, study, work on assignments, etc.)

☐ 28. Fails to follow necessary steps in math problems (e.g., does steps in the wrong order, omits a step, etc.)

☐ 29. Does not read or follow written directions (e.g., instructions for homework, assignment directions, etc.)

☐ 30. Changes from one activity to another without finishing the first, without putting things away, before its time to move on, etc.

Raw Score_____

APPENDIX D

M10

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mrs Yael Chemel

CLEARANCE CERTIFICATE	**M10M101102**
PROJECT	The Association between Sensory Modulation and Attention in Preschool Learners
INVESTIGATORS	Mrs Yael Chemel.
DEPARTMENT	Department of Occupational Therapy
DATE CONSIDERED	26/11/2010
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 25/01/2011 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mrs D Franzsen

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

APPENDIX E

Personal Information

This information needs to be provided in order me to contact you if your child is found to be a risk of a problem with sensory modulation or attention.

This information will be kept separate from other data sheets by the researcher to maintain confidentiality.

Name of Parent or caregiver: _____

Relationship to Child: _____

Contact number of parent/caregiver: _____

Name of your Child: _____

Date of Birth of your Child : _____

Code:_____

APPENDIX F

Demographic Questionnaire

Code:_____

Age: _____

School: _____

Grade/Class: _____

Sex: _____

Therapy received:

Please fill out appropriate box

Therapy	Yes	No	Duration	Reason
Speech therapy				
Occupational Therapy				
Play Therapy				
Physiotherapy				

APPENDIX G

INFORMATION SHEET

The effect of sensory modulation difficulties on attention in preschool learners attending a preschool

TEACHER PARTICIPATION

Hello,

My name is Yael Chemel, a Masters student from the Occupational Therapy Department of the University of Witwatersrand medical school. I am investigating the relationship between sensory modulation disorder and attention difficulties in the classroom for learners aged 3 -5 years old. I would be most grateful if you would participate in this work.

Recent research in occupational therapy describes a disorder in which children find it hard to properly regulate their sensory input, so that they are over stimulated by some sensations or do not respond enough to sensory input from the environment. These sensory experiences include touch, movement, body awareness, sight, sound and the pull of gravity. The brain needs to interpret these stimuli at a certain level and this is called sensory modulation. Sensory modulation provides a foundation for later, more complex learning and behaviour.

When a child has problems with sensory modulation they can't filter input from the environment adequately and maybe distracted other things going on around them like noise or may try to avoid certain situations if they find the input from the environment is too much for them to tolerate like too much noise. This can affect their behaviour in the classroom environment. There are factors resulting in incorrect treatment being given or approach chosen. Children may therefore be prescribed medication or be referred for special needs education inappropriately.

I wish to establish if there is a relationship between sensory modulation and inattention in the classroom. To do this each child will be assessed by their parents using the Sensory Profile. Permission for the study has been obtained from the children's' parents.

I am inviting you the teacher to assist with the assessment of attention in the classroom and asking you to complete the Sensory Profile School Companion so as to provide scores for

modulation and the ADDES-3 attention test so as to gain a standard score of attention on children in your class. These assessment forms for each child will take approximately 20 minutes to complete. No further treatment or procedures will be done on the participants. These scores will then be compiled and analysed using various statistical methods.

This research should guide the approach to each child's inattention problems in the classroom, if any are found. Also if a child in you class presents with an abnormal score of attention or sensory modulation I will inform the parents so they can access the necessary occupational therapy for the child if they wish. In addition, at the end of the study I will present the findings to you, on request.

You may withdraw from this research at any time without having to give a reason. Remember that this study is completely voluntary and not taking part in it or withdrawing from it, carries no repercussions of any sort.

Confidentiality will be maintained by the use of a code instead of names on all results. Only the researcher will have a list of names and codes to enable the codes to be linked to a particular child.

Feedback from the study will be provided on request

Please feel free to contact me
Yael at 072 633 1976
or the secretary of the Ethics Committee at the University where ethical clearance for the study was obtained.
Anisa Keshav at (011) 7171234

If you are happy to take part in the study, please read and sign the attached consent form.

Thank you
Yael Chemel

INFORMED CONSENT

Teacher

I am willing to participate in the study "The effect of sensory modulation difficulties on attention in preschool learners attending a preschool" and complete the forms as requested

Name:_____

Signature: _____

Date:_____

APPENDIX H

PERMISSION LETTER

The Headmistress
School
.....
.....
.....

Dear Madam

My name is Yael Chemel, a masters student from the Occupational Therapy Department of the University of Witwatersrand. I am investigating the relationship between sensory modulation disorder and attention difficulties in the classroom for learners aged 3 -5 years old. I would be most grateful if you would participate in this work.

Sensory modulation difficulties, an inability to regulate sensory input and filter out extraneous sensations, are often noticed in a classroom environment by teachers or facilitators. There is very limited research to suggest that there is a relationship between sensory modulation difficulties and attention. Therefore teachers and other professionals may misinterpret inattention related to SMD as being caused by other factors resulting in incorrect treatment being given or approach chosen. Children may therefore be prescribed medication or be referred for special needs education inappropriately.

I wish to establish if there is a relationship between sensory modulation and inattention in the classroom. To do this each child will be assessed by their parents using the Sensory Profile. Permission for the study has been obtained from the children's' parents and by their teacher using the Sensory Profile school companion so as to provide scores for modulation. The teacher will then assess each child using the Sensory Profile School Companion so as to provide scores for modulation and the ADDES-3 attention test so as to gain a standard score of attention. These assessment forms will take approximately 20 minutes to complete. No further treatment or procedures will be done on the participants. These scores will then be compiled and analysed using various statistical methods. Both parents and teachers will be asked to sign informed consent for the study.

At the end of the study I will present the findings to you, on request.

Confidentiality will be maintained by the use of a code instead of names on all results. Only the researcher will have a list of names and codes to enable the codes to be linked to a particular child.

Costs to the school: none

PERMISSION

I hereby give permission for the research to be completed with teachers and children at the school.

Signature: Date:

Subject to any restrictions:

APPENDIX I

INFORMATION SHEET

The effect of sensory modulation difficulties on attention in preschool learners attending a preschool

PARENT/CAREGIVER PARTICIPATION

Good Day,

My name is Yael Chemel a masters student from the Occupational Therapy Department of the University of Witwatersrand. I am investigating the relationship between sensory modulation disorder and attention difficulties in the classroom. I would be most grateful if you and your child would consider participating in this study.

Recent research in occupational therapy describes a disorder in which children find it hard to properly regulate their sensory input, so that they are over stimulated by some sensations or do not respond enough to sensory input from the environment. These sensory experiences include touch, movement, body awareness, sight, sound and the pull of gravity. The brain needs to interpret these stimuli at a certain level and this is called sensory modulation. Sensory modulation provides a foundation for later, more complex learning and behaviour.

When a child has problems with sensory modulation they can't filter input from the environment adequately and maybe distracted other things going on around them like noise or may try to avoid certain situations if they find the input from the environment is too much for them to tolerate like too much noise. This can affect their behaviour in the classroom environment. There is very limited research to suggest that there is a relationship between sensory modulation difficulties and attention. Therefore teachers and other professionals may misinterpret inattention related to SMD as being caused by other factors resulting in incorrect treatment being given or approach chosen. Children may therefore be prescribed medication or be referred for special needs education inappropriately.

The relationship between sensory modulation and inattention in the classroom therefore needs to be investigated. To do this each child will be assessed by their parents/caregiver using the Sensory Profile form and by their teacher using the Sensory Profile School Companion so as to provide scores for sensory modulation. The teacher will then assess each child using the ADDES-3 attention test so as to gain a standard score of attention.

These forms are similar to the form that you have filled out and therefore is based on observations only. Your child will not be expected to deviate from their classroom tasks in any way. The assessment form I am asking you to fill in will take approximately 10 minutes each to complete. No further treatment or procedures will be done on the participants. These scores will then be compiled and analysed using various statistical methods.

If the scores found place your child at risk for a sensory modulation or attention problem I will inform you so that you can follow up with further occupational therapy assessment if you wish. I will provide the names of occupational therapy services if requested. In addition, at the end of the study I will present the findings of the study to you, on request.

You may withdraw your child from this research at any time without having to give a reason. Remember that this study is completely voluntary and not taking part in it or withdrawing from it, carries no repercussions of any sort.

Confidentiality will be maintained by the use of a code instead of names on all results. Only the researcher will have a list of names and codes to enable the codes to be linked to a particular child.

If you have any queries please don't hesitate to contact me on 072 633 1976

If you are happy to allow your child to take part in the study, please read and sign the attached consent form.

Thank you

Yael Chemel

INFORMED CONSENT FORMS

I agree to allow my child to participate in the study outlined in the information sheet:

Parent/caregiver: _____

Name of participant: _____

Signature: _____

Date: _____