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UNIVERSITY OF THE WITWATERSRAND
OCCUPATIONAL THERAPY DEPARTMENT

SENSORY MODULATION DEFICITS AND ANXIETY SYMPTOMS IN CHILDREN RECEIVING OCCUPATIONAL THERAPY

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A research report submitted to the Faculty of Health Sciences,
University of the Witwatersrand, Johannesburg,
in partial fulfilment of the requirements for the degree of
Master of Science in Occupational Therapy.
Ethical clearance number: M111112.

Johannesburg, 2016

CANDIDATE'S DECLARATION

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

…… [Signature]

17th day of May, 2016

ABSTRACT

This study aimed to identify the association between observable sensory behaviours and anxiety symptoms in school-aged children. The children were between the ages of 8-10 years and attended Remedial Schools. The participants were receiving occupational therapy and were identified as having a Sensory Modulation Disorder (SMD). Parents rated their children on the Sensory Profile, and scores were correlated to the Spence Children's Anxiety Scale, completed by the children. Participants showed high quadrant scores indicating "low registration" and sensory "over-responsivity" (avoidance and sensitivity to sensory input). Further, the participants were identified to be an "at risk" population for anxiety disorders, as scores of elevated anxiety exceeded normal populations. Although total anxiety scores correlated with only avoidance quadrant scores (and not sensitive scores as predicted,) other scores indicating emotional behaviours correlated moderately with total anxiety scores. It is concluded that children with SMD are at risk of presenting with anxiety disorder symptoms, and must thus be monitored for these.

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NOMENCLATURE

ADHD: Attention deficit hyperactivity disorder is a childhood disorder with symptoms which can be identified in adolescence and adulthood. Symptoms of ADHD include the child struggling with staying focused and paying attention, difficulty with managing their behaviour, and hyperactivity.(1)

ASD: Autistic Spectrum Disorder: is a disorder which is identified by the child showing deficits with their social skills, interaction and communication. Children with ASD often show repetitive patterns of behaviour, have limited interest and participate in few activities independently. In order for the diagnosis to be made, symptoms must be present in the child, in the early years of development (typically in the first two years of life). Further, symptoms must affect the child's functioning in their social, play, school and self-care areas of functioning.(2)

DSM: The Diagnostic and Statistical Manual of Mental Disorders (currently DSM V,) is a classification system of conditions which is referred to by psychiatrists, psychologists and other mental health clinicians. It contains symptoms, as well as diagnostic criteria for every psychiatric disorder.(3)

EEG: An electroencephalogram (EEG) is a test which detects electrical (neural) activity in the brain through applying metal electrodes (discs) to the scalp. The neural activity is interpreted on an EEG recording.(4)

SCAS: Spence Children's Anxiety Scale is a child self-report questionnaire, which can be used by children aged 8-12 years old to assess their anxiety symptoms. The scale assesses six domains of anxiety including generalised anxiety, panic/agoraphobia, social phobia, separation anxiety, obsessive compulsive disorder and physical injury fears.(5)

SD: Standard Deviation is a measure that is used to identify the amount of deviation a set of numerical values has. When the standard deviation is close to "0", it shows that the points of data are very close to that of the mean, whereas a standard deviation that is high, shows that the points are more dispersed.(6)

SMD: Sensory Modulation Disorder is identified when a child shows behaviours indicating difficulty in responding appropriately to the intensity of their sensory input, often showing mal-adaptive functioning. Individuals with SMD often respond to nonthreatening sensory

input by showing either craving, avoidant, sensitive or defensive behaviours that are inappropriate reactions to the sensory input in the environment.(7)

ANXIETY: Anxiety is a normal human emotion but inappropriate amounts of anxiety results in Anxiety disorders. In order for an Anxiety disorder to be diagnosed, the person must show distress and fear which results in their daily life activities being affected. (8)

SENSORY PROCESSING: is the process whereby the brain takes sensory neural messages from the environment and through processing these result in appropriate motor responses. Sensory Processing Disorder (SPD) is a disorder identified in children, when the sensory stimuli received by the brain are disorganised and affects the child's participation in daily life activities, as well as coordinated motor responses. (9)

INTRODUCTION

1.1 PREFACE

Children attending occupational therapy sessions are often treated for Sensory Modulation Disorders (SMD). SMD is identified by children struggling to modulate their sensory input, which results in emotional and behavioural reactions.(7) Further, children with sensory over-responsivity often avoid or act sensitively to sensory input, resulting in them struggling to suitably participate in expected and developmentally appropriate life activities. (10)

When clinicians work with school-aged children who have been identified with SMD, they observe that certain children also present with behaviours that are indicative of anxiety symptoms. Thus confusion arises as to whether the anxiety behaviours observed by occupational therapists are attributable to SMD or a true anxiety disorder. Further, the parent-report screening tools used as part of the diagnosis of SMD or anxiety, rate the frequency of the child's behaviour. These are self-report questionnaires in which the parents comment on the regularity of observed behaviours. (5, 11) Many of the behaviours observed with both anxiety and SMD are very similar and therefore these behaviours can be attributed to either diagnosis.(12, 13) Confusion also arises as these children are still young and often struggle to appropriately verbalise exactly what they are feeling,(14) resulting in clinicians being unable to identify and explain whether the symptoms are anxiety or sensory based.

Supporting literature has identified a link between the anxiety symptoms and sensory over-responsivity in children with SMD. (12, 13) Children with sensory over-responsivity often struggle to participate in occupational activities successfully, which results in them withdrawing or avoiding certain situations. (15) Avoidance of situations which provoke worrying or uneasy feelings would also be the expected response of a child who is anxious. Thus, the study aimed to understand the relationship between sensory modulation disorder and anxiety symptoms in children, and to ascertain whether the identification of SMD, puts the child at a greater risk of having possible anxiety disorder in the future.

1.2 STATEMENT OF THE PROBLEM

Many children with sensory modulation disorder, who attend occupational therapy sessions, also present with anxiety symptoms. It is difficult for the occupational therapists to differentiate which

symptoms are related to sensory over-responsivity and which are true anxiety symptoms. This can affect the treatment approaches, as well as frames of reference used in therapy, as the clinician is not always sure whether a Sensory Integrative or Psychosocial approach is more suitable.(16) Further, if the clinician is using the wrong approach, it could affect the successful consolidation of treatment aims, and progress made in therapy. Thus, it is vital for clinicians to understand the relationship between SMD and Anxiety clearly, to assist clinicians in performing effective therapy, based on evidence based research.

1.3 THE PURPOSE OF THE STUDY

The purpose of the study was to describe the sensory modulation dysfunction in a sample of children attending occupational therapy and identified as having SMD and to establish their self-report anxiety levels. The purpose of the study was also to describe the association (if any) between SMD and anxiety symptoms in a sample of children identified with SMD and specifically to investigate whether the reported link in literature between sensory over-responsivity symptoms and elevated anxiety holds true in a South African sample.

1.4 RESEARCH QUESTION

What does the sensory modulation dysfunction of a sample of children with SMD look like and do they have elevated self-reported anxiety levels? Is there any identifiable association between SMD behaviours and self-reported anxiety behaviours, particularly within the group identified as having sensory over-responsivity behaviours?

1.5 AIM OF THE STUDY

The aim of the study was to investigate the sensory modulation dysfunction and anxiety levels of a sample of children identified as having sensory modulation disorder, who were receiving occupational therapy. The study aimed to investigate whether there is an association between SMD behaviours and self-reported anxiety behaviours, particularly within the group identified as having sensory over-responsivity behaviours.

1.6 OBJECTIVES OF THE STUDY

1. To describe the sensory modulation dysfunction of a group of children with Sensory Modulation Disorders.
2. To determine whether a group of children with SMD have elevated anxiety levels.
3. To explore the association between self-reported anxiety and specific SMD patterns.

1.7 HYPOTHESES OF THE STUDY (Related to Objective 3)

The following hypotheses are related to Objective 3 described above, where the association between specific SMD patters (ie: sensory over-responsivity) and self-reported anxiety symptoms were explored in more detail. The hypotheses were formulated based on supporting literature which shows possible associations between the following constructs below:

1. There will be an association between the sample's total Anxiety scores and their sensory over-responsivity scores.
2. There will be an association between the sensory factor scores relating to emotion/anxiety and the sample's total anxiety scores.
3. There will be an association between the sensory section scores relating to emotion/anxiety and the sample's total anxiety scores.

1.8 NULL HYPOTHESES:

1. There will be no association between the sample's total Anxiety scores and their sensory over-responsivity scores.
2. There will be no association between the sensory factor scores relating to emotion/anxiety and the sample's total anxiety scores.
3. There will be no association between the sensory section scores relating to emotion/anxiety and the sample's total anxiety scores.

1.9 JUSTIFICATION OF THE STUDY

This study will assist clinicians in better understanding the association between SMD and Anxiety. It will clarify whether these are stand-alone disorders or whether there is an overlap and association between the symptoms observed in school aged children who attend occupational therapy services. Further, the study will identify whether children with SMD are at risk for presenting with anxiety disorders. This study will contribute to the evidence based research by

clarifying the relationship between SMD and anxiety, thereby assisting clinician's with implementing effective treatment, as well as possibly preventing comorbid anxiety disorders, in clients seen with SMD.

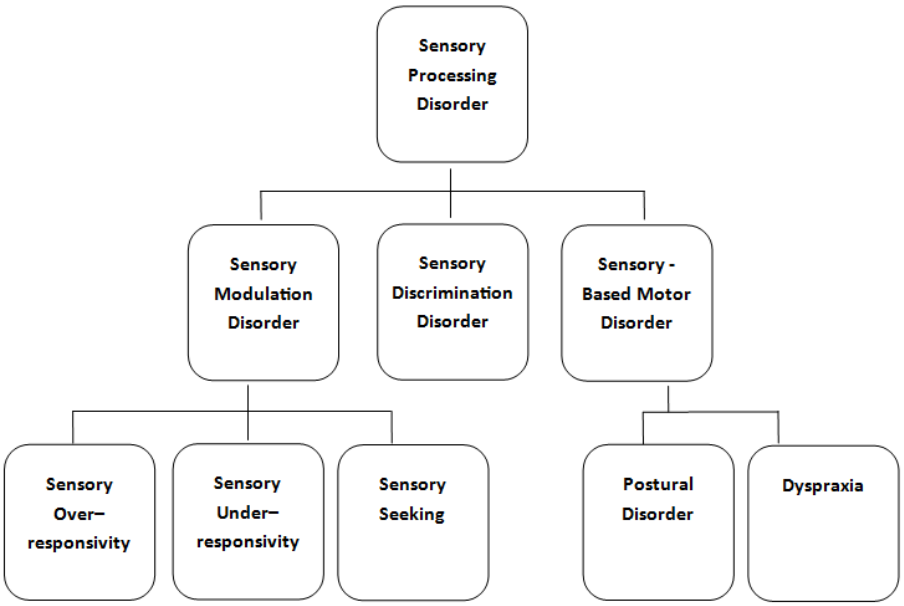
LITERATURE REVIEW

This literature review will focus on explaining how this study was developed and investigated. It includes the literature that was reviewed to understand the sensory modulation disorder diagnosis, as well as the criteria that define the anxiety diagnosis. Further research will be examined to understand the association between the behaviours observed and reported in school-aged children who present with Anxiety and Sensory Modulation Disorder (SMD).

2.1 UNDERSTANDING THE SENSORY MODULATION DISORDER DIAGNOSIS:

Sensory Integration theory was first described in the early 1960's by Dr A. Jean Ayres. At that time she was defining her field of study which involved children with learning difficulties, and their atypical responses to their sensory environments. (9) Ayres hypothesized Sensory Integration Dysfunction to relate to an individual's neurological difficulty with "detecting, modulating, discriminating and responding to sensory information". (9) Ayres explained sensory processing and integration processes to be the foundations for learning, perception, and action. (17)

Current thinking has supplemented the initial understanding of Sensory Integration Dysfunction as referred to by Ayres, and now describes Sensory Processing Disorder. (7) This condition is made up of three patterns: Sensory Modulation Disorder (SMD), Sensory Discrimination Disorder (which refers to the child having trouble with understanding the characteristics of sensory stimuli [e.g., the duration, intensity, spatial or time-based properties relating to the sensory input]) and Sensory-Based Motor Disorder (*Postural disorder*: in which an individual presents with postural core stability, balance and coordination problems, and *Dyspraxia*: which includes problems in ideating, and executing motor actions and receiving correct feedback on movements performed.) (7, 9)



The three patterns of Sensory Processing Disorder

For the purposes of this discussion, only SMD will be explained in detail.

> "Sensory Modulation is the ability to regulate and organize the intensity and nature of responses to sensory input so that responses can be appropriately graded to the constantly changing sensory experiences of daily life." pg715 (7)

Sensory Modulation describes an individual's ability to control and organise their responses to sensory stimuli, by filtering out unnecessary sensory input, and only concentrating on the relevant stimuli, in order to sustain an optimal level of arousal. (10) Sensory Modulation Disorder results in an individual struggling to achieve and maintain a developmentally appropriate response to their sensory stimuli, resulting in changes to their emotions, attention or concentration and presents with additional behavioural responses.(7, 9, 18) These individuals also struggle to adapt to challenges or a break in routine within their daily life activities. (19)

Studies into SMD have shown that children with SMD present with both behavioural responses, as well as physiological reactions to sensory modulation which affect their everyday activities. (20-22) A study by Bar-Shalita, Vatine and Parush (2008) showed that the child's responses to sensory stimuli must notably affect their participation in age appropriate life activities and routines, in order for SMD to be classified as a condition. (10) The prevalence of SMD in the United States is estimated to be 5–16% (19, 23) in the public school population and 30–80% in children with developmental disabilities. (1, 15, 17) The prevalence rates in South Africa are unknown.

2.1.2 THE CLINICAL PICTURE OF SENSORY MODULATION DISORDER:

The clinical picture of SMD varies between individuals and is closely related to the varying and different symptoms. (7) However, usually one or combinations of the following sensory systems are involved: vestibular (movement), proprioceptive (deep pressure), tactile, visual, auditory, olfactory, and gustatory (smell). An individual with SMD will respond to the input in different manners and is classified by being: sensory over-responsive, sensory under-responsive, sensory seeking (craving), or a combination of behaviours from these three subtypes. (7, 9, 21, 24-26)

- Sensory over-responsivity can be explained as a child having larger response to sensory stimuli than is typical. This results in the child responding to weaker stimuli more intensely, with a quicker onset or the individual sensing the stimuli for longer than those around them. (1, 7, 9) The individual responds to the input with "fight, flight, or freeze" behaviours, and is then observed to be impulsive, aggressive, or withdrawn in their reactions to the stimuli. These children contain their behaviours at school where there is a bombardment of multi-sensory input, and often show emotional/behavioural reaction during pickup time or when they come home. (15) Sensory over-responsivity is believed to be an inherent characteristic of SMD (27).
- Consequently, sensory under-responsivity, is when an individual disregards or responds passively to the sensory stimuli. This individual's responses seem to be less intense or show a slower commencement than those around them. (1, 7, 9) The individual is described as lethargic, self-absorbed and difficult to engage and can seem to be unaware of sensory input in their environment. These individuals seem to lack motivation to explore sensory materials and environments around them. These children have difficulty with concentrating, listening, following directions and often have uncoordinated motor actions. (15)
- Individuals with sensory seeking/craving behaviours react with an intense, limitless desire for the sensory input in their environment. These individuals are usually energetic and participate in activities which will result in receiving the most intense sensation.(7, 9) They are described to be constantly moving, touching and interacting with their environment. These children may seek loud sounds or unusual smell or taste experiences. (15)

Children with all three of the SMD subtypes show difficulty with the grading or regulating the intensity of their responses to sensory input.(9) Ayres included another pattern of behaviour when describing her original work, in which she suggested that one SMD pattern was characterised by a difficulty with overreacting to ordinary tactile input, which she categorised as Tactile Defensiveness. (7, 18)

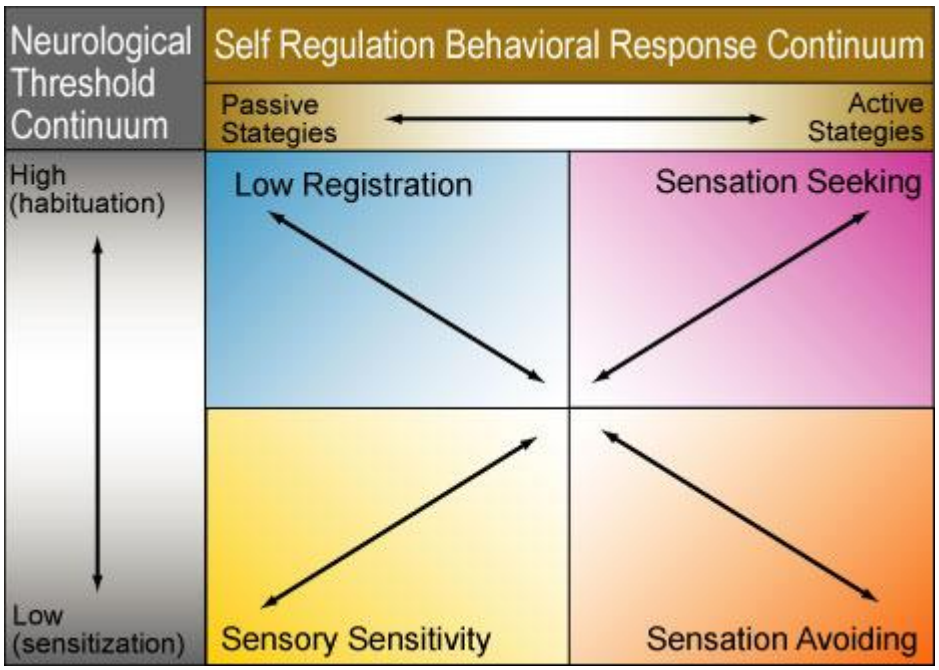
2.1.2 DUNN'S CONCEPTUAL MODEL OF SENSORY PROCESSING

Winnie Dunn supplemented Ayres' previous theories on sensory processing and developed her own model to complement the understanding of SMD. This model is referred to as Dunn's Conceptual Model of Sensory Processing. (28) Dunn's model hypothesised the interaction between neurological thresholds and behavioural reactions, and the continuum that they have with each other. (27) The model is based on the theory that there is a connection between the sensory nervous systems (and how they operate) and the strategies that the person uses to regulate these inputs. Dunn {together with many colleagues(29)} proved that the interaction of the nervous system with self-regulation creates four basic patterns of sensory modulation dysfunction. Further, research showed that the four basic patterns occur from early life to adulthood, and that children with a range of disabilities including Attention-Deficit Hyperactivity Disorder, Autism Spectrum Disorder, as well as those with developmental and learning disabilities show unique and more intense sensory modulation patterns, in contrast to "typically" developing children. (29)

According to Dunn's model, Neurological Thresholds refer to the extent of stimulation that the neuron receives before responding. Dunn explains that on the one end of the continuum, a person with a *high* neurological threshold will require more stimulation before responding, as opposed to the *low* threshold, where a person requires a very little amount of or low intensity stimulation before reacting. (28, 30)

The Behavioural Reaction is the person's reaction to the thresholds. The person will either act *in accordance* to or will try to *counteract* their neurological threshold. Behaving in *accordance* means that the person will react in a passive /agreeable way to the neurological threshold. Therefore behaving *in accordance* with a *low* threshold means that the response to the sensory stimuli is quick (as the person may be more sensitive to it). Conversely, responding *in accordance* with a *high* threshold means that there is a longer response time to the sensory input or the person may even miss the stimuli in the environment. (28, 30)

Counteracting behaviours show that the person is working against the threshold to achieve homeostasis (i.e.: stable and constant thresholds). When a person *counteracts* a *low* threshold, they display avoidant behaviours to the sensory stimuli as they become overwhelmed by even the low-intensity input. On the contrary, *counteracting* a *high* threshold involves the person craving or seeking sensory stimuli because they need to reach a higher threshold which requires more intense sensory input. (28, 30)



(31)

Figure 2.1: Dunn's Neurological Threshold Continuum

As a result of the interaction between the neurological threshold continuum and the behavioural response continuum, Dunn hypothesised four patterns of sensory modulation tendencies: poor registration, sensory seeking, sensory avoidance, and sensory sensitivity. (27, 29)

- Poor (Low) registration: behaviours are characterised by high neurological thresholds and behaviours which act in accordance to their threshold. (30, 32) People with poor sensory registration will appear disinterested, have a dull affect and appear overly tired or apathetic. They will disregard or have a slow response to sensory stimuli as compared to others. (27)
- Sensory Seeking: behaviours are characterised by high neurological thresholds and behaviours which counteract their threshold. (30, 32) People who seek out sensory experiences are described as active, excitable and continuously engaging. They pursue extra sensory input by participating in situations with will provide rich sensory experiences. (27)
- Sensory Avoiding: behaviours are characterised by low neurological thresholds and behaviours which counteract their threshold (30, 32). When people avoid certain inputs, it is because they are bothered by input more than others. They are resistant to change and reliant on rigid rituals, which allows them to limit their exposure to the offending inputs. (27)
- Sensory sensitivity: behaviours are characterised by low neurological thresholds and behaviours which act in accordance to their threshold. When people have sensory sensitivity, they detect more input than others. (30, 32) Behaviours are described as the person being

distractible or hyperactive, having difficulty screening stimuli, and discomfort with certain sensation.(17, 27, 33-35)

Dunn further explains that the brain is always trying to achieve a balance of neurological activity on this continuum, thereby modulating the neural activity to either facilitate or inhibit sensory responses from their world. A person with intact sensory modulation will be able to inhibit some responses and only respond to the necessary inputs, in order to react with an adaptive (goal directed) response to the situation. (27)

However, when children struggle with appropriate modulation of their sensory input they can be observed to be overstimulated and over-aroused by input that they are sensitive or avoidant to.(12) Kimball (1993) introduced a theory of a protective mechanism sometimes utilised by children in severe sensory overload. She termed this “shut down”, and explained that some children quickly go from over-arousal to physiological shut down, as a mechanism to protect their systems.(36)

2.1.3 THE SENSORY PROCESSING DISORDER DIAGNOSIS

Since 1995, experimental studies have been carried out to validate Sensory Processing Disorder (which includes SMD) as a separate diagnosis. This research has advanced the theory of Sensory Processing Disorder and increased the awareness of this disorder as a novel diagnosis. (9) One such study researching the signs and symptoms of Sensory Processing Disorder, is attempting to develop a standardised tool to classify and distinguish the subtypes of Sensory Processing Disorder. This tool which is currently being developed by Schoen, Miller and Green, is termed the Sensory Performance Scales. The scale has questions from all of the hypothesised six subtypes of Sensory Processing Disorder and includes an assessment-report section (completed by the occupational therapist), as well as a both parent and self-report checklists. (37)

Further research has been done to differentiate Sensory Processing Disorder as a novel disorder, this time identifying it from Attention Deficit Hyperactivity Disorder (ADHD). In a retrospective study, the data of the participants with the lowest 5% of scores (i.e. scored indicating the most severe symptoms) for ADHD and sensory processing were identified to be studied further. Of the entire group (who had either ADHD or Sensory Processing - sensory over-responsivity symptoms), 40% showed symptoms of ADHD and SPD (SOR), and about 30% had symptoms of only ADHD **or** only Sensory Processing Disorder-sensory over-responsiveness. (9, 17) This research study suggests that Sensory Processing Disorder-sensory over-responsiveness may be a separate

diagnosis from ADHD. SMD is often associated with comorbid diagnoses of ADHD, Learning Disabilities, Developmental Coordination Disorder and Autism Spectrum Disorder. (33, 34, 38, 39)

One final study looking at the central nervous system (CNS) examined possible brain processes that may cause SMD. The hypothesis of the study was based on Ayres' theory that the behavioural reactions associated with SMD (such as tantrums, avoidant behaviours, or defensive tactile behaviours), might be explained by immature or faulty sensory brain processes. (40) The researchers hypothesised that by providing auditory stimulation, the brain sensory activity would be atypical. Further they hypothesised that sensory gating (the capacity that the central nervous system has to inhibit sensory responses to stimuli found to be irrelevant. This is shown electro-physiologically on an EEG by a smaller amplitude in response to the stimulus) would be atypical in children with sensory over-responsivity. (4)

The results of the study displayed that children with Sensory Processing Disorder (SPD) showed a reduction in amplitudes and thus less sensory gating than the control of children without SPD in the study. This advocates that children with Sensory Processing Disorder have more difficulty focusing on only relevant sensory input, as they struggle to inhibit irrelevant stimuli.(4) The study therefore proved that children with Sensory Processing Disorder display unique sensory processing as compared to the control without SPD. This study provides validity for Sensory Processing Disorder to be a stand-alone disorder and furthermore supports that sensory over/ under-responsivity are subtypes in the current clinical classification of the disorder. (4) However, there is still a gap in the research, and therefore still a significant need for more research to be performed to identify and understand sensory processing disorder as a stand-alone diagnosis.

The Diagnostic and Statistical Manual (DSM)-V revision committee were considering whether Sensory Processing Disorder should be included as a separate diagnosis in the "novel diagnoses" section of the DSM-V. Nonetheless, in December 2012 it was decided that the diagnosis would not be included separately. However, the following reference of Sensory Processing Disorder type symptoms is included in the DSM-V under the Autism Spectrum Disorder's diagnostic criteria:

> "Hyper- or hypo-reactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement)." (3)

"Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behaviour (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat food every day)."(3)

These diagnostic symptoms hint to what parents of children with sensory modulation difficulties identify as SMD behaviours. However, even these symptoms are similar to those of an anxiety diagnosis, as identified by the adherence to routine and ritualised patterns (such as is seen with Obsessive Compulsive Disorder-Anxiety diagnosis). (3)

Furthermore, when looking at the Diagnostic Manual Criteria for Generalised Anxiety Disorder (GAD), the following physical/cognitive symptoms are necessary:

> "The anxiety and worry is associated with at least 3 of the following physical or cognitive symptoms (*In children, only 1 symptom is necessary for a diagnosis of GAD)*:
>
> Restlessness or feeling keyed up or on edge, tiring easily; more fatigued than usual, impaired concentration or feeling as though the mind goes blank, irritability (which may or may not be observable to others), increased muscle aches or soreness, and difficulty sleeping (due to trouble falling asleep or staying asleep, restlessness at night, or unsatisfying sleep." (3)

The underlined symptoms of increased energy/restlessness and impaired concentration are the same types of behaviours that can be observed in a child with SMD. It is therefore very evident that there is an overlap of symptoms and similar behavioural manifestations which are identified in children with both SMD and anxiety. However the link between these two disorders has still not been identified.

2.2 UNDERSTANDING THE ANXIETY DIAGNOSIS:

Anxiety is one of the most common diagnoses in childhood psychopathology.(8) Anxiety is described as an emotional response which presents with cognitive (e.g: worried or anxious thoughts), behavioural (e.g: avoidance of or distress when exposed to fear situations) and physiological (body response e.g: increased heart rate, trembling, shortness of breath) components.(41, 42) Anxiety can be described as a tension, apprehension, worry and general distress, which manifest without the presence of actual danger(43)

Prevalence rates of anxiety diagnoses in children (in the Unites States of America [USA]) range from 3 – 24%. (44) Anxiety disorders have a relatively equal prevalence rate among the younger boys and girls, but become more prevalent in females, by adolescence.(8) Current studies in the USA report that nearly 1 in 3 adolescents will show symptoms to meet the criteria of having an anxiety disorder. (45) The presence of anxiety symptoms in adolescence is a significant predictor of the progression of the disorder in adulthood (46), indicating the importance of treating childhood anxieties, to alleviate long-term psychological, social and economic difficulties. (47)

A study by Kessler et al (2005) revealed that the median age that anxiety disorders are diagnosed is 11 years-old. Their study researched the percentage of anxiety disorders as lifetime illnesses and they identified the following percentages: specific phobia 12.5%; social phobia 12.1%; generalised anxiety disorder 5.7%; posttraumatic stress disorder 6.8%; obsessive–compulsive disorder 1.6%; separation anxiety disorder 5.2%; and panic disorder 4.7%. (48)

Further, many children who have Learning Disabilities, (49) Attention Deficit Hyperactivity Disorder (50) and Autistic Spectrum Disorder (2, 12, 44, 51) have been shown to be populations at risk for having anxiety problems, as compared to the general population. (1, 21, 38, 52)

2.2.1. THE CLINICAL PICTURE OF ANXIETY

Children who suffer from anxiety try to cognitively regulate their emotions in order to better cope with experiencing that emotion in the stress provoking situation. Furthermore, they may also present with avoidance behaviour strategies which assist them with evading these anxiety provoking situations. (8, 41) These symptoms include passive withdrawal, a fear to approach strangers and distress to verbalise their needs.(53)

Children who suffer from anxiety are described to experience an intense, automatic emotional and physical experience. When placed in an anxiety-provoking situation, these children may have mild physical symptoms such as feeling uneasy or being scared. They may even experience stomach-aches, headaches, or even temper tantrums when faced with anxiety provoking situations.(8) However, if the environment is extremely provoking, the child may have severe symptoms such as a panic attack and heart palpitations.(54) A child with severe anxiety will try to implement very overt and intentional coping strategies in order to deal with these reactions, (8, 41) as many children may be too young to communicate to their parents or teachers what is bothering them.

However, because children who suffer from anxiety symptoms try to cope or internalise these symptoms, few children are referred for or provided with treatment. (55) Furthermore, as all

children and adolescents exhibit normal fear or anxiety in certain situations, and because there are stages where increased anxiety is age appropriate, ensuring that the anxiety symptoms are correctly diagnosed can be challenging.(8) It is therefore vital to identify when the anxiety symptoms and fear is excessive and persistent, to ensure that the correct clinical diagnosis is made (56, 57) to prevent future disorders. Hence, it is vital through research to delineate the association between SMD and anxiety disorders, and to understand them more clearly, so the correct diagnosis and treatment can be provided for the child.

When looking at the Anxiety Disorders defined in the new DSM-V, the following sub-categories fall within the broader Anxiety Diagnosis: Separation Anxiety Disorder; Selective Mutism; Specific Phobia; Social Anxiety Disorder (Social Phobia); Panic Disorder; Panic Attack; Agoraphobia; Generalized Anxiety Disorder (GAD); Substance/Medication-Induced Anxiety Disorder; Anxiety Disorder Due to Another Medical Condition; Other Specified Anxiety Disorder and Unspecified Anxiety Disorder. (3)

2.2.2. ANXIETY IN THE SOUTH AFRICAN POPULATION

A study carried out in South Africa investigated the prevalence rates of the mental disorders in the country. (58) Results indicated that in the child and adolescent populations, the most common mental disorders were generalised anxiety disorder (11% of the study sample), followed by posttraumatic stress disorder and major depressive disorder (both 8%). Both generalised anxiety disorder and posttraumatic stress disorder are subtypes of the broader anxiety disorder diagnosis. (58) A study by Muris, Loxton, Neumann et al. (2002), aimed to define the Anxiety Symptoms in a South African normal school population. The findings of the study indicated that levels of South African children's anxiety were relatively high (with a mean total Anxiety score of 40.1 when using the Spence Children's Anxiety Scale). (59) This highlights the high occurrence and incidence rate of anxiety disorders in our local child population.

Furthermore the study identified considerable variances with the cultural fears and anxiety symptoms among South African as compared to children in other countries. The following compulsive behaviours were more prevalent in the South African sample: "Keeps checking if done things right" and "Has to do things over and over again." While the following physical separation symptoms: "Worries about being away from parents" and "Scared to sleep away from home". (59) The findings of their study highlighted how cultural factors influence how the children with anxiety experience these symptoms.

The etiology of anxiety disorders in children is unclear, but there has been some research performed and theories proposed. Early theorists speculated that anxiety resulted from three factors: faulty information processing in the brain, an increased sensitivity to information, and increased reaction to input from the environment. (50) From a sensory approach, Jean Ayres also suggested that if a child shows sensory modulation dysfunction, this may lead to identifying problems with anxiety, concentration, and other emotionally-related behaviours. (50) However, the cause is still unclear, and as a result, it is important to continue to research and to understand the aetiology and disorders of anxiety in children.

2.3 THE ASSOCIATION BETWEEN SENSORY MODULATION DISORDER AND ANXIETY:

Occupational therapists are trained to assess and treat problems relating to sensory modulation and affective disorders such as anxiety, in children, adolescents and adults.(60) According to Youngstrom (2002), the role of the occupational therapist when treating any disorder, is to assist the clients to be able to "attain, regain or maintain their ability to participate in occupations." Pg.47 (61) In order for anxiety disorders to be diagnosed, the person must have difficulty with performing personal, social and occupational activities, (3, 62-64) and therefore occupational therapists have a vital role in the treatment of the disorder.

Sensory Modulation Dysfunction also has a significant effect on an individual's ability to successfully engage in occupations, as a child may seek, avoid or react sensitively to certain activities, thereby having difficulty with participating in the occupational activities successfully. (60) A child with SMD may have further deficits with social skills which affects their participation in play, school and social activities, which can be as a result of impaired self-confidence/esteem. They can also show difficulty with performing personal daily life skills; and are often assessed to have delayed fine-, gross-, and sensory-motor skill development. (36) At school, in the intense classroom environment, more physical and social stimuli result in children with SMD feeling distressed. (2)

Bar-Shalita et al. (2008) showed in their study, that children with SMD presented with regression with their engagement in occupations, satisfaction for the activity, and the frequency of activity performance. This study was highlighted as the first to show that children with SMD have inadequate participation in daily activities.(10) The research further emphasised that SMD affects every area of the child's participation in "daily activities of academic function, play, and leisure,

including habits and routines". (10) Pfeiffer and Kinnesley (2005) also supported a positive relationship between anxiety and sensory defensiveness across all age bands, and showed poorer functionality in certain areas of occupational performance. (60) This study was looking at the relationships between dysfunction in sensory modulation, symptoms of affective disorders (such as anxiety and depression), in children and adolescents with Asperger's disorder. It was quality research indicating a very strong relationship between anxiety and both of the components of sensory over-responsivity (sensory sensitivity and sensory avoiding) for all the children in the study. Further the study indicated relationships between symptoms of anxiety with functional academics, and that of depression with academics, leisure, and social skills. Thus the study showed that the sample was struggling to participate effectively in their occupational performance life activities, as a result of their affective disorders. Occupational therapists are therefore the specialists who treat children with both SMD and anxiety disorders, (60, 65) with the aim of promoting optimal performance in life roles and occupations.(19, 66)

Children with SMD and anxiety symptoms live in a fear-filled and unpredictable world. Further, children with SMD have been identified as a population who struggle to adapt to the changing environment and show increased anxiety symptoms because their world is perceived as unpredictable and over-stimulating. (15) Both of these disorders have been shown to have detrimental effects on an individual's functioning in all areas of their lives, especially in the academic and social areas.(60, 64)

Children, who are anxious or sensitive to certain sensory input, find the world a threatening place and they may fear movement, unexpected noises and startling touch. (54, 64) Further studies have shown that children with sensory over-responsiveness (ie: sensitivity or avoidance to sensory input,) show symptoms of avoidance, aggression, anxiety and defiance which may affect their psychological well-being. (67) Parents of children with anxiety or SMD symptoms will attempt to structure their child's world so that is predictable, in order for their child to feel less threatened. These children may have to avoid shopping malls and other over-stimulating environments, such as birthday parties or going on outings.

2.3.1 THE PHYSIOLOGICAL ASSOCIATION BETWEEN ANXIETY AND SENSORY MODULATION DISORDER

When looking at the association between SMD and anxiety from a physiological perspective, Jean Ayres (1972) hypothesised that a child who struggles with the ability to modulate incoming sensory stimuli may result in the child also presenting with distractibility, anxiety, and other stress-

related behaviours.(50, 68) Ayres also explained that the problems commonly associated with SMD, manifest as symptoms of increased emotion and behavioural reactions including anxiety, aggression, and inattentiveness (9, 40) This shows that from the very beginning of sensory integration theory, Ayres was already connecting these two constructs.

Numerous studies have investigated the relationship between sensory over-responsiveness and anxiety in the central nervous system. They highlighted that irregularities of the amygdala may affect sensory over-responsiveness and anxiety and theorised that a larger amygdala might explain an elevated fear response in children, and therefore increase the risk for both anxiety disorders and sensory over-responsive behaviours. (12, 41, 69) Studies have associated the amygdala specifically with the child showing increased fear reaction to sensory stimuli, (70) as it projects to cells which focuses the child's attention to the fearful stimulus, and to sensory regions which then elicit an exaggerated sensory response to the stimuli. The study showed a positive association between the amount of "enhancement" in the behavioural response with the amount of amygdala activation, (70) which shows that children with sensory over-responsive behaviours may have over-active amygdalas.

Research into the hypothalamus, amygdala, and reticular formation also show a positive association between anxiety and sensory over-responsiveness. (50). When one experiences anxiety, there is activation of the autonomic nervous system which can be identified by physiological symptoms such as palpitations, increased breathing rate, dilation of the pupils, and a decreased need to eat. (50, 71) The hypothalamus, receives neural messages from the amygdala, which also has shared connections with the reticular formation and the frontal cortex. Projections from the reticular formation, (which plays a major part in modulating levels of arousal) go to the amygdala, and thus the memory of a previous stimulus and the person's reaction to the incoming stimuli are connected.(71)

Further anatomical studies emphasised that irregularities of the insula and its connective network would likely influence both anxiety and SMD. The insula is responsible for the excitation-inhibition balance and therefore dysfunction would lead to poor processing of information in the sensory modalities and problems with emotional regulation. Additionally, changes to the function and connective properties of the insula have also been closely associated with anxiety traits. (41) Thus these anatomical structures are all involved in both the child's reaction to sensory stimuli, as well

as the emotional response linked to these. This identifies the physiological association and possible connection between the SMD and anxiety disorders.

2.3.2 SENSORY DEFICITS AND ANXIETY BEHAVIOURS

When exploring the relationship between sensory deficits (as a whole) and anxiety problems, the association has been well documented across the age-bands.(72) Research has shown that anxiety and sensory hypersensitivity are both associated with high levels of sensory arousal.(73) A positive relationship between anxiety and sensory hypersensitivity (sensory over-responsiveness) was confirmed when looking at sensory defensiveness, anxiety and perception of pain in adults.(67) Further research into adult's reporting anxiety symptoms have indicated that higher levels of anxiety were correlated to the participant's increased sensitivity to sensory stimuli. (74)

Current research studies are focusing on the association between sensory over-responsivity and symptoms of anxiety in children. (12, 60, 75-77) Many studies have found a positive relationship between the constructs. Sensory over-responsivity (auditory and tactile) was associated with higher levels of fear and anxiety in young children,(76) a positive relationship was established for the constructs in children and adolescents with Asperger's disorder, (60) as well as with toddlers with autism spectrum disorders, who demonstrated significantly greater levels of general anxiety as compared to those with low levels of sensory modulation problems.(65)

It has been theorised that sensory under-responsiveness and depression are associated with decreased levels of arousal whereas sensory over-responsiveness and anxiety are associated with increased levels of arousal.(60) Green and Ben-Sasson (2010) highlighted the difficulty in differentiating the constructs, as they are characterised by similar behavioural reactions. (12) Further they identified various hypotheses to explain the causation of the two constructs:

Their first hypothesis looked at anxiety contributing to sensory over-responsiveness. They explained that in people, generalised hyper-arousal stimulates a state of hyper-vigilance (i.e. the person scanning the situation for stimuli indicating threats and preparation for the possible threat).(12, 78) A child with hyper-arousal and hyper-vigilance focuses their attention on a specific stimulus. Therefore these children, who are continuously searching their surroundings for potential threats, are more likely to notice and react to threatening input in the environment. (12)

Green and Ben-Sasson's second hypothesis looked at sensory over-responsiveness contributing to anxiety. They gave the example of children with sensory over-responsiveness, being avoidant of unpleasant sensory stimuli (e.g: an aversive noise made by a balloon). As the child experiences

these objects (e.g balloon making a loud noise when popping), unconsciously the two scenarios become linked. Then eventually the stimuli which they are fearful of may provoke a fearful response – without even the presence of an aversive noise (e.g: afraid of all balloons). (12) Thus the possibility that a child with sensory over-responsiveness might become fearful/avoidant to stimuli associated with undesirable sensory experiences such as balloons, heights, prickly textured clothing etc., is easy to imagine. Through context conditioning, the child learns when to expect the unwanted sensory stimuli (e.g: the aversive noises), which may result in them refusing/avoiding situations where they anticipate these noises to be e.g: attending birthday parties or restaurants. (12) In this scenario the unwanted sensory stimuli become linked to everyday objects, and it is these objects which the children then start to fear.

The hypothesis "sensory over-responsiveness contributing to anxiety" described above, was proven in a supplementary study. Green et al. (2012) showed how over time, the emergence and effects of sensory over-responsivity were predictors of future anxiety disorders in children with autism spectrum disorder. Their study proved how sensory over-responsivity symptoms remained stable between the two time points (a year apart), while anxiety symptoms increased in their population. (79) Although this research was performed on children with ASD, it is good quality research which proved that sensory over-responsivity symptoms emerge earlier than anxiety symptoms and can also be recognised as predictors of later anxiety disorders. Thus it is a significant finding, as it substantiates the hypothesis of the current research project, whether there will be an association between SMD and anxiety symptoms in children.

Regarding the avoidance reactions that children have to intense anxiety or sensory over-responsivity, it is hypothesised that a person will become anxious and thus avoid situations as a result of constant overreactions to irrelevant sensory input in the environment. (60) Similarly, when examining sensory modulation disorder, it has been theorised that in order to protect their brain from constant bombardment and thus sensory overload, children with severe sensory over-responsivity attempt to block out or avoid all sensory stimuli.(36, 80) No research could be found to substantiate these theories further, but hypothetically they could explain the physical reaction seen in children with both sensory over-responsivity and anxiety in dealing with either sensory over-stimulation or intense reaction to anxiety symptoms.

Lidstone, Uljarevic, Sullivan et al. (2014) performed a study to identify the restricted and repetitive behaviours, anxiety and sensory features in children with autism spectrum disorders (81) Although

their topic was focused on children with ASD, they were still highlighting the behavioural and anxiety symptoms associated with SMD. Further this research was similar to the one in the study as they used both the Sensory Profile and SCAS as two of their testing tools. Their study proved a positive relationship between anxiety (using the SCAS) and quadrant scores on the Sensory Profile. (81)

There is limited research regarding treatment and the ways of reducing anxiety in response to sensory-based treatment, which strengthens the need for continuous research into understanding the sensory over-responsiveness–anxiety connection. One study highlighted a substantial decrease in anxiety symptoms in adults who struggled with sensory defensiveness, after performing sensory-based treatment, (82) whereas a deep-pressure (sensory proprioceptive) program for children with Autistic Spectrum Disorder has been shown to moderately reduce anxiety. (83)

In summary, the literature has shown that there is indeed an association and a close link between SMD and anxiety disorders. As many of the symptoms overlap, this leads to a difficulty when identifying SMD and making an anxiety diagnosis. Therefore, we will now discus the ways of identifying these disorders in more detail.

2.4 MAKING THE SENSORY MODULATION OR ANXIETY DIAGNOSIS:

When identifying SMD in children, therapists use their clinical observations, as well as on relying on objective questionnaires such as the Sensory Profile (Dunn, 1999) or the Sensory Processing Measure (Parham, 2007), which highlight the signs, symptoms and behaviours of the child. These questionnaires are usually completed by the child's parents or teachers. (9, 84) Based on parent reports, children with SMD struggle to appropriately respond to sensory stimuli, resulting in the child not participating in daily life activities as their peers. (10) The anxiety diagnosis is also made based on self-reported questionnaires or interviews,(43) but within the child population, parent/self-report questionnaires are more common.

An important consideration is that the parent questionnaires completed by parents, are highlighting and rating the behaviours that are associated with either SMD or anxiety. (11, 43) By the parents identifying certain behaviours, the child is scored and profiles or diagnoses are determined. Therefore these screening tools are used as part of the assessment to understand the behaviours that the parents are observing in their environment. It is then the clinician's role to perform a complete assessment to further understand the behaviours being observed. (11)

As these tools are based on the child's behaviour, and as mentioned in the literature, there is an overlap in the behaviours associated with SMD and anxiety, (12) it can become complicated for the therapist to tease out exactly which behaviours are attributed to which disorder. Furthermore, the differential diagnoses, such as Attention Hyperactive Deficit Disorder (ADHD), Autistic Spectrum Disorder (ASD) are also partly diagnosed based on the child's behaviour. (1, 65) The behavioural responses of children with sensory modulation disorder when faced with threatening sensory inputs may be identified as inattention, impulsivity, or hyperactivity; or a combination of attention difficulties, which also characterise the attention difficulties highlighted as symptoms of Anxiety, ADHD, or ASD. (50) And as mentioned above, a stomach ache or social avoidance e.g: at a party could be associated and explained by all these disorders.

Another aspect to take into account is that children who are young and unable to verbally explain their feelings of being overwhelmed (SMD) or anxious, can usually only explain that they don't feel nice and then use avoidance strategies to escape the threatening situation. Thus their behaviours or even these feelings are usually not well explained and hence not well understood.

Another limitation with using screening tools solely in making diagnoses is that the tools and rating scales do not identify a disorder. Rather, the questionnaires highlight the types of disorders and symptoms for the clinician to consider, as a basis of the child's emotional or behavioural difficulties. It is therefore always important for the child to be referred to a trained clinician for a thorough assessment.

2.4.1 Tools used when identifying Sensory Modulation Disorder:

The Sensory Profile (Dunn, 1999) (27) and Sensory Processing Measure (Parham, 2007)(84) are standardised measures used to describe and identify sensory modulation problems. The Sensory Profile has been found to discriminate between children with typical development and children who have sensory modulation differences. (85) In addition, discrete patterns of sensory differences have been identified among groups of children with different types of neurodevelopmental disabilities such as between children with autism and attention deficit hyperactivity disorder. (11)

The Sensory Processing Measure is another parent-report, standardised assessment of sensory modulation behaviours.(84) This is a newer assessment that combines the School Assessment of Sensory Integration (SASI) and Evaluation of Sensory Processing (ESP). The Sensory Processing

Measure consists of the Sensory Processing Measure "Home form" which is a parent-report questionnaire and the "Main Classroom" form, which is a teacher questionnaire. (84)

Brown, Morrison and Stagnitti (2010) researched the convergent validity of the Sensory Profile and the Sensory Processing Measure. Findings of the study showed moderate correlations. (86) This suggests that the scales are assessing similar sensory modulation behaviours.

Table 2.1: A table depicting differences between the Sensory Profile and Sensory Processing Measure

	SENSORY PROFILE	**SENSORY PROCESSING MEASURE**
What they measure	SMD	SMD
Tools	One parent report questionnaire	Sensory Processing Measure "Home form" - parent-report questionnaire "Main Classroom" form - teacher questionnaire
Age band	3-10 years	5 - 12 years
Standardised	Yes	Yes
Psychometrics:	Sensory Processing • Auditory Processing • Visual Processing • Vestibular Processing • Touch Processing • Multisensory Processing • Oral Sensory Processing Modulation • Sensory Processing Related to Endurance/Tone • Modulation Related to Body Position and Movement • Modulation of Movement Affecting Activity Level • Modulation of Sensory Input Affecting Emotional Responses • Modulation of Visual Input Affecting Emotional Responses and Activity Level Behaviour and Emotional	Eight parallel standard scores: • Social Participation • Vision • Hearing • Touch • Body Awareness (proprioception) • Balance and Motion (vestibular function) • Planning and Ideas (praxis) • Total Sensory Systems

	Responses • Emotional/Social Responses • Behavioural Outcomes of Sensory Processing • Items Indicating Thresholds for Response Provide discrete patterns of sensory differences – ie: Sensory Quadrant scores: • Poor registration • Sensory seeking • Sensor avoidant • Sensory sensitive	
Scores:	Typical Performance, Probable Difference, or Definite Difference a	Typical, Some Problems, or Definite Dysfunction.

These scales are parent-report measures, often used by occupational therapists as screenings tool to measures a child's sensory modulation abilities. They are standardised tools which provide an overview of the effect of SMD on the child's participation in daily activities, and are scored based on the parents rating their child's sensory behaviours.(11) When examining child versus parent perception of SMD, researchers have indicated (but not yet proven) that the relationship and accuracy between the parent and child's own perception of behaviour is weak, particularly for behaviours that are difficult to observe.(87) However, no child-report tools are available for the identification of sensory modulation difficulties overall.(26) The only tool available is the Touch Inventory for Elementary-School-Aged Children (Royeen, 1999). This child report tool identifies the child's reaction to various tactile events. (88)

Further, there is no assessment or screening tool that diagnoses the sub-types of SMD directly, and therefore clinicians rely on the parent-report screening tools as a vital part of the assessment process.(17) Schoen, Miller and Green (2008) therefore developed a tool which aimed to measure sensory over-responsivity and they evaluated its psychometric characteristics in a pilot study. (37) The scale is called the Sensory Over-Responsivity (SensOR) Scales include the SensOR Assessment, which is administered by an occupational therapist to identify the child's performance, and the SensOR Inventory, a caregiver self-rating scale. Both scales measure sensory over-responsivity in seven sensory categories.

These screening tools should not be considered a complete assessment; they only screen for indications that a comprehensive assessment is needed. Occupational therapists perform in-depth assessments to identify SMD. The assessment is first approached through observation and history taking – usually during interview and by using screening tools such as the Sensory Profile. (26) Assessment tools that can be used in conjunction with the interview include the Sensory Integration and Praxis Test (SIPT), (89) the Motor Assessment Battery for Children (MABC), Bruininks-Oseretsky Test of Motor Proficiency (BOT2), Miller Assessment for Pre-schoolers (MAP). (26) The formal assessment tools, together with the occupational therapist's observation, interview with the parents and information provided by the teacher, enable the child's SMD to be identified accurately and fully.

The researcher was unable to find previous research using the Sensory Processing Measure to identify SMD, when comparing SMD to anxiety scores. The original Sensory Profile has been used in few studies to identify SMD and compare scores to anxiety.(60, 81) It was therefore decided to use the Sensory Profile as the tool to collect data on SMD in the current study.

The Sensory Profile (see ***Appendix A****)* provides a standardised measure to assist therapists in measuring a child's sensory processing abilities, and the influence (strengths and barriers) that their sensory modulation has on their participation in their daily activities. (27) The profile was set out to measure sensory hypersensitivity and hyposensitivity in children between the ages of 3 to 10 years of age. This is a parent report questionnaire that is completed by the parents or caregivers of the individual. The Sensory Profile has 125 questions and is rated on a 5-point Likert scale ranging from "always" (100% of the time) to "never" (0% of the time), thereby reporting on the frequency of their child's behaviours. (27)

The main factor analysis carried out on the Sensory Profile was conducted on 1,115 children, 3 to 10 years of age who were typically developing. The research on the Sensory Profile took place from 1993 to 1999 in the USA, and included children with and without sensory modulation difficulties. (90) The Sensory Profile consists of 125 questions which are then scored and divided into nine factor sections: Sensory Seeking, Emotionally Reactive, Low Endurance/Tone, Oral Sensory Sensitivity, Inattention/Distractibility, Poor Registration, Sensory Sensitivity, Sedentary and Fine Motor/Perceptual. (27)

These factors are further clustered into three section categories: Sensory Processing, Modulation and Behavioural and Emotional responses. (27) The Sensory Processing section specifies the child's

responses to their basic sensory systems. The Modulation section highlights the child's ability to regulate their neural messages through the facilitation or inhibition to differing sensory responses. The Behavioural and Emotional responses section identifies the child's emotional and behavioural responses to their sensory processing. (27) The quadrant scores on the Sensory Profile explain the child's patterns of SMD – ie: how the child is reacting to the sensory input, in response to the threshold continuum, and self-regulation/ responsiveness continuum. The four patterns include: Sensation Seeking, Sensation Avoiding, Sensory Sensitivity and Low Registration. (27)

When looking at the function / dysfunction of the sample, it is important to remember that different diagnoses (ie: children with SMD, ASD or ADHD) present with different sensory profiles, scoring higher and lower on different parts of the Sensory Profile. Thus when one is using the Sensory Profile, one is looking at patterns of function and dysfunction that give an indication of a possible diagnosis.

Children with Autism Spectrum Disorder (ASD), and with Attention Deficit Hyperactivity Disorder (ADHD), were compared to children without disabilities, regarding the Sensory Profile factor scores. (91) Children without disabilities showed more behaviours for the "Sensory Seeking" factor, whereas children with ASD and ADHD showed a high incidence of behaviours for "Oral Sensitivity", "Inattention/Distractibility", and "Fine Motor Perceptual". Similarly, Dunn and Bennett (2002) showed that children with ADHD showed more behaviours regarding: "Sensory seeking", "Emotionally Reactive", and "Inattention/Distractibility" factors, as compared to the typical control group. (92) Children with Autism Spectrum Disorders (ASD) have also been identified to score higher on the "Emotionally Reactive" factor, than those without the disorder.(93)

In terms of the Sensory Profile section scores, children with Autism Spectrum Disorders (39), Attention Deficit Hyperactivity Disorder and Asperger's Syndrome (33, 94) have all been identified by their parents to engage in behaviours indicating difficulty with modulating their sensory input, which affect their emotional responses; when compared to control in the studies.

Further, when looking at research done using the Sensory Profile quadrant scores, two studies highlighted that children who presented with Attention Deficit Hyperactivity Disorder symptoms, (4) as well as children with known learning disabilities (5) scored with definite difference scores for the quadrant scores on the Sensory Profile. This indicates that research done on children with comorbid disorders such as ASD, ADHD and learning disabilities; have all indicated that these

children struggle with certain factors, section and quadrant scores on the Sensory Profile, thereby indicating that SMD is identifiable within these comorbid disorders.

2.4.2 Tools used when making the Anxiety diagnosis

When making an Anxiety diagnosis, there are numerous screening tools that can be used. Both the Spence Children's Anxiety Scale (SCAS)(5) and Self-Report for Childhood Anxiety Related Emotional Disorders (SCARED)(95) have been identified to be useful when researching childhood anxiety in South Africa. (59) However, other screening scales such as the Depression and Anxiety in Youth Scale (DAYS), Beck Anxiety Inventory for Youth (BYI), Multidimensional Anxiety Scale for Children (MASC) and State-Trait Anxiety Inventory for Children (STAIC) can all used as screening tools as part of the assessment process.(43)

Table 2.2: A table depicting differences between the Spence Children's Anxiety Scale (SCAS) and Self-Report for Childhood Anxiety Related Emotional Disorders (SCARED

	Spence Children's Anxiety Scale (SCAS)	**Self-Report for Childhood Anxiety Related Emotional Disorders (SCARED)**
What they measure	Anxiety	Anxiety
Developed	As a screening tool in normal populations	As a screening tool in clinical populations
Tools	Child report questionnaire (8-12 years) Parent report (not used in the study)	Child report questionnaire Parent report
Age band	8-12 years	8-18 years
Standardised	Yes	Yes
Psychometrics:	Six domains of anxiety (in line with the DSM IV) including: • generalized anxiety, • panic/agoraphobia, • social phobia, • separation anxiety, • obsessive compulsive disorder • physical injury fears PLUS a Total Anxiety Score	Also in line with the DSM IV • general anxiety disorder, • separation anxiety disorder, • panic disorder, • social phobia • Also assesses symptoms related to school phobias.
Rated:	Rated on a four-point scale with a range of possible answers (ranging from 0 - never → 3 –always)	Rated on a three-point scale (0 - almost never, 1 - sometimes, 2 - often).

The childhood anxiety scales mentioned above, assess and screen anxiety symptoms and all show good reliability and have been investigated to appropriately measure the severity of anxiety related symptoms. (43) Nevertheless, these scales don't always distinguish clearly enough between the observed symptoms and identifying them to anxiety disorders or other psychiatric disorders such as mood disorders. However, modern scales such as the SCAS, SCARED or MASC perform better at distinguishing the symptoms and comparing them to the DSM diagnostic disorders. Further these tests are short and are therefore the tools of choice to be used in research studies. (43)

The most widely used diagnostic screening tools are those which follow the DSM-IV criteria, such as the Revised Children's Anxiety and Depression Scale (RCADS) and the Spence Children's Anxiety Scale (SCAS) as they largely align with the DSM diagnostic categories. These screening tools are useful to identify levels indicating dysfunction and thus levels of anxiety among children and they can be useful in tracking progress made through treatment.(14)

The SCAS was chosen to be used in the study for a few reasons. Firstly the SCAS has been investigated within a South African population and was found to have suitable validity and reliability within our population. Although anxiety profiles of South African children were different from European children, this research suggested that the SCAS was still an appropriate tool for measuring anxiety levels in South African children. (59) Secondly, it is structured and scored in line with the DSM-IV criteria and indicate a cut off – of elevated anxiety.(14) Studies using the SCAS have shown that it is appropriate for the use of in co-morbid diagnoses such as Autistic Spectrum Disorder (47, 81) or even typical child populations. (96) Further, the SCAS has both a parent and child report questionnaire. The Child report questionnaire was chosen to be used in the study, as it more accurately displays the true anxiety symptoms of the participant. (87) Lastly, the SCAS seems to be broader in scope, in range of the severity of symptoms, as well as in the scoring range, as compared to the SCARED. (97)

As mentioned above, the screening tools can't be used alone in diagnosing any disorders, and the same applies for anxiety in children. The challenge in assessing for the symptoms of anxiety disorders is that the clinician needs to be able to distinguish symptoms indicating a true disorder, from 'normal' developmentally appropriate fears and worries. Therefore screening tools and parental interviews help to assess the presence of anxiety disorders in children, as well identify how the symptoms and disorder interfere with daily functioning. (43)

When looking at anxiety disorders, Spence (2001) emphasised the importance of implementing programs that aim at prevention strategies and the need for early intervention of anxiety problems in children.(98) Therefore, once parents or teachers express concerns relating to anxiety in a child, a comprehensive assessment should be performed by a psychologist or psychiatrist. The process of making a diagnosis includes interviewing the child on their own, as well as interviewing a parent and teacher who can report on the child's symptoms and behaviour. Since there is a high level of comorbid disorders in children with anxiety disorders, it is essential for the healthcare professional to consider all comorbid diagnoses. (99)

The Spence Children's Anxiety Scale (see ***Appendix B)*** is a measurement screening tool which helps clinicians to identify anxiety symptoms in a child. The SCAS has both a parents and child-report questionnaire. The self-report (child) questionnaire was developed to assess the severity of anxiety symptoms and has thus been structured in line with diagnoses of the anxiety disorder proposed by the DSM-IV. (100) As such, the SCAS covers a broad range of the anxiety disorders spectrum and assesses symptoms of: generalised anxiety disorder, separation anxiety disorder, social phobia, panic disorder and agoraphobia, obsessive–compulsive disorder, and specific phobia represented by a subscale named "physical injury fears". (101)

The Spence Child Anxiety Scale assesses a child's perception of how frequently he or she experiences anxiety symptoms. (100) The original scale was developed on children between the ages of 8-12, and involved a large sample (698) of Australian children. (101) When completing the SCAS, the child is asked to rate the extent to which they experience each of the 44 symptoms on a 4-point Likert scale which ranges from answers indicating "never" to those indicating "always." Of the 44 questions, there are six positively worded "filler items", (included to reduce "negative response bias"), which are not included in the total scoring. (101)

Of the 38 anxiety items, six identify separation anxiety, six social phobia, six obsessive compulsive problems, six panic, three agoraphobia, six generalised anxiety/overanxious symptoms and five items concerning fears of physical injury. The scores are then totalled and scored for "elevated" or "normal" levels of anxiety. These score indicating elevated anxiety were pre-determined by the SCAS scoring for age and gender of the child completing the scale. (101) These were determined by the cut off scores obtained by Spence et al. (1998) when compiling the test based on the normative test population. As the researchers divided their population by gender and age, the cut off scores indicating elevated anxiety are different for boys and girls.

In conclusion, it is clear that children with SMD and anxiety often present with overlapping symptoms. With both SMD and anxiety, the child struggles to participate in occupational activities successfully, often resulting in the child withdrawing or avoiding certain situations. Further, there is a clear association between anxiety and sensory over-responsivity in children with various disorders. Thus, the study aimed to understand the relationship between sensory modulation disorder and anxiety symptoms in children. Further, it must be understood whether the identification of SMD, puts the child at a greater risk of having possible anxiety disorder in the future.

As a result of the literature reviewed, the hypotheses were determined. As there is an overlap between SMD and anxiety symptoms, it was hypothesised that the participant's total anxiety scores will be associated with the over-responsive "Sensory Sensitive" and "Sensory Avoidant" quadrant scores on the Sensory Profile. Further, it was hypothesised that the factor and summary scores which include emotion (and anxiety) questions on the Sensory Profile will also be associated with the total anxiety scores for the sample.

METHODOLOGY

This chapter will look at the methods and procedure that was performed when executing this research study. The design and type of research used will be discussed, as well as the sample that was selected and the reasons for doing so. The measurement tools will also be explained, as well as the data analysis tests that were used to interpret the data collected.

3.1 RESEARCH DESIGN

The type of research that was used in this research study was quantitative: descriptive, correlational, cross sectional research.

The purpose of quantitative research is to examine a theory in order to establish facts and to show causal relationships. (6) Quantitative research is divided into three categories: true experimental, quasi-experimental and non-experimental research. (6) A researcher using quantitative research designs endeavours to explain what it is they are seeing and the effect it has on the subject. The overall goal of quantitative research is to convey numerically what is being observed in the study and to arrive at precise and discernable conclusions. Quantitative research designs are structured and predetermined. They do not change during the study, as they are formal and act as a detailed plan of how to perform the research. The data that is gathered is quantifiable and statistical, and usually produces numerical data, as was the data obtained from the measuring tools in the study. (6)

As per quantitative non-experimental research procedures, the researcher in this study had contact with the study sample on a short-term basis. The researcher's role was limited to collecting and measuring data - the interactions with the sample were in no way influential, thereby not interfering with or skewing the data. In this particular research project, quantitative research was used to determine the association between sensory modulation disorders (SMD) and anxiety in children.

Descriptive research is used when a researcher is attempting to describe, explain and interpret conditions of the "present" in the study. Therefore, the purpose of descriptive research in this study was to examine an association that was happening during a specific time, and was thus as the researcher was concerned with circumstances, changes or associations that existed in a certain situation. (6) Correlational research (a sub-type of descriptive research), tests for the relationships

between two variables, to establish how one variable affects the other (6). A correlation design was suitable, as statistics were used (from the numerical data collected) to determine the associations between variables, specifically when looking at the behaviours related to SMD and anxiety disorders in children.

3.2 STUDY POPULATION AND SIZE

3.2.1 STUDY POPULATION AND RESEARCH SITES

The study population consisted of children between the ages of 8 – 10 years attending remedial schools in the northern and north eastern suburbs of Johannesburg and receiving occupational therapy. Originally five occupational therapy practices at private remedial schools within the researcher's near environment were conveniently sampled, but due to difficulties in achieving a big enough sample (described below), the population was expanded to include all children attending occupational therapy at remedial schools in the North-East Johannesburg area. Convenience sampling was used as schools were selected based on their physical location in relation to the researcher. Children attending remedial schools were chosen, to ensure the study sample would have a similar background of learning difficulties.

3.3 STUDY SAMPLE

3.3.1 SAMPLE SIZE

During the formulation and proposal of this study, the study sample for this research was set out to include a sample size at 70 children. The sample size was calculated based on power analysis using a 0.05 error 1 alpha level. This sample size was calculated by approximating the total number of 8-10 years olds who attended occupational therapy services in five schools (at the time of formulating the protocol). This was approximated by the number of clients aged 8-10 years that the occupational therapists were providing services to. The survey sample table using a 95% confidence interval was then used to calculate the sample size. (101) The sample size that was determined for 85 children attending occupational therapy services was a sample of 70 for the study.

3.3.2 STUDY POPULATION AND RESEARCH SITES

These children were all to be attending Occupational Therapy in the five remedial schools that were going to be approached to be included in the study. This was convenience sampling, but further the study focused on children attending occupational therapy in a remedial environment,

to ensure that the sample being studied were all similar. The children were to be between the ages of 8-10 years old.

3.4 SELECTION CRITERIA

Children were included in the sample based on a set of inclusion and exclusion criteria. These criteria had to be modified during the data collection phase of the study due to difficulties in finding enough children to make up the sample. Below is an indication of the original inclusion and exclusion criteria and what actually happened during data collection.

Table 3.1 The Inclusion Criteria:

PROPOSED	WHAT OCCURRED
The sample included learners who attended existing occupational therapy services at practices in five remedial schools,	The sample included children aged 8-10, attending occupational therapy from any remedial school in North-Eastern Johannesburg.
Their parents/caregivers were asked to participate if the children are aged between 8 – 10 years of age and are receiving Occupational Therapy.	The children, aged 8-10 were included in the study after being identified by their parents and therapists of having sensory modulation difficulty.

Exclusion Criteria

The sample excluded learners in the school:

- Whose parents/caregivers did not sign informed consent.
- Whose parents/caregivers were unable to complete forms due to not being fluent in the English Language
- Whose parents incorrectly completed the forms sent home.

The current sample was studied in a real-world situation. As such, there were a number of variables such as co-morbid diagnoses; medication; the length that the sample attended occupational therapy, as well as other therapy disciplines that the sample attended which could not be controlled. If these had been controlled the sample size would have been too small for the

research to be significant. Further there was limited research on the effect of these variables on anxiety and SMD in the literature.

3.4.1 DIFFICULTIES IN OBTAINING A SAMPLE

When performing the data collection, it became clear that the sample size approximated for the study was over-calculated. In actuality, it became evident that there were far fewer 8-10 year olds receiving occupational therapy in the five remedial schools. In addition, one occupational therapy practice at a remedial school declined to participate in the study, further limiting the sample. Since the study sample attended remedial schools, with Occupational Therapy during the school day, the therapists had limited contact with the parents. Consequently, many of the information letters which were sent home to the parents were never returned. Furthermore, some of the data/forms collected were incorrectly completed, and therefore could not be included in the research.

It was therefore decided that the researcher would broaden the sample base by including other occupational therapy practices at remedial schools within north-eastern Johannesburg. The data collection was carried out over 9 months, to include as many participants as possible. Eighty-five copies of the information letters (*Appendix D*) were handed out and only 46 were returned, a percentage response rate of 53%. Sensory Profiles were then sent to the 46 parents who consented for their children to participate in the study and 46 children completed the SCAS forms. A total of 10 profiles could not be included, as they were incomplete and therefore weren't included in the study sample. Thus the final sample size consisted of 36 children, aged between 8-10 years old.

3.5 MEASUREMENT INSTRUMENTS

The following measurement tools were included in the research study. The Sensory Profile, together with the Demographic Questionnaires, were completed by the parents. Thereafter, their children completed the Spence Children's Anxiety Scale (SCAS), during school time.

3.5.1 Sensory Profile

The Sensory Profile (see ***Appendix A****)* provides a standardised measure to assist therapists in measuring a child's sensory processing abilities, and the result that their sensory modulation has on their participation in their daily living activities. (27) The profile was used in this study to measure the sensory hypersensitivity and hyposensitivity in children between the ages of 8 to 10 years of age. This is a judgment-based questionnaire that is completed by the parents or caregivers of the individual. The Sensory Profile has 125 questions and is rated on a 5-point Likert

scale ranging from always" (100% of the time) to "never" (0% of the time), thereby reporting on the frequency of these behaviours. (27)

The Sensory Profile consists of 125 questions which are then scored and divided into nine factor sections: Sensory Seeking, Emotionally Reactive, Low Endurance/Tone, Oral Sensory Sensitivity, Inattention/Distractibility, Poor Registration, Sensory Sensitivity, Sedentary and Fine Motor/Perceptual. (27)

These factors are further grouped into three section categories: Sensory Processing, Modulation and Behavioural and Emotional responses. (27)

These sections are subdivided as follows:

Sensory Processing: this section specifies the child's responses to their basic sensory systems:

- Auditory: measures the child's responses to things heard,
- Visual: measures the child's responses to things seen,
- Touch: measures the child's responses to stimulation that touch the skin,
- Vestibular (Movement): measures the child's responses to movement,
- Oral Sensory: measures the child's responses to touch and taste stimuli in the mouth,
- Multi-Sensory: measures the child's responses to activities that contain a combined sensory experience. (27)

Modulation: this section highlights the child's ability to regulate their neural messages through the facilitation or inhibition to differing sensory responses. This section if further broken down into:

- Sensory Processing Related to Endurance/Tone: measures the child's ability to sustain performance,
- Modulation Related to Body Position and Movement: measures the child's ability to move efficiently,
- Modulation of Movement Affecting Activity Level: measures the child's demonstration of activeness,
- Modulation of Sensory Input use their body senses to generate emotional responses,
- Modulation of Visual Input Affecting Emotional Responses and Activity Level measures the child's ability to use visual cues to establish contact with others. (27)

Behavioural and Emotional responses: this section identifies the child's emotional and behavioural responses to their sensory processing and is thus further subdivided into:

- Emotional/Social Responses: indicates the child's psychological coping strategies,
- Behavioural Outcomes of Sensory Processing: indicates the child's ability to meet performance demands,
- Items Indicating Thresholds for Response: indicates the child's level of modulation. (27)

Dunn then combined the factor section scores and hypothesised four quadrants of sensory modulation tendencies: poor registration, sensory seeking, sensory avoidance, and sensory sensitivity. The quadrant scores are indicative of the child's pattern on SMD and are used by clinicians in understanding the child's sensory modulation difficulties. (27)

3.5.1.1 Sensory Profile Reliability and Validity:

Reliability:

Internal test reliability was examined, using the Cronbach's coefficient alpha. This test provides an indication regarding the accuracy and preciseness of the Sensory Profile. The alpha values for various sections ranged from .47-.91, indicating good internal consistency and the reliability of test scores.(90)

Validity:

Convergent and Discriminant validity of the Sensory Profile were established by comparing scores obtained on the Sensory Profile with functional tasks scored on the *School Function Assessment (SFA)*. This assessment was used as the researchers hypothesised that as it was a functional assessment of the children at school, certain school functions (e.g: fine motor or socialisation scores) would be comparable to sensory processing. (90) Results showed meaningful correlation between the scores for the "Performance items" on the SFA and the Fine Motor Factor in the Sensory Profile, moderate correlation between the "Behavioural/Interaction" sections on the SFA and the "Modulation" sections of the Sensory Profile, suggesting convergent validity. (90, 102)

To examine Content validity for the profile it had to be identified that: a) the profile tested the full range of behaviours identified with sensory processing difficulty and b) that the items were grouped appropriately within the different sections. Results indicated that 80% of the therapists (who were participating in the study for content validity) agreed on the placement for 63% of the

items in the categories. For the items that the participants did not agreed upon, new categories were developed.(90, 102)

3.5.2 Spence Children's Anxiety Scale (SCAS)

The Spence Children's Anxiety Scale (see ***Appendix B****)* is a measurement tool which helps clinicians to identify anxiety symptoms in a child. The SCAS is child -report questionnaire that was developed to assess and identify anxiety symptoms and has thus been structured in line with diagnoses of the anxiety disorder described by the DSM-IV. (100) As such, the SCAS covers a broad range of the anxiety disorders spectrum and assesses symptoms of: generalised anxiety disorder, separation anxiety disorder, social phobia, panic disorder and agoraphobia, obsessive–compulsive disorder, and specific phobia represented by a subscale named "physical injury fears". (101) The SCAS was used in the study to get an overall, as well as sub-category scores for the participant's anxiety levels.

3.5.2.1 Spence Children's Anxiety Scale Reliability and Validity:

Reliability:

The psychometric properties of the SCAS have been proven to be satisfactory for an age group of children aged 8 -12 years. The questionnaire possesses adequate internal consistency and test–retest stability. Furthermore, the structure and factor grouping of the scales was shown to be in line with the categories described in the DSM IV. The SCAS has also shown good concurrent and convergent validity, as scores of the SCAS correlate strongly with scores on other child self-reported anxiety measures. These report questionnaires included the *State–Trait Anxiety Inventory for Children* (STAIC), the *Revised Children's Manifest Anxiety Scale* (RCMAS), and the *Fear Survey Schedule for Children – Revised*. The SCAS also possess adequate discriminant validity, as research identified that the SCAS scale is able to differentiate between children with and without anxiety disorders. (101)

Validity:

The SCAS is well researched: numerous studies have reported the reliability and validity of SCAS, including studies across multiple cultures including Australian, Dutch, German, Japanese, and South African populations. (101) A study was carried out in South Africa determining the psychometric properties of the SCAS on a South African sample.(59) Results from the study showed that the scale seemed appropriate and useful to be carried out on the South African

population, even though results did differ from the western countries (Australia, Netherlands, Belgium, Germany) which the tool was previously normed on.(59)

3.5.3. Demographic Questionnaire

A short questionnaire was completed by each parent (see ***Appendix E)*** in order to obtain relevant demographic information such as the child's age, sex, previous occupational therapy attended and the parent's contact information. The reason for the child's referral to Occupational Therapy, as well as the duration of the current Occupational Therapy sessions was also included and collected. This information was then kept separate from all other forms, and was coded.

3.6 DATA COLLECTION PROCEDURE:

After ethical clearance was granted a permission letter (*see* ***Appendix C)*** was signed by the principal of each school that was proposed to be included in the study. Permission was also granted by the head Occupational Therapist in each school. The researcher then met with the Occupational Therapists in the schools who agreed to participate in the study. At this meeting, the proposed correlational study was explained in detail. Additionally, the Occupational Therapists were provided with the Information letters to hand out to the parents of the children that they thought would be suitable to participate in the study. Children who were identified by their parents and therapists of having sensory modulation difficulty were included in the study. The information letter (which was sent home to the parents), included the parent's consent form for participating in the study.

Once the Occupational Therapists received consent from the parents, an envelope containing the Demographic questionnaire and Sensory Profile was sent home. The parents returned the completed forms in sealed envelopes to the Occupational Therapists, who then set them aside for the researcher. The researcher only went to perform the SCAS with the children participating in the study, once the completed consent and Sensory Profile envelope had been returned by the parents. The researcher received all forms in sealed envelopes from the Occupational Therapists.

The researcher spent about 10 minutes with each child. Each child had to sign an assent form (***Appendix F***) showing that they agreed to participate in the study. The reason for participating in the study, as well as the SCAS and the SCAS's Likert scale was explained to the child and they then completed the scale independently. The researcher was available to answer or to clarify questions for the children, but did not assist the children in choosing their answers. Most of the participants

were able to complete the SCAS independently as the questions are simple, clear, and unambiguous and are easy for a child to answer.

The researcher then scored both the Sensory Profile and the SCAS for each participant. All the Sensory Profiles were all scored first, and the information computed into tables. Then all the SCAS forms were scored and computed into tables. This was done in an attempt to reduce bias and to ensure that the researcher was not influenced by the scores from one questionnaire, when scoring the second.

All scored information from the questionnaires, as well as the demographic information (*see* ***Appendix E***) completed by the parents, was entered into and Excel spread sheet. The data was converted to numbers through the use of codes, for easy interpretation and comparison when computed through the use of STATISTICA. STATISTICA is a statistics and analytics programme which helped the researcher to analyse, compare, correlate and make association between the various headings of numerical data researched.

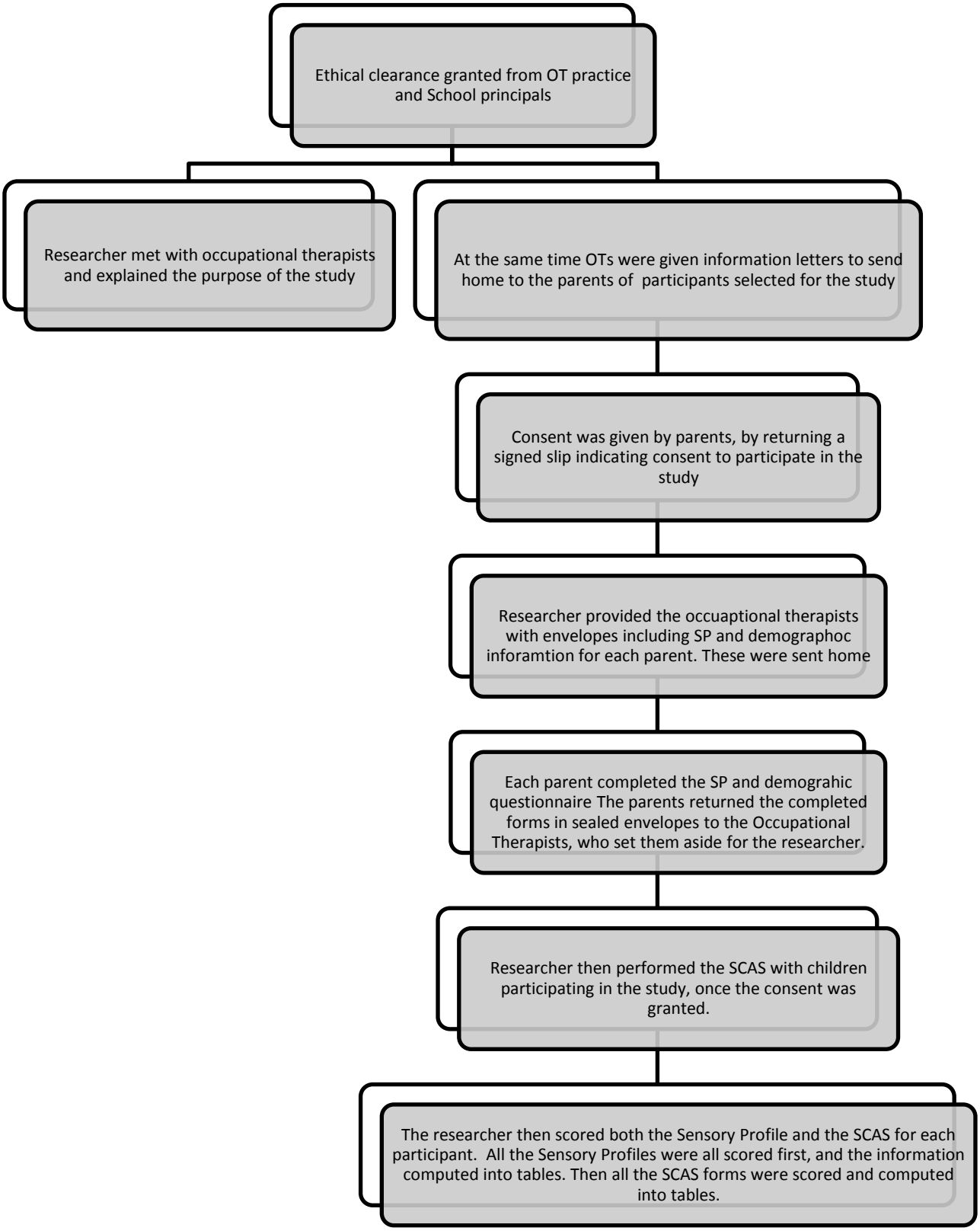


Figure 3.1: A flow chart to depict the data collection procedure

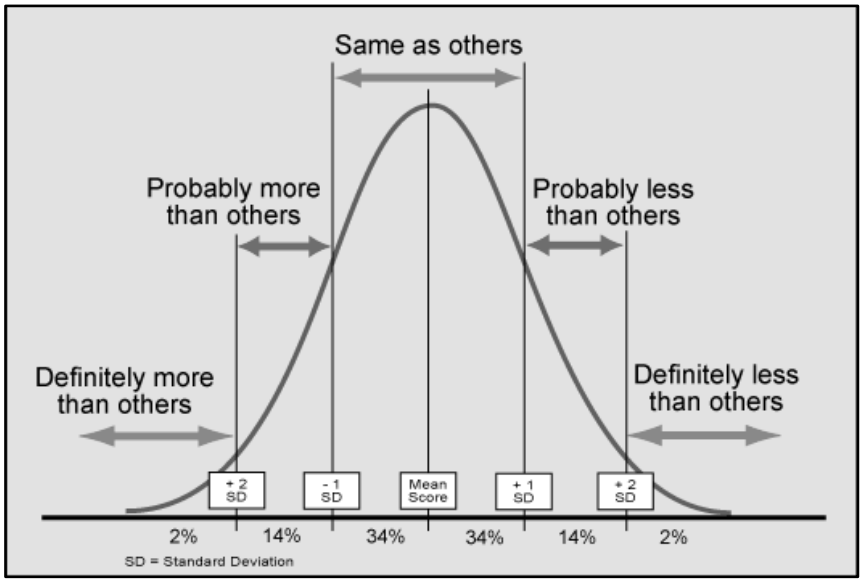
3.7 INTERPRETING THE SENSORY PROFILE AND SPENCE CHILDREN'S ANXIETY SCALE QUESTIONNAIRES

3.7.1. Interpreting the Sensory Profile:

The Sensory Profile is scored using the scoring sheet provided with the profile. An electronic version of the scoring sheet was computed/calculated by the researcher and used for the purposes of this study. This electronic version was randomly checked against the typical scoring processes as provided by the Sensory Profile Scoring sheet. Results proved that the electronic version provided accurate scores. Dunn's scoring sheet converts all the scores to what is called "cut scores." Cut scores are determined for each section and factor and identify how the child's performance relates to that of the typical population (ie: the children without disabilities used in Dunn's studies).

The Sensory Profile Scoring Sheet identifies the following classification system:

- **Typical Performance**: a child who scores with Typical performance, scores within the normative section of the Bell curve ie: at or above the 1 standard deviation (SD), below the mean = -1SD, or about 84% of the population. (27) When a child gets this score, it means that they are responding to stimuli just like their peers.
- **Probable difference**: this indicates that the child's scores fall at or above the 2 SD below the mean ie: between -1→ -2 SD. This means the child responds to stimuli 'probably more than others'. (27) As all the cut –off scores on the Sensory Profile are based on the normal bell curve, a 'probable difference' score means that the child responds to the input more than about 84% of peers, less than 2% of peers and the same as 14% of peers.
- **Definite difference**: this score indicates that the child responds to stimuli 'definitely more than others'. As all the cut –off scores on the Sensory Profile are based on the normal bell curve, 'definitely more than others' score means that the child responds more than about 98% of peers and about the same as 2% of peers. (27)



Bell curve: Normal Distribution

Furthermore, Dunn went one step further and characterised the classification system to identify if the child scores "more than" or "less than" others, for the Quadrant Scoring. In the Quadrant Scoring, a child can score Probable and Definite difference, either "less than" or "more than" they typical range. (27) "More than others" simply means that the child performs the behaviours listed in that grouping, more than typical peers, while "less than others" simply means that the person does the behaviours less than typical peers.

However, in her research Dunn focused on the interpretation of the "more than other" categories ie: those in -1 → -2 SD **BELOW** the mean, more than she did with those in the "less than other" categories ie: those in +1 → +2 SD **ABOVE** the mean (above the typical range). The Sensory Profile is therefore not sensitive enough to interpret the scores of those in the "less than others" range. For the purposes of this research, the "less than other" scores are not going to be investigated, and the focus ~~will be~~ is on the "more than other" score differences.

3.7.2 Interpreting the Spence Children's Anxiety Scale:

The SCAS is scored according to T-Scores. T-Scores are a standardised score that is calculated from the total distribution of scores within the sample. The raw scores were rescaled so that T-scores had a mean of 50 and a standard deviation of 10. These were then converted to z-scores. This scoring process ensured that all anxiety subscale scores on the SCAS, as well as the total score could be interpreted the same way, with the same mean and standard deviation, (5) even though they initially had a different numbers of items and different means per the age or gender groups.

When scoring the SCAS, a T-score of 60 (ie: 10 above the mean of 50, or 1 standard deviation below the mean), corresponds to the 84th percentile. This T-score (60) is the maximum score for the child to still be considered to have normal anxiety levels. 84% of the sample will fall within the "normal" anxiety levels. A T-Score exceeding 60 translates into elevated anxiety, where the higher the T-score, the more severe the anxiety levels. (5)

The SCAS was chosen as the anxiety tool to be used in the study, as the scoring scale is based on the same premise, as that of the Sensory Profile, ie: that the tools both are measuring the "dysfunction" of the sample, as compared to the normative scores. As with the Sensory Profile, the totalled scores where converted to negative z-scores, to show where the child scored with relation to the normal distribution. The z scores identify the relationship to the mean, in a group of scores. The scoring and converting to z scores assists the researcher to identify where the elevated anxiety scores fall on the normal distribution curve, and compare these to the z-scores received from the Sensory Profile.

3.8 DATA ANALYSIS:

Once the scores for each child's Sensory Profile and SCAS were calculated, a spread sheet with all the data was computed. This data sheet also included all the demographic information for each participant (*see **Appendix E***). This allowed the researcher to then enter the information into the STATISTICA programme.

Firstly, the data was analysed to categorise the demographic information. The number of male and female participants, as well as the percentages of each gender were computed to identify the frequency in the sample. The ages of the participants were calculated to identify a mean age and standard deviation. The number of years that the participants spent in therapy were totalled and divided by the number of participants, to obtain an average time spent in occupational therapy. Further the main reasons for the participants receiving occupational therapy were listed, with the most common aims being highlighted. Lastly, the number of children receiving play therapy for their anxiety, as well as the number of children on medication to treat anxiety was calculated.

The next set of data that was analysed was that of the participant's Sensory Profile, to understand the overall sensory profile of the sample. In this section, the participant's forms were scored using the Sensory Profile scoring tool. Further, the data was analysed using the Sensory Profile's classification system of: Typical, Probable Difference and Definite Difference. The data was numerically displayed using the "z scores" of Typical = 0, Probable Difference = -1 and Definite

Difference = -2. For each section, the number of z-scores were added-up, to identify where the majority of the participants scored ie: Typical, Probable Difference and Definite Difference. These were then computed into graphs using the Microsoft Word Table tool, to highlight and illustrate the data collected.

The data from the SCAS scales was analysed in a similar manner, to determine whether the sample would present with elevated anxiety levels. Through the use of the scoring program online, each participant's total and sub-category score was a converted into a T-score. All scores exceeding the T-score of 60 indicated elevated anxiety, and these were recorded as such. The number of participants showing "elevated" and "typical" anxiety was then totalled, for both the total SCAS scores, as well as sub-categories. Further the sub-categories of the participants (12 participants) showing elevated anxiety overall, was also calculated in the same way. These scores were all converted to z-scores, to be easily compared to the Sensory Profile scores. These scores were then computed into graphs using the Microsoft Word Table tool, to clarify the data collected.

In order to explore the association between self-reported anxiety and specific sensory modulation disorder patterns, the researcher then turned to using statistical tests to analyse the relationships between the data collected. All relationships were correlated using the raw score data, as these numerical data was comparable (as compared to using T or Z scores, which had differing cut off points.) Non-parametric statistical tests were used as the study had a small sample, which was not normally distributed, as the participants all had identified sensory modulation disorders. Further the Sensory Profile and SCAS provide scores which are ordinal or ranked (by giving the numerical data categories), and therefore non-parametric in nature.

The Non-Parametric, **Spearman Rank Correlations** test was used to correlate and identify relationships between the Totals SCAS scores, and different scores on the Sensory Profile, as was highlighted in the hypotheses.

The Spearman Tests were run using the STATISTICA programme, and were used to analyse and identify correlation coefficients for:

- The relationship between the total SCAS scores and sensory "hypo-sensitivity" quadrants of
  - Sensory sensitive quadrant scores
  - Sensory avoidant quadrant scores
- The relationship between the total SCAS scores and summary scores on the Sensory Profile, relating to anxiety and emotions:

- Modulation of Sensory Input Affecting Emotional Responses
- Behaviour and Emotional Responses Section

- The relationship between the total SCAS scores and the "emotionally reactive" factor score on the Sensory Profile

The graphs computed through STATISTICA, as well as the correlation coefficients for the relationships mentioned above were all collected and analysed.

As the sensory hypo-sensitivity quadrants showed weak relationships and low correlation, it was decided to analyse the data further. The raw Sensory Avoidance Quadrant scores were grouped according to their classification system (ie: Typical = 0, Probable Difference = 1 and Definite Difference =2). These groups were computed using the Kruskal Wallis H Test, with the Total SCAS raw scores as the dependent variable, to identity if the groups of data are significantly different form each other.

The **Kruskal-Wallis H Test** is a nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of independent variables with a dependent variable. (6) The Kruskal-Wallis H Test was used to investigate whether there were differences in level of anxiety between the Sensory Avoidance Quadrant raw scores which were grouped according to their classification system (ie: Typical = 0, Probable Difference = 1 and Definite Difference =2).

3.9 ETHICAL CONSIDERATIONS:

Ethical clearance was granted from the University of the Witwatersrand's Ethics Committee of Research on Human Subjects (*see* ***Appendix G***). Permission was then obtained from each principal and Head Occupational Therapist in the schools to access children from the occupational therapy practices (*see* ***Appendix C***). Before the start of the research, each parent and child signed an informed/assent form (***Appendix F***), granting their permission to participate in the study. The parents/caregivers were informed that participation in the study was voluntary and they could withdraw permission at any time. Each parent received telephonic feedback on the results of the research, and more in-depth results were emailed upon request. The parents of children who scored high on the SCAS (and whose anxiety was not already being addressed), were provided with contact numbers of Psychologists, either from the school, or in their surrounding areas.

As mentioned above, in order to ensure confidentiality, the completed forms were coded and scores were kept separate from the child's personal information, in a secure location. All the sensory Profile and SCAS questionnaires were scored separately from the personal information of the sample. All completed forms will be securely retained for the six year period (as prescribed by the Ethics Committee), where after they will be destroyed.

CHAPTER 4 - RESULTS

This study aimed to measure the sample's sensory modulation dysfunction and the level of anxiety, with the purpose of investigating the association between these two constructs. The sample consisted of 36 children, attending occupational therapy at remedial schools. The sample's sensory modulation dysfunction was measured on the Sensory Profile and the level of anxiety on the Spence Children's Anxiety Scale. The following chapter will display the results of the study and is divided under the following headings: Demographics of the Study, Sensory Modulation Profile, SCAS Anxiety Profile and the association between SMD and Anxiety.

4.1 DEMOGRAPHICS:

The original target sample size for this study was set at 70 children, but during data collection it became clear that this sample size would not be reached. A total of 85 information letters were sent out, and 46 families agreed to participate in the study. However, there were 10 incorrectly filled out sensory profiles, and thus the final sample that was included was 36 children. These children were aged between 8-10 years old. There were twenty-one 8 years olds, nine 9 year olds and six 10 year olds, with the mean age of the participants being 8.5 years (SD 0.7). The sample was made up of 26 males and 10 females, with the majority of the sample being male (72.2%).

All of the children were recommended by their occupational therapists (and parents) to participate in the study, after being identified during their occupational therapy assessment to have sensory modulation disorder (SMD). The length of attendance of occupational therapy sessions varied greatly from three months to six years, with the average being 21 months (1 year, 9 months). In addition to sensory modulation difficulties, the two other most common reasons for attending occupational therapy was to improve upper limb strength / fine motor skills and to improve postural/trunk control.

Of the sample, ten children solely attended occupational therapy, with the majority of the children attending at least two types of therapy. These included physiotherapy, speech and hearing therapy, play therapy (psychology) and remedial therapy. Of the total sample, seven children were attending play therapy (psychologist) sessions with the aim to improve their anxiety, and five children were taking medication for their anxiety. This information is displayed in table 4.1, 4.2, and 4.3.

Table 4.1: Gender of the sample in years (n=36)

	8 years	9 years	10 years
Boys	15 (42%)	6 (17%)	5 (14%)
Girls	6 (17%)	3 (8%)	1 (2%)
Total	**21 (58%)**	**9 (25%)**	**6 (17%)**

Table 4.2: The number of therapies attended by the sample (n=36)

	Occupational therapy only	2 therapies	More than 3 therapies
Number of children	10 (28%)	15 (42%)	11 (30%)

Table 4.3: Reason for attending Occupational Therapy (n=36)

	Sensory Integration	Fine Motor	Postural Control	Other: Developmental Delay /Planning / Visual Perception
Number of children	36 (100%)	10 (28%)	6 (17%)	8 (22%)

*** The children were referred for numerous reasons; hence the reasons do not add up to 36.**

4.2 SENSORY MODULATION PROFILE:

As mentioned in Chapter 3, the Sensory Profile is divided into factor scores, section scores and the quadrant scores. Section 4.2 is divided among these headings, to display the participants profile for their sensory modulation scores. The Sensory Profile for each participant was analysed to create a Sensory Modulation Profile for the total sample.

All the figures depict the participants' scores according to the Sensory Profile's classification system of: Typical, Probable Difference and Definite Difference. As per the data analysis, the researcher numerically displayed these as the "z scores" of Typical = 0, Probable Difference = -1 and Definite Difference = -2.

4.2.1 Factor Summary Scores:

The Sensory Profile factor summary scores for the sample (n=36), describe the combining of raw scores to display information under the following categories: Sensory Seeking, Emotionally

Reactive, Low Endurance/Tone, Oral Sensory Sensitivity, Inattention/Distractibility, Poor Registration, Sensory Sensitivity, Sedentary and Fine Motor/Perceptual.

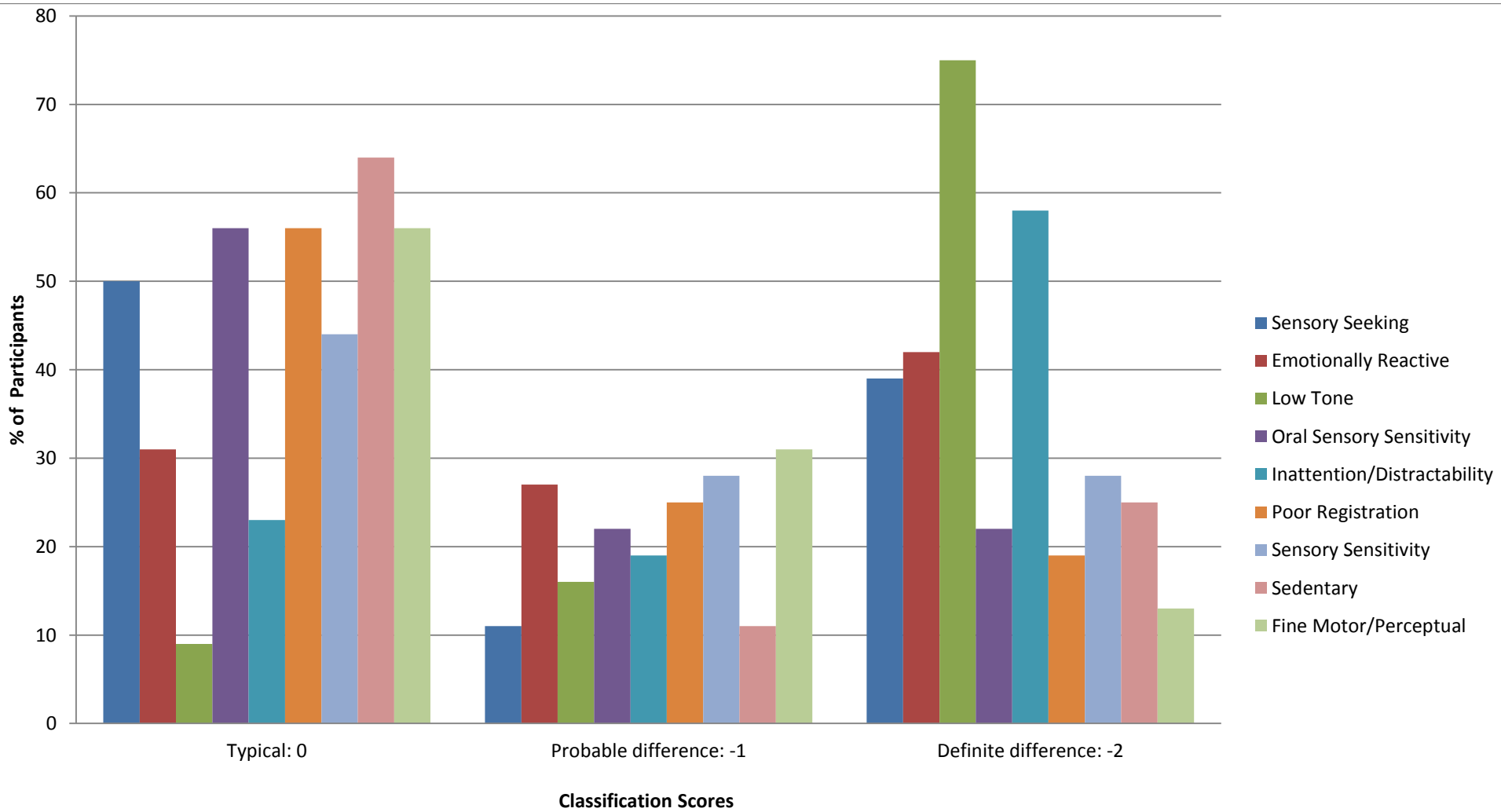


Figure 4.1: Sensory Profile Factor Summary Scores

Out of a total of nine categories, three categories had the largest proportion of "definite difference" scores – these were the Emotionally Reactive (42%), Inattention/Distractibility (58%) and Low tone (75%) categories. Thus the sample showed the most dysfunction in these three factors.

In the "typical" category, there were five out of nine categories in which more than 50% of the participants scored typically (Sensory Seeking, Oral sensory sensitivity, Poor Registration, Sedentary and Fine Motor Perceptual).

Thus the majority of the sample scored typical for the majority of Factor Summary categories.

4.2.2 Section Summary Scores:

The Sensory Profile's "Sections Summary Scores" are divided into the following sections: Sensory Processing, Modulation and Behaviour and Emotional Response. For the purposes of this study, only the scores relating to modulation and behaviour were analysed and are depicted below:

4.2.2.1 Modulation Section: Modulation of Sensory Input Affecting Emotional Responses

This section highlights a child's ability to modulate their sensory input which affects emotional responses. Questions that are grouped into this combined section score include the following: Whether the child has rigid personal hygiene rituals; if they are overly affectionate with others; if the child can understand body language or facial expressions, and if the child avoids eye contact.

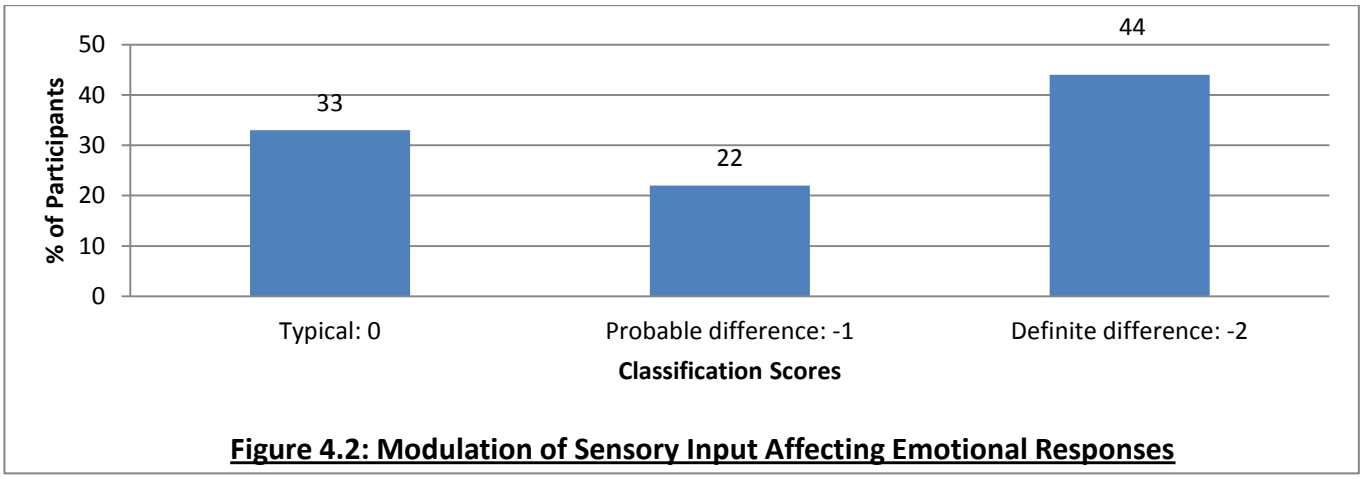


Figure 4.2: Modulation of Sensory Input Affecting Emotional Responses

Figure 4.2 illustrates the participant's (n=36) scores for the section scores of "Modulation of Sensory Input Affecting Emotional Responses" on the Sensory Profile. The largest percentage (44%) of the participants scored in the definite difference category. This indicates that children in the sample showed dysfunction in this section.

4.2.2.2 Behaviour and Emotional Responses Section:

This section is one of the most pertinent in the Sensory Profile, as it includes the questions that associate modulation and behavioural (including anxiety) reactions. The questions which make up these scores mainly include the child's behavioural and emotional responses, their reaction to changes in routine, as well as their performance and perseverance in play activities.

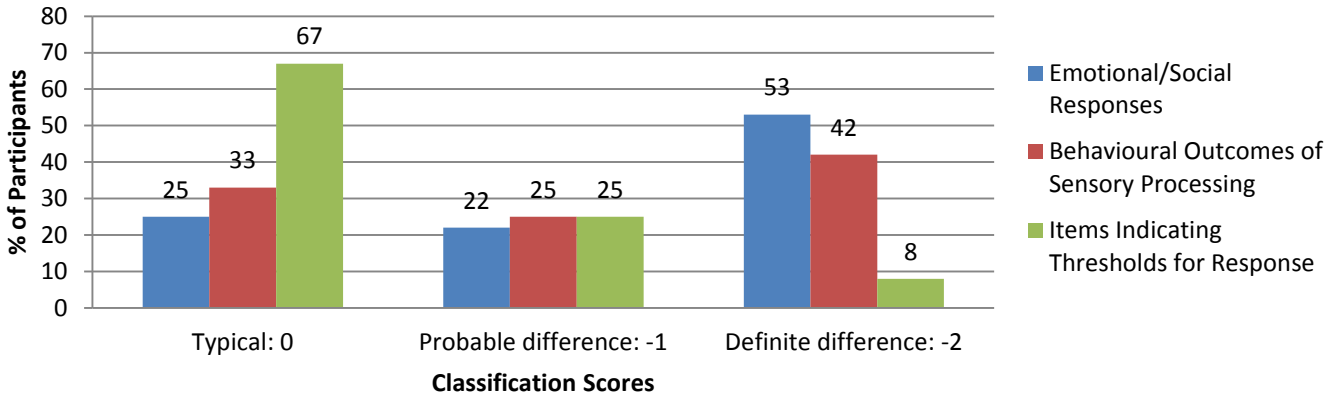


Figure 4.3: Behaviour And Emotional Responses Section Summary Scores

This graph (Figure 4.3) shows the participants' (n=36) scores for the Behaviour and Emotional Responses Section in the Sensory Profile's section summary. The majority of the sample scored in the definite difference category for Emotional/Social Responses (53%) and Behavioural Outcomes of Sensory Processing (42%), while a further 22% scored in the probable difference range for the Emotional/Social Responses category and a further 25% in the Behavioural Outcomes of Sensory Processing category. However 67% of the participants scored typical for the Items Indicating Thresholds for Response section. The questions which added to make the "Items Indicating Thresholds for Response" score are not really pertinent to the study, as they describe the child's reactions to smelling strong odours.

4.2.3 Quadrant Scores:

4.2.3.1 Quadrant Scores of the whole sample:

The Quadrant Scores in the Sensory Profile are the closest to that of a diagnosis on the Profile, and have been used in this study to indicate the total scores per quadrant - for each participant, in terms of their Sensory Modulation.

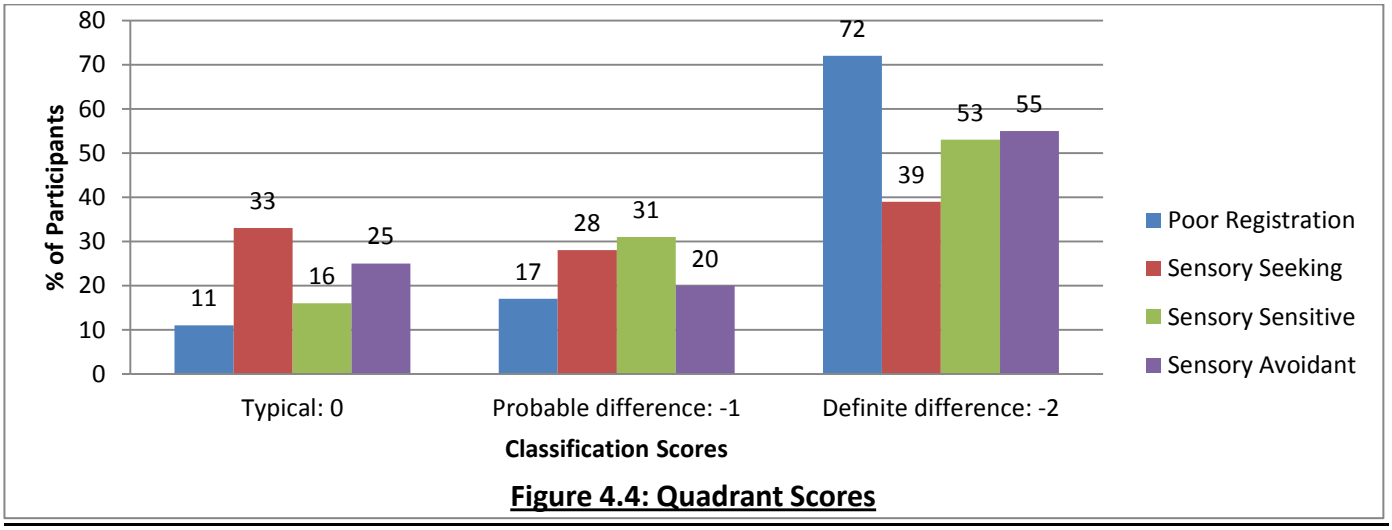


Figure 4.4: Quadrant Scores

Figure 4.4 shows that the majority of the participants (n=36) scored within the definite difference category, for each of the quadrants. This means that the participants have an overall sensory profile indicative of SMD and present with difficulty when modulating sensory input. For the sensory "sensitive" quadrant, 53% of the participants showed definite difference scores, as well as 55% for the "avoidant" quadrant. This means that compared to the typical and probable difference scores, the majority of the sample scores with definite difference in the categories indicating sensory over-responsivity.

4.3 SPENCE CHILDREN'S ANXIETY SCALE ANXIETY PROFILE:

The following graphs provide information on the second objective of the study: to determine the anxiety profile of the children with SMD in order to identity if the participants showed elevated anxiety levels.

4.3.1 TOTAL Spence Children's Anxiety Scale Score:

The SCAS Scales completed by the participants (n=36), provided a Total SCAS score for each child. These were totalled and are illustrated by the following pie graph:

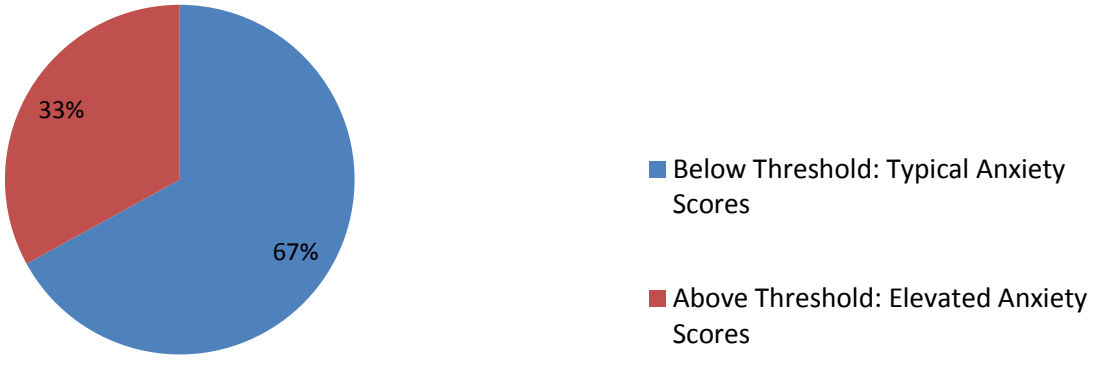


Figure 4.5: Total Spence Children's Anxiety Scale Scores

The Figure above (4.6) shows that only 33% of the participant's scored a total score of elevated anxiety. Thus the incidence of elevated anxiety in this sample was 33%.

4.3.2 Children with Heightened Anxiety Compared to Children without Heightened Anxiety

The following table depicts the difference between the participants who scored above and below the threshold for anxiety. The differences for gender, as well as those participants on medication and those attending play therapy are displayed below:

Table 4.4: Differences in gender and the number of participants on medication, and attending play therapy for participants above and below the anxiety threshold:

	12 above the threshold – ie show anxiety	24 below threshold
Male, n=26	9 – 35%	17 – 65%
Female, n=10	3 – 30%	7 - 70%
Number of participants on medication, n=5	1 – 20%	4 – 80%
Number referred for play therapy, n=7	3 – 43%	4 – 57%

It is interesting to note from the table above that a similar number of boys (35%) and girls (30%) from the total sample, showed increased total anxiety scores on the SCAS. Further it seems that the medication taken by the sample seemed to assist with their anxiety symptoms, as the majority (80%) scored with non-indicative anxiety levels on the SCAS. Lastly, the effect that play therapy has on the children attending sessions also seemed to assist in decreasing the total SCAS score overall as 43% of those attending play therapy indicated total anxiety overall, whereas 57% had scores indicating no anxiety symptoms overall.

4.3.2.1 TOTAL Spence Children's Anxiety Scale Score for the participant's on medication and for those receiving play therapy:

The total SCAS scores completed by the participants (n=5) who were taking medication for anxiety symptoms, are illustrated by the following pie graph:

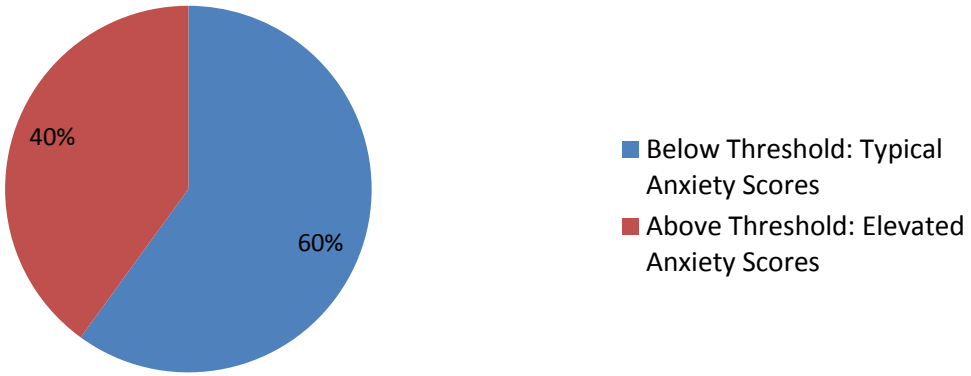


Figure 4.6: Total Spence Children's Anxiety Scale Scores for participants on medication (n=5)

The total SCAS scores completed by the participants (n=7) who were attending play therapy to address their anxiety symptoms, are illustrated by the following pie graph:

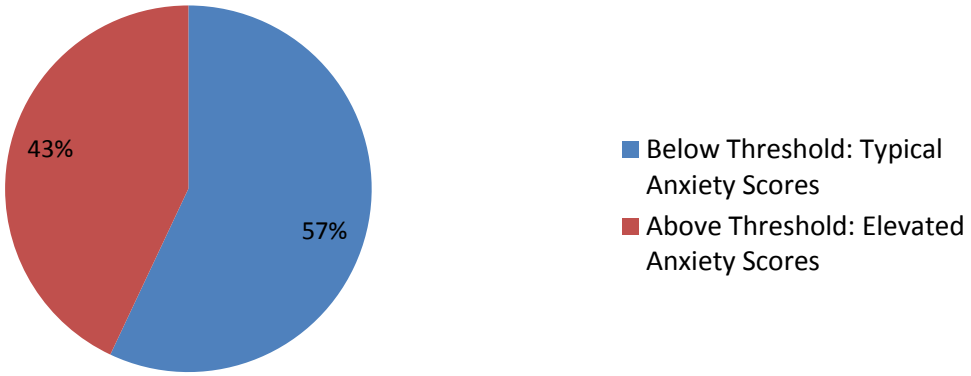


Figure 4.7: Total Spence Children's Anxiety Scale Scores for participants receving play therapy for anxiety (n=7)

From the figures above, it is again clear that the total SCAS score for the total sample (see figure 4.5), as well as those participants who are taking medication for anxiety (figure 4.6) or those who are attending play therapy to address their anxiety (figure 4.7) all show above threshold incidence rate of anxiety that are very similar. The total sample's rate for increased anxiety was 33%, while

the participant's on medication was 40% and those attending play therapy was 43%. As can be expected the percentage of the sample who have identifiable anxiety (43% and 40%) is higher than that of the total sample (33%), as these children have symptoms which have been identified by their parents and other professionals too.

4.3.3.2 Individual Anxiety Categories - Spence Children's Anxiety Scale Scores for participants with elevated anxiety, on medication and attending play therapy:

The SCAS sub-category scores for the total sample are shown below. The SCAS is scored in such a way that the participants could have scored with elevated anxiety in more than one category. Therefore, the scores do not add up to 100%:

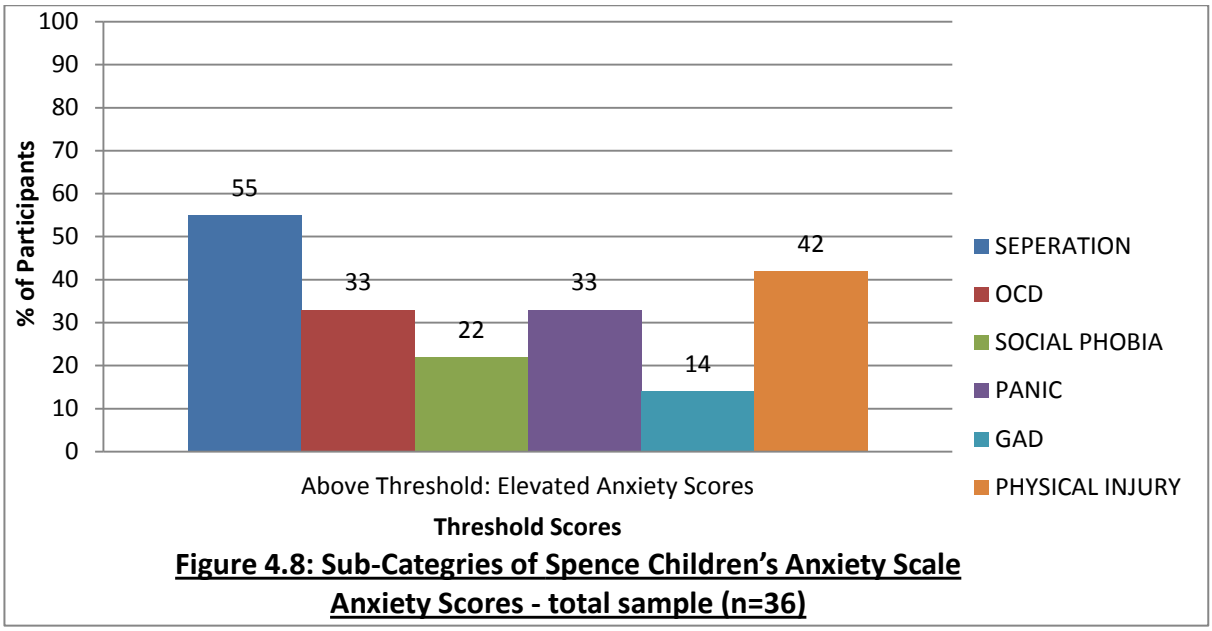


Figure 4.8: Sub-Categries of Spence Children's Anxiety Scale Anxiety Scores - total sample (n=36)

The scores of the participants who showed Total Anxiety overall (n=12), were analysed further. This was one to identify which of the sub-categories on the SCAS, in which these participants scored highest. The SCAS is scored in such a way that the participants could have scored with elevated

anxiety in more than one category. Therefore, the scores do not add up to 100%.

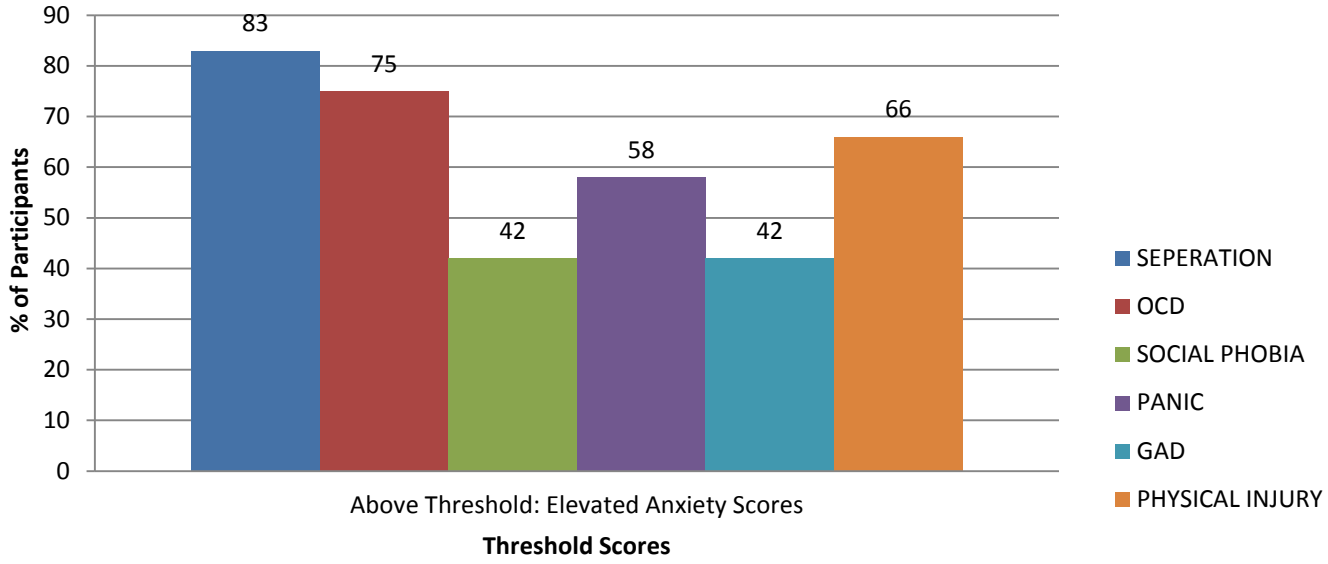


Figure 4.9: Sub-Categries of Spence Children's Anxiety Scale Anxiety Scores (n=12)

The SCAS Scale is divided into sub-categories to provide a more in-depth look into the child's anxiety. The graph's above (figure 4.8 and 4.9) shows these sub-categories: separation anxiety, obsessive compulsive disorder (OCD), social phobia, panic, generalised anxiety/overanxious disorder (GAD) and items concerning fears of physical injury. (101)

The SCAS subcategory scores for the total sample, as well as those 12 participants with elevated anxiety are shown above (figure 4.8 and 4.9). When looking at the graphs, the two look very similar. As can be expected the scores for each sub-category are higher for those with 12 with elevated anxiety, as they are only a third of the total sample.

The total sample (n=36), as well as those with elevated anxiety (n=12) showed the following sub-category scores: 55% and 83% scored with elevated scores for the separation anxiety scale, 33% and 75% scored with elevated scores for OCD symptoms, 42% and 66% scored with elevated scores for fears related to physical injury and 33% and 58% scored with elevated scores identifying panic symptoms. For the categories of social phobia 22% and 42% scored with elevated scores, and for GAD 14% and 42% of the children scored with elevated scores for those categories.

4.3.3.3 Quadrant Scores of the participants with elevated anxiety scores:

One last section was compared to the total sample, to see the difference that the SP Quadrant scores would show for the sample with elevated anxiety (n=12), those on medication for anxiety symptoms (n=5) and those attending play therapy for anxiety symptoms (n=7).

The following graph shows the Quadrant scores for the 12 participants who scored with above-threshold levels, indicating increased anxiety symptoms:

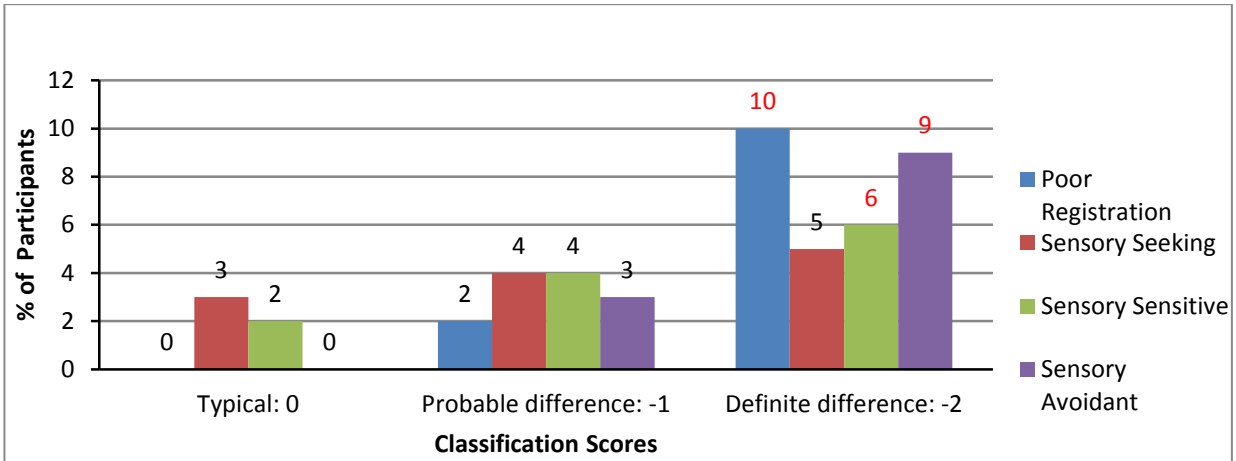


Figure 4.10: Quadrant Scores of the participants with increased anxiety on the Spence Children's Anxiety Scale (n=12)

The following graph shows the Quadrant scores for the 7 participants who are attending play therapy due to increased anxiety symptoms:

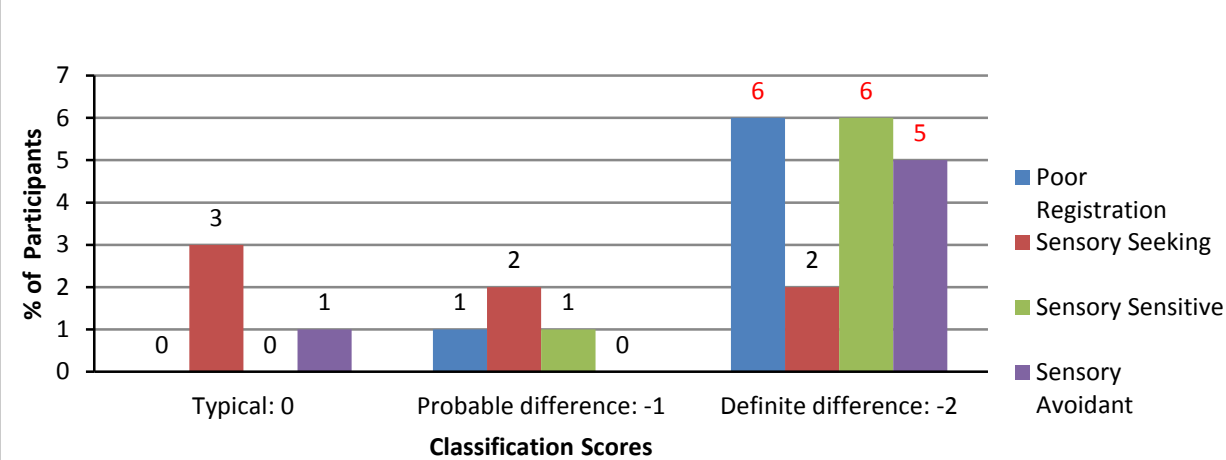


Figure 4.11: Quadrant Scores of participants who are reciving play therapy for anxiety symptoms (n=7)

The last graph shows the Quadrant scores for the 5 participants who are taking medication due to increased anxiety symptoms:

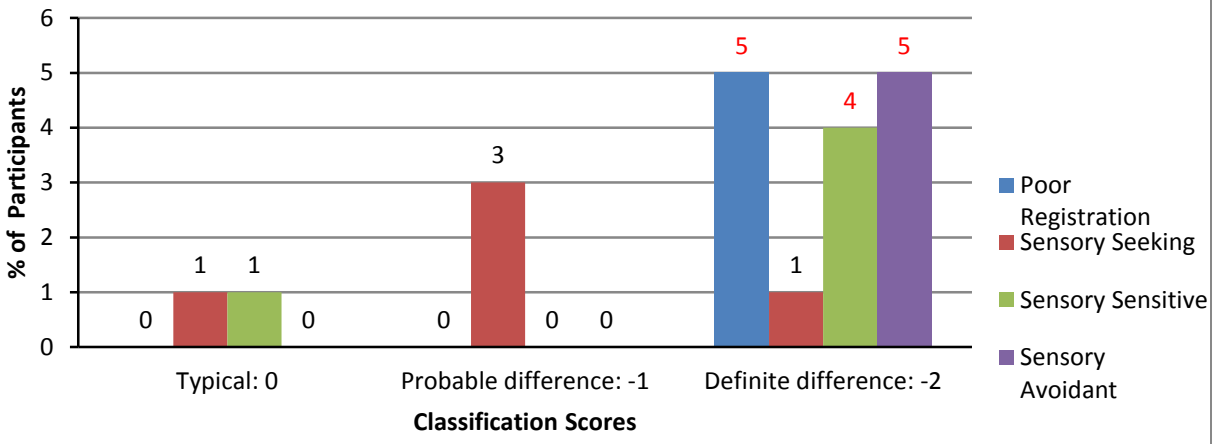


Figure 4.12: Quadrant Scores for participants taking medication for anxiety (n=5)

Figures 4.10-4.12 shows the participant's with elevated anxiety (n=12), those attending play therapy for anxiety (n=7) and those on medication for anxiety (n=5), ALL showed quadrant scores very similar to that of the total population. Again, the majority of these participants scored within the definite difference category, indicating SMD. Further one can postulate that other variables such as children taking medication and those with identified anxiety diagnoses may not affect the total SMD results overall

4.4 ASSOCIATION BETWEEN SENSORY MODULATION DISORDER AND ANXIETY:

The results in this section are going to reflect the association of specific components, as set out in the hypotheses of the research. The results ~~will~~ look at the association between the Total SCAS Scores and specific items from the participant's Sensory Modulation Profile to see if any correlation may be established. These ~~will~~ include: the Sensory Sensitive and Sensory Avoidant Quadrant Scores, Sensory Profile Factor: Emotionally Reactive factor and certain Sensory Profile Section Scores: Sensory Modulation Section (Modulation of Input Affecting Emotional Responses) and the Behavioural and Emotional responses section (Emotional/Social Responses, Behavioural Outcomes of Sensory Processing and Items Indicating Thresholds for Response).

The data in this section was computed using **Spearman Rank Correlations** - to identify the association between two variables, or the **Kruskal Wallis H Test** - when finding significance between

groups of information. In order to understand the data clearly, it must be clarified that negative correlations are noteworthy, as the higher a SCAS score is, the more dysfunction is present, while the lower a Sensory Profile score is the more dysfunction is present.

The following hypotheses are discussed in more detail, as evidence from the literature support the following associations:

4.4.1: HYPOTHESIS 1: There will be an association between the sample's total anxiety scores and their sensory over-responsivity scores.

To test hypothesis 1, a Spearman Rank Correlation was performed to determine the association between the raw Total SCAS Scores, as well as the raw Sensory Sensitive and Sensory Avoidant Quadrant scores. The null hypothesis was that there was no association between these constructs. The results were as follows:

4.4.1.1 SENSORY SENSITIVE SCORES AND TOTAL ANXIETY SCORES

The Total SCAS scores were correlated with the raw scores of the Sensory Sensitive Quadrant. The Spearman Rank correlation showed:

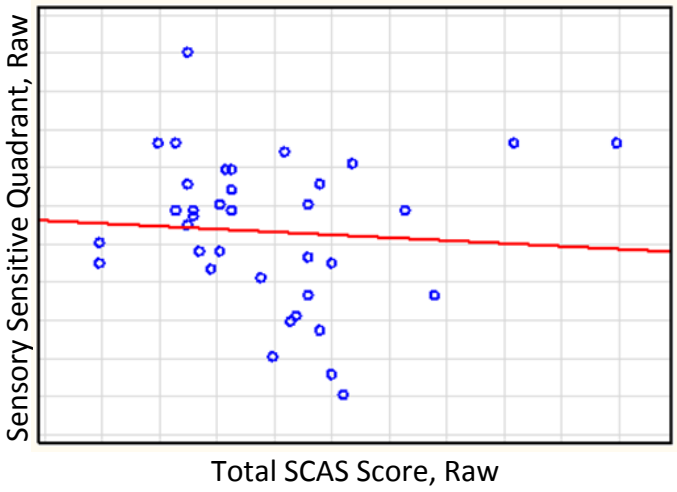


Figure 4.13 Relationship between Total Spence Children's Anxiety Scale raw scores and Sensory Sensitive Quadrant Scores

The sensory sensitive and Total SCAS correlation showed a correlation coefficient of r = -0.20; $p<0.05$, which is interpreted as a weak, negative correlation. The r^2 for the Sensory Sensitive and Total SCAS was 4%, showing that 4% of the variance in the Total SCAS Anxiety Scores could be explained by the variance in the Sensory Sensitive Quadrant score. This shows that there is a poor association between sensory sensitivity and total anxiety scores.

4.4.1.2 SENSORY AVOIDANT SCORES AND TOTAL ANXIETY SCORES

The Total SCAS scores were correlated with the raw scores of the Sensory Avoidant Quadrant. The Spearman Rank correlation showed:

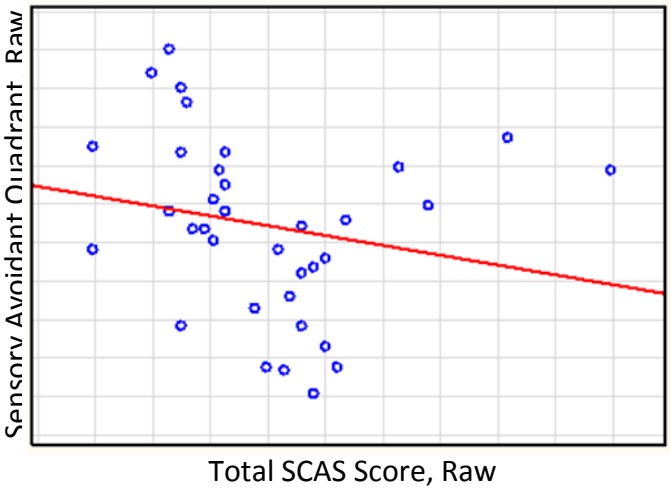


Figure 4.14: Relationship between Total Spence Children's Anxiety Scale raw scores and Sensory Avoidant Quadrant Scores

The sensory avoidant and Total SCAS correlation showed a correlation coefficient r = -0.38; $p<0.05$, which is interpreted as a low correlation. The r^2 for the Sensory Avoidance and Total SCAS was 14%, showing that 14% of the variance in the Total SCAS Anxiety Scores could be explained by the variance in the Sensory Avoidance Quadrant scores. This however shows that there is a better (albeit still weak) association been sensory avoidant and total anxiety scores, as compared to sensory sensitive and anxiety scores. This correlation was highlighted as significant.

In order to analyse the data further, the raw Sensory Avoidance Quadrant scores were grouped according to their classification system (ie: Typical = 0, Probable Difference = 1 and Definite Difference =2). These groups' Total SCAS raw scores were compared using the Kruskal Wallis H Test, to investigate whether there were differences between the groups.

The test showed that there was a statistically significant difference between the three groups regarding their Total SCAS raw scores (H=7.07, p=0.029). Unfortunately the Kruskal Wallis H Test cannot indicate the direction of the differences between groups, but can only indicate whether there is a significant difference. This result means that children with definite difference and probable difference Sensory Avoidant scores (dysfunctional scores) have significantly different anxiety scores from those in the typical categories. In order to determine the direction of the anxiety scores, average scores for each group had to be calculated. The average SCAS anxiety score

for the definite difference sensory avoidant score was 36.1 (SD 11.13, range 6-50), for the probable difference group 46 (SD 25.90, range 19-96) and for the typical group 26 (SD 19.27, range 6-78) (see figure 4.15 below). Both the definite difference and probable difference groups had higher anxiety scores than the typical group with the probable difference group displaying the highest average as well as the highest range in anxiety scores.

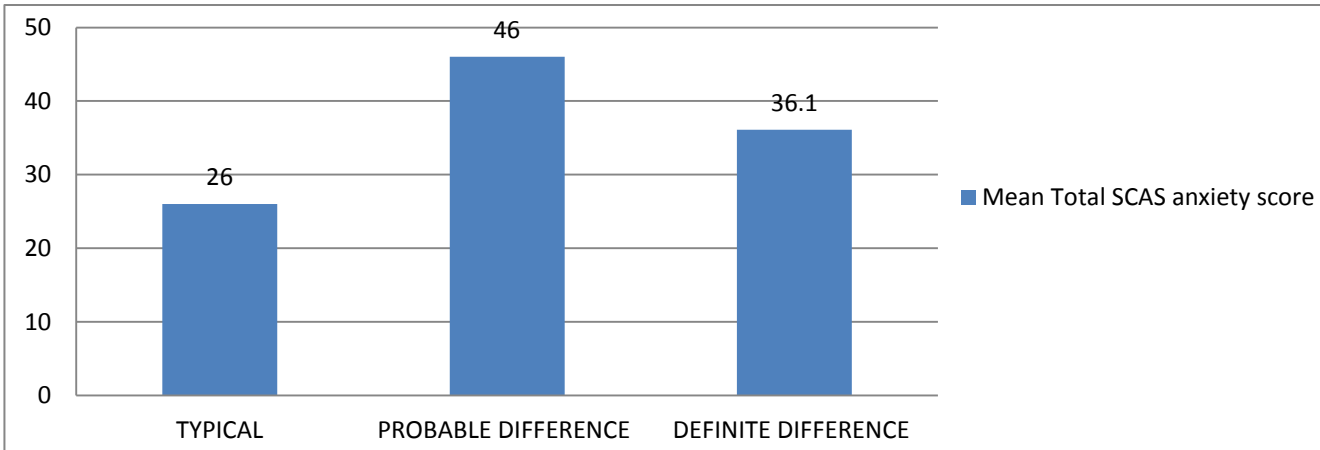


Figure 4.15: Mean Total SCAS anxiety scores for the Sensory Avoidance Quadrant groups

Therefore the null hypothesis that there will be no association between the sample's total anxiety scores and their sensory over-responsivity scores was partially rejected. There was a very weak association between the Sensory Sensitive Quadrant and Total anxiety scores, thus the null hypothesis is accepted for this quadrant – there is no association between sensory sensitivity and anxiety. However, even though the Sensory Avoidant Quadrant showed only a weak association with the Total anxiety scores on the Spearman's Rank Correlation, there was a significant difference between the anxiety scores of the three groups of scores on the avoidant quadrant, with the probable difference group showing the highest levels of anxiety. Thus the null hypothesis is partially rejected – there is some evidence of a relationship between sensory avoidance and anxiety, with the definite difference and probable difference avoidant groups displaying more anxiety in this sample than the typical group.

4.4.2: HYPOTHESIS 2: There will be an association between the sensory factor scores relating to emotion/anxiety and the sample's total anxiety scores.

The Sensory Profile Factor section is made up of numerous factor scores. However only the association between the Emotionally Reactive factor and the Total SCAS scores was tested, in order

to identify the associations between these constructs. This factor was chosen as it was hypothesised to be associated because of the underlying theory or evidence in literature.

The Total SCAS scores were compared to the raw scores of the Emotionally Reactive Factor, with the null hypothesis predicting no association between the constructs. The Spearman Rank correlation showed:

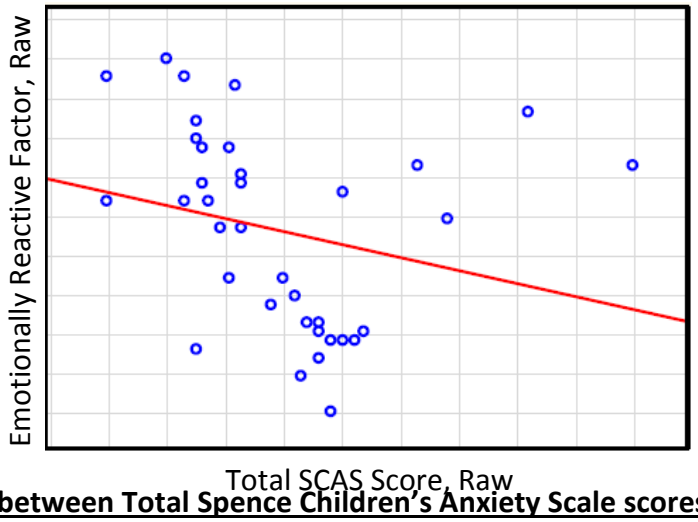


Figure 4.16 Relationship between Total Spence Children's Anxiety Scale scores and Emotionally Reactive Factor Scores

The Emotionally Reactive Factor and Total SCAS correlation showed a correlation coefficient of $r = -0.43$; $p<0.05$, which is interpreted as a moderate, significant correlation. The r^2 shows that 18% of the variability in the Total SCAS Anxiety Scores could be explained by the variability in the Emotionally Reactive Factor scores. This shows that there is a moderate association been the constructs and therefore we reject the null hypothesis, and conclude that there is an association between the emotionally reactive factor scores and total anxiety scores.

4.4.3: HYPOTHESIS 3: 3. There will be an association between the sensory section scores relating to emotion/anxiety and the sample's total anxiety scores.

The Sensory Profile Section is made up of three broader categories: Sensory Processing, Sensory Modulation and Behaviour and Emotional Responses. For the purposes of the study only the scores that were hypothesized in the literature to have a relationship with modulation or anxiety (emotions) were investigated further. Therefore this section only focuses on one item from the Sensory Modulation section, but all three items from the Behaviour and Emotional Responses Section.

4.4.3.1 Sensory Modulation Section

4.4.3.1.1 Modulation of Input Affecting Emotional Responses

As mentioned above, the only modulation score that was computed into the Spearman's rank to show a correlation was the score: Modulation of Input Affecting Emotional Responses. The other scores did not associate modulation with anxiety, and were therefore not investigated further; the null hypothesis was that there was no association between the Modulation of Input Affecting Emotional Responses scores and total anxiety score.

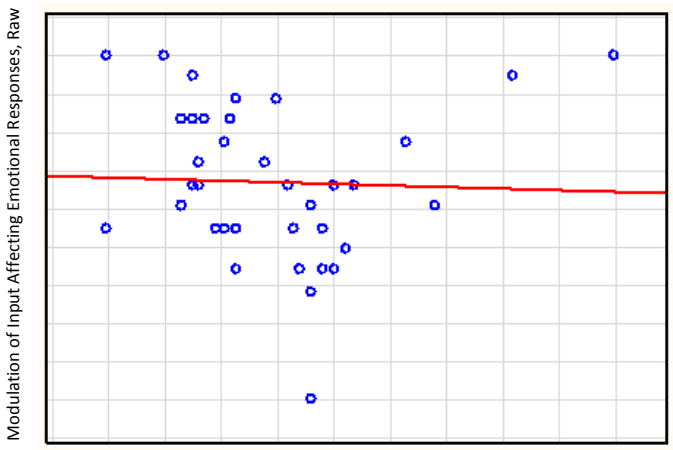


Figure 4.17 Relationship between Total Spence Children's Anxiety Scale scores and Modulation of Input Affecting Emotional Responses section Scores

The above mentioned section score and Total SCAS correlation showed a correlation coefficient of r = -0.27; $p<0.05$, which is interpreted as a weak correlation. The r^2 for the Modulation of Input Affecting Emotional Responses section and Total SCAS was 7%, showing that 7% of the variance in the Total SCAS Anxiety Scores could be explained by the variance in the Modulation of Input Affecting Emotional Responses section scores. This weak association is not enough evidence of an association between the Modulation of Input Affecting Emotional Responses section and the Total SCAS Anxiety scores, thus the null hypothesis is accepted.

4.4.3.2 Behavioural and Emotional Responses Section

The Behavioural and Emotional responses section is further divided into the following scores: Emotional/Social Responses, Behavioural Outcomes of Sensory Processing and Items Indicating Thresholds for Response.

4.4.3.2.1 Emotional/Social Responses

The Total SCAS scores were computed with the Emotional/Social Responses scores using Spearman's Rank correlations. The results showed:

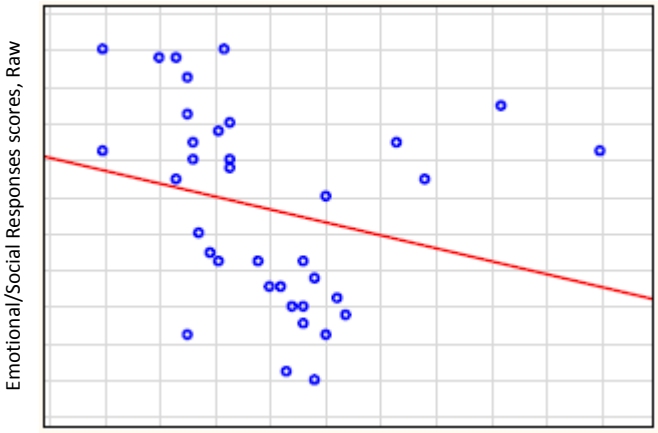


Figure 4.18 Relationship between Total Spence Children's Anxiety Scale scores and Emotional/Social Responses section Scores

The Emotional/Social Responses section score when correlated with the Total SCAS scores showed a correlation coefficient of r = -0.44; $p<0.05$, which is interpreted as a moderate, significant correlation. The r^2 shows that 19% of the variability in the Total SCAS Anxiety Scores could be explained by the variability in the Emotional/Social Responses section scores. This shows that there is a moderate association between the constructs and therefore the null hypothesis is rejected. Thus there is evidence of an association between the Emotional/Social Responses section scores and total anxiety scores.

4.4.3.2.2 Behavioural Outcomes of Sensory Processing

The Total SCAS scores were computed with the Behavioural Outcomes of Sensory Processing scores using Spearman's Rank correlations. The results showed:

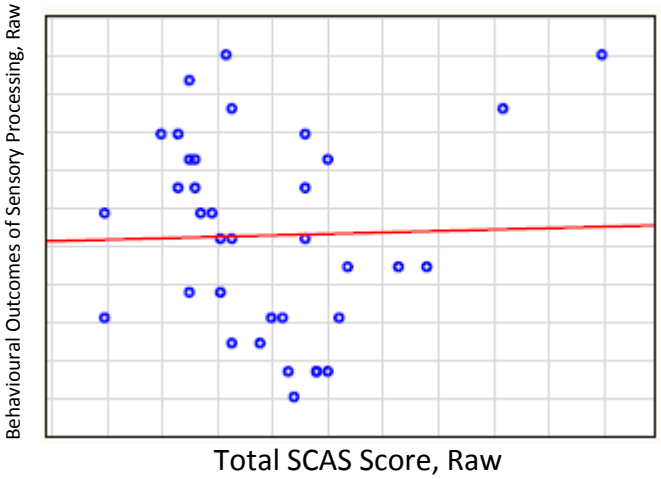


Figure 4.19 Relationship between Total Spence Children's Anxiety Scale scores and Behavioural Outcomes of Sensory Processing section Scores

The Behavioural Outcomes of Sensory Processing section score when correlated with the Total SCAS scores showed a correlation coefficient of r = -0.21; $p<0.05$, which is interpreted as a weak

correlation. The r^2 for the Behavioural Outcomes of Sensory Processing section and Total SCAS was 4%, showing that 4% of the variance in the Total SCAS Anxiety Scores could be explained by the variance in the Behavioural Outcomes of Sensory Processing section scores. This weak association is not enough evidence of an association between the Behavioural Outcomes of Sensory Processing section and the Total SCAS Anxiety scores, thus the null hypothesis is accepted.

4.4.3.4.3 Items Indicating Thresholds for Response

The Total SCAS scores were computed with the Items Indicating Thresholds for Response section scores using Spearman's Rank correlations. The results showed:

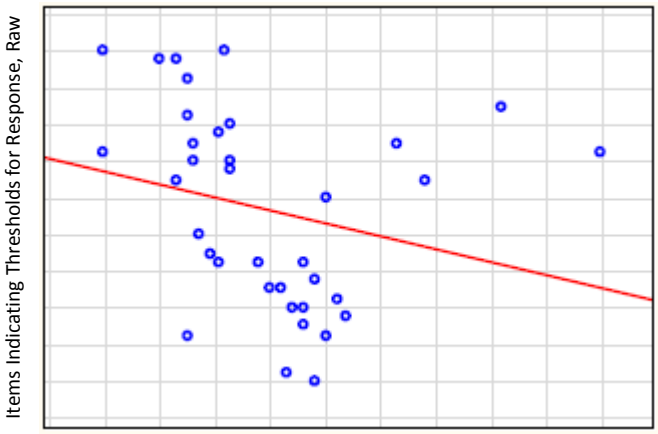


Figure 4.20 Relationship between Total Spence Children's Anxiety Scale scores and Items Indicating Thresholds for Response section Scores

The Items Indicating Thresholds for Response section score and Total SCAS correlation showed a correlation coefficient of $r = -0.30$; $p<0.05$, which is interpreted as a weak correlation. The r^2 for the Items Indicating Thresholds for Response section and Total SCAS was 9%, showing that 9% of the variance in the Total SCAS Anxiety Scores could be explained by the variance in the Items Indicating Thresholds for Response section scores. This weak association is not enough evidence of an association between the Items Indicating Thresholds for Response section and the Total SCAS Anxiety scores, thus the null hypothesis is accepted.

4.5 RESULTS CONCLUSION:

In conclusion, with reference to the Sensory Profile of the sample, the participants scored typical for the majority of the factor scores, only showing dysfunction in the Emotionally Reactive, Inattention/Distractibility and Low tone factor categories. Further in the section scores, the largest percentage of the participants scored in the definite difference category (indicating dysfunction) for the "Modulation of Sensory Input Affecting Emotional Responses," "Emotional/Social Responses" and "Behavioural Outcomes of Sensory Processing" on the section scores. Overall, the participants

scored within the majority for the definite difference category, for each of the four sensory profile quadrants. This means that the participants showed an overall sensory profile indicative of SMD.

The total SCAS scores for the participants showed that the incidence of elevated anxiety in this sample was 33%. Of the children who had the elevated anxiety (n=12), they then scored high in the following SCAS sub categories: 83% scored with elevated scores for the separation anxiety scale, 75% scored with elevated scores for OCD symptoms, 66% scored with elevated scores for fears related to physical injury and 58% scored with elevated scores identifying panic symptoms. For the categories of social phobia and GAD, 42% of these 12 children scored with elevated scores for those categories.

When comparing the total SCAS scores, sub-category SCAS scores, as well as quadrant scores for the portion of the sample who indicated above threshold anxiety levels, as well as those on medication or attending play therapy for anxiety; it is clear that overall these factors did not affect the results, as they were similar overall to those of the total sample. However it can be noted that similar amount of boys and girls from the total sample, showed increased total anxiety scores on the SCAS. Further it seems that the medication taken by the sample, as well as the play therapy received for anxiety symptoms, seems to assist in decreasing the total SCAS score overall.

Only three hypotheses were proven to be noteworthy and show association through the use of statistical testing: a) That there is an association between the sample's total Anxiety scores and their avoidant - sensory over-responsivity scores, b) That there is an association between the emotionally reactive sensory factor scores and the sample's total anxiety scores and c) That there is an association between the Emotional/Social Responses section scores section scores and the sample's total anxiety scores.

DISCUSSION

This chapter discusses the results of the research project. The aims and hypotheses will be explored in relation to the literature already discussed, to identify if the hypotheses formulated for the study were supplemented by findings of other literature and confirmed or rejected based on the results of the study. The following sections are discussed in the chapter: the demographics of the sample, the sensory modulation dysfunction and the anxiety level of the sample. Lastly the association between SMD and anxiety- as well as the limitations of the study will be argued.

5.1 DEMOGRAPHICS OF THE SAMPLE

The sample comprised thirty-six children all of whom were all receiving occupational therapy. The sample of the study was not indicative of the normal population, as they all attended occupational therapy services at Remedial Schools. As such, all the children in the study had an educationally identifiable learning disability, and had sensory modulation difficulties, which were identified by their occupational therapists. Children with identifiable learning disabilities often have other co-morbid diagnoses such as Anxiety, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD) or Sensory Modulation Disorder (SMD)(29, 49, 91). Further, children with SMD, ASD and ADHD process sensory inputs in a different manner than children without these disabilities (91) and so the results of the study based on this SMD population can be comparable to those of similar, or expected co-morbid diagnoses mentioned above.

It is interesting to note that 72% (n=26) of the sample where male, thus the minority were female children. The literature shows that the common misconception that more males than females have learning disabilities is incorrect. A study by Robinson (1997) showed that in fact the ratio of males to females with a learning disability is 2.2:1 for child referrals which were recommended by the school. The researcher postulated that the difference in the estimates is related to the increased school behaviour problems identified in boys – which most likely lead to more referrals being made. (103) The same could be true for the boys in this study, as they not only have identifiable learning disabilities, but SMD difficulties too, which can possibly increase the amount of disruptive behavioural and concentration difficulties in the classroom environment, and thus increase the amount of referrals to occupational therapy. No literature could be found to identify the estimates of boys versus girls, in relation to SMD. However, by the number of males versus females included

in studies relating to SMD, it is postulated that there is possibility of more males being identified with and treated for SMD.

Further, when looking at the gender differences between children who rated themselves to have above and below threshold anxiety levels, it was interesting to note that a similar number of both males (35%) and females (30%), showed increased anxiety levels overall (see table 4.1). Therefore, although in the current sample there is evidence that there is increased number of male children treated for SMD, there were also equal number of males and females being treated for anxiety symptoms.

There may be a misconception of gender differences among the various disorders, however very limited research is available to support this hypothesis regarding SMD. For anxiety however, literature shows a relatively equal prevalence rate among younger boys and girls, but anxiety disorders become more prevalent in females, by the time they reach adolescence. (8)

5.2 SENSORY PROFILE OF THE SAMPLE

The participants in the study were all graded by their parents using the Sensory Profile, in order to identify their Sensory Modulation difficulties. The Sensory Profile is a proven tool to accurately identify the sensory difficulties in the child population; as Dunn and colleagues have proven that majority of the sensory profiles questions are uncommon behaviours for the typical population without disabilities. (22, 85)

5.2.1 Quadrant Scores:

In order to identify if the study sample did in fact present with SMD overall, the participants' scores for the four quadrants in the Sensory Profile were analysed first. The combined Sensory Profile scores displayed that the majority presented with "definite difference" scores (ie: child responds to behaviours more than others), for all of the four quadrants in the Sensory Profile (see figure 4.4). As the Sensory Profile does not have a total score, the quadrant scores are indicative of SMD.(27) This indicates that the whole sample did indeed present with difficulty when modulating sensory input.

There is little similar research examining the Sensory Profile quadrant scores of children with other disabilities. However two studies highlighted that children who presented with Attention Deficit Hyperactivity Disorder (ADHD) symptoms, (33) as well as children with known learning disabilities (34) were scored as showing more behaviours, (and therefore definite difference scores) for the quadrant scores on the Sensory Profile. This means that the participants with ADHD and learning

disabilities also showed significant difficulties with sensory modulation compared to children without disabilities.

The scores obtained in this study compare favourably with the scores obtained by the populations in the aforementioned studies with learning disabilities and ADHD, common co-morbid diagnoses of SMD. Furthermore, as the participants in this study were biased – they had been previously identified by their occupational therapists to have SMD – they were expected to show impairment in all four quadrants, and the results confirmed that they did.

When examining the quadrant scores, the majority of the participants' scores indicated dysfunction for the "poor registration," (72%) "sensory avoidant" (55%) and "sensory sensitive" (53%) quadrants (see figure 4.4). The sensory avoidant and sensory sensitive scores can be explained as the sample showing sensory over-responsivity symptoms (low neurological threshold for input) overall. This is important to note, as this will be extrapolated when associating the specific SMD patterns and anxiety later in the discussion.

The high percentage of participants who scored with "poor registration" is quite apparent. It could be argued that the high percentage of children presenting with symptoms of poor registration, could be in fact related to the high rate of "avoidant" behaviours. This is similar to Ben Sasson et.al (2007) research, as they identified that low registration could not be assessed separately from avoidant and sensitive symptoms, as they proved poor registration symptoms to moderately correlate with avoiding symptoms (r =0.55).(25) It could therefore be hypothesised that this "mixed" pattern of over-responsivity (ie: high avoidance and sensitive scores), as well as under-responsivity (ie: high "poor registration" scores) (22) may be common in children with SMD. This could be explained by the "shut down" theory.

This theory postulates that if the child is so overstimulated from input that they are sensitive to and cannot avoid this sensation, they can then present with low registration type behaviours, in an attempt to protect, shut down and guard their systems from overstimulation. (25, 26, 36) It would be interesting to interrogate the "poor registration" behaviour further to see if there is a pattern as to when this behaviour is most likely to occur as this could provide evidence for the shut-down theory. However, at present, there is little research on this phenomenon and thus it is difficult to say with certainty exactly when, how and if shut down is occurring.

5.2.2. Factor Scores:

The participant's sensory profile showed that they scored "typical" for the majority of the factor sections ie: there were five categories in which there were above 50% of the participants scoring typical (Sensory Seeking, Oral sensory sensitivity, Poor Registration, Sedentary and Fine Motor/Perceptual). A possible contributing factor for these typical scores could be that the average time spent in occupational therapy was 21 months, and as such, improvements with regard to Sensory Modulation, Endurance and Fine Motor/Perceptual difficulties may already be showing progress. These are areas of difficulty often focused as main aims of treatment during occupational therapy sessions. Further, over 21 months, the children would have progressed and developed from occupational therapy (and other therapy such as physiotherapy, if attending), as well as normal development over a 2 year period, and thus improvements with their endurance and fine motor would be probable.

In addition, there is a strong link between children with poor registration type behaviours, and sedentary activities. Children with poor registration often appear disinterested, and seem overly tired or apathetic. They will often have a slow response to sensory stimuli as compared to others. (27) Thus these children spend a lot of their time in sedentary activities, where little active movement and interaction with their environments is required. It therefore is expected that these two categories would both score typical, as they are so strongly connected.

Three categories had the largest proportion of "definite difference" scores – these were the "emotionally reactive" (42%), "inattention/distractibility" (58%) and "low tone" (75%) categories (see figure 4.1). Only the emotionally reactive score was researched further, as the other two categories were not appropriate to the subject and research topic, as they were not related to the aims of the study and the hypotheses set out to investigate.

The conclusion can therefore be made as corroborated by these results, that children with SMD show increased emotional behaviours which contribute to the "emotionally reactive" factor scores. Further the hypothesis that the current sample with SMD would have elevated "emotionally reactive" factor scores, could therefore be accepted. Increased emotional and behavioural symptoms are expected in children with SMD, as these children often misinterpret their sensory input, resulting in them becoming over-stimulated, resulting in behavioural symptoms and emotional dysregulation.(79)

5.2.3 Section Scores:

There are numerous section scores on the Sensory Profile, relating to modulation, however, only one score identifying the participant's ability to modulate their sensory input was investigated further. This section score was highlighted as it looks at particular sensory input, which effect emotional responses.

The participants' scores indicated dysfunction for the "Modulation of Sensory Input Affecting Emotional Responses" section summary (see figure 4.2). This was expected based on the sample's results for the emotionally reactive factor score. Further, there is literature supporting the increased emotional behaviours in children with SMD. The study by Davies et al (2007) showed that that the behavioural reactions associated with SMD (such as tantrums, avoidant behaviours, or defensive tactile behaviours), might be explained by children with SMD having immature or faulty sensory brain processes. (4) The researchers showed that children with Sensory Processing Disorder (SPD) showed a reduction in amplitudes and thus less sensory gating than the control of children without SPD.(4) This supports the current findings that the sample in the current study would present with definite difference score for being "emotionally reactive," as they have difficulty focusing on only relevant sensory input, as they struggle to inhibit irrelevant stimuli, resulting in more behavioural outbursts.

Upon analysing all the scores indicating dysfunction (i.e: definite difference category), in the "Behavioural and Emotional Reaction" section summaries, the majority of the sample again scored in the definite difference category for the "emotional/social responses" (53%) and "behavioural outcomes of sensory processing" (42%) (See figure 4.3). This indicates that across the participants, the majority where highlighted by their parents as frequently being emotional, as well as displaying certain difficulties with modulating their emotional or behavioural reactions.

The Emotional/Social Responses category includes question items such as the child having "definite (predictable) fears"; "seems anxious"; being "stubborn or uncooperative"; having "poor frustration tolerance"; "cries easily"; "has nightmares" and "has fears that interfere with daily routine."(27) These questions can all be attributed to anxiety directly or symptoms of behaviour associated with anxiety, seen in the child population. (8) Children with ADHD have also been identified to have significant impartments with their Emotional/Social Responses summary section in the Sensory Profile. (33, 94)

Therefore, across the diagnoses of children who typically are described to have SMD symptoms, (1, 12) it is clear that these children, as well as the ones in the current study, present with difficulty when modulating their sensory input, as well as regulating their emotions and associated behaviours. SMD results in children feeling over-whelmed and therefore they struggle to appropriately respond to their sensory stimuli. This results in changes to their emotions, and presents with additional behavioural responses.(7, 9) Accordingly, the null hypothesis that the participants would not have elevated summary scores relating to anxiety and emotions can be rejected.

In conclusion, the discussion of this study has shown that the participants with SMD, presented with SMD and difficulty with modulating their sensory input across all four quadrants in the Sensory Profile. The participants showed the most difficulty with their sensory "avoidant and sensitive" behaviours, (collectively known as sensory over-responsivity). The participants also showed difficulty with "poor registration" behaviours, which was explained by the "shut-down" theory.

In the factor and summary sections, the participants showed difficulty with behaviours relating to emotions and anxiety, which was expected, as children with SMD, often struggle to modulate their sensory Input, often becoming overwhelmed and reacting with behavioural outbursts.

5.3 THE ANXIETY LEVEL OF THE SAMPLE:

Once all the SCAS forms were scored, the participant's total SCAS scores showed that 33% (n =12 of 36) of the participant's scored with elevated anxiety overall (see figure 4.5). This indicates that the majority of the sample did not present with elevated anxiety levels.

With reference to the literature, anxiety levels in the child population are estimated to range from 3-24% in the USA. (44) Local research into the prevalence of anxiety symptoms in South Africa does not indicate an overall rate for anxiety in our child population. However literature has identified Generalised Anxiety Disorder to affect 11% of the child population, and Posttraumatic Stress Disorder to affect 8%. (58) Therefore, although the majority of this study's participants did not score with elevated anxiety levels, 33% is higher that the "typical" South African or USA population. Therefore the research objective to determine whether a group of children with sensory modulation disorder will have elevated anxiety levels, showed that although they don't have elevated anxiety scores overall, when comparing them to normal child population, children with SMD are at higher risk for presenting with anxiety symptoms as a comorbid diagnosis.

A study identifying the anxiety levels among the typical child population showed a prevalence rate of 17-35%, (96) a level similar to the one identified in this study. A study by Muris et al (2002,) identifying South African children's anxiety levels using the SCAS, indicated that anxiety levels were relatively high, as the mean Anxiety total score was 40.1 when using the SCAS. (59) The average of the current participant's SCAS scores was 35.5, indicating that although the average score was lower than the study mentioned, it is still comparable. In contrast to this study, the children in Muris's study were not identified as having SMD but were from a typical population attending mainstream Primary Schools.

Further, comparison of the total SCAS scores of the sample taking anxiety medication (40% scored with elevated anxiety overall, n=5, see figure 4.6), as well as those who attend play-therapy for their anxiety difficulties (44% scored with elevated anxiety overall, n=7, see figure 4.7), showed similar results to that of the total participants. This indicates that these factors did not in fact affect the total results, but that their anxiety levels are slightly higher. This can be expected as this sample was both smaller in number than the total sample (thus could have increased scores), but also these children were identified to have anxiety symptoms and thus could present with elevated anxiety scores for their specific samples.

This information is very relevant, as these children - both the "typical" population in Muris et al's study and the current study, who have been identified with SMD, are all South African children. This can then raise an interesting idea, as possibly the psycho-social environment in which the South African child lives, results in higher anxiety scores, and presenting with increased anxiety levels. Factors such as crime, and therefore associated post-traumatic stress reaction to being involved in a crime based incident can be affecting the psyche of South African children.

This was corroborated by findings that South African children show high levels of posttraumatic stress disorder (58), as a result of the high crime in the country. One interfering factor, however, is that Muris et al's study was performed in the Western Cape, where there is associated gang violence, which is not necessarily experienced by all children in all neighbourhoods in South Africa. In the North-Eastern Suburbs of Gauteng, other factors such as the children's prenatal or comorbid diagnoses, increased television time, as well as suburban factors such as traffic, financial pressure or family relationship stress, are all issues which can add to and influence the child's anxiety levels. This could stem from the children's parent's being more stressed in the busy suburban lifestyles,

which in turn places more stress in the family environment, which can heighten the child's overall anxiety level.

This information is relevant and applicable to the children in the current study, as these children have all got identifiable prenatal and comorbid diagnoses of SMD, and learning disabilities. Further 33% scored as having increased anxiety overall, which could be interpreted as an additional comorbid anxiety diagnosis. Thus occupational therapists need to be aware of the influence of the environment on anxiety and should perhaps inquire more carefully and in depth regarding the experiences of children in therapy.

Further, a later study by Muris et al (2006) identified that parental rearing beliefs were positively associated with anxiety symptoms. Their analysis showed that parents who were anxious and overprotective appeared to be associated with anxiety symptoms in their children. (55) Often, in the South African society, parents are anxious about crime etc. which can result in children perceiving their world as more fearful.

In the current study, the individual SCAS sub-categories of participants who showed elevated anxiety overall (n =12 participants), also showed high scores for the anxiety sub-categories on the SCAS: they scored 83% for separation anxiety, 75% for OCD symptoms and 58% for panic symptoms. These 12 participants scored 42% for generalised anxiety disorder and social phobia; and 66% for fears related to physical injury. In light of the information discussed above relating to anxious and over-protective parenting, it is not surprising that such a large percent of the sample therefore scored with having high anxiety, showed increased separation anxiety and panic symptoms. Children of over-protective parents are often bought up around very anxious parents, and through nurturing they therefore do not only learn about anxiety and worrying from their parents, but they often will then struggled to separate from their parents, which often results in increased panic symptoms.

It is interesting to note, that people with learning disabilities have been found to experience increased levels of psychological distress, including anxiety, possibly owing to their increased rate of exposure to psychosocial disadvantage.(49) This could further explain for the increased portion of social phobia scores obtained in the study.

It is interesting to note, that a similar amount of boys (35% of the boy sample) and girls (30% of the girl sample) of the total sample, showed increased total anxiety scores on the SCAS (see table 4.4) Further it seems that the medication taken by the sample seems to assist with their anxiety

symptoms, as the majority of those participants on medication, (80%) scored with non-indicative anxiety levels on the SCAS. Lastly, the effect that play therapy has on the children attending sessions also seems to assist in decreasing the total SCAS score overall as 43% of those attending play therapy indicated total anxiety overall, whereas 57% had scores indicating no anxiety symptoms overall. Thus it evident that both medication as well as play therapy assist those participants who receive these treatments, in feeling more in control and thus reducing their anxiety symptoms.

It can therefore be concluded that children with SMD are a population which are at higher risk for having comorbid anxiety symptoms. It is therefore of paramount importance for clinicians to be aware of the risk that these children have with developing anxiety symptoms, and to be able to differentiate these from sensitive or avoidant behaviours associated with SMD.

In conclusion, the anxiety level of the sample was 33%. Although the majority of this study's participants did not score with elevated anxiety levels, 33% is higher that the "typical" South African or USA population. Thus, children with SMD are at higher risk for presenting with anxiety symptoms as a comorbid diagnosis.

Reasons for this in the South African context can be attributed to crime, stressful lifestyles, as well as high levels of Post-Traumatic Stress Disorder. Further anxious rearing and overprotection was shown to be unique predictors of anxiety symptoms, and could also be a reason that South African children are showing increased anxiety levels. Results from the sample (although small) indicated that both medication, as well as play therapy may assist children with reducing and controlling their anxiety symptoms.

5.4 THE ASSOCIATION BETWEEN SENSORY MODULATION DISORDER AND ANXIETY:

In order to establish the possible association between SMD and anxiety, the Total SCAS scores of the participants' were compared to different scores from the Sensory Profile - to identify correlations and relationships.

5.4.1 Hypothesis 1: Association between sensory over-responsivity and anxiety scores:

The seminal hypothesis of this study was to investigate a definite association between the total anxiety SCAS scores and the sensory over-responsive (low threshold) quadrants on the Sensory Profile, being "Sensory Avoidance" and "Sensory Sensitivity". This hypothesis is strengthened by

research showing a significant positive relationship between sensory over-responsiveness (hyper-sensitivity) and anxiety in children. (12, 60, 75-77) Sensory over-responsivity is believed to be an inherent characteristic of SMD (27) and children with sensory processing difficulties have proven differences on a neurological level (through neuroimaging methods) than those with no difficulties. (4)

The findings of this study indicated that anxiety and sensory over-responsivity overall were not fully associated. Upon closer examination of the results, it is evident that there was only a positive association with anxiety scores and participants who showed sensory avoidance behaviours as compared to the sensory sensitivity behaviours (see figures 4.13 and 4.14).

As such, it can therefore be concluded that SMD behaviours and anxiety symptoms cannot be one and the same. That means that although children with both SMD (sensory over-responsivity) and anxiety perceive their world as threatening, and although they often struggle to adapt to the changing environment as they perceive it as unpredictable and overwhelming,(15) these two disorders are not one. Further, as the scales used in the study could not be correlated significantly, it shows that they are being used to identify and measure two differing constructs and disorders.

When looking at the behaviours identified by parents when completing the SP, it is clear that the questions relating to emotion and behaviour are very clear and precise. An example of this can be the questions in the Emotional/Social Response section where parents are asked directly the frequency at which their child experiences the following emotions: “Is sensitive to criticism; has definite fears, seems anxious; displays excessive emotional outbursts when unsuccessful at a task; is stubborn or uncooperative; has temper tantrums, has poor frustration tolerance, cries easily.”(27) However, the questions in the SCAS are not as direct, as it is a child-report questionnaire and thus they are firstly worded in a more child friendly manner, but also rather discuss physical symptoms that the child can relate too e.g: “I worry about things, I feel afraid or when I have a problem my heart beats very fast.”(5) Therefore, although both tests ask similar questions in the same manner, they both are successful in collecting appropriate and similar information regarding emotions and behaviours associated with these.

The strength of the Sensory Profile tool is that there are questions that directly identify and are related to both anxiety and emotions. However, these questions are scored into both the greater factor and modulation sections(27), which often provides similar results. A shortcoming of the tool is that a child with behavioural difficulties, often present with sensory avoiding difficulties, as the

tool includes the emotional questions in this Sensory Avoidant quadrant score. It would be more beneficial to clinicians if the tool provided the emotional difficulties as a separate factor score, leaving the avoidant quadrant score to be calculated on pure sensory system questions, so that anxiety and sensory avoidant behaviour can be clearly differentiated. Thus, although the current tool provides some indication of the emotional behaviours common with SMD, the results are not as clear as in the SCAS where the child either has increased or decreased anxiety, based on a specific threshold.

Both the SP and the SCAS are very useful assessment tools, providing accurate scores for both SMD and anxiety. The difficulty however arises, as it is difficult to discern whether the behaviour and emotion discussed and scored in the SP Emotional/Social Response section are as a result of SMD over-responsivity difficulties or can be true anxiety diagnostic symptoms. Thus, it is vital that occupational therapists use the anxiety screening tools, as well as collateral information and objective observable behaviours during the assessment, in conjunction with the SMD screening tools, to decipher whether the anxiety behaviours observed are as a result of SMD over-responsivity and over-arousal, or are true anxiety symptoms.

Whilst reviewing the literature, it is immediately evident that relevant research already performed, has only investigated sensory over-responsiveness as a whole (ie: including both sensory sensitive and avoidant behaviours and scores).A study by Pfeiffer, Kinnesley, Reed and Herzberg (2005) showed a positive relationship between sensory over-responsivity (hyper-sensitivity) and anxiety in a population of children and adolescents with Asperger's disorder.(60) Their study found relationships for both components of sensory over-responsivity – sensory sensitive (r=.443, p = .001) and sensory avoidance (r=.467, p =.001).(60) Further, a study by Lidstone, Uljarevic, Sullivan et al. (2014) also showed a positive relationship between anxiety (using the SCAS) and quadrant scores on the Sensory Profile. (81) Their scores indicated correlations of anxiety and sensory sensitivity (r=.61, p =.01) and avoidance (r=.71, p =.01), again indicating a strong association between sensory over-responsivity and anxiety overall when looking at their sample who had Autistic Spectrum Disorders. (81)

This finding rings true, as children with Autistic Spectrum Disorders children have been described to have inherent SMD difficulties, as well as very high levels of anxiety. (2, 12)

Results of the current study showed weaker correlations and relationships between anxiety and sensory sensitive scores (r= -0.20; p <0.05) (figure 4.7) as well as sensory avoidance (r= -0.38; p

<0.05) (figure 4.8) scores. The reason for the lower correlations could be ascribed to the small sample size; or the current sample only being identified by SMD, as opposed to having comorbid diagnoses as mentioned above. When performing the study, the researcher did not identify or attain significance to the comorbid diagnoses of the sample. Thus it is unclear, what attribution the results have to the diagnoses of the sample. Possibly if the sample had SMD and comorbid Autistic Spectrum Disorders, the results may have been different.

Nevertheless, according to Dunn, sensory-sensitivity and sensory-avoidance are conversely related concepts which both fall under the broader "low-threshold" category.(27) That means, that children with sensory sensitivities will respond *passively* to low-sensory thresholds while children who avoid certain stimuli are responding *actively* to the same low-sensory thresholds by avoiding these. Therefore, although only "sensory avoidance" scores showed a positive relationship to anxiety scores, the results can still be considered indicative of sensory over-responsivity symptoms in general.

Due to the overlapping symptoms associated with both anxiety and SMD, one has to wonder about the mutual relationship between the two constructs. The participants in this study all presented with SMD and their scores for sensory over-responsivity were high (as indicated by the quadrant scores on the Sensory Profile). Seeing that this sample has been identified at risk for anxiety symptoms, the sensory over-responsivity could be hypothesised as exacerbating or pre-determining the anxiety symptoms, or vice versa.

Research which supports this hypothesis was performed by Green, Ben-Sasson, Soto and Carter (2012), who collectively proved that sensory over-responsivity predicts the development of anxiety in children with Autistic Spectrum Disorder.(79) This was to verify an earlier hypothesis identified in their research (12), whether anxiety is a predictor of sensory over-responsivity or vice versa.

They proved that anxiety did not predict changes in sensory over-responsivity or SMD difficulties in the toddlers participating in the study. However, sensory over-responsivity was shown to emerge earlier in childhood than anxiety. Their study revealed sensory over-responsivity scores staying stable over time, with an increase in anxiety symptoms. The results indicated that sensory over-responsivity predicted increases in anxiety symptoms or that it was shown to exacerbate a predisposition for the disorder. (79) This research forms the bedrock for the current study as it verifies that children with sensory over-responsivity are at risk for comorbid anxiety disorders. Thus the fact that the majority of the participants scored definite difference for their "sensitive" and

“avoidant” quadrant scores (see figure 4.4) indicating sensory over-responsivity, and although only “avoidant” quadrant scores were moderately associated with total anxiety scores, children with sensory over-responsivity have been proven to be an at risk population for developing anxiety disorders.

As there is now evidence that the two constructs are related and that SMD can predict future anxiety disorders, the relationship between SMD and anxiety is on a neurological level must be significant. As occupational therapists don’t usually perform research using neuro-imaging it can only be hypothesised that both these conditions could stem from a common neuro-pathology. Literature showed that SMD and anxiety have common neural associations such as amygdala abnormalities, (12, 41, 69) or activation of the same pathways in the hypothalamus, amygdala, and reticular formation (50, 71), or insula (41). This theory was in fact proven by research performed by Green et al. (2012) as they showed that sensory over-responsivity symptoms are an earlier manifestation of this central nervous system pathology, while anxiety symptoms manifest later. (79) This indicates that even from an anatomical level, the SMD over-responsivity behaviours are apparent earlier on in life, such as in the current study, and can be a predictor for future manifestations of anxiety symptoms. Further this shows that sensory over-responsivity behaviours and anxiety symptoms are related.

Due to the evidence of the relationship between SMD and anxiety, courtesy of many researchers, it is vital that parents with children who have either diagnosis (but especially those with SMD/sensory over-responsivity) are educated in the preventative interventions and symptoms of anxiety. A child with SMD diagnosis alone struggles to appropriately participate in their daily occupations and activities like their peers.(10) Comorbid SMD and anxiety diagnoses will cause even greater deficits. It is therefore important for clinicians to be aware of this, to provide dual and effective treatment for both SMD and anxiety.

There is no evidence-based effective treatment approach for both SMD and anxiety; however calming-alerting sensory treatments such as deep pressure-proprioceptive input or other sensory regulating input may also reduce anxiety. (60, 79) Further, the data from this study showed that those children receiving play therapy, as well as those on medication for their anxiety symptoms, seem to have reacted positively to these treatment intervention, as the majority in both cases scored as having no anxiety symptoms overall (see table 4.4).

As occupational therapists treat children with both sensory over-responsivity and anxiety, it would be interesting to note and study the effectiveness of decreasing anxiety symptoms with sensory-based treatment intervention, possibly in addition to or before providing children with anxiety medication. Parents often struggle to decide whether medications are necessary to treat anxiety disorders and if the side effects outweigh the benefits. If proven to be beneficial, sensory-integration therapy may provide the parents with an alternate option, when deciding on the most effective treatment approach for their children with anxiety disorders.

In summary, when describing the hypotheses of the study, sensory over-responsivity was shown to be partly associated to anxiety overall. This was true, as only the participant's "avoidant" but not "sensitive" quadrant scores could be associated to total SCAS scores. Thus this proved that SMD behaviours and anxiety symptoms cannot be one and the same. Further, as the scales used in the study could not be correlated significantly, it shows that they are being used to identify and measure two differing constructs and disorders.

However it was discussed how the two sensory "avoidant" and "sensitive" constructs are converse but related concepts, and thus it was concluded that overall the sample's sensory over-responsivity scores were weakly associated to their total SCAS anxiety scores. The reasons for the lower correlations could be ascribed to the small sample size; or the current sample only being identified by SMD, as opposed to having comorbid diagnoses.

Previous literature substantiated this association as proved in this study. Previous studies with children of similar ages, who were identified with sensory over-responsivity difficulties, were shown to have higher levels of anxiety. Further one study proved that the toddler's in their study showed stable sensory over-responsivity and SMD behaviours over a year period, but increased anxiety levels. They concluded that a child with SMD/sensory over-responsivity is at risk for possibly anxiety diagnoses in the future. These studies verify that the finding of the current study must be true, and that children with SMD/sensory over-responsivity must be monitored for possible anxiety symptoms.

5.4.2 Hypothesis 3: Association between scores on the Sensory Profile which relate to emotions and the total SCAS scores for the participants:

In order to identify if there was an association between the participant's scores related to emotional/behaviours on the sensory profile and anxiety, certain factor and section scores on the Sensory Profile were correlated with Total SCAS scores.

The “Emotionally Reactive” factor on the Sensory Profile and Total SCAS correlation showed a moderate, significant correlation and association been the constructs. (See figure 4.9). Further the “Emotional/Social Responses” section score also showed a moderate, significant correlation and association when correlated with the Total SCAS scores. (See figure 4.13). This was the only sub-section in the sensory profile that was proven to correlate to SCAS total scores. Therefore these two scores were shown to have a moderate association when comparing these behaviours to anxiety scores overall.

It must be noted that both the “Emotionally Reactive” factor scores, and “Emotional/Social Responses” section use very similar, and sometimes overlapping raw data to form the total scores,(27) and therefore these associations can be viewed as one and the same. The types of questions that are included in these sections are related to anxiety and emotions overall. Examples of the questions include “Is sensitive to criticism; has definite fears, seems anxious; displays excessive emotional outbursts when unsuccessful at a task; is stubborn or uncooperative; has temper tantrums, has poor frustration tolerance, cries easily.”(27) Similar questions are asked in the SCAS, relating to the fears and worries of the participant. However, the participant’s behavioural reactions are not identified in the SCAS.

When a child has SMD, and particularly sensory over-responsivity, they often present with symptoms of avoidance, aggression and anxiety which may affect their psychological well-being. (67) This is true, as the sensory modulation disorder, results in the child struggling to maintain a developmentally appropriate response to their sensory stimuli, resulting in changes to their emotions, attention or concentration and thus they have additional behavioural responses.(7, 9, 18) This does however show that the data from the Sensory Profile summary showing increased emotional behaviours has been shown to be associated to overall higher anxiety scores on the SCAS Scale. Thus, the behaviours associated with both SMD and anxiety, have been shown to be associated, as predicted in the hypotheses.

Possibly, as SMD is a predictor for later anxiety disorders, and as the study sample were identified to be at a higher risk for anxiety symptoms, the Sensory Profile factor and section scores can be an important tool for clinicians to use in therapy. Simply, children with SMD who score as having increased emotional reactions (ie: definite difference scores) for both the factor and section scores described here on the Sensory Profile, should be monitored for difficulties and symptoms associated with anxiety symptoms.

In summary the hypothesis showing a positive relationship between the factor and summary scores on the Sensory Profile relating to emotions and anxiety was also proven to be moderately associated. This confirms that clients who score with difficulty on these certain sections must also be monitored for possible anxiety symptoms.

It must be noted that variables such as medication, as well as time spent in play therapy did not affect the participant's scores with regard to their SP quadrant scores, total anxiety SCAS scores or even their sub-category SCAS scores (see section 4.3.2), as they were similar overall to those of the total sample. Although these variables were not controlled, when comparing the results of the participants with elevated anxiety to that of the total sample, they don't seem to have affected the overall results of the study.

5.5 LIMITATIONS OF THIS STUDY

The first limitation of the study was the sample size. A convenient sample was used, as only children who had SMD were invited to participate in the study. During the formulation and proposal of this study, the study sample for this research was set out to include a sample size of 70 children. In actuality only 36 children were approved to be included in the study, as some of the forms were incomplete and far fewer families were in fact willing to participate. Further the sample only represented one region (Johannesburg) and only children with SMD who were attending occupational therapy were included.

The second limitation was that the researcher did not evaluate the presence, or absence, of comorbid disorders other than SMD. However, the study wanted to determine the association between anxiety and SMD, irrespective of co-morbid diagnoses. As the literature shows, children with SMD regularly present with other diagnoses too.(33, 34, 38, 39) The percent of this sample that might have comorbid autistic spectrum disorder or attention deficit hyperactivity disorder was not taken into account or asked for directly during data collection.

Lastly, the tools used in the study to quantify SMD – were parents report tools. Most of the tools available and in use to screen SMD in children are parent-report tools,(17) which rely on secondary information based on the child's behaviour. Although no research to date has examined differences in child versus parent perception of SMD, researchers have indicated that the association between these two perception of behaviour is weak, particularly for behaviours that are difficult to witness.(87) Self-report questionnaires which directly involve the child's perception, will become

invaluable in identifying a more comprehensive understanding of the child's own perception of SMD.

CONCLUSION:

This study set out to identify the relationship between observable sensory modulation difficulties, and anxiety symptoms in the school going child population. The objectives of the research aimed to understand the sensory modulation difficulties of the sample as a whole, to determine whether a group of children with SMD showed have elevated anxiety levels, and finally to explore the association between self-reported anxiety and specific SMD patterns – relating to sensory over-responsivity.

In conclusion, this study has shown that the majority of participants with Sensory Modulation Disorder (SMD) presented with behaviours indicating difficulty with poor registration, as well as the majority showing over-responsivity to sensory symptoms, being that of avoidance and sensitivity to sensory inputs. It was not expected that the sample would show difficulty with poor registration, and it was postulated that the high percentage of children presenting with low-registration symptoms could be resultant from increased bombardment of the sensory system (due to sensory avoidance or sensitivity). As a result of this increased sensory input, and the sample's poor sensory modulation, they therefore present with low registration type behaviours, in an attempt to shut down and protect their systems from further overstimulation.

Further, the quadrant scores proved that the children with SMD in the study were identified by their parents as having difficulty with modulating their sensory input. The sample also showed increased emotional and behaviours problems, as identified on certain factor, and section scores in the Sensory Profile.

The study sample were identified to be "at risk" for developing anxiety symptoms later in life, as 33% of the sample self-reported anxiety symptoms on the SCAS, a rate higher than that of the normal population. Therefore, children identified as having SMD are an "at risk" population who should be monitored for future symptoms relating to anxiety. Additionally, the data showed that those children receiving play therapy, as well as those on medication for their anxiety symptoms, seem to reacting positively to these treatment intervention, as the majority in both cases scored as having no anxiety symptoms overall.

As set out in the objectives and hypotheses of the study, Sensory profile scores relating to emotional reactions and behaviours on the Sensory Profile were moderately correlated with total anxiety scores, and thus the hypotheses could be accepted. This means that children who showed difficulty with modulating their sensory inputs, resulting in increased emotional behaviours; could be at risk for presenting with anxiety symptoms.

Additionally, the hypothesis that there will be an association between the sample's total Anxiety scores and their sensory over-responsivity scores was partially accepted. The two constructs of sensory over-responsivity (avoidance and sensitive quadrant on the Sensory Profile) and anxiety were correlated and results showed that only "avoidance" symptoms could be correlated with total anxiety scores. However, this proved that SMD and anxiety must be two differing disorders, which only share overlapping symptoms. However, the distinction between the two was still unclear. Thus, through the use of research, it was shown how behaviours identified with sensory over-responsivity in children, can predict future anxiety disorders. Further it was theorised in the literature that sensory over-responsivity can even exacerbate a predisposition for anxiety in the child. Thus, it is vital for clinicians to be aware of this, to recognise anxiety symptoms in their clients and to educate parents to identify the signs and symptoms of anxiety disorders in their children.

6.1 IMPLICATION FOR CLINICAL PRACTICE:

The results of the study have important implications for clinicians in occupational therapy practice. It behoves clinicians to educate teachers about the ramifications of the child having SMD (sensory over-responsivity) and anxiety in the class situation:

In the discussion, children with SMD/sensory over-responsivity have been identified to be at risk for having comorbid anxiety symptoms or diagnoses.(79) Anxiety or emotional behaviours may be exacerbated by bothersome or unexpected sensory input experienced by the child.(12) It is therefore imperative for clinicians and teachers to be cognisant of this fact when dealing with children with these difficulties. These children may require additional time to calm down and refocus. They may also require additional sensory calming or organising input from the teacher (26) before achieving appropriate activity levels in the class or therapy situation.

It is well worth remembering that sensory over-responsivity affects a child's performance and attention levels, as Dove and Dunn (2008) explained that each sensory response pattern affects the child's learning. (34) The sensory avoidant pattern result in the child avoiding or showing an

aversion to sensory input, thereby presenting with symptoms of being easily disturbed by noise, visual or tactile stimulations. Sensory sensitivity results in the child responding too quickly to input thereby getting distracted, not completing work tasks or being distracted by stimuli in the environment.(17, 33-35) Children in the study with SMD were identified by their parents to be more emotional and show more behaviours linked to emotion. It is essential for clinicians and teachers to be aware of the affect SMD has on learning, and to treat the children with sensitivity to prevent increased emotional outbursts, anxiety or poor self-esteem in the classroom and OT sessions.

Studies such as this one provide clinicians with further evidence to help validate and explain to parents the intricate relationship which SMD (sensory over-responsivity) and anxiety have in the child population. Researchers have discussed the difficulty in differentiating between anxiety and sensory over-responsivity based on behaviour, (12, 13) as they are characterised by similar behavioural sections. As already discussed, sensory over-responsivity can be a predictor for future anxiety problems (79) and thus it is imperative that parents with children with SMD are being educated about the signs and symptoms of anxiety, (56, 57) to prevent future disorders.

Further, SMD has been proven to affect the child's engagement, satisfaction and thus participation in age appropriate life activities. (10) It is vital that parents understand this to ensure that their children are able to participate with adequate motivation and perform all activities expected of them. Additionally an anxiety diagnosis will only hinder the child's participation in daily activities, and often when the child starts to struggle to perform their daily routines optimally, this can be an indication for parents that something is hindering their child.

6.2 IMPLICATIONS FOR FUTURE RESEARCH:

Results from the study showing SMD over-responsivity (avoidance type behaviours) to correlate to anxiety symptoms, corroborated by research showing that sensory over-responsivity could be used to pre-determine anxiety symptoms, has interesting consequences for future research. It would be valuable through the use of longitudinal studies, to be able to track and re-assess the current participant's anxiety scores in a few years' time. This would allow the researcher to verify if in fact SMD behaviours identified in childhood could predict anxiety symptoms later on in adolescence.

The results of the study support the need for the development of measurement tools focussing on the relationship between anxiety and SMD. Occupational therapists are trained to treat and improve a child's participation in all areas of their development. Further, occupational therapists

have been identified as the clinicians who can treat both SMD and anxiety disorders, as they both affect optimal performance in daily life activities. (60) Tools which not only measure SMD, but also symptoms of anxiety will help clinicians to measure improvements and changes as a result of the occupational therapy interventions and to guide future aims and goals for treatment.

The results also identify the need for clinicians to implement correct treatment approaches, for both SMD and anxiety disorder.(19, 66) It is important that when the child who has SMD and anxiety symptoms is being assessed, that the clinicians bears in mind the possible relationship between anxiety disorders and sensory modulation and implements correct treatment procedures.

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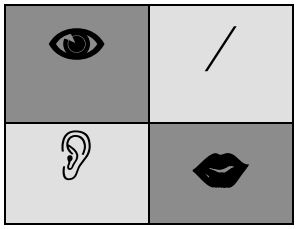
APPENDICES

Appendix A: SENSORY PROFILE



SENSORY PROFILE

Winnie Dunn, PhD. OTR, FAOTA

CAREGIVER QUESTIONNAIRE

CODE:

INSTRUCTIONS

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

Use the following key to mark your responses:

Always	When presented with the opportunity, your child always responds in this manner, 100% of the time.
Frequently	When presented with the opportunity, your child frequently responds in this manner, about 75% of the time.
Occasionally	When presented with the opportunity, your child occasionally responds in this manner, about 50% of the time.
Seldom	When presented with the opportunity, your child seldom responds in this manner, about 25% of the time.
Never	When presented with the opportunity, your child never responds in this manner, 0% of the time.

ITEM			A. AUDITORY PROCESSING	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
👂	L	1	Responds negatively to unexpected or loud noises (for example, cries or hides at noise from vacuum cleaner, dog barking, hair dryer)					
👂	L	2	Holds hands over ears to protect ears from sound					
👂	L	3	Has trouble completing tasks when the radio is on					
👂	L	4	Is distracted or has trouble functioning if there is a lot of noise around					
👂	L	5	Can't work with background noise (for example, fan, refrigerator)					
👂	H	6	Appears to not hear what you say (for example, does not "tune-in" to what you say, appears to ignore you)					
👂	H	7	Doesn't respond when name is called but you know the child's hearing is OK					
👂	H	8	Enjoys strange noises/seeks to make noise for noise's sake					
			Section Raw Score Total					

ITEM			B. VISUAL PROCESSING	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
👁	L	9	Prefers to be in the dark					
👁	L	10	Expresses discomfort with or avoids bright lights (for example, hides from sunlight through window in car)					
👁	L	11	Happy to be in the dark					
👁	L	12	Becomes frustrated when trying to find objects in competing backgrounds (for example, a cluttered drawer)					
👁	L	13	Has difficulty putting puzzles together (as compared to same age children)					
👁	L	14	Is bothered by bright lights after others have adapted to the light					
👁	L	15	Covers eyes or squints to protect eyes from light					
👁	H	16	Looks carefully or intensely at objects/people (for example, stares)					
👁	H	17	Has a hard time finding objects in competing backgrounds (for example, shoes in a messy room, favourite toy in the "junk drawer")					
			Section Raw Score Total					

ITEM			C. VESTIBULAR PROCESSING	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
→	L	18	Becomes anxious or distressed when feet leave the ground					
→	L	19	Dislikes activities where head is upside down (for example, somersaults, roughhousing)					
→	L	20	Avoids playground equipment or moving toys (for example, swing set, merry-go-round)					
→	L	21	Dislikes riding in a car					
→	L	22	Holds head upright, even when bending over or leaning (for example, maintains a rigid position/posture during activity)					
→	L	23	Becomes disoriented after bending over sink or table (for example, falls or gets dizzy)					
→	H	24	Seeks all kinds of movement and this interferes with daily routines (for example, can't sit still, fidgets)					
→	H	25	Seeks out all kinds of movement activities (for example, being whirled by adult, merry-go-rounds, playground equipment, moving toys)					
→	H	26	Twirls/spins self frequently throughout the day (for example, likes dizzy feeling)					
→	H	27	Rocks unconsciously (for example, while watching TV)					
→	H	28	Rocks in desk/chair/on floor					
			Section Raw Score Total					

ITEM			D. TOUCH PROCESSING	*ALWAYS*	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
	L	29	Avoids getting "messy" (for example, in paste, sand, finger paint, glue, tape)					
	L	30	Expresses distress during grooming (for example, fights or cries during haircutting, face washing, fingernail cutting)					
	L	31	Prefers long-sleeved clothing when it is warm or short sleeves when it is cold					
	L	32	Expresses discomfort at dental work or tooth brushing (for example, cries or fights)					
	L	33	Is sensitive to certain fabrics (for example, is particular about certain clothes or bed sheets)					
	L	34	Becomes irritated by shoes or socks					
	L	35	Avoids going barefoot, especially in sand or grass					
	L	36	Reacts emotionally or aggressively to touch					
	L	37	Withdraws from splashing water					
	L	38	Has difficulty standing in line or close to other people					
	L	39	Rubs or scratches out a spot that has been touched					
	H	40	Touches people and objects to the point of irritating others					
	H	41	Displays unusual need for touching certain toys, surfaces, or textures (for example, constantly touching objects)					
	H	42	Decreased awareness of pain and temperature					
	H	43	Doesn't seem to notice when someone touches arm or back (for example, unaware)					
	H	44	Avoids wearing shoes; love to be barefoot					
	H	45	Touches people and objects					
	H	46	Doesn't seem to notice when face or hands are messy					
			Section Raw Score Total					

ITEM			E. MULTI-SENSORY PROCESSING	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		47	Gets lost easily (even in familiar places)					
		48	Has difficulty paying attention					
	L	49	Looks away from tasks to notice all actions in the room					
	H	50	Seems oblivious within an active environment (for example, unaware of activity)					
	H	51	Hangs on people, furniture, or objects even in familiar situations					
	H	52	Walks on toes					
	H	53	Leaves clothing twisted on body					
			Section Raw Score Total					

ITEM			F. ORAL SENSORY PROCESSING	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
	L	54	Gags easily with food textures or food utensils in mouth					
	L	55	Avoids certain tastes or food smells that are typically part of children's diets					
	L	56	Will only eat certain tastes (list:_____)					
	L	57	Limits self to particular food textures/temperatures (list: _____)					
	L	58	Picky eater, especially regarding food textures					
	H	59	Routinely smells non-food objects					
	H	60	Shows strong preference for certain smells (list: _____)					
	H	61	Shows strong preference for certain tastes (list: _____)					
	H	62	Craves certain foods					

			(list: _____)					
	H	63	Seeks out certain tastes or smells (list: _____)					
	H	64	Chews or licks on non-food objects					
	H	65	Mouths objects (for example, pencil, hands)					
			Section Raw Score Total					

MODULATION								
ITEM			G. SENSORY PROCESSING RELATED TO TONE/ ENDURANCE	**ALWAYS**	**FREQUENTLY**	**OCCASIONALLY**	**SELDOM**	**NEVER**
		66	Moves stiffly					
	H	67	Tires easily, especially when standing or holding particular body position					
	H	68	Locks joints (for example, elbows, knees) for stability					
	H	69	Seems to have weak muscles					
	H	70	Has a weak grasp					
	H	71	Can't lift heavy objects (for example, weak in comparison to same age children)					
	H	72	Props to support self (even during activity)					
→	H	73	Poor endurance/tires easily					
→	H	74	Appears lethargic (for example, has no energy, is sluggish)					
			Section Raw Score Total					

ITEM			H. MODULATION RELATED TO BODY POSITION AND MOVEMENT	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
⁄		75	Seems accident-prone					
👁		76	Hesitates going up or down curbs or steps (for example, is cautious, stops before moving)					
➜	L	77	Fears falling or heights					
➜	L	78	Avoids climbing/jumping or avoids bumpy/uneven ground					
➜	L	79	Holds onto walls or banisters (for example, clings)					
➜	H	80	Takes excessive risks during play (for example, climbs high into a tree, jumps off tall furniture)					
➜	H	81	Takes movement or climbing risks during play that compromise personal safety					
➜	H	82	Turns whole body to look at you					
🧍	H	83	Seeks opportunities to fall without regard to personal safety					
🧍	H	84	Appears to enjoy falling					
			Section Raw Score Total					

ITEM			I. MODULATION OF MOVEMENT AFFECTING ACTIVITY LEVEL	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
🔄	L	85	Spends most of the day in sedentary play (for example, does quiet things)					
🔄	L	86	Prefers quiet, sedentary play (for example, watching TV, books, computers					
➜	L	87	Seeks sedentary play options					
➜	L	88	Prefers sedentary activities					
➜	H	89	Becomes overly excitable during movement activity					
🔄	H	90	"On the go"					
🔄	H	91	Avoids quiet play activities					

			Section Raw Score Total					
ITEM			J. MODULATION OF SENSORY INPUT AFFECTING EMOTIONAL RESPONSES	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
/		92	Needs more protection from life than other children (for example, defenceless physically or emotionally)					
	L	93	Rigid rituals in personal hygiene					
/	H	94	Is overly affectionate with others					
/	H	95	Doesn't perceive body language or facial expressions (for example, unable to interpret)					
			Section Raw Score Total					

ITEM			K. MODULATION OF VISUAL INPUT AFFECTING EMOTIONAL RESPONSES AND ACTIVITY LEVEL	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
	L	96	Avoids eye contact					
	H	97	Stares intensively at objects or people					
	H	98	Watches everyone when they move around the room					
	H	99	Doesn't notice when people come into the room					
			Section Raw Score Total					

BEHAVIOUR AND EMOTIONAL RESPONSE								
ITEM			L. EMOTIONAL / SOCIAL RESPONSES	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
/		100	Seems to have difficulty liking self (for example, low self-esteem)					
/		101	Has trouble "growing up" (for example, reacts immaturely to situations)					
/		102	Is sensitive to criticisms					
/		103	Has definite fears (for example, fears are predictable)					
/		104	Seems anxious					
/		105	Displays excessive emotional outbursts when unsuccessful at a task					
/		106	Expresses feeling like a failure					
/		107	Is stubborn or uncooperative					
/		108	Has temper tantrums					
/		109	Poor frustration tolerance					
/		110	Cries easily					
/		111	Overly serious					
/		112	Has difficulty making friends (for example, does not interact or participate in group play)					
/		113	Has nightmares					
/		114	Has fears that interfere with daily routine					
/		115	Doesn't have a sense of humour					
/		116	Doesn't express emotions					
			Section Raw Score Total					

ITEM			M. BEHAVIOURAL OUTCOMES OF SENSORY PROCESSING	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		117	Talks self through tasks					
		118	Writing is illegible					
		119	Has trouble staying between the lines when colouring or when writing					
/		120	Uses inefficient ways of doing things (for example, wastes time, moves slowly, does things a harder way than is needed)					
/	L	121	Has difficulty tolerating changes in plans and expectations					
/	L	122	Has difficulty tolerating changes in routines					
			Section Raw Score Total					

ITEM			N. ITEMS INDICATING THRESHOLDS FOR RESPONSE	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		123	Jumps from one activity to another so that it interferes with play					
	H	124	Deliberately smells objects					
	H	125	Does not seem to smell strong odours					
			Section Raw Score Total					

ICON KEY	
	Auditory
	Visual
	Activity Level
	Taste/Smell
	Body Position
	Movement
	Touch

THRESHOLD KEY	
	Neither low nor high
L	Low
H	High

SCORE KEY	
1	Always
2	Frequently
3	Occasionally
4	Seldom
5	Never

Appendix B: SPENCE CHILDREN'S ANXIETY SCALE

SPENCE CHILDREN'S ANXIETY SCALE

Your Name: _____ **Date:** _____

PLEASE PUT A CIRCLE AROUND THE WORD THAT SHOWS HOW OFTEN EACH OF THESE THINGS HAPPEN TO YOU. THERE ARE NO RIGHT OR WRONG ANSWERS.

1.	I worry about things	Never	Sometimes	Often	Always
2.	I am scared of the dark	Never	Sometimes	Often	Always
3.	When I have a problem, I get a funny feeling in my stomach	Never	Sometimes	Often	Always
4.	I feel afraid	Never	Sometimes	Often	Always
5.	I would feel afraid of being on my own at home	Never	Sometimes	Often	Always
6.	I feel scared when I have to take a test	Never	Sometimes	Often	Always
7.	I feel afraid if I have to use public toilets or bathrooms	Never	Sometimes	Often	Always
8.	I worry about being away from my parents	Never	Sometimes	Often	Always
9.	I feel afraid that I will make a fool of myself in front of people	Never	Sometimes	Often	Always
10.	I worry that I will do badly at my school work	Never	Sometimes	Often	Always
11.	I am popular amongst other kids my own age	Never	Sometimes	Often	Always
12.	I worry that something awful will happen to someone in my family	Never	Sometimes	Often	Always
13.	I suddenly feel as if I can't breathe when there is no reason for this	Never	Sometimes	Often	Always
14.	I have to keep checking that I have done things right (like the switch is off, or the door is locked)	Never	Sometimes	Often	Always
15.	I feel scared if I have to sleep on my own	Never	Sometimes	Often	Always
16.	I have trouble going to school in the mornings because I feel nervous or afraid	Never	Sometimes	Often	Always
17.	I am good at sports	Never	Sometimes	Often	Always
18.	I am scared of dogs	Never	Sometimes	Often	Always
19.	I can't seem to get bad or silly thoughts out of my head	Never	Sometimes	Often	Always
20.	When I have a problem, my heart beats really fast	Never	Sometimes	Often	Always
21.	I suddenly start to tremble or shake when there is no reason for this	Never	Sometimes	Often	Always
22.	I worry that something bad will happen to me	Never	Sometimes	Often	Always
23.	I am scared of going to the doctors or dentists	Never	Sometimes	Often	Always
24.	When I have a problem, I feel shaky	Never	Sometimes	Often	Always
25.	I am scared of being in high places or lifts (elevators)	Never	Sometimes	Often	Always

26.	I am a good person.....	Never	Sometimes	Often	Always
27.	I have to think of special thoughts to stop bad things from happening (like numbers or words).....	Never	Sometimes	Often	Always
28	I feel scared if I have to travel in the car, or on a Bus or a train.....	Never	Sometimes	Often	Always
29.	I worry what other people think of me.....	Never	Sometimes	Often	Always
30.	I am afraid of being in crowded places (like shopping centres, the movies, buses, busy playgrounds).....	Never	Sometimes	Often	Always
31.	I feel happy.....	Never	Sometimes	Often	Always
32.	All of a sudden I feel really scared for no reason at all.....	Never	Sometimes	Often	Always
33.	I am scared of insects or spiders.....	Never	Sometimes	Often	Always
34.	I suddenly become dizzy or faint when there is no reason for this.....	Never	Sometimes	Often	Always
35.	I feel afraid if I have to talk in front of my class.....	Never	Sometimes	Often	Always
36.	My heart suddenly starts to beat too quickly for no reason.....	Never	Sometimes	Often	Always
37.	I worry that I will suddenly get a scared feeling when there is nothing to be afraid of.....	Never	Sometimes	Often	Always
38.	I like myself.....	Never	Sometimes	Often	Always
39.	I am afraid of being in small closed places, like tunnels or small rooms.	Never	Sometimes	Often	Always
40.	I have to do some things over and over again (like washing my hands, cleaning or putting things in a certain order).....	Never	Sometimes	Often	Always
41.	I get bothered by bad or silly thoughts or pictures in my mind.....	Never	Sometimes	Often	Always
42.	I have to do some things in just the right way to stop bad things happening.....	Never	Sometimes	Often	Always
44.	I would feel scared if I had to stay away from home overnight.....	Never	Sometimes	Often	Always
45.	Is there something else that you are really afraid of?.....	YES	NO		
	Please write down what it is_____				
	_____				
	_____				
	How often are you afraid of this thing?.....	Never	Sometimes	Often	Always

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Appendix C: PERMISSION LETTER – CONSENT FORM SCHOOL / OT

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

The Principal and OT Department

..... School

.....

.....

.....

Dear Sirs/ Madams

My name is Michal Tauby. I am a Masters student from the Occupational Therapy Department of the University of Witwatersrand. I am investigating the association between sensory deficits and anxiety symptoms in children aged 8 - 10 years old. I would be most grateful if you would participate in this study.

Sensory modulation difficulties (SMD), (an inability to regulate sensory input and filter out extraneous sensations) and anxiety symptoms are often noticed in a classroom environment by teachers or by Occupational Therapists during therapy. They are cognisant that these anxiety symptoms can be related to deficits in sensory modulation in various different sensory modalities like tactile, auditory, visual or vestibular processing. However, there is very limited research and consequent poor understanding of exactly which symptoms related to anxiety, are associated with SMD. Therefore therapists and other professionals may misinterpret anxiety symptoms as being related to SMD and the child may be presenting with an actual anxiety disorder. These children may require medication or additional therapy and assistance and they may never receive this.

I wish to establish if there is an association between sensory modulation and anxiety symptoms in school going children who are attending Occupational Therapy. To do this each child will be assessed by their parents using the Sensory Profile. Permission

Occupational Therapy

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for the study will be obtained from the children's parents/caregivers and by the child themselves. The child will then complete the Spence Children's Anxiety Scale (SCAS) during school time so as to provide a standard score of anxiety symptoms. The SCAS will be administered by the researcher or their assistant. This assessment form will take approximately 10 minutes to complete. No further treatment or procedures will be done on the participants. These scores will then be compiled and analysed using various statistical methods. Both parents/caregivers and children will be asked to sign informed consent for the study.

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

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

Costs to the school: none

If you have any queries please don't hesitate to contact me on 073 233 7111.

If you are happy to allow the students to participate in the study, please read and sign the attached consent form.

Thank you,

Michal Tauby.

PERMISSION

PRINCIPAL:

I hereby give permission for the research to be completed with the children at the

_____ School.

Signature: ……..…….…… Date: ……

Time: ……

Subject to any restrictions:

_____

_____

_____

_____

OCCUPATIONAL THERAPIST:

I hereby give permission for the research to be completed with the children during therapy.

Signature: ……..…….…… Date: ……

Time: ……

Subject to any restrictions:

_____

_____

_____

]

Appendix D: PARENT INFORMATION LETTER

SENSORY DEFICITS AND ANXIETY SYMPTOMS IN CHILDREN RECEIVING OCCUPATIONAL THERAPY.

Good Day,

My name is Michal Tauby. I am a Masters student from the Occupational Therapy Department of the University of Witwatersrand. I am investigating the association between sensory deficits and anxiety symptoms in children aged 8 - 10 years old. I am inviting you and your child to participate in the research and I would be most grateful if you and your child would consider participating in this study.

Sensory modulation difficulties (SMD) (an inability to regulate sensory input and filter out extraneous sensations) and anxiety symptoms are often noticed in a classroom environment by teachers or by Occupational Therapists during therapy. They are cognisant that these anxiety symptoms can be related to deficits in sensory modulation in various different sensory modalities like tactile, auditory, visual or vestibular processing. However, there is very limited research and consequent poor understanding of exactly which symptoms related to anxiety, are associated with SMD. Therefore therapists and other professionals may misinterpret anxiety symptoms as being related to SMD and may not manage the child's anxiety appropriately.

I wish to establish if there is an association between sensory modulation and anxiety symptoms in school going children who are receiving occupational therapy. I am asking that you as the parent fill in a Sensory Profile form on your child. This form takes approximately 20 minutes to complete and will provide scores for sensory modulation. There are 125 questions about your child's response to various and different sensory stimuli. These questions are based on the visual, auditory (hearing), movement, touch (tactile) and taste/oral sensations. The form also looks at your child's endurance and posture, as well as their emotional and behavioural responses to different stimulation.

I will be asking your child to complete the Spence Children's Anxiety Scale during school time so as to provide a standard score of anxiety symptoms. This assessment form will take approximately 10 minutes to complete, and will administrated by myself or a research assistant. This is easy for children to fill in and asks the child about anxiety about their anxiety symptoms, their response to anxious situations as well as their physical symptoms

when placed in an anxiety provoking situation. The child is also asked to list what things make them afraid or anxious.

Your child will be invited to participate and asked to sign to say if they agree to do so. You and your child may withdraw from this research at any time without having to give a reason. Remember that this study is completely voluntary and not taking part in it or withdrawing from it, carries no repercussions of any sort.

No further treatment or procedures will be done on the participants. These scores will then be compiled and analysed using various statistical methods. Both parents/caregivers and children will be asked to sign informed consent for the study.

If the scores from the assessment tools place your child at risk for an anxiety problem I will inform you so that you can follow up with further assessment, should you wish. I will provide the names of psychologist or play therapy services if requested. In addition, at the end of the study I will present the findings of the study to you, on request.

Confidentiality will be maintained by the use of a code instead of names on all results. Only the researcher will have a list of names and codes to enable the codes to be linked to a particular child. All data from this study will be stored in a secure location for 6 years according to HPCSA regulations.

If you have any queries please don't hesitate to contact me on 073 233 7111. If you have any concerns or complaints about ethical issues please contact the Secretary of the Human Research Ethics Committee at Wits, Anisa Keshav, at 011 1717 1234.

If you are happy to allow your child to take part in the study, please read and sign the attached consent form. Please place the informed consent form in its own envelope (see envelope provided) and not with the information and background forms. Please place all forms and envelopes into the big envelop provided and return this to your child's occupational therapist at the school.

Thank you.

Michal Tauby

INFORMED CONSENT FORM

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

Parent/caregiver: _____

Name of participant: _____

Signature: _____

Date: _____ Time:

_____

Appendix E: DEMOGRAPHIC QUESTIONNAIRE

Dear Parents

Please complete this personal information form, so that I can contact you, should your child be found to have a high score on the Spence Anxiety Children's Scale.

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

Please can you also complete the Demographic Questionnaire. This information will be used as part of the research project. Please return both these forms to school in a separate SEALED envelope, to ensure the confidentiality of your child's information for this research project.

Thanking you,

Michal Tauby.

……

Name of Parent or caregiver: _____

Relationship to Child: _____

Contact number of parent/caregiver: _____

Name of your Child: _____

Date of Birth of your Child: _____

Code:

DEMOGRAPHIC QUESTIONNAIRE

SENSORY DEFICITS AND ANXIETY SYMPTOMS IN CHILDREN RECEIVING OCCUPATIONAL THERAPY.

Code: ☐

Age: _____

School: _____

Grade/Class: _____

Sex: _____

Previous Therapy received: (Please fill out appropriate box)

Therapy	**Yes**	**No**	**Duration**	**Reason**
Occupational Therapy				
Physiotherapy				
Speech Therapy				
Play Therapy				
Other				

Current therapy:

Reason for referral to OT: -

_____

How long has your child been in OT for?

_____

Does your child take any medication? If yes, for what condition?

_____

ADDITIONAL COMMENTS:

_____

_____

Appendix F: ASSENT FORM - PARTICIPANTS

Hi,

My name is Michal and I am going to ask your mom and dad to tell me about some of the things you enjoy and don't like to do at home and at school. Is it okay if they fill in the form about you?

I also want you to please fill in this short form about how you feel in certain situations. This form will take about 10 minutes to do. This form will be completed now in your OT session and it is easy to understand but if you have any questions, please feel free to ask your OT for help!

Anxiety is the feeling of uneasiness and worry that we sometimes feel in a new or different situations. This form will ask you questions about anxiety – like what kind of things make you anxious, how you act when you feel worried, scared or anxious and any physical symptoms that you have (like sweating, or your heart beating fast) when you are having these anxious, worrying feelings.

INFORMED ASSENT FORM – PARTICIPANT:

I agree to participate in the study and complete the Spence Children's Anxiety Scale.

Child signature: _____

Witness: _____

Date: _____ Time: _____

Appendix G: ETHICAL CLEARANCE CERTIFICATE

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

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Miss Michal C Tauby

CLEARANCE CERTIFICATE	M111112
PROJECT	Sensory Deficits and Anxiety Symptoms in Children Receiving Occupational Therapy
INVESTIGATORS	Miss Michal C Tauby.
DEPARTMENT	Department of Occupational Therapy
DATE CONSIDERED	25/11/2011
M1111120DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 27/01/2012 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Lyndsay Kock

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

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...