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THE SENSORY PROFILE OF CHILDREN WITH SPEECH AND LANGUAGE DISORDERS IN LONDON AND THE SOUTH OF ENGLAND.

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

Johannesburg 2008

DECLARATION

I, Janine van der Linde declare that this research report is my own work. It is being submitted for the degree MSc. 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)

…….day of ……. 2008.

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- To my family and friends who had to put up with days and nights of reading, writing and stress due to the research project.

ABSTRACT

Children presenting with communication difficulties are among the most commonly occurring developmental problems. They were observed to have problems with their everyday activities in all the occupational performance areas, as well as displaying behaviours that have a negative impact on their functioning. These behaviours appear similar to those described in children with sensory processing and sensory modulation difficulties. Literature indicated a possible connection between speech and language difficulties and poor sensory integration.

This study used the Sensory Profile, a parent report measurement of the child's sensory responsiveness in daily life, to investigate the sensory processing and modulation of children with Specific Language Impairment, as reflected in their behavioural and emotional responses.

The study indicated that this population has specific areas of sensory processing that are unique to children with SLI and that differ significantly in their sensory responsiveness from typical children and children with other conditions like Autism and Attention Deficit Hyperactivity Disorder.

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NOMENCLATURE

Behavioural threshold: "the way people act in consideration of their thresholds. At one end of the continuum children respond in accordance with their threshold. At the other ends of the continuum children respond to counteract their thresholds. This means they would work against their threshold."[12,14.41]

Neurological threshold: "the amount of stimuli required for a neuron to respond. At one end of the continuum the thresholds are very high (this means a lot of stimuli is needed to meet the threshold) and on the other end thresholds are low (this means it takes very little stimuli to meet the threshold)" The ends of the neurological continuum are called habituation and sensitization.[12,14.41]

Specific language impairment: is delayed acquisition of language that cannot be explained in terms of reduced hearing, mental or physical handicap, emotional disturbance or psychosocial deprivation.[3,19]

Sensory integration (SI): Neuro-physiologically it refers to "the neurological process that organizes sensation from the body and the environment."[10] Behavioural manifestation of adequate sensory reception, registration and synthesis. Integration leads to the production of adaptive environmental interactions.[11]

Sensory processing disorder is the new term to be used instead of SI.[47]

Sensory processing: Functions related to sensation occurring in the central nervous system includes the reception, modulation, integration and organization of sensory stimuli, including behavioural responses to sensory input. The registration of sensory information according to the neurological threshold of an individual and the behavioural response it elicits.[10,19]

Sensory modulation: "the ability to regulate and organize reactions to sensory input in a graded and adaptive manner (behavioural)."[10]

The balancing of excitatory and inhibitory inputs and adapting to environmental changes (neurophysiologic).[10]

ABBREVIATIONS

ADHD - Attention Deficit Hyperactivity Disorder

ANS – Autonomic Nervous System

CNS – Central Nervous system

DCML - Dorsal column medial lemniscus

DP II – Developmental Profile II

DSM-IV - Diagnostic and statistical manual of Mental disorders. 4thEdition. Text Revision

ICD-10 – International Classification of Disease version 10

LEA – Local Educational Authority

OTA – Olfactory, Tactile, Auditory

SD – Standard deviation

SENCO - Special Educational Needs Co-ordinator

SFA – School Function Assessment

SLI – Specific Language Impairment

USA – United states of America

VV - Visual, vestibular

WHO – World Health Organization

CHAPTER 1

1. INTRODUCTION

1.1 Introduction & Validation

Working in a specialist school for children with speech and language difficulties, it was observed that many of these children have problems with their everyday activities in all the occupational performance areas as well as displaying behaviours that have a negative impact on their functioning and learning like constantly making noises, sensory seeking behaviour which include constantly moving, physical clumsiness, loss of attention in class and poor organization of themselves. These behaviours as well as an observed sensitivity to certain “foods, food textures and to sounds” appear similar to those described in children with sensory processing and sensory modulation difficulties.[1]

Children identified with speech and language disorders are those who do not develop language skills normally, irrespective of any obvious intellectual or physical disorders.[2,3] Literature describes a considerable variation in the pattern and severity of abnormal language development and different types of speech and language impairments/disorders including Developmental Language delay/disorder, Specific Language Impairment (SLI), Semantic & Pragmatic disorders and High level language disorders.[2] SLI, sometimes also referred to as developmental language disorder, is diagnosed when children present with language impairment which is not due to intellectual disability, physical disability, hearing loss, emotional problems or environmental deprivation.[3.] These children have a specific or primary speech and language impairment and the ICD-10 further makes a distinction between expressive and receptive forms of language difficulties.[4] The DSM-IV further describes an expressive communication disorder and a mixed receptive expressive disorder.[5, 6] The diagnosis however needs to be confirmed by a Speech and Language therapist following a full standardized assessment.[7, 8]

Characteristics of SLI are late onset of speech, discrepancy between verbal and non verbal skills or a discrepancy between receptive and expressive language, lack of concentration, history of "glue ear", difficulty with fine and gross motor skills, poor short term memory, word finding difficulties and poor interaction with peers.[3,4]

The ICD-10[4] states that the disorder or delay in developmental speech and language impairments are strongly related to biological maturation of the central nervous system and in most cases functions affected are language, visio-spatial skills and motor coordination.[4] These children do not acquire language skills spontaneously and need to be taught the skills in a structured environment that uses a combination of movement, sights, sounds and touch.[3] Recently speech therapists have also become concerned by a set of behaviours in children with this condition, described as chronic disorganization.[7] This may be related to sensory integration dysfunction as other researchers have suggested that there could be a link between chronic disorganization and speech and language and that children with speech and language impairments may have vestibular, tactile and auditory processing problems as well as modulating the amount of sensation they receive. [8] The processing of sensory input refers to the functions the nervous system uses to receive, regulate, organize (sensory modulation) and understand sensory input according to the neurological threshold of the child.[9, 10] Sensory modulation is therefore a part of the sensory processing, where the modulation of sensations refer to the regulation and organization of sensory input in an adaptive manner. Sensory modulation facilitates and inhibits responses in order to respond appropriately to a task following sensory input.[11]

Miller [1] also indicated that:

> "Children with sensory processing disorders suffer from devastating symptom complexes that significantly affect their self regulation, self esteem, social participation, school performance and other functional abilities." (p 10)

Very little research is however available on what behaviours children with SLI exhibit and why.

This study will investigate the sensory processing and modulation of children with SLI as reflected in their behavioural and emotional responses, to determine if they have difficulties in sensory processing and modulation.

The benefit of the study is to establish what intervention strategies based on this assessment could be used to improve the functional performance and learning of children with SLI in the classroom and in terms of their other everyday activities.[12] Occupational therapists address these occupational performance deficits of clients by including intervention in occupations that are meaningful like eating, drinking, dressing, sleeping and playing, social interaction, as well as school and community activities.[13]

This population has traditionally only been treated by speech and language therapists.[3,8,13] Using the Sensory Profile Questionnaire[14] (appendix A) to identify problems may increase the involvement of occupational therapists as part of the therapy team in the treatment of these clients.

1.2 Statement of Problem

Communication disorders are amongst the most commonly occurring developmental problems in England and it is estimated that 7% of children between the ages of 5-10 years have speech and language difficulties.[8, 9] Language is the unique attribute that defines us as humans and is also the main medium of education.[3] Children with speech and language impairments have difficulties with most aspects of everyday tasks and in learning about their world.[9, 10]

It was observed that children with speech and language impairments present with behaviours that could be indicative of sensory processing or modulation problems which are reflected in behavioural and emotional responses.[11] Research has shown that the Sensory Profile[14] of children with various disabilities, which measures these behavioural and emotional responses, is uniquely different from children without disabilities.[15] This then raised the question as to whether children with speech and language impairments will show dysfunction on the Sensory Profile[14] and if there are certain characteristics or patterns that demonstrate a unique trend in this sample.

1.3 Aim of the Study

The aim of the study is to determine the Sensory Profile[14] of children with SLI.

The focus will be on scores that fall in the definite difference column or in a combination of the probable difference column with the definite difference column when scoring this assessment.

1.4 Objectives of Study

Using the Sensory Profile[14] the study will determine:

- Sensory processing of children with SLI in each sensory system including the modulation, behavioural and emotional responses that reflect the child's behavioural outcomes.
- What responsiveness in the factor scores might be characteristic of children with specific language impairment?
- Whether there are unique patterns of performance in this population.
- How the performance differs for those with predominantly receptive difficulties when compared to those with predominantly expressive difficulties or those who have a mixed picture of receptive and expressive difficulties.
- Whether the patterns of performance in this population differ from the patterns already established in other populations by research and described in the literature.

CHAPTER 2

2. LITERATURE REVIEW

Speech and language impairments/disorders may be the most common impairments in childhood.[16] This review of the literature will consider speech and language, specific language impairment (SLI) and the influences of the nervous system and sensory processing on language. The theory of sensory integration and the development and application of the sensory profile in disorders of sensory processing will also be discussed.

2.1 Specific Language Impairment

Language is the unique attribute that defines us as humans and is used as the main medium of education in our schools.[3] Language is defined as:

> "A socially shared code where a system of symbols are used to represent concepts that is meaningful to others using the same code" [17] (p 88)

Research indicates that communication disorders are amongst the most commonly occurring developmental problems in England and it is estimated that 7% of children between the ages of 5-10 years, have speech and language difficulties.[18]

These disorders fit into a broad classification of speech and language disorders identified by the World Health Organization (WHO 1993) and are divided into expressive and receptive problems.[3] Receptive language disorders are defined as language comprehension -2 SD below age level whereas severe disruption of expressive language needs to be present for a disorder to be identified in this area.[16] The DSM-IV also describes a mixed receptive expressive disorder.[5] Although various speech and language disorders of both types have been identified and linked to conditions like autism and hearing impairment, the disorder identified as specific language impairment (SLI) was the focus of this study as there is no known neurological cause for the disorder.[3]

Specific language impairment is characterized by significant limitations in language functioning in the absence of a hearing impairment, deficits in oral structure and function, low non verbal intelligence scores or the diagnosis of obvious neurological damage.[19] Language performance scores are significantly lower than intellectual performance scores on non-verbal tasks. Clinical identification is based on the absence of other contributing factors.[20, 21]

Children with SLI experience difficulty in learning the rules of language, registering the different contexts for language and constructing word reference associations.[3,16] They also have a history of "glue ear", difficulty with their vocabulary, late onset of speech, a discrepancy between verbal and non verbal skills or between receptive and expressive language, a word finding difficulty and auditory processing problems.[4,7] Other characteristics commonly seen, unrelated to language per se, are poor social skills, a lack of concentration, difficulty with fine and gross motor skills, a poor short term memory, and poor interaction with peers.[22] Difficulties with planning, organizing and sequencing their thoughts, and difficulty in beginning and completing tasks are also features of the condition.[9] This results in problems at a functional level as children with SLI also have difficulties with almost all aspects of everyday tasks and in learning about their environment.[23]

2.2 The Influence of Neural Organization and Sensory Processing on Language

The related problems experienced by children with SLI make it obvious that speech and language abilities are not mere cognitive functions, but are dependent on Central Nervous System (CNS) organization and processing of information at all levels.[24,25]

A deficit in sensory perceptions or inefficient coordination of sensory input is believed to affect all domains of speech and language, including praxis, interpersonal relationship organization and attention.[26]

The ICD-I0[4] supports this in a statement which indicates that a disorder or delay in developmental speech and language is strongly related to biological maturation of the central nervous system and in most cases the functions affected are not only language, but visio-spatial skills and motor coordination as well.[4, 7]

Schul et al[20] and Kruger et al[17] indicated that in addition to weakness in language, these children also experience difficulties with slow processing, perceptual, gross and fine motor skills and cognitive processing. Disturbed auditory processing is identified as a potential risk for the development of speech and language disorders.[27] A functional description of auditory processing is described by Burleigh, McIntosh and Thompson[28] as:

> "A condition in which one has problems processing or interpreting auditory information when it is presented in a less than optimal listening environment" [28] (p 142)

Problems in this form of processing present as inconsistent awareness of sound and are commonly found in conjunction with other dysfunctions that manifests as attention seeking, temper tantrums, hyperactivity, impulsivity and oppositional behaviours.[10,11] Owens[3] further described that poor auditory processing can also result in poor self-regulation behaviours. Poor self regulation then results in behaviours such as hyperactivity, impulsivity, daydreaming, problems sitting still, completing assignments, increased anxiety, attention seeking, temper tantrums etc.[29]

Children with SLI do not acquire language skills spontaneously and need to be taught these skills in a structured environment, that uses a combination of movement, sight, sounds and touch.[3] Ayres proposed that for speech- language skills to develop, the sensory and motor portions of the brain, especially the vestibular and auditory systems, must have efficient neural connections with the speech-language areas.[30]

Guenther,[31] Hulslander et al[32] and Evans[33] also found that different types of sensory processing influence different language problems and that a child with speech and language disorder may therefore present with vestibular, tactile and auditory processing problems. Reisman[34] also found that children with speech and language disorders then have difficulty in modulating the amount of sensation they receive.

Looking at the various sensory systems and the role they play in speech and language problems the literature indicated that:

- Difficulties within the **vestibular system** is expected in children with speech and language difficulties, as the vestibular system is a major organizer of sensory channels and plays a big role in the development of speech and contributes to the development and acquisition of word understanding and speech.[35]
- The **tactile system** also plays a role in the development of the child's functional and language skills.
    - **Firstly** the tactile system is important for determining behaviour, as humans are dependent on touch until our language skills have developed.[21] Poor understanding of language can be due to poor tactile input, as the child is bothered by the texture in food and the clothes that they are wearing, or threatened by an unexpected touch, which can cause poor peer interactions inadequate modulation.[14,21]
    - **Secondly** Mauer[9] also indicated that tactile system dysfunction can have an influence on the difficulty in articulating sounds as there are various touch receptors in the face and mouth.[9] Tactile difficulties in the mouth can lead to poor oral sensory processing, which is expected in this population.[36,37] Oral processing is important for the production of sound, placement of the tongue and lips, pressure of the lips.[35,37] Children also use the oral motor mechanism for calming or self-regulation and the mouthing of objects provides organization of sensory and motor behaviour.[37]
    - **Thirdly** tactile skills may also play a major role in the development of body scheme, which is needed for a child to feel what the body is doing without looking at it, for motor planning and fine motor or manipulation skills.[38]

      In a study conducted by Kruger et. al. [29] and Webster, Majnemer, Platt and Shevell[39] they found fine motor skill difficulties in all children with language disorders participating in their study.

The sensory processing and modulation of the input from the sensory systems therefore play a huge role in the development of communication competence,

as it relies on sensory experiences with the environment and the ability to respond to this adaptively in order to develop correctly.[9]

Processing sensory information correctly is therefore the key factor in the ability to exhibit adequate adaptive responses, in the organization of behaviour.[40]

2.3 Sensory Integration (SI)

2.3.1 Introduction to Sensory Integration

Sensory integration results from the brain's ability to integrate certain information received from the body's seven basic sensory systems within the central nervous system.[41] These sensations are touch, auditory, gustatory, smell, vision, movement and body position.[41] The CNS creates a combined picture of this information to form a whole brain function.[41] Bundy, Lane and Murray[10] describes sensory integration (figure 2.1) as:

> "the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment." (p 479)

The end product of this integrative process is then an increase in adaptive behaviour responses, highly adaptive body movements, occupational engagement, complex behaviour and easier learning.[26]

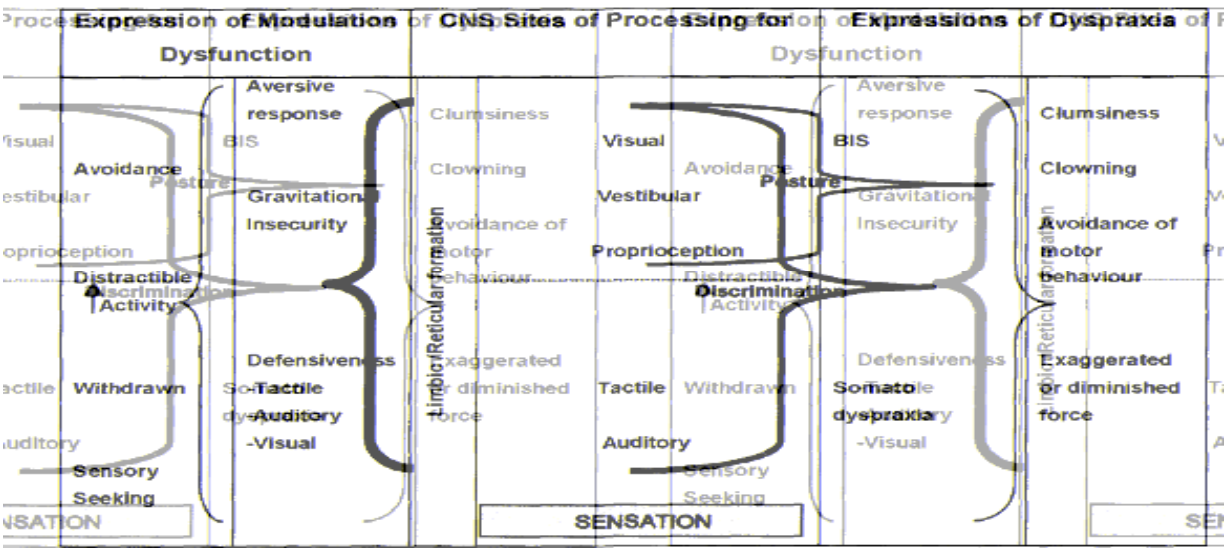


Figure 2.1 Patterns of SI dysfunction. Taken from: Bundy A C, Lane S L, Murray E A. Sensory Integration: Theory and Practice. Second Edition. Philadelphia: F.A. Davies Company. 2002.

2.3.1.1 Sensory processing

Sensory processing or discrimination is the term that refers to the internal process that the nervous system uses to receive, organize and understand sensory input. [41, 42] It includes the ability to interpret the information the brain has received, to give it meaning and context. The response to the environment is based on the sensory information that is available.[21,25,41,42] This is different from sensory acuity, which is simply the clarity with which the sensory organs receive input.[30] It is recognised that sensory processing influences social, cognitive and sensory motor processing and that poor sensory processing abilities can affect functional performance in daily life.[43] For example a child that does not process tactile information correctly e.g. hypersensitive to tactile information, may have difficulty with giving or receiving hugs and may reject touching anyone except his mother.[33] Sensory processing is therefore the way the central nervous system receive and organize sensory input into responses, whereas sensory modulation is the balance between increasing/decreasing the amount of sensory input that enters the central nervous system.[30, 38 and 47.]

2.3.1.2 Sensory Modulation

The modulation of sensory input is critical to the functioning of the CNS from a neurosciences perspective. Modulation is the ability to regulate sensory information and to generate an appropriate response that matches the demands and expectations of the environment[10] It further plays a role in regulating the habituation and sensitization of the person's responses to the environment.[10]
Habituation occurs when the CNS recognizes stimuli as familiar and response to the stimulus is discontinued, resulting in a decrease in transmission among cells.[10, 25] During sensitisation the CNS recognises the stimuli as important, unfamiliar or potential harmful and generates a heightened response.[10, 25]

When a child has difficulty modulating between habituation and sensitization, they present with maladaptive behaviours, which then result in them being over excitable, hyperactive or overly lethargic.[3,25,30] The limbic system and thalamic regions are hypothesized to be at the root of modulation dysfunction.[44]

The interconnection between the limbic system, the hypothalamus, the thalamus and the reticular activating system provides inhibitory and excitatory mechanisms that regulate attention and arousal and emotional tone.[25] The thalamus is described as the main relay centre for the processing of sensory information in the CNS.[25] The thalamus is also involved in emotion and behaviour.[10,25]

The limbic system then plays a role in learning, memory, aggression, motivation and expression of emotion.[44, 45]

Royeen and Lane[45] suggest that:

> "The involvement of the limbic system provides an explanation for the emotional or social difficulties often observed." (p110)

The hypothalamus is the component of the limbic system that is responsible for the control of the autonomic nervous system (ANS), which plays a significant role in the regulation of sensory processing and that is indicative of the individual's emotional state. [25, 42, 44] The ANS activates the flight-fight responses for protection and survival. [25, 42, 44] The hypothalamus further plays a role in maintaining good behaviour and emotional responses.[25, 44]

The reticular activating system also plays a role in the conscious-alert state, as it is a diffuse system that runs through the brainstem and that has major connections with motor and sensory pathways.[45] As the reticular activating system has connections to various motor and sensory pathways it can be activated by many types of sensory stimulation and contributes to modulation of sensory input and the regulation of behaviour. [45]

2.3.2 Effect of Sensory Integration Dysfunction on Behaviour and Function

Various theories have been developed to describe the effect of sensory processing and modulation on behaviour and function.[25] An understanding as to why sensory integrative dysfunction occurs and how it presents is important in understanding the effect on behaviour and function.

In research between 1964 to 1972 Ayres identified sensory modulation within the tactile system and hypothesized that the dysfunction in the tactile system is the result of imbalance between the dorsal column medial lemniscus (DCML) system and the antero-lateral system.[10,25,42]

The DCML system carries “discriminative touch”, deep pressure and proprioception and input results in a calming effect, whereas the antero-lateral system is largely for protection/survival and carries pain, temperature and crude touch. [10, 25, 42]

Ayres hypothesized that the provision of deep tactile pressure, proprioceptive and other input mediated by the dorsal column activate the DCML system and that by this activation the antero-lateral systems could be over ridden suppressing threatening stimuli. This is based on the gate theory by Melzack and Wall.[25] Ayres believed that activating the DCML system close the gating mechanism, which would block protective responses to touch and limit emotional response, as well as hyperactivity and distractibility.[10,24,25,30] She further hypothesized that light touch would open the gating mechanism and trigger defensive reactions. [10,24,25,30] The concept of a triad of defensiveness was also discussed by Ayres. [10,24,25,30]

Following Ayres research, Knickerbocker then investigated this concept further and introduced the term sensory defensiveness. She suggested that defensiveness can be observed in the olfactory (O), the tactile (T) and the auditory (A) system, the OTA triad.[44] Knickerbocker further developed a dyad-triad theory which suggested that the dysfunction was the result of imbalance between inhibition and excessive excitation within the nervous system.[44] This then resulted in sensory dormancy or defensiveness, causing the child to be over active, distractible and disorganized. She also described sensory dormancy, where excessive inhibition of incoming stimuli results in behaviour that is disorganized.[44] Knickerbocker then identified clusters within other sensory systems which included the OTA (olfactory, tactile and auditory system) triad, as well as the V, V (visual, vestibular) dyad, where the child may experience dormancy or defensiveness.[10,25,30,44] She did however not indicate if the triad and dyad could be present in the same child.

Between 1987 and 1989 Royeen and Lane developed the hypothesis that placed sensory modulation on a linear continuum, which included extremes from sensory dormancy or hypo-responsivity to defensiveness or hyper-responsivity.[10, 45]

They believed that the dysfunctional individual either spent excessive time at one end of the spectrum or the other, or fluctuated between the two. [10, 45] They also hypothesized that a child with sensory modulation difficulties is unable to stay in the middle of the spectrum.[25, 42, and 44]
Royeen and Lane[44] further suggested that the continuum was circular where there are fluctuations between sensory defensiveness and dormancy.

In 1997 Hanchu linked sensory processing disorders to anatomical areas. She discussed the importance of interpreting behavioural responses and stated that problems in processing information, may influence the ability to generate automatic adaptive responses.[42, 45]

Dunn then proposed in 1999 a new theoretical model, that uses concepts from neurosciences literature to understand how sensory receptors receive stimuli from the environment, how the CNS interprets the information and what output is generated.[11, 14] The model looks at sensory processing as an interaction between neuroscience and behavioural concepts, which help with interpretation of young children's behaviour and functional performance. [12,14,30,41] Her model included a continuum similar to Royeen and Lane in terms of sensory modulation, in which she describes a neurological threshold where the ends are habituation and sensitisation.[10, 14, 30, 41]

According to Dunn, to produce functional behaviours, modulation of information needs to create an interchange along the habituation and sensitisation continuum. If there is poor modulation, maladaptive behaviour will result as too much sensation. This is found where there is a low threshold, resulting in behaviour that is over excitable or hyperactive (figure 2.2).
Too much habituation occurs with a high threshold and results in overly lethargic and inattentive behaviour.[12, 14, 30, 41]

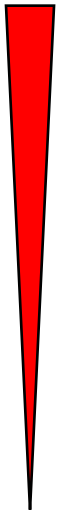
Behaviour response continuum				
Neurological threshold continuum 			**Acting according to threshold**	**Acting to counteract threshold**
			Passive behaviour	**Active behaviour**
	Needs a lot of input before registering	**HIGH** (Habituation) Nervous system recognise that something familiar has occurred	**LOW/ POOR REGISTRATION** Do not notice sensory events in daily life	**SENSATION SEEKING** Find ways to extend or enhance sensory events in daily life.
	Needs very little input for registration	**LOW** (sensitisation) Nervous system enhances potentially important stimuli.	**SENSITIVE TO STIMULI** Notices every event in daily life	**SENSATION AVOIDING** Find ways to limit sensory input during daily activities

Figure 2.2 Relationships between behavioural responses and neurological thresholds. (Adapted from: Dunn W. The Sensory Profile User's manual. First Edition. San Antonio: The Psychological Corporation. 1999)

When the impact of neurological thresholds on the behavioural responses is considered, a range of possible interpretations of behaviours emerge, depending on the effect of the high or low thresholds on performances.[12,14] Based on Dunn's model the four quadrants of the thresholds relating to behaviour identified are:

- Low registration: These children have high thresholds for stimuli and act in accordance with this threshold. This means they do not notice sensory events, do not respond to initial auditory information, are uninterested in the world, show flat dull affect, have low energy levels & poor endurance. Deficits in proprioception make them appear clumsy and they may need high amount of proprioceptive input to participate successfully in physical activities.[12,14,30]
- Sensation seeking: A high threshold for stimuli results in behaviour to counteract the threshold. These children are very active, continuously engaging in activities, enjoy sensations and generate extra input, humming or making noises while working, touching objects, chewing on things, looking for extra sensory input and appear excitable with disregard for safety. [12,14,30,41]

- Sensory sensitivity: These children have low thresholds and act in accordance with passive self-regulation. They notice stimuli quite easily and are easily distracted by movements, sounds and smells. They are therefore distractible, hyperactive and do not have ability to habituate. They present with oral sensitivity and heightened awareness of what is going on around them and use passive strategies by allowing things to happen to them rather than removing themselves from the situation. [12,14,30,41]
- Sensation avoidance: This child has a low threshold for stimuli and acts in a way to counteract the threshold with active self-regulation. The child will limit the sensory input throughout the day by creating rituals and daily routines. They become extremely unhappy if these are disrupted and present with disruptive behaviour and sometimes emotional outbursts. This active self-regulation occurs because unfamiliar sensory input is difficult to understand and organize or it might be threatening to their nervous systems. [12,14,30,41]

Children engaging in predictable patterns of behaviour, provide a high rate of familiar sensory input, while simultaneously limiting the possibility of unfamiliar input. These avoidance patterns of behaviour interfere with their use of materials and restrict the child's willingness to participate in daily self-care tasks. This may lead to the child imposing rules and restrictions upon others as well.[12, 14, 30, and 41]

The theories described above considered the physiology of the individual without including the effect of the sensation being received from the environment. Miller, Reisman, McIntosh and Simon[46] described a model that highlights how the external contextual factors interact with internal characteristics in sensory modulation. The Ecological model of sensory modulation proposes that the individual responses can be understood only within the context of the external factors and considers four external dimensions - culture, environment, relationships and tasks in relation to sensory integration theory and practice.[46] The internal dimensions listed in their model are sensation, emotion and attention. Maladaptive behaviour is observed when there is an imbalance between the external dimensions and the internal dimension.[46]

Miller [47] then proposed three subtypes of modulation similar to that compare to those described by Dunn [14], i.e. sensory over-responsivity compared to sensory sensitive & avoiding behaviours, sensory under-responsive compared to low registration and sensory seeking compared to sensory seeking.[47]

According to Miller [47] studies confirmed that it is possible for a child to have a single disorder, but more likely they were a combination of patterns/disorders. A combination of disorders can be found due to the disorders result from brain structure, as the brain's systems are interrelated and if a physiological or biochemical problem is experienced in one area it affects operations in another area. [8, 19, 36, 40.] Children can be oversensitive in one area e.g. touch, but under responsive in another area, e.g. movement.[47]

2.3.3 Measurement of sensory processing

Dunn developed a measure which evaluated sensory modulation and the processing in the sensory systems, as well as behavioural and emotional responses that reflect the child's behavioural outcomes as a result of this sensory processing or discrimination.[11, 12, 14] She referred to the resultant Sensory profile as a measure of sensory processing, which has been widely used both clinically and in research.[14, 41, 48] (Appendix A).

Already it has made a valuable contribution to the diagnostic and treatment planning process used with dysfunctional individuals and has increased the understanding of the nature of sensory processing. The Sensory profile measures sensory processing abilities in a standardized way as well as the effect of sensory processing on functional performance.[14, 15]

The Sensory profile[14] is a judgment based caregiver questionnaire, consisting of 125 items, for children aged five to ten years. It reports the frequency of behavioural occurrences that are used to measure the patterns of performance indicative of difficulties experienced in sensory processing. The questions require the caregiver's responses about the child's behaviour on a frequency scale indicating always, frequently, occasionally, seldom or never.[14, 15, 41]

The information gained from the Sensory profile links performance strengths and barriers with sensory processing patterns.[14,15,41] It evaluates possible contributions of sensory processing to a child's daily performance, as it provides information regarding tendencies in response to stimuli and which sensory systems are likely to contribute to or create barriers during functional activities.[14,15,41] The sensory processing considered includes the auditory, visual, vestibular, tactile, multi-sensory and oral sensory systems.[14]

Modulation is assessed by relating the body position and movement, including the ability to move effectively, what movement affects activity level and the effect of sensory and visual input, on emotional responses.[14] It also assesses function of the senses in generating emotional response and the use of visual cues to establish contact with others is also included.[15] Behavioural and emotional responses indicate the child's psychosocial coping strategies as well as the outcomes of sensory processing, as seen in the ability to meet performance demands.[1,30,41] (appendix B for Sensory profile score summary sheet)

Studies using the Sensory profile indicated that children with disabilities respond differently from children without disabilities, suggesting underlying sensory processing and modulation difficulties, which is reflected in their behavioural and emotional responses.[49]

2.4 Conditions with Sensory processing and Modulation profiles

Research has been done on sensory processing and the resulting behaviour with various conditions like Autism, Asperger syndrome and Attention deficit hyperactivity disorder (ADHD).[43, 49, 50]

This research has indicated that the sensory profile was useful in evaluating the contributions of sensory processing to children's daily performance patterns.[26,41,43,49,50] Although these studies had relative small sample sizes and other limitations they found highly significant sensory processing and modulation patterns unique to each population.[26,41,43,49,50] Ermer and Dunn[15] indicated that the Sensory profile can be used to discriminate between various conditions as the profile for each group is significantly different from the others and discriminant analysis showed that various factors are more prominent in certain diagnoses.[15,51]

Children with Autism process sensory information differently with a low incidence in sensory seeking and a high incidence in oral sensory, inattention/distractibility and fine motor/perceptual factors. A comparison of children with Asperger syndrome and normal children found a significant difference on 22 of 23 items on the Sensory profile.[43] This provides evidence that children with Asperger syndrome have a different sensory processing pattern.[41,43]

Difficulty in factors associated with both hypo-responsiveness including low endurance, low tone and poor registration as well as hyper-responsiveness in emotional reactivity and sensory sensitivity were identified.[41,43] These scores suggest problems with the modulation of input rather than the way in which the child responds, as their responses varies from one situation to the next.[41,43] Since a sample of convenience was used, the study did not reflect a broad representative population and the findings of the study should be interpreted with care in terms of generalisation.[41,43]

Many researchers indicate that children with ADHD have decreased ability to process sensory information, as they react to stimuli that are easily ignored by other children and are easily over stimulated.[15,48,50] Ermer & Dunn[15] found that children with ADHD exhibit greater frequency and intensity in sensory seeking behaviours and that inattention and distractibility impair their functional ability. Dunn, when working with Bennett found that children with ADHD differed significantly, in their sensory responsivity and the number of visuo-motor difficulties they present with, which correlates with previous findings on fine motor/perceptual factors.[50] The subject's diagnoses and the effect of medication on sensory processing was not verified prior to the study which limits the validity of this study.[50]

In all these studies the Sensory profile was found to best discriminate between the high incidence factors like sensory seeking behaviours, inattention and distractibility and low incidence factors like oral sensory sensitivity and fine motor perceptual behaviours.[15,41,43,50]

Research on sensory integration in other conditions or diagnoses, including language problems has not included a sensory profile of children, with these conditions and did not, investigate the effect of sensory processing on their behaviour.[9, 17, 24, 29]

2.5 Sensory integration and children with Specific language impairment

Ayres described that the CNS mediates language development and therefore speech and language is seen as an end product of sensory integration.[30] As speech and language development depend on many sensory integrative processes, sensory integration disorders have been shown to influence speech and language.[30] Hulslander et. al [32] also found that children with speech and language disorder may present with sensory processing problems, as well as difficulty in modulating the amount of sensory input they receive, resulting in sensory integrative dysfunction.[32]

Griffer [29] quoted Ayres who suggested that

> "Sensory integration therapy facilitates speech-language acquisition by enhancing the efficiency of sensory processing at brain stem level which then provides the foundation for more complex higher level processing which is necessary for language development." p. 394

In a critical review of the effectiveness of sensory integration on language development it was also found that sensory integration treatment has a positive influence on the language development of children.[9,17,24,29,30]

It is therefore necessary to consider the concepts and theories that have been developed in terms of sensory processing and sensory modulation, as well as the influence of the various systems and processes on the development of language and the influence thereof on behaviour of children with SLI.[9, 11, 30, and 42]

2.6 Summary

Children diagnosed with SLI present with other problems which affect their behaviour and function in everyday activities.[4, 7] This behavioural dysfunction may be related to a dysfunction in sensory integration. An influence of neural pathways and sensory processing in language and communication problems has been established. A number of hypotheses have been put forward as to why the integration of sensory input is important in behaviour and function and the effects of sensory processing and modulation in relation to this have been discussed. Previous research has been able to identify specific sensory processing problems for various conditions using the Sensory profile developed by Dunn.[15, 41, 49]

These have been related to the behavioural and occupational performance of the child indicating the link between sensory integration and the ability to function in everyday activities. Very little research has been done on speech and language disorders, specifically in relation to sensory processing and sensory modulation.

CHAPTER 3

3. RESEARCH METHODOLOGY

3.1 Research design

A quantitative, descriptive cross sectional research design was used, as the purpose of the study was to portray the profile of sensory processing abilities in a population of children with SLI. The research was conducted using standardised questionnaires: the Sensory profile questionnaire[14] (Appendix A), Sensory profile scoring summary sheet (Appendix B), the Worksheet for calculating quadrant scores (Appendix C), as well as the Developmental profile II[52] (DP II) (Appendix D). The DP II was used to reduce the threat to internal validity of the study and to ensure a homogeneous sample was used and identify children with pervasive developmental delay.

A similar research design and questionnaire was used by other researchers to determine if children with Autism, Aspergers syndrome and ADHD have poor sensory processing and how it affected their behaviour.[12, 15,41,48,49]

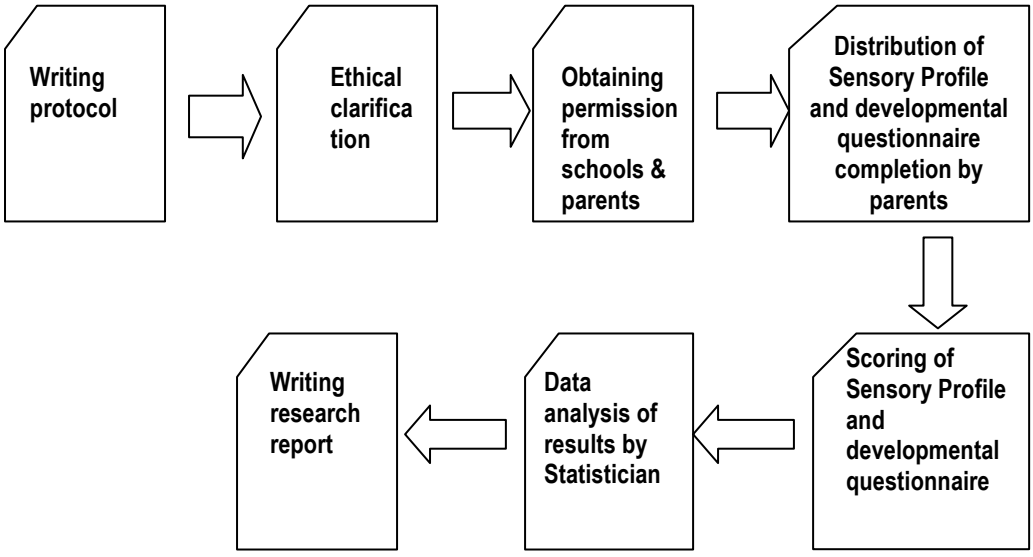


Figure 3.1 Flowchart of methodology

3.2 Selection of subjects

3.2.1 Study population

The study population consisted of the parents/guardians and children, five to ten years 11 months of age, who were diagnosed as having a specific speech and language disorder (with a statement of special educational need) (appendix E). The sample of children was drawn from this population attending special schools for children with speech and language disorders and mainstream schools with language units/bases in Greater London and the South of England.

The following inclusion and exclusion criteria were used to determine whether a child qualified for participation in the study:

Inclusion criteria:

- All children must be identified and diagnosed by a Speech and language therapist as having a primary speech and language disorder - Specific language impairment (SLI) of either an expressive or receptive nature or a mixed receptive expressive nature and have a statement of special educational needs**.**
- Children and their parents/guardian need to be English speaking and the children must be between the ages of five to ten years 11 months.

Exclusion criteria:

- Children diagnosed by a paediatrician as having Autism, Autistic spectrum disorder, ADHD, Epilepsy, a Cognitive disorder or Cerebral palsy will be excluded from the study. The literature and research indicated that these children may already have sensory processing issues due to their disability and were therefore not included in the study.[15,16,25,41,43]
- Children with pervasive developmental delay [52].

3.2.2 Sampling method

Research studies on sensory processing in other populations used various sampling methods. In the studies on ADHD, Autism and Asperger syndrome a convenience sample was used.[14, 41,43,49,50]

The subjects for research on the Sensory profile used a national sample in the USA, were identified by occupational therapists and were randomly selected from a geographical sample of members of the Sensory integration special interest section.[14, 48, 49] These therapists then contacted the parents of the children in their communities to participate in the study.[14, 48, 49] The population for this study was obtained in the same manner. The special needs coordinators/speech and language therapists at the special schools and mainstream schools with language units/bases involved with children with speech and language disorders in Greater London and the South of England, were contacted to assist in the study. The special needs coordinators/speech and language therapists were invited to participate in the study and to identify all the children that complied with the inclusion criteria.

3.2.3 Sample size

A relatively small sample was required to detect a deviation away from "typical performance" to what the Sensory profile[14] labels as a "probable difference or definite difference". If the latter difference exits it was likely to be in excess of two standard deviations (SD) based on the normal range for "typical performance". The envisaged data analysis required a sample size of at least 40 participants to achieve a difference of 2 SD at the power of 95%.

260 children with speech and language disorders were initially identified as meeting the inclusion criteria for the study, but only 16 questionnaires were returned to the researcher. As this sample was too small, a second request for participants was sent out and another 60 children were identified. Only eight of this group responded. Two of these questionnaires could not be used as the children had pervasive developmental disorders. Therefore only 22 of the questionnaires could be used for data analysis. Losses from the study were not recovered due to the difficulty in reaching this population. This small sample is a limitation in this study and it will have an effect on the internal validity of the study and results therefore cannot be generalized to the population.

3.3 Measurement techniques

3.3.1 Background information (appendix B)

Background information of each participant regarding the participants was collected by the use of the demographic information section on the Sensory profile scoring sheet. The information was gathered to ensure that the participants adhered to the inclusion criteria, as well as to gather more information regarding the participants that could assist with the interpretation of the information received in the questionnaires. The following Information was gathered:

1. Age of the participant (the child needed to be between five years and 10 years 11 months in order to be included).
2. Gender: male and female.
3. Type of difficulty (e.g. receptive difficulties, expressive difficulties or mixed receptive expressive difficulties)
4. Type of intervention received (e.g. speech and language therapy, occupational therapy, physiotherapy, early intervention).
5. Type of schooling the participant was receiving. (special education or mainstream education).

3.3.2 Questionnaires

Two self report questionnaires completed by the children's caregivers, were used.

3.3.2.1 The Developmental profile II (Appendix D)

The Developmental profile II[52] was used to determine if the children selected had any pervasive developmental delays. This test was used as it has been designed to evaluate children from infancy through 9 1/2 years. The DP-II includes 186 items, each describing a particular skill. The test assesses the development in five areas; physical age, self-help age, social age, academic age and communication age. The respondent simply indicates whether or not the child has mastered the skill in question.[52] The DP-II test was chosen as it could be appropriately used for the sample (children aged between 5 -10 years) and because it could be filled in as a questionnaire by the parents.

Other tests identified e.g. Gilliam Asperger's disorder scale and the Childhood Autism Rating Scale (CARS) required additional training and specify that a therapist complete the form and were therefore not suitable to use in this study.

3.3.2.1.1 Reliability and validity

The test has internal reliability coefficients reported at 0.79 for physical skills, 0.78 for self-help skills and 0.82 for social skills, 0.70 for academic skills and 0.83 for communication skills, which indicated a high degree of homogeneity among items on each scale.[52]

In terms of validity, the accuracy of parental report of children's performance has been a focus of the DP II. In a study to determine parent accuracy as informants, it was found that coefficients ranged from 0.57 to 0.77 on estimates of the same ability.[52] Another study compared parents and professionals assessments of the functional level of developmentally delayed children. The results showed a coefficient of 0.85. The literature indicated that discrepancies between parent's estimates were greater in children with physical ailments.[52] Parents needed to circle the answer to a question on the form (pass for yes or fail for no) e.g. "does the child help with dressing by holding out arms for the sleeves or feet for the shoes?" (See appendix N: for instructions on completion of forms)

3.3.2.1.2 Scoring of the Developmental profile II

When scoring the DP II the following steps must be completed.

1. Parents indicated whether a child is able to do a task = pass (yes) or fail (no). All items up to the child's chronological age are answered. The more items passed the higher the scale score or the better the child's developmental age will be.
2. Firstly the **basal credit** is determined. This is done by determining the section e.g. Toddler II 25-30 months in which **all** items were scored as passed. It will then show the basal credit as e.g. 30 months. This is then the highest number of months scored for that skill. (The basal credit

months are then filled in on the scoring summary at the end of each skill section).

3. **Additional credit** is determined by adding the months earned over and above the basal credit. (The additional credits are then filled in on the 2nd block on the scoring summary at the end of each skill section)
4. The age for the section e.g. physical is then determined by the sum of the basal credit and the additional credit. This is filled in on the scoring summary in the third block.
5. The **month's differential** is then determined by: subtracting the child's chronological age from the section age. This then indicates the number of month's that the child is behind.
6. The child's actual **developmental age** for a section is then determined by subtracting the month's differential from the chronological age.[52]

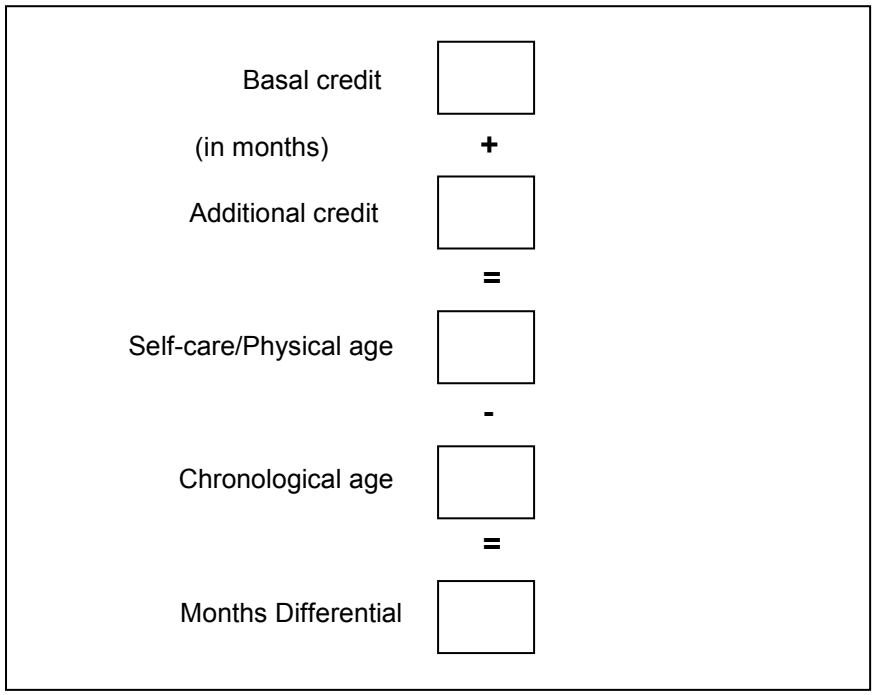


Figure 3.2 Explanation of development scoring summary (adapted from the Developmental profile II) [52]

3.3.2.2 The Sensory profile questionnaire (appendix A)

The measurement of the children's sensory processing was done using the Sensory profile, [14] a standardized questionnaire. Research indicates that the Sensory profile is a good assessment to use as the items show a high correlation with sensory perceptions.[14,15,41,48,49]

The Sensory profile reflects sensory processing, modulation and behaviour and emotional functioning.

Sensory processing is assessed in a number of modalities: auditory, visual, vestibular, and tactile, multi-sensory, as well as oral and sensory processing.[14]

The **modulation of input** following sensory processing is measured under the following headings: modulation or 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 and modulation of visual input affecting emotional responses and activity level.[14]

The **behavioural and emotional responses** as a result of sensory processing and modulation are measured as: emotional/social responses, behavioural outcomes of sensory processing and items indicating thresholds for responses.[14]

The Sensory profile also indicates various **factors,** one or more of which can be the outcome related to the child's sensory processing and modulation. These factors are sensory seeking, emotionally reactive, low endurance/tone, oral sensory sensitivity, inattention/distractibility, sedentary and fine motor/perceptual.[14] The **factor scores** provide additional information which deal with the patterns of the child's responsivity to the environment.[14]

Quadrant scores provide additional information regarding the child's neurological thresholds and behavioural response patterns.[53] Further research was done following the publication of the Sensory profile and items were identified as being indicative of behaviour that is either low registration or sensation seeking. These items were combined onto a worksheet for calculating quadrant scores, which was developed in 2003, and these are added to the original Sensory profile score sheet (appendix C). [53]

The respondent completes the questionnaire by indicating the frequency with which their child engages in the behaviours in the assessment by marking: 1 - always; 2 – frequently; 3 – occasionally; 4 – seldom; 5 – never. [14]

Questions were asked on the child's sensory processing, modulation and the effects of this on behavioural and emotional responses. [15, 41,43,48,49]

3.3.2.2.1 Reliability

The test is also reliable with an internal consistency that is calculated at an alpha coefficient that ranged for items from .47 to .91. Items indicating a threshold have the lowest consistency with a coefficient of .47 and factor 6: emotional reactivity the highest of .91. [14, 43] The small standard error of measurement ranges between 1.0 –2.8. and is an indication of a reliable test.[14, 43]

3.3.2.2.2 Validity

Content validity: This was determined by a literature review, expert review and category analysis. Items were selected on the basis of how well they identified sensory-processing difficulties, discriminated among children with and without difficulties. Eight therapists reviewed the list of items and then a study was conducted to categorise items. Results indicated that 80% of the therapists agreed on the category placements on 63 % of the items.[14]

Construct validity: This is made up of convergent validity and discriminant validity

Convergent validity indicated that there were large correlations between the Sensory profile factor 9 and the three sections of the School Function Assessment (SFA). There were moderate correlations between behavioural regulation on the SFA and the modulation section of the Sensory profile.[14]

Discriminant validity indicated that there were low correlations between the SFA and the items on the Sensory profile.[14]

3.3.2.2.3 Scoring of Sensory profile

The questionnaire requires a respondent to choose an answer as follows: 1 - always; 2 – frequently; 3 – occasionally; 4 – seldom; 5 – never. [14]

Each answer is then scored e.g. always receives a score of 1 and occasionally receives a score of 3. At the end of a subdivision all the scores under always are added (1+1…), all the scores under frequently are added (2+2 …) and all the scores under occasionally are added (3+3…) etc. to obtain the subtotal for each answer. These subtotals are then added to determine the total raw score for the subdivision.[14]

The total raw score for each section is then transferred to the Sensory profile summary score sheet (appendix B). On the score sheet the raw score obtained by the child is then compared to the total raw score in order to determine the level of performance.

The total score for each section is then calculated for three different levels of performance:

1. **Typical performance**: scored at or above the point 1SD below the mean.[14]
2. **Probable difference**: is scored at or above the point -2SD below the mean, but lower than 1SD below the mean. This range indicate questionable areas of sensory processing abilities.[14]
3. **Definite difference**: is scored well below the mean, below -2SD. This range indicates that the child is performing like a child in the lowest 2% of the research sample.[14]

3.4 Ethical considerations

Ethical clearance was obtained from the Ethics committee for research on human subjects at the University of the Witwatersrand (M 060413). (appendix F). Prior to the start of the study permission was also obtained from the Local educational authority (LEA), or from the head teacher of the participating schools' according to each schools set procedures. All the parents/guardians of the children identified were contacted for informed consent to participate in the study.

Participation in the study was voluntary and participants could drop out of the study at any time without giving an explanation.

Confidentiality was maintained by the use of a number for each child instead of names on all questionnaires and results. Names of participants identified were protected at all times and were not published or made public at any time. The researcher was the only person who had access to the information and was the only person to have access to the name list and the numbers used. The list of names was kept locked in an office within a locked cabinet and will be destroyed on the completion of the study.

It was necessary to know the identity of the child so that if problems were identified on the questionnaires, parents/guardians could be contacted and informed about these problems.

Feedback was offered on request from the parents, by providing them with a short report as devised by the Sensory profile computer program.[54] (Appendix P)

3.5 Research procedure

The population for this study was obtained from within Greater London and the South of England. The participants were obtained by sending out a request to participate to the parents/guardians of children identified by the special needs coordinator/speech and language therapist/occupational therapist at schools within this area. The study was conducted over period of a year from July 2006 to July 2007.

Step 1: The researcher contacted the LEAs in the Greater London and the South of England by e-mail requesting information regarding special schools for speech and language disabilities and mainstream schools with a language unit or base. No ethical permission was needed from the department of education or the LEAs prior to the start of the study.

Step 2: The schools listed by the LEA's were contacted by post and given the opportunity to participate in the study (Appendix G & H). The letter sent to the schools explained the aim of the study and invited the head teacher and the special needs coordinator/speech and language therapist/occupational therapist at

the school to participate in the study by identifying children that met the inclusion criteria for the study.

The researcher then contacted the special needs coordinators/speech and language therapists/occupational therapists from the schools where the head teacher gave permission for the study to be conducted in their school, to request their assistance in the study. (Appendix I & J)

Information sheets (Appendix K) and informed consent sheets were sent to these special needs coordinators/speech and language therapists/occupational therapists who signed informed consent if they agreed to participate. (Appendix J)

The special needs coordinators/speech and language therapists/occupational therapists were then asked to distribute letters regarding the study to the parents/guardians of the children they identified as fitting the inclusion criteria.

Step 3: The letters provided for the parents/guardians contained information regarding the study, and information brochure about sensory modulation and an informed consent form. The parents/guardians were requested to return the informed consent form to the researcher if they were willing to participate in the study. (Appendix K, L & M)

Information about sensory processing was included for the parents/guardians to make clear to them that sensory processing is a normal function in any person and it was therefore believed to be very important to offer parents/guardians information regarding the impact of sensory processing in daily life with the information sheet for this study.

Step 4: On receipt of the informed consent form the parents/guardians were sent the two questionnaires to complete. This procedure was followed to ensure confidentiality throughout the research process as the name of the child was kept separate from the questionnaires and known only to the researcher. (Appendix A, D & N)

Step 5: The parents/guardians were asked to complete the questionnaire according to the enclosed guidelines and to return it to the researcher in the self-addressed envelope.

On receipt of the questionnaire a number was assigned to each child to ensure confidentiality. (Appendix O)

Following the study, the parents/guardians of children who participated were contacted and a report on the outcome of the Sensory profile was provided. (appendix P) Contact details were included in case parents wanted to discuss the report or needed more information regarding problems identified.

Step 6: Scoring of questionnaires and analyzing of data.

3.6 Data processing and analysis

3.6.1 Data processing

All information was reviewed in terms of the total population, as well as in terms of the children with expressive difficulties, receptive difficulties and those with a combination of both.

3.6.1.1 Background Information

The background information was obtained on the score sheet, which is a separate sheet from the Sensory profile and coded so that only the researcher could understand the information. From the score sheet the background information was analysed using descriptive statistics, including percentages, means and standard deviations, by assigning code a yes (1) or no (0) in order to determine the percentage of the population's by gender and diagnosis in terms of expressive/receptive or combination of difficulties and intervention received. The following were determined:

- the mean age of the sample.
- the mean number of impairments reported for each child
- the mean number of interventions received.

3.6.1.2 Developmental profile

- The data was divided into three groups for children with SLI e.g. mixed receptive expressive difficulties, receptive difficulties and expressive difficulties.

- Firstly the mean chronological age for each group was determined. All the mean chronological ages for children in the group were added together and then divided by the amount of children in a group.
- The mean developmental age was determined. The developmental ages for children in a group were added together and then divided by the number of children in the group to determine the mean developmental age.
- The same procedure was followed for each section of the test for each group.
- The average age per skill was then compared to the child's chronological age to determine if the children were functioning on an age appropriate level or below. Those with pervasive developmental delay were eliminated from the study.

3.6.1.3 Sensory profile

The raw scores and mean scores for each section were determined.

In order to determine the percentage of the sample receiving a typical score, probable difference scores or a definite difference score, the information was processed by assigning a score of 1 to the section of the participant's scores fell in that range or a score of 0 if the score did not fall in that range.

Example: If the participants' score fell within the probable difference range a score of 1 was assigned for probable difference and a score of 0 for typical score and definite difference.

The mean and standard deviation were calculated for each section.

Scores that fell within the definite difference range (below – 2SD) were considered to be indicative of a problem. Due to the small sample size it was also necessary in certain sections to combine the probable difference (-1SD) and definite difference (-2SD). As probable difference already lies below -1SD difficulties, it can be supposed that the child has difficulty in that area. In cases where there was not enough information to indicate a definite difference for a section, the combination of scores was then considered to determine if a larger percentage of the sample is having difficulties with that area of functioning.[12]

The scores for the typical population, the Autistic population and the ADHD population were obtained from the literature in order to compare them to the study sample.[14, 49, 50] The data was analysed under the supervision of a statistician. All

questionnaires were scored according to the guidelines in the manuals for the tests.

3.6.2 Statistical methods

Both ordinal data: (Likert scale ranked 1-5) and nominal data (gender) were organized for analysis.

Descriptive statistics were used to describe data regarding the percentage of the sample obtaining a typical score, a probable difference score or a definite difference score.[55]

The raw scores, mean and standard deviations were also determined.[55]

The following statistical procedures were used to analyze the data:

Parametric data was analyzed using the t-tests. This was used to establish if there were differences between the study population, the typical population, the autism population and the ADHD population.[55]

Non-parametric statistics, the Fisher test was used to determine if there were differences between the children with expressive difficulties, receptive difficulties and a combination of both. Testing was done at the 0.05 level of significance.[55]

Data analysis was done against the expected values for “typical performance” according to the range indicated on the Sensory profile scoring sheet.

CHAPTER 4

4. RESULTS

This chapter describes the results for the DP-II and the Sensory Profile completed on participants with SLI 260 children with speech and language disorders were identified but only parents and caregivers of 24 children completed the questionnaires. Two of these participants were found to have pervasive developmental disorders, diagnosed by a medical officer, so the final sample consisted of 22 questionnaires.

4.1 Demographics according to type of SLI

Of the total sample of 22 questionnaires eight were for females and 14 for males, thus the largest percentage of the sample was boys. Their mean age was 99 months (8 years 2 months) with an age range of 61 months to 128 months. Questionnaires allowed further categorisation of the participants by type of SLI into receptive language difficulties, expressive language difficulties and mixed receptive and expressive difficulties

4.1.1: Age & gender according to type of SLI

Table 4.1: Age & gender according to type of SLI

	Mixed receptive and expressive difficulties		**Receptive language difficulties**		**Expressive language difficulties**	
	40.91%		31.82%		27.27%	
Gender	2 girls	7 boys	3 girls	4 boys	3 girls	3 boys
Mean age (in months)	111	89	107	96	105	86
Age range	61 – 128 months		81 – 127 months		67 – 120 months	

Just fewer than half the sample presented with mixed receptive & expressive difficulties, with receptive and expressive difficulties being almost equally distributed in the remainder of the sample.

A combination of expressive and receptive difficulties were more prevalent in this sample (nine children) compared to receptive language difficulties (seven children) and expressive difficulties (six children). It was also found that the girls in the sample were at least 12 months older than the boys in all three groups.

4.1.2 Intervention received according to type of SLI

Table 4.2 shows that children with mixed receptive and expressive difficulties (100% of the mixed sample) received more intervention and special education than children with receptive (57%) and expressive difficulties (83%).

Table 4.2: Intervention received according to type of SLI

N = 22	**Mixed receptive and expressive difficulties**	**Receptive language difficulties**	**Expressive language difficulties**
Total participants	**9**	**7**	**6**
Early intervention	2 (22%)	0	1 (16%)
Mainstream education	2 (22%)	4 (57%)	4 (66%)
Special education	8 (88%)	4 (57%)	3 (50%)
Occupational therapy	6 (66%)	4 (57%)	4 (66%)
Physiotherapy	3 (33%)	1 (14%)	0 (0%)
Speech and language therapy	9 (100%)	4 (57%)	5 (83%)

More than half of all three groups also received occupational therapy, which is an indication that their difficulties are having such an impact on their occupations (self care, school work and play) that it warrants a referral to an occupational therapist for intervention.

4.1.3 Developmental Skills by SLI Type according to the Developmental profile II

These results indicated that the sample developmental skills were well below that expected for children of their age. The results of the DP-II indicated that the mean chronological age for this sample was 99 months but there were no statically significant differences in the chronological ages between the groups.

According to the DP-II the mean developmental age was 51.8 months. This is well below that of the chronological age. The participants with expressive difficulties had the most difficulties with these developmental skills as the difference between their chronological age and developmental age differs with 52.10 months (4 years 3 months). This group was statistically significantly lower in the developmental age than the receptive group ($p \leq 0.02$) as were the mixed group ($p \leq 0.03$). Participants with expressive difficulties also had the most difficulty with physical skills, social skills, academic skills and communication skills and were significantly different to the receptive group ($p \leq 0.04$).

Table 4.3: Developmental Profile II: Mean developmental skills ages (in months) according to type of SLI.

	Mixed receptive and expressive difficulties	**Receptive language difficulties**	**Expressive language difficulties**
	Mean score	**Mean score**	**Mean score**
Mean chronological age	100.0	101.5	95.50
Mean developmental age	50.36	61.74	43.40
Difference chronological and developmental age	*49.64*	*39.76*	*52.10*
Physical skills	58.56	70.86	41.33
Self help skills	45.89	63.43	47.33
Social skills	47.22	59.86	43.67
Academic skills	55.44	64.57	43.67
Communication skills	44.67	50.00	41.00

No other statistically significant differences were found even though the participants with mixed difficulties had the most difficulty with self-help skills. The self-help skills that were measured in the DP-II were all personal management activities which include dressing, washing and eating.

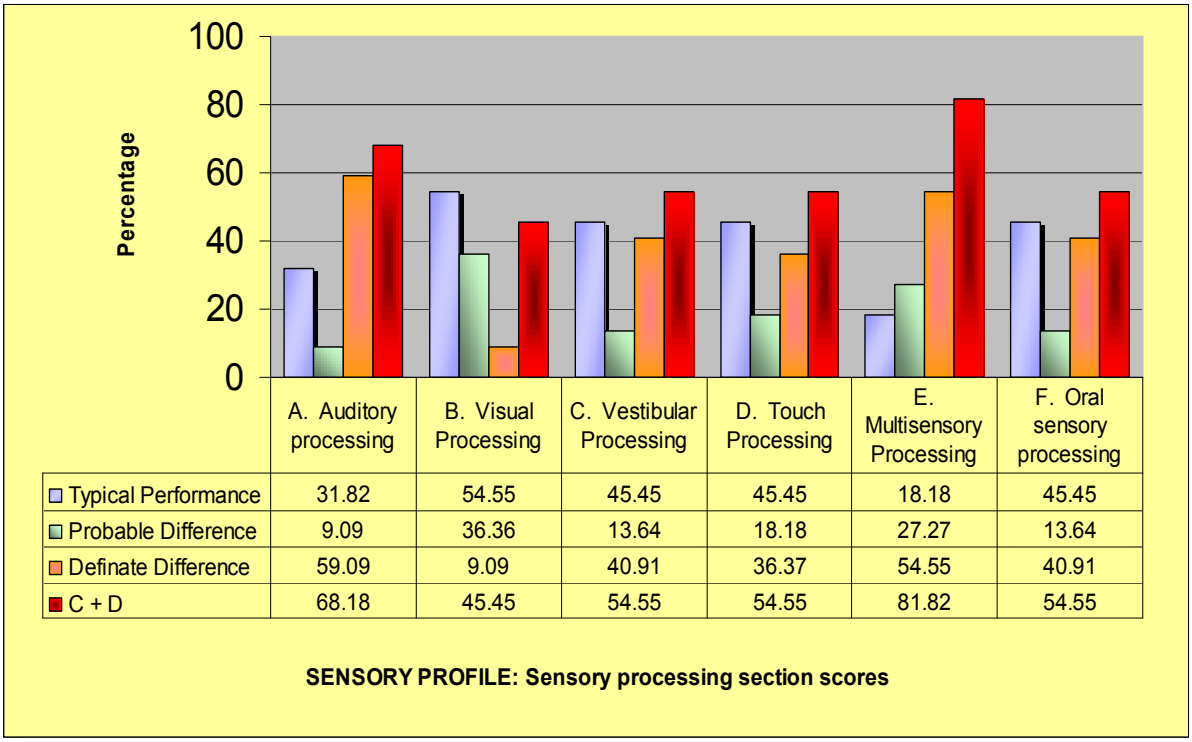
4.2 Sensory Profile

The Sensory Profile for the entire sample, with all three subgroups together were analysed first.

4.2.1 Sensory processing section scores

Sensory processing in the six different modalities was analysed.

Figure 4.1 indicates that the main difficulties for sensory processing were in multi-sensory processing (81.82% of the sample received a score of probable and definite difference) and auditory processing (68.18%).



	A. Auditory processing	B. Visual Processing	C. Vestibular Processing	D. Touch Processing	E. Multisensory Processing	F. Oral sensory processing
Typical Performance	31.82	54.55	45.45	45.45	18.18	45.45
Probable Difference	9.09	36.36	13.64	18.18	27.27	13.64
Definate Difference	59.09	9.09	40.91	36.37	54.55	40.91
C + D	68.18	45.45	54.55	54.55	81.82	54.55

Figure 4.1: Sensory profile results for sensory processing.

The combination of probable and definite scores also indicated some dysfunction in vestibular processing (54.55%); touch processing (54.55%) and oral processing (54.55%). Only visual processing received a typical score of more than 50%.

4.2.2 Modulation section scores

As seen in figure 4.2 dysfunction was noted in modulation of sensory input affecting emotional response, as 81.82% of the children, obtained a combined score of probable and definite difference.

A combined score also indicated that more than half of the sample (54.54%) of the children had difficulties with modulation of movement affecting activity level.

All other categories scored above 50% for typical performance.

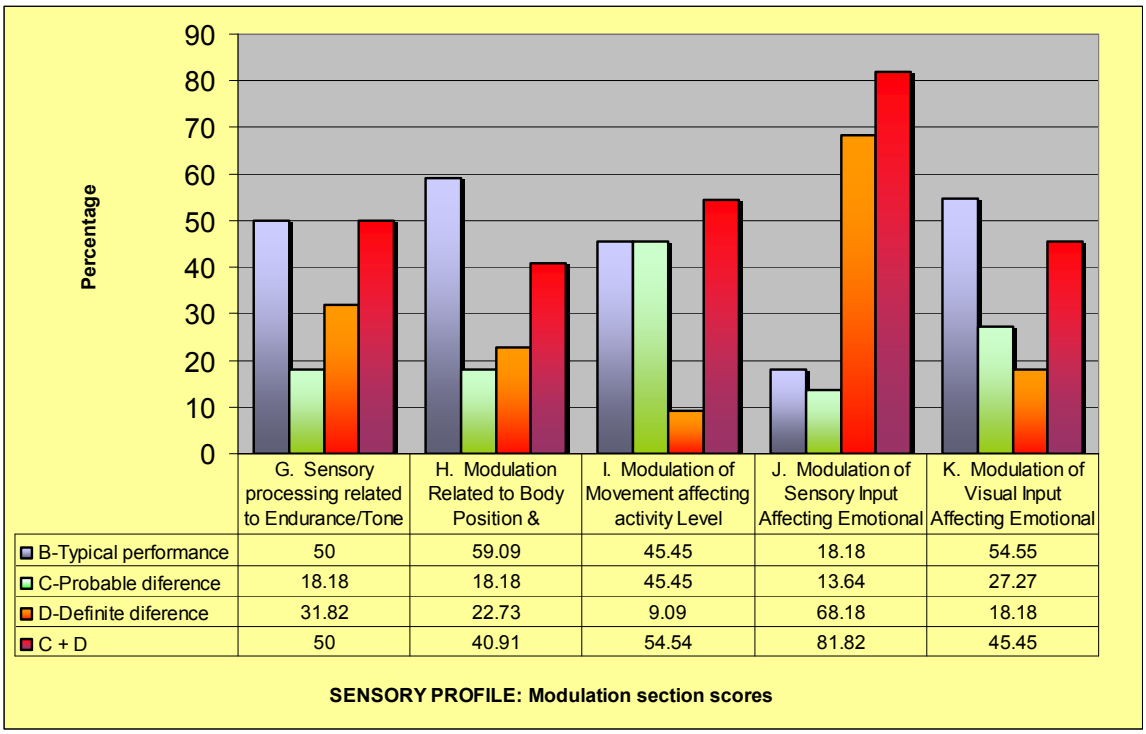


Figure 4.2: Modulation section results on the sensory profile.

4.2.3 Behavioural and emotional responses section scores

Behaviour and emotional responses on the Sensory Profile proved to be problematic for the SLI sample.

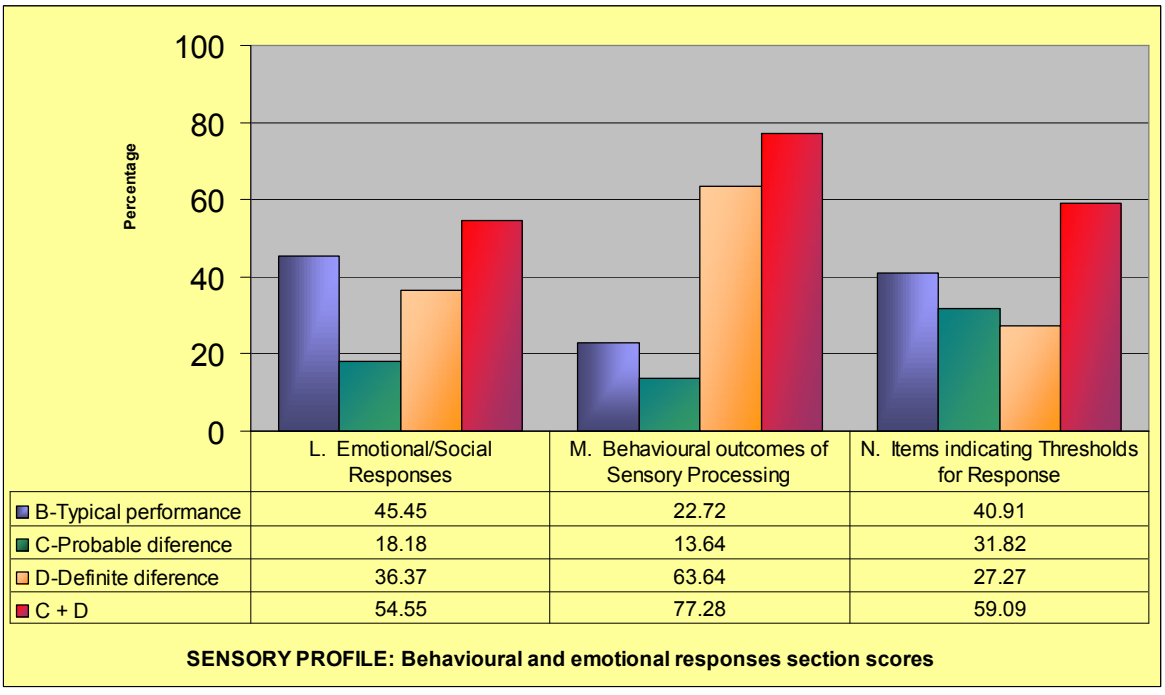
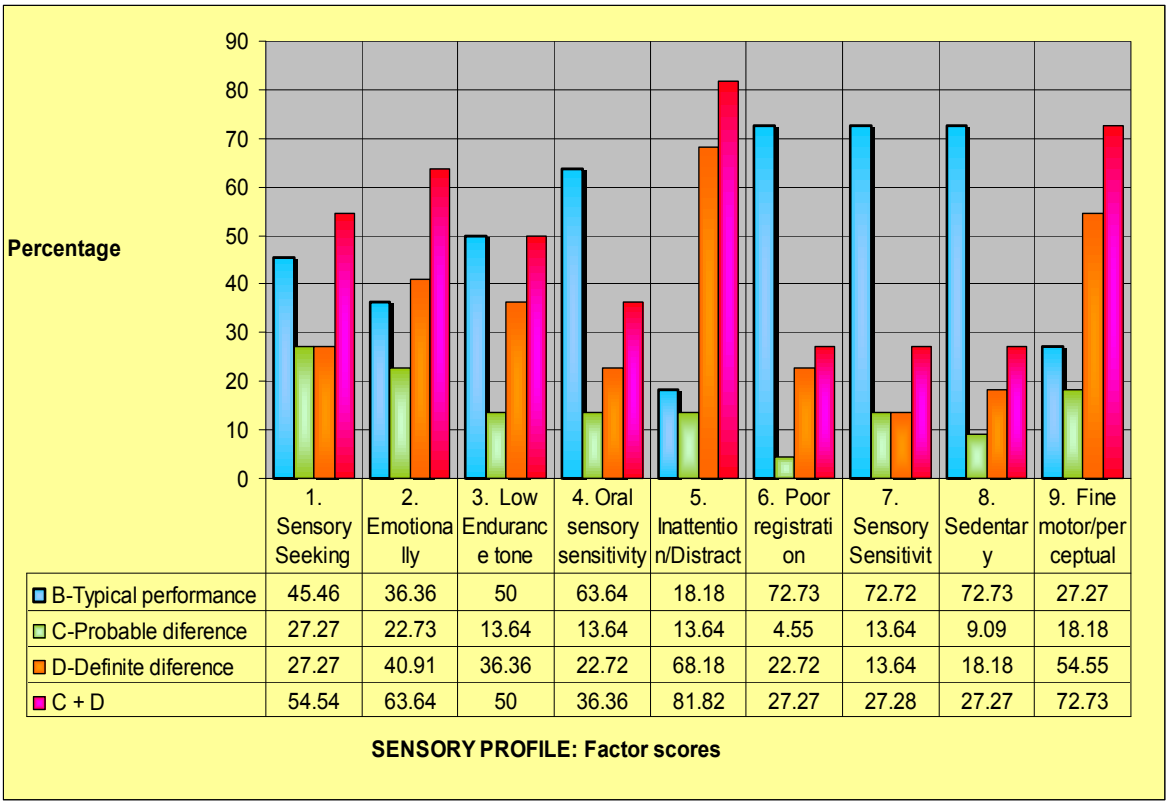


Figure 4.3: Behavioural and emotional responses section results on the Sensory profile.

The results showed that 77.28% of this sample had difficulty with behavioural outcomes of sensory processing and that more than half of the sample had difficulties with items indicating thresholds for response (59.09%) and emotional and social responses (54.55%).(Figure 4.3)

4.2.4 Factor scores

The Sensory Profile also indicates factor scores. These were determined by factor analysis that indicated responsiveness in various meaningful patterns of performance.[12] Nine factors were found to be meaningful to describe children's responsiveness (overly responsive or under responsive) to sensory input: sensory seeking, emotionally reactive, low endurance/tone, oral sensory sensitivity, inattention/distractibility, poor registration, sensory sensitivity, sedentary and fine motor/perceptual skills.



	1. Sensory Seeking	2. Emotionally	3. Low Endurance tone	4. Oral sensory sensitivity	5. Inattention/Distract	6. Poor registration	7. Sensory Sensitivit	8. Sedentary	9. Fine motor/perceptual
B-Typical performance	45.46	36.36	50	63.64	18.18	72.73	72.72	72.73	27.27
C-Probable diference	27.27	22.73	13.64	13.64	13.64	4.55	13.64	9.09	18.18
D-Definite diference	27.27	40.91	36.36	22.72	68.18	22.72	13.64	18.18	54.55
C + D	54.54	63.64	50	36.36	81.82	27.27	27.28	27.27	72.73

Figure 4.4: Factor score results on the sensory profile

Figure 4.4 indicate that this sample had difficulties with factor 5: inattention and distractibility (81.82%), factor 9: fine motor/perceptual (72.73%), factor 2: Emotionally reactive (63.64%) and factor 1: sensory seeking (54.54%).

4.2.5 Quadrant score

Dunn proposed a theoretical model that looked at the relationship between neurological thresholds and behavioural (self regulation) strategies. Four basic patterns of responding to sensory events in everyday life were identified low registration, sensation seeking, sensory sensitive and sensation avoiding. The SLI sample has difficulties with all four quadrants. The results in figure 4.5 indicate that this sample is sensory sensitive (81.81%) in their behaviour and also sensory seeking behaviour (77.27%)

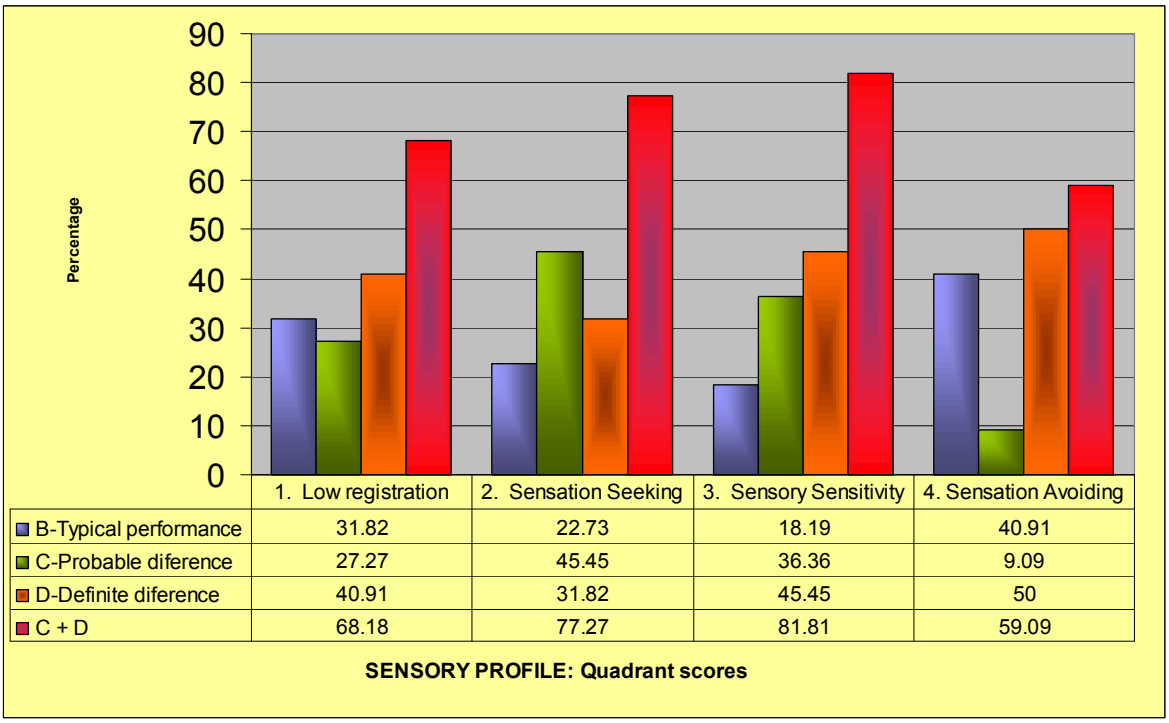


Figure 4.5: Quadrant score results on the sensory profile

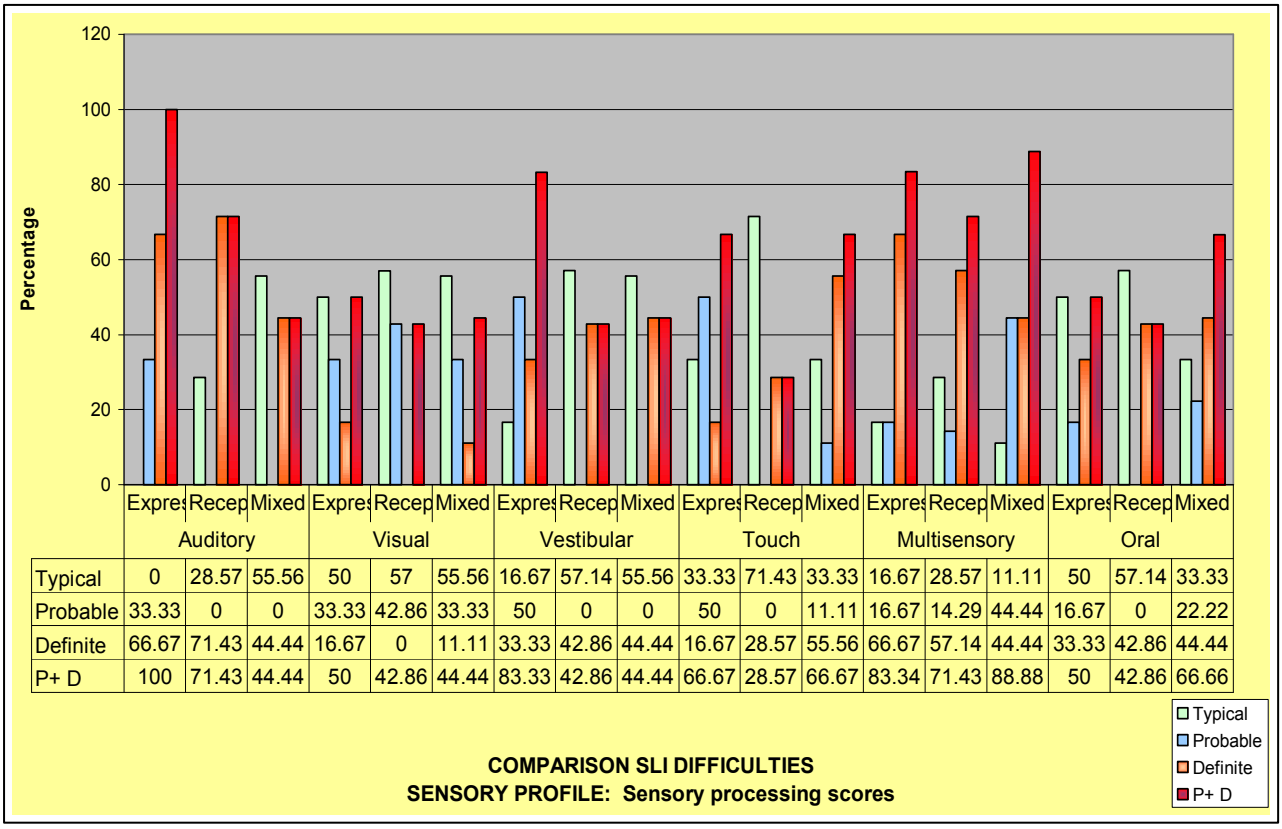
It was also found that 68.18% of the sample showed low registration of sensory input, with 59.09% of the sample having difficulty with sensory avoiding behaviour.

4.3 Comparison of scores between mixed receptive expressive difficulties, receptive difficulties and expressive difficulties.

Another question raised during the research was to establish if there are any differences in the Sensory Profile between the various groups of difficulties e.g. for those with predominantly receptive problems when compared to those with

predominantly expressive problems or those who have a combination of receptive and expressive problems.

Fisher exact tests indicated a moderate significance (p=0.063) between mixed receptive-expressive difficulties, receptive difficulties and expressive difficulties on only auditory processing. No other significant differences were found.



	Auditory			Visual			Vestibular			Touch			Multisensory			Oral		
Typical	0	28.57	55.56	50	57	55.56	16.67	57.14	55.56	33.33	71.43	33.33	16.67	28.57	11.11	50	57.14	33.33
Probable	33.33	0	0	33.33	42.86	33.33	50	0	0	50	0	11.11	16.67	14.29	44.44	16.67	0	22.22
Definite	66.67	71.43	44.44	16.67	0	11.11	33.33	42.86	44.44	16.67	28.57	55.56	66.67	57.14	44.44	33.33	42.86	44.44
P+ D	100	71.43	44.44	50	42.86	44.44	83.33	42.86	44.44	66.67	28.57	66.67	83.34	71.43	88.88	50	42.86	66.66

Figure 4.6: Comparison sensory scores between types of SLI difficulties

The expressive group were found to have difficulties with auditory processing (100%), vestibular processing (83.3%), touch processing (66.67%) and multi-sensory processing (71.43%). The receptive group had the difficulties with auditory processing (71.43%) and multi-sensory processing (71.43%). The mixed group had difficulties with touch processing (66.67%), multi-sensory processing (88.88%) and Oral sensory processing (66.66%).

Figure 4.6 indicates that 100% of the group with expressive difficulties and 71.43% of the group with receptive difficulties obtained probable and definite difference scores for auditory processing. Difficulties with vestibular processing were found in 83.33% of children with expressive difficulties.

It was also found that 66.67% of children with expressive and mixed difficulties obtained scores of probable or definite difference for touch processing.

Multi-sensory processing was found to be a problem for all three groups; expressive difficulties = 83.34%, receptive difficulties = 71.43 % and mixed difficulties 88.88%. Children with mixed difficulties had the most difficulty with oral processing = 66.66%

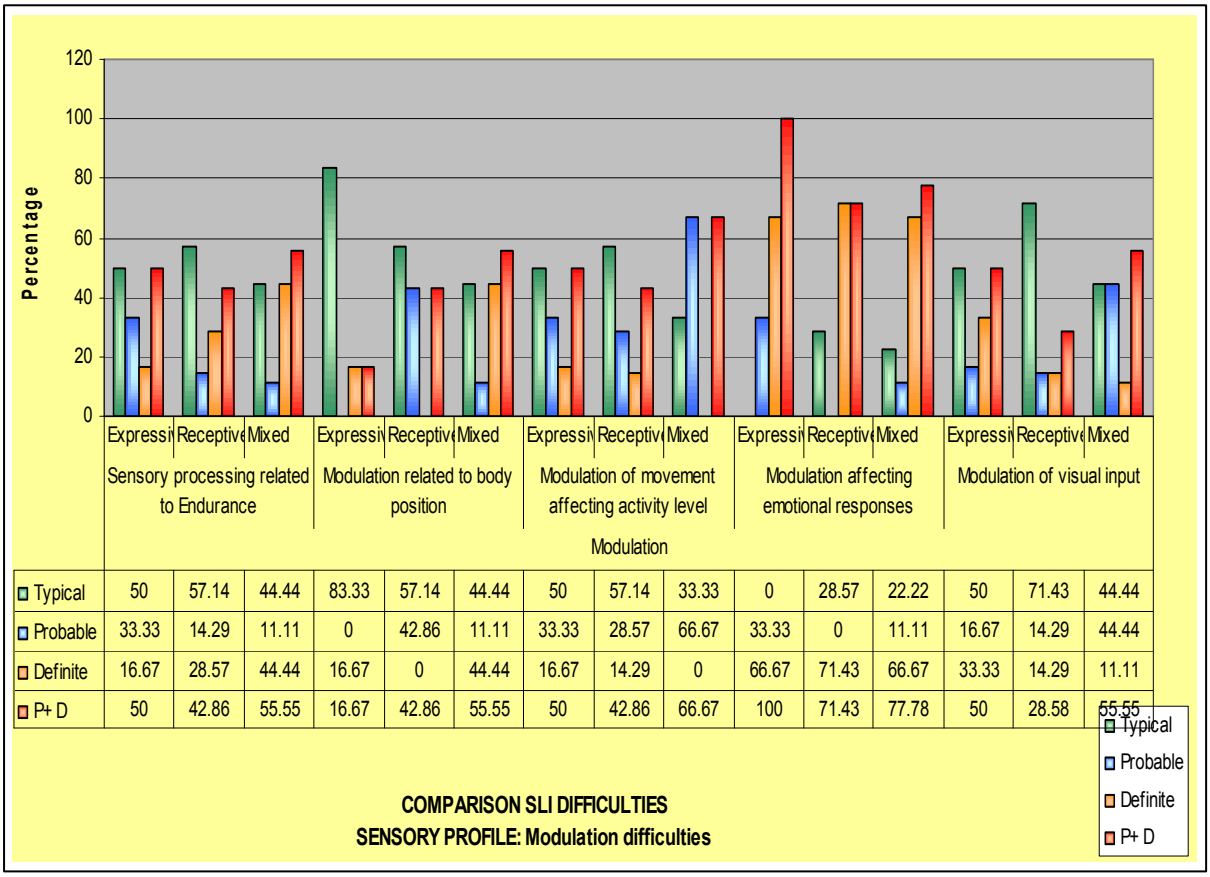
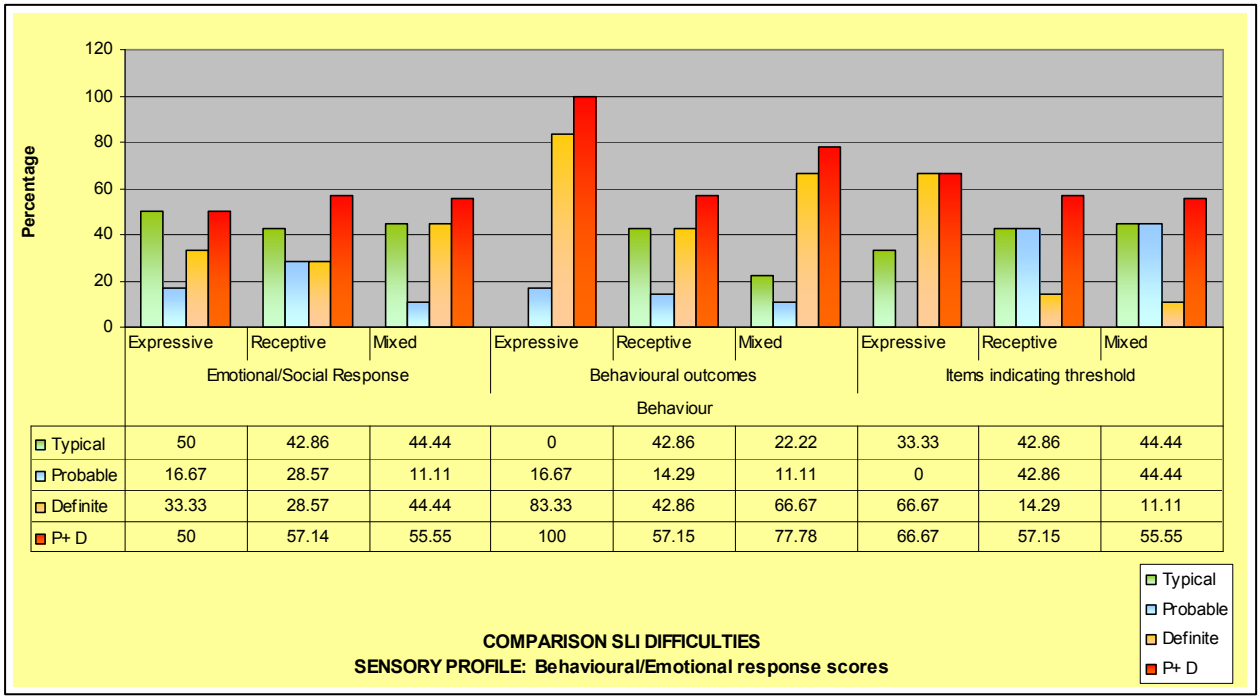


Figure 4.7: Comparison modulation scores between types of SLI difficulties

Figure 4.7 indicated that 66.67% of children with mixed difficulties had difficulties with modulation affecting activity level. Modulation of sensory input affecting emotional responses were found to be a problem for 100% of the children with expressive difficulties, 71.43 % of children with receptive difficulties and 77.78% of the children with mixed difficulties.



	Expressive	Receptive	Mixed	Expressive	Receptive	Mixed	Expressive	Receptive	Mixed
Typical	50	42.86	44.44	0	42.86	22.22	33.33	42.86	44.44
Probable	16.67	28.57	11.11	16.67	14.29	11.11	0	42.86	44.44
Definite	33.33	28.57	44.44	83.33	42.86	66.67	66.67	14.29	11.11
P+ D	50	57.14	55.55	100	57.15	77.78	66.67	57.15	55.55

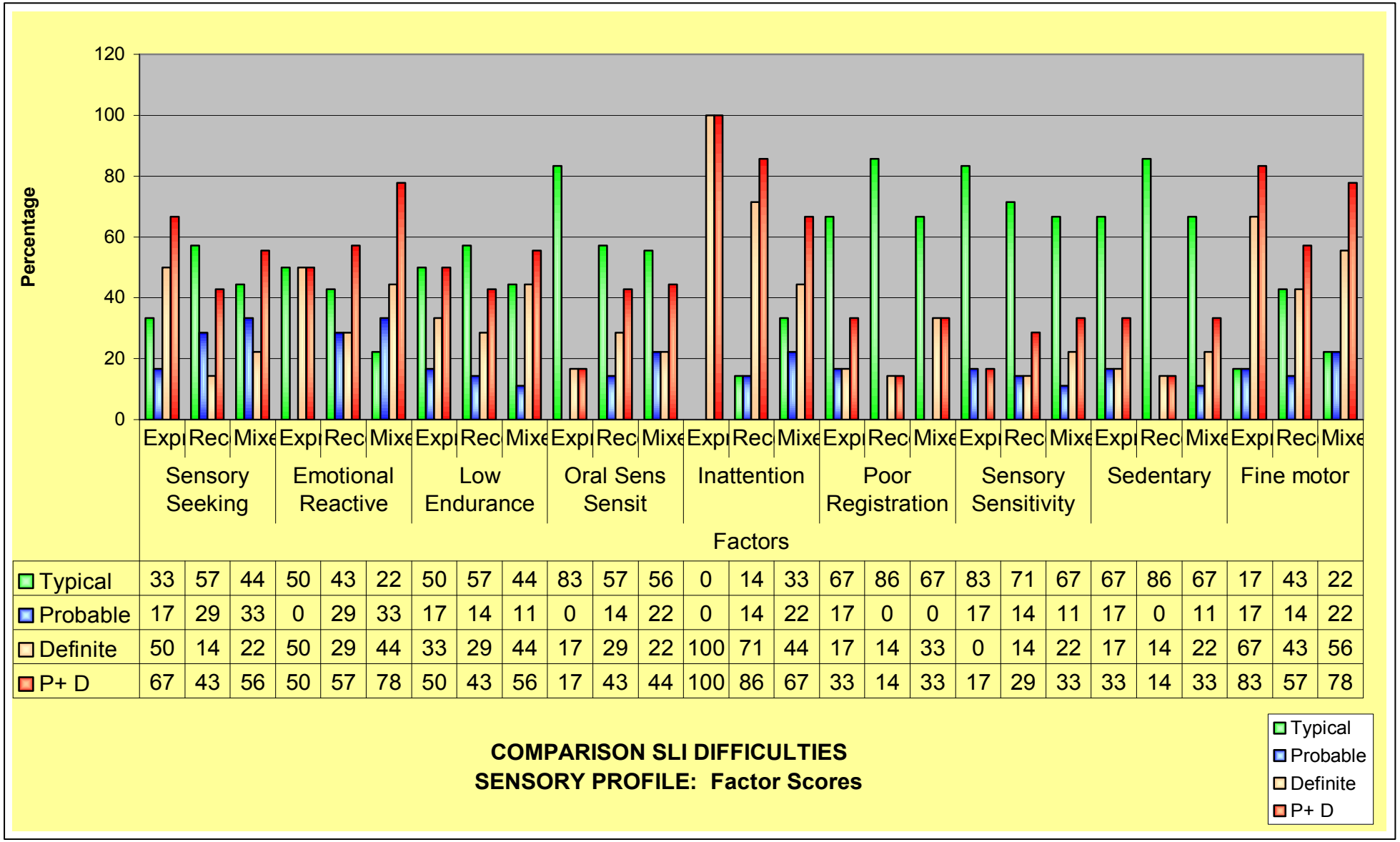
Figure 4.8: Comparison behaviour/emotional section scores between types of SLI difficulties

A 100% of children with expressive difficulties and 77.78% of children with mixed difficulties had probable and definite difference scores for behavioural outcomes of sensory processing (figure 4.8)

Figure 4.9. (See next page for graph)

The group of children with mixed receptive-expressive difficulties were found to have difficulties with emotionally reactive (77.77%), Inattention/distractibility (66.66%) and fine motor/perceptual skills (77.78%).

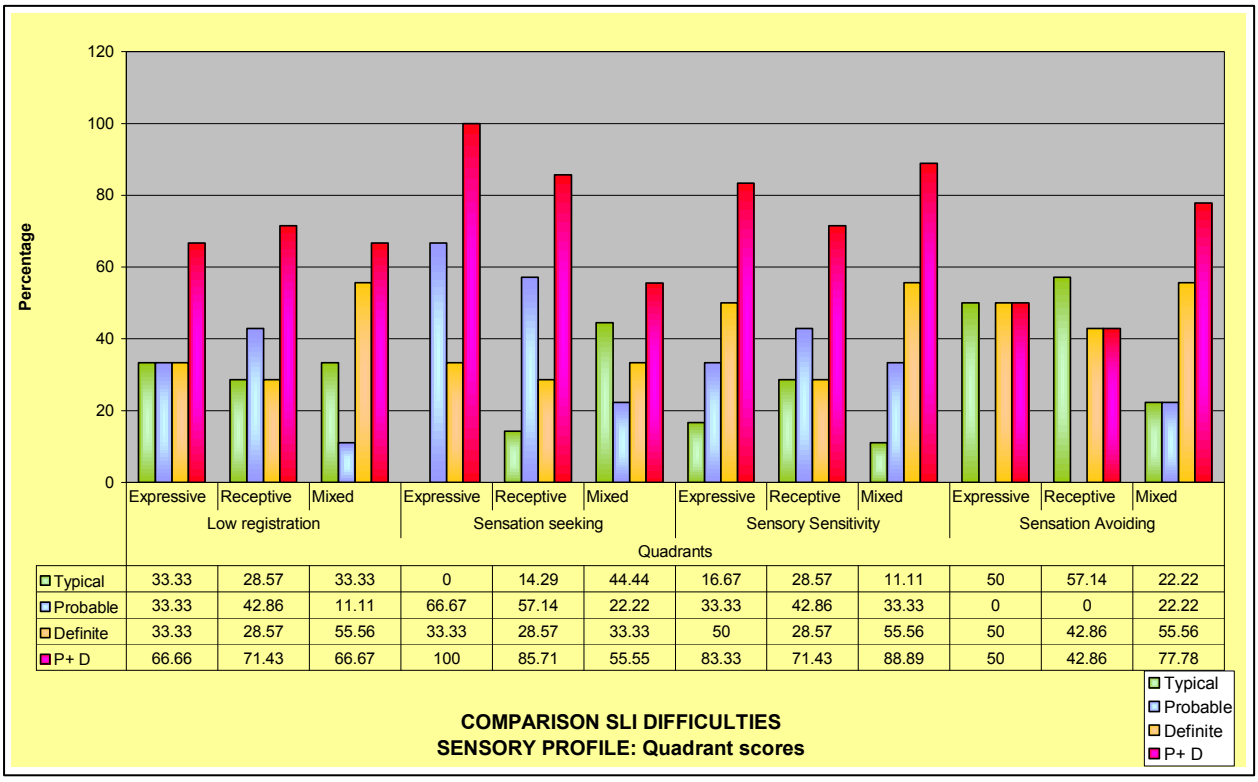
Figure 4.9 showed the difference in the factor scores between the three groups of speech and language difficulties. Children with expressive difficulties were found to have difficulties with sensation seeking (66.67%), emotionally reactive (50%), inattention/distractibility (100%) and fine motor/perceptual skills (83.34%). Children with receptive difficulties were found to obtain probable and definite difference scores for emotionally reactive (57.14%), inattention/distractibility (85.72%), fine motor/perceptual skills (57.15%).



	Sensory Seeking			Emotional Reactive			Low Endurance			Oral Sens Sensit			Inattention			Poor Registration			Sensory Sensitivity			Sedentary			Fine motor		
Typical	33	57	44	50	43	22	50	57	44	83	57	56	0	14	33	67	86	67	83	71	67	67	86	67	17	43	22
Probable	17	29	33	0	29	33	17	14	11	0	14	22	0	14	22	17	0	0	17	14	11	17	0	11	17	14	22
Definite	50	14	22	50	29	44	33	29	44	17	29	22	100	71	44	17	14	33	0	14	22	17	14	22	67	43	56
P+ D	67	43	56	50	57	78	50	43	56	17	43	44	100	86	67	33	14	33	17	29	33	33	14	33	83	57	78

Figure 4.9: Comparison factor scores between types of SLI difficulties

The quadrant scores as seen in figure 4.10 also indicated that all three groups showed patterns in all four quadrants. Low registration was found to be a pattern of behaviour for expressive difficulties (66.66%), receptive difficulties (71.43%) and mixed receptive-expressive difficulties (66.67%). (Figure 4.10)



	Low registration			Sensation seeking			Sensory Sensitivity			Sensation Avoiding		
	Expressive	Receptive	Mixed	Expressive	Receptive	Mixed	Expressive	Receptive	Mixed	Expressive	Receptive	Mixed
Typical	33.33	28.57	33.33	0	14.29	44.44	16.67	28.57	11.11	50	57.14	22.22
Probable	33.33	42.86	11.11	66.67	57.14	22.22	33.33	42.86	33.33	0	0	22.22
Definite	33.33	28.57	55.56	33.33	28.57	33.33	50	28.57	55.56	50	42.86	55.56
P+ D	66.66	71.43	66.67	100	85.71	55.55	83.33	71.43	88.89	50	42.86	77.78

Figure 4.10: Comparison quadrant scores between types of speech and language difficulties

Sensory seeking behaviour patterns were found in 100% of the expressive difficulties group, 85.71% of the receptive difficulties group and 55.55% of the mixed group. It was further found that 83.33% of the group with expressive difficulties showed sensory sensitivity patterns of behaviour, 71.43% of children with receptive difficulties had sensory sensitivity and 88.89% of the mixed receptive-expressive group were sensory sensitive.

Sensory avoiding was only found to be a difficulty for the mixed receptive-expressive group (77.78%)

4.4 Comparison of Scores between SLI and other populations.

The study also investigated the difference in patterns of performance in this sample and how they differ from the patterns with **other populations** already established in other research and the literature. **Significant at p= 0.05**

Table 4.4: Comparison of scores between populations (red indicates areas where there were significant differences).

Sensory Processing	Speech M	St Dev	Typical M	St Dev	p	Autism M	St Dev	p	ADHD M	St Dev	p
A. Auditory processing	25.8	7.0	33.1	3.8	0.00	25.0	5.1	0.63	23.8	5.4	0.16
B. Visual Processing	32.8	6.5	37.4	4.2	0.00	30.6	6.0	0.21	30.5	5.7	0.11
C. Vestibular Processing	45.0	7.5	51.7	3.1	0.00	42.8	4.7	0.19	42.7	7.2	0.19
D. Touch Processing	70.2	11.7	81.6	7.2	0.00	60.1	10.6	0.00	65.4	10.1	0.06
E. Multi-sensory Processing	23.0	4.6	30.4	2.7	0.00	20.7	4.3	0.06	22.3	3.8	0.47
F. Oral sensory processing	44.6	11.4	53.0	6.4	0.00	38.2	10.0	0.03	44.4	9.8	0.93
Modulation											
G. Sensory processing related to Endurance/Tone	35.4	9.4	42.5	3.5	0.00	34.4	8.7	0.69	36.9	8.0	0.46
H. Modulation Related to Body Position & Movement	40.3	8.2	45.7	3.5	0.00	35.9	5.5	0.02	36.6	6.7	0.04
I. Modulation of Movement affecting activity Level	22.5	3.9	27.0	3.5	0.00	21.4	3.2	0.26	21.8	4.0	0.47
J. Modulation of Sensory Input Affecting Emotional Responses.	12.4	3.4	18.1	1.9	0.00	11.7	2.9	0.42	14.3	2.7	0.01
K. Modulation of Visual Input Affecting Emotional Responses and Activity Level	13.8	3.4	16.8	2.1	0.00	12.6	2.4	0.13	12.6	2.7	0.10
Behaviour and Emotional Responses											
L. Emotional/Social Responses	57.1	11.9	70.6	9.0	0.00	50.9	8.4	0.03	53.0	9.6	0.10
M. Behavioural outcomes of Sensory Processing	16.9	4.7	25.2	2.9	0.00	16.9	3.1	1.00	19.3	3.9	0.02
N. Items indicating Thresholds for Response	10.9	2.5	13.4	1.5	0.00	10.1	2.8	0.28	10.0	2.3	0.12
Factor scores	**Speech M**	**St. Dev**	**Typical M**	**St Dev**	**P**	**Autism M**	**St Dev**	**p**	**ADHD M**	**St Dev**	**p**
1. Sensory Seeking	58.1	11.5	74.1	7.3	0.0	56.1	10.4	0.51	51.9	12.5	0.04
2. Emotionally reactive	48.6	12.0	65.2	9.1	0.00	43.0	8.3	0.05	46.0	10.2	0.32
3. Low Endurance tone	35.4	9.4	42.3	3.5	0.00	34.4	8.7	0.69	36.9	8.0	0.46
4. Oral sensory sensitivity	33.1	9.6	39.2	5.4	0.00	30.5	7.0	0.25	33.5	8.3	0.84
5. Inattention/Distractibility	19.4	5.8	27.9	3.7	0.00	19.9	4.3	0.72	18.0	4.6	0.25
6. Poor registration	34.1	4.6	36.7	3.4	0.00	27.5	5.2	0.00	30.9	4.5	0.01
7. Sensory Sensitivity	16.8	3.7	18.4	2.1	0.00	15.0	4.5	0.13	16.6	3.2	0.81
8. Sedentary	13.5	4.4	15.0	2.6	0.03	12.9	3.4	0.57	13.7	3.5	0.83
9. Fine motor/perceptual	7.5	3.3	13.4	1.8	0.00	7.1	2.3	0.60	9.6	2.5	0.00

A significant difference in performance was also found between the SLI sample and children with ADHD in modulation related to body position & movement (p=0.04), modulation of sensory input affecting emotional responses (p=0.01), behavioural outcomes of sensory processing (p=0.02), factor 1: sensory seeking (p=0.04), factor 6: poor registration (p=0.01) and factor 9: fine motor/perceptual (p=0.00).

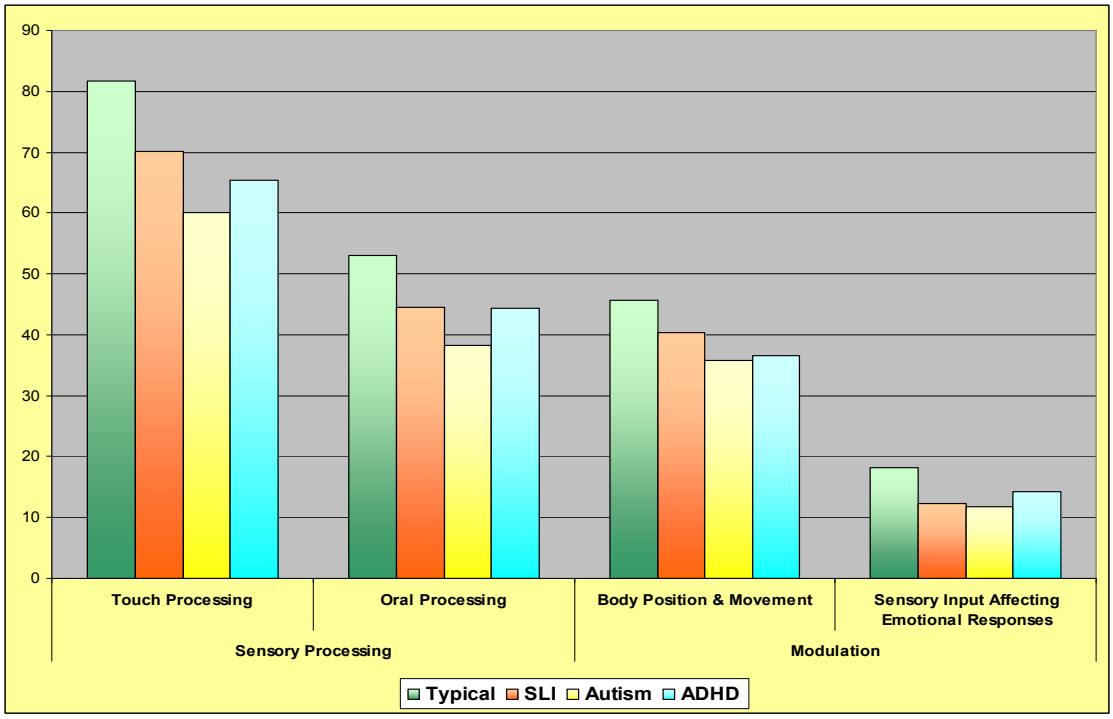


Figure 4.11: Comparison of raw scores between populations for sensory processing & modulation.

As can be seen in Figure 4.11 the sensory processing and modulation of the SLI group is similar to that of the ADHD group except for sensory input affecting emotional responses where the scores are lower and more similar to the autistic group.

Figure 4.12 shows a similar trend for behavioural and factor scores

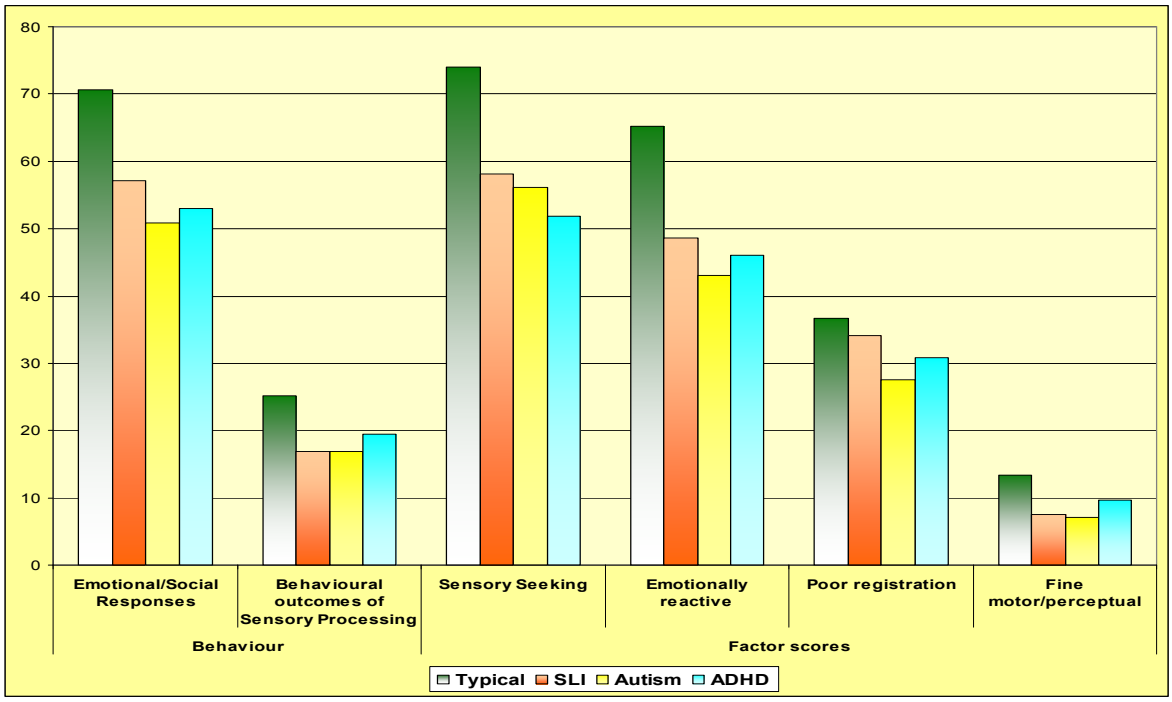


Figure 4.12: Comparison of raw scores between populations for behaviour and factor scores.

4.5 Summary of Results

The objectives of the study were to determine the following:

- The sensory processing of children with SLI in each sensory system including the modulation and behavioural and emotional responses that reflect the child's behavioural outcomes. The statistical analysis did indicate that the SLI sample had difficulty with all areas of **sensory processing** (multi-sensory processing and auditory processing, as well as vestibular processing, touch processing and oral processing). Visual processing proved to be an area of strength for the sample.

  The sample were experiencing difficulties with **modulation** of sensory input affecting emotional response and modulation of movement affecting activity level.

  Behaviour and emotional responses on the Sensory Profile proved to be problematic for the sample SLI population.
- What responsiveness in the factor scores might be characteristic of children with specific language impairment? The results indicated that the sample had difficulties with factor 5: inattention and distractibility, factor 9: fine motor/perceptual, factor 2: emotionally reactive and factor 1: sensory seeking.

- To determine whether there are unique **patterns of performance** in this sample. Four basic patterns of responding to sensory events in everyday life were identified in literature through the quadrant scores.

  It was found that the study sample had difficulties in all four quadrants, but especially in sensory sensitivity and sensory seeking patterns of behaviour.
- To establish how the performance on the sensory Profile **differs** for those with predominantly receptive problems when compared to those with predominantly expressive problems or those who have a mixed picture of receptive and expressive problems. T-test analysis indicated that there was only a mild significant difference between the groups for auditory processing. Although there were differences in other areas none were proven to be significant.
- To determine whether the **patterns of performance** in this sample differ from the patterns with **other populations** already established in other research and the literature. T-test analysis found that there were significant differences between the sample and the **normal/typical population** in all areas measured on the sensory Profile.

  Significant differences were found between the sample SLI and the **Autistic** population in modulation related to body position & movement, emotional/social responses, factor 2: emotionally reactive, and factor 6: poor registration, as well as touch processing and oral sensory processing.

  A significant difference in performance was also found between the sample and children with **ADHD** in modulation related to body position & movement, modulation of sensory input affecting emotional responses, behavioural outcomes of sensory processing, factor 1: sensory seeking, factor 6: poor registration, and factor 9: fine motor/perceptual.

  The results found in the study indicated that the objectives measured showed that there are differences in the way that children with SLI process sensory information, how it reflects in their behaviour and in their specific patterns of behaviour. It is different from other populations, but does not necessarily differ between the type of speech and language difficulties the group were experiencing.

CHAPTER 5

5. DISCUSSION

5.1 Introduction to discussion and overview of the study

The results of this study will be discussed in terms of the demographics of the sample and the Model of Sensory Processing. The total samples' Sensory Profiles will be discussed in order to determine the sensory processing patterns of the SLI participants. This includes how the Sensory Profile are influenced by sensory processing in the various systems, the modulation and behavioural and emotional responses that reflect the participants' behavioural outcomes, as well as how it is reflected in their factor scores. The sensory profile for the SLI participants was compared to the sensory profile of other populations, already established in research. This was done as the literature indicated differences between various disability groups that can assist with the diagnosis of the specific disability.[14, 15, 41, 48, 49, 50]

The participants were divided into three groups: those with expressive, receptive and mixed expressive-receptive difficulties. These groupings were considered according to the developmental delays and areas of school performance, social skills, self-care and physical skills as identified on the DP-II and differences in Sensory Profile found for each group.

The scores obtained on the DP-II and Sensory Profile for 22 participants with SLI were analysed to establish if a unique sensory profile exists for this sample of children. A methodological constraint of this study was the small sample size. This may have influenced the magnitude of the correlations found in the study. The external validity in terms of generalisation to a larger population has also been affected.

5.2 Demographics

The gender demographics of the sample (eight females and 14 males) were consistent with the literature that indicated boys as presenting more with more language difficulties than girls with an approximation of 2:1 male: female ratio.[16]

Table 4.2 indicated that children with mixed difficulties received the most intervention in terms of speech and language therapy and occupational therapy. More children in this group were found to need special schooling compared to those with only receptive or expressive difficulties. However, only 22% of children with mixed receptive expressive difficulties and 16% of children with expressive difficulties received early intervention.

Literature indicated that early intervention was very important as the brain has increased neuro-plasticity for therapy when a child is younger.[30] As this sample group did not have early intervention to address their skills it is possible that earlier intervention could have prevented the development of some of the problems they present with currently. It is possible to determine both sensory processing difficulties [Infant and Toddler Sensory Profile (age 0 – 36 months)] [56] and speech and language skills at a very young age. Risk factors that may result in the development of SLI have been identified by Stanton-Chapman, Chapman, Bainbridge and Scott[23]. These include very low birth weight, a low five minute Apgar score, low level of maternal education and/or having a family member with a language problem.[23] Thus early intervention to addressing sensory processing difficulties could have had enhanced their learning and the use of speech and language skills.

5.3 The SLI sample on the Sensory profile

The Sensory Profile is a parent/caregiver report questionnaire with a five point Likert scale. It is suitable for children between three and ten years old and allows a choice in terms of identifying sensory processing and the behaviour associated with it. This questionnaire is one of the most reliable and valid standardized measurements of sensory processing available and can be completed in the absence of a therapist.

The Sensory profile was used to determine the sensory processing skills of the SLI participants, as literature indicated that different diagnoses have unique patterns of sensory processing specific to that disability.[12, 14, 49, 50, 51] The results of this study indicated that participants with SLI have a Sensory profile with a unique pattern of sensory processing which appears to be specific to the condition.

There was a statistically significant difference between the sensory processing, modulation and behaviour/emotional outcomes of sensory information of the SLI sample and that of the typical population. When considering the SLI sample in terms of functional behaviours, the effect of the high or low thresholds on behavioural response (divided into four patterns or quadrant scores including Sensory Seeking, Low Registration, Sensation Avoiding and Sensory Sensitive) were considered.[14] Although a child could fit into one of the four basic patterns of responding to sensory events in everyday life, literature indicated that most children have a combination of the patterns of behaviours.[14]

5.3.1 Sensory sensitive

The results in figure 4.5 of this study showed that this SLI sample seemed to be predominantly (81.81%) sensory sensitive. Children with sensory sensitivity have a low neurological threshold, notice stimuli quite easily and have a tendency to act in accordance with thresholds.[11, 12, 14,]

The results found, therefore, were not unexpected as the behaviour described for sensory sensitive children was very much the same as that observed in children with speech and language difficulties**.**[30] They tended to be easily distracted by movements, sounds, smells; are hyperactive and easily distracted by input from the environment. All three groups within the SLI sample had difficulties in terms of sensory sensitive behaviour (figure 4.10).

When considering the six modalities in which sensory processing is measured the SLI sample was found to react significantly differently to **auditory processing** when compared to the typical population (figure 4.1). Although multi-sensory processing were worse than auditory processing, auditory processing is a better indicator for sensory sensitivity, which are reflected in the increased sensitivity to sounds from the environment, seen in these participants.[14] The difficulties experienced by this sample with auditory processing were not unexpected, as it is well known that auditory processing plays an important role in the development of speech and language and that poor auditory processing is a potential risk for the development of speech and language disorders.[3, 41, 50]

According to Murray-Slutksy et.al.[25], poor auditory processing is the inability to discriminate verbal instructions or conversation from background noise. This was observed in participants with SLI as they found it very difficult to modulate auditory information in a very noisy room. Noisy environments, crowded rooms, unstructured tasks and frequent changes (in their schedule or the way that a task is performed) could result in the inability to follow instructions or understand what has been said. In children with sensory sensitivity the noise from the environment may have a negative effect on their behaviour. This was consistent with the literature that indicated that children with a low threshold react to a greater extent and more frequently to auditory stimulation.[12, 14.] This was reflected in the poor scores for communication and academic skills as seen in the whole sample, but especially in the expressive group as determined by the DP-II (table 4.3).

To explain the behaviour patterns of participants with sensory sensitivity, the literature indicated that these children are cautious about taking part in situations, hypersensitive, fearful, easily upset or negative and defiant.[12, 14] This could be due to poor modulation of sensory input. The items measured in Items indicating threshold for response in particular, could play a role in the sensitivity of sensory input and the way it influences behaviour. The statistical results (figure 4.7 & figure 4.8) showed that there is a difference in the three SLI groups for the various patterns of behaviour, which could also be an indication of poor modulation. This would have an influence on their ability to pay attention which will be discussed later.

Sensory sensitivity and especially auditory processing difficulties could possibly be further linked to behaviour in the Sensory profile, particularly **behavioural outcomes of sensory processing**. It was found that 77.28% (figure 4.3) of the total SLI sample had an inability to meet the performance demands of their environment, resulting in behavioural difficulties. It was however the expressive (100%) and mixed (77.78%) groups that struggled most with the behavioural outcomes of sensory processing. All three groups identified in the SLI sample also had difficulty with the modulation of emotional responses (expressive = 100%, receptive = 71.43% and mixed = 77.78%).

These greater emotional and behavioural reactions were probably linked to the greater difficulties with sensory processing and functional skills found in the expressive and mixed groups.

Children with poor auditory processing have further behavioural difficulties such as anxiety, increased frustration, temper tantrums, being easily upset in new situations, hyperactivity, impulsivity and irritability. This resulted in deficits in social participation, school performance and other functional tasks.[28]

Due to their low threshold, sensory sensitive children tend to act in accordance with that threshold, which results in hyperactive and distractible behaviour. This is reflected in the results in figure 4.4, which indicated that participants with SLI have patterns of behaviour consistent with **Factor 5: inattention/distractibility**. The items for factor 5 could be linked to the difficulties this sample was experiencing with auditory processing as the factor scores indicate the child's reactivity to sensory experience and could be closely linked to the behaviour observed in e.g. a noise environment.

Difficulties with touch processing, especially tactile defensiveness may also play a role in inattention/distractibility.[50] It is possible that the child may be so aware of things touching him e.g. labels on his clothes, the chair he is sitting on etc. that he would not be able to focus on a task and would react every time he was touched or bumped, especially in class. This would then further have an influence on not only self-help skills and physical skills, but also on academic skills and communication skills.

Again the difficulties with touch processing (figure 4.6) were found in the expressive and mixed receptive expressive groups. This was expected as literature indicated that tactile system dysfunction could have an influence on the difficulty in articulating sounds as various touch receptors are found in the face and mouth.[9]

Over sensitivity to touch input may also play a role in fine motor tasks as the child may have difficulties with discriminating between objects e.g. pencils, beads, shapes, puzzles etc. Poor touch processing may also make it difficult to manipulate a pencil or scissors in the correct way. The SLI sample was found to have difficulties with **Factor 9:- fine motor/perceptual skills** (figure 4.4)**.** The items described by Ermer and Dunn[15] for factor 9 were measured as difficulty in staying between lines when colouring or writing, writing is illegibly as well as difficulty with putting puzzles together. This indicates deficits in fine motor skills which and in all three groups of the SLI sample (Figure 4.9) were found to have as they had difficulties with factor 9.

The sample was observed to be sensitive to certain foods (textures and tastes) as a result of over sensitivity and difficulties with oral processing (figure 4.1). Oral sensory processing measures the response to touch and taste in the mouth.[12] The children were observed to be very picky eaters who had difficulty with chewing food and took quite a long time to complete a meal. Literature described participants with speech difficulties to be sensitive to certain foods and food textures, tastes and smells.[1, 35, 38]

The results indicated no difficulties for factor 4: oral sensitivity. This could be due to the fact that the factor score measure the sensory modulation pattern for oral input rather than the response to taste and touch.[51]

Figure 4.6 also showed that it was the group with mixed receptive-expressive difficulties that were experiencing the most difficulties with oral processing. The group with expressive difficulties as expected also had more difficulties in oral processing than the receptive group, as this processing is important for the production of sound, placement of the tongue and lips, pressure of the lips.[35, 37]

5.3.2 Sensory avoidant

Although figure 4.5 indicated the lowest factor score (59.09%) for the SLI sample was for the sensory avoiding pattern of response, it was still found to be problematic. This behaviour pattern is marked by low neurological thresholds where the child is overly aware of what is happening in their environment and actively attempts to counteract thresholds.[12] The children engage in disruptive behaviours and either withdraw or engage in emotional outbursts.

They demonstrate various coping strategies, to keep events at bay, like creating rituals for their daily life. The mixed receptive expressive group was found to have more difficulties with sensation avoiding behaviour than the other two groups (figure 4.10).

Sensory avoiding patterns are best described by the items for **Factor 2: emotional reactive, as well as behavioural outcomes of sensory processing.** Figure 4.4 indicated that 63.64% of the SLI sample had difficulties with factor 2 and figure 4.3 indicated that 77.28% of the sample struggled with behavioural outcomes.

Factor 2 and emotional outcomes of sensory processing are influenced by difficulties with auditory processing, as well as with tactile processing; especially if there are increased sensitivities in these areas. An increased sensitivity to auditory input will result in more awareness of noise in the environment. In sensory avoidant children this would result in poor tolerance to change, as constant adaptation to the noise has to be made as they try to avoid the noise. Difficulty in adapting their threshold to the auditory input also results in poor frustration tolerance, crying, temper tantrums, being stubborn and uncooperative and anxiety in terms of the surrounding noise[15]**.** This occurs in areas where there is a lot of noise like the supermarket, mall or movies. These behaviours are consistent with those measured in factor 2 and behavioural outcomes.

Tactile defensiveness also results in emotional reactive behaviour as the child reacts negatively and emotionally to touch sensations as they have a low threshold and react to counteract the incoming information by avoiding it.[14, 34]

Behaviour outcomes (figure 4.3) were found to be a difficulty for the SLI sample. They were found to have the inability to meet the performance demands of their environment, resulting in behavioural difficulties, having difficulty tolerating changes in plans and routine expectations, crying easily, being stubborn and uncooperative, having definite fears, temper tantrums and finding difficulty in making friends.[30] This is very similar to children with tactile defensiveness who were described as reacting negatively and emotionally when trying to avoid touch sensations.[10, 30]

The group with mixed receptive expressive difficulties were found to have more difficulties with being emotionally reactive than the expressive and receptive groups (figure 4.9).
This could be due to the fact that children are experiencing more frustration in understanding what is required of them and expressing their needs and frustrations.

5.3.3 Sensory seeking

Figure 4.5 found that 77.2% of the SLI sample experienced sensory seeking behaviour, which is described as behaviour due to a high neurological threshold and the tendency to actively counteract these thresholds.[14] As a high threshold cause the child to have inadequate neural activation, participants then tend to increase their sensory experience in order to gain more information from the environment.[12,14] Sensory seeking behaviour is displayed by typical children without disabilities, as they explore their environment to gather information.[11,12] The groups with expressive (100%) and receptive (85.71%) difficulties were found to display more sensory seeking behaviour than the mixed receptive expressive group (table 4.10).

Factor 1: sensation seeking indicated that the SLI sample may have such a high threshold that they are continually seeking movement in activities by twirling, spinning and engaging in risk taking behaviours. Scores for the SLI sample for factor 1: sensation seeking were found to be significantly different from those of the typical population (table 4.4). The mean raw score for participants with SLI was much lower than that of typical children, indicating that they are engaging in this type of behaviour more than typical children.

Literature indicated that multiple sensory systems were involved in sensory seeking behaviour.[11] This was evident in the SLI sample (figure 4.1) in that 81.82% of the sample had difficulties with multi-sensory processing (activities that contained combined sensory experiences.) The behaviours observed in the SLI population such as making noises while working, constantly fidgeting or moving around, physical clumsiness, being more excitable than other children, poor organization and lack of consideration for their own safety while playing, were

similar to those described for participants with sensory seeking behaviour patterns.[14]

Touch processing may also have played a role in the low scores found for items in sensory seeking. An under active touch system, in particular may result in behaviours that represent sensory seeking, like the avoiding of wearing shoes, the constant touching people and objects and not noticing when the hands and face are messy.[10, 25, 30] These behavioural responses are different from those found in children with a low threshold for tactile input (tactile defensiveness) that results in sensory sensitivity or sensory avoiding behaviour.

It is also possible that difficulties within the vestibular system may contribute to sensory seeking behaviour, hyperactivity and distractibility as this also has an influence on muscle tone.[30] Children with low muscle tone tend to move around and fidget frequently in order to maintain their position against gravity. Thus another way to interpret the behaviour seen is from a vestibular processing point of view. It is suspected that the SLI sample is more likely to have had poor processing of the vestibular system; resulting in these behaviours (figure 4.1). The SLI group with expressive difficulties had the most difficulties with vestibular input and it is suspected that this group has an under active vestibular system (figure 4.6).

Ayres found that children that have difficulties with auditory processing, as well as vestibular processing, have difficulties with body movement and motor planning.[30] Since the vestibular system has a link to the visual system it plays a role in eye movements which could influence perceptual skills, especially spatial awareness and fine motor co-ordination.[30] When looking at all the influences of the vestibular system on body movement, the visual system, motor planning and the disorganized influence thereof, it could be possible that it is the vestibular system that had an influence on the poor scores for **Factor 9: fine motor/perceptual skills** in the absence of visual processing difficulties. Figure 4.1 indicated that visual processing was a strength for this sample. Items as indicated on page 56 are related to difficulties in fine motor skills.

Ermer and Dunn[15] in their description of the factor items measured some of the behaviours in these items as the child having difficulty in staying between lines when colouring or writing; writing is illegible and having difficulty with putting puzzles together. This indicated difficulties with fine motor skills. Factor 9 was found to be more problematic for the group with expressive difficulties and mixed receptive expressive difficulties than for the group with receptive difficulties (figure 4.9). Difficulties with fine motor skills and vestibular processing were therefore expected in these groups. Ayres[30] described in the literature that the vestibular system contributes to the development of word understanding, speech production and difficulties with body awareness and motor planning. Poor motor planning especially, will have an influence on colouring in between the lines, controlling a pencil. Both groups will also have difficulty with writing to dictation or copying of sentences.

Although **modulation related to body position and movement** is thought to be the best indication of sensory seeking patterns it is possible that the scores obtained for **modulation of movement affecting activity level** which measures the child's activeness, can also be an indication of sensory seeking behaviour. Although only 40.91% of the sample had difficulties with **modulation related to body position and movement** their scores were significantly lower than the typical population but significantly higher than the Autistic and ADHD populations. 54.54% of the SLI sample struggled with the modulation of movement affecting activity level (figure 4.2). These areas were significantly different from the typical population (table 4.4).

5.3.4 Low registration

Low registration had not been expected in the SLI sample, but the results showed that 68.13% did have low registration behavioural patterns (figure 4.5). Low registration children are not aware of their surroundings and are uninterested in what is going on around them for e.g. they may not notice people coming in through a door.[14] They have low energy levels and are constantly tired with low endurance. This is due to their high neurological threshold that requires a lot of input before the child becomes aware of the input from the environment.[11, 14]

This is different from sensory seeking. Although the child also has a high threshold, the child tends to increase their sensory experience in order to gain more information from the environment.[12,14] It was found that although all three groups within the SLI sample had difficulties with low registration, more participants with receptive problems had difficulties within this area (figure 4.10). No significant differences were found between the three groups, however. Low registration of sensory input may well have an influence on the receptive skills of the child. Children with low registration seem uninterested and miss cues that guide their behaviours. It is possible that parents may interpret their lack of response as poor receptive skills or that poor receptive skills may be confused with low registration.

The literature describes **Factor 3: low endurance/tone, Factor 6: poor registration** and **sensory processing related to endurance/tone** as playing a role in determining if the child has low registration. Figure 4.2 and figure 4.4 indicated that the study sample did not seem to have any difficulties in these factors, but 54.54% of the sample did have difficulties with **modulation affecting activity level**. This could be influenced by poor vestibular processing, especially if the child has a under responsive vestibular system.[14, 26] Dunn also suggested that children, with low registration need more proprioception than typical children to participate in physical activities.

Factor 6: poor registration items were found to be good indicators of low registration. There were significant differences between the SLI sample and the typical children (table 4.4) and children with Autism and ADHD for this factor.

According to Dunn children with Sensory modulation difficulties can have any combination of patterns of behaviours and behaviours can fluctuate between various systems. It is possible that the behaviours in this sample may have fluctuated between sensory sensitivity and low registration. A child can become so over stimulated that it results in the child going into “shut down”.[45, 50] Children who shut down show no interest in exploring their environment. Their inner drive is disrupted and they are not motivated to explore.[50]

They display some of the same behaviours as those described for low registration. This means that the child appears unaware of what is going on around them, may not notice people around them, is uninterested in what is going on around them, has low energy levels, low endurance and is constantly tired.[12]
Thus there may be different reasons for the behaviour reported as low registration in this sample. The child may either have low registration of sensory input or the child's over stimulation may have resulted in shut down behaviour that mirrors low registration behaviour. It is however important to note that low registration may have an impact on the child's performance skills, as task performance seems to be better with low registration because of lack of noticing other stimuli[11]

Sensory sensitive and sensory seeking behaviours were found to be the most common patterns of behaviour for the SLI sample. All three SLI groups had difficulty with sensory sensitive behaviour, whereas the expressive and receptive groups were found to have the most difficulties with sensory seeking behaviour (table 4.10). The results could explain some of the characteristics commonly seen, unrelated to language per se, for e.g. poor social skills, a lack of concentration, difficulty with fine and gross motor skills and poor interaction with peers, difficulties with planning, organizing and sequencing their thoughts, and difficulty in beginning and completing tasks are also features of the condition.[9, 22]

5.4 The SLI sample on the Developmental Profile II

The Developmental profile-II includes 186 items, each describing a particular skill. The test assesses the development in five areas; physical age, self-help age, social age, academic age and communication age. The respondent, usually a parent or caregiver, simply indicates whether or not the child has mastered the skill in question.[52] Since children with pervasive developmental delays e.g. Autism and Asperger's Syndrome also struggle with speech and language difficulties, the DP-II was used to determine if the participants in this sample had any pervasive developmental delays, as these diagnoses were excluded from the study. [6, 25]

Parents were asked to identify pervasive developmental delays in their children at the beginning of the study (in the background questionnaires), prior to the sending out of the questionnaires. As the literature already indicated that children with pervasive developmental delay have difficulty with sensory processing it was decided to exclude these children from the study. Two parents did not clearly indicate this on their background information sheet and on marking the DP-II the parents indicated that the child has Asperger's syndrome. Due to this these two children's questionnaires could not be used for the study, and were excluded.

Table 4.3 indicated that according to the DP-II, the developmental age for the mixed receptive expressive group was 50.36 months, for the receptive group 61.74 months and the expressive group were 43.40. The expressive group was the youngest and their scores were equivalent at five months lower. This was well below their chronological age, with the group with expressive difficulties being the most delayed. This could be an indication of pervasive developmental disorder, but the results of the test must be interpreted with caution. A pervasive developmental disorder is characterized by poor communication skills or the presence of stereotypical behaviour or interests and poor reciprocal social interaction skills like those found in Autism or Aspergers Syndrome.[5] Although the test does look at social and communication skills, there is no clear indication of any pervasive behaviour (stereotyped behaviour or interests) in the test. The two children that were excluded were diagnosed prior to participation. The DP-II therefore affected the internal validity of the study as it could not be used for the original purpose of identifying PDD, but it did give an indication of the areas of functional deficits for each of the sub groups.

Although research showed that the DP-II used as parent report questionnaire is quite accurate, with good internal validity and reliability (parent accuracy varied ranged from 0.57 to 0.77), the reliability of the information provided by parents in this study on the DP-II had to be questioned.[52] The researcher treated some of the participants of the study in therapy and according to occupational therapy observations and clinical testing the participants functioned distinctly higher than that indicated by the parents.

It could be a possibility that the parents did not understand the questionnaire or that they have a different perception of their child's skills. Parents indicated at times that their children were unable to perform the tasks, but the occupational therapists observed that participants did in fact have the ability to do the tasks.
It is however possible that the child was only able to achieve part of the skills, but not the whole skill, resulting in very low scores even though their abilities were better. The outcome of the test scores were therefore not a reliable indication of the child's functioning especially as the DP-II was not as suitable to assess pervasive developmental delay as predicted.

Although the accuracy of information from the DP-II was questionable, the participants in the study sample did definitely function below their chronological age. Some delay in the development of skills was expected as the literature does indicate that poor sensory processing has an influence on age appropriate learning.[1, 11, 12]

Scores on the DP-II for academic, social and communication skills were significantly lower than the sample's chronological age (table 4.4). This result could have been influenced either to the SLI's poor speech and language or by their difficulties with sensory processing. The expressive and mixed groups were statistically significantly lower in the developmental age than the receptive group ($p \leq 0.02$). These groups were found to have the lowest scores for functional skills. It had been expected that the mixed group would have more difficulties due to their more complex language deficits. Participants with expressive difficulties had the most difficulties with physical skills, social skills, academic skills and communication skills and were significantly different to the receptive group ($p \leq 0.04$).
The DSM-IV states that the development of expressive language relies on the acquisition of receptive skills.[5] It is therefore possible that the expressive group have a general delay that was impacting on all areas of functioning.

5.5 Integration of the results of the SP and DP II

Poor sensory processing abilities have an influence on social, emotional, cognitive and sensori-motor development.[1, 14, 30]

When analysing the sections of the DP-II, as expected the SLI sample had the most difficulties with communication and social skills. It was also evident that their communication difficulties had an impact on their academic skills as these were also well below their chronological age. This would influence skills such as the following of instructions and reading, writing and maths.[1]

The expressive and mixed groups experienced the most difficulties with all developmental skills areas, as well as with sensory processing (table 4.3). As poor sensory processing has such a huge influence on development, it is possible that there is a link between the sensory processing and skills development in this group. The fact that the mixed group had severe difficulties, (table 4.3 & figure 4.6 – 4.10) was expected in the light of their more involved difficulties in speech and language skills. The expressive group was also found to have considerable difficulties with sensory processing and skill development. The receptive group, had difficulties with developmental skills, but had less difficulty with sensory processing.

Since the SLI sample presented with poor sensory processing and this has a severe influence on self regulation, self esteem, social participation, school performance and other functional abilities, it could be assumed that the developmental delay found was to some extent related to this. The literature does also indicate that poor sensory processing has an influence on age appropriate learning.[11]

All four patterns of behaviour described in the sensory profile could have an influence on a child's functional skills. Social and academic skills could be influenced in children with sensory sensitive patterns of behaviour.

The role of poor auditory processing in sensory sensitive behaviour has been discussed above. The inability to follow instructions or understand what has been said is reflected in the poor scores for communication and academic skills especially in the expressive group.[12, 14] Over sensitivity to touch may result in poor fine motor tasks as poor touch processing combined with poor vestibular processing are associated with difficulties in manipulating objects like a pencil or scissors in the correct way. This will reflect on both physical and academic skills.

The SLI sample was found to have some difficulty in sensory avoiding behaviour (figure 4.5). This could be associated with their inability to meet the performance demands of their environment resulting in behavioural difficulties, or difficulty tolerating changes in plans and expectations and changes in routine.
This could result in academic and social skill difficulties. Other behaviours such as having definite fears, temper tantrums and finding it difficult to make friends could be reflected in their social skills scores.[30]

Sensation seeking behaviour also had an impact on the functional outcomes for the SLI sample. Social and academic skills in particular were negatively influenced. Children with sensory seeking behaviour would find it very difficult to keep quiet in class and to sit still on their chair. They would be constantly moving and their poor organization would result in an inability to focus on tasks and to finish tasks resulting in poor academic skills. A child with sensory seeking behaviour may also have difficulties with social skills as they may be unaware of personal space and may find it difficult to make friends. Poor vestibular processing in these participants, as discussed above, could also have an influence on their communication skills.

The problems that the SLI sample had with communication and social skills could also be linked to their difficulty with low registration. As children with low registration seem uninterested in their environment and miss cues that guide their behaviours it may be difficult for them to develop social skills. Low registration may also influence physical skills as Dunn suggested that children with low registration need more proprioception than typical children to participate in physical activities.[14]

It was evident from the results that the SLI sample varies between the four patterns of sensory processing and that it is their poor processing that has the most impact on their functional skills. The SLI sample struggled with physical skills, self-care skills, communication skills and academic skills.
The results therefore confirm the statement by Miller[1] that:

> "Children with sensory processing disorders suffer from devastating symptom complexes that significantly affect their self regulation,

self esteem, social participation, school performance and other functional abilities." p 1.

5.6 Comparison of the SLI sample to other conditions

The results in table 4.4 indicated that the SLI sample had significant different sensory processing in all aspects to that of the typical population.[14] Some differences between the Autistic or ADHD populations were also identified and reflected the influence of sensory processing on the development of speech and language.[24, 30]

Research has been done on sensory processing and the resulting behaviour with various conditions like Autism and Attention Deficit Hyperactivity Disorder (ADHD).[43,49,50] Although these studies had relatively small sample sizes and other limitations they found highly significant sensory processing and modulation patterns unique to each population.[26,41,43,49,50] In all these studies the Sensory Profile was found to best discriminate between the high incidence factors like sensory seeking behaviours and inattention & distractibility and low incidence factors like oral sensory sensitivity and fine motor perceptual behaviours.[15,41,43,50]

5.6.1 ADHD & ADD

As the DSM-IV described ADHD as an associated diagnosis with speech and language disorders, it was expected that the SLI sample will have similar difficulties as those discussed in the ADHD population.[5] Literature further indicated that children with ADHD had a different pattern of performance on the Sensory profile from children without disabilities.[50] Researchers indicated that children with ADHD have decreased ability to process sensory information, as they react to stimuli that are easily ignored by other children and are easily over stimulated.[15,48,50] Dunn and Bennet did a factor analysis and found that there are factors that are specific to the ADHD population e.g. that there is a high incidence of Factor 1, 5 and a low incidence of behaviours on Factor 4, 9 in the ADHD population.[50]

The difficulties on the Sensory Profile observed in the SLI sample were very similar to those observed in the ADHD population.

These include difficulties with auditory processing, touch processing, multi-sensory processing, emotional/social responses and behavioural outcomes of sensory processing [50]

Statistical analyses (table 4.4) showed however, that the SLI sample differed significantly from the ADHD population in other aspects. Their scores were significantly higher for modulation related to body position and movement, emotional and social responses, factor 1: sensory seeking and factor 6: poor registration.

The difference in the scores for **modulation related to body position and movement** can be an indication that the ADHD population is finding it more difficult than the SLI sample to move effectively. This was expected as research indicated that hyperactive children have more soft neurological signs such as abnormal postural tone, poor balance and incoordination.[50]

This behaviour in the SLI sample is due to low muscle tone (related to poor vestibular processing) and the need to move around and fidget in order to maintain their positions against gravity. The behaviour appears to be similar to the sensory seeking behaviour displayed by the ADHD population who are constantly seeking more sensory input in order to generate responses.[50]

Since the behaviour in the SLI sample occurred less often, they were less likely than the ADHD population to be distracted as Dunn hypothesized that while sensory seeking behaviours in the typical population enabled learning, in the ADHD population it generated distraction[12]

Scores for **modulation of sensory input affecting emotional responses** for the SLI sample were also statistically higher than those of children with ADHD. Poor modulation results in behaviour difficulties as children were unable to regulate the input from the environment.[14, 49] This impaired ability to organize and process sensory information appropriately can lead to irritability, impaired ability to concentrate, clumsiness and frustration.[25] These behaviours were similar to those observed in children with mood disorders, anxiety disorders or oppositional defiant disorders.[5] Researchers found that as many as 75% of children with ADHD also have mood disorders.

Therefore the profile for SLI participants indicated that the sample appeared to have better psychosocial coping strategies than children with the other diagnoses.

Factor 6: poor registration items were found to be good indicators of low registration. Although this study found that the SLI sample had no difficulties with factor 6: Poor registration, there were significant differences between the SLI sample, typical children and children with ADHD for this factor.
Although significantly lower than typical children, the SLI participants scored better than the ADHD population. It is known that children with ADHD have poor registration of information and they are therefore expected to not receive and process sensory information properly.[50] Dunn proposed that children with poor registration may have inadequate neural activation, which can result in sensory seeking behaviour.[14] As children with ADHD have more difficulties with poor registration, it is possible that it can contribute to them being more sensory seeking than the SLI sample.

The SLI sample had significantly lower scores than the ADHD population for the modulation of sensory input that affected emotional responses, behavioural outcomes of sensory processing and factor 9: fine motor/perceptual skills (table 4.4). The mean scores obtained by the SLI sample were less than the lower limit of the confidence interval for children with ADHD in all these areas. This indicated that the difficulties in children with SLI for these aspects were significantly more severe than for children with ADHD. This poses the question whether the SLI sample have more behavioural difficulties affecting their performance.

It was found that 77.28% (figure 4.3) of the SLI sample had difficulties with **behavioural outcomes of sensory processing** affecting their ability to meet the performance demands of their environment resulting in behavioural difficulties. They presented with lower scores for both this aspect and **modulation of sensory input affecting emotional responses,** than the ADHD population, which indicated a higher incidence of these behaviours in the SLI sample.
It is proposed that due to the SLI participant's difficulty with speech and language, they find it more difficult to meet the demands set by the environment which results in more frustration and emotional outbursts.

The mean raw scores for **factor 9: fine motor/perceptual** skills were also found to be lower for the SLI sample than the ADHD sample.

This agrees with the findings of Kruger et al[29] and Webster et al [39] that children with language disorders have problems with fine motor skills, whereas children with ADHD have more visuo-motor perceptual difficulties.[50] Good vestibular, visual and touch processing are necessary to develop good fine motor and perceptual skills.[30] As the SLI sample obtained better scores for vestibular and visual processing than the ADHD population, it is possible that the SLI sample has more difficulties with fine motor skills due to poor motor planning. Literature indicated that touch processing is critical to the development of hand skills.[42]

5.6.2 Autism

Literature indicated that children with Autism had the opposite pattern of performance from children without disabilities.[15] Factor analysis studies indicated that they have a low incidence of behaviours on Factor: 1 sensory seeking, and a high incidence of oral processing and behaviours on Factor 4: oral sensory sensitivity, factor 5: inattention and factor 9: fine motor/perceptual, that contributed to the differences found in children with Autism from typical children.[15]

Dunn and Saiter[41] also described children with Autism as having more difficulties with oral sensory processing and that visual processing proved to be a strength for this sample. As children with Autism also have severe speech and language difficulties it is very important to distinguish between autism and SLI when diagnosing a child, and the sensory profile can assist in making the diagnoses as the results indicated that there are various differences between the two populations.

Significant differences were found (table 4.4) between the Autistic population and the SLI sample in touch processing, oral sensory processing, modulation related to body position and movement, emotional and social responses and factor 2: emotionally reactive and factor 6: poor registration.

According to the literature, oral processing was found to be the most discriminating for children with Autism. They are described as having oral sensitivity to particular tastes, textures and smells.
Since oral processing also plays a role in the development of speech (the production of sound, placement of the tongue and lips, pressure of the lips etc. when producing words.[29, 31] It was expected that the SLI sample might have similar difficulties with oral processing. Their mean scores for both oral processing and oral sensory sensitivity were higher than those for Autistic population (table 4.4) indicating that the Autistic population have more difficulties.

Two other scores that were significantly lower for Autistic population than the SLI sample were touch processing and emotional /social response section of the sensory profile.

Thus due to the **touch processing** scores the Autistic population would be expected to be much more sensitive to touch input resulting in more rigid and inflexible behaviour.[11,25] This could have an influence on daily routines where the child is very dependent on a specific routine. The SLI participants experienced more flexible behaviour than that observed in the Autistic population.

The **emotional/social** section measures the child's psychosocial coping strategies. This area was expected to be more of a problem for the Autistic population as they have difficulty transitioning from one activity to the next.[25] Although it was expected that children with speech and language difficulties will experience frustration, with subsequent emotional outburst, results indicated that it would not have as a severe impact on their function as in the Autistic population.

Modulation related to body position and movement investigated the child's ability to move effectively. This area was significantly lower for the Autistic population than that of the SLI sample. This was expected as children with Autism display repetitive motor movements like whole body rocking or jumping in one place.[25]

As with ADHD the SLI sample had significantly lower scores than children with Autism for factor 6: poor registration. Literature describes children with Autism as being in their own world, not aware of what is going on around them, especially when they are over focused on an object or part thereof.[25, 50]

5.7 Conclusion

It is evident that the SLI sample has difficulties with sensory processing and modulation that has an influence on their behaviour and performance.

The group with expressive difficulties were found to have the greatest deficits with developmental skills as well as sensory processing skills, resulting in emotional and behavioural difficulties. This group's sensory processing patterns were also found to change between sensory seeking, sensory sensitive and low registration.

The mixed receptive expressive group also functioned well below their chronological age for developmental skills. This group in particular had more difficulties with multi-sensory and oral processing than the other groups. The mixed group was also found to alternate between three patterns of sensory processing, but were mostly sensory sensitive when compared to the expressive group that was more sensory seeking.

Although the group with receptive difficulties also functioned well below their chronological age for developmental skills, they did function significantly better than the other two groups. This group had difficulties with multi-sensory processing and items indicating thresholds. Inattention was the biggest factor for this group, which also alternated between three patterns of sensory processing. Sensory seeking behaviour was more prevalent than sensory sensitivity and low registration.

The SLI sample presented with behaviours from all four patterns of sensory processing reactivity according to Dunn's Model of sensory processing. Literature indicated that children do not only have single processing patterns but can have several.[11] These patterns might also be different for the various systems. In this

SLI sample they were sensory sensitive to auditory stimulation, but sensory seeking for vestibular input.
Unfortunately no research was available regarding the processing patterns (quadrants) of the Autistic and ADHD populations so no comparisons could be made at this level.

The difficulties experienced on the Sensory Profile sections by the SLI sample were significantly different to that of the typical population and various differences were also found between the Autistic and ADHD populations. The Autistic population have statistically significant more sensory processing difficulties than the SLI sample in all aspects whereas the differences between the SLI sample and the ADHD population vary.

The OT working with the SLI sample would expect their developmental skills to be lower than those of typical children, and that they would have difficulties with poor processing from the senses, especially auditory processing. These children would also display disorganized behaviour due to their poor ability to modulate sensory input. Emotional responses to sensory input, especially from the environment will also be observed. Inattention and poor fine motor skills were also an indication of poor sensory processing in this population. It was also evident that the SLI sample difficulties on the Sensory Profile have an influence on their behaviour and functioning at school and at home as sensory processing difficulties could be related to skill deficits identified by the DP- II.
It would therefore be important to assess children with SLI to determine their Sensory profile and to take the results into account during treatment planning and intervention.

Chapter 6

6. Conclusion

6.1. Introduction

The purpose of this study was to determine the sensory profile of children with Specific speech and language impairment. The data was obtained from participants through the completion of the Sensory Profile Questionnaire. The focus of the outcome of the Sensory profile questionnaires was on scores that fell in the probable difference column and definite difference column, when scoring this assessment.

It was evident from the outcome of the questionnaires that children with SLI have sensory processing that is significantly different from typical children without disabilities, as well as from other disabilities with speech and language difficulties such as Autism and ADHD.

The final results indicated that SLI sample had difficulties with all four sensory processing patterns of behaviour, especially sensory sensitivity and sensory seeking. This was influenced by the difficulties in the sensory systems, especially multi-sensory processing and auditory processing. Touch, vestibular and oral processing also seems to be problematic for the sample. Poor modulation of the above mentioned input resulted in problems with modulation of sensory input affecting emotional responses and modulation of movement affecting activity level. These difficulties resulted in behavioural and emotional responses.

The factor scores are indicative of the child's responsivity and have been described as being discriminating between disabilities. The SLI sample had difficulties with factors1: sensation seeking, 2: emotionally reactive, 5: Inattention/distractibility, 9: fine motor/perceptual.

6.2. Critical Evaluation of the Study

Both the negative and positive aspects of the study are discussed below:

- The Sensory profile is a valid tool to measure the sensory processing, modulation and behaviour outcomes of children with speech and language impairments.

- The Developmental Profile II was used to determine if the children had any Pervasive developmental delays. The reliability this assessment tool with children with SLI had to be questioned however. The therapist observed that the test did not reflect the children's abilities. For future research it would be more valid for the researcher to complete the assessment in order to eliminate this error.
- A methodological constraint of this study is the small sample size. The number of participants was limited to 22 (n=22). This may have influenced on the magnitude of the correlations found in the study as well as the external validity.
- A further limitation was that that although ADHD was an exclusion criteria, it was possible that undiagnosed ADHD children were included in the sample.

6.3. Implications of the study

- Only 63% of the children in this study were found to be receiving occupational therapy (OT) as part of their therapeutic regime. From the researcher's own experience it was found that children with speech and language difficulties in the UK are only referred to OT in order to address difficulties with motor skills, such as gross and fine motor skills and handwriting. As it was evident from the study that this sample has difficulty with sensory processing which influences their activities of daily living it is essential all children with speech and language difficulties should be referred to OT for assessment. The evaluation of sensory processing and the influence thereof on all activities of daily living should be addressed in appropriate intervention.
- The study also indicated that a very small number of this sample received early intervention. Ayres[30] described the benefits of early intervention as it critically impacts trajectory development in various areas. Referral for early detection of sensory processing difficulties should be encouraged so these problems can be addressed timeously as sensory processing plays a role in the development of speech and language skills.[10,30] Early intervention may assist in the improvement of language skills.
- The research also indicated that children with speech and language impairments have sensory processing that is significantly different from that of typical children without disabilities. Their sensory processing difficulties are

negatively influencing not only their development of speech and language but also their functional abilities and participation in activities of daily living. It is then important to ensure that these issues are addressed in school and at home.

- The most important finding is that the children with SLI have sensory processing that is very different from children with Autism and ADHD. The literature indicated that the differences found between disability groups can assist in the process of obtaining a diagnosis. This will be especially helpful in determining a differential diagnosis for children with SLI, Autism and Aspergers as all three groups have difficulties with speech and language, but have different sensory processing issues.
- It will beneficial to train teachers, therapists and parents working with children with speech and language disabilities about the concept of sensory processing. In order to optimise the sensory processing for learning, caregivers and teachers need to learn how to make adjustments in the classroom and at school.

  The curriculum focuses very much on the use of multi-sensory input to enhance learning in children with special needs. The literature indicates that knowledge regarding sensory processing will indicate which sensory systems are triggering anxious reactions and which systems to use to their advantage.
- Occupational therapists needs to ensure that a Sensory Profile is included in an OT assessment for a child with speech and language difficulties, as the research indicates that they do have sensory processing difficulties that are interfering with their daily life.

6.4. Future Research

Directions for future research include the following:

- Replication of this study with a larger group of participants would further add to the validity of the information gained.
- A study to investigate the difference in sensory processing between children with SLI and children with learning difficulties to determine if there is a different way in which they process information.

- A study to investigate whether determining and addressing sensory processing during early intervention will have an influence on the children's speech and language, as well as functional skills as they grown older.
  Comparisons can be made between children receiving early intervention and those children that did not.
- A further study to investigate if a treatment program such as a "sensory diet" or formal treatment sessions using a sensory integration approach will make a difference in the speech and language abilities of this sample and their functioning in school and at home.

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APPENDICES

Appendix

A: Sensory profile caregiver questionnaire

B: Sensory profile score summary sheet

C: Worksheet for calculating quadrant scores

D: Developmental profile II

E: Statement of special educational needs

F: Ethical permission

G: Cover letter to request permission from school to do research at the schools from the Local Education Authority and Head teachers of schools

H: Permission letter from head teacher

I: Letter to request for participation from special needs coordinator/speech and language therapist/occupational therapist

J: Participation letter from special needs coordinator/speech and language therapist/occupational therapist

K: Information brochure on sensory processing (Additional information for teachers and parents on the concept of sensory processing)

L: Participation **l**etter to parents

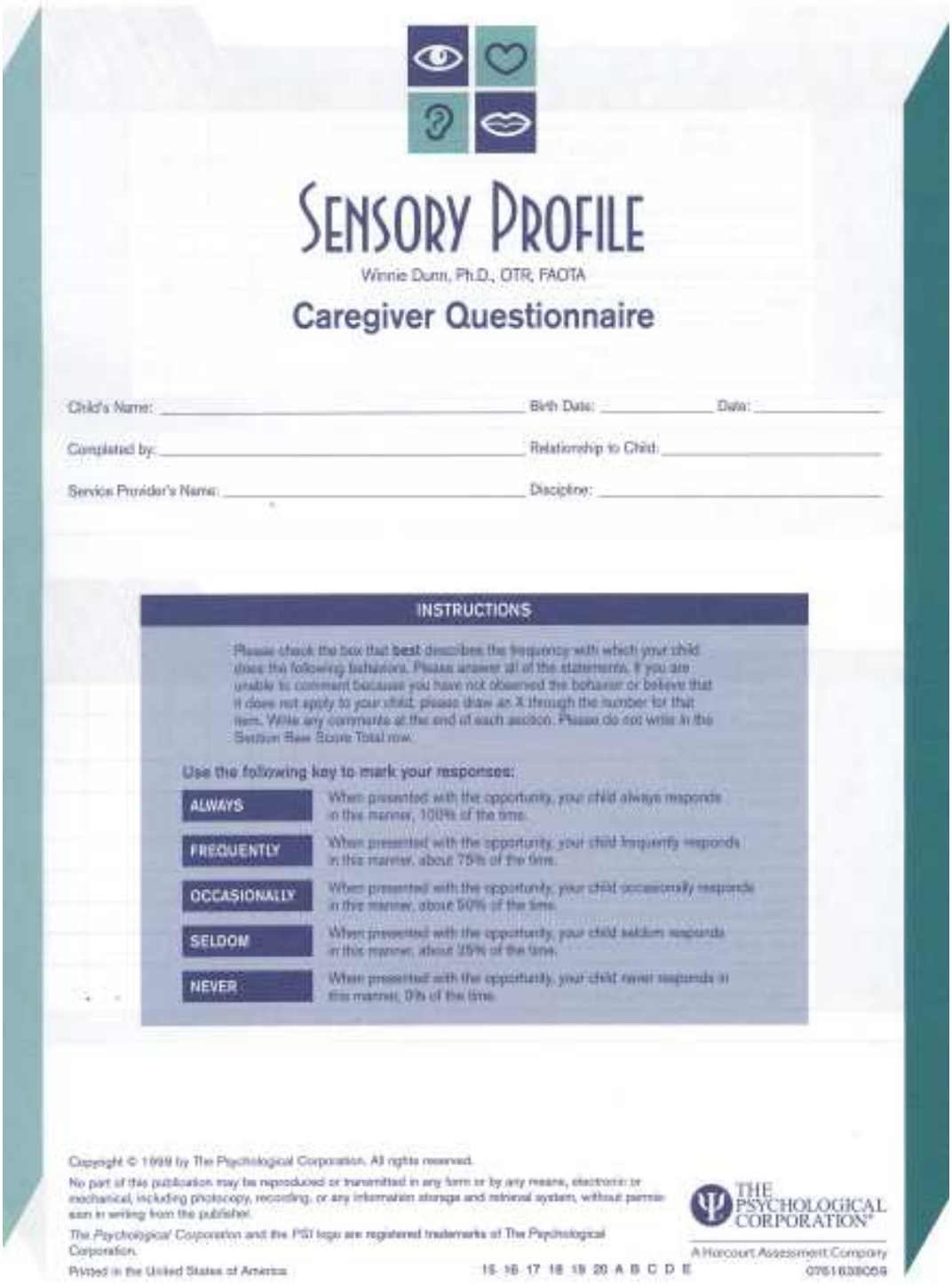
M: Consent form for parents agreeing to participate

N: Letter with instructions for the completion of the sensory profile and the developmental profile.

O: Respondent records

P: Sensory profile feedback report

APPENDIX A



SENSORY PROFILE

Winnie Dunn, Ph.D., OTR, FAOTA

Caregiver Questionnaire

Child's Name: _____ Birth Date: _____ Date: _____

Completed by: _____ Relationship to Child: _____

Service Provider's Name: _____ Discipline: _____

INSTRUCTIONS

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

Use the following key to mark your responses:

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

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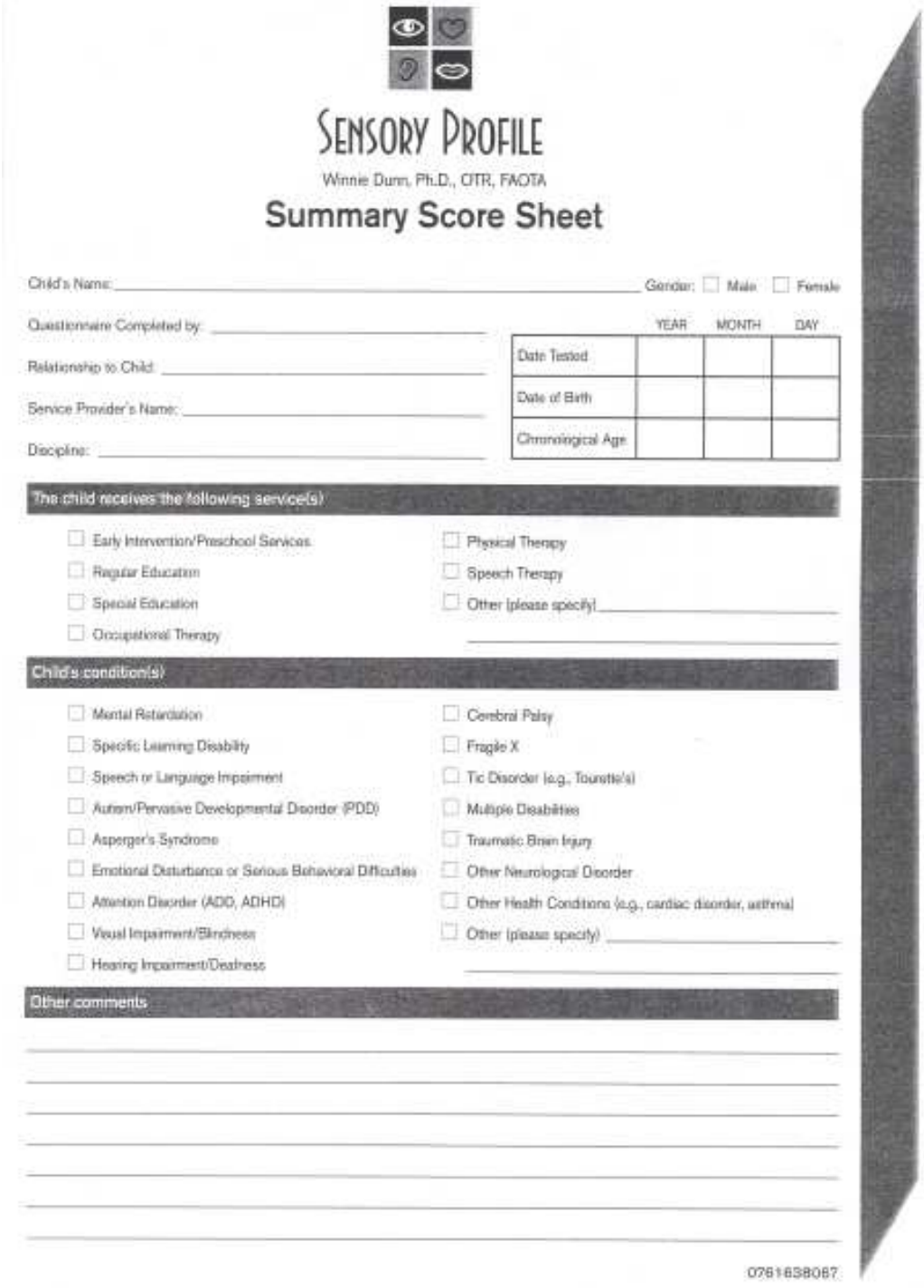
APPENDIX C



Sensory Profile

Winnie Dunn, Ph.D., OTR, FAOTA

Summary Score Sheet

Child's Name: _____ Gender: ☐ Male ☐ Female

Questionnaire Completed by: _____

Relationship to Child: _____

Service Provider's Name: _____

Discipline: _____

	YEAR	MONTH	DAY
Date Tested			
Date of Birth			
Chronological Age			

The child receives the following service(s)

- ☐ Early Intervention/Preschool Services
- ☐ Regular Education
- ☐ Special Education
- ☐ Occupational Therapy
- ☐ Physical Therapy
- ☐ Speech Therapy
- ☐ Other (please specify) _____

Child's condition(s)

- ☐ Mental Retardation
- ☐ Specific Learning Disability
- ☐ Speech or Language Impairment
- ☐ Autism/Pervasive Developmental Disorder (PDD)
- ☐ Asperger's Syndrome
- ☐ Emotional Disturbance or Serious Behavioral Difficulties
- ☐ Attention Disorder (ADD, ADHD)
- ☐ Visual Impairment/Blindness
- ☐ Hearing Impairment/Deafness
- ☐ Cerebral Palsy
- ☐ Fragile X
- ☐ Tic Disorder (e.g., Tourette's)
- ☐ Multiple Disabilities
- ☐ Traumatic Brain Injury
- ☐ Other Neurological Disorder
- ☐ Other Health Conditions (e.g., cardiac disorder, asthma)
- ☐ Other (please specify) _____

Other comments

_____

_____

_____

_____

_____

_____

_____

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APPENDIX D

WORKSHEET FOR CALCULATING QUADRANT SCORES ON THE SENSORY PROFILE (Dunn, 1999)

For Children Ages 3–10 Years

Quadrant Grid

Instructions: Transfer from the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) the item raw score that corresponds with each item listed. Add the Raw Score column to get the Quadrant Raw Score Total for each quadrant.

Quadrant 1 Low Registration		Quadrant 2 Sensation Seeking		Quadrant 3 Sensory Sensitivity		Quadrant 4 Sensation Avoiding	
Item	Raw Score	Item	Raw Score	Item	Raw Score	Item	Raw Score
6		8		3		1	
7		24		4		2	
47		25		14		5	
50		26		18		9	
53		27		19		10	
66		28		21		11	
67		40		30		15	
68		41		31		20	
69		44		32		22	
70		45		33		29	
71		46		34		36	
72		51		39		37	
73		59		48		54	
74		60		49		76	
75		61		55		85	
		62		56		86	
		63		57		87	
		80		58		88	
		81		77		93	
		82		78		103	
		83				104	
		84				105	
		89				107	
		90				108	
		94				109	
		123				110	
						111	
						112	
						114	
Quadrant Raw Score Total		Quadrant Raw Score Total		Quadrant Raw Score Total		Quadrant Raw Score Total	

Quadrant Summary

Instructions: Transfer the Quadrant Raw Score Totals from the Quadrant Grid to the corresponding Quadrant Raw Score Total box. Plot these totals by marking an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference)***

		←Less Than Others*			More Than Others→*	
Quadrant	**Quadrant Raw Score Total**	**Definite Difference**	**Probable Difference**	**Typical Performance**	**Probable Difference**	**Definite Difference**
Low Registration	/75	**	75——73	72————64	63———59	58———15
Sensation Seeking	/130	**	130–124	123———103	102—92	91———26
Sensory Sensitivity	/100	**	100—95	94————81	80———73	72———20
Sensation Avoiding	/145	145—141	140—134	133——113	112—103	102——29

*See Expanded Cut Score Theory explanation at www.SensoryProfile.com

**There can be no Definite Difference for this quadrant.

***Classifications are based on the performance of children without disabilities (n = 1,037).

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APPENDIX E: Statement of special educational needs

What is a Statement?

The reason for making a statement is when the resources within the child's school cannot reasonably meet all the special educational provision required to meet a child's needs. These resources could be money, specialist staff, staff time and equipment.

A statement is a legal document that should provide information about the child's special educational needs and what provision is necessary to meet those needs. It will specify the type and name of the school that is considered to be able to meet those needs.

The statement will be based on the recommendations detailed in the reports or 'advice's' that have been collected for the statutory assessment (by the Educational Psychologist, Paediatrician, Speech and Language therapist etc.) and these will be attached as ' appendices' to the statement.

THE 5 STAGES OF A SPECIAL NEEDS ASSESSMENT

Stage One

The teachers or head of year tutor gathers information and identifies any particular special needs of the child and consults with the SENCO (Special Educational Needs Co-ordinator). For children of statutory school age National Curriculum level descriptions for each subject enable the school to consider the individual child's attainment and progress against the expected levels for the majority of their peers. Those children whose overall attainments or attainment in specific subjects fall significantly outside the expected range may have special educational needs.

Stage Two

When a teacher or the Special Educational Needs Coordinator (SENCO) identifies a child with SEN, interventions will be provided that are additional to or different from those made through the school's usual differentiated curriculum and strategies. This stage is known as **School Action**.

For a child at School Action the SENCO and the child's teacher(s) will decide what further action will be taken to enable the child to progress. These will be recorded in an Individual Educational Plan (IEP).

This is a detailed plan targets for the child to achieve, along with a date for a review to see how much progress has been made.

Stage Three

IEP's will be reviewed at least twice a year. IEP reviews may conclude that the child has made sufficient progress and that an IEP no longer needs to be maintained. However, for some children the IEP review may conclude that the help of external support services (Educational Psychologist or specialist teacher is required. This stage is known as **School Action Plus**.

If the child is not making progress the SENCO or Head teacher will discuss with the parent whether to instruct the LEA (Local Education Authority) to make a statutory assessment, which is a thorough look at the child's deficits, strengths or learning difficulties to decide if different or extra educational help should be injected.

Stage Four

The LEA based on the information that has been gathered from the Educational Psychologist, Paediatrician, Speech and Language therapist etc. about the child in the statutory assessment.

Stage Five

The LEA considers whether to issue a statement of Special Educational Needs and writes a statement of the help required and goals to be met. There is ongoing monitoring and reviews.

FORMAT OF A STATEMENT FOR SPECIAL EDUCATIONAL NEEDS

A Statement of Special Educational Needs is set out in 6 parts

Part 1-Introduction-The child's name and address, date of birth, home language and religion and names and address of parents.

Part 2-Special Educational Needs-This details each and every one of the child's special educationally needs, as identified by the LEA during the assessment.

Part 3-Special Educational Provision-This gives details about the educational provision considered appropriate to meet a child's SEN. It describes:

- All the special help that the LEA think the child should get to meet the needs listed in part 2
- The long-term objectives to be achieved by that special help.
- The arrangements for setting short-term targets, regularly reviewing your child's progress towards those targets and how your child's progress is to be monitored.

Part 4-Placement-The type and name of school where the special educational provision is to be made, OR how any arrangements will be made out of school hours OR off school premises

Part 5- Non -Educational Needs- This describes any non -educational needs that your child has, as agreed between the LEA and the health services, social services or other agencies; such as school transport.

Part 6 Non Educational Provision- This describes how your child will get the help to meet the non-educational needs described in part 5.

Appendices-

These are all reports or advice's that were gathered to make the statement and such include:

- Parental evidence and advice

- Educational advice
- Psychological advice
- Medical advice
- Social services advice

Any other advice, such as views of the child.

APPENDIX F: Ethical permission

Ethical permission form University of the Witwatersrand

Ethical clearance was obtained from the Ethics Committee for Research on Human Subjects at the University of Witwatersrand.
(permission nr: **M 060413**).

Postgraduate research committee

The Postgraduate research committee, approved the research study.
(permission nr: **R14/49**).

APPENDIX G: Cover letter to request permission from school to do research at the schools from the Local Education Authority and head teachers of schools

Janine van der Linde
Meath School
Brox Road
Ottershaw
Surrey
KT16 0LF

16th June 2006

The Head teacher
Blossom house School
8 The Drive
Wimbledon
London
SW20 8TG

Dear Madam

I am Janine van der Linde, the Occupational Therapist at Meath school in Ottershaw, Surrey. I am currently completing a research project for a Masters degree in Occupational Therapy, at the University of the Witwatersrand in South Africa. I am investigating the sensory processing skills of children with specific language disorders and the effect it has on their behaviour and participation in school. I would be most grateful if you would consider participating in this study by giving permission for the special needs co-ordinator or therapist in your school to assist in identifying suitable children for the study from the special needs register.

Why am I doing this?

Research has shown that the way that children react to the sensations around them has an impact on their performance of daily tasks at home and at school. (Please see the attached information brochure for more information on sensory processing).

If the children have problems in the way that these sensations are processed in the brain it can have a negative impact on their performance of tasks and learning.

Children with sensory processing problems exhibit behaviours such as constantly making noises, show sensitivity to certain foods and food textures, sensitivity to sounds, sensory seeking behaviour e.g. constantly moving, physical clumsiness, constantly needing to regain their attention in class and poor organization of self. Studies have indicated that children with disabilities process information very different from children without disabilities. I don't know if this is true in children with speech and language disorders and will be grateful if you would consider giving permission for the special needs co-ordinator at your school/s to be approached to participate in a study to examine this. Knowledge regarding this will assist in compiling the best possible occupational therapy treatment programmes for these children, as well as assist with providing information to the teachers and therapists on how to adapt the environment in the class to assist these children with their sensory needs and to optimise learning.

What do I expect from the participants in the study?

I would like to invite all special needs co-ordinators and therapists in special schools and mainstream schools with a language unit/base in London and the South of England to participate in the study.

The special needs co-ordinator or therapist will be requested to identify children with speech and language disabilities, from the **special needs register** with the following inclusion criteria:

- Assessed as having a primary speech and language disorder (expressive or receptive).
- English speaking
- Between the ages of 5 to 10 years.

- Children without autism, pervasive developmental delays, cognitive disabilities and neurological impairments e.g. cerebral palsy or epilepsy.

The special needs co-ordinator or therapist will then be asked to send the permission forms to the parents in order to gain consent from the parents for participation in the study. A full information pack, an information sheet and an informed consent form will be provided to submit to the parent.

On receipt of the permission forms, I will invite the parents to complete the sensory profile caregiver questionnaire and a Developmental Profile II. (A self-addressed envelope will be provided in order to make it easier for them to return the questionnaire.)

These profiles will give me the necessary information to determine what the most common problems are. The information sheet will make it clear to parents that they will not be penalised for not participating in the study.

Are there benefits to the participants?

Yes. The results will assist with determining which aspects the children with language disabilities have the most difficulty with. It will also assist in formulating a program of how the classroom can be adapted to be sensory friendly to the child, in order to improve learning. Parents are more than welcome to contact me if they have specific questions regarding the questionnaire or regarding their child's profile. If any problems are identified in terms of the results on the sensory profile I will contact the parent and advise them on referrals to an occupational therapist. This procedure will be followed as each Occupational Therapy department has their own referral procedures and protocols. Information on the sensory profile will then be passed on to the occupational therapist on receipt of written consent from the parent. Information on the outcome of the study will also be available on request.

What about confidentiality?

Confidentiality will be maintained by the use of a code instead of names on all questionnaires and results. The child/parent's identity will be protected at all times and will not be published or make public at any time and I will be the only person to have access to the name list and the codes used.

This list will be kept locked in an office within in a locked cabinet. The forms will be destroyed at the completion of the study.

Ethical considerations

The postgraduate research committee, as well as the Human research ethics committee at the University of Witwatersrand approved the research study. Both committees approved the study (permission nr: **R14/49**).

Please contact me if you would like to have a copy of the research protocol that will provide detailed information on the theoretical background of the study as well as on the statistical information for the study.

If you have any queries or need more information, please contact me at telephone number 01932 872 302 OR 07722124561 or janinevdl@yahoo.com.

Thank you
Janine van der Linde
Occupational Therapist

APPENDIX H: Permission letter from head teacher

OCCUPATIONAL THERAPY STUDY ON SENSORY PROCESSING

TO BE RETUNED TO:

Janine van der Linde
Meath School
Brox Road
Ottershaw
Surrey
KT16 0LF

I hereby grant Janine van der Linde permission to conduct the study entitled “The sensory profile of children with speech and language disorders in London and the South of England” in the following school/s.

_____

Signature of Head teacher: _____

Date: _____

APPENDIX I: Letter to request for participation from special needs teacher/speech and language therapist/occupational therapist

Janine van der Linde

Meath School

Brox Road

Ottershaw

Surrey

KT16 0LF

16th June 2006

The Occupational therapist

Blossom house School

8 The Drive

Wimbledon
London
SW20 8TG

Dear Madam

I am Janine van der Linde, the occupational therapist at Meath School in Ottershaw, Surrey. I am currently completing a research project for a master's degree in Occupational Therapy, at the University of the Witwatersrand in South Africa. I am investigating the sensory processing skills of children with specific language disorders and the effect it has on their behaviour and participation in school. I would be most grateful if you would consider participating in this study by giving permission for the special needs co-ordinator or therapist in your school to assist in identifying suitable children for the study from the special needs register.

Why am I doing this?

Research has shown that the way that children react to the sensations around them has an impact on their performance of daily tasks at home and at school. (Please see the attached information brochure for more information on sensory processing). If the children have problems in the way that these sensations are processed in the brain it can have a negative impact on their performance of tasks and learning.

Children with sensory processing problems exhibit behaviours such as constantly making noises, show sensitivity to certain foods and food textures, sensitivity to sounds, sensory seeking behaviour e.g. constantly moving, physical clumsiness, constantly needing to regain their attention in class and poor organization of self. Studies have indicated that children with disabilities process information very different from children without disabilities. I don't know if this is true in children with speech and language disorders and will be grateful if you would consider giving permission for the special needs co-ordinator at your school/s to be approached to participate in a study to examine this. Knowledge regarding this will assist in compiling the best possible occupational therapy treatment programmes for these children, as well as assist with providing information to the teachers and therapists on how to adapt the environment in the class to assist these children with their sensory needs and to optimise learning.

What do I expect from the participants in the study?

I would like to invite all special needs co-ordinators and therapists in special schools and mainstream schools with a language unit/base in London and the South of England to participate in the study.

The special needs co-ordinator or therapist will be requested to identify children with speech and language disabilities, from the **special needs register** with the following inclusion criteria:

- Assessed as having a primary speech and language disorder (expressive or receptive).
- English speaking
- Between the ages of 5 to 10 years.

- Children without autism, pervasive developmental delays, cognitive disabilities and neurological impairments e.g. cerebral palsy or epilepsy.

The special needs co-ordinator or therapist will then be asked to send the permission forms to the parents in order to gain consent from the parents for participation in the study. A full information pack, an information sheet and an informed consent form will be provided to submit to the parent.
On receipt of the permission forms, I will invite the parents to complete the sensory profile caregiver questionnaire and a Developmental Profile II. (A self-addressed envelope will be provided in order to make it easier for them to return the questionnaire.)
These profiles will give me the necessary information to determine what the most common problems are. The information sheet will make it clear to parents that they will not be penalised for not participating in the study.

Are there benefits to the participants?

Yes. The results will assist with determining which aspects the children with language disabilities have the most difficulty with. It will also assist in formulating a program of how the classroom can be adapted to be sensory friendly to the child, in order to improve learning. Parents are more than welcome to contact me if they have specific questions regarding the questionnaire or regarding their child's profile. If any problems are identified in terms of the results on the sensory profile I will contact the parent and advise them on referrals to an occupational therapist. This procedure will be followed as each occupational therapy department has their own referral procedures and protocols. Information on the sensory profile will then be passed on to the occupational therapist on receipt of written consent from the parent. Information on the outcome of the study will also be available on request.

What about confidentiality?

Confidentiality will be maintained by the use of a code instead of names on all questionnaires and results. The child/parent's identity will be protected at all times and will not be published or make public at any time and I will be the only person to have access to the name list and the codes used.

This list will be kept locked in an office within in a locked cabinet. The forms will be destroyed at the completion of the study.

Ethical considerations

The postgraduate research committee, as well as the Human research ethics committee at the University of Witwatersrand approved the research study. Both committees approved the study (permission nr: **R14/49**).

Please contact me if you would like to have a copy of the research protocol that will provide detailed information on the theoretical background of the study as well as on the statistical information for the study.

If you have any queries or need more information, please contact me at telephone number 01932 872 302 OR 07722124561 OR janinevdl@yahoo.com.

Thank you
Janine van der Linde
Occupational Therapist

APPENDIX J: Participation letter from special needs coordinator/speech and language therapist/occupational therapist

OCCUPATIONAL THERAPY STUDY ON SENSORY PROCESSING

To be completed by special needs coordinator/speech and language therapist/occupational therapist

RETURN TO:

Janine van der Linde
Meath School
Brox Road
Ottershaw
Surrey
KT16 0LF

Consent form

I _____ am willing to participate in the study as outlined in the information sheet and am willing to assist with identifying children to participate in the study, and to contact parents in order to obtain informed consent for the study.

Special needs coordinator/therapist: _____
Signature: _____
Date: _____

How many children identified? _____

Researcher: _____
Signature of researcher: _____
Date: _____

APPENDIX K: Information brochure on sensory processing (additional information for teachers and parents on the concept of sensory processing)

INFORMATION BROCHURE SENSORY PROCESSING
(Additional information for teachers and parents on the concept of sensory processing)

Our senses give us information on our world around us and help us to survive. The senses receive information from both outside and inside our bodies. When we engage in activities we use several senses at the same time. The convergence of these senses e.g. movement (vestibular), tactile (touch), auditory (hearing), olfactory (smelling) and oral (tasting) is called sensory processing. This process tells us what is going on, where, whether it matters, and if we must respond. Sensory processing influence how children move, learn, but also how they behave, how they play and make friends, as well as on how they feel about themselves. Sensory processing happens in the brain and when detection of the input or the processing thereof is disorganised, the brain cannot process the information that is coming in from the environment. The child cannot react to the sensory information to behave meaningful, in a consistent way. The child may also have difficulty in planning and carrying out movements.

Children with sensory processing disorders have specific behaviours in which they react on sensory processing disorders. Four ways of processing information have been identified by researchers e.g.

Low registration: These are the children that are not aware of what is going on around them, may not notice people coming in the door and are uninterested in what is going on around them. They have low energy levels and are constantly tired with low endurance.

Sensory seeking: These children enjoy sensations and find ways to enhance sensory events.

Sensory avoiding: They limit sensory input throughout the day and create rituals and routines. They can get very unhappy if rituals are disrupted, they can have emotional outbursts.

Sensory sensitive: These children notice stimuli quite easily and are distracted by movements, sounds, smells. They are distractible and might become upset.

Children with sensory processing difficulties can show these behaviours on reaction to one sense or to more than one. It can also fluctuate between senses.

Examples of the reactions to various senses are:

VESTIBULAR (Movement sense)

Low registration	Sensory seeking	Sensory avoiding	Sensory sensitive.
Does not notice being moved.	Craves fast spinning movement. Constantly fidgeting.	Avoids movement. Anxious about falling.	Gets carsick

TACTILE (Touch sense)

Low registration	Sensory seeking	Sensory avoiding	Sensory sensitive.
Unaware of messy face hands.	Plays in mud Bumps into furniture.	Avoids touching or being touched.	Dislike certain clothes & textures

PROPRIOCEPTION (Position sense)

Low registration	Sensory seeking	Sensory avoiding	Sensory sensitive.
Lacks inner drive to move. More alert after pushing and moving.	Craves hugs and being squeezed, pressed.	Maybe rigid and uncoordinated	Does not like movement or being in certain positions.

AUDITORY (Hearing sense)

Low registration	Sensory seeking	Sensory avoiding	Sensory sensitive.
Ignores sounds.	Welcomes loud noises. Talks with loud voice.	Overexcited too many noises.	Covers ears to block out sounds.

OLFACTORY (smelling sense)

Low registration	Sensory seeking	Sensory avoiding	Sensory sensitive.
Unaware of odours.	Seeks strong odours.	Objects to odours.	Sensitive to smells.

GUSTATORY (Taste sense)

Low registration	Sensory seeking	Sensory avoiding	Sensory sensitive.
May eat food without noticing spices etc.	Lick things. May prefer spicy food. Chewing objects	Objects to certain tastes.	Objects to certain tastes, textures etc.

VISUAL

Low registration	Sensory seeking	Sensory avoiding	Sensory sensitive.
Ignores visual stimuli. Responds slowly and may not turn away from lights.	Seeks visually stimulated scenes. Attracted to shiny objects.	Avoids light	Overexcited too much to look at. Poor eye contact

References:

Stock Kranowitz C. The Out of Sync Child. New York: The Berkley Publishing Group. 2005.

Dunn, W. 2001. *The sensations of everyday life: theoretical, conceptual and pragmatic considerations.* 2001. The American Journal of Occupational Therapy, 55(6), p. 608-620.

APPENDIX L: Participation letter to parents

Janine van der Linde

Meath School

Brox Road

Ottershaw

Surrey

KT16 0LF

September 2006

Dear Parents

I am Janine van der Linde, an Occupational therapist at a special school in, Surrey. I am currently completing a research project for a Masters degree in Occupational Therapy, at the University of the Witwatersrand in South Africa. I am investigating the sensory processing skills of children with language disorders and the effect it has on their behaviour and participation in school. I would be most grateful if you would consider participating in this study.

Why am I doing this?

Research in has shown that the way that children react to the sensations around them has an impact on their performance of daily tasks at home and at school. (Please see the attached information brochure for more information on Sensory processing.). If the children have problems in the way that these sensations are processed it can have a negative impact on their performance of tasks and learning. Children with sensory processing problems exhibit behaviours such as constantly making noises, show sensitivity to certain foods and food textures, sensitivity to sounds, sensory seeking behaviour e.g. constantly moving, physical clumsiness, constantly needing to regain their attention in class and poor organization of self. Studies have indicated that children with disabilities process information very different from children without disabilities.

I don't know if this is true in children with speech and language disorders and will be grateful if you would consider giving permission for the speech and language therapists at your school/s to be approached to participate in a study to examine this. Knowledge regarding this will assist in compiling the best possible occupational therapy treatment programmes for these children, as well as assist with providing information to the teachers and therapists on how to adapt the environment in the class to assist these children with their sensory needs and to optimise learning.

What do I expect from the participants in the study?

I would invite you to agree to give consent to fill in a background information sheet, a Sensory profile questionnaire and a Developmental Profile II about your child. You will need to give written consent by filling in the attached form and then return it to me in the self-addressed envelope.

On receipt of the consent form I will send you the background information sheet, the Sensory Profile and Developmental Profile to complete. The Sensory Profile questionnaire contains 125 questions on your child's behaviour and will take approximately 10 – 20 minutes to complete. This profile will give me the necessary information to determine what the most common problems are. The Developmental Profile will ask questions regarding your child's development and will also take about 10 minutes to complete. I request that you return the background information sheet and the questionnaire by post in the stamped addressed envelope provided before the end of September 2006. You will not be penalised for not participating in the study and can withdraw at any time.

Are there benefits to the participants?

Yes. The results will assist with determining which aspects the children with language disorders have the most difficulty with. The results of the study will assist Occupational Therapists in formulating a program of how the classroom can be adapted to be sensory friendly to the child in order to improve learning. You are more than welcome to contact me if you have specific questions regarding the study or your child's profile. If any problems are identified on your child's profile you will be given feedback on this in a short report and you can then contact your local occupational therapist regarding intervention.

I will pass on the Information on the questionnaire to your occupational therapist, but only on receipt of your written consent to do so.

May I withdraw from the study?

Certainly you may do this at any time without having to give a reason. Remember that the study is completely voluntary and not taking part in it, or withdrawing from it, carries no penalty of any sort and schooling will not be influenced.

What about confidentiality?

Confidentiality will be maintained by the use of a code instead of names on all questionnaires and results. Your identity will be protected at all times and will not be published or make public at any time and I will be the only person to have access to. I will be the only person to have access to the name list and the codes used. This list will be kept locked in an office within in a locked cabinet. The forms will be destroyed at the completion of the study.

Ethical considerations

The postgraduate research committee, as well as the Human research ethics committee at the University of Witwatersrand approved the research study. Both committees approved the study (permission nr: **R14/49**).

If you have any queries, more information may be obtained by contacting me, Janine van der Linde at telephone number 07722124561 OR janinevdl@yahoo.com .

If you are willing to take part in the study, please read and sign the attached consent form and return it in the self addressed envelope. The questionnaires will be sent to you on receipt of the consent form.

Thank you
Janine van der Linde
Occupational Therapist

APPENDIX M: Consent form from parents

OCCUPATIONAL THERAPY STUDY ON SENSORY PROCESSING

TO BE RETURNED TO:

Janine van der Linde
Meath School
Brox Road
Ottershaw
Surrey
KT16 0LF

Consent form

I agree to participate in the study outlined in the information sheet and to return the questionnaires. I am aware that participation is voluntary and that there is no penalty for participation or voluntary withdrawal.

I hereby give permission that the special needs coordinator/speech therapist may disclose information to the researcher that may assist in the research.

Name of parents: _____

Signature of parents: _____

Date: _____

Researcher: _____

Date: _____

FOR OFFICE USE:

NAME OF PARTICIPATING SCHOOL: _____

NUMBER OF QUESTIONNAIRE: _____

APPENDIX O: Respondent Records

NAME LIST OF PARENTS AND CHILDREN IDENTIFIED

NAME OF SCHOOL: _____

NAME OF SPECIAL NEEDS CO-ORDINATOR: _____

LETTERS OF CONSENT INCLUDED: YES / NO

Nr. Profile	Name of participant	Address	Referral form included	Permission form included.	FOR OFFICE USE
1					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					

APPENDIX N : Letter with instructions for the completion of the Sensory Profile and the Developmental Profile

Janine van der Linde
Meath School
Brox Road
Ottershaw
Surrey
KT16 0LF

September 2006

Dear Parents

Thank you very much for your letter expressing your interest and willingness to participate in my research.

Please find enclosed the two questionnaires that need to be completed. Unfortunately the forms are quite lengthy, but the information you provide will really be of great help.

HOW TO FILL IN THE FORM

SENSORY PROFILE (Blue-green form)

As parents are experts on their child's behaviour, the questionnaire asks the parent to report on their child's behaviour.

This questionnaire measure a child's sensory processing abilities (how the child responds to sensory events and how that response influences their functional performance in daily life). This form will help me to determine if there are specific patterns or ways in which children with speech and language impairment process sensory input.

Please read through all the items and check the box that describes the frequency with which your child reacts during the day:

Always – Your child responds in this manner always or 100% of the time.
Frequently - Your child responds in this manner frequently or 75% of the time.
Occasionally - Your child responds in this manner occasionally or 50% of the time.
Seldom - Your child responds in this manner seldom or 25% of the time.
Never - Your child responds in this manner never or 0% of the time.

Please answer **ALL** the questions. There is no right or wrong answer as it is important to get a correct picture of your child and how they react to sensory input. Please be as honest as possible as this will give the most accurate information.

DEVELOPMENTAL PROFILE - II (grey form)

This questionnaire will help to provide information on the child's functional development. This will assist me to determine if your child has problems with functional tasks e.g. physical tasks (motor coordination, strength, motor skills), self help skills (eating, dressing), social skills (how the child relates to friends), Academic skills and communication skills (expressive and receptive skills). This questionnaire will be compared to the sensory profile to determine the way children processing sensory input influences their functional development.

Please read the question and indicate a yes (pass) or no (fail) by marking the answer with a cross. There are 5 different sections. Only complete the questions up to those for your child's age OR if your child is older than 9 years please fill in all the questions.

The school requested that I keep them up to date with the participants in the study (just the names of the participants no other information). Please let me know if you do not want me to inform the school that you are participating. If you do not contact me regarding this I will assume that you give permission for me to inform the school of your participation in the study.

I will also appreciate it if you can give me a copy of the scores your child obtained in their Speech and Language therapy assessment.

This is however compulsory and I will only use the information to see if there is a difference between higher and lower scores for expressive or receptive language problems.

Please return the questionnaires in the envelope provided, before the end of September 2006.
The data from the questionnaires will then be processed and hopefully I will be able to determine a profile for children with speech and language impairments. I will send you a short report of my findings as soon as I have the results. As research can be a lengthy process I will try to keep you up to date during the process.

If you have any queries or need more information, please contact me on telephone number 01932 872 302 OR 07722124561 OR janinevdl@yahoo.com.

Thank you
Janine van der Linde
Occupational Therapist

APPENDIX P: Sensory Profile Feedback report

SENSORY PROFILE™
Winnie Dunn,
Ph.D., OTR, FAOTA

Summary and Interpretive Report

Child's Name: Noah Jones
Date of Birth: 07/10/1993
Age: 6 Years 1 Months
Service Provider: Pat Flores
Discipline: Occupational Therapist
Daily Life Concern:

Sex: Male
Administration Date: 08/16/1999
Completed By: Sara Jones
Relationship to Child: Mother

The Sensory Profile was administered as part of a comprehensive assessment to determine whether aspects of sensory processing might be contributing to performance challenges in the daily life of Noah Jones.

The Sensory Profile is a measure of childrenís responses to sensory events in daily life. The caregiver completes the Sensory Profile by assessing the frequency of the child's responses to certain sensory processing, modulation, and behavioral/emotional events as described in the 125 items. We know from research that the Sensory Profile can help identify the childís sensory processing patterns; then we can consider how these patterns might be contributing to or creating barriers to performance in daily life.

Sara Jones, Noah's mother, reports the following concerns about the child: None. The Sensory Profile was given as a part of a total assessment that included interviews, observations, and other tests to reveal the possible contribution of sensory processing patterns to Noah's challenges.

Summary of Scores

The following paragraphs describe the child's performance on the Sensory Profile. Please also refer to the Summary Score report for a visual summary of Noah's scores.

Sensory Processing

Noah has Probable Difference scores in the following sections:

- Visual Processing
- Vestibular Processing

It is possible that these areas are a challenge for Noah. The team will need to conduct additional observations to determine the contribution of these areas to Noah's performance challenges.

Noah has difficulty in the following sections:

- Auditory Processing

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- Touch Processing
- Multisensory Processing
- Oral Sensory Processing

When children have difficulty in these sensory systems, it means that this form of sensory input is confusing, upsetting, or not meaningful to the child. In any case, difficulty with sensory input can interfere with the child's ability to complete important activities successfully as other children do.

Modulation

The following scores for Modulation sections are within the Probable Difference classification:

- Sensory Processing Related to Endurance/Tone
- Modulation Related to Body Position and Movement
- Modulation of Movement Affecting Activity Level
- Modulation of Visual Input Affecting Emotional Responses and Activity Level

Further evaluation is recommended, particularly additional skilled observation to determine how Noah modulates input during the demands of daily life.

He has difficulty with

- Modulation of Sensory Input Affecting Emotional Responses

This means the child will have problems in the following areas:

- Responding appropriately to social and environmental cues, becoming inflexible or upset by situations more easily than others.

Behavioral and Emotional Responses

He scored in the Probable Difference range on the following sections:

- Emotional/Social Responses
- Items Indicating Thresholds for Response

This indicates the need for further testing in this area.

The following sections were in the Definite Difference range:

- Behavioral Outcomes of Sensory Processing

- Difficulty with Behavioral Outcomes of Sensory Processing indicates that he has a poor work product. When sensory processing is also difficult for the child, a poor score here suggests a relationship between performance demands and the child's inaccurate "maps" of the body and/or the world, making performance imprecise.

Interpretation of Scores

Noah is having difficulty with some aspects of daily life performance. Sara Jones, his mother, indicated that Noah is having difficulty in the following areas: None. The Sensory Profile scores reveal that Noah has some useful and some difficult ways to understand and use sensory information.

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Noah is having difficulty with other ways of processing sensory information and these are likely to be interfering with daily life performance. He is having difficulty with

- Visual Processing
- Vestibular Processing
- Sensory Processing Related to Endurance/Tone
- Modulation Related to Body Position and Movement
- Modulation of Movement Affecting Activity Level
- Modulation of Visual Input Affecting Emotional Responses and Activity Level
- Emotional/Social Responses
- Items Indicating Thresholds for Response
- Auditory Processing
- Touch Processing
- Multisensory Processing
- Oral Sensory Processing
- Modulation of Sensory Input Affecting Emotional Responses
- Behavioral Outcomes of Sensory Processing

Other assessments, interviews, and other observations should augment the Sensory Profile findings. The therapist will meet with the teachers and his parents to construct additional plans to support him in daily life, with attention to his sensory processing needs.

Pat Flores
Occupational Therapist

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SENSORY PROFILE
Winnie Dunn,
Ph.D., OTR, FAOTA

Caregiver Questionnaire (Full) Report

Child's Name: Noah Jones
Date of Birth: 07 / 10 / 1993 Age: 6 Years 1 Months Sex: Male Administration Date: 08 / 16 / 1999
Service Provider: Pat Flores Discipline: Occupational Therapist
Completed By: Sara Jones Relationship to Child: Mother

Services:

1. Early Intervention/Preschool Services
2. Regular Education
3. Special Education
4. Occupational Therapy
5. Speech Therapy
6. Other

We are investigating ways to support Noah and the classroom teacher in regular education

Conditions:

1. Autism/Pervasive Development Disorder (PDD)

Comments:

Section Comments:

Auditory Processing:
Noah makes a lot of noise and it seems to calm him
Touch Processing:
Noah does better if we stick to a set routine for personal hygiene
Emotional/Social Responses:
Easily upset when his routine is disrupted

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Section and Factor Summaries

Section	Classification		
	Typical Performance	Probable Difference	Definite Difference
Sensory Processing			
A. Auditory Processing			X
B. Visual Processing		X	
C. Vestibular Processing		X	
D. Touch Processing			X
E. Multisensory Processing			X
F. Oral Sensory Processing			X
Modulation Processing			
G. Sensory Processing Related to Endurance/Tone		X	
H. Modulation Related to Body Position and Movement		X	
I. Modulation of Movement Affecting Activity Level		X	
J. Modulation of Sensory Input Affecting Emotional Responses			X
K. Modulation of Visual Input Affecting Emotional Responses		X	
Behavior and Emotional Responses			
L. Emotional/Social Responses		X	
M. Behavioral Outcomes of Sensory Processing			X
N. Items Indicating Thresholds for Response		X	

Factor	Classification		
	Typical Performance	Probable Difference	Definite Difference
1. Sensory Seeking		X	
2. Emotionally Reactive			X
3. Low Endurance/Tone		X	
4. Oral Sensory Sensitivity			X
5. Inattention/Distractibility		X	
6. Poor Registration			X
7. Sensory Sensitivity	X		
8. Sedentary		X	
9. Fine Motor/Perceptual		X	

*Classifications are based on the performance of children without disabilities (n=1,037).

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