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A pilot study of the effect of a sensory diet on the in-seat behaviour of grade one learners in the classroom

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CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

Sensations flow constantly into the brain at a rapid rate and these sensations need to be adequately acted upon, organized and integrated if a person is to learn efficiently. The reticular activation system (RAS) is responsible for the regulation of alertness, as well as the coordination and regulation of attention that is essential to learning and to behaviour management [1]. Sensory processing dysfunction presents as the inability to properly regulate sensory input and to maintain a situation-appropriate state of alertness resulting in ineffective learning. Occupational therapists working with children with disabilities offer a unique perspective in the delivery of service to these children by considering the sensory aspects of behaviour. From a sensory integrative (SI) frame of reference, an underlying component of many of the behaviours observed in children with disabilities is to either avoid or generate sensory stimulation.[2]Therefore, sensory modulation dysfunction (SMD) in children causes difficulties in processing sensory input appropriately which may impede the acquisition of concept and motor learning and thus the ability to carry out everyday activities.[3] Through the use of SI principles the occupational therapist assists the child in his or her overall motor and conceptual learning by the inclusion of meaningful activities in therapy that provide specific sensory stimuli to obtain an adaptive response.[4] Clinical observation has also indicated that these treatment methods affect factors such as a child's attention span and organisational ability.[5]

All children need sensory input and experiences to grow and learn, but this is even more crucial for the child with sensory modulation or integration dysfunction. A daily sensory diet that includes a combination of alerting, organizing and calming techniques has been shown to fulfill the sensory needs of these dysfunctional children. [6] In combination with individual occupational therapy (OT) the sensory diet is used to optimise a child's level of arousal for learning.

The sensory diet is comprised of various specific activities that enhance the child's opportunities to receive beneficial sensory input at frequent intervals, thereby enabling him or her to participate optimally in the occupational performance activities that comprise his or her daily schedule. Sensory integrative therapy affords the child favourable participation and encourages competence in activities and thus facilitates greater opportunities for success throughout the day. [7]

This is of importance in the grade one learner with identified sensory processing problems as the first year of formal schooling is especially important in establishing patterns of behavioural, emotional, cognitive and social functioning which will in turn influence the child's future scholastic development. By determining a child's threshold for tolerating sensory stimuli the occupational therapist helps families and teachers alike to understand a child's reaction to experiences easily tolerated by peers.[2] A school based sensory diet may therefore have a role to play in improving the attention based and behavioural adjustments of these grade one learners in their learning as measured by outcomes in functional abilities like reading and writing. After extensively reviewing the literature it has become apparent that studies into the effects of a sensory diet on a child's observable performance (behaviour) is limited. Only a small number of studies of SI have examined the immediate effects of treatment delivery.[5]

1.2 STATEMENT OF THE PROBLEM

A child suffering from a sensory processing disorder (SPD) has difficulty in adequately organising external (environmental) and internal (own senses) sensory input in the brain resulting in problems processing information. Over the last thirty years empirical evidence characterising the physiologic and behavioural manifestations of sensory processing impairments has been studied. Children who respond atypically (i.e. over-or under-responsive) to sensory stimuli suffer from behavioural consequences including distractibility, impulsivity, high activity levels and anxiety. All of these significantly affect their self esteem, self regulation, social skills, school performance and activities of daily living [8-14].

Little data is however currently available on the effects of SI intervention school based strategies that help maintain and regain the child's behaviour needed for participation in academic tasks.[5,6,12,15,16] Mulligan in 2001 expressed the increased need for school-based therapists to collaborate with teachers to identify strategies that could be designed to enhance school performance and handle classroom behaviours. In working closely with the grade one educator this study addressed this need and illustrated the use and evaluation of a strategy involving a therapist-teacher partnership.[15]

1.3 THE PURPOSE OF THIS STUDY

The purpose of this pilot study therefore was to examine the effectiveness of a sensory diet through observing whether a correlation between the implementation of a sensory diet in the classroom setting and an improvement in the child's in-seat behaviour and level of arousal (attention) does occur.

This was done by monitoring and documenting the grade one learners' pre-intervention and intervention in-seat behaviour and attention span during a handwriting lesson.

1.4 THE AIM OF THE STUDY

The aim of this pilot study was to investigate a correlation between a sensory diet and in-seat behaviour of a learner in the classroom.

1.5 OBJECTIVES OF THE STUDY

The objectives were to:

1. Describe the degree of different types of sensory processing difficulties found in grade one learners at a school for children with special needs.
2. Establish a cause-effect relationship between a school based sensory diet and in-seat behaviour during a handwriting lesson.

1.6 JUSTIFICATION OF THE STUDY

As the information gained through this pilot study could make a useful contribution to the body of knowledge of SI and education, it was felt that in conducting this pilot study, scholastic problems presented in clients in need of OT and/or remedial learning, may be addressed in a more insightful and holistic manner. Furthermore, this pilot study will assist in generating a body of reliable, credible evidence that will validate investment in potential larger, more expensive, randomized control group designs in the future. The inclusion of future control group designs can then be used to further demonstrate external validity of the findings obtained in this initial pilot study. [17,18]

1.7 NUL HYPOTHESIS

Sensory diets do not influence in-seat behaviour and arousal levels of grade one children with sensory processing problems.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This literature review considers SI, sensory processing disorder (SPD) and its association with different diagnoses. The assessment of sensory processing disorder and daily behaviour in the classroom as well as factors affecting classroom seating is highlighted. Finally treatment in terms of a sensory diet and the effectiveness of therapy in relation to SPD are reviewed.

2.2. SENSORY INTEGRATION

Occupational Therapy aims to improve the occupational performance (functional skills) of clients using a holistic approach that considers the person, their environment and occupations that are personally meaningful.[19] The primary occupation or normal daily activities of a child, is that of being a student and includes school and related activities such as engagement to task, listening, and playing with peers. Children and adults alike all depend on adequate SI functioning in order to carry out daily tasks in work, play or leisure and personal management.

The concept and theory of sensory integration (SI) comes from a body of work developed by Ayres. [20] As an occupational therapist, she was interested in the way in which sensory processing and motor planning disorders interfere with activities of daily living and learning in children.

Research over the past three decades has resulted in SI disorders now being described in terms of SPD. Many cognitive and developmental founding theorists [21-23] encompass sensory processing as an integral component for the foundation of their work . In turn, the sensory processing in the auspice of SI is based on the premise that when an infant successfully meets the challenges of his or her environment, the brain learns to organize the sensation for production of adaptive responses.[24] Typically developing children seek information about their world through the sensory system and use this information to form adaptive responses. Adequate sensory modulation allows for the typically developing child to adapt to sensory input and thus function optimally in constantly changing environments.

It is the Central Nervous System's (CNS) ability to modulate responses (i.e. balance between habituation and sensitization) which permits the young child to generate appropriate responses to stimuli in the environment. The physiology behind sensory processing is based on neurological thresholds. Neurological thresholds refer to the amount of stimuli required for a neuron or neuronal system to respond. In the presence of a low neurological threshold the CNS is able to respond quickly to a sensory stimulus and vice versa. At the extreme ends of the neurological threshold are habituation (high thresholds; recognition of familiar stimuli that do not require additional attention) and sensitization (low thresholds; enhancing the awareness of important stimuli).

The RAS has extensive interconnectivity with all the sensory systems persistently impacting on their level of arousal. It plays a vital part in the functioning of sensory modulation as it greatly influences the calm-alert state, the period of processing and integrating sensorimotor information required for maximal functioning (i.e. optimal sensory registration, orientation and arousal). [25] Arousal refers to a continuum of alertness from low arousal or "calm state" associated with drowsiness and mental lethargy to high arousal or "alert state" associated with distractibility and hyperactivity. Modulation of arousal is essential for optimal engagement, attention and learning in the classroom.[18] When a child is in a state of severe over arousal he or she is then at risk of going into a state of sensory shutdown. This concept was introduced by Kimball in 1993 and describes a protective mechanism against severe overload. [3]

2.2.1. Sensory Processing Disorder (SPD)

A dysfunction in SI or sensory processing is described as a decreased ability to process sensation resulting in difficulty in participating in daily functional contexts which can interfere with learning and behaviour. In 1997, Dunn and Brown conducted an extensive national study on the sensory profile of children without disabilities and did an exploratory factor analysis of their scores. [26] The findings of this study support the developmental theories as even though the profile of the typical child may demonstrate a heightened level of activity, as a group, no pattern of inattention, distractibility, or oral sensory sensitivity is apparent when compared with their peers who have disabilities. Furthermore, the typically developing children were observed to not experience the same difficulties with fine motor and academic (perceptual) tasks as the sample population of children with disabilities. Overall, their frequency, intensity or pattern of behaviour suggests that they adapt appropriately to sensory input. [2]

Sensory Processing Disorder presents as inefficient neurological regulation and processing of sensory information leading to an inability to maintain a situation-appropriate state of alertness that often results in problems with learning, development, and behaviour. [6] Extensive research has been conducted since the early 1970s correlating the physiologic and behavioural signs of SPD, such as distractibility, impulsivity, high activity levels and anxiety, with difficulties in social, scholastic and personal management tasks[8-10,12-14,27] Even though subtle signs are manifested in infancy or as in early childhood, a SPD problem is frequently missed until the child enters formal schooling and then appears as learning or behavioural problems.

Sensory processing dysfunction affects individuals of all intellectual levels, age and socioeconomic groups. Literature suggests that there may be a genetic component.[28,29] Ayres initially approximated that 5-10% of all children experience SPD but current research estimates an increase in this prevalence with up to 30% for children without other disabilities.[6,21,30,31] However, the percentage of children for whom difficulty in optimal sensory processing interferes with activities of daily living, is thought to be much smaller. This was highlighted in two studies in which 5.3% of kindergarten children in America [32] and between 9% of 3- to 6-year-old children, in China, with severe symptoms and 28% with mild symptoms, met criteria for SPD. Two of the major learning and developmental problems associated with SPD are auditory processing difficulties and speech delay. Anatomically, this is because the auditory system works closely with the vestibular, tactile and proprioceptive systems and these are in turn all related to speech production and language processing.
Various studies conducted on the ASD population have highlighted this association between auditory processing and sensory dysfunction. [33,34] It has also been found that children with certain diagnoses exhibit sensory processing patterns that are discernibly different.[2]

Two general types of sensory integrative or sensory processing dysfunctions exist, namely dyspraxia (planning difficulties) and poor sensory modulation.[20] This research is especially focusing on SMD and its impact on the child's learning in the classroom environment.

The understanding of sensory modulation has changed from when it was first coined by Ayres, as the "brain's regulation of its own activity." Through the last four decades various researchers have contributed to refining its definition.

Currently, the accepted description of sensory modulation is that it is the person's ability to regulate his or her response to incoming internal (inside the body) and external (environmental) sensory information and to shift from one state of arousal to another so as to appropriately adapt his or her behavioural responses [13,35,36]. It is the ability of the (CNS) to respond, either psychologically or behaviourally, to sensory stimulation in a manner that is adaptive. This is achieved by regulating, organising and prioritising incoming sensory input; inhibiting or suppressing irrelevant sensory information and prioritising or helping the child focus on relevant information.

2.2.2 Sensory Modulation Disorder

Murray-Slutsky in 2000 stated that there are three phases of sensory modulation, namely registration (acknowledgement of sensory information), orientation (evaluation of the significance of the registered information) and arousal (preparation for action-the voluntary mechanism whereby effort and energy must be expended). [36] Any imbalance between inhibition and facilitation of sensory input within the CNS will result in over-or-under registration, orientation or arousal. A SMD is diagnosed when this occurs. SMD is seldom devoid of all registration. Sensory registration occurs when the child searches his or her memory for neuronal models that attribute meaning to experience. Therefore, registration is often observed to be absent when the sensory stimuli are assessed to be meaningless to the child and are therefore ignored. [36]

A study carried out in 1999, examining the relation of physiological and behavioural responses in children with SMD to typically developing children found that children diagnosed with SMD have significantly different physiological reactions to sensory stimuli than typically developing children. An additional noteworthy finding of this study was the statistically significant correlation between the children's physiologic responses to stimulation and their parent report score on their behaviour as recorded on the Sensory Profile.[13]

Sensory-defensiveness is described as a neural processing disorder of having a low threshold for sensory input. This affects the modulation of sensory input triggering an inappropriate response to non-threatening sensory stimuli. This disorder is believed to be evident when one system (i.e. anterolateral system) operates without effective modulation of the other system (Dorsal Column Medial Lemniscus-DCML) and when an imbalance in the CNS is present. The DCML is described as modulating arousal and has strong inhibitory influences on the anterolateral system.

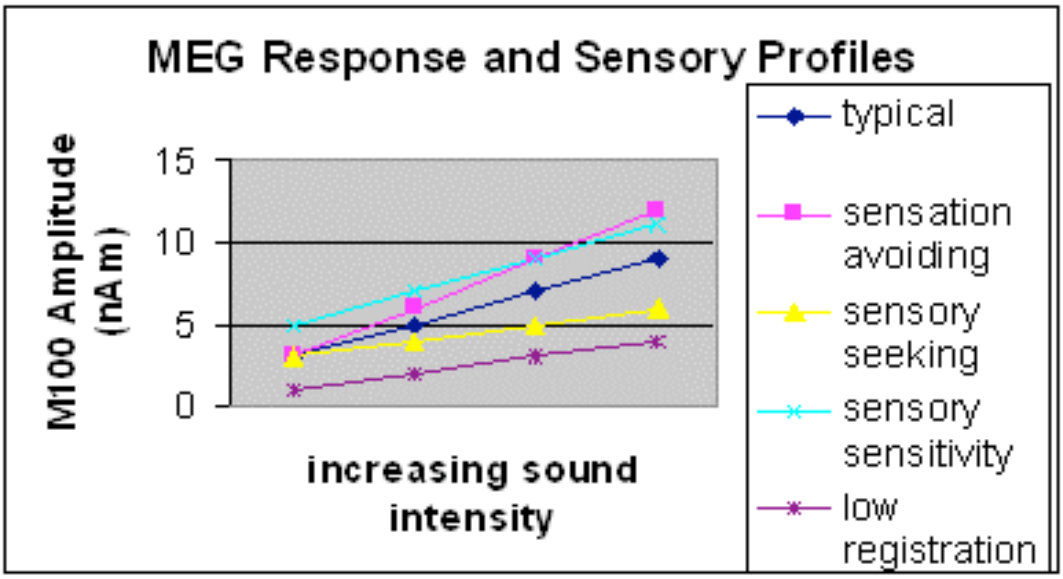
A study performed by Schaaf, Miller, Seawell, and O'Keefe supports this notion as it found that children with SMD have less effective parasympathetic functions than typically developing children.

The parasympathetic nervous system, a part of the autonomic nervous system, helps individuals adapt to changing conditions by regulating the body's recovery from a stressful situation and returning it to its optimal condition. It works in conjunction with and as a result of the sympathetic system, which has been linked by electrodermal responsiveness to SMD.[12] Suboptimal parasympathetic functioning in individuals with SMD was highlighted in the results of a study conducted by Smith, Kinnealey, Barriocanal, Witt, Im, and Kanamalla which suggest that sensory-defensive persons have compromised CNS metabolic capacity (as depicted by reduced levels of total creatine and increased levels of glutamate in the thalamus and frontal cortex). [12,25,36,37] Sensory inputs that are most vulnerable to defensiveness include touch, sound, vestibular sensation, vision and taste.

In a defensive modulation disorder, difficulty with registration, orientation or arousal is evident. These range from a lack of sensory registration of input (self-regulation and not low registration) to an over-stimulation (over-responsiveness or hyper arousal) of sensory input. This interplay between sensory deprivation and over stimulation leads to a child's erratic and unpredictable responses. Findings of a pilot study exploring the relationship between physiologic and behavioural measures of sensory responsivity and defensive SMD, showed that atypical sensory orientation in children with SMD is associated with atypical behavioural responses to sensory stimulation. [13] The behavioural responses to sensory input reflect the self regulation strategies utilized by a child on a continuum with passive self regulation strategies(in which the person lets sensory events occur) at one end, and active self regulation strategies (in which the person selects active strategies to control their own sensory experiences) at the other.[37]

Dunn, a leading investigator in the field of SI, has conducted extensive research in sensory processing and temperament. In one of her studies she hypothesized the pathophysiology of sensory-modulation disruption (i.e. inability of the nervous system to habituate / get used to the given stimulus) by assuming the patterns of brain activity be consistent with their patterns of sensory processing and types of temperament (please refer to figure 2.1 below). [13]

Figure 2.1 Relationship between sensory processing and temperament



Research conducted over the past thirty years has shown that children with certain behavioural and developmental disabilities process sensory information differently when compared to children without disabilities. [21,38,39]

2.3. DIAGNOSTIC GROUPS SHOWING PREVALENCE OF SENSORY PROCESSING AND SENSORY MODULATION DISORDERS

Disorders of regulation for example often have a strong underlying contributing sensory processing dysfunction. That is, typically developing infants are able to maintain an internal equilibrium through modulating environmental sensory input. Their regulation capacity allows them to modulate their arousal level while either remaining engaged or disengaging from the task.

Children who are diagnosed with regulatory disorders experience difficulties establishing appropriate sleeping and eating patterns, are unable to calm or console themselves, and may overreact to environmental stimuli. [40]Although there is no description or provision for this diagnosis in the Diagnostic and Statistical Manual Text Revised (DSM-IV-TR), it is a category in the diagnostic manual of the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood (DC: 0-3R). Here, it is recognised as the Regulation Disorders of Sensory Processing (RDSP) thus giving emphasis to the fact that sensory processing difficulties are a fundamental indicator examined in these disorders.[41]

Research has identified attention-deficit hyperactivity disorder (ADHD) and autistic spectrum disorder (ASD) or pervasive developmental disorder (PDD) as two of the biggest contributing conditions to RDSP. Because of this close association, diagnostic dilemmas often become apparent, when children have co-morbidity of RDSP and ADHD or PDD or at other instances are misdiagnosed. [42] The association of all these diagnoses with SPD, as well as other conditions including anxiety related conditions (Selective Mutism) and developmental delay were of importance in this pilot study and were included in the sample.[43]

Children diagnosed with Learning Difficulties (LD) or psychiatric disabilities such as ADHD, ASD or PDD are also frequently found to have difficulties processing sensory input. [44]

2.3.1 Learning disabilities (LD)

Sensory Processing Disorder is commonly present in the children with LD and contributes greatly to the scholastic challenges facing these children. While research indicates that sensory processing problems are found in up to 70% of children who are considered learning disabled by schools, the problems of SI are not confined to children with LD. [45,46]

2.3.2 Attention Deficit Hyperactivity Disorder (ADHD)

Hallmark symptoms of ADHD which impair the child's ability to function optimally in any environment include inattention, impulsivity and distractibility. [47]Extensive research has been conducted on the ADHD child's distractibility by extraneous stimuli, and its association with the inability to adequately process and respond to sensory input. [13,48-53]

Ayres (1979) theorised that in ADHD decreased sensory processing abilities leads to over stimulation and reaction to stimuli that are commonly ignored or filtered out. This was thought to be the reason for the ADHD child's constant reaction to extraneous stimuli, making the child appear distracted and overactive.[21] Almost two decades later, Bennett and Dunn [38] used the Sensory Profile to compare the sensory behaviours of children with ADHD to those of typical children and found statistically significant differences between the two groups, within sensory seeking, emotionally reactive, and inattention/distractibility factors. [2] When the sensory processing behaviours of children with ADHD were analysed on the Sensory Integration and Praxis Tests (SIPT) they could not really be distinguished from those children without ADHD on the basis of these scores. However areas of relative weaknesses with sensory processing of vestibular input, space visualization and in most areas of praxis were noted when in children with ADHD. [54]

When considering sensory modulation in children with ADHD in particular, a physiological study in 2001 investigated the presence of SMD by gauging their responses to repeated sensory stimulation. Electrodermal reactivity (EDR) was measured and compared to that of a control group of typically developing children. Children with ADHD displayed greater abnormalities in sensory modulation on both physiological and parent-report measures as well as more variability in their responses. Also, levels of SMD correlated highly with measures of psychopathology. [55]

A later study in Israel correlated SMD with psychopathological components of behaviour and emotion. Mothers' perceptions of the responses of their preschool children, with and without ADHD, to sensory events in daily life indicated that children with ADHD demonstrated statistically significant differences in their sensory responsiveness, sensory processing as well as behavioural and emotional responses. The study further suggested that young children with ADHD may be at an increased risk of various sensory processing difficulties unrelated to their core ADHD symptoms.[56] Also, various analyses of somatosensory processing depict the presence of tactile defensiveness or hyper-responsiveness to touch in a marked percentage of the ADHD population.[53,57]

Of interest, a study published in February 2008 indicated that tactile defensiveness is gender-specific as the females with ADHD displayed higher levels of tactile defensiveness than males with ADHD. [57]

In 1998, Meyer conducted a study of the prevalence of ADHD in North Sotho speaking primary school children in South Africa and found that boys (9.6%) were more affected by girls (4.4%). [58]

2.3.3 Autistic Spectrum Disorder (ASD) or Pervasive Development Disorder (PDD)

Another prevalent developmental disorder which has a strong link with sensory processing disorder is ASD which occurs in one to six children out of 1000. [59] Although the diagnostic criteria for autism or PDD does not include the quality or frequency of sensory responses [47], abnormal responses to sensory experiences have been studied and are accepted as clinically significant [60-64] in these children. In particular, researchers in the field of OT have attributed the atypical and often peculiar behaviours (such as repetitive stereotyped behaviours, self-stimulation, or strong aversive responses to commonly occurring sensory experiences) observed in these diagnoses[65] to sensory experiences. These atypical, peculiar behaviours are noted to create functional impairments in all environments and interfere with daily classroom tasks.

Bennet and Dunn when describing the sensory profile of children with autism, indicated that they display a high incidence of oral sensitivity, inattention and distractibility as well as perceptual or fine motor skill delay.[2] Studies have generally been conducted on children with PDD, who especially show high arousal and anxiety levels. [66-72] In 1997, Greenspan & Wieder found that 95% of the 200 children with autism reviewed in their study had sensory modulation difficulties.[73]

2.3.4 Anxiety-related Disorders

Selective mutism, an anxiety-related condition in which the child display's a lack of speech in unfamiliar situations (most commonly at school) [74,75] is also related to sensory processing difficulties.

Physiological studies of children with selective mutism have suggested that their sympathetic nervous system does not function optimally. That is, they experience chronically high levels of sympathetic nervous system arousal accounting for many of the manifestations of inhibition (e.g., reduced exploration to avoid over stimulation) [76] as well as having a lower threshold for sympathetic arousal in response to certain external stimuli causing them to have sensory sensitivities (e.g. sensitivity to certain noises or smells). [75] As described earlier, high levels of sympathetic nervous system arousal are evident in children with SMD due to suboptimal parasympathetic nervous system functioning inhibiting homeostasis between the two systems to take place.[12]

2.4 MEASUREMENT OF BEHAVIOUR RELATED TO SENSORY PROCESSING

Dunn and Ermer have suggested in their investigation of the sensory profile that patterns of behaviour associated with certain disorders can be reflected in populations of children without disabilities. Nonetheless, the frequency or intensity of these behaviours differentiates the groups. Thus although sensory seeking behaviours may be observed in typically developing children, the frequency and intensity of these behaviours is much more prominent in children diagnosed with ADHD for example. [38] The Short Sensory Profile (SSP), an assessment developed by Dunn, has therefore been used in research in discriminating groups of children with the diagnoses described above from typically developing children as well as utilised in accurately classifying the sensory profile for each disability category.

The sensory profile for each disability category reflects certain behavioural patterns which are a result of the child's sensory processing difficulties and closely resemble patterns of behaviour accepted as symptomatic for the diagnostic group into which they fall. [2] Currently many studies derive their sensory diagnostic data of children with and without disabilities using the SSP.

2.4.1 Short Sensory Profile (SSP)

The Short Sensory Profile evaluates the behaviours indicative of sensory processing dysfunction such as discrimination and registration (over or under response) to touch, taste, smell, sound, vision and movement input. [13] The SSP is comprised of a parental report of observed behaviours and the frequency or intensity of which these behaviours occur within the child's natural environment. Parents are often uniquely intuitive regarding their child's behaviour and are able to highlight behaviours not readily observed in traditional testing arenas. [2]

Research into parental rating scales has shown them to be a trustworthy source of information. These studies have shown that correctly interpreted parental concern expressed on rating scales can be as accurate as developmental-behavioural screening tests used when trying to detect children with disabilities.[77-81] Literature reveals that the reliability and validity of the SSP are outstanding as internal reliability (using Cronbach's alpha) is researched to be >0 .95 for a sample of children with and without disabilities. Subscale reliabilities (0.70-0.90) across three samples have been found.
Furthermore, discriminant validity has been proven, as the SSP is especially useful in establishing symptomatology in children with SPD in comparison to a typically developing child of the same age. [32]

Parent rating scales often need to be compared to more objective data in research situations. Objective rating scales are seen to be a good tool to collect systematic information from the classroom setting, an environment which is known to be rich in diagnostically important information.[82] In order to observe the participant's in-seat behaviour during the handwriting lesson, a widespread search was conducted so as to find an observation scale appropriate for the classroom setting and precise in measuring the attention (i.e. sustained attention, ability to focus) and behavioural expectation of a student whilst seated at the desk.[83,84]

2.4.2. Daily Behaviour Assessment Scale

Of all the current literature reviewed, few measures of observation of behaviour for children that were relevant to the natural classroom setting were found. [85] The rating scale found most suited for the needs of this pilot study to assess behaviour in the natural environment was the Daily Behaviour Assessment Scale. This scale allows a teacher or health professional to observe and assess the child's behaviour. Edwards, a South African occupational therapist, formulated this checklist "to gauge how much change was taking place immediately after a therapy session, and how long the effect was evident."(p 25) [86] Edwards derived this rating scale for teachers to monitor the child's daily performance in the classroom in addition to encouraging therapist-teacher communication through the teacher giving the therapist ongoing report-back of the child's classroom behaviour. [82,86]

2.5 FACTORS INFLUENCING TREATMENT OF SENSORY MODULATION DISORDER

In order to implement an intervention programme in the classroom, particularly while the child is expected to work while seated, it was important to know what factors should be considered in implementing a programme to influence behaviour related to SMD.

2.5.1 Medication

Children diagnosed with psychiatric conditions often are prescribed pharmacotherapy to positively influence their behaviours, mood or anxiety level. Literature and classroom evidence indicates that impulsiveness and inattention to scholastic tasks, seen in a child diagnosed with ADHD, when not on medication, changes to adequate academic performance when medicated. Thus pharmacotherapy was an important external factor that needed to be considered in each observation during this pilot study. Medication commonly used to aid children's concentration in the classroom environment, include psycho-stimulants, Concerta and Straterra, Risperidone (Risperidol) and Valproic acid (Epilim).

The effects and intended side-effects of all these medications to help monitor the drug's effectiveness and safety were therefore reviewed.[8] Psycho-stimulants are prescribed to increase attention and concentration and decrease impulsiveness and hyperactivity in children and adults with ADHD. Concerta (Methylphenidate) is a long-acting extended-release tablet. It is usually taken once a day in the morning with or without food.

Concerta belongs to the Methylphenidate drug family which is a class of medications called central CNS stimulants. The side effects are mainly to the CNS (i.e. nervousness, difficulty falling asleep or staying asleep, dizziness, headaches) or gastro-intestinal (nausea, vomiting, diarrhoea, loss of appetite, stomach pain) based. Straterra is a part of the Atomoxetine class of medications which are called selective norepinephrine reuptake inhibitors. It comes in a capsule form that is taken orally. Atomoxetine also has the potential of producing gastrointestinal (i.e. heartburn, nausea, vomiting, loss of appetite, weight loss, constipation, stomach pain) CNS (i.e. excessive tiredness, dizziness, headache, mood swings), Autonomic Nervous System (ANS) (i.e. dry mouth, sweating, hot flashes, burning or tingling in the hands, arms, feet, or legs) and systemic (difficulty urinating, muscle pain) side effects.[87]

A review of the short- and long-term safety and efficacy of psycho-stimulants for the treatment of children with ADHD concluded that psycho-stimulants displayed efficacy and safety in short-term studies. Longer-term studies showed no conclusive evidence that careful therapeutic use of psycho-stimulants was harmful. [88]

Risperidone (Risperidol) is used to treat behavioural problems such as aggression, impulsivity, self-injury, and sudden mood changes in children and teenagers diagnosed with autism between the ages of 5-16 years.

Risperidone is in a class of medications called atypical antipsychotics and may cause ANS (i.e. dry mouth, increased saliva), CNS (i.e. anxiety, agitation, restlessness, difficulty falling asleep or staying asleep, drowsiness, dizziness), gastro-intestinal (i.e. nausea, vomiting, diarrhoea, constipation, heartburn increased appetite, weight gain, stomach pain) and systemic (i.e. vision problems, muscle or joint pain, dry or discoloured skin, difficulty urinating) side effects. [87]

Although Valproic acid (Epilim) is primarily an anticonvulsant it is often used in children for its mood stabilising properties, treating outbursts of aggression or in assisting thinking, learning, and understanding. Valproic acid may cause many side effects in gastrointestinal (i.e. diarrhoea, constipation, heartburn, changes in appetite, weight changes), CNS (i.e. drowsiness, dizziness, headache, agitation, mood swings, abnormal thinking, memory loss, uncontrollable shaking of a part of the body, loss of coordination, uncontrollable movements of the eyes, blurred or double vision, ringing in the ears) and systemic (i.e. back pain, stuffed or runny nose, sore throat, hair loss) regions. [87]

2.5.2 Diet

The child's diet is another variable that needs to be considered. Good nutrition is important in enhancing brain functioning and learning and essential for optimal scholastic achievement. Several dietary components, such as protein, fat, B vitamins, iron, chorine, and antioxidants, support brain function and neurotransmitter activity. [89,90] Compelling research confirms that breakfast consumption is important as it reduces physical symptoms (of stomach pain, headache, muscle tension, fatigue) and enhances scholastic task performance (attention, concentration, memory, problem solving). [89,91] A study conducted by Swensson on nutrition and its effect on learning in primary school children found that post intervention (following a healthy eating plan), 50 percent of the students showed an improvement in their behaviour and academia.[92]

On the other hand, 'bad' nutrition comprising of food colourants and preservatives have been found to exacerbate hyperactive behaviours (inattention, impulsivity, and overactivity). Research findings show that these adverse effects are not just seen in children with extreme hyperactivity (i.e. diagnosed ADHD), but can also be observed in the general population and across the range of severities of hyperactivity. Increased hyperactivity is associated with the development of learning difficulties and therefore these adverse effects could negatively affect the child's potential to attain optimal scholastic achievement. [93-95]

2.5.3 Sleep

Sufficient sleep is another variable needed for adequate learning to take place. Sleep theorists' hypothesise that the brain produces and consolidates neural networks for memory and cognition during the rapid eye movement (REM) phase of sleep. The National Sleep Foundation of America stated that shortened sleep encroaches on the required time for restoration the body needs for muscle repair, memory consolidation and release of hormones regulating growth and appetite. This results in poor concentration, poor decision making and difficulty in engaging optimally in scholastic and social events. [96]

Recent research on children has further associated the importance of sleep to behaviour and mood as well. A child who is sleep deprived appears hyperactive, impulsive, experiences mood swings and may be less apt to listen or pay attention, thus exhibiting behaviour similar to children diagnosed with ADHD. [97]

2.5.4 Stressors

Lastly, the presence of possible stressors (situational or emotional) the child may be experiencing is another external factor which may influence the child's level of internal distractibility thus negatively impacting on in-seat behaviour and ability to concentrate.

2.6 OCCUPATIONAL THERAPY FOR SENSORY MODULATION DISORDER

All individuals require a certain degree of sensory experiences to be skilful, adaptive and organized in their daily lives. In order to function optimally in the classroom, a child must be able to register, process, and respond appropriately to sensory input.[98-102] Children with SMD often experience difficulty in achieving and maintaining an appropriate level of arousal to remain attentive and engaged in the classroom.

Furthermore, the busy multi-sensory classroom environment is often unpredictable (e.g. disruptions), [98] potentially influencing the child's level of arousal [18] as well as making it difficult for children with SMD to respond appropriately to incoming sensory stimuli. [2,52,103] As children with SMD may struggle to participate appropriately within traditional classroom expectations, their sensory needs should be considered by both therapist and teacher when implementing methods to manage classroom behaviour.[98] In 2001 Mulligan reported an increased need for therapists to design strategies to enhance school performance in children with attention difficulties. [15] A study examining the intervention success of weekly collaborative consultation between therapists and teachers found an overall positive effect suggesting that when occupational therapists and teachers collaborate on behalf of students, they can facilitate student success in a variety of performance areas.[104]

2.6.1 Sensory Diet

In using the sensory integration frame of reference, the occupational therapist can provide the teacher with specific intervention techniques that can enhance the child's performance in the typical multi-sensory classroom setting. This intervention technique is called a school based sensory diet.[3-5,105,106] The sensory diet is a planned and scheduled activity programme designed to meet the sensory needs of the child's nervous system by providing successful strategies for self-modulating sensory input. The premise behind sensory modulation strategies is to provide the CNS with the type of sensory stimuli that bodies need to attain and maintain an optimal state of arousal for learning.[3,15,18]

Thus the sensory diet serves as an important intervention strategy in assisting the child with SMD to reach his or her optimal level of functioning through designing an environment that provides sensory modulation strategies which include the child's preferred stimuli and that control the stimuli the child perceives as aversive.[2] It includes a combination of alerting, organizing and calming sensory strategies that can fulfil the sensory needs of sensory modulation dysfunctional children. [6,107,108]

King described that although SI therapy works with all the senses, the vestibular, tactile, and proprioceptive senses are predominantly used as they are large sources of calming and organising input. [109] The calming and organising sensory inputs included in the sensory diet formulated for this pilot study are reviewed and include vestibular input, proprioceptive input, deep pressure touch input as well as the Wilbarger brushing and joint compression protocol :

2.6.1.1 Movement or Vestibular Input

The vestibular system is located in the inner ear. Anatomists regard the vestibular system as the internal compass of the human body as it is the reference point against which other sensory input is measured. This evaluation allows the CNS to obtain information on the location of a stimulus, spatial and temporal concepts, body orientation to the environment and hence ultimately contributes greatly to the organization of body and brain for effective, everyday functioning. [36,110]Thus, the vestibular system works continuously and provides the body with a great source of sensory (vestibular) input which further impacts on arousal levels. [109] Vestibular input plays a role in creating an optimal learning condition for the brain. Studies suggest a connection between vestibular input and increased levels of alertness, cognitive (mental function and learning) and motor (reflex integration, gross and fine) development. [111-113] In 1985 Bass completed a study whereby six learning disabled children engaged in running for 45 minutes in the morning prior to school. The increased sensory and motor input received in running was correlated with increased attention when participating in class work.[114]

This finding is further supported in animal studies done in 1999 which revealed that regular exercise in the form of running (linear vestibular input) may trigger the growth of new brain cells responsible for learning and memory. [115] Furthermore, in a teacher survey conducted in northern New England, the use of motor breaks was observed to be one of the strategies receiving the highest frequency and effectiveness ratings in improving the performance of children with ADHD.[15]

This data is congruent with an experimental study investigating the impact of break time on classroom behaviour of fourth graders. The participants were observed to be more on-task and less fidgety in the classroom on days when they had had break time.[116] In turn, these results are in keeping with the findings of a meta-analysis done on almost 200 studies on the effect of exercise on cognitive functioning that suggests that physical activity supports learning. [117]

Another means of providing vestibular input to a child when in the classroom is through the use of two external assistive devices utilised as alternative seating (i.e. therapy ball and inflated seat cushions). These may help students regulate their arousal level through movement and increased sensory input to the brain whilst executing deskwork. Sensory Integration theory postulates that increased movement input opportunity may regulate arousal levels thus improving classroom in-seat behaviours and sustained attention. [85,118,119]

2.6.1.2 Proprioceptive Input

The proprioceptive system gives the nervous system input on the position of muscles, joints and tendons. Proprioceptors are the neuroreceptors in all our muscles, tendons, joints and ligaments and are stimulated when a joint is moved, compressed or stretched. Thus, as the proprioceptors receive input whenever movement occurs, they provide the body with a large source of sensory input. Proprioceptive input can vary in intensity. The heavier and more intense the proprioceptive input, the greater the effect of the input. [109] The vestibular and proprioceptive senses work in tandem to provide the CNS with a stable frame of reference against which others sensory inputs may be interpreted. Information received from these two systems i.e. orientation of body (from proprioceptors) and head (from vestibular receptors) contributes to total-body awareness and control. [36]

2.6.1.3 Deep pressure touch input

Extensive research on the effect of deep pressure all concur that it has a calming and organizing effect on the child who is “out of sync” with his / her external sensory world. In a variety of clinical settings, deep pressure has been found to have positive effects. [120,121] Sensory strategies for deep pressure, such as rolling a child up in a gym mat, making a "mat sandwich" with the child as the “filling”, having the child rest under a munch mat or pile of pillows, or following the Wilbarger brushing and joint compression protocol are used in SI therapy to calm children with sensory modulation difficulties. [21,122]

Moreover, studies using weighted vests, which provide the child with deep pressure input, have shown an increase in on-task behaviour, attention span, as well as a decrease in aggressive and self-stimulating behaviours. [67,100,123-125] Perhaps one of the most precise measurements of the effects of deep pressure input is research conducted on Grandin's Hug Machine, a device that allows self-administration of body pressure applied along both sides of the person's body, with lateral pressure pushing inward onto the body. As a result, this "squeeze machine" purely provides the person with a whole body experience as deep pressure is applied to a wide area of the body. Through working with children, Grandin reported that 5 minutes of sustained use of the squeeze machine was the minimum typically required period needed to obtain a readily detectable calming effect. Thus, these research findings support the hypothesis that deep pressure touch input may have a calming effect for children with autism, ADHD and LD. [66,122,126]

2.6.1.4 Wilbarger Brushing and Joint Compression Protocol

The Wilbarger brushing and joint compression regime is another major treatment modality used in SI therapy, which provides the child with a combination of deep pressure touch input and proprioceptive input. It is specifically recommended for use with children who have SMD with manifestations of sensory defensiveness (over-responsiveness to sensory input). [127]

A specific non-tickling, non-scratching and frictionless surgical brush is used to make firm, brisk movements over most of the body (especially the arms, legs, hands, back and soles of the feet) to provide deep pressure. [106] A technique of systematic deep joint compression follows the brushing. Research conducted in examining the effectiveness of the Wilbarger Protocol in treating sensory defensiveness has noted improvements in behaviour (better social interaction, less temper tantrums, reduced anxiety levels)[102] and sensory processing. [102,128] Physiological research using salivatory cortisol to measure the effects of the Wilbarger protocol on sympathetic arousal found that all the participants' cortisol levels moved in the direction of modulation indicating that the Wilbarger Protocol has a calming and organizing effect on sensory modulation.[129]

2.6.2 Effectiveness of Therapy

In the past 35 years the effectiveness of occupational therapy using a SI approach has been largely reviewed by a number of authors. [130]

2.6.2.1 Occupational Therapy Sensory Integration

Meta-analysis and systematic reviews in the 1980s of earlier studies revealed that the SI literature supported the effects of SI therapy, especially when the therapy modality used was vestibular input and when the dependent measure was some type of motor reflex, language, gross or fine motor evaluation. [111,113,131-133] These studies are however outdated.

In the following decade separate systematic reviews were conducted by a number of authors, such as Polatajko and colleagues in 1992, Hoehn and Buameister in 1994 and a meta-analysis done by Vargas and Camilli in 1999. Although noteworthy effect was replicated for SI treatment effects in earlier studies, these reviews agreed that the latest studies did not show overall positive effects and it was unclear whether OT-SI was more effective than various alternative treatment methods.[16,134,135] However, the meta-analysis conducted by Vargas and Camilli has been criticised as having notable methodological flaws including extremely small heterogeneous sample sizes, very broad treatment descriptions and a lack of power to the extent that if an effect was present it was unlikely to be detected. [130,136]

Research studies into the effectiveness of OT-SI have thus shown mixed results.[5,137] This phenomenon is not only related to OT-SI, however, but is a concern that is shared with other well-known paediatric treatment modalities of neurodevelopmental therapy, optometric visual training and auditory integration therapy. The Institute of Child Health at the University of Cape Town conducted a scientific literature review of the results of controlled and other studies performed in the course of the last 25 years on the effectiveness of these physical interventions commonly recommended for children with neurodevelopmental delay. There was an the absence of scientific evidence for efficacy patterning in all the therapies reviewed as controlled studies failed to provide evidence to support claims made for the interventions examined. From the findings of the literature review the Institute of Child Health did not recommend any of these therapies for children with neurodevelopmental delay.[138] However, this deduction is viewed to be controversial as the beneficial effect of these therapies is observed clinically.

In demonstrating the effectiveness of OT-SI and of these other therapies, researchers are often limited to observable behaviours. In turn, research is often geared to reflect belief systems and the assumptions about the behaviours which are expected to be influenced by the different therapies. [139] Clinical observation has indicated that OT-SI affects factors such as a child's attention, organisation, motor planning as well as academic and motor performance. [5,140 141]

OT-SI has also shown to significantly improve goal-directed tasks and bring about a behavioural change in autistic children. [142]

Consecutively, key limiting factors of research into OT-SI include flaws in assessment techniques (e.g. lack of control for tester bias) and study design (e.g. maturation not controlled for).
There is often a paucity of funding and with treatment efficacy studies being expensive and difficult to carry out, smaller samples are inevitably recruited. The sample is inherently heterogeneous of the population of children affected by SI dysfunction leading to a lack of control group and producing a non-equivalence of groups at pre-test. In addition to these methodological and design problems which seriously cloud interpretation of research results on OT-SI, the treatment procedures analysed are not always specifically OT-SI based.

For this reason, alternative explanations of positive outcome as well as ambiguous research findings among studies appear related, in part, to the conceptual foundation of OT-SI. Moreover, true SI difficulties vary from one individual to the next and changes in response to the individual's response to therapy makes a concise description of research findings difficult. [143] [144] [145] [5] Research findings are currently being assessed as accurate by inspecting data in terms of best available level of evidence. This means identifying the research that is least susceptible to bias, more generalisable and which has utilised methodologically sound techniques. The gold standard for outcomes based studies is randomized controlled trials (RCTs) which compare the targeted intervention to either an active alternate placebo group, or to a no treatment group or to both. There are four criteria needed to achieve a RCT. These include an objectively defined homogeneous sample, manualised intervention (i.e. using a detailed written manual to define the intervention and allows treatment to be replicated), meaningful outcomes that are sensitive to hypothesized changes and rigorous methodology. [136,146]

In this literature review the studies were scrutinised using the criteria stipulated by the Australian's National Health and Medical Research Council.[147,148] Only one recently previously published study evaluating the outcome of OT-SI could be located that met the above-mentioned criteria. This reported study (level of evidence: II) was conducted by Miller, Coll and Schoen and set out to investigate if OT-SI better ameliorates attention, cognitive/social, sensory, or behavioural problems than an active alternate placebo treatment (using an activity protocol) or a passive placebo (received no treatment as were on a waiting list).

It encompassed a culmination of 10 years of research on various pilot studies, used a homogeneous sample, a manualised treatment, had outcome measures sensitive to change from OT-SI and most importantly had randomisation to treatment groups with blinded evaluators. The OT-SI group, compared to the placebo and no treatment groups, made significant gains on goal attainment scaling, on the Attention subtest as well as the Cognitive/Social composite of the Leiter International Performance Scale Revised. Furthermore, improvement trends on the SSP, Child Behaviour Checklist, and EDR were evident in the OT-SI group in comparison to the control groups.[136]

Only a number of other studies could be found meeting only a few of the above-mentioned criteria. The previously mentioned study using salivatory cortisol to measure the positive effects of the Wilbarger protocol on sympathetic arousal used precise assessment technique and measured specific sensory integration effect physiologically.[129]

In 2003, a comparative study with a concurrent control group (level of evidence: III-2) evaluated the effectiveness of the Sensory Integrative Protocol (SITP) in treating children with pre-primary impairments using an experimental and control group. Accurate assessment techniques (DeGangi-Berk Test of Sensory Integration and the Miller Assessment for Preschoolers) were used. The results of this study depicted that "Sensory Integration Treatment Protocol" based on the theory of SI is effective in reducing SI dysfunction and improving pre-school performance in children diagnosed with pre-primary impairments. [24]

Positive effects for SI therapy were also noted in two other comparative (level of evidence: III-2) studies as well. Humphries, Snider and McDougall's "Clinical evaluation of the effectiveness of sensory integrative and perceptual motor therapy in improving sensory integrative function in children with learning disabilities" study showed significant improvement in the participants' SI functioning after receiving 72 one hour therapy sessions for three hours per week.[149] In their investigation on the effect of SI therapy on smooth pursuit eye movements, tracking and learning time Horowitz, Oosterveld and Adrichem reported that the treatment group displayed a significant reduction in the number of saccades eye movements, time necessary to accomplish smooth pursuits and organizational time after 6-9 months of one hour weekly SI therapy.[150]

A third level III-2 evidence study explored the effectiveness of SI therapy for ADHD. Although only one measure showed a treatment effect most reflective of SI, on the whole no significant differences between the experimental and control groups were evident thus failing to show any improvement attributable to SI.[151]

In 1997 Boruch described the implementation of rigorous effectiveness studies as complicated and stressed that pilot studies were required prior to initiating the intended study so as to resolve problematic issues.[152] Three years later Portney and Watkins highlighted that pilot studies needed to be conducted prior to the final study so as to identify limitations that could have an impact on the final study through testing the feasibility of methods, defining selection criteria, choosing appropriate outcomes and clarifying programmatic issues.[153]

In order to determine whether OT-SI is effective Miller, Schoen, James and Schaaf stated that a single study cannot justifiably answer such a complex question and emphasised the importance of conducting a pilot study to prepare for a randomized controlled study of the effectiveness of OT-SI.

More specifically, there is only a small number of studies of SI that have examined the immediate effects (such as child's attention and organisation) of a sensory diet used for facilitating an optimal level of arousal for learning in the classroom[5,15,16,154].

Six level of evidence: 4 (case series) studies involving single case series of therapy balls, inflated seat cushions, weighted vest and sensory diet usage were found. Again, most of these studies have used single system designs which although can produce accurate results are generally too prone to bias to allow determination of their validity beyond their immediate setting.[147]

2.6.2.2 Use of Sensory Strategies

In 2003, Schilling and colleagues used a single participant, A-B-A-B interrupted time series design to investigate the effects of therapy balls as alternate classroom seating as a sensory strategy for children with ADHD. Results depicted improved in-seat behaviour and legible word productivity in these children. Also, therapists and teachers reported observing substantial student differences in a change in movement patterns (e.g. bouncing, gentle rocking) while seated on the therapy balls which although might be seen as fidgetiness it could be indicative of self regulation in each student modulating according to their personal sensory need so as to maintain an optimal state of arousal for learning. [52]

A year later Schilling and Schwartz evaluated the frequency of specific behaviours (attention and engagement), of four children with autism before, during and after the use of therapy balls as alternate classroom seating.

Both studies suggested similar results for the same intervention and showed that the participants displayed improvement in their in-seat behaviour and engagement during the use of therapy balls for alternate classroom seating.

However, these studies findings are weakened by the fact that limited external validity and generalisability across a wider population are present due to the study method (single participant design, limited participants, no control group) and data analysis (no standardised outcome measures, measurements were opinion based and participative in nature) used. Nonetheless, this research has depicted a clinically important difference in behaviour of children with ASD and ADHD when seated on therapy balls. In practice, therapy balls have already been launched as alternate classroom seating arrangements in Switzerland and in a private school in Florida. Literature reports that children in the private Florida school have demonstrated overall improvements in work habits, particularly in attention and classroom behaviour, when seated on the therapy balls. This is because when using a therapy ball as a seat, the child is offered the opportunity to self regulate via vestibular input by actively moving so as to maintain an optimal arousal level. [18,44]

Findings of another time-series study investigating inflated seat cushions, a different type of seating alternate, showed trends that correlate with the findings of increased in-seat behaviour and decreased out-of-seat behaviours from Schilling and Schwartz's 2004 study on the use of therapy balls as a seating alternative for children with autism. Of interest, a statistically significant increase in fidgety behaviours was observed in both studies when the participants sat on either seating alternative. The fidgetiness is hypothesised as a need for movement so as to modulate the environmental sensory input in order to enhance their level of arousal for adequate learning. [85,103]

In 2001 research was conducted in two studies on the use of weighted vests as a sensory strategy with children with ASD and ADHD. One study using a quasi-experimental, single system AB design found that weighted vests increased on-task behaviour during fine motor activities in children with ADHD [124] whilst the other ABA single participant design found that the use of weighted vests increased duration of attention to task, decreased the number of distractions as well as self-stimulatory behaviours in preschoolers with PDD. [67]

Although these studies showed improvement in specific behaviours associated with the use of weighted vests, both studies are weakened by the small sample sizes used. The ABA design is preferred over the AB design as it used a withdrawal phases to examine latent effects of wearing the weighted vest and thus decreased any effects due to maturation and practice. [44,155]

Only one study could be found investigating the use of a sensory diet (without external assistive devices) coupled with individual occupational therapy intervention with six autistic preschool children. This multiple case study design reported overall improvement (increased tolerance to sensory stimulation and positive experiences during the sensory motor play) as evidenced through higher engagement levels and higher frequency of verbalization. Although this research is analyzing the use of the sensory diet, it is not done in isolation (as it explores individual OT intervention as well). [156]

After reviewing the literature it is evident that sensory strategies providing vestibular (therapy balls or inflated cushions for seating) and proprioceptive (wearing a weighted vest) input appear to improve classroom behaviours and attention in children with self regulatory psychiatric disabilities such as ASD and ADHD. Nevertheless, more extensive research with careful design and precise data analysis is necessary to determine specific guidelines and protocols for sensory strategy interventions. [44]

2.7. Conclusion

A child's ability to access learning opportunities in the classroom is believed to be affected by his or her capacity to pay attention and demonstrate active (i.e. visible behaviours indicating participation and engagement) or passive (i.e. quiet activities such as looking at the teacher while listening in class) on-task behaviours. [84,157-160] On-task behaviour, whether the child is actively or passively engaged, is associated with learning as when a student is attentive and engaged during a lesson, more learning opportunity if afforded.[85,103,158] Children with psychiatric disabilities such as ASD, PDD, ADHD and LD often have difficulties processing and interpreting sensory information contributing to difficulties in on-task behaviours in attending to and being productive at schoolwork. As a result, children with sensory processing difficulties often engage in various behaviours (e.g. chewing on shirt or pencil, thumb sucking, fidgety or rocking in chair) in an attempt regulate their sensory systems when seated in the busy multi-sensory classroom environment so as to enhance opportunity in on-task behaviours.

Therefore, the occupational therapist's priority within the school system is to provide successful sensory strategies for children with SMD to self-modulate the environmental sensory input when trying to learn at the desk. In the United States recent law now stipulates that occupational therapists in the school system have to use evidence to support practice. [161] [103]

Presently, occupational therapists, along with other rehabilitation professionals, are experiencing an increased emphasis on outcomes based intervention so as to develop practice guidelines and justify treatment policy. [139] This is especially relevant in the school setting as a teacher may view sensory strategies as difficult to implement if little information and evidence is provided regarding the benefits on a child's behaviour and attention. Due to the large number of school based occupational therapists as well as the increasing evidence of SI difficulties in both children diagnosed with and without disabilities, further research on the effectiveness of SI school based strategies is needed. [73] Recent research [18,44,52,67,85,124] has shown that external devices (therapy ball for seating, weighted jacket) offer strategies in providing a child with SPD an opportunity to attain and maintain an optimal state of arousal for learning when in the multisensory classroom environment.

However, in light of the literature reviewed, little data is currently available on the effects of SI intervention school based strategies (without the use of external assistive devices) that help maintain and regain the child's behaviour needed for participation in academic tasks. [15] [5,12,16]. After over 35 years of research only a handful of pilot studies on the effectiveness of OT-SI are documented [9,13,32,55,130,162-167]. Moreover, there is only one published RCT pilot study of OT-SI by Miller, Coll and Schoen that is based on a series of prior pilot studies investigating the effectiveness of OT-SI on children with SMDs. Findings suggested that OT-SI may be effective in ameliorating difficulties of children with SMD. [136]

Thus, as research data is scrutinized in terms of best available level of evidence, more vigorous outcomes based research, like the study conducted by Miller, Coll and Schoen, is definitely needed in the investigation of the effectiveness of SI therapy so as to further elucidate the theory and its utility which will improve the lives of a variety of children with developmental disabilities. [167,168]

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

Chapter three examines the key constructs behind the methodology of this pilot study. The choice of research design, selection of the sample population and ethical considerations taken into account will first be discussed. The measurement techniques and research procedure will then be outlined. Lastly the collection and analysis of data will be explained.

3.2 RESEARCH DESIGN

For this pilot study a quasi-experimental research design was used with participants partaking in a four week programme. The programme was chosen to investigate the cause-and-effect relationship between the independent (sensory diet) and dependent (observable behaviours) variables. The dependent variables chosen are behaviours which allowed direct recordable observation. In using this design the researcher was able to simulate a cause-effect relationship between two the variables, i.e. sensory diet with behaviour change.

A single-group pre test post test design was used whereby the researcher measured only one group of participants successively, before and after exposure to the intervention. A single study quasi-experimental research design has been criticised for its lack of a control group with which to compare results as well as a lack of control in the research setting and situation. This type of research design is exposed to a greater number of threats of internal and external validity, which may decrease confidence and generalization of the study's findings. Nonetheless, this design of research was selected for this pilot study as it has advantages both in terms of practicality and feasibility.

This type of design supports the rationale behind and the purpose of this pilot study in investigating the effectiveness of an implemented programme in a small group of participants in the classroom environment which is as close as possible to the natural scholastic setting. Secondly, the pre-test post-test research design chosen for this pilot study is a cost-effective approach to identifying an educational and behavioural intervention.

In this pilot study the pre-test phase collected data to establish a baseline of the participants' standard of performance. During this time behaviours were observed within the controlled classroom environment allowing identification of the participants' behavioural performance patterns prior to the intervention. [18] The intervention phase refers to when the sensory diet was introduced for two weeks. The post test phase occurred on the last day of the study, after the last intervention was conducted. Two independent observers completed the modified daily behaviour assessment scale on the data collected i.e. video recordings of participants' response to being exposed to the sensory strategies. As data was collected at a pre-test phase as well as when intervention was completed in the post-test, the research design allowed for reliable and valid data to be collected over a period of time.

3.3 SAMPLE SELECTION

The pilot study was conducted in a special needs school in the Johannesburg northern suburbs. These children have been admitted to the school due to having barriers to learning adequately, such as LD, ADHD, PDD, SPD, dyslexia, dyspraxia as well as psychiatric disorders such as elective mutism.

A total of 11 participants were recruited in this pilot study from the grade one class at the school. The participants included eleven males and one female and ranged in age from seven years six months to nine years five months. Each participant had difficulty in learning and thus required special educational needs. The sample was determined and selected on the basis of its availability and were thus selected from the population of grade one children at the school. Stratified sampling was used and the sample varied in terms of gender, culture, concomitant diagnoses and medications used. Medications remained constant throughout the pilot study.

All children in the only grade one class at the school were invited to participate in the pilot study. Parental consent was obtained for 92% of children and these formed the sample. A sample size of 15 participants was calculated to effectively detect a difference between the pre and post test of 0.5 in the outcome measure of in-seat behaviour. Only 11 participants could be recruited, demonstrating 73% power for detecting a difference. This calculation was based on a standard deviation of 0.5 and a student *t*-test at the 0.05 significance [169] which better supported the premise of a pilot study aimed at South African children meeting these specific inclusion criteria:

1 Between the ages of seven to nine years old

2 In the Grade one at a school for learners with special educational needs

3.4 ETHICAL CONSIDERATIONS

Study procedures were approved by the Committee for Research on Human Participants at the University of the Witwatersrand (Appendix A). Permission to conduct the study was sought from the principal of the study venue, Cedarwood School (Appendix II), via an information letter sent to the school. (Appendix III).

Prior to the study, an information sheet that:

- described the purpose of the study
- described its potential risks/benefits
- asked for consent for the child to participate and to be videoed
- explained rights to confidentiality
- allowed for withdrawal at any time without consequence
- invited a request feedback from the study

was distributed and explained to all parents/guardians. (Appendix IV) Verbal assent was obtained from all participants. Written consent was obtained from the participants' parents/guardians. Permission from participants' class teacher and facilitators were also sought (Appendix V) to allow for the research to be conducted in their class.

After informed consent and assent were obtained and prior to the baseline session, and when requesting verbal assent, special care and effort were taken to ensure that the participants understood the information presented. The participants were assigned a number which became their identification throughout the research to maintain confidentiality.

3.5 MEASUREMENT TECHNIQUES

3.5.1 Short interview questionnaire (Appendix VI)

As reviewed earlier in the literature, a nested case-control study conducted at Peking University among 310 preschool and school children in Beijing showed that the risk factors of child sensory integrative dysfunction were mainly associated with biological and genetic factors and secondary to psychosocial factors. [170]

Thus as sensory processing difficulties which are non-conducive for learning may be influenced by certain internal and external factors impacting on ones level of arousal, it is important to account for these extraneous variables at the onset of the pilot study. Thus, the parents or caregivers of the participants were required to complete a short interview questionnaire to ascertain the participant's demographical data (age, sex, diagnosis, medication, type of therapy participant received or receiving, sleeping pattern, nutrition and degree of stress) prior to the initiation of the pilot study. With the data collected from the parent questionnaire these internal and external factors were taken into account when comparing the participants' medical, developmental and academic details with the research data. Graphical representations of this data in the form of tables, pie charts and histograms showing the degree of presence of these extraneous variables are depicted in the findings.

3.5.2 The Short Sensory Profile

The SSP (Appendix VII) was designed as a screening tool for clinicians to simply and quickly distinguish between children with and without sensory processing difficulties. The SSP is a well used research tool geared at aiding researchers to easily incorporate a sensory processing measure into their research protocols. The SSP is a self-explanatory Likert-scaled questionnaire completed by the caregiver of the child. It takes about ten minutes to complete.

It comprises 38 observations grouped into 7 components, namely [13,171]:

1. tactile sensitivity: the child's response to touch experiences in daily life
2. taste or smell sensitivity: the child's response to taste and smell experiences in daily life
3. movement sensitivity: the child's response to movement experiences in daily life
4. underresponsive / seeks sensation: the child's level of noticing sensory events in daily life

5. auditory filtering: the child's ability to use and screen out sounds in daily life
6. low energy / weak: the child's ability to use muscles to move in daily life
7. visual / auditory sensitivity: the child's response to sounds and sights in daily life

The caregiver is required to read each item and tick the box (always, frequently, occasionally, seldom, never) that best describes the frequency of the behaviour seen in the child. Each response is thereafter scored according to a point system with frequent behaviours receiving a lower score for undesirable behaviour and a higher score for desirable performance (i.e. "always" receiving 1 point and "never" receiving 5 points). Thereafter the total raw scores are calculated for each section and plotted accordingly on the appropriate classification column of either 'typical performance', 'probable difference' or 'definite difference'. 'Typical performance' is a score at or above point 1 standard deviation (SD) below the mean and indicates typical sensory processing abilities of the child. 'Probable difference' represents a score at or above 2 SD below the mean but not lower than 1 SD below the mean and signifies questionable areas of sensory processing abilities of the child. 'Definite difference', a score below the point 2 SD below the mean mark, indicates that the child has sensory processing problems. [171]

The internal reliability of the test was calculated using the Cronbach's coefficient alpha and estimated to range from 0.70 to 0.90. The SSP also has a high internal validity as findings upon examination of the inter-correlations of the SSP total and the sections scores yielded all correlations to be significant at $p<.01$. [171]

Profiling of the child's sensory system was done in this pilot study. The SSP was an important tool in this study as it was able to ascertain the appropriate sensory inputs required for each participant's sensory processing needs. With this baseline data, the aim of the pilot study of whether if when the participants received the required sensory input, observable improvement in behaviour and attention in the handwriting lesson was possible to determine. [2]

3.5.3 Pre-test and post-test videos

The participants' in-seat behaviour was observed by means of video recordings in their natural classroom environment. Three video cameras were set up in the classroom and remained there for a six week period (two week familiarisation period prior to the start of research, two week no intervention pre-test period and subsequently two week intervention post-test period).

On the two days of data recording the video cameras were discreetly switched on prior to the children entering the classroom to begin their handwriting lesson. The participants' in-seat behaviour during the handwriting lesson was recorded. In total, six video recordings were obtained for data analysis. Each video was assigned a random code so as to ensure triple-blinding of the assessors analysing the data.[172]

3.5.4 Daily behaviour assessment scale

The specific observations of the participants' in-seat behaviours on video were evaluated by means of an adapted version of *The Daily Behaviour Assessment Scale* (Appendix IX). The original rating scale was derived by an OT, R. Edwards [86], in 1986 and is based on various behaviour assessments. It was developed out of a need to rate a child's ongoing classroom behaviours and thus gauge the effect of therapy. The seven areas of behaviour that the checklist covers include concentration and attention, behaviour in class, perseverance and task completion, organisational ability, ability to cope with new situations, responsibility and initiative and emotional control.

Expert-jury validity was done through the use of seven experienced SI certified professionals marking the most overt in-seat observable behaviours that may easily be observed during a handwriting lesson. Twelve out of the 32 behaviours were selected as being the most overt behaviours important for successful classroom participation. An expert jury is frequently used during pilot studies aimed at the development and measurement of an intervention.[173] The Daily Behaviour Assessment Scale was then summarised and converted into a visual analogue scale (Appendix X).

3.5.5 Measurement of in-seat behaviours

After the pilot study was completed two independent judges observed and evaluated the recordings. The judges were trained to complete the revised Daily Behaviour Assessment scale as a visual analogue scoring system by watching the necessary required number of video recordings. Prior to the judges watching the actual recordings, inter-rater agreement (i.e. the percentage of observational units in which the judges agreed upon) was established. This was done through the judges watching five one-minute recordings and comparing and discussing the observations. [18] Once consistent inter-observer agreement was established the judges began scoring the video recordings. Preceding the evaluation of the raw data by the observers, each tape was randomly assigned a number.

Concealment was adhered to as this ensured blinding of the observers so that they were not able to tell when each tape was recorded. As this procedure entailed the observers relating the intervention to the overall theoretical SI framework so as to ensure that the measurement was actually logically related, the observers needed to have experience in SI and child development. Thus, two external occupational therapists with at least two years paediatric experience and SI certification were used to enhance the observations and produce dichotomous data and promote construct validity. [18,173]

3.6 RESEARCH PROCEDURE AND DATA COLLECTION

The study was conducted during the period of October and November 2007 in the grade one class at Cedarwood School. The data were collected on 12 in-seat behaviours in the pre and post-test phases of the pilot study by means of three video cameras which captured the 11 children at their desks.

The research was performed over a four week period during the morning handwriting lesson. This lesson was decided upon for data collection as it is a time in which the child is required to concentrate optimally when seated at the desk. Thus the in-seat behaviour and the child's level of arousal (concentration) may be carefully observed during the handwriting session. Furthermore, observing the child's performance at the desk early in the morning and not directly before a recess should eliminate the participant being hungry or having their concentration span exceeded, and ensures optimal performance.

Actual session times varied since data were collected in the natural environment and the length of time the teacher remained at the handwriting lesson varied. Thus the data collection sessions ranged from a minimum of seven minutes to a maximum of ten minutes per recording during the pre and post-test phases.

The data were collected on two days of the four week pilot study. Single-blinding was done in the participants being unaware of the specific days in which their behaviour was recorded so that this knowledge would not consciously or unconsciously influence their performance.[172] Similarly, a two week familiarisation period was done prior to the start of the study so as to limit the Hawthorne Effect i.e. that the participants were performing better on the study task since they were getting special attention in being video taped. [174]

Each participant's behaviour was recorded twice during the study process i.e. onset of pilot study (pre-test) and at the conclusion of the pilot study (post-test). However, student absences or changes in the school schedule (e.g. child leaving class to attend a therapy session) resulted in variability in the number of sessions (data points) that occurred for all the participants. Furthermore, one participant needed to be excluded due to a lack of data points. The pre-test phase ran over two weeks, allowing the researcher to accumulate an initial baseline recording of the participants' behaviour. The post-test intervention phase then ran successively over the following two weeks. During the post-test phase the sensory diet was implemented even on the days data were not being collected. At the end of the research a summary of the findings will be published and given to each participant's caregiver, the teacher and school.

3.6.1 Pre test phase (No intervention)

3.6.1.1 Obtaining permission

Consent was obtained from the school, parents / guardians and from the educators. The researcher also obtained verbal assent from each child individually. During requesting verbal assent special care and effort were taken to ensure that the participants understood the information presented. Of all the 12 children in the class, only one parent/ guardian refused consent. All 12 children were recorded however the child without consent's in-seat behaviour was not observed by the independent observers.

3.6.1.2 Determining sensory needs of participants and drawing up sensory diet

During the pre-test phase the sensory needs of the learners were established and the sensory diet was developed. The parents of the participants were required to complete a short interview questionnaire (Appendix VI) to obtain a brief personal, medical and psycho-social background of the participant together with the SSP. In conjunction with the scoring of each participant's SSP the researcher also independently observed the pre-test videos of each participant.

Therefore, the baseline data was collected from the above-mentioned transcripts, namely:

I. Short interview questionnaire (Appendix VI)
II. The Short Sensory Profile (Appendix VII)
III. Video recordings
IV. The Daily Behaviour Assessment Scale (Appendix IX)

Once the sensory needs of the participants had been established the sensory diet intervention was designed for the overall class. On the whole, the sample population's sensory profile suggested that the participants generally displayed dysfunction in their processing of sensory input and thus the need for an intervention (sensory diet) was indicated to optimise their level of arousal for learning.

As the sensory profile furthermore suggested typical sensory processing abilities for tactile, visual and auditory input these modalities were not further considered in the development of the programme.

The sample population showed sensory processing problems in sensation seeking behaviour, difficulty in filtering out irrelevant auditory input and lowered energy levels. The sensory diet was formulated by changing the participants' daily routine in introducing appropriate proprioceptive and vestibular based sensory activities that are calming and organising in nature (Appendix X) at the start of the school day.

3.6.2 Intervention

The sensory diet was implemented for two school weeks first thing in the morning prior to the first (handwriting) lesson. During this period no specific training was provided to the staff members. The sensory diet ran for thirty minutes and was executed by the researcher. The sensory diet began with a five minute pictorial review of the daily events, followed by a 15 minute period of vestibular input based activities or the execution of the Wilbarger brushing and joint compression regime. The last ten minutes comprised of proprioceptive and or deep pressure based tasks. The daily sensory diet also included various organising sensory activities / "breaks" that the teacher may do with the children when she felt that their level of arousal was not conducive for learning. Furthermore, it also encouraged the use of kinaesthetic learning in writing letters learnt in the air during the handwriting lesson. Please refer to Appendix XII for the detailed sensory diet used during the intervention.

3.6.3 Post test phase

The post-test data collection occurred on the last day of the two week period at the same time as the initial pre-test recording. Each participant's in-seat behaviour was inconspicuously video recorded during the morning handwriting lesson, which followed immediately after the execution of the sensory diet programme.

3.6.4 Control of extraneous variables

Throughout the study, the following efforts were made to hold all extraneous variables or factors constant that may have potentially influenced the end results of the study:

- The classroom activities and teacher was not altered. The cameras remained in the classroom throughout the entire study. The initial pre-test recording took place on the first day of the two week pre-test period.
- The teacher's classroom management style, expectations, and activities were not altered throughout the pilot study. Prior to initiating the study the staff was instructed not to give prompts on the in-seat behaviour throughout the duration of the study. Nonetheless, staff intervention would occur if a learner exhibited a behaviour that would be potentially destructive to the child, his peers, or teacher (e.g. throwing objects).[18]
- A familiarisation period was done in positioning the cameras video taping the participant's behaviour in the classroom at various places two weeks prior to the commencement of research so that their novelty wore off. This was of great importance as a threat to the internal validity of this pilot study was that the behaviour of the child was altered simply by the process of paying extra attention to him or her[175].

3.7 DATA ANALYSIS

Descriptive and statistical analysis was performed to examine trends in changes of pre- and post-intervention behavioural scores. The numerical data were obtained from the adjusted Daily Behaviour Assessment Scale completed during the pre and post-test phases of the research. The scale was quantified and the data was expressed in percentages and frequencies. That is, pre-and post-test behaviour was derived as the proportion of time in which the non-desirable in-seat behaviour was observed relative to the number of one min periods the child was observed (maximum 10), and then expressed as a percentage.

Descriptive statistics were performed to examine distributional properties of all variables and participant demographics. Initially pre-and post test behaviour was compared using the student's paired t-test. Because of the small sample population, these scores were also compared using Wilcoxon's matched pairs signed rank test which is a non-parametric test.

The data were also analysed using Poisson's regression to the normal distribution to calculate *p* values (using a chi-squared distribution) to compare the number of observations in a period of time intervals. Poisson regression is often used to analyse count data as it can be used to model the number of occurrences of an undesirable behaviour as a function of some independent variables.[169] In this pilot study, 'count' was the number of time intervals in which non-desirable in-seat behaviour was present and exposure was the time observed i.e. total number of one minute time intervals observed. [176] The latter methodology is preferred since essentially counts were observed over time i.e. the scenario for which Poisson regression was developed.

As the data collection sessions ranged from a minimum of seven minutes to a maximum of 10 minutes per recording during the pre and post-test phases, the use of Poisson regression was also appropriate for calculating the rate data (event rates). This statistical tool allows the event rates (count of events occurring to a particular unit of observation) to be calculated as events per unit time, allowing the observation window to vary for each unit.[177]

Thus, the incidence rate ratio (IRR) also follows from the latter and facilitates interpretation i.e. IRR< 1 suggests an improvement (reduction in incident of non-desirable behaviours) as a result of intervention and IRR > 1 indicates a deterioration of behaviour / ineffectiveness of intervention.

3.8 CONCLUSION

A single-group pre test post test quasi-experimental research design was used on a convenient sample of 11 participants in this pilot study to explore the effects before and after exposure to the intervention of a sensory diet on the in-seat behaviours of the child. The results of these findings will be discussed in the following chapter.

CHAPTER FOUR: RESULTS

4.1 INTRODUCTION

In chapter four the results of the pilot study are depicted. This pilot study evaluates the effectiveness of a sensory diet on certain in-seat behaviours of 12 grade one learners during a writing lesson. The participant baseline data is first examined in this chapter. This includes examining the demographic and sensory profile history of the participants. Thereafter other key variables (therapies and medication participants had and were currently receiving at the time of the research; specialised assistive devices used by participants; significant stressors experienced by the participants; sleeping patterns and nutrition of the participants) that may influence the participant's performance are investigated. After that, the overall performance prior to intervention is compared with the overall performance post intervention generating a single group performance score per measurement period.

4.2 DEMOGRAPHICS

Table 4.1 illustrates the basic demographics of the sample. Ultimately, the data from 11 participants (three African and eight Caucasian) recruited in this pilot study could be analysed. The participants ranged in age from seven years six months to nine years five months and included ten males and one female. Sixty four percent of the sample population were diagnosed with varying conditions. The two most predominant diagnostic categories included psychiatric conditions and LDs (i.e. dyslexia).

Psychiatric conditions included one participant having ADHD, another being Electively Mute, another having Asperger's Syndrome and two participants having Oppositional Defiance Disorder.

Table 4.1: Summary of Participants Demographics at Pre-test (n=11)

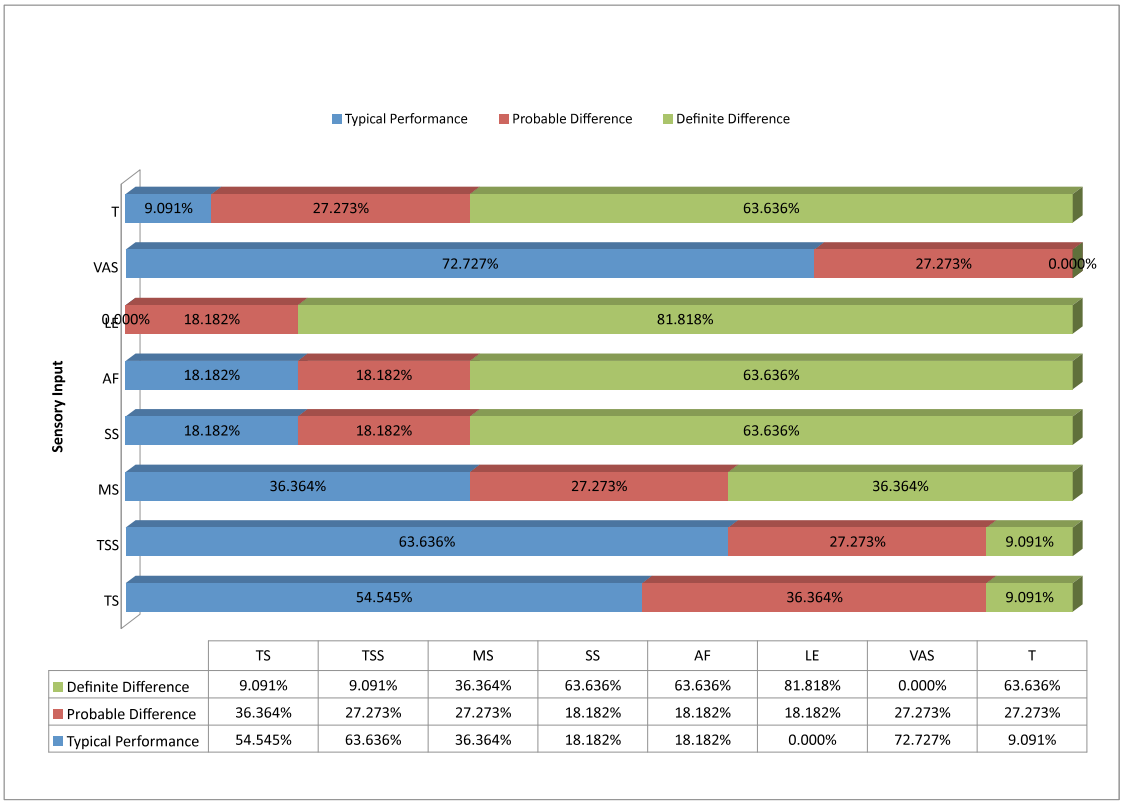
Demographic characteristic	Frequency (Percentage)
Age Range	
7-8 years old	2 (18 %)
8-9 years old	6 (54 %)
9-10 years old	3 (27 %)
Diagnosis	
None	4 (36%)
Psychiatric Condition	5 (45%)
Learning Difficulties	4 (36%)
Asthma	1 (9 %)

From the parent questionnaire it was furthermore reported that 36 % of the participants had siblings who experienced similar difficulties.

4.3 SENSORY PROFILE

Figure 4.1 illustrates the frequencies of overall sensory processing difficulties of the sample.

The sensory profile of each participant was assessed with the SSP. The participants displayed a 63 % significant 'definite difference' (dysfunction) in their overall processing of sensory input.



	TS	TSS	MS	SS	AF	LE	VAS	T
Definite Difference	9.091%	9.091%	36.364%	63.636%	63.636%	81.818%	0.000%	63.636%
Probable Difference	36.364%	27.273%	27.273%	18.182%	18.182%	18.182%	27.273%	27.273%
Typical Performance	54.545%	63.636%	36.364%	18.182%	18.182%	0.000%	72.727%	9.091%

Figure 4.1: Frequency of Overall Sensory Processing Difficulties from Sensory Profile (n=11)

KEY:

TS = TACTILE SENSITIVITY — TSS = TASTE / SMELL SENSITIVITY

MS = MOVEMENT SENSITIVITY — SS = SEEKS SENSATION

AF = AUDITORY FILTERING — LE = LOW ENERGY / WEAK

VAS = VISUAL /AUDITORY SENSITIVITY — T = TOTAL

TYPICAL PERFORMANCE: TYPICAL SENSORY PROCESSING (SP) ABILITIES (SCORE AT/ABOVE POINT 1 SD)

PROBABLE DIFFERENCE: QUESTIONABLE AREAS OF SP ABILITIES (SCORE AT OR A ABOVE 2 SD BELOW THE MEAN BUT NOT LOWER THAN 1 SD BELOW THE MEAN)

DEFINITE DIFFERENCE: SP PROBLEMS (SCORE BELOW THE POINT 2 SD BELOW **MEAN** MARK)

The sample population scored within the 'definite difference' range for sensation seeking behaviour, difficulty in filtering out irrelevant auditory input and lowered energy levels. All these behaviours often impact negatively on the child's participation when seated at the desk.

4.3.1 Sensory profile and diagnosis category

Figures 4.2 and 4.3 below compare the data collected from the parents' questionnaire concerning diagnosis of the participants with the scores of the SSP. Overall, the participants scored within the 'typical performance' range (60%) for taste / smell sensitivity and visual / auditory sensitivity and fell within the normal (typical performance) to borderline (probable difference) range for tactile sensitivity.

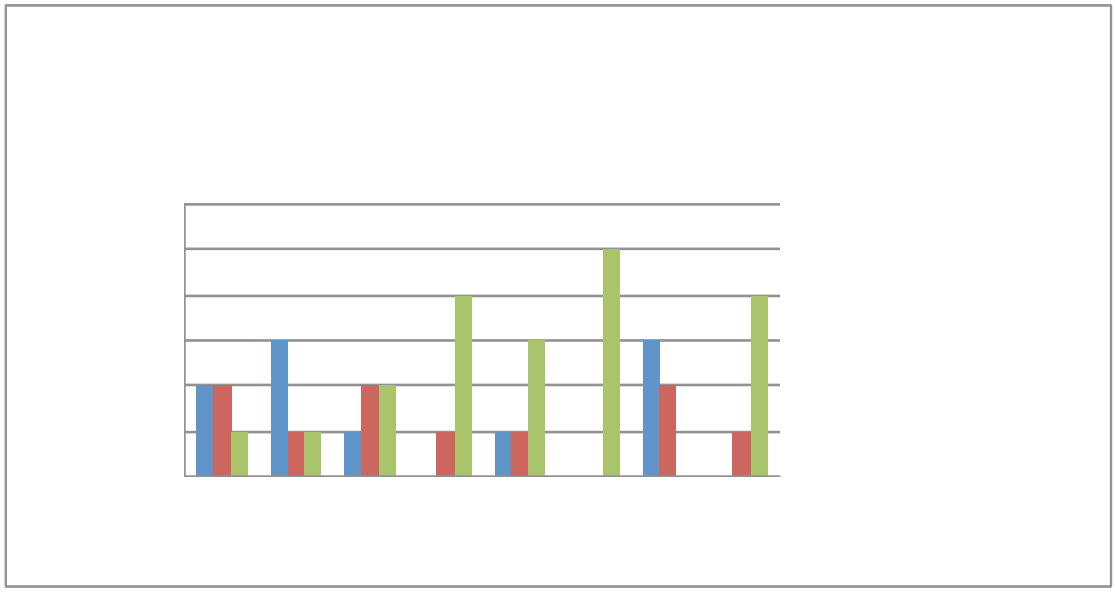


Figure 4.2: Comparison of the sensory profile of participants with psychiatric conditions (n=4)

Most of the participants showed 'probable and definite differences' in movement seeking behaviour. Three fifths (60%) of this specific sample showed a 'definite difference' in their ability to filter auditory input. The majority (80%) of these participants showed 'definite difference' in sensory seeking behaviours.

All participants with a psychiatric condition attained a 'definite difference' 100% score in *low energy* behavioural category. When reviewing the overall total score of participants with psychiatric conditions, 80% of their sensory profile fell within the 'definite difference' range of dysfunction.

The implication of dysfunction in the sensory processing of participants with LDs is especially noteworthy in the low energy category in which a 100% 'definite difference' score was attained.

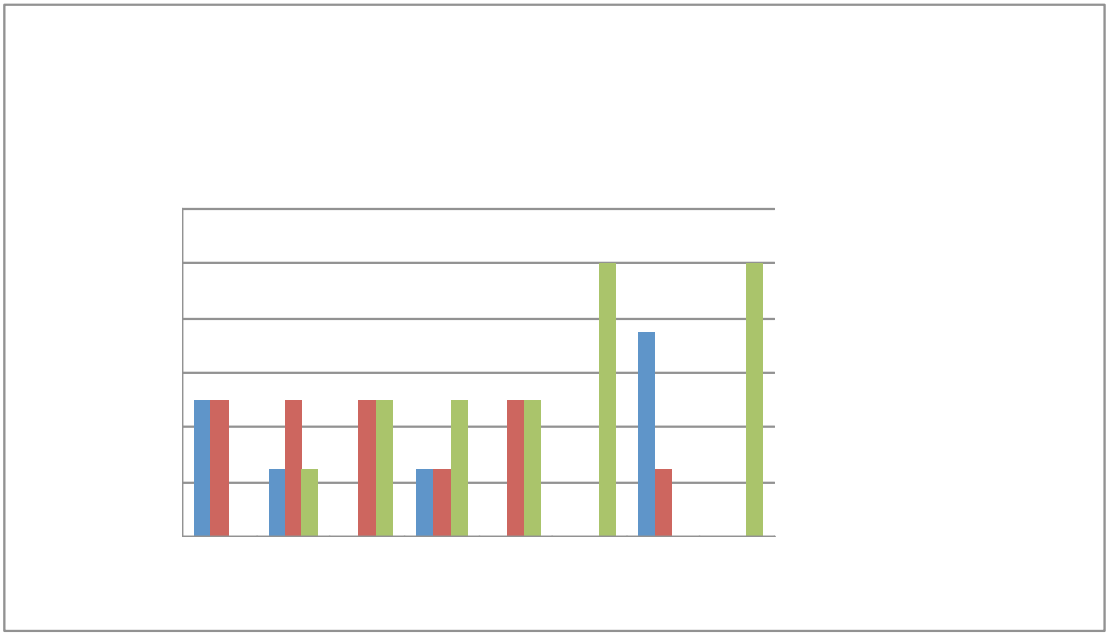


Figure 4.3: Comparison of the sensory profile of participants with learning difficulties (n=4)

The participants showed potential indicators of dysfunction for movement seeking, sensory sensitivity and auditory filtering behaviours as scores for these categories fell equally in the borderline ('probable difference') to poor ('definite difference') range. Strength for visual/auditory sensitivity was noted with these participants scoring 75% 'typical performance'.

Overall, most of the psychiatric conditions and learning disabled diagnostic categories displayed a high percentage of total 'definite differences' in processing sensory input. Low energy and movement seeking behaviours were exceptionally predominant in the two groups. On the whole, both participant groups showed no marked differences in visual and auditory sensitivities. However, differences were noted in auditory filtering (hyperresponsive- sensitive to sounds or hyporesponsive- oblivious to sounds). The participants with psychiatric conditions faired better in processing taste and smell input but showed a higher degree of sensory sensitivity as compared to the participants with LDs.

4.4 THERAPIES

4.4.1 Therapy and medication

Table 4.2 illustrates the therapy and medication history of the sample population.

Table 4. 2: Percentage of rehabilitative and habilitative therapy and pharmacotherapy received by the participants

REHABILITATIVE AND HABILITATIVE THERAPY				PHARMACOTHERAPY			
Therapy Attendance (past /current)	Entire sample population (n=11)	Psychiatric conditions (n=5)	Learning difficulties (n=4)	Medication Group	Entire sample population (n=11)	Psychiatric conditions (n=5)	Learning difficulties (n=4)
Occupational Therapy	11 (100 %)	5 (100 %)	4 (100 %)	Bronchodilators and Corticosteroids	1 (9 %)	0 (0 %)	0 (0 %)
Physiotherapy	5 (45 %)	3 (60 %)	3 (75 %)	Mood Stabilisers and Anti-convulsant (Epilim)	1 (9 %)	0 (0 %)	0 (0 %)
Speech and Language Therapy	10 (90 %)	4 (80 %)	3 (75 %)	Decrease Impulsivity (Risperidol)	1 (9 %)	1 (20 %)	0 (0 %)
Play Therapy	7 (63 %)	4 (80%)	3 (75 %)	Psycho-stimulants	5 (45 %)	1 (20 %)	2 (50 %)
				None	4 (36 %)	3 (60 %)	2 (50%)

A hundred percent of the sample population received OT and most (90%) received speech and language therapy (SLT) at some point in their development illustrating their need for additional support in reaching their optimal level of functioning. Over half (63%) also underwent play therapy (63%). Only 45 % of the entire population received physiotherapy. However, according to the sensory profile of the entire population, 9 participants (81 %) scored within the 'definite difference' range for low endurance.

Certain participants were receiving pharmacotherapy. Of the eleven participants, 36 % were not on any pharmacotherapy. Of the remaining participants on medication, five of the seven were taking psycho-stimulants (27% Concerta, 18% Straterra) to enhance their concentration.

One participant was on Risperidol to aid in decreasing his impulsivity. Another participant was on Epilim for its mood stabilising properties. Table 4.2 indicates that the administration of medication was not only confined to those participants with psychiatric conditions and LD.

Despite the participants' diagnoses and difficulties, 82 % of the caregivers reported in the parent questionnaire that they perceived their child to be coping at school.

4.4.2 Specialised Assistive Devices

Figure 4.4 illustrates the degree and type of specialised programmes the participants receive.

Figure 4.4 depicts the type and degree of intervention the participants were receiving pre-test. Weighted jackets were worn by 45% of the sample and one child was sitting on an inflatable cushion. These external assistive devices provide proprioceptive and vestibular input.

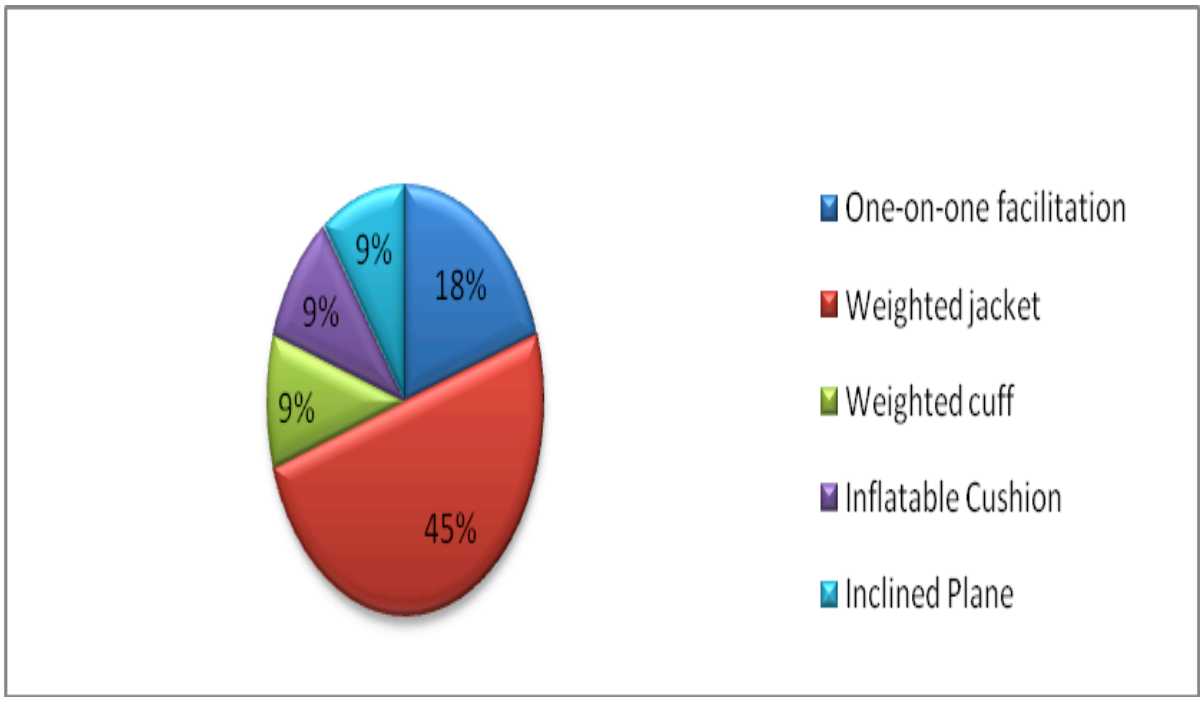


Figure 4.4: Degree and type of specialised programmes participants are receiving (n=11)

4.5 SIGNIFICANT STRESSORS

Figure 4.5 illustrates the significant stressors the participants were experiencing at the onset of research study.

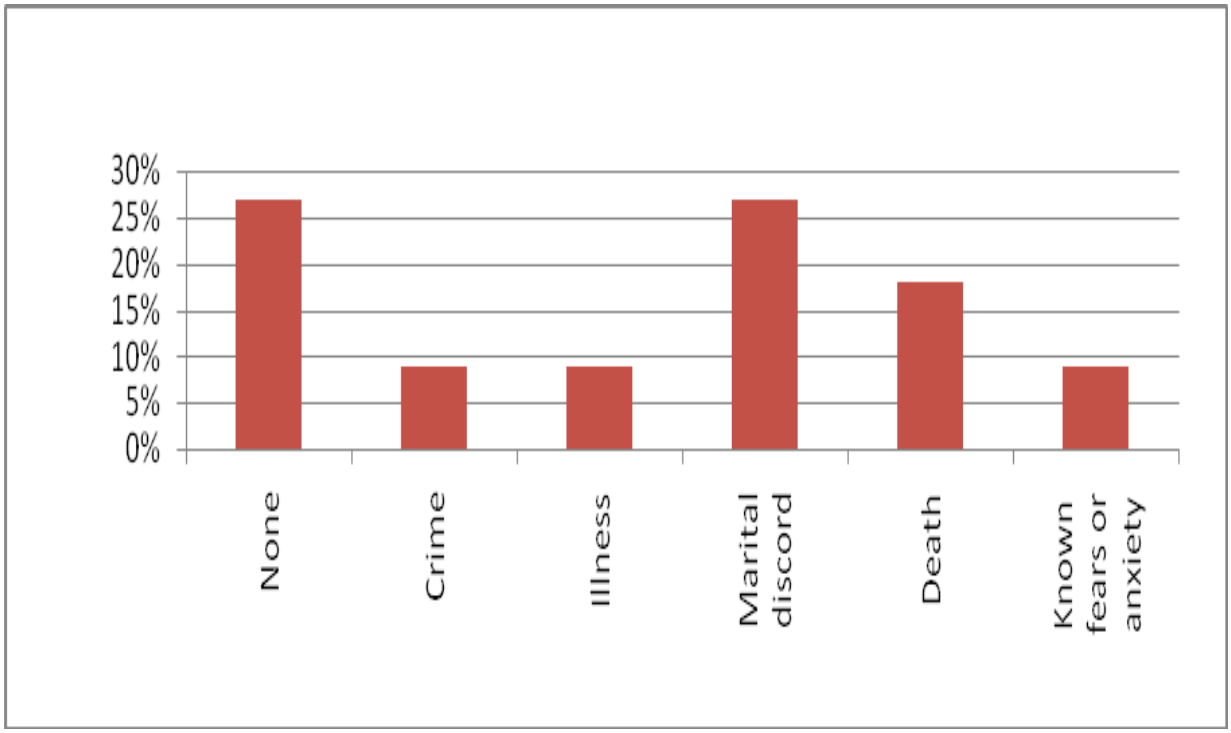


Figure 4.5: Significant stressors participants were experiencing. (n=11)

From the parent questionnaire it was reported that 73 % of the sample population were experiencing some form of stress. Situational stress included crime (9 %), illness (9%), death (18%) and parental marital discord (27 %). Only one participant was reported to experience emotional stress of known fear / anxiety. Although almost three quarters of the participants were experiencing a significant stressor only one participant's caregiver described the home environment as tense.

4.6 SLEEPING PATTERNS AND NUTRITION

Table 4.3 illustrates the sleeping patterns and consumption of sweets of participants.

Table 4.3: Sleeping patterns and consumption of sweets of participants (n=11)

Amount and quality of sleep		**Frequency of sweets consumed**	
Between 8 – 10 hours	8 (72 %)	Infrequently	4 (36 %)
Between 10-12 hours	2 (18 %)	Two –three times a week	4 (36 %)
Good	8 (72 %)	Only on weekends	2 (19 %)
Poor	2 (18 %)	Everyday	1 (9 %)
Fluctuation	1 (9 %)		

Overall the participants were observed to follow good sleeping and eating patterns. 63 % of the participants took a daily multivitamin. In addition, the consumption of sweets during weekdays was minimal and thus not seen to negatively influence the participants' concentration and activity levels during the school day.

4.7 COMPARISON PRE AND POST INTERVENTION

The effect of intervention is highlighted in Appendix XI in the form of a table comparing the pre and post intervention results. Due to the small limited sample size, each participant's data was analysed so that specific patterns may be determined. A visual summary of this comparison is shown in the four line graphs below.

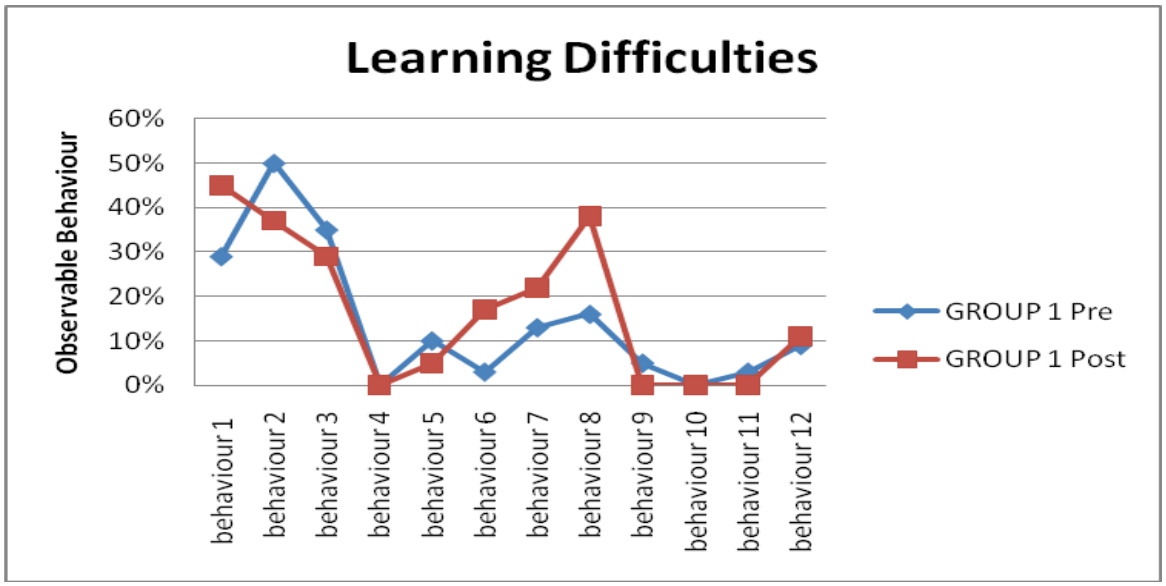


Figure 4.6: Pre and post test comparison of in-seat behaviours in participants with learning difficulties (n=4)

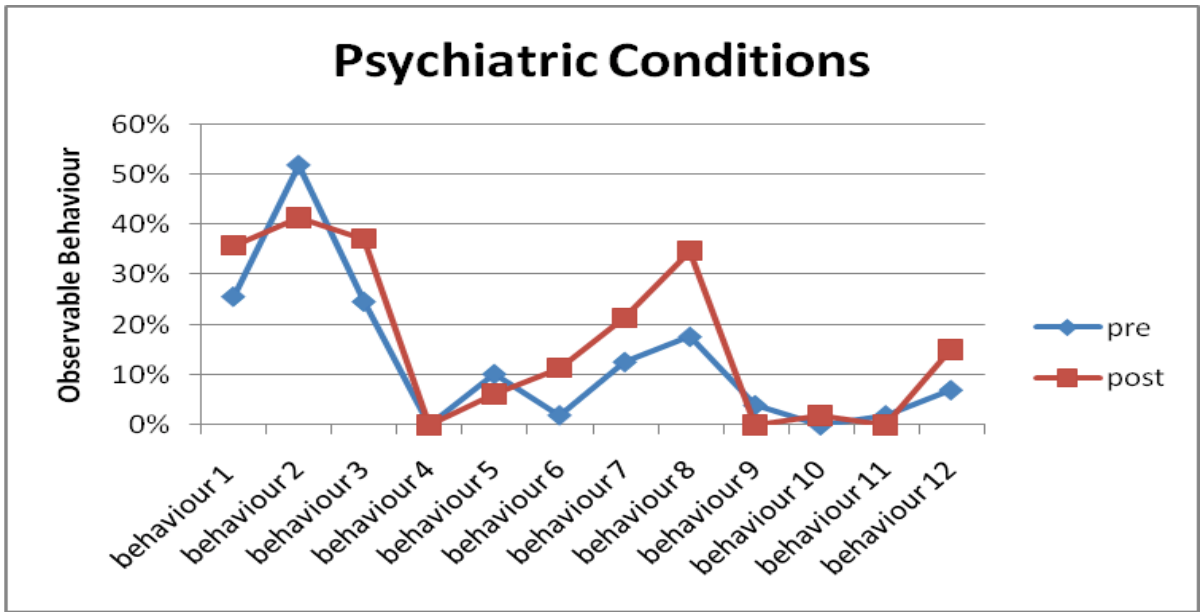


Figure 4.7: Pre and post test comparison of in-seat behaviours in participants with psychiatric conditions (n=5)

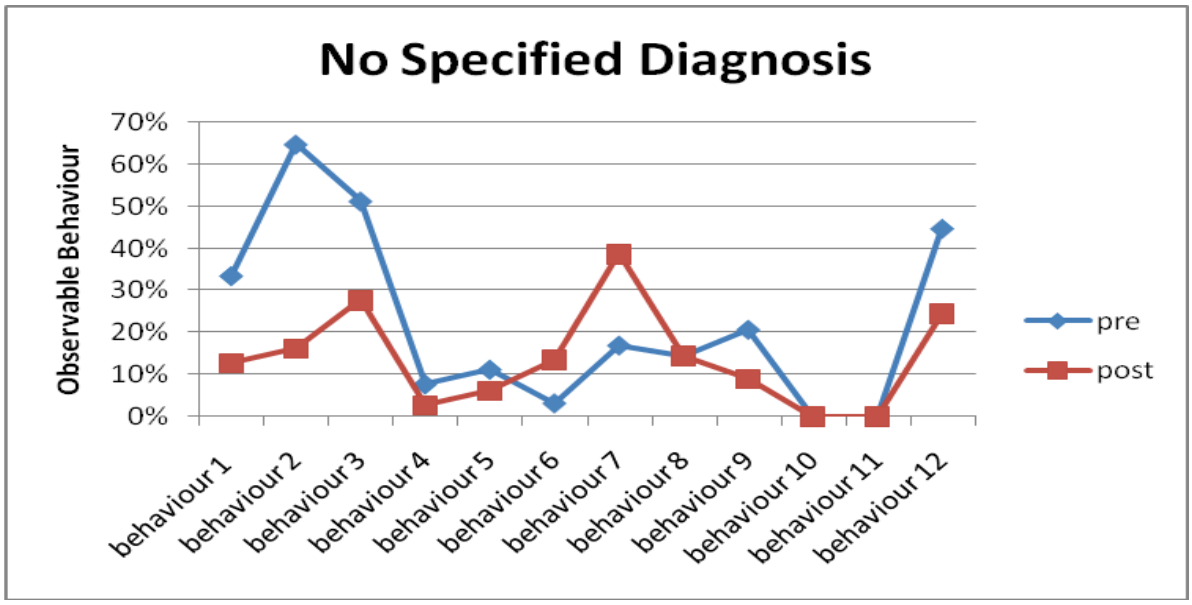


Figure 4.8: Pre and post test comparison of in-seat behaviours in participants with no specified diagnosis (n=4)

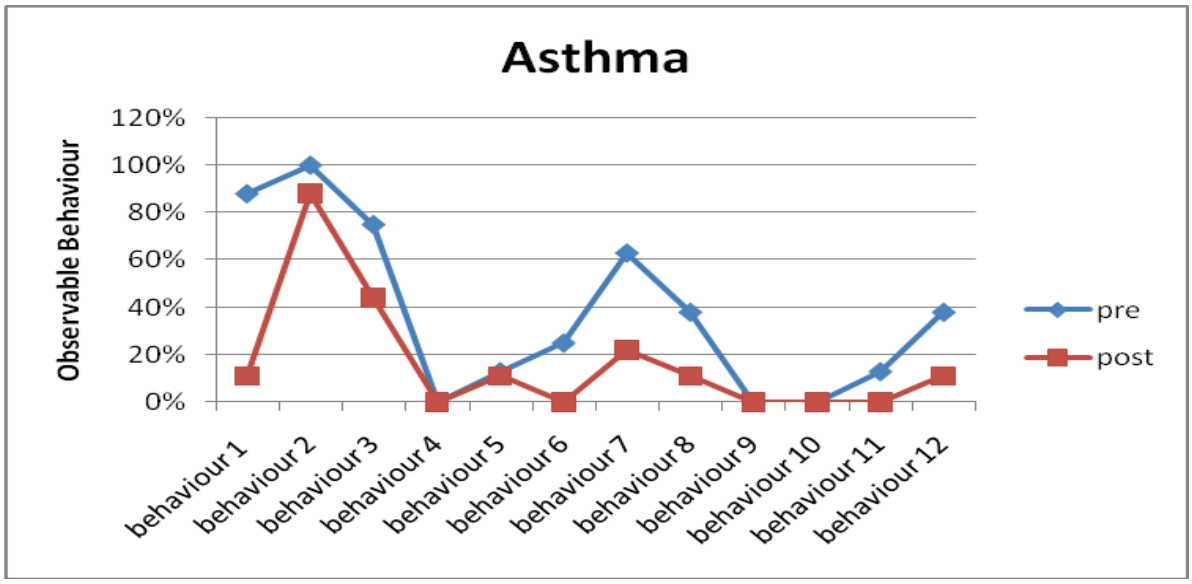


Figure 4.9: Pre and post test comparison of in-seat behaviours in participant with asthma (n=1)

When looking at certain behaviours 1(easily distracted internally), 3(restless, overactive, fidgety), 6(disorganised on self and on his work) and 12 (not able to initiate and carry out tasks independently) those participants without a psychiatric condition or LDs (figures 4.8 and 4.9) benefited more from the programme than the other participants (figures 4.6 and 4.7) who displayed fluctuations in these behaviours.

Generally, most of the participants showed improvement in behaviour 2 (easily distracted externally). Improvement for behaviour 5 (gives up easily and wont complete the task) was noted in participants without a diagnosis (figures 4.8 and 4.9) as well as those diagnosed purely with a psychiatric condition (figure 4.7).

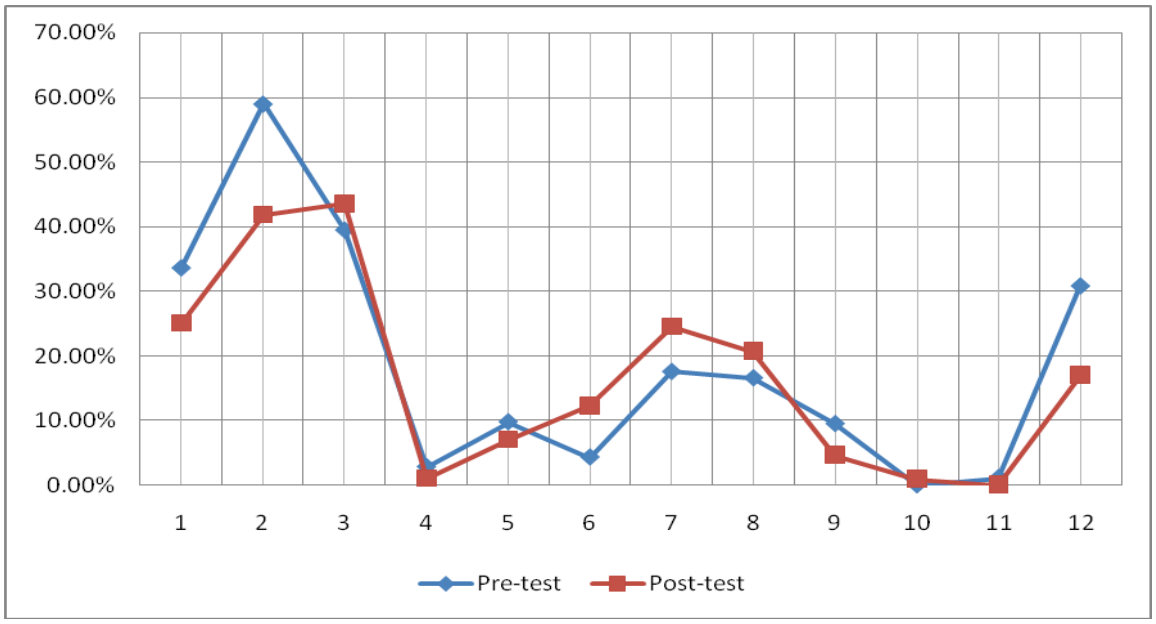
On the whole, no change in behaviour 4 (gets out of seat, needs to move around) was evident as 9 out of the 11 participants stayed the same with only improvement noted in three participants. Similarly only four participants showed improvement in behaviour 9 (impulsive, works too hard, lacks planning) and six of the other seven participants showed consistency in their pre and post test scores.

Behaviours 10 (lacks confidence and withdraws) and 11 (isolates self from others) also illustrated no change positively or negatively towards the implementation of the sensory diet.

No trend could be established for any of the participant categories for behaviours 7 (can't get down to his work) and 8 (slow to complete a task) as inconsistencies were noted throughout the sample population.

Of all the 11 participants, the participant diagnosed only with asthma (figure 4.9) and one participant 8 (psychiatric condition) profited the most from the sensory diet intervention as they showed definite signs of improved or consistent (no change) behaviour.

To examine the overall effect of intervention on in-seat behaviour, a general linear model analysis, paired *t*-test and Poisson regression were completed on observation scores.



KEY FOR BEHAVIOURS

1. Easily distracted internally, daydreams
2. Easily distracted by ext stimuli
3. Restless, overactive fidgety
4. Gets out of seat, needs to move around
5. Gives up easily and wont complete the task
6. Disorganised on self, and in his work independently
7. Cant get down to his work
8. Slow to complete a task
9. Impulsive, works too fast, lacks planning
10. Lacks confidence and withdraws
11. Isolates self from others
12. Not able to initiate and carry tasks out

Figure 4.10: Comparison of mean percentages of behaviours present pre and post-test (n=11)

In figure 4.10 above, the mean percentage of behaviours pre and post are compared. Improvement in behaviour (noted as a decrease in the frequency of the undesirable in-seat behaviour) was observed in behaviours 1, 2, 5, 9 and 12. Regression in behaviour is illustrated in behaviours 3, 6, 7, 8. Consistent behaviour (insignificant change) was observed in behaviours 4, 10 and 11 throughout the two phases of the pilot study.

Table 4.4 compares the parametric and non-parametric test pre and post test scores.

Table 4. 4: Parametric and non-parametric comparison of pre and post test scores (n=11)

Behaviour	**Mean (S.D.) Pre-test**	**Mean (S.D) Post-test**	***P*-value paired *t*-test**	***P*-value signed-test**
Easily distracted internally, daydreams	25.87	31.14	0.42	0.56
Easily distracted by external stimuli	22.01	32.90	0.07	0.08
Restless, overactive fidgety	25.33	31.79	0.72	0.69
Gets out of seat, needs to move around	4.85	3.35	0.37	0.37
Gives up easily and wont complete the task	13.01	5.71	0.58	0.69
Disorganised on self, and in his work	8.22	19.65	0.29	0.39
Cant get down to his work	22.36	21.78	0.41	0.30
Slow to complete a task	21.71	25.57	0.55	0.50
Impulsive, works too fast, lacks planning	16.86	6.48	0.29	0.40
Lacks confidence and withdraws	0.00	3.01	0.34	0.32
Isolates self from others	3.76	0.00	0.34	0.32
Not able to initiate and carry tasks out independently	31.90	16.31	0.16	0.29

After analysing the data using parametric (student's paired t-test) and non-parametric (Wilcoxon's matched pairs signed rank) methods it was evident that certain behaviours (1, 2, 3, 7 and 12) were more pronounced. Due to the limited sample size, statistical findings were non-conclusive indicating no significant improvements or regressions in participants' in-seat behaviours so as to accept or refute the hypothesis. The only slight (but not significant) improvement was detected in behaviour 2 (easily distracted by external stimuli) where $p = 0.07$.

Table 4. 5 illustrates the Poisson coefficient, *p*- value and Incident Rate Ratio (IRR) for all the behavioural outcome measures used.

Table 4.5: Comparison of the number of observations in a period of time intervals (n=11)

Behaviour	**Poisson Coefficient**	***P*-value (chi-squared distribution)**	**Incidence Rate Ratio (IRR)**
Easily distracted internally, daydreams	- 0.29	0.28	0.75
Easily distracted by external stimuli	-0.36	0.09	0.70
Restless, overactive fidgety	0.76	0.74	1.08
Gives up easily and wont complete the task	-0.20	0.69	0.82
Disorganised on self, and in his work	0.99	0.09	2.70
Cant get down to his work	0.33	0.32	1.40
Slow to complete a task	0.21	0.55	1.24
Impulsive, works too fast, lacks planning	-0.78	0.19	0.46
Not able to initiate and carry tasks out independently	-0.56	0.07	0.57

As no change in behaviour was observed, analysis could not be made for behaviours 4 (gets out of seat, needs to move around), 10 (lacks confidence and withdraws) and 11 (isolates self from others). This corresponds with data in table 4.4. Marginally significant improvement trends ($0.05 < p \leq 0.1$) were observed in behaviours 2 (easily distracted by external stimuli) where $p = 0.09$ and 12 (not able to initiate and carry tasks out independently) where $p= 0.07$. In turn, a marginally significant trend regression in behaviour 6 (disorganised on self, and in his work) where $p= 0.09$ was noted.

The IRR illustrated improvement in post-test scores of behaviours 1 (easily distracted internally, daydreams), 5 (gives up easily and wont complete the task) and 9 (impulsive, works too fast, lacks planning). The IRR illustrated deterioration of behaviours 3 (restless, overactive fidgety), 7 (can't get down to his work) and 8 (slow to complete a task). These results confirm changes indicated in table 4.4.

Thus, in reviewing the results of all the statistical tools used it is evident that the Poisson regression is the more favoured tool for this pilot study. Although only marginally significant, $0.05 < p \leq 0.1$, Poisson regression detected an effect for behaviours 2, 6, and 12 (Table 4.5) while the t-test could only detect an effect for behaviour 12 (Table 4.4).

4.8 CONCLUSION

Due to the nature of this study the sample size is limited to 11 participants. The two most predominant diagnostic categories included psychiatric conditions and LDs Overall, most of the psychiatric conditions and learning disabled diagnostic categories displayed a high percentage of total 'definite differences' in processing sensory input on the SSP. Due to the limited small sample size, statistical findings were non-conclusive indicating no significant improvements or regressions in participants' in-seat behaviours so as to accept or refute the hypothesis. However upon close analysis marginally but not significant improvements could be detected in behaviour 2 and 12 and a marginally yet not significant regression in behaviour 6. Thus, after analysing the data it is evident that on the basis of the results obtained in this pilot study, the null hypothesis established in the beginning of this pilot study is accepted for all behaviour except 2 (easily distracted by external stimuli) and 12 (not able to initiate and carry tasks out independently).Thus statistically the hypothesis is rejected but clinical differences as described above are still worth pursuing.

CHAPTER FIVE: DISCUSSION

5.1 INTRODUCTION

Chapter five encompasses the discussion of the prevalence of SPD in the sample population, extraneous variables which might have possibly influenced the child's performance are highlighted and thereafter the effectiveness of the implementation of the sensory diet is reviewed. Limitations of this pilot study are presented and finally directions for future research are suggested.

5.2 DEMOGRAPHIC DATA AND SENSORY PROFILE OF GRADE ONE LEARNERS IN SPECIAL NEEDS SCHOOL

Ahn, et al stated in 2004 that establishing epidemiological prevalence rates of SPD is imperative for research relating to the aetiology and effectiveness of intervention for SPD.[32]In this pilot study the prevalence of different types of sensory processing difficulties found in grade one learners at a school for children with special needs had to be firstly be established so appropriate treatment could be provided in relation to the profiles.

As the sample utilised in this study included participants in an education system catering for their various LDs, a demographic analysis was done in order to explore whether other demographic characteristics which may impede on the participant's sensory processing were present. This was in order to establish whether these would coincide with current literature on the prevalence and predisposition of sensory processing difficulties in children. Investigations done over the past three decades have illustrated that children with certain behavioural and developmental disabilities process sensory information differently than children without disabilities.[21,38,39] Furthermore, Schaffer and colleagues have estimated that over two-thirds of the children with learning difficulties have sensory processing problems. [46]

One of the most important demographic traits explored was the diagnostic groups present in this sample (table 4.1). The two main diagnostic categories included LDs (i.e. dyslexia) and psychiatric conditions.

It is not surprising that the LD population comprised 36% of the overall sample population as research has estimated that over 50% of the children in special education have a LD. Over two-thirds of these have sensory processing problems. [46] Psychiatric disorders, the other major category, also included a variety of conditions. All of these disorders are regarded as having some type of sensory regulation dysfunction. The association of these psychiatric disorders to SPD and research into the SI theory and the relative efficacy of SI procedures for children with differing diagnoses is still sparse. Most literature is focused on the sensory processing ability of children diagnosed with ADHD. [13,52,53]

Only one participant in this study was diagnosed with ADHD but the diagnosis needs to be considered carefully as in a study by Miller et al only five participants were diagnosed with ADHD, but when all participants were screened 15 met criteria for ADHD. Consequently, one may deduce that not all participants are accurately diagnosed and accordingly, the legitimacy of the diagnosis in this sample is questioned. In 1998, Meyer stated that ADHD is the most prevalent child psychiatric disorder in South Africa. [58] It would thus be expected that in a remedial class, more participants would be diagnosed with ADHD.

When considering other demographic variables information found was specific to RDSP and not purely SPD. Since these are closely linked this information was viewed as pertinent, especially since the sample used does exhibit many of the conditions contributing to both.[43]

No norms related to either RDSP or SPD for a South African or international population, in terms of population groups or developmental indices could be found.
The lack of ethnographic data was also apparent in the study by Ahn et al investigating the prevalence of parents' perceptions of SPD among kindergarten children. This study advised that prevalence rates be assessed in other population groups to determine whether their rates were generalisable beyond their sample.

In terms of developmental status the samples' ages ranged between seven years six months to nine years five months, with only two participants being less than eight years old (table 4.1). Studies over the past ten years have not been able to describe the long-term stability of RDSP over time, but have noted that regulation capacities increase with age.

Recent literature on RDSP by Reebye and Stalker in 2007 stated that while by the age of six most children have learned to adjust their behaviours and sensory needs, many of the early symptoms and behavioural responses continue to be demonstrated by children with RDSP until about the age of eight, when these behaviours decrease and social skills increase. Based on this premise it would be expected that the sample population utilised in this pilot study are more socially appropriate and do not have many overtly negative behaviours. [41] In turn, as evident in the results from this pilot study, no change in the observable social skill behaviours were evident between the pre and post test phases of this research-which is in keeping with current literature on RDSP (tables 4.4 and 4.5).

Due to the small size of this sample and limited available literature specific to SPD in terms of population group and developmental trajectories of the rise or decline in the prevalence of sensory processing disorders with age, it is not possible to generalize the results of this study with confidence. Thus the population group and developmental indices of the sample cannot be confidently commented upon in terms of SI theory.[32] Clinically however, Occupational Therapists mostly treat SPD in the paediatric population. A reason for this may be that teenagers and adults seem to develop coping strategies (such as playing sport, smoking, eating), or adapt their careers, relationships and lifestyles according to their sensory needs or preferences. Thus, an assumption can be made that their symptoms appear less obvious since they are cognitively managing (self regulating) themselves.

Gender is the third demographic index viewed in establishing epidemiological prevalence rates of sensory processing disorders in this sample. Over 90% of the sample was male (table 4.1) which is in keeping with the current literature of boys displaying more sensory processing deficits than girls. [41,46] However, girls are observed to show greater signs of tactile defensive symptoms than boys.[29,57]

Lastly, genetic predispositions were further investigated in the sample. It was estimated that 36 % of the participants had siblings who experienced similar difficulties (page 50). Twin correlation studies suggest moderate genetic influences, thus supporting this estimate. [28,29]

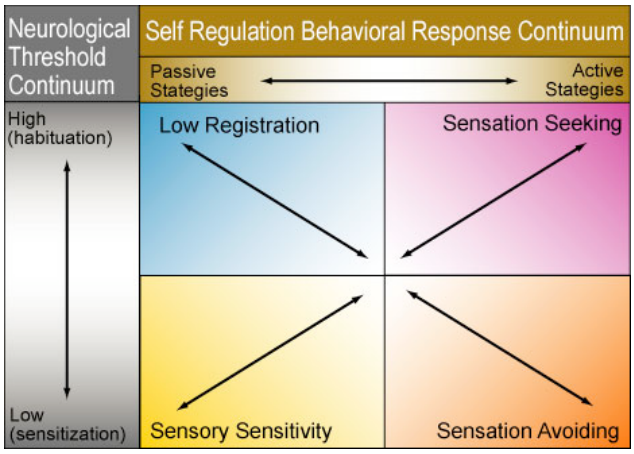
Using the SSP, a parent-report survey screening instrument, this study estimated that the overall sample (figure 4.1) showed a 63% significant 'definite difference' (dysfunction) in their overall processing of sensory input.

The sensory input found to be most disorganizing for the participants was auditory input. Sixty percent of the sample showed a 'definite difference' in filtering out irrelevant auditory input. This can either occur in a low threshold for auditory input as the child is sensitive to sounds or in a high threshold for auditory input as a child is oblivious to sounds. When a child has difficulty in filtering out irrelevant auditory input it means that the child requires *internal* control in paying enough attention to sounds to notice important stimuli rather than the child requiring *external* control (i.e. more controlled environment) in order to be productive. This is because the child is not so distracted externally that he or she cannot engage optimally in the task at hand but rather that he or she cannot register incoming pertinent auditory input appropriately in order to engage optimally in the task.[171]

Overall, the participants fell within the normal (typical performance) to borderline (probable difference) range for tactile sensitivity and within the 'typical performance' range (60%) for taste / smell sensitivity and visual / auditory sensitivity.

The child's behavioural responses to sensory input reflect the self regulation strategies utilised by the child. The participants were seen to be utilising self regulation strategies falling on both ends of the continuum i.e. predominant passive self regulation strategies (allows perceived threatening sensory events to occur) included lowered energy levels. On the other end of the continuum, evident active self regulation strategies (child selects active strategies to control own sensory experiences) found in the sample population included sensation seeking behaviour. 80% of the participants scored within the 'definite difference' range indicating the use of predominantly movement seeking behaviour. [37]

Figure 5.1 Relationship between neurological threshold continuum and self regulatory strategies



Thus, in terms of the various sensory modulation disorders, the sample was observed to be heterogeneous in nature. That is, indicators of low threshold for sensory input (e.g. registering and orientating to all environmental auditory input and thus having difficulty in filtering out irrelevant auditory input) were observed in combination with high threshold for sensory input (e.g. lowered energy levels, difficulty filtering out irrelevant auditory input as child oblivious to the sound) and sensory seeking (e.g. movement seeking) behaviour.
As a result, the sensory strategies chosen for the sensory diet were mostly vestibular and proprioceptive sensory tasks that were organizing in nature.

The SSP's discriminant validity is described as sound.[32] Literature hypothesises the prevalence of SPD to be between 5% to 30% for children without disabilities. [6,21,30,31] From this high percentage (63%) of SPD dysfunction found in the sample, it is assumed that many of the participants possessed co-morbidities in conditions.

When reviewing the overall total score of participants with psychiatric conditions (figure 4.2), 80% of their sensory profile fell within the 'definite difference' range of dysfunction in sensory processing.
Interestingly, children diagnosed with RDSP often have responses that resemble ADHD in terms of difficulties with social skills, emotional, attention and impulse control. This includes Asperger's Syndrome, with more intense social behaviours and ASD. After a three year follow-up study in British Columbia it was found that children initially diagnosed as RDSP were later confirmed with a diagnosis of ADHD or ASD. This supports the hypothesis that RDSP in which sensory integration difficulties are more prominent may be a vital indicator prior to the diagnosis of ADHD or ASD. [41] In turn, a study conducted in Israel suggested that young children with ADHD may be at an increased risk of various sensory processing deficits, exclusive to the core symptoms of ADHD.[56]

It is estimated that over two-thirds of the children with LD have sensory processing problems. [46] In this pilot study (figure 4.3), the participants with LD attained a 100% 'definite difference' total score of dysfunction in sensory processing. 27 % displayed co-morbid LD and psychiatric illnesses. 80% of the participants with ADHD and all the participants with LD were found to display co-morbid sensory processing difficulties, making the management of a child with an additional diagnosis more complex, than that for a child with only one of these disorders.

Both LD and psychiatric condition categories attained a 'definite difference' 100% score in *low energy* behavioural category. From a SI perspective, lowered energy levels in a child with SMD could be indicative of the child going into a state of sensory shut down.[3] This protective mechanism against severe overload may occur when the child with SMD is in the classroom environment as he or she is continually bombarded with multisensory stimuli.

Movement seeking behaviours were exceptionally predominant in the two groups as well. This self regulatory strategy is often calming and organising for the "disorganised out of sync" child. That is, a child with SMD will seek out other sensory inputs such as movement input in order to dampen out the other more perceived "threatening" sensory inputs. After analyzing the SIPT score patterns of children with ADHD Mulligan reported that children with ADHD demonstrated difficulty in processing movement input adequately. [54]

The participant groups showed no marked differences in visual and auditory sensitivities. The participants with psychiatric conditions faired better in processing taste and smell input but showed a higher degree of sensory sensitivity as compared to the participants with LD.
The child with co-morbid ADHD and RDSP is reported to have more problems because of the aspects of regulation difficulties, temperamental problems, spatial, motor and SI difficulties that interact and often compound the problems created by ADHD.[41]

After analyzing the incidence rate of sensory processing difficulties in the sample the assumption is made that the majority of the participants would benefit from the implementation of a sensory diet programme. However, extraneous variables impacting on classroom in-seat behaviour had to be established before the sensory diet could be introduced.

5.3 EXTRANEOUS VARIABLES IMPACTING ON IN-SEAT BEHAVIOURS

Children with sensory processing difficulties, LDs, psychiatric conditions or a co-morbid diagnosis often require external assistance, guidance and facilitation to reach their optimal level of functioning. The holistic management of these children often includes to some extent rehabilitative and habilitative therapies (including assistive devices); pharmacotherapy, reduction of stressors; healthy nutrition and good sleep patterns.

In analysing these variables a better understanding of the participants' performance when seated at the desk could be ascertained.

As the sample was exclusively recruited from a remedial school, the utilisation of therapy intervention was expected. The degree to which the sample received a specific therapy at some point in their development was investigated (table 4.2). All the participants reported to had received or were in the process of receiving OT. This was true for 90% of the sample for SLT. These two simultaneously well utilised therapies coincide with the theory stating that the outcome of sensory-motor experiences constructs the framework of understanding on which language is based. As poor sensorimotor skills may result in poorly developed language, the child referred to SLT for language delay is often also referred for OT for sensory-motor delay. That is, in order for adequate language development to occur, the child may require assistance given in OT in interpreting, organising, navigating, conceptualising and becoming connected with his or her world. [178]

Speech and language are thus adaptive responses that develop as a result of sensory input from the environment.[178] Literature has observed a strong correlation between auditory processing difficulties and SMD. [33,34] In this study, more than half (60%) of the sample population showed a 'definite difference' in filtering out irrelevant auditory input due to underlying SMD.

Over half (63%) of the sample population underwent play therapy. Bearing in mind that 45% of the sample population were diagnosed with psychiatric conditions, literature reveals that another association exists with SMD and emotional and behavioural difficulties. A classical sign of sensory integration dysfunction is the inability of the child to unwind or calm themselves.

Self-regulation refers to the ability to attain, maintain, and change arousal appropriately for a task or situation as well as control one's emotional, mental or physical responses to sensations. [8,36,37] Dunn hypothesized that patterns of sensory processing be a sign of the nervous system's thresholds and that one's temperament may be the expression of both nervous system operations and sensory processing patterns. Behavioural sequelae are thought to include anxiety, distractibility, impulsivity and high activity levels. [13]

Thus the child with sensory integration difficulties tends to have an increase in CNS excitation and thus is likely to be in a state of constant arousal and attention in order to be alert for impending threats (anxiety, fear and anticipation of noxious stimuli). This stage of high arousal impacts modulation at all levels and is often connected with inappropriate high emotional tones and autonomic nervous system responses of fight or flight. Therefore, the child with SMD may encounter difficulty with modulating and dealing with the sensory input on a daily basis which may negatively impact on the child's emotional and social responses. Often, a referral to play therapy is made by the OT as sensory modulation has a reciprocal influence on the emotive system, improved modulation will improve the child's emotional coping strategies, just as an improvement in the emotive system will also improve the modulation of incoming stimulation.[25,36]

Only 45 % of the entire population received physiotherapy. However, according to the sensory profile of the entire population, 81 % of participants scored within the 'definite difference' range for low endurance.

This further strengthens the conjecture that the lowered endurance deficit is related to sensory processing difficulties rather than postural control problems which are dealt with primarily in physiotherapy. Furthermore, both sample subgroups of psychiatric conditions and learning difficulties scored 100 % 'deficit difference' for *low endurance* but not all of those respective sample groups received physiotherapy intervention. However, it's important for one to appreciate that although a child with SMD is not primarily treated for his or her sensory modulation difficulties in physiotherapy, a child with SMD will benefit greatly from the proprioceptive weight bearing activities done in physiotherapy which are calming and organising in nature.

In the sample for this pilot study five children were wearing weighted jackets and one child used a weighted cuff (figure 4.4). These assistive devices provide the child with both proprioceptive and deep pressure input. Numerous studies using weighted jackets have shown an increase in on-task behaviour and attention span. [67,100,123-125] One participant was using an inflatable cushion, which provides vestibular input which research indicates may help regulate arousal levels through movement and increased sensory input to the brain whilst executing deskwork. [85,118,119] The external sensory assistive devices used by the participants prior to the initiation of the pilot study intervention indicated that those participants might further benefit from other sensory diet strategies which incorporate vestibular, deep pressure and proprioceptive inputs.

Any specialised assistive devices provided by a therapist and used by the participants were also investigated so as to further understand what types of strategies were incorporated into the classroom environment. Most external assistive devices and strategies used with a sensory basis are often incorporated into a sensory diet providing the child with calming and organising input when seated in a multi-stimuli busy environment, like the classroom, so as to enhance their concentration. Current investigations [18,44,52,67,85,124] have shown that external devices like weighted jackets and inflatable cushions offer strategies in providing a child with SPD an opportunity to attain and maintain an optimal state of arousal for learning. Sensory integrative theory hypothesises that increased movement, deep pressure and proprioceptive input opportunity may regulate arousal levels thus improving classroom in-seat behaviours and sustained attention. [109 85,118,119 120,121]

The therapies described above are often prescribed in conjunction with pharmacotherapy (table 4.2) which is often given to children so as to improve their behaviours, concentration, mood or anxiety level. 64%, of the sample, were on pharmacotherapy. The administration of medication was not only confined to those participants with psychiatric conditions and learning difficulties.

One participant, diagnosed with a psychiatric condition was reported to be using Risperidol to treat behavioural problems such as aggression, impulsivity, self-injury, and sudden mood changes. Another participant using Valproic acid (Epilim) was not diagnosed with epilepsy or with a psychiatric condition although this drug is primarily an anticonvulsant. It was used for its mood stabilising properties, treating outbursts of aggression or in assisting thinking, learning, and understanding.

In this study, five of the seven participants that were on medication were taking psycho-stimulants (27% Concerta, 18% Straterra) to enhance their concentration. Four participants without a diagnosis or with a diagnosis of LD were taking psycho-stimulants as compared to one participant diagnosed with a psychiatric condition. Psycho-stimulants are prescribed to increase the ability to pay attention and decrease impulsiveness and hyperactivity in children and adults with ADHD. [87]

Two assumptions were made from these comparisons. Firstly, participants may not be accurately diagnosed thus weakening the legitimacy of the diagnosis in this sample as discussed above. Secondly, since more participants were attending the rehabilitative and habilitative therapy services this appears to be the choice of intervention preferred over pharmacotherapy.

In conjunction to this, despite the participants' diagnoses and difficulties, 82 % of the caregivers reported in the parent questionnaire that they perceived their child to be coping at school. This could mean that despite their child's difficulty or disability, with the correct and preferred intervention in place, the child is able to function more appropriately.

Also, although all these medications have many gastrointestinal, CNS, ANS and systemic side-effects these were not particularly considered in the study. Side-effects which may hinder the child's concentration would be agitation, mood swings, abnormal thinking, memory loss (Epilim); difficulty falling asleep or staying asleep (Concerta and Risperidol) or experiencing excessive tiredness or drowsiness (Straterra and Epilim). Insufficient sleep and lethargy would influence the child's in-seat behaviour.[87]

Positively, all participants were reported to follow good sleeping patterns indicating that that side-effect of Concerta was not apparent. The side-effects of excessive tiredness and drowsiness associated with Straterra and Epilim could have been linked to the lowered energy levels reported in the SSP for three of the participants. [8]

The formulation of the sensory diet designed for this pilot study was based on the observable symptomatic behaviours reported by the caregivers on the SSP and observed by the primary researcher (i.e. what one can see despite the medication prescribed). In comparison to medication, the sensory diet treatment modality may be seen to be more flexible and adaptable to the child's state of arousal as it may address the behaviour in the moment in which it occurs. This pilot study highlighted the usage of medication by children with sensory modulation difficulties. Furthermore it depicted possible discrepancies in the diagnosis of a given participant and the ambiguity of prescribed pharmacotherapy for a specified disorder. Due to these uncertainties in diagnosis and medication it may be postulated that as a medical diagnosis is a clinical deduction, medication may at times be prescribed in a trial and error manner in children displaying sensory modulation difficulties. Thus it may be noteworthy when wanting when to introduce a sensory diet intervention to not only be aware of what medication the children are using but more importantly, whether the medication is actually helping as well as whether the medication and sensory strategies are supporting and complimenting each other. A future pilot study looking into this association is highly recommended.

From the parent questionnaire it was reported that 73 % of the sample population were experiencing some form of stress (figure 4.5). Because children with SPD often have difficulty in understanding their outside world through their sensory system, they require structure and a sense of control over their environment. Self-regulation difficulties manifest as an inability to maintain suitable or appropriate behaviours especially in times of situational stress, such as crime (experienced by 9 % of participants), illness (experienced by 9% of participants), death (experienced by 18% of participants) and parental marital discord (experienced by 27 % of participants); emotional stress (anxiety disorder) as well as change of environment or routine (e.g. relocating, new teacher). Correct structure, routine and consistency are required for these children in order to make them feel secure, content and thus cope emotionally. [8,36,37] The exposure to these stressors may have influenced their in class behaviour due to affecting their ability to regulate but was not analysed in relation to this study.

On the onset of the pilot study the participant's eating and sleeping patterns (table 4.3) were analysed as unhealthy eating habits and poor sleeping patterns could negatively influence the participants' in-seat behaviour. Healthy nutrition plays an integral in brain functioning and learning and is essential for optimal scholastic achievement. [89,90,92] On the whole, the participants were observed to follow healthy eating patterns. Furthermore, 63 % of the participants took a daily multivitamin. In addition, the consumption of sweets during weekdays was minimal and thus not seen to negatively influence the participants' concentration and activity levels during the school day.

Good sleep patterns are essential for growth, learning, social and emotional well being. [96,97] 72 % of the sample reported to have a restful, good sleeping pattern. Two participants were reported to have poor sleeping patterns and one participant was described as having fluctuating sleeping patterns. The rest of the sample (82%) received between 8-10 hours sleep per night. A child who is sleep deprived appears to have symptoms (i.e. hyperactive, impulsive, experiences mood swings and may be less apt to listen or pay attention) similar to a child diagnosed with ADHD. A study of young children conducted at the University of Montreal showed that those who slept significantly fewer hours than the recommended period were more hyperactive and impulsive and scored lower on two cognitive skills tests than those who got plenty of sleep. [97]

Due to the limited sample size, a further in-depth analysis between nutrition and sleeping patterns was not done during the various phases of the research and thus can not be correlated with the participants' behaviour. However, the participants' in-seat behaviour could have further been negatively impacted upon if the participants started eating unhealthily or received insufficient sleep at any stage in the research and thus the lack of an analysis between the eating and sleeping patterns across the various research stages may be seen as a limitation in this pilot study.

5.4 THE EFFECT OF A SCHOOL BASED SENSORY DIET INTERVENTION ON GRADE ONE LEARNERS' IN-SEAT BEHAVIOUR DURING A HANDWRITING LESSON

The aim of this pilot study was to explore the effectiveness of a sensory diet intervention on the in-seat behaviour of a learner in the classroom. To attempt to make the evaluation of this intervention as close as possible to reality, it was conducted in the natural setting of a classroom environment.

As this investigation is a pilot study, a small convenient sample of 11 participants was used, weakening the sensitivity of the outcome measures. Thus, not enough power was present to demonstrate significance of behavioural differences, although differences were found, in individual participants as well as in the various diagnostic groups, but these need to be interpreted with caution (figures 4.6, 4.7, 4.8, 4.9 and 4.10).

Although not significant, a trend was observed for certain behaviours to improve in a positive direction (reduced undesirable in-seat behaviours), regress in a negative direction (increased undesirable in-seat behaviours) or remain constant (no improvement or reduction in undesirable in-seat behaviours).

The overall sample's capability to pay attention and demonstrate active (writing) and passive (watching and listening to the teacher explain the lesson) on-task and in-seat behaviours was observed to be better after the implementation of the sensory diet intervention in certain behaviours. The participants' active or passive engagement was observed in a handwriting lesson as both of these on-task behaviours were then associated with learning. Junod et al explained that when students are attentive and engaged during class, they have more opportunities to learn.[158]

After analyzing the data with various statistical tools, a trend was observed for certain on-task in-seat behaviours to improve clinically.

An improved, positive trend for distractible behaviour was firstly noted. The participants (as evident as an increase on the post-test percentage and IRR as well as in the parametric and non-parametric tests) demonstrated less internal distractibility and even less external distractibility (seen as an increase on the percentage, student's paired t-test, Wilcoxon's matched pairs signed rank test where p = 0.07 and the Poisson regression where p = 0.09) (table 4.4 and 4.5).

Sensory integration theory postulates that children with sensory modulation dysfunction have difficulty focusing adequately on the task at hand as the they may be irritated or distracted by external visual and auditory input when seated in the multisensory classroom. These children have difficulty in filtering out irrelevant environmental stimuli and as a result are pulled from one experience to the next (seen as distractibility) thus unable to maintain the focus of attention needed for successful learning.[179]60% of this sample population showed a 'definite difference' in filtering out irrelevant auditory input. One may presume that the calming and organizing sensory inputs (deep touch-pressure, slow vestibular as well as proprioceptive input) administered to the participants in the sensory diet facilitated an improvement in filtering out irrelevant auditory sensory input thus reducing their internal and external distractibility and simultaneously developing better focus of attention for the task at hand.[179]

Consequently, from the marginal improvement noted in the post-test percentage and IRR of two behaviours, viz. not giving up easily and completing the task; being less impulsive, not working too fast, better planning; the sample appeared to better organised within themselves. Sensory integration is based on the premise that in SID the brain does not process or organise the flow of sensory inputs in a way that gives the person exact information about him or herself and the world. Therefore, learning is very difficult and children with severe difficulties in filtering and organising sensory input may experience their sensory world as confusing and threatening. This often results in additional emotional or behavioural difficulties.[179] The assumption is made that improved sensory modulation aided the participants to be more "in sync" with their external world and thus demonstrate better on-task behaviours and emotions. This, in turn, lead the participants to be better able to initiate and carry tasks out independently as noted by a positive trend in the percentage, student's paired t-test, Wilcoxon's matched pairs signed rank test and Poisson regression (p= 0.07).

One may deduce that calming and organizing sensory strategies provided to the participants allowed them to make adaptive responses (such as less internal and external distractibility, not giving up easily and completing the task; being less impulsive, not working too fast, better planning) that integrated the sensations and enhanced the organization of the brain. The participants were then better able to organize the sensory information required for engagement on the task at hand.[179]

Traditional classroom expectations infer that on-task behaviour and attention lead to greater learning opportunities and off-task behaviours may threaten these opportunities. This inference may be deduced that the overt nature of active (e.g. motor or auditory interruptions) and passive (e.g. looking around the room) off-task behaviours prevent a student from remaining engaged in academic instruction. [158]

A child who is restless, overactive and fidgety, may appear disorganized on self and in his work, have difficulty in getting down to his work and be slow to complete a task. A negative trend for all of these behaviours was observed in this pilot study. After the implementation of the sensory diet, the participants appeared more restless, overactive and fidgety (as demonstrated in the student's paired t-test, Wilcoxon's matched pairs signed rank test and an increased percentage and IRR). Fidgety behaviours have been commonly viewed as a distraction to attention and learning as well as a threat to appropriate in-seat behaviour. The increase in these behaviours after the administration of the sensory diet may initially be viewed as a negative result of in-seat behaviours as it made the child appear disorganized on self and in his work, have difficulty in getting down to his work and be slow to complete a task.

The sensory diet designed for this sample was comprised mainly of vestibular, deep touch pressure, and proprioceptive input which are known to provide large sources of calming and organising input, so as to modulate the nervous system. Examples of such activities included crawling, rolling, marching, hopping tasks.

A well modulated nervous system has a level of arousal and attention appropriate for the task, blocks out irrelevant information, attends to relevant stimulation, and responds appropriately and in direct proportion to the input.

Although a marginally significant trend regression (p= 0.09) was noted in the participants displaying disorganization on self, and in their work, this was thought to be a function of their restlessness, overactivity and fidgetiness.

As discussed previously, evidence of improved modulation was noted after the administration of the sensory diet (less internal and external distractibility, not giving up easily and completing the task; being less impulsive, not working too fast, better planning, better able to initiate and carry tasks out independently. It is important to note that the sensory diet was only administered prior to and not during the handwriting lesson. A hypothesis could be made that the sensory diet was able to bring the participants to a productive calm alert state, the period of processing and integrating sensorimotor information required for maximal functioning, at the start of the handwriting lesson. However, as the lesson progressed and the participants' sensory systems were observed to become more overaroused due to the continual bombardment of auditory and visual sensory input, the participants required more organizing sensory input. In turn, the level of difficulty and the practice challenges of handwriting may also have affected the participants' modulation as increased anxiety and stress levels are known to increase sensory overarousal in children with SMD. This is because these children have less effective parasympathetic functions than typically developing children, causing their sympathetic "fight-flight – flight" nervous system to be more in use [13].

Self regulation is necessary for one to maintain appropriate attention to tasks as it allows one to adapt to the changing demands of the environment. A calm alert state is facilitated by sensory input from the vestibular system acting on the RAS. The RAS has extensive interconnectivity with all the sensory systems persistently impacting on their level of arousal and plays a vital part in the functioning of sensory modulation as it greatly influences the calm-alert state. [25] The increased in-seat movement seeking behaviour (restlessness, overactivity and fidgetiness) is assumed to be self regulatory strategies utilised by the participants during the handwriting lesson in an attempt to self calm and organise their sensory world so as to maintain an optimal state of arousal for learning. [85,103,179] This is in keeping with the findings of the participants' sensory profile of self regulatory strategies most commonly used, which was predominantly movement seeking behaviour.

These participants would have benefited from ongoing sensory strategies whilst seated at the desk such as a weighted jacket (providing deep touch pressure and proprioceptive input) and a vestibular based seating alternative such as an inflated cushions or therapy ball.

Three behaviours demonstrated consistency throughout the two phases of the pilot study and thus were not influenced positively or negatively by the sensory diet intervention. These behaviours include getting out of seat, needing to move around; lacking confidence and withdrawing; and isolating self from others.

Figures 4.6 to 4.10 visually analysed and interpreted the trends between the pre and post test phases of each participant and different diagnostic groups. Specific patterns of differences found in the participants and their behaviours were observed.

Participants without a psychiatric condition (figure 4.7) or learning difficulty (figure 4.6) were observed to show a positive trend of improvement in six of the 12 undesirable in-seat behaviours after the implementation of the sensory diet programme. These behaviours include being easily internally distracted, being easily externally distracted, being restless, overactive, fidgety; giving up easily and not completing the task, disorganization on self and on his / her work; not being able to initiate and carry out tasks independently. This positive trend for certain behaviours in participants with only SPD or an intact sensory processing suggest that the implementation of a sensory diet may be warranted in these children for improving these behaviours. Possibly, a future study would be recommended in focusing on this correlation.

Learning disabled individuals (figure 4.6) showed a positive improvement only in not being easily externally distracted. This trend may be interpreted as an improvement in the participants' sensory processing abilities. The sensory diet appeared to reduce over-stimulation and thus participants no longer reacted to external stimuli but were better able to ignore or filter out unimportant environmental stimuli and only register to stimuli pertinent to the task at hand. It is thought that this group did not show as much improvement as the non-diagnosis group due to other complications associated with learning difficulties like low self esteem and poor memory.

Participants diagnosed with a psychiatric condition (figure 4.7) showed positive improvement in behaviours related to the external environment (not being easily externally distracted) and task (not giving up easily and completing the task). It is especially relevant that improvement was noted in the behaviour of not being easily externally distracted as this is the one symptom ("distraction by extraneous stimuli") which is a diagnostic criterion for ADHD but is also thought to be associated with the ADHD child's inability to adequately process and respond to sensory input. [2,13,48-53] Thus, a postulation can be made that post-intervention, the participants were not over-stimulated, were able to ignore or filter out unimportant environmental stimuli and only register to stimuli pertinent to the task at hand for an adequate period of time in order to complete the task. This group did not show as much improvement as the non-diagnosis group due to difficulties associated with their psychiatric condition like anxiety, internal distractibility and low self esteem.

Of all the 11 participants, two participants diagnosed with asthma (figure 4.9) and a psychiatric condition profited the most from the sensory diet intervention as they showed definite signs of improved or consistent (no change) behaviour. Due to the heterogeneous nature of the sample of various sensory modulation disorders, the general sensory strategies chosen for the sensory diet implemented in this pilot study were mostly vestibular and proprioceptive sensory tasks that were organizing in nature. Wilbarger stated that the sensory diet is only effective if it is individualised to the child's specific needs. [106] Thus the sensory diet was probably most effective in those two participants as it met their specific modulation needs.

Certain behaviours were observed to remain generally constant during the pre and post test across the various participant diagnostic categories. The four categories of in-seat behaviours which illustrated no change positively or negatively towards the implementation of the sensory diet include getting out of seat, needing to move around; impulsivity, working too fast, lacking planning; lacking confidence and withdrawing; and isolating self from others.

The last two behaviours may be classified as social deficits which may be as a result of sensory sensitivity. This no change observation in these social behaviours is in keeping with current literature on RDSP in that by the age of eight behavioural tendencies decrease and social skills increase. Therefore it can be assumed that these behaviours did not need to be improved as nine of the eleven participants were over the age of 8. [41] No trend could be established for any of the participant categories for two behaviours (not getting down to their work; slow in completing a task) as inconsistencies were noted throughout the sample population.

5.6 LIMITATIONS OF STUDY AND DIRECTIONS FOR FUTURE RESEARCH

Since this was a pilot study, several limitations were inherent in this study. These highlight the importance of conducting pilot effectiveness studies prior to implementing a RCT study as the observed methodological sources of error found can then be controlled in future RCT studies. The following findings highlight limitations of this study and suggest directions for future studies:

The population included in the research was a limited sample of the South African population as the research was only conducted at one school in Gauteng. The study included only one primary school, thus limiting the sample size for the six, seven and eight year old sample groups. The study was not a true reflection of the population at large, as participants were determined by there placement in the grade one class. Thus, the small sample size from one school and geographical area limited the socioeconomic, ethnic, and gender differences, and thus prohibited generalization of the results of this pilot study to a larger population. Therefore, the use of a sample for the three groups of children with difficulties (psychiatric conditions, LDs and children with special education needs without a diagnosis) and ages warrants further pilot studies for differences. In addition, the sample was heterogeneous in terms of the various sensory modulation disorders present. Therefore, a sample size of 11 was not extensive enough to establish the generality of effects observed in this investigation across a broad range of children with SPD as not all children with SPD have same the sensory needs. As a result, this study provides a stepping-stone for a larger study to be conducted in the future. Larger samples of children within these diagnostic categories and with various sensory modulation disorders could be randomly selected and assigned to a treatment or control group over a longer intervention period. This random allocation and use of a control group would further validate these findings as well as provide more rigorous and reliable findings.

This pilot study was implemented in a naturally-occurring classroom environment. Successfully implementing the sensory diet intervention during a typical handwriting lesson provided a realistic and precise view of the positive features and challenges of this intervention. It also offered insight into the logistics of how this intervention could be successfully put into practice in a classroom. Further research should be performed to determine if results similar to or stronger than those in this study can be replicated in other classrooms. Replication of results could support the trends observed in the in-seat behaviours in this pilot study.

Although the results of this pilot study represents a major contribution to research and practice of school based SI therapy in the absence of other higher level evidence studies, one must be cautious not to over-generalise the findings. The short duration of this pilot study limited the opportunity to observe relationships between the sensory diet and long term improvement of in-seat behaviours. The effect of this intervention must be investigated over time.

Even though in-seat behaviours measured were defined to include concrete, observable actions, data collection remained somewhat subjective as only a rating scale was used. Literature argues that even when rating scales with cut-offs are used, assessments of behaviour components are subjective as difficulties arise in categorising behaviour as either "normal" or "abnormal".[82]

This was evident in this pilot study in the cluster of behaviours observed (restless, overactive and fidgety = may appear disorganized on self and in his work= have difficulty in getting down to his work = be slow to complete a task) which were thought to stem from the observation of being restless, overactive and fidgety. Thus, definitions of behaviours should be altered in the future to be as specific as possible. Furthermore, the use of subjective measures should be supplemented by more objective measures (e.g. physiological data).

In turn, the in-seat behaviour checklist created specifically for this pilot study, should be altered in the future so as to address only the most relevant behaviours, that is, the behaviours in which trend was observed to improve in a positive direction.

Although changes in the frequency of certain behaviours were apparent, statistical significance was not achieved for any of these changes. The role of this study is to rather act as a pilot to assist in providing a basis for future studies.

Finally, prior to executing a RCT on the effectiveness of the sensory diet in the classroom, a recommendation is made for future pilot studies focussing on the effects of medication in SMD individuals. One study could investigate the effects of the sensory diet in including a control group without any medication and another study may be conducted on the same children on and off their medication while being exposed to the sensory diet.

5.7 CONCLUSION

The high prevalence of different types of sensory processing difficulties found in the grade one learners at a school for children with special needs validated the necessity for the implementation of a sensory diet in the classroom.

This pilot study was structured according to the needs stipulated by Cermak and Henderson on the efficacy of SI procedures. It was conducted on the entire grade one class at Cedarwood School and met the need of relative efficacy of SI strategies for children with differing diagnoses, degrees of disabilities and of different ages. It also met the need to include an examination of the immediate effect of SI strategies as well as provided a representation of examining change over time. Furthermore, it was set out to be clinically accountable functionally, with outcome measures based on areas of behaviour significant to paediatric OT. [5]

Trends of decreased undesirable in-seat behaviour (internal and external distractibility, giving up easily and not completing the task; impulsivity, working too fast, poor planning and inability to initiate and carry tasks out independently) were evident. Trends of increased undesirable in-seat behaviours (restless, overactive and fidgety, disorganized on self and in his work, difficulty in getting down to his work, slow to complete a task) were also noted.

However, all trends were not found to be statistically significant. Caution should be exercised in interpreting and generalising the results of this pilot study due to its small sample size and lack of statistical power.

Thus, due to the absence of research studies on the effects of school based sensory strategies (without external aids) on a child's in-seat behaviour and limited evidence of the effects of sensory integration, this pilot study will set a foundation for future research and will contribute to the body of knowledge on sensory integration.

CHAPTER SIX: CONCLUSION

The aim of this pilot study was to explore the effectiveness of a sensory diet intervention on in-seat behaviour of a learner in the classroom. As the nature of this research was to pilot the sensory diet's effectiveness, a convenient sample population was selected so as to try absorb as much information (positive outcomes and limitations) of this intervention. Extensive research has shown that children with certain behavioural and developmental disabilities process sensory information differently than children without disabilities.[21,38,39] Hence, the convenient sample was recruited at a school for special needs, where the research was also conducted.

The study first needed to examine the prevalence of different types of sensory processing difficulties found in the grade one learners at a school for children with special needs so as to validate the necessity for the implementation of a sensory diet in the classroom. A high percentage of the overall sample population showed a significant dysfunction in their overall processing of sensory input. The sensory input found to be most disorganizing for the sample was auditory input as the participants appeared to have difficulty filtering out irrelevant auditory input. This meant that they could not register incoming pertinent auditory input appropriately in order to engage optimally in the task. The participants were also observed to display marked sensation seeking behaviour which was predominantly movement seeking behaviour. Sensation seeking behaviour may be understood as a self regulatory strategy that brings about a sense of calmness and organisation. A child with SMD will seek out other sensory inputs such as movement input in order to dampen out the other more perceived "threatening" sensory inputs.

The study then set out to examine the effectiveness of the sensory diet intervention. This pilot study demonstrated that the sensory diet intervention was indeed effective in improving certain in-seat behaviours across participants with varied ability levels, despite not all the participants responding in the same manner. Caution should however be exercised in generalising the results of this pilot study due to its small sample size, lack of randomisation, and absence of a control group.

The main conclusions arising from the study are summarized as follows:

- A trend for distractible behaviour to improve in the hypothesized direction was noted. An assumption is made that the calming and organizing sensory inputs (deep touch-pressure, slow vestibular as well as proprioceptive input) administered to the participants in the sensory diet facilitated an improvement in filtering out irrelevant auditory sensory input thus reducing their internal and external distractibility and simultaneously developing better focus of attention for the task at hand.

- A trend of work ethos related behaviours (not giving up easily and completing the task; being less impulsive, not working too fast, better planning; better able to initiate and carry tasks out independently) to improve in the hypothesized direction was observed. It is hypothesized that as the sensory diet promoted appropriate regulation of the participants' responses to sensory input (noted in being less distracted by internal and external sensory inputs), it enhanced an optimal level of arousal for task engagement.

- Trends of various in-seat behaviours (restless, overactive and fidgety, disorganized on self and in his work, difficulty in getting down to his work, slow to complete a task) to regress in the hypothesized direction were also noted. These undesirable behaviours were thought to stem from the increased in-seat movement seeking behaviour (restlessness, overactivity and fidgetiness). Movement seeking behaviour was found to be a self regulatory strategy most commonly utilised by the sample population. The presence of this movement seeking behaviour indicates that the participants would also benefit from ongoing calming and organizing sensory input during the lesson (e.g. weighted jacket, inflated cushion or therapy ball) and not only from a sensory diet administered prior to the lesson.

Although these results were not statistically significant, the trends discovered provide valuable information to occupational therapists and classroom teachers. These trends demonstrated that the sensory diet can be used in the classroom and may contribute to decreasing undesirable in-seat behaviours and thus increase learning opportunities and optimal engagement in tasks.

Additionally, the increase in fidgety behaviours may lead occupational therapists to aid teachers to recognize students' need for movement and modulation of the sensory input in their environment to improve their ability to learn.

This pilot study depicted how an intervention addressing SMD can be translated into effective practice in a classroom context. Thus, classroom teachers would benefit from a better awareness of the sensory needs of students and an available technique (i.e. sensory diet) to address these needs in the classroom. Due to the lack of research studies on the effects of a school based sensory diet and limited evidence of the effects of SI, this pilot study will set a foundation for future research. This pilot study has provided evidence-based practice for OT- SI based intervention for a sensory diet that can assist children with sensory modulation difficulties cope optimally in the multisensory classroom environment. Miller and colleagues stated that researchers interested in OT effectiveness research should execute pilot studies that build on each other instead of attempting to do the "one perfect" study. They believe that only by building programmatic research can a body of knowledge be created to move the empirical basis of the OT profession forward.[130] Thus, from this pilot study a larger-scale randomized controlled trial should be carried out to evaluate the efficacy of a school based sensory diet.

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APPENDICES

APPENDIX I:

Application for ethical clearance

APPENDIX II:

Letter of permission from Cedarwood School

APPENDIX III:

Letter of explanation sent to the school explaining the purpose and procedure of the research

30 March 2007

Child Integration Centre

Ground floor, West Wing

Capital Place, Block G

Lonehill Office Park

Lonehill Boulevard

Lonehill

Dear Mrs. Raymond

I, Maria Demopoulos, am an occupational therapist currently completing my Masters degree at the University of the Witwatersrand. I am investigating the effect of a sensory diet on the in-seat behaviour of grade one learner's in the classroom. I am inviting the grade one learner's at your school to consider participating in this study.

The research will be comprised of two phases. Phase one will consist of no treatment and be solely based on observing the child's behaviour at the desk. Phase two will consist of implementing a sensory diet throughout a two week duration period. In determining this data I will need to video tape each child's behaviour at their desk.

The research procedures will require no additional costs. Please note that the videotapes will only be watched by the researcher and selected observers (two other Occupational Therapists) and will be destroyed at the end of the research.

If there are any further questions please don't hesitate to contact me.

_____

M .Demopoulos

BSc (OT) Wits MSc (OT) II

APPENDIX IV:

School consent letter to be obtained from parents

Dear Parents

Good Day. I, Maria Demopoulos, am an occupational therapist currently completing my Masters degree at the University of the Witwatersrand. I am investigating the effect of a sensory diet on the in-seat behaviour of grade one learner's in the classroom. I am inviting you and your child would consider participating in this study.

Research has shown that sensations flow constantly into the brain at a rapid rate and these sensations need to be adequately acted upon, organized and integrated if a child is to learn efficiently. Difficulty in processing sensory input appropriately may lead to a child not being able to maintain a situation-appropriate state of alertness which will result in ineffective learning. This is of significance in the grade one learner with identified sensory processing problems as the first year of formal schooling is especially important in establishing patterns of behavioural, emotional, cognitive and social functioning which will in turn influence the child's future scholastic development.

Occupational therapists make use of a sensory diet to afford the child favourable participation and encourage competence in activities and thus facilitate greater opportunities for success throughout the day. A sensory diet is comprised of various specific activities that enhance the child's opportunities to receive beneficial sensory input at frequent intervals.

A school based sensory diet may therefore have a role to play in improving the attention based and behavioural adjustments of the grade one learners in their learning of important concepts needed for reading and writing. This study is aimed at observing this role and I would be grateful if you and your child will participate in this study to examine this.

It is felt that if the child receives the correct sensory input, including a combination of alerting, organizing and calming techniques that can fulfill the sensory needs' the child's level of arousal for learning will be optimised. If permission is granted for your child to be part of this research your child's behaviour during the handwriting lesson during a four week period will be observed on two separate occasions. The research will be comprised of two phases. Phase one will consist of no treatment and be solely based on observing the child's behaviour at the desk.

Phase two will consist of giving your child a sensory diet so as to achieve appropriate attention and behaviour during deskwork throughout a two week duration period. In determining this data I will need to video tape your child's behaviour at their desk.

I will be asking you to fill out a brief questionnaire about your child and a sensory profile on your child – this should only take about 20 minute of your time.

The research procedures will require no additional costs. Please note that the videotapes will only be watched by the researcher and selected observers (two other Occupational Therapists) and will be destroyed at the end of the research.

Please note that the data collection techniques can not hurt your child in any way, and that your child will be able to choose not to participate or withdraw from the research at any time without having to give reason. Remember that the study is completely voluntary and not taking part in it, or withdrawing from it, carries no penalty of any sort- your child will not be compromised in any way and schooling will not be influenced.

Lastly, confidentiality of your child will be maintained at all times through the use of codes instead of names on all results. I.e. each child will be assigned a subject number by which they will be referred by throughout the entire research. Only the chief investigator will have a list of names and codes to enable the code to be linked to a particular child. The list will be kept locked in an office.

If there are any further questions please don't hesitate to contact me on 083 469 9834. If you are happy to allow your child to take part in the study, please read and sign the attached consent forms and complete the Sensory Profile and questionnaire in as much detail as possible.

Thank-you for your time

_____

M .Demopoulos

BSc (OT) Wits MSc (OT) II

CONSENT TO BE PART OF RESEARCH

I agree to allow my child to participate in the study "The Effect of a Sensory Diet on the In-seat Behaviour of Grade One Learner's in the Classroom" outlined in the information sheet:

Parent/ Guardian:

_____

Signature: _____

Date: _____

CONSENT TO BE VIDEO TAPED

I, _____ the parent/guardian of _____ hereby give permission for my child's behaviour to be videotaped during the handwriting lesson.

I understand that the videotapes will be watched by the researcher and two other Occupational Therapists and will be destroyed upon the completion of the research.

_____ _____

Signature Date

APPENDIX V:

Teacher informed consent to observe child in the class

Dear Grade One Teacher

Good Day. I, Maria Demopoulos, am an occupational therapist currently completing my Masters degree at the University of the Witwatersrand. I am investigating the effect of a sensory diet on the in-seat behaviour of grade one learner's in the classroom. I am inviting you and the children in your class to consider participating in this study.

Research has shown that sensations flow constantly into the brain at a rapid rate and these sensations need to be adequately acted upon, organized and integrated if a child is to learn efficiently. Difficulty in processing sensory input appropriately may lead to a child not being able to maintain a situation-appropriate state of alertness which will result in ineffective learning. This is of significance in the grade one learner with identified sensory processing problems as the first year of formal schooling is especially important in establishing patterns of behavioural, emotional, cognitive and social functioning which will in turn influence the child's future scholastic development.

Occupational therapists make use of a sensory diet to afford the child favourable participation and encourage competence in activities and thus facilitate greater opportunities for success throughout the day. A sensory diet is comprised of various specific activities that enhance the child's opportunities to receive beneficial sensory input at frequent intervals.

A school based sensory diet may therefore have a role to play in improving the attention based and behavioural adjustments of the grade one learners in their learning of important concepts needed for reading and writing. This study is aimed at observing this role and I would be grateful if you and the children in your class will participate in this study to examine this.

It is felt that if the child receives the correct sensory input, including a combination of alerting, organizing and calming techniques that can fulfill the sensory needs' the child's level of arousal for learning will be optimised. If permission is granted for this research to be conducted in your classroom, the children's behaviour during the handwriting lesson on two separate occasions during a four week period will be observed. The research will be comprised of two phases. Phase one will consist of no treatment and be solely based on observing the child's behaviour at the desk.

Phase two will consist of giving the child a sensory diet so as to achieve appropriate attention and behaviour during deskwork throughout a two week duration period. In determining this data I will need to video tape the child's behaviour at their desk. Three cameras video taping this behaviour will be positioned in the classroom two weeks prior to the commencement of the research and remain there until the research is completed (six weeks in total). Please note that the videotapes will only be watched by the researcher and selected observers (two other Occupational Therapists) and will be destroyed at the end of the research.

During the baseline and intervention phases, collection on behaviour and attention will occur in the middle ten minutes of the thirty minute handwriting session. This permits for ten minutes at the beginning of the session for a potential late start and ten minutes at the end of the lesson for early completion.

Lastly, please note that all the information will be treated confidentially and that your name will not be mentioned in the study or publications of the results.

If there are any further questions please don't hesitate to contact me on 083 469 9834. If you are happy to partake in this study, please read and sign the attached consent form.

Thank-you for your time

_____

M .Demopoulos

BSc (OT) Wits MSc (OT) II

I hereby declare that:

- I am participating in this study, entitled *THE EFFECT OF A SENSORY DIET AND ON THE IN-SEAT BEHAVIOUR OF GRADE ONE LEARNER'S IN THE CLASSROOM* on my own accord
- I understand why the research is being done
- I give permission for the researcher to include children in my grade one class in the study
- I understand that all the information will be treated confidentially and that my name will not be mentioned in the study or publications of the results
- I understand that I have the right to inquire about the results of the research

Contact details:

Name: _____

Tel (w):_____

(c): _____

_____ _____

Signature Date

_____ _____

Eye Witness Date

APPENDIX VI:

Parent Interview Questionnaire

QUESTIONNAIRE NUMBER: _____ **QUESTIONNAIRE FORM**

PLEASE FILL THIS OUT AS ACCURATELY AS POSSIBLE. THE INFORMATION OBTAINED FROM THIS QUESTIONNAIRE WILL GUIDE THE RESEARCHER IN DETERMINING ANY OTHER EXTERNAL FACTORS THAT COULD INFLUENCE THE CHILD'S BEHAVIOUR IN THE CLASSROOM. PLEASE NOTE THAT THIS FORM WILL BE TREATED WITH CONFIDENTIALITY AT ALL TIMES.

1. **Personal Background History:**

- Date: _____
- Child's name: _____
- Date of birth: _____

2. **Medical History:**

- Has your child ever suffered from a recognised general medical condition in the past or presently?

  ☐ Yes ☐ No

- Is your child currently taking any medication? ☐ Yes ☐No If yes, please state the name and dosage of medication your child is taking.

- Has your child ever been referred for:

  ☐ Speech and hearing therapy ☐ Occupational therapy

  ☐ Physiotherapy ☐ Play therapy

  If so, why and for how long did your child receive therapy?

- If your child is still attending therapy, please provide the name and contact details of the therapist

  Therapist: _____ Contact Details: _____

  Therapist: _____ Contact Details: _____

  Therapist: _____ Contact Details: _____

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3. School History:

- Do you feel that your child is coping with his/ her schoolwork? ☐ Yes ☐No
  If no, please explain further

- Is your child currently benefiting from a specialised programme or any aids (e.g. weighted jacket) or modifications in the classroom to help him or her cope better?
  ☐ Yes ☐No If yes, please list these

- Do you have any other children with school problems or suffering from a specific disorder? ☐ Yes ☐ No If yes, please explain further

---

4. Social History:

- How would you describe your home atmosphere / environment?

- Are there any stresses or causes of tension in the home? (Please elaborate)

- Have there been any significant stressors that have influence your child? (Death of relative / pet, accident etc) ☐Yes ☐ No If yes, please explain further

---

5. General:

- Describe your child's sleeping patterns?

- What is your child's weeknight bedtime? _____
- Does your child wake up during the night? _____
- Describe your child's routine including times: (sleep, meals, homework, play, TV etc.)?

Week days:

Week end days:

- Describe your child's average:

Breakfast: _____

School Lunch: _____

Daytime Snacks: _____

Dinner _____

- Is your child on a multivitamin? Yes/No Brand: _____
- Which liquids does your child most commonly drink? _____
- How regularly does your child eat sweets? _____

_____

Parent's signature

Thank you very much for taking the time to complete this questionnaire- it is greatly appreciated.

APPENDIX VII:

Short Sensory Profile

APPENDIX VIII:

Verbal assent form from each child

Verbal Assent

Subject number: _____

Hello (*child's name*)

My name is Maria and I will be visiting your classroom quite often during the next ten weeks to spend some time with you whilst doing a special programme. You will not get into any trouble if you don't want to be a part of this programme. Do you understand?

During the programme I would like to do some changes to your desk and chair to make it easier for you to write. I would also like to do some exercises and games with you and your classmates before you sit down at your desk to help you concentrate better when learning to write. Is that ok?

I will have three video cameras in the corners of the classroom that will take some pictures while you write. Is that alright?

_____ _____

Researcher Date

_____ _____

Eye witness Date

APPENDIX IX:

Daily Behaviour Checklist

DAILY BEHAVIOUR ASSESSMENT SCALE

Please tick off the most significant observable behaviours needed during deskwork and rate these in the final column.

Item					**F**
Concentration and Attention					
1. Easily distracted by own thoughts, daydreams					
2. Easily distracted by external stimuli (noise and things he sees)					
3. Appears to be bored, lacks motivation					
Behaviour in Class					
4. Restless, overactive, fidgety					
5. Gets out of seat, needs to move around					
6. Disrupts class, disturbs others					
7. Speaks out of turn, demands to be in the spot-light					
Perseverance and Task Completion					
8. Easily frustrated when attempting tasks					
9. Gives up easily and wont complete the task (fails to finish the task)					
Organisational Ability					
10. Disorganised on self, and in his work					
11. Cant get down to his work					
12. Slow to complete a task					
13. Impulsive, works too fast, work lacks planning					
Ability to Cope with New Situations					
14. Refuses to attempt new tasks					
15. Becomes over-excited, lacks self-control					
16. Lacks confidence and withdraws					
17. Cant cope with a number of different stimuli at the same time					
18. Has a low self esteem					
Social Interaction					
19. Has difficulty making friends					
20. Is not accepted by peers					
21. Isolates himself from others					
22. Is aggressive towards others					
23. Antagonises others					
24. Has poor interaction with teacher					
Responsibility, Initiative					
25. Not able to initiate activities and carry them out independently					
26. Not able to assume responsibility for his own work					
27. Not able to assume responsibility in classroom activity					
Emotional Control					
28. Temper outbursts, explosive unpredictable behaviour					
29. Labile, cries easily and often					
30. Stubborn, withdraws, sulks easily					
31. Anxious, easily embarrassed					

APPENDIX X:

Therapist informed consent to assist in revising the Daily Behaviour Checklist

Dear Paediatric Occupational Therapist

I, Maria Demopoulos, am a sensory integration trained paediatric occupational therapist currently completing my Masters degree at the University of the Witwatersrand. I am investigating the effect of a sensory diet on the in-seat behaviour of grade one learner's in the classroom.

Research has shown that sensations flow constantly into the brain at a rapid rate and these sensations need to be adequately acted upon, organized and integrated if a child is to learn efficiently. Difficulty in processing sensory input appropriately may lead to a child not being able to maintain a situation-appropriate state of alertness which will result in ineffective learning. As occupational therapists, we make use of environmental modifications and a sensory diet to afford the child with identified sensory processing problems favourable participation and competence in scholastic activities.

In order to assess the significance of the school based sensory diet in improving the attention based and behavioural adjustments of grade one learners, this study will be observing a child's behaviour during handwriting lessons at three different intervals during a four week period. The research will be comprised of two phases. Phase one will consist of no treatment and be solely based on observing the child's behaviour at the desk. Phase two will consist of giving the child a sensory diet and classroom modifications so as to achieve appropriate attention and behaviour during deskwork. In determining this data the child's behaviour at their desk will be videoed. The videotapes will then be watched by two judges (Occupational Therapists) who will score the child's behaviour according to a revised and shortened version of the Daily Behaviour Assessment Scale.

I need your help in evaluating the 31 criteria of the Daily Behaviour Assessment Scale so as to summarise this scale to the 8 items representing the most significant observable behaviours needed during deskwork.

This will be done through a process of elimination. Initially, the completed Daily Behaviour Assessment Scale will be presented to you. You will be required to tick off the eight most significant observable behaviours. Thereafter, all the scales will be analysed and a second revised version of the form will be sent out.

Again, you will be required to choose the most important behaviours. This process will be continued till a consensus is reached amongst the focus group.

Agreement to participate in this research study is by your completion of the attached consent form. Your response will be kept confidential. Participation is voluntary, and should you decide not to participate in this study you will no way be negatively influenced.

Thank you for taking time to read this letter. Your participation will be greatly appreciated. If there are any further questions please don't hesitate to contact me on 083 469 9834.

Yours Sincerely

_____

M. Demopoulos

BSc (OT) Wits MSc (OT) II

Consent Form

I agree to participate in the study outlined in the information sheet.

Name: _____

Signature: _____

Date: _____

Contact number: _____

Fax number: _____

Email: _____

APPENDIX XI:

Example of Observation Sheet Used: Daily Behaviour Checklist (Revised)

APPENDIX XII:

Sensory Diet Programme

SENSORY DIET ROUTINE

1. Start each morning with an outline of the schedule for the day; highlight any changes that may be different. Use a picture schedule for the day's events and review this. Keep it simple with shorter lengths of time, such as for the morning schedule before lunch, then review the afternoon after lunch. When an activity is completed, then the picture goes in the all done basket, with the next activity always at top. Use large picture symbols and simple words and place it where it can be seen such as on the desk or on the board so that it can be found easily.

2. Start the sensory diet: First address vestibular registration processing. Vestibular input is the strongest of the brain stem sensations and lasts the longest in the brain chemical release. It is the fastest way to calm anyone with slow, gentle, rhythmic swinging from a double hung point. It also decreases stress chemicals the fastest.(15 min)
   E.g.: Swinging, jumping to letters or spelling words, bdpq code charts, soldier walks, Simon says

3. Wilbarger Brushing and Joint Compression Routine (every 2 hours): The Wilbarger Protocol for brushing and joint compressions helps the child modulate his/her responses to sensory stimulation. The child that requires high levels of concentration should be brushed before work. It provides deep pressure and proprioception which will assist in focussing attention, reducing distractibility and preventing high levels of disorganisation.

   The brush should only be the oval surgical brush, with deep pressure starting at palms of hands and going up and down arm, back, and other arm without letting up and using long strokes. Then continue on leg and bottom of feet.

   Follow brushing with strong, hard joint compressions (10 times at least) to fingers, thumb, wrist, elbow, and shoulder, and ask them to jump 20 times with straight legs if time is short..

4. Next address muscle tone, strength and proprioceptive modulation by providing joint and muscle input. Proprioceptive input is sensory input to the joints and muscles and is best to do every 2 hours.

5. Deep Pressure Touch-Deep Pressure Touch is very important every 2 hours and helps keep the brain focused, clear, and enables us to concentrate and stay with a task longer. Dopamine & Serotonin are released when deep pressure touch is administered.

6. After at least 25 minutes of "sensory prep" work, then ask the child to sit at the desk and do a learning activity.

7. Provide opportunities for organising sensory breaks when you observe that the child's level or arousal starts waning and is no longer conducive for learning (e.g. becomes distractible or starts daydreaming). A small sensory break should take place in between each 30 minute period and a larger 20 minute sensory break should be given after each 2 hour block (i.e. such as break time making sure that the child receives vestibular and proprioceptive input).
   Examples of calming choices include:

   - Swinging in a linear movement.
   - Being "sandwiched" between bean bags
   - Having a therapy ball rolled over them and deep pressure all over their body.
   - Wearing a weighted blanket
   - Brushing and joint compressions
   - Jumping with ankle and wrist weights on a trampoline, counting to 20.
   - Medicine ball basketball or catch and throw game
   - Chair push ups
   - Carrying or pushing heavy objects
   - Animal walks, wheelbarrow walking, crab walking, crawling through tunnels through an obstacle course

After sitting for longer than 30 minutes, give a 10 minute movement break, which doesn't mean that they have to run around in a disorganized manner. Be creative and find ways to incorporate the academics into the movement, keep it structured and organized such as lying on belly on the floor whilst writing, standing at a desk.

8. Follow with strong proprioceptive input every 90 minutes to joints and muscles and linear vestibular input throughout his day.

Auditory distractions	• Forewarn Child of any loud noises before they occur (i.e. bells/fire alarms). • Keep your voice low. Child is often sensitive to loud and/or high pitched noise and will respond better to a low voice or even whispering in a noisy classroom. • Allowing Child to wear earplugs in a noisy activity. Explain that earplugs do not prevent him/her from hearing, but simply lowers the volume to a tolerable level. • Get a white noise machine e.g. fan
Visual distractions	• Permit the child to avoid eye contact when answering a question if he/she needs to block off his/her visual sense in order to concentrate better. • Use reading highlighters to highlight the lines.
Tactile distractions	• If the proximity of classmates irritates the child, help him find a spot where he will feel safe. • Putting red or blue painters tape around their personal space to give boundaries as to where they need to stay, and prevent other students from entering their space. • Separate space areas to prevent incidental touch by others; designate spaces for circle time (e.g., carpet square) • approach the child from the front and warn the child before touching • avoid touch to sensitive areas (e.g., hair, face, neck, abdomen) • use firm touch and avoid light touch • Arrange the classroom seating to minimize the risk of being bumped by others. • He/she should not have a child next to her who is likely to talk t during concentration activities.

Auditory breaks or movement breaks scheduled throughout the day. These will provide the child's body with a 'break' during concentration activities and thus assist him/her to refocus, and attend to new instructions. These are especially relevant if he/she becomes tired and fidgety.	• Child becomes teacher's assistant and bring back books from one point of the class to the next for increased heavy work input • Child becomes office messenger. • Walk to another class and back • Chair push-ups • Stand up and jump on the spot (or do star jumps) 10 times • Do 5 hand to hand presses (place hands together as if praying and then push them hard together) • Child to stand at the desk or to work on the floor in a prone-on-elbows position (on stomach) • Make sure the students have movement breaks in between sitting tasks, a good rule is that for every 20-30 minutes of sitting a child under 8 years needs 10-15 minutes of movement e.g. quick ten-twenty jumping jacks, wheelbarrow walking, and bdpq code charts, The Infinity Walk • You can do times tables, spelling, reading, etc in standing in their "box" outlined on the floor, laying on their bellies, jumping, standing on one foot, marching
Calming and organizing - These activities will help the child to self regulate his/her arousal level and focus his/her attention on the task at hand.	• Soldier Walks to a metronome beat: Russian soldiers with same arm and leg up and down, then British soldier with opposite arm and leg. • Tree waving: Have class march around the room following a path that is marked clearly on the floor (can also use path to follow for creeping activities) with no obstructions in the way and have students pretend to be trees waving in the breeze, "How slowly can you wave" You can do this standing behind chairs as well if the marching is too distracting and unorganized.
Consistent routine. The child with sensory modulation difficulties may have trouble getting organised to do what is necessary.	• Use a picture schedule for the day's events and review the events of day at school. The activities for the day are reviewed in the order they are executed. Then the children know that unstructured activities are limited to certain amount of time and what is expected next. This visual reminder along with verbal cues of what transitions are coming will reinforce the routine.. When an activity is completed, then the picture goes in the all done basket, with the next activity always on top.

They may struggle to overcome a feeling of chaos, internally and externally. They are most comfortable when things are "just so," exactly as they were yesterday and will be tomorrow. Child copes better in a classroom that is clearly structured as opposed to one that runs on spontaneity.	• Using a timer like an egg timer can help when working on structured tasks, so that the student understands when the timer goes off, they can then play. Reset the timer again to show how long they have to play before the next transition. • Use simplified instructions with the children verbalizing steps to complete task.

Note:

- Once they have received a regular "sensory diet" of these above activities every two hours in their day, then attention and a calm yet ready to learn state of mind can be achieved.

- After a disorganized and unstructured time (such as break time or a classroom visitor popping in) do a classroom calming activity

- During ring time include the following accommodations to help the child sit still:
  - sit on an inflated seat cushion
  - use hand "fidgets"
  - use a weighted jacket to get calming sensory input, as well as a physical cue to stay seated.

Monday Intervention Phase (week one and two)

Time Span	Event	Activity
5 min	Go over schedule for the next 2 weeks and the day	Highlight changes. Use a picture schedule for the day's events and review this.
15 min	Vestibular input / Brushing	• march in place, alternating the speed and rhythm • games with clapping patterns using speed and rhythm • rolling • Simon says
10 min	Proprioceptive input / Deep pressure input	• seat walking while sitting on the floor with legs extended • Ring-Sit-Pull: Students sit in a ring or long-leg posture, legs extended out in front of them on the floor. They grab their feet and pull, doing approximately ten repetitions. • Back-to-back Pull: Partners sit with backs together, arms inter-locked at the elbows. Each one alternately rolls forward, trying to raise his partner off the floor slightly. • self-imposed body hugs • Crawling to desk • Chair push ups with hands on either side of chair and student pushes whole body up 10-20 times, or to the counting or ABC recital in the am. • Table Pull: While sitting at either the desk or at a table, have each child pull across and grab the opposite edge. Repeat about ten pulls, as they pretend to compress the table. • Finger Pulls: Have each student pretend they are pulling gloves on, starting at the top of each finger, and pulling down. They may follow this by pulling each finger of glove off. • *Finger-fidget activities:* pencil aerobics
	Kinesthetic Learning - Air writing (visual/kinesthesia)	Write letters with large arm movements with and without vision.
	Sensory diet activity / "break"	- Swinging in a linear movement - Wearing a weighted blanket in calm space - Brushing and joint compressions - Chair push ups - Carrying or pushing heavy objects - Crab walking
	Movement break	- standing on one foot - marching

Tuesday Intervention Phase (week one and two)

Time Span	Event	Activity
5 min	Go over daily schedule	Use a picture schedule for the day's events and review this.
15 min	Vestibular input / Brushing	• games with clapping patterns using speed and rhythm • Leopard crawl through tunnel
10 min	Proprioceptive input / Deep pressure input	• Elevate anything to make them reach up high to promote stretching and elongation • self-imposed body hugs • Ring-Sit-Sit-ups: Have partners facing each other on the floor. Legs should be out straight front of them, soles of feet together. Have them work on alternate sit-ups, and especially during the sit-up phase, the one sitting should work hard to pull his partner up. The partner lying down should-not assist in the sit-up. To add finger traction/proprioception, have them pull each other up as they both grab onto the plastic rings. • Wheelbarrow walk: Weight is on hands, while a second person holds legs. Instead of 'walking', have the student with hands on floor rock forward and backward. • Shoulder Depressors: Assume long-sitting posture. With hands at side of hips, push palm into floor, raising bottom off the floor. Legs need to remain straight. Rock forward/backward or side-to side as possible. • seat walking while sitting on the floor with legs extended • Hand Rub: Have each student place hands in 'prayer' position, Fingers interwoven, and alternate palm pressing and finger pulling. • *Finger-fidget activities:* pencil aerobics
	Kinesthetic Learning - Air writing (visual/kinesthesia)	Write letters with large arm movements with and without vision.
	Sensory diet activity / and movement break	- Swinging in a linear movement - Wearing a weighted blanket in calm space - Brushing and joint compressions - Activities on board

Thursday Intervention Phase (week one and two)

Time Span	Event	Activity
5 min	Go over daily schedule	Use a picture schedule for the day's events and review this.
15 min	Vestibular input / Brushing	• games with clapping patterns using speed and rhythm • wrapping in blanket (weighted blanket) and rolling • ten-twenty jumping jacks • bdpq code charts • The Infinity Walk
10 min	Proprioceptive input / Deep pressure input	• Elevate anything to make them reach up high to promote stretching and elongation • self-imposed body hugs • Wall Pushing: Students stand facing the wall, hands up at about shoulder level, and push, pretending to try to push right through the wall. Have them push to the count of 10 while pushing. Upgrade to doing slow, repetitive push-ups, coming forward and touching the wall with their nose only, before straightening arms again and pushing away. • Leg Pulls: Have students individually roll up into a ball, pulling or squeezing legs below knee, pair up with partners. While one student sits with back to wall, and bears down with hands into floor for stability, the partner literally pulls each leg from the ankle a series of about ten times. • Pushing chairs under the table / on top of table • "Popcorn" activity in chair (popping up at different speeds or intervals) / Chair push ups with hands on either side of chair and student pushes whole body up 10-20 times, or to the counting or ABC recital in the am. Or performed bilaterally, then alternating R-L-R-L and varying the rhythm (first use arms then legs) • Finger Pulls: Have each student pretend they are pulling gloves on, starting at the top of each finger, and pulling down. They may follow this by pulling each finger of glove off. • Clapping: Incorporate hand clapping/thigh slapping rhythms in either a loud or soft format. • Clothespins: Any activities involving opening/closing clothespins can be used. Emphasize using the thumb and individual finger alone in order to give input to all fingers. • *Finger-fidget activities:* pencil aerobics and pencil walking
	Kinesthetic Learning - Air writing	Write letters with large arm movements with and without vision.
	Sensory diet activity / and movement break	- Swinging in a linear movement - Wearing a weighted blanket in calm space - Brushing and joint compressions - Activities on board

APPENDIX XIII:

Table of comparison of the effect of in-seat behaviour of each subject pre and post-test

		LEARNING DIFFICULTIES			PSYCHIATRIC			N0 SPECIFIED DIAGNOSIS PRESENT				ASTHMATIC
BEHAVIOUR	**PHASE**	**11**	**12**	**1**	**4**	**8**	**10**	**2**	**3**	**7**	**9**	**6**
1. Easily distracted internally, daydreams	Pre	20%	20%	10%	63%	0%	33%	30%	10%	50%	44%	88%
	Post	50%↓	0% ↑	29% ↓	100↓	0% =	50%↓	29% ↑	14% ↓	22%↑	0%↑	11%↑
2. Easily distracted by ext stimuli	Pre	30%	33%	60%	75%	25%	66%	60%	70%	63%	66%	100%
	Post	0% ↑	60% ↓	43% ↑	43% ↑	11% ↑	50%↑	43% ↑	43% ↑	22%↑	0%↑	88%↑
3. Restless, overactive fidgety	Pre	40%	66%	10%	25%	0%	22%	40%	60%	50%	55%	75%
	Post	10% ↑	20%↑	43% ↓	43%↓	0% =	80%↑	43 %↓	57 %↑	0%↑	11%↑	44%↑
4. Gets out of seat, needs to move around	Pre	0%	0%	0 %	0%	0%	0%	10%	10%	0%	11%	0%
	Post	0% =	0% =	0 % =	0% =	0% =	0%=	0% ↑	0% ↑	11%↓	0%↑	0%=
5. Gives up easily and wont complete the task	Pre	0%	0%	0 %	38%	13%	0%	0%	20%	25%	0%	13%
	Post	10% ↓	10% ↓	0 % =	0% ↑	11% ↑	10%↑	0% =	14% ↑	11%↑	0%↑	11%↑
6. Disorganised on self, and in his work	Pre	0%	0%	10 %	0%	0%	0%	0%	0%	13%	0%	25%
	Post	10% ↓	0% =	0 %↑	57% ↓	0% =	0%=	0% =	43% ↓	0%↑	11%↓	0%↑
7. Cant get down to his work	Pre	0%	0%	0 %	50%	13%	0%	0%	10%	25%	33%	63%
	Post	0% =	0% =	29 %↓	57% ↓	11% ↑	10%↓	57% ↓	43% ↓	44%↓	11%↑	22%↑
8. Slow to complete a task	Pre	0%	0%	0 %	63%	25%	0%	0%	20%	38%	0%	38%
	Post	0% =	10% ↓	57 %↓	86% ↓	11% ↑	10%↓	29% ↓	29% ↓	0%↑	0%=	11%↑
9. Impulsive, works too fast, lacks planning	Pre	0%	11%	10%	0%	0%	0%	0%	50%	0%	33%	0%
	Post	0% =	0% ↑	0% ↑	0% =	0% =	0%=	0% =	14% ↑	11%↓	11%↑	0%=
10. Lacks confidence and withdraws	Pre	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Post	0% =	0% =	0% =	0% =	0% =	10%↓	0% =	0% =	0%=	0%=	0%=
11. Isolates self from others	Pre	0%	0%	10%	0%	0%	0%	0%	0%	0%	0%	13%
	Post	0% =	0% =	0% ↑	0% =	0% =	0%=	0% =	0% =	0%=	0%=	0%↑
12. Not able to initiate and carry tasks out indepen.	Pre	0%	0%	10%	25%	88%	0%	0%	50%	63%	66%	38%
	Post	10% ↓	10% ↓	11% ↓	11% ↑	33% ↑	10%↓	29% ↓	14% ↑	55%↑	0%↑	11%↑

The extent to which behavioural changes in response to the implementation of the sensory diet for each subject is indicated in the table as = (no change in behaviour), ↑ (improvement in behaviour) and ↓ (regression in behaviour).