SENSORY INTEGRATION

Overview of the Chapter

This chapter describes how efficient or inefficient processing of inputs from our senses facilitates or impedes the process of academic and practical learning; and how Sensory Integrative Therapy helps rectify processing deficiencies, thus enabling children to perform academic and practical tasks more easily and efficiently. This chapter is divided into five parts.

A. Sensory Integration

This section briefly describes:

- The role played by our external and internal senses in the learning process
- Processes involved in integrating inputs from the senses

B. Sensory Processing Disorder

This sub-section briefly explains the nature of sensory processing disorder. Three aspects of this disorder are: difficulties with *modulating* and *discriminating* sensory inputs; and *coordinating motor movements*. Special attention is given to understanding:

- Symptoms and consequences of sensory *modulation* difficulties
- Types of auditory and visual *discrimination difficulties* and *sensory-motor coordination difficulties* described in greater detail in the next sub-section.

C. Auditory, Visual, and Visual-Motor Processing

Persons need to display several types of *auditory*, *visual*, and *visual-motor* skills in order to perform academic and practical tasks efficiently. Deficient skills in these areas often cause difficulty for academic learning. Hence a separate sub-section is allotted to describe skills and related deficiencies in each of these three areas:

- *Auditory processing*
    - The nature and symptoms of auditory processing difficulty
    - Clusters of auditory processing skills: auditory awareness, discrimination, identification and comprehension
    - How auditory processing deficiencies negatively impact the learning process
- *Visual processing*
    - Symptoms of visual processing difficulty
    - Types of visual processing
    - Difficulties associated with deficient visual processing
- *Visual-motor processing:*
    - Symptoms of visual-motor integration difficulty
    - Types of visual-motor integration difficulty
    - Difficulties associated with deficient visual-motor integration

D. Model of Sensory Integration

Jane Ayres, an occupational therapist observed that apart from processing inputs from each of the senses, the brain also *integrates* inputs from different sensory systems. Difficulty integrating sensory

inputs results in academic difficulties. Ayres model of sensory integration forms the basis for Sensory Integrative Therapy. Thus this subsection outlines:

- The key tenets of Jane Ayres *Sensory Integration Theory.*
- Levels of sensory processing within the nervous system and brain
- Role of vestibular, tactile and proprioceptive processing in language and learning

E. Sensory Integrative Therapy

Building on the tenets of Ayres' theory, this sub-section briefly describes:

- Aim of Sensory Integrative Therapy
- Sensory Integrative treatment method
- Outcomes of Sensory Integrative Therapy

Sensory Integration

We receive information about the world around us through our external senses of taste, smell, sight, hearing, and touch; and get inputs from the inner world of our bodies through our tactile, vestibular and proprioceptive senses. When the nerves carrying inputs from different senses connect or *integrate* efficiently within the brain, we are able to learn as well as perform tasks of daily living easily and without much effort. This chapter reviews some basic information about:

- How inputs from our senses contribute towards helping us learn and handle daily tasks
- How we might have difficulty learning and performing tasks of daily living when our brain is not able to effectively integrate inputs from the senses.

We first describe the special role played by our tactile, vestibular and proprioceptive senses before we attempt to understand what is 'sensory integration' and 'difficulty with sensory integration'.

Inputs from internal and external senses

We are often fairly well attuned to the sensory inputs we receive from the world *around us* –

- Buildings, vehicles, mountains and rivers we *see*
- Sounds of vehicles and birds, chimes of a clock, music that we *hear*
- The aroma of coffee brewing in a pot, or the scent of flowers that we *smell*, etc.
- Delicious foods, beverages, or deserts that we *taste*

However, we may not be as well attuned to crucial sensations and signals we receive from *our bodies* though our *inner senses*.

Let us take a look at the senses were may not be well attuned to - our tactile, vestibular, and proprioceptive senses that keep us connected to the inner world of our bodies.

- *Tactile* cells within our skin receive information about the shape and texture of objects, vibration, touch, pain, temperature, and pressure. They enable us to gauge the shape, texture, weight, hardness or softness of objects even though we might not see them, like when we are searching for a torch, key or book in the dark.

- Our *vestibular sense* informs us that we are moving, or surrounded by something moving – like when we sense the movement of a bus or train we are travelling in, even though we are partially asleep. Our vestibular sense also enables us to achieve physical balance, and to coordinate the movement of eyes, head and body, like when we are sitting at a desk writing an essay, riding a bicycle, walking a tight rope, or climbing a steep hill.

- *Proprioceptive sensors* located in muscles, ligaments, joints, and tendons tell us where body parts are without having to look at them. They enable us to walk without bumping into objects, and to manipulate objects like pencils, scissors, machines, etc. without having to consciously attend to our muscular movements.

These inner senses begin functioning while we are in the womb of our mothers. After birth they begin connecting with other senses and brain centres.[1]

Aspects of sensory processing and integration

Information received from each of our senses is *processed* within the brain. Jean Ayres – an occupational therapist and psychologist - observed through her studies in physical development, neuroscience, and muscular function, that:

- The brain selects, enhances or inhibits, compares and unifies information received through our internal and external senses in a flexible manner. For example in order to identify a musical tune of the nursery rhyme 'Jack and Jill' being played in a room, we need to:
    - Focus on the tune (select and enhance)
    - Filter out (inhibit) competing sounds like voices of persons talking, or the sound of fans in the room
    - Match (compare) the tune with the tune and words of the song stored in our memory
    - Identify (unify) it as an instrumental version of the rhyme 'Jack and Jill'.
- Unified information is then organized for use in use in the environment around us; as well as for learning, regulation of emotions and behaviour[2].

In order to use information unified by the brain, one has to *integrate the input* from several senses in order to *learn*; and engage a set of muscles in order to *create an output* For example, in order to *learn* and *sing* a song, one needs to:

- *Hear* a song
- *See* the lyrics printed on a page
- *Remember* the tune and lyrics
- *Store* the words and tune in my memory

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[1] *A parent guide to understanding integration. (Article doesn't cite source)*

[2] Fisher, A.G., & Murray. E.A. (1991). In Mauer. D.M. (1999). Issues and applications of sensory integration theory and treatment with children with language disorders. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390. (added initials to authors' first name as given in the article's references)

- *Vocally sing* out the song by engaging one's vocal cords, and moving the muscles of one's jaws and face.

Sensory Processing Disorder is associated with difficulty organizing and integrating *inputs* from our senses in order to produce *outputs* of various types such as:

- Ocular-motor *output* (movement of eye muscles, and focusing of one's gaze)
- Vocal *output* (speaking or singing)
- Motor *output* (writing, throwing, or moving to avoid an object thrown at us) is known as Sensory Processing Disorder.

Sensory Processing Disorder

What is sensory processing disorder?

Sensory Processing Disorder (SPD) is the current term for what was earlier called *Sensory Integrative Dysfunction*. Miller (2013) describes SPD as:

> A neurophysiologic condition in which sensory input either from the environment or from one's body is poorly detected, modulated, or interpreted and/or to which atypical responses are observed[3].

Thus, persons who are unable to efficiently integrate inputs from the senses - attend to, behave, or give an inappropriate or problematic muscular response when they anticipate or receive a sensory stimulation.

- For example: If a person is unable to visually track the movement of a ball that is thrown at him by continually adapting his visual focus, and if he is not able to coordinate the movement of his body, arms and fingers to catch the ball, he might clasp his hands either before or after the ball approaches him, and not be able to catch the ball; or he might position himself wrongly, and get hit by the ball.

When difficulties like these interfere with an individual's ability to handle daily tasks and routines, they are considered to be a disorder.

Types of sensory processing difficulties

Miller et al. (2007)[4] suggest that there are three aspects to Sensory Processing Disorder:

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[3] Miller, L.J. (2014), Sensational kids- Revised edition. In K. Kopp; & T. Schier. (No date). Making sense out of sensory processing disorder.
http://depts.washington.edu/lend/pdfs/Making_Sense_Sensory_Processing_Disorder103114.pdf

[4] Miller, L J, *et. al*. (2007)? In K. Kopp, T. Schier. (No date) , Making sense out of sensory processing disorder
http://depts.washington.edu/lend/pdfs/Making_Sense_Sensory_Processing_Disorder103114.pdf (is this refe as given below)
Miller, L.J., Coll, J.R., & Schoen, S.A. (2007). A randomized controlled pilot study of the effectiveness of occupational therapy for children with sensory modulation disorder. *American Journal of Occupational Therapy*, *61*, 228-238. In K. Kopp, T. Schier. (No date). Making sense out of sensory processing disorder

- Sensory Modulation Disorder (SMD)
- Sensory Discrimination Disorder which may affect our visual, auditory, tactile, taste, smell, and interoception (sense of internal organs)
- Sensory-Based Motor Disorder (SBMD) such as dyspraxia and postural disorder

Sensory modulation disorder

Persons who have difficulty detecting, modulating, interpreting or responding to sensory stimuli have *Sensory Modulation Disorder*. These persons may either i) over-respond or ii) under-respond to sensory inputs; or iii) may crave for sensory experience[5]. Persons with such challenges may:

- Have difficulty sustaining attention on tasks
- Make inappropriate motor responses (movement of muscles or limbs) when receiving or anticipating a sensory input.
- Behave in inappropriate or problematic ways in response to situations

Persons who are *over-responsive* to sights, sounds, touch, movement, tastes or smells may:

- Get aggressive or impulsive when overwhelmed by sensory stimuli
- Become irritable, fussy and moody
- Avoid interacting or cultivating relationships with others
- Become over-cautious and fearful of trying out new things
- Get upset when routines or situations in their environment are changed unexpectedly

Persons who are *under-responsive* to sensory stimuli may:

- Be very slow in responding to directions or instructions
- Not notice when they are touched
- Endure high amounts of pain
- Prefer activities where they are not required to move too much
- May be passive, quiet and withdrawn; and lack motivation and drive
- Have difficulty engaging in social interactions

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http://depts.washington.edu/lend/pdfs/Making_Sense_Sensory_Processing_Disorder103114.pdf
(check this reference - James, K., Miller, L.J., Schaaf, R.., Nielsen, D.M., & Schoen, S.A. (2011) Phenotypes within sensory modulation dysfunction. *Comprehensive Psychiatry*, *52*, 715-724. Doi:10.1016/i.comppsych.2010.11.010

http://www.atotalapproach.com/images/docs/Phenotypes-within-Sensory-Modulation-Dysfunction.pdf
2 references in same endnote ?

[5] Kopp, K & Schier, T. (No date). Making sense out of sensory processing disorder. http://depts.washington.edu/lend/pdfs/Making_Sense_Sensory_Processing_Disorder103114.pdf

(check this reference - James, K., Miller, L.J., Schaaf, R., Nielsen, D.M.& Schoen, S.A. (2011) Phenotypes within sensory modulation dysfunction. *Comprehensive Psychiatry*. 52, 715-724. Doi:10.1016/i.comppsych.2010.11.010.
http://www.atotalapproach.com/images/docs/Phenotypes-within-Sensory-Modulation-Dysfunction.pdf (two references in same endnote)

Persons who *crave sensations* need a great deal of sensory stimulation. They may:

- Like crashing into, or touching objects or people
- Swing, swirl, rock, or jump excessively
- Talk constantly or have trouble awaiting their turn to speak in conversation

Patterns and combinations of the above three types of dysfunctions vary from person to person. For example, some may be under-responsive to touch, but over-responsive to sounds. Still others may be over-responsive to light touch, but crave for deep touch.

Sensory discrimination

Auditory and visual inputs play an important role in learning. For example, we pick up much information by *hearing* spoken instructions, and by *reading* printed material. Thus, we need to be able to process auditory and visual information efficiently in order to learn. Several skills are required to process auditory and visual information. Some of these processes involve the ability to discriminate or distinguish sights and sounds. In addition, amidst the learning process, auditory and visual inputs need to be integrated with motor tasks like writing or manipulating tools. The next sub-section takes a look at these processes in greater detail.

Auditory, Visual & Visual-Motor Processing

Academic learning as well as learning in day-to-day situations requires an effective use of a combination of auditory, visual, and motor abilities. Children who have deficient abilities or skills within (e.g., auditory or visual alone), or between these areas (e.g., between auditory and visual; visual and motor), often find it difficult to handle different kinds of learning tasks; and may suffer from deviant or delayed academic and communication development[6].

[6] Ayres, A.J. (1976); Ayres & Mailloux. (1981); Magrun& Ottenbacher; MoCue & Keefe. (1981). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

Auditory Processing

Much practical and academic learning takes place through detecting and interpreting (identifying the nature of) sounds that we hear in our environment (like that of wind, flowing rivers, or songs of birds), as well as of verbal information or instructions that we receive. Thus, our capacity to learn is greatly limited when our ability to process auditory inputs is compromised, as with those who suffer from Auditory Processing Disorder (APD).

What is Auditory Processing Disorder?

Children with Auditory Processing Disorder (APD) do not have a hearing impairment. They have difficulty processing and making meaning of sounds. Most persons are able to process sounds instantly and efficiently, and interpret what they hear. However, the hearing process gets scrambled for persons with APD. For such persons, the sentence "Tell me how the chair and the couch are alike" might sound like "Tell me how a cow and hair are like[7]". They have difficulty understanding the *sounds* of spoken language, not the *meaning* of what is being said.[8]

Persons who display (Central) Auditory Processing Disorder (C)APD often display deficits in one or more auditory skills such as locating the direction of sounds; discriminating sounds from one another; reproducing sounds in the sequence and proper rhythm in which they are presented; separating sounds in the foreground from those in the background; or identifying sounds that are not clearly presented[9].

Symptoms of Auditory Processing difficulty

Children with Auditory Processing Disorder manifest symptoms such as[10]:

- Difficulty understanding speech when background noises are present
- Difficulty repeating or recalling similar sounding words

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[7] Young, M.S., & Maxine, L. (No date). Recognizing and treating children with central auditory processing disorders. http://www.scilearn.com/alldocs/mktg/10035-952MYoungCAPD.pdf .

The Understood Team (No date). Understanding auditory processing disorder. *Understood for Learning & Attention Issues*. https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/auditory-processing-disorder/understanding-auditory-processing-disorder Retrieved on May 23, 2018. (two reference)

[8] No Rererence? Or is it for the above?

[9] Darouie, A; Abdollahi, F. Z; Joulaie, M., & Ahmadi, T. (2017). Central auditory processing disorder in children. *Global Journal of Otolaryngology*, *6*(5), 001-003. https://www.tums.ac.ir/1396/10/03/GJO.MS.ID.555698.pdf-fzamiri-2017-12-24-02-45.pdf Retrieved on May 15, 2018.

[10] Lliadou, V et.al. (2017). A European perspective on auditory processing disorder-current knowledge and future research focus. *Frontiers in Neurology,* 8: 622. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5702335/ Retrieved on May 23, 2018.

- Seeking facial cues to understand what is being said
- Responding inadequately to directions
- Exhibiting educational difficulties despite adequate hearing ability

Auditory processing skills

The ability of the brain to perceive and interpret information associated with sounds is known as auditory processing. We need to have specific sets of skills in order to successfully interpret and comprehend the sounds we hear[11], [12]. Researchers are not fully agreed about the order in which these skills are cultivated. However they may be broadly classified into four separate sets such as auditory awareness, discrimination, identification, and comprehension[13]:

Auditory awareness

- *Auditory awareness*: ability to detect sounds
- *Sound localization*: ability to locate the source of sounds
- *Auditory attention/ figure ground*: ability to focus on relevant sounds amidst the presence of competing irrelevant sounds, e.g., of a person's speech against background noises

Auditory discrimination

- *Discrimination of sounds in the environment*: ability to detect the difference between sounds in the environment – wind, rain, train, motorcycle, etc.
- *Discrimination of suprasegmentals*: ability to differentiate between rate, intensity, duration, pitch, etc., of human speech
- *Discrimination of segmentals*: ability to notice, compare, and distinguish between specific, and/ or like-sounding speech sounds e.g., *seventy* and *seventeen*

Auditory identification

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[11] Loraine S. S. (2010). Auditory processing – A breakdown of skills. Super Duper Publications. https://www.superduperinc.com/handouts/pdf/243_AuditoryProcessing.pdf Retrieved 23 May, 2018

[12] The Understood Team (no date). Understanding auditory processing disorder. *Understood for Learning & Attention Issues*.

https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/auditory-processing-disorder/understanding-auditory-processing-disorder Retrieved on May 23, 2018

[13] Johnson, C.D., Benson, P.V., & Seaton, J.B. (19977). *Educational audiology handbook.* San Diego: Singular Publishing Group

Stredler-Brown, A., & Johnson, C.D. (2004). *Functional auditory performance indicators: An integrated approach to auditory skill development (3rd ed.).* Retrieved from http://www.cde.state.co.us/cdesped/download/pdf/FAPI_3-1-04g.pdf (page not found)

Roeser, R.J., & Downs, M.P. (2004). *Auditory disorders in school children: The law, identification, remediation 4th ed.* New York: Thieme Medical Publishers, Inc. (3 references)

- *Auditory association*: ability to attach meaning to sounds and speech
- *Auditory feedback/ self-monitoring*: ability to change speech production (pitch, pace, etc.) based on hearing oneself speak
- *Phonological awareness*: ability to identify, segment, blend and manipulate sounds in oral language communications

Auditory comprehension

- *Auditory memory & sequential memory*: ability to retain auditory information (including the order of sounds in words like 'elephant', not 'ephelant') both immediately and after a period of time.
- *Auditory closure*: ability to understand a spoken message even when a part of the message is interrupted or missing.
- *Auditory comprehension*: ability to understand longer spoken sentences, to follow directions and understand stories.
- *Linguistic auditory processing*: ability to interpret, retain, organize, and manipulate spoken language for higher level learning and communication.

Auditory processing and learning ability[14]

The ability to recognise or interpret what one hears is called auditory perception. Deficits in auditory perception in the areas of phonological awareness, auditory discrimination, auditory memory, auditory sequencing, and auditory blending are associated with learning disabilities.

- *Phonological awareness* is the ability to recognize that words are composed of individual sounds, like the word cat is made up of three sounds c/a/t. Children with deficient phonological auditory discrimination skills find it difficult to:
    - Isolate and count the number of sounds in a word
    - Recognize similarities in rhyming words, e.g., mat, fat, cat…
    - Recognize differences in alliterated words e.g., cap, cat…

- *Auditory blending* is the ability to blend phonemes or individual sounds into a complete word.

- *Auditory memory* is the ability to remember and recall words or directions spoken orally, e.g., open your bag, take out your English text book, and place it on the table.

- *Auditory sequencing* is the ability to remember the order of items that are arranged in sequence e.g., days of the week, months of the year, etc.

[14] (Blue book 268-270)

Children can have deficits in one, some, or all areas spoken about. Their level of difficulty in one or more of these areas can range from mild to severe. These deficits may compromise their academic as well as practical learning ability.

- Recent research suggests that auditory processing issues may be a contributing factor to dyslexia[15]. It is estimated that about 30 to 50% of children with dyslexia have (C) APD and exhibit poor verbal working memory and phonological processing[16].

Activities to develop auditory processing skills

Activities that classroom teachers can conduct to help children develop auditory processing skills[17] are detailed in the *Appendix* section on 'Auditory *Processing'.* Activities are presented for development of skills in the areas of:

- Auditory awareness
- Auditory discrimination
- Phonological awareness of language sounds
- Developing auditory memory

Diagnosing Auditory Processing Disorder

There are several steps in diagnosing APD. If a paediatrician rules out the possibility of an ear infection, a speech-language pathologist or school psychologist may want to assess the child's receptive language, listening comprehension skills, and cognitive abilities. However, only a trained audiologist can conduct tests needed to make a diagnosis of APD.

The ability to read and write requires the ability to integrate auditory as well as visual abilities. For example, *reading* requires that a person be able to associate sounds with written words. Persons with visual processing deficits may experience numerous challenges in these areas.

VISUAL PROCESSING

Visual perception requires much more than a 20/ 20 vision. Many children with good eyesight have difficulty organizing and making sense of visual information. This is because images like symbols, pictures, or the distance between objects are processed by the brain. When the brain is unable to process visual inputs efficiently, it affects a person's ability to read and write, like in persons with

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[15] Rosen, S. (2003). Auditory processing in dyslexia and specific language impairment: Is there a deficit? what is its nature? does it explain anything? *Journal of Phonetics, 31*(3-4), 509-527. http://www.sciencedirect.com/science/article/pii/S0095447003000469

[16] Darouie, A; Abdollahi, F. Z; Joulaie, M., & Ahmadi, T. (2017). Central auditory processing disorder in children. *Global Journal of Otolaryngology*, *6*(5), 001-003. https://www.tums.ac.ir/1396/10/03/GJO.MS.ID.555698.pdf-fzamiri-2017-12-24-02-45.pdf Retrieved on May 15, 2018

[17] Blue book, p. 294 – 296.

dyslexia; and also the ability to perform tasks of day-to-day living like sorting objects or engaging in sports[18].

Symptoms of visual processing difficulty

Children with visual processing difficulties may display some of the symptoms mentioned below[19]. They may:

- Get distracted or overwhelmed by too many things within their field of vision
- Tire easily, or lose their place on a page when reading
- Find it difficult to copy what is written on a board, or write within lines or margins
- Reverse letters or numbers when reading or writing
- Have difficulty remembering or comprehending what they read silently
- Omit, substitute, repeat, or confuse similar words
- Have difficulty sizing, or spacing written words
- Ignore function signs, or omit steps when doing maths

Types of visual processing difficulty

Deficiencies in different visual processing abilities contribute to the difficulties mentioned above; and individuals can have more than one of these[20] such as difficulties with visual discrimination, figure-ground discrimination, long or short-term visual memory, visual sequential memory, visual-spatial relationships, and visual closure; and difficulties with perceiving form constancy.

Visual discrimination is the ability to recognize similarities and differences between shapes, size, colours, objects and patterns.

- This ability enables us to understand and respond to our environment; and to read and write[21].
- Persons with visual discrimination difficulty may mix or confuse similar-looking letters like *b, d, p, or q;* or numbers like *6 and 9*[22]. Thus they may find it difficult to read or write.

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[18] Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention Issues.* https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

[19] Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention Issues.* https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

[20] Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention Issues.* https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

[21] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/

[22] Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention issues.* https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

Figure ground perception is the ability to filter out unimportant visual information within one's visual field, and to focus on what is relevant to one's enquiry or search, for example – spotting a coin in a tray filled with articles of different kinds; or finding a phrase on a densely printed page[23].

- Persons with figure-ground discrimination difficulty may struggle with finding specific information on a written page; picking out numbers in word problems; finding objects like an eraser in a pouch; or maintaining visual attention for long periods of time[24].
- They may have difficulty with academic as well as practical learning.

Visual memory is the ability to immediately recall symbols, shapes, objects, or scenes that one has seen.

- This ability plays an important role in remembering what we have read (words, spellings, concepts, events); and performing activities of daily living (locating where we have placed books, keys, or other articles).
- It also enables the conversion of short term memory into long-term memory.
- Children with difficulty in this area may struggle with reading, spelling, remembering what they have read, or recalling skills they have learned[25].

Visual sequential memory is the ability to remember and recall the sequence of numbers, alphabets, words, objects, or events in the correct order.

- This ability is necessary for academic tasks such as reading, spelling, and comprehension; and for performing sequential tasks of daily living like brushing one's teeth or getting dressed.
- Children with visual sequencing difficulties may make errors when reading and spelling – like changing the order of alphabets, numbers or words that they have read; skipping lines when reading; or organizing their ideas[26].

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[23] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/

[24] Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention issues.* https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues
What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/

[25] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/
Arky. B. (No date). Understanding visual processing issues. *Understood for learning & attention issues.*https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

[26] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/
Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention issues.*

Perception of *visual spatial relationship* is the ability to visually perceive two or more objects in relation to each other and to the viewer.

- This ability helps persons understand what it means to form a circle; to stand first, midway or last in a line; or put a weight on top of a pile of loose sheets of paper.
- Deficiency in this area makes it difficult for persons to tell the distance of objects from each other on a map, or maintain a consistent distance between words when writing.
- Such a deficiency can affect one's problem solving ability and school performance[27].

Visual closure is a visual perceptual skill that enables us to quickly view and mentally determine what words or objects are even when they are only partially visible.

- This ability enables us to read words together instead of every alphabet at a time, quickly recognize differences in similar-looking words (e.g., sow and saw; or board and beard), to read quickly and fluently; and to locate and identify partially hidden objects.
- Persons with deficiencies in this area find it difficult recognize a word if a letter is missing; or an object if some of its parts are missing – like recognizing a truck in a picture if the wheels are missing or hidden from view[28].

Perception of *form constancy* is the ability to perceive that an object remains the same even when it changes its size, or position**.**

- This ability enables us to perceive that the letter 'A' can remain the same even when it is presented in different fonts and sizes (A, A, a), or when it is placed in different words or sentences, or in different environments like on a page, website or billboard.
- This ability enables us to label and categorize objects, and to organize materials.
- Persons with difficulty in this area may struggle to identify alphabets written in different fonts on the same page; or may tend to reverse numbers or letters[29].

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https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

[27] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/
Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention issues*. https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

[28] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/.
Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention issues*. https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

[29] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/

Difficulty with visual processing in one or more of the areas mentioned above is likely to have a negative impact on a person's academic performance, as well as ability to perform some tasks of day-to-day living. They may experience additional difficulties when they are required to produce a motor output in response to visual inputs.

Developing visual processing skills

Activities that classroom teachers can conduct to help children develop visual processing skills in the areas mentioned below are described in the Appendix section on *'Visual Processing.'*

- Visual discrimination
- Visual figure-ground perception
- Short and long-term visual memory
- Visual sequential memory
- Visual spatial relationship
- Visual closure
- Form constancy

Visual-Motor Processing

Perceptual distortions occasioned by visual processing difficulties confuse the responses we need to give when a motor output is required. These difficulties are compounded for persons who are not able to adequately coordinate their muscular movements in order to respond effectively to situations, like copying a text from a board, tying shoe laces, bouncing or kicking a ball. Visual and motor processing abilities that may be compromised among such persons include difficulty with visual focus, visual tracking, and visual-motor coordination.

Types of visual-motor difficulty

Visual focus is the ability to see objects clearly at a close distance. The lenses of the eye need to change their shape when shifting focus from one object to another – as when we read or write.

- Persons who find it difficult to do this may find the text blurring, get eye fatigue or headaches when reading; and may have difficulty copying from a board or book[30].

Visual tracking is the ability to control the movement of the eyes by using the oculomotor system (vision and eye muscles working together).

- Two aspects to this ability are: a) focusing our gaze on a moving object – like tracking the movement of a ball; and b) shifting our gaze from one object to another – say, when reading words in a paragraph.

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[30] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/
What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/

- Children with deficient visual tracking ability may move their head while reading; skip words, or use their fingers to focus on words they are reading; or have difficulty catching or hitting a moving ball[31].

Visual motor integration is the ability to interpret visual information and respond with a motor action (movement of muscles and limbs), for example, striking a moving ball with a bat. If what we see with our eyes is not perceived correctly, the muscles will get incorrect messages, and one is likely to make an inappropriate motor response.

- Children with such difficulties struggle with tasks that require eye-hand, eye-foot, eye-mouth coordination, or coordinating the movement of muscles and limbs in both sides of the body.
- They may have difficulty with tasks like reading, copying from a board or book, writing within margins; playing football or basketball; or activities of daily living like tying shoe laces or getting food on a fork[32].
- Such difficulties may compromise their academic as well as practical learning and performance.

The presentation thus far has focused on a variety of sensory skills in the auditory, visual and motor areas. The role of developed or deficient skills in these areas is best understood within the context of a theory of sensory processing and integration. The next subsection briefly presents the tenets of Jane Ayres' *Sensory Integration Theory.*

Activities to develop visual-motor skills

Activities that classroom teachers can engage to help children develop visual-motor skills in the areas mentioned below are described in the *Appendix* section on *'Visual-Motor Skills.'*

- Visual focus
- Visual tracking
- Visual-motor integration

Model of Sensory Integration

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[31] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/
What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/

[32] What, Why and How. Series 4-visual skills. Your Therapy Source, Inc. https://www.yourtherapysource.com/product/what-why-and-how-series-4-visual-skills/.
Arky, B. (No date). Understanding visual processing issues. *Understood for learning & attention issues*. https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/visual-processing-issues/understanding-visual-processing-issues

Tenets of Sensory Integration Theory

Ayres Sensory Integration[33] theory conceptualizes her observations about how the brain organizes and coordinates the inputs it receives, and about how deficient integration of sensory inputs can be enhanced through occupational therapy. The theory and practice of this process[34] is commonly known as *Sensory Integration Theory*.

Sensory integration theory holds that[35],[36]

- The sensory information we receive from the environment or from within our bodies, is processed and integrated within the central nervous system (CNS), and is used to plan and organize our response to the environment.
- Inefficient processing and integration of inputs received from the senses results in difficulties in conceptual and motor learning, and also inhibits our ability to interact effectively with our environment.
- The nervous system is malleable during the early years of a child's life; and the efficiency of our neurological system to organize and integrate the inputs it receives can be enhanced through appropriate intervention. Hence, providing meaningful, planned and enhanced sensory experiences to help individuals respond adaptively to their environment enhances their ability to integrate sensory inputs and to learn effectively.

Sensory Integration theory assumes that[37]:

- The brain operates as a single integrated organism
- Senses within the sensory system function and develop in an interdependent manner
- Different portions of the brain interact with one another in order to enable individuals to function

Levels of sensory processing

Sensory inputs that we receive are processed at different levels. The basic as well as complex processes function in an interdependent manner. 'Higher or subsequent' specialized levels of processing depend on the way sensory information is processed at 'lower or initial' levels.

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[33] Fisher, A.G; & Murray. E.A. (1991). In Mauer. D.M. (1999).Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[34]Ayres, A.J. (1986). Ayres sensory integration. https://www.siglobalnetwork.org/ayres-sensory-integration

[35] Ayres, A.J. (1986). p.1, 10? Ayres sensory integration. https://www.siglobalnetwork.org/ayres-sensory-integration. (should this be mentioned)

[36] Fisher, A.G., & Murray, .E.A. (1991). In Mauer. D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[37] Ayres, A.J. (1972b); Fisher, A.G; & Murray, E.A. (1991). In Mauer. D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

- Most of the information received from the vestibular sense (associated with 'movement') is processed in the brainstem;
- Information from the somatosensory system (touch, and proprioception – awareness of body parts) is processed in the thalamus – where the information received is 'filtered' and 'refined'.
- These sensory inputs are then passed on to the cerebral cortex where they are analyzed and made available for higher functions such as perception, abstraction, reasoning, language, and learning.

Sensory Integration theory holds that when information is effectively processed in the brain stem and thalamus, it helps enhance our learning and behavioural performance[38].

Role of vestibular, tactile & proprioceptive processing in language and learning

Ayres (1979) held that the vestibular, tactile and proprioceptive senses provide the foundation for learning and language.

- These systems facilitate the development of eye-hand coordination; and enable children to learn about objects and their action upon objects[39] thereby providing meaning to sensation, and purposefulness to movement[40].
- At a subsequent processing stage, we meaningfully associate what is learned through movement and touch with information obtained from the visual and auditory systems.
- For speech and language skills to develop the vestibular and auditory systems need to have efficient neural connections with the speech and language areas of the brain.

Deficient processing associated with five systems – the limbic, vestibular, tactile, proprioceptive systems, and organization within the Central Nervous System[41] - provide an insight into the kind of sensory integration difficulties a person is likely to experience.

The *limbic system* (hippocampus, amygdala, and hypothalamus) determines which sensory information to register, bring to attention, and respond to.

- When the limbic system does not perform this task efficiently, a child may ignore, or over-register auditory and visual inputs[42].

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[38] Ayres, A.J. (1972). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[39] Sensory Integration International, (1991). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[40] Ayres, A.J. (1979). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[41].Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[42] Ayres, A.J. (1979). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

- Afflicted children may not be able to remain alert and focused when dealing with language comprehension tasks that require the processing of large amounts of auditory information[43].

The *vestibular system* coordinates and modulates muscular activity when communicating through body language, nonverbal expression, and written language[44].

- Under or over responsiveness to movement involved in activities such as swinging, climbing and running keeps children from relating to others, and learning through many functional and play-related activities[45].
- Vestibular dysfunction may make decisions difficult with respect to personal space such as how close to stand to others.

A child with an under or over responsive *tactile system* may have difficulty developing fine motor skills involved in writing and feeding.

- Difficulty with oral motor movement may result in problems articulating sounds because of lack of adequate information from touch receptors in and around the face and mouth[46].
- Children with tactile dysfunction may withdraw when being touched, avoid wearing certain types of clothing or eating certain types of food, or using their fingertips to manipulate objects.

Proprioceptive dysfunction results in difficulty figuring out the position of the body in space; clumsiness, difficulty manipulating small objects or learning new motor skills.

- These deficits make it difficult for afflicted persons to conceptualize and plan what actions to engage in, and to implement motor tasks[47], e.g., arranging books and stationery on a desk, climbing up a ladder, or walking up a hill on an uneven path.

Speech and language are cognitive functions that depend on *Central Nervous System (CNS) organization* at all levels[48].

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[43] Trott, Laurel, & Windeck. (1993). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[44] Trott et al. (1993); Ayres, A.J. (1979). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[45] Ayres, A.J. (1979); Ayres, A.J., & Tickle. (1980); Cook. (1990); & Zisserman. (1992). In Mauer, D.M.(1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[46] Trott et al. (1993). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[47] Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[48] Windeck, & Laurel. (1989). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

- Deficits in perception and inefficient coordination of sensory input is believed to affect speech and language, organization of practical activities, interpersonal relationships and attention[49].

Symptoms of sensory processing dysfunction that a child manifests will depend on the demands of the environment as well as the system in which the sensory integrative breakdown occurs. Breakdown may occur when integrating auditory and visual input; or within the limbic, vestibular, tactile or proprioceptive systems. Language-learning problems that children exhibit include difficulties with planning, organizing, sequencing their thoughts, beginning and completing tasks[50].

Sensory Integrative Therapy

Sensory Integrative Therapy (SIT) is based on the premise that:

- The plasticity of the child's developing nervous system allows for the 'repair' of nervous system deficiencies
- The control of tactile, vestibular and proprioceptive sensory inputs enhances the functioning of the nervous system[51] .

Aim of Sensory Integrative Therapy

Sensory Integrative Therapy aims at:

- Improving the way the brain processes and organizes sensations.[52]
- This in turn enhances the child's ability to respond effectively to situations in the environment.

Thus, SIT exercises are designed to help the child:

- Strengthen and develop the vestibular, tactile and proprioceptive systems in order to develop higher functions such as attention, language, motor abilities and interaction with the environment[53].
- In this way SIT is expected to have a positive impact on communication, academic and executive performance of children and adolescents[54].

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[49] Roley & Laurel. (1989). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[50] Schwarzbeck. (1994). In Mauer, D. M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[51] Fisher et al. (1991). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[52] Ayres, A.J. (1979). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[53] Ayres, A.J. (1979). In Mauer, D.M.(1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[54] Ayres, A.J. (1974); Fisher, A.G; & Murray. E.A. (1991). In Mauer, D.M.(1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

SIT may be beneficial to children with a variety of developmental disabilities, including:

- Learning Disabilities[55]
- Attention deficit disorders[56]
- Pervasive developmental disorders[57]
- Mental retardation[58]
- A number of social behavioural problems.[59]

Sensory Integrative Treatment Method

Traditional SIT involves the "use of enhanced, controlled, sensory stimulation in the context of a meaningful, self-directed activity in order to elicit an adaptive behaviour"[60]. SIT therapists do not merely attempt to elicit a specific motor response. They provide various forms of vestibular, tactile and proprioceptive sensory stimulation - adapted to the needs of the child - through activities that assist the process of sensory integration.

- Vestibular stimulation is achieved through the use of specific types of equipment[61] such as: ramps to slide down, platforms to swing on, bolsters to climb over, inner tubes to jump into, and trapezes to swing from[62].

- Therapists encourage children to choose the activity that appeals to them, to make spontaneous decisions through active involvement in the therapeutic process, and to engage in increasingly challenging tasks. The rationale behind this procedure is:

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[55] Clark et al. (1989). In Mauer, D.M.(1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[56] Ayres, A.J. (1979). In Mauer, D.M.(1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390). (are these from D.M. Mauer article?)

[57] Fallon et al. (1994). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[58] Clark; F., & Shuer, J. (1978). In Mauer, D.M .(1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390). (initials added from references of the article)

[59] Ayres, A. J; & Tickle, L.S. (1980). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[60] Ayres, A.J. (1979). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[61] Clark et al. (1989). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[62] A Parent's Guide to Understanding Sensory Integration (no source given in article)

- When children personally choose the activity to engage in, they are more motivated to engage in the activity. In addition, active involvement provides the best opportunity for changes in the brain that lead to growth, learning, and better organization of behavior.

- The therapist while guiding the process encourages the child to personally decide how to respond while engaging in goal-directed activity rather than instructing the child how to respond[63]. This empowers the child to make independent decisions.

- Activities adjusted to the child's individual needs are graded in an ascending order of difficulty that challenge the child to come up with more organized, mature responses[64].

The ultimate aim of providing SIT for children with Learning Disabilities is to stabilize and enhance the functioning of their nervous system, so that they may spontaneously be able to make adaptive sensory-motor responses. In addition, SIT is expected to enhance the functioning of relevant areas of the cerebral cortex associated with oral and written language[65].

Treatment Outcome

Outcome studies have indicated that children who underwent Sensory Integrative Therapy (sometimes referred to as 'Occupational Therapy') demonstrated gains in various areas such as:

- Motor, language, cognitive or academic skills[66]
- Improved ability to organize responses to the physical environment[67]
- Improved social interactions and play[68]
- Increased ability to attend to tasks or maintain emotional control when stressed[69]

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[63] A Parent's Guide to Understanding Sensory Integration (no source given in article)

[64] Koomar, & Bundy. (1991). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[65] PDF on `A Parent's Guide to Understanding Sensory Integration (no source given in article)

[66] Ayers, A.J. (1972a, 1972 b, 1978); Ayers A.J., & Mailloux. (1981); Magrun et al. (1981); Ottenbacher, (1982); White, (1979). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[67] Humphries, Wright, Snider, McDougall, (1992). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[68] Fallon, et al. (1994). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[69] de Quiros, (1976)., Rosenwinkel, et al. (1980). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

- Studies also suggest that SI is effective in combination with other approaches[70]

A child's condition may sometimes require interventions that are often inter disciplinary in nature. For example, children who have difficulty with auditory processing, learning and organisation, may be at risk for language disorders. Such a child may require a combination of Sensory Integrative Therapy, audiology training, remedial education, and training in communication skills[71].

Role of therapists

An interdisciplinary approach is called for when a child exhibits deficits across several areas of processing and learning. Thus, therapists who administer interventions in specialized fields (e.g., sensory integrative therapy, audiology) as well as clients who access their services need to understand the role played by other professionals in addressing related areas of a child's difficulty.

An ophthalmologists and optometrist might be able to confirm or rule out the role of physiological impediments to vison

- Ophthalmologists are medical specialists who deal with the organic health of the eyes as well as refractive errors. They are concerned with the 'physiology of the eye and its organic aspects, diseases, and structure.' (Blue book, p. 243)
- An optometrist is a nonmedical specialist concerned with the measurement and correction of vision.
- Deficient visual processing may be indicated when the role of physiological deficiences have been ruled out.

An otologist and audiologist might be able to confirm or rule out the role of physiological impediments to hearing

- Otologists are medical specialists responsible for the diagnosis and treatment of auditory disorders. (Blue book, p. 245)
- Audiologists are nonmedical specialists who detect hearing impairments. They specialize in the physical process of hearing; in testing, measuring, and rehabilitating those with hearing impairments. (Blue book, p. 245)

Paediatric neurologists and occupational therapists may be able to identify the role played by deficient neurological functioning by analysing symptoms that a child displays.

- Pediatric neurologists are able to identify developmental delays, atypical language, motor and behavior growth. They may be involved in managing physical and mental health of

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[70] Ayres, A.J., & Maillou. (1981); Kanter, Kanter, & Clark. (1982). In Mauer, D.M. (1999). Issues and applications of integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[71] Clark, Mailloux, Parham, & Bissell. (1989). In Mauer, D.M.(1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

children including language development, school adjustment and academic learning (Blue book, p. 242 – 243).

- Occupational Therapists are trained to diagnose and develop an intervention plan for children who exhibit difficulties in sensory integration[72]. Thus it is important for clients to know that:
    - ***o*** Children with learning problems have difficulties in sensory integration which makes it difficult for them to begin and complete tasks; or to plan, organize and sequence their thoughts and motor activity[73].
    - o Difficulties in integrating sensory inputs are connected with difficulty in language and communication[74].
    - o Movement enhances the ability to integrate sensory information, which in turn enables the child in using language to describe his or her world[75].
    - o Rather than helping a child develop specific motor skills for gymnastics or sports, occupational therapists engage a variety of activities to help a child develop underlying abilities that will enable him/ her to learn others skills more efficiently[76].

- Speech and Language Pathologists

Conclusion

This chapter highlighted and illustrated the fact that efficient or inefficient processing of inputs from our senses, respectively facilitate or impede the process of practical and academic learning. It also presented the theoretical basis for understanding how *Sensory Integrative Therapy* helps to rectify processing deficiencies thus enabling children to perform academic and practical tasks more easily and efficiently. Subsections of this chapter indicated that:

- Inputs we receive from the external world, and the internal world of our bodies through the senses (sight, hearing, taste, smell, touch, proprioception, and vestibular) play an important role in the learning process. Inputs need to be efficiently processed before they can be effectively utilized. Deficient processing compromises a child's ability to engage in academic

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[72] Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[73] Schwarzbeck, (1994). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390.

[74] Ayres, A.J. (1979). In Mauer, D.M. (1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[75] Fisher et al. (1991). In Mauer, D.M.(1999). Issues and applications of sensory integration theory. *Language, Speech & Hearing Services in Schools*, *30*(4), 383-390).

[76] A Parent's Guide to Understanding Sensory Integration (no source given in article)

and practical learning. Heavily deficient sensory processing is called Sensory Processing Disorder.

- There are three aspects to Sensory Processing Disorder (SPD): difficulties with modulating and discriminating sensory inputs; and difficulty coordinating motor movements. Sensory modulation difficulties may make it difficult for children to sustain attention on tasks; cause them to make inefficient motor responses to sensory stimuli; and to emotionally underreact or overreact to their circumstances.

- Several skills are required to effectively process auditory and visual sensory inputs; and to integrate visual and motor outputs. Processing deficiencies within and across these areas have a negative impact on a child's ability to learn; to perform academic tasks, and to manage activities of daily living.

- Jane Ayres' *Sensory Integration Theory* provides a theoretical basis for understanding how inefficient processing and integration of sensory inputs impedes a child's ability to handle academic tasks, and perform practical tasks of daily living; and how these deficiencies can be rectified through *Sensory Integrative Therapy.*

- *Sensory Integrative Therapy* provides various forms of vestibular, tactile and proprioceptive sensory stimulation - adapted to the needs of the child – in order to enhance the process of sensory integration. Research findings suggest that SIT:
    - Helps to stabilize and enhance the functioning of the child's nervous system thus enabling him/ her to make adaptive sensory-motor responses.
    - Enhances the functioning of relevant areas of the cerebral cortex associated with oral and written language

Information provided in this chapter forms the basis for identifying the nature of children's processing difficulties. Interventions that can help children deal with specific areas of processing difficulty have been presented in the Appendix.