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Sensory Integration in Mental Health

Introduction

- The field of sensory integration (SI) is still to be evolving due to rigorous and ongoing research within the field. The work of Dr. A.J. Ayres that she has done between the late 1960s and the 1990s has not only confirmed the theoretical basis of SI and the developing child but has also been expanded.
- Parham states that although components of play are relevant throughout the lifespan, ‘play is a significant and primary occupation of children’. Play is the occupational performance area that allows for the continuation, enhancement and growth of neural processing, physical endurance, perceptual motor abilities and behaviour.

- The relationship between SI and play can no longer be ignored. Play provides opportunities for the intake of sensory input, but SI forms an important foundation for the development of occupational performance components, motor skills and thus the abilities involved in play.
- In children with child psychiatric conditions, it is not yet clear whether SI deficits coexist with the pathology or whether it is an integral part thereof. With conditions such as intellectual disability, attention disorders and developmental coordination disorders (DCD), sensory processing difficulties are described as part of the challenges these children experience, but it does not form part of the diagnostic criteria.

- Autism is however an exception where sensory processing difficulties are described as part of the diagnostic criteria. In the Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5), Autistic Spectrum Disorders (ASD) have a Criteria for diagnosis related to restricted, repetitive patterns of behaviour where two of the four behaviours specified are related to sensory processing issues; insistence on sameness, with difficulties in changes and transitions and hyper or hypo-reactivity to sensory stimulation or unusual interest in sensory aspects of the environment.

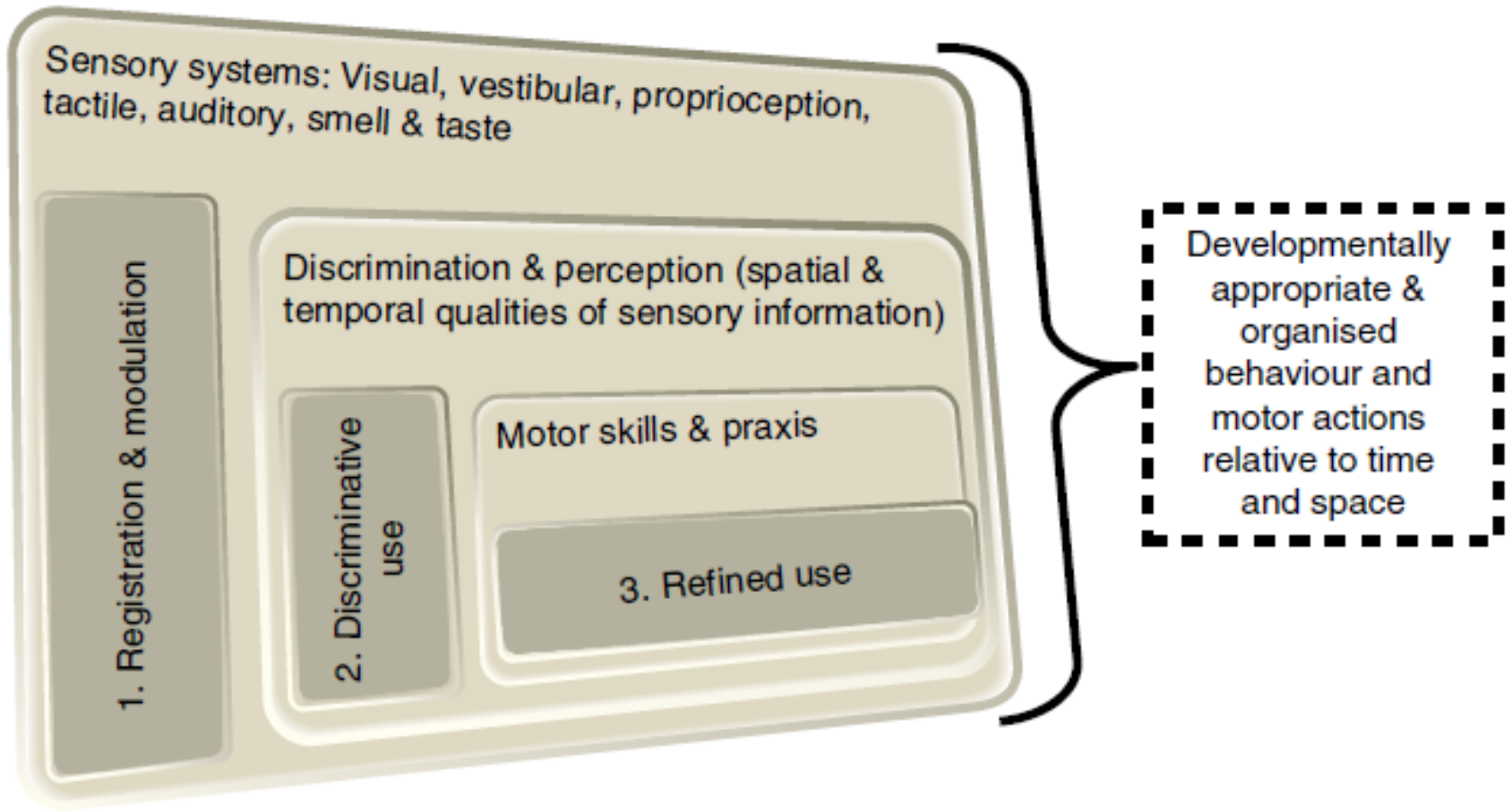
- Ayres (1989, p. 22) defined SI as ‘the neurological process that organises sensations from one’s body and from the environment and makes it possible to use the body effectively in the environment’.
- She displays the importance of the interactions between the different sensory systems and the role that the processing of sensory information and the integration of it plays in learning and behaviour (end products) (Ayres 1972). End products represent abilities and skills such as concentration, organising skills, academic learning abilities, self-esteem, self-control and self-confidence. The model demonstrates not only how sensory systems work together but also how sensory systems contribute to increasingly complex behaviours

- **Sensory systems**
- The fact that sensory information provides an important foundation for learning and behaviour is well described in SI literature based on the work of Ayres. Although all the sensory systems are crucial in typical development and function, the three sensory systems that are central in SI theory and practice are the tactile, vestibular and proprioceptive systems, also referred to as ‘body-related’ or body-centered senses (Schaaf et al. in Kramer & Hinojosa 2010).

Ayres had originally proposed the following on brain function, learning and behaviour, and this still holds true:

- Perceptual awareness supports and facilitates occupational engagement.
- Motor learning is influenced by, if not dependent on, incoming sensation.
- Body awareness creates a postural model to understand visual-motor development.
- Postural control is essential for skilled academic and motor performance.

- Tactile, vestibular, proprioceptive, and visual systems provide key data in the development of reading and writing.
- The ability to focus and maintain attention and to keep a steady level of activity, and the way in which the nervous system responds to tactile sensation, are related.
- The sensory systems develop in an integrated and dependent manner.
- Visual and auditory processing depend on foundational body-centered senses.

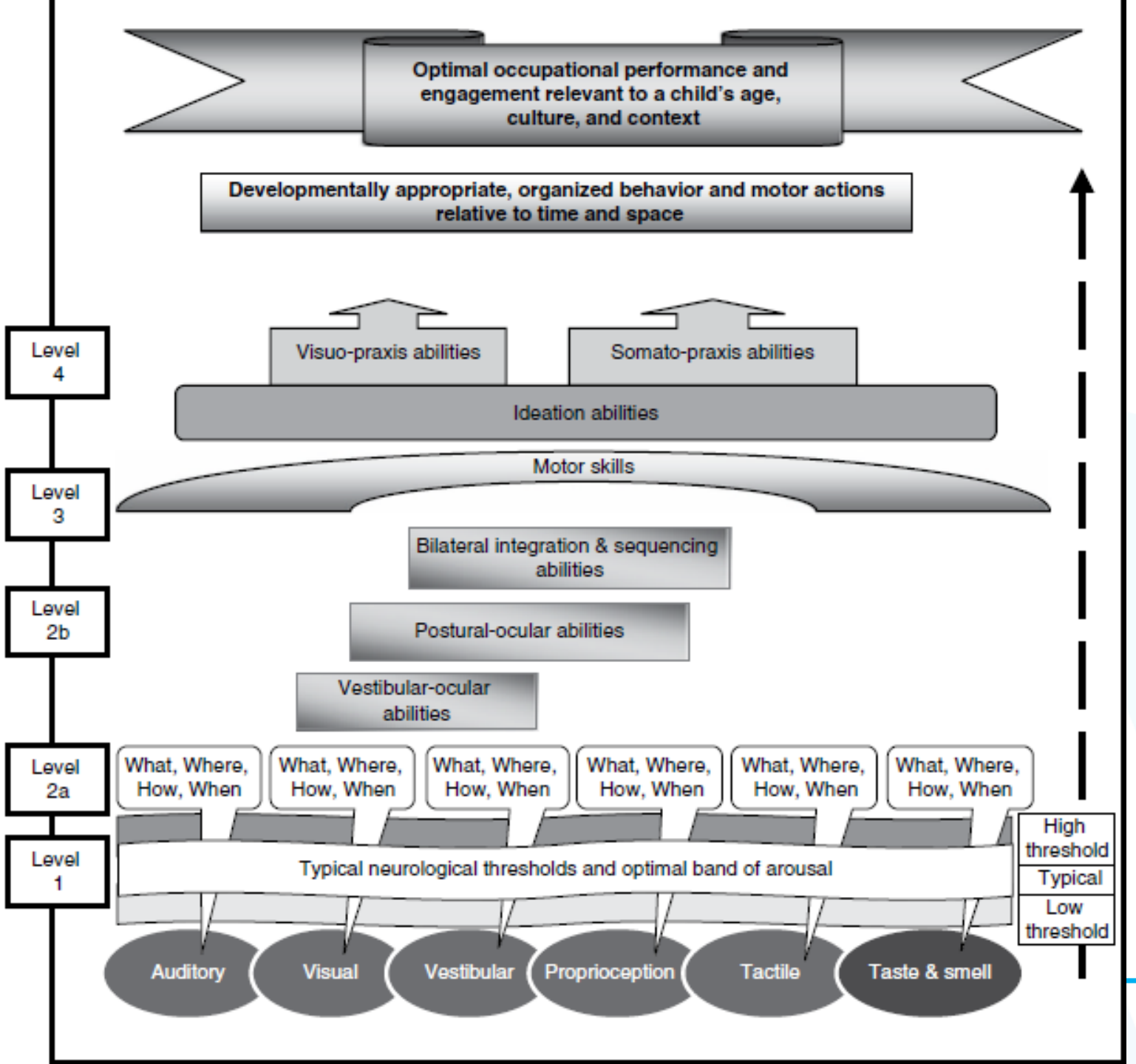


Levels of SI that support organised behaviour.

- The first level in Figure represents registration, arousal and modulation which are viewed as overarching modulation although it can be debated whether registration is part of modulation. For sensory information to be modulated, it needs to be registered, and for the purpose of this model, registration of sensory information is seen as the first part in the process of modulation. When sensory information is modulated, it contributes to the ability to focus on and concentrate and engage in those activities that are in the foreground at a given moment in time.

- The second and next level of SI is that of discrimination and perception that provides information on spatial and temporal qualities of sensory information received. Discrimination and perceptual abilities allow for a ‘higher’ and more involved level of participation in activities as cognitive involvement is also required. An example would be ‘what am I touching?’, ‘what are the qualities of the object that I am touching?’ and also ‘when did I touch it?’ and then ‘how do I need to react?’ Cognitive recognition, meaning and decision-taking now form an important part of the process.

- Following on that, is the third level that represents refined use that is possible when integration of sensory information contributes and supports motor skills and praxis. On this level, more advanced motor and cognitive functioning are required for successful interaction and engagement in activities. The requirements for successful participation also become more complex.
- An example of skilled action could be the ability to ride a bicycle, and that of praxis the ability to perform new motor actions with a fair amount of success, for example, to attempt to jump with a skipping rope for the first time. As soon as the action becomes learnt because of practice and repetition, it becomes a skill and no longer requires praxis abilities.


Optimal occupational performance and engagement relevant to a child's age, culture, and context
Developmentally appropriate, organized behavior and motor actions relative to time and space
Level 4
Visuo-praxis abilities
Somato-praxis abilities
Ideation abilities
Level 3
Motor skills
Level 2b
Bilateral integration & sequencing abilities
Postural-ocular abilities
Vestibular-ocular abilities
Level 2a
What, Where, How, When
What, Where, How, When
What, Where, How, When
What, Where, How, When
What, Where, How, When
What, Where, How, When
Level 1
Typical neurological thresholds and optimal band of arousal
High threshold
Typical
Low threshold
Auditory
Visual
Vestibular
Proprioception
Tactile
Taste & smell

- Level 1: Registration and modulation of sensory information are functional outcomes observed at this level.
- Level 2a: Basic discrimination and perceptual functions are functional outcomes observed at this level.
- Level 2b: More advanced discriminatory and perceptual abilities and functional use are outcomes observed at this level, with signs of skilled motor actions starting to develop. Discrimination of spatial and temporal qualities becomes more accurate and advanced.
- Level 3: Motor actions become more and more skilled as well as praxis abilities for executing novel motor actions.

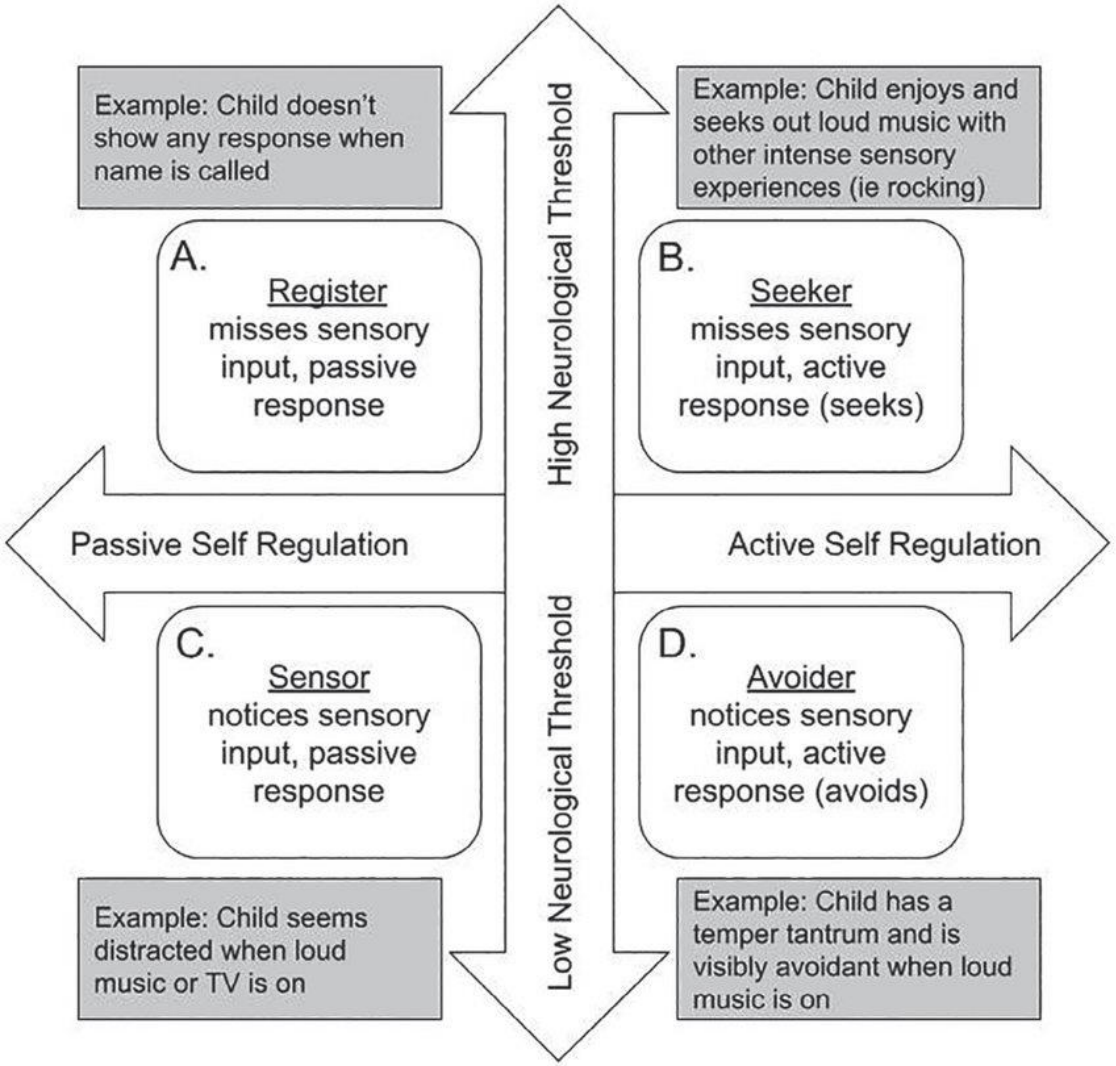
- **Sensory registration level 1:**
- Sensory registration refers to the point where the brain registers sensory information/becomes aware of incoming sensory information. IT is referred to as the neurological threshold. Neurological thresholds are viewed to be on a continuum, where on the one side of the continuum, a low neurological threshold would imply that very little sensory information is needed before the brain registers it, whereas on the other side, a high neurological threshold would imply that a lot of sensory information is needed before the brain registers it.

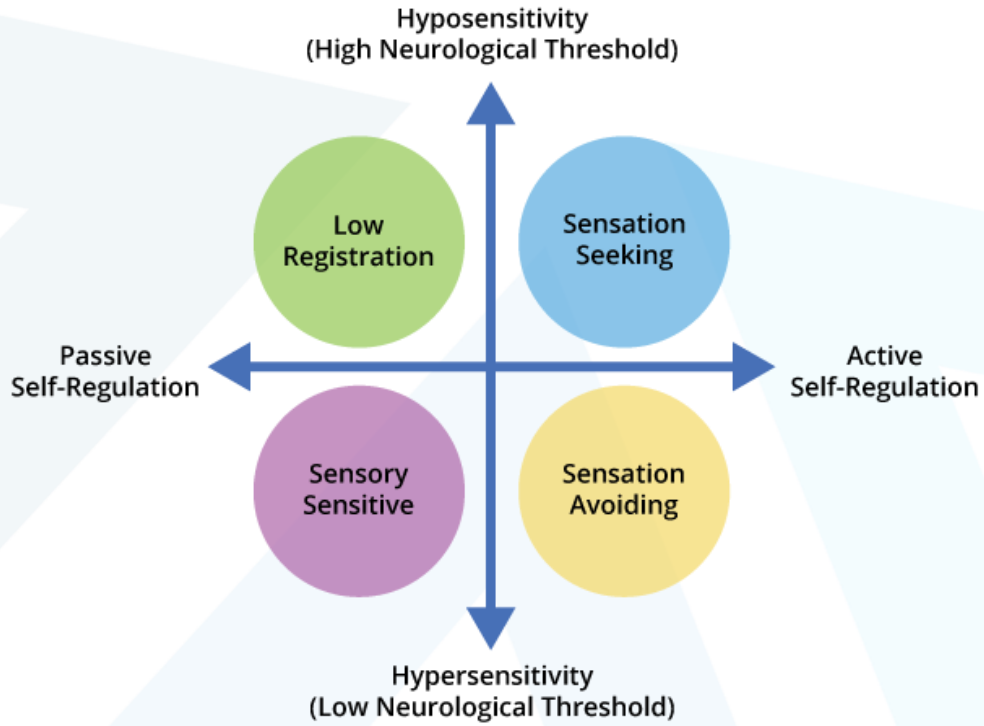
- Low neurological thresholds can result in avoidant or sensitive behaviours pertaining to that specific sensory system, and high neurological thresholds can result in poor registration or seeking/craving behaviour. An example of this could be that a child could crave for movement activities due to the high neurological threshold for movement, but would not want to play in a group on play equipment due to a low neurological threshold for auditory information. All the screaming and shouting bothers the child, and playing on play equipment alone or with only a few friends present would be preferred.

- Neurological thresholds can differ within each sensory system with the implication that an individual's sensory profile is in a certain sense like a fingerprint. No two individual's sensory profiles are exactly the same.
- **Sensory modulation level 1:**
- Sensory modulation refers to the brain's ability to adapt to sensory information (from inside the body or from the environment) in such a way that it supports optimal engagement in meaningful daily activities. It includes the brain's ability to habituate to non-threatening/unimportant sensory information or sensitisation to threatening/ harmful sensory information.

- Modulation is also a brain function that needs to happen within all the different sensory systems. Sensory modulation plays an important role in daily functioning especially in terms of the ability to focus, concentrate and be ready for engagement in the task at hand.
- Adequate modulation of sensory information supports the capability of the individual to sustain engagement in activities despite variability within the body and/or the environment, and it is thus of great importance in the learning process of a child.
- Sensory modulation also supports optimal levels of arousal to engage in activities. It further contributes to not only stability in emotions but also impacts on behaviour.

- Dunn's Sensory Profile (1999) described the neurological thresholds and how they contribute to modulation and behaviour. She also describes the four different sensory profiles that have emerged from her research, namely, low registration and sensory seeking (SS) (representative of high neurological thresholds) and sensory sensitive and sensory avoiding (representative of low neurological thresholds).


Example: Child doesn't show any response when name is called
Example: Child enjoys and seeks out loud music with other intense sensory experiences (ie rocking)
A.
Register
misses sensory input, passive response
B.
Seeker
misses sensory input, active response (seeks)
High Neurological Threshold
Passive Self Regulation
Active Self Regulation
C.
Sensor
notices sensory input, passive response
D.
Avoider
notices sensory input, active response (avoids)
Low Neurological Threshold
Example: Child seems distracted when loud music or TV is on
Example: Child has a temper tantrum and is visibly avoidant when loud music is on


Hyposensitivity
(High Neurological Threshold)
Low Registration
Sensation Seeking
Passive Self-Regulation
Active Self-Regulation
Sensory Sensitive
Sensation Avoiding
Hypersensitivity
(Low Neurological Threshold)

- The Sensory Processing Measure (SPM) is the other well-researched sensory processing measurement instrument that is used in practice (Parham et al. 2006). It measures sensory processing, praxis and social participation at home, school and community settings and is done according to structured and unstructured observations.
- Dysfunctions are described according to the work of Miller et al. (2007), namely, sensory over responsivity (SOR), sensory under-responsivity (SUR) and SS.

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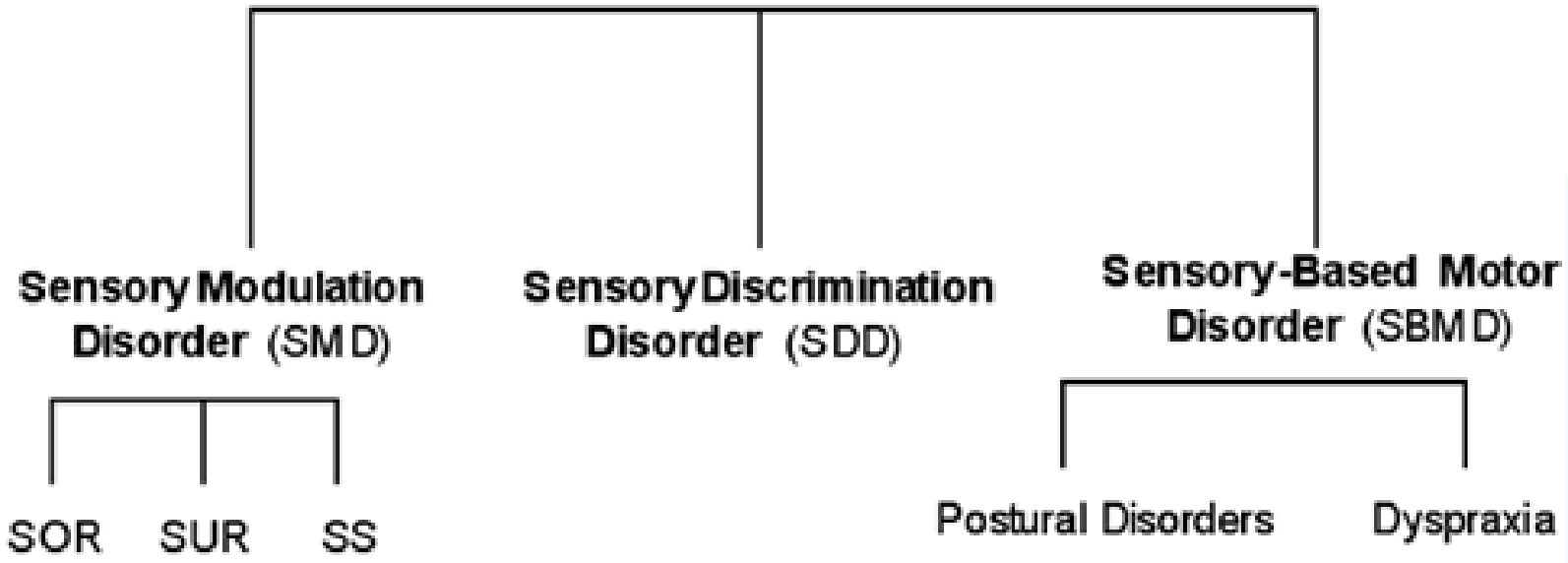
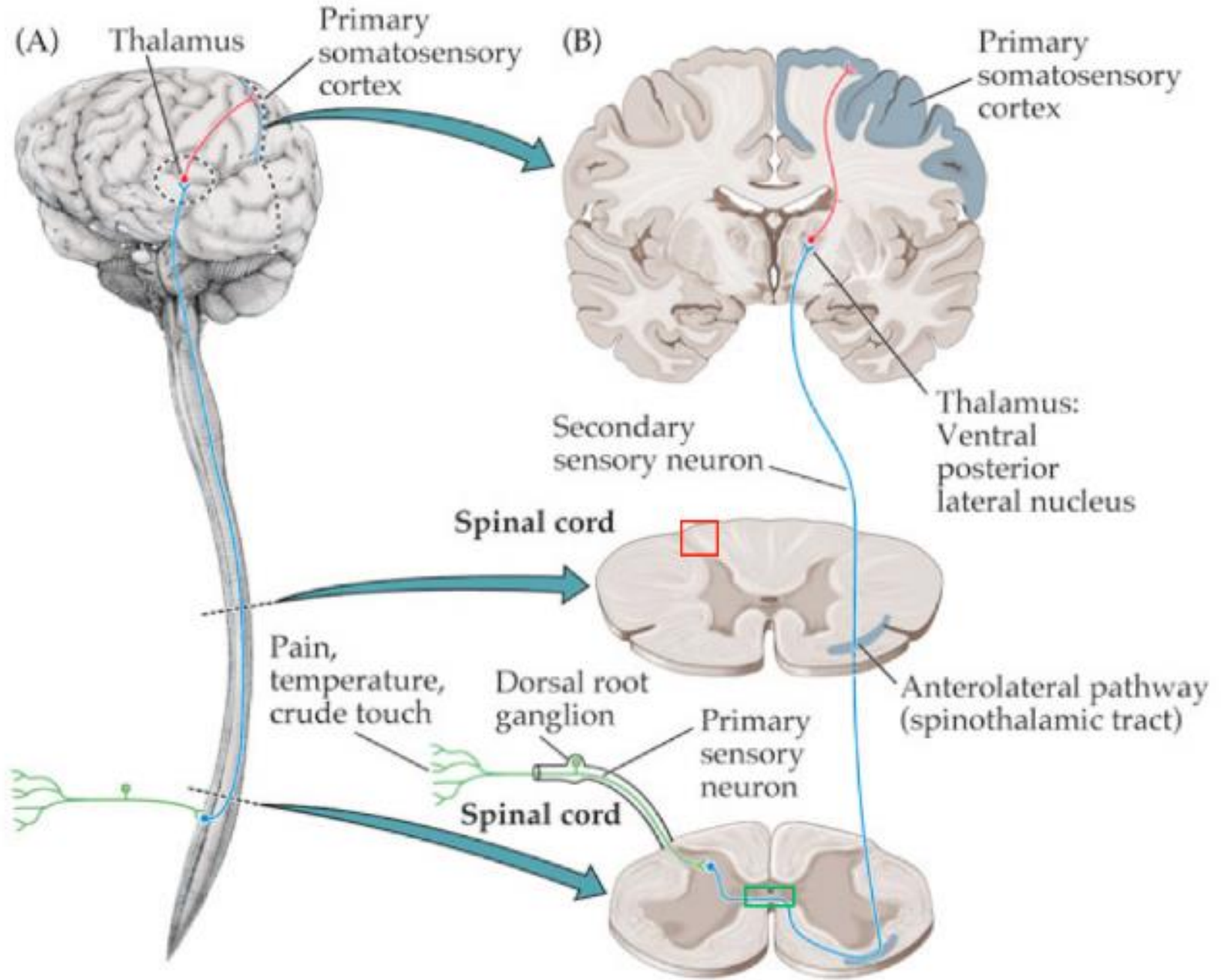
SENSORY PROCESSING DISORDER (SPD)

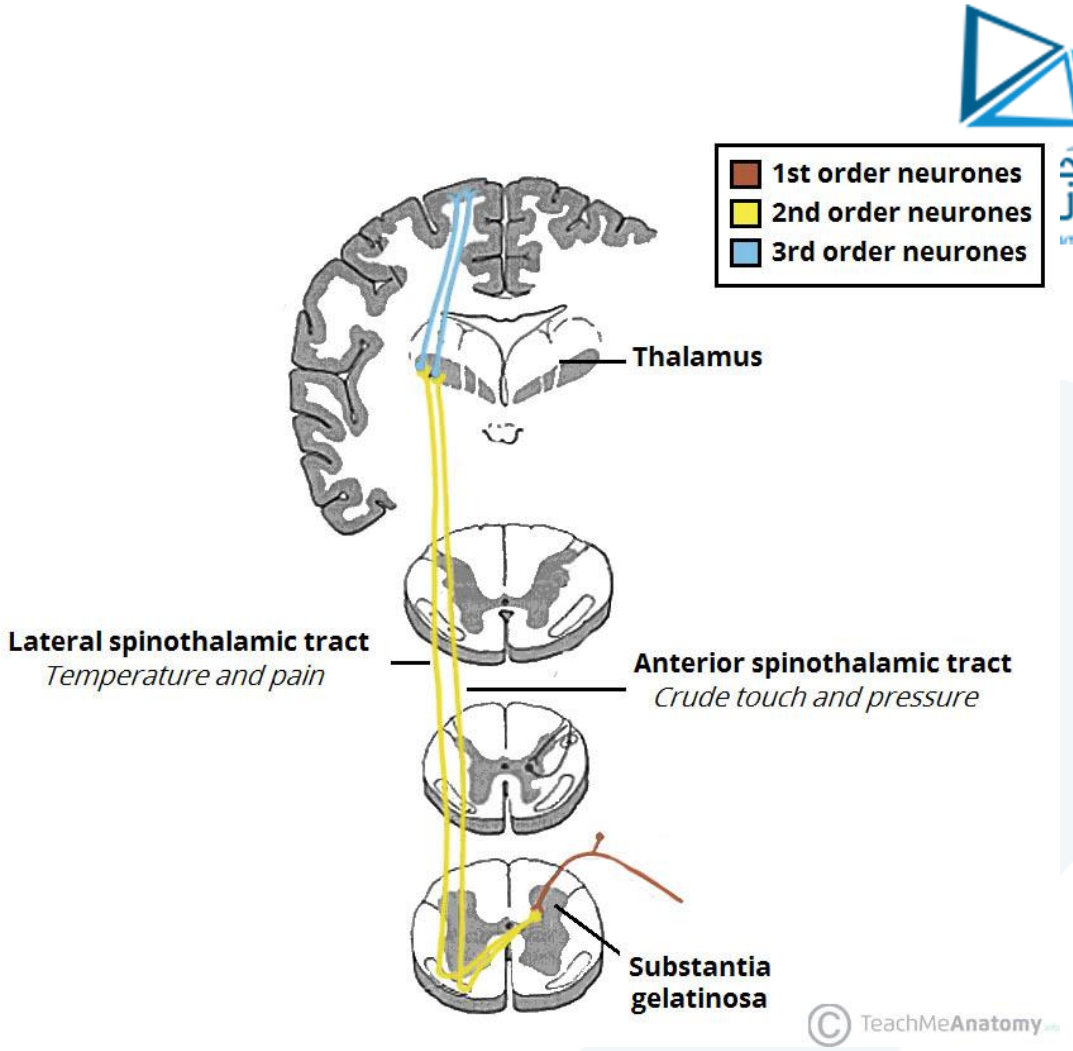


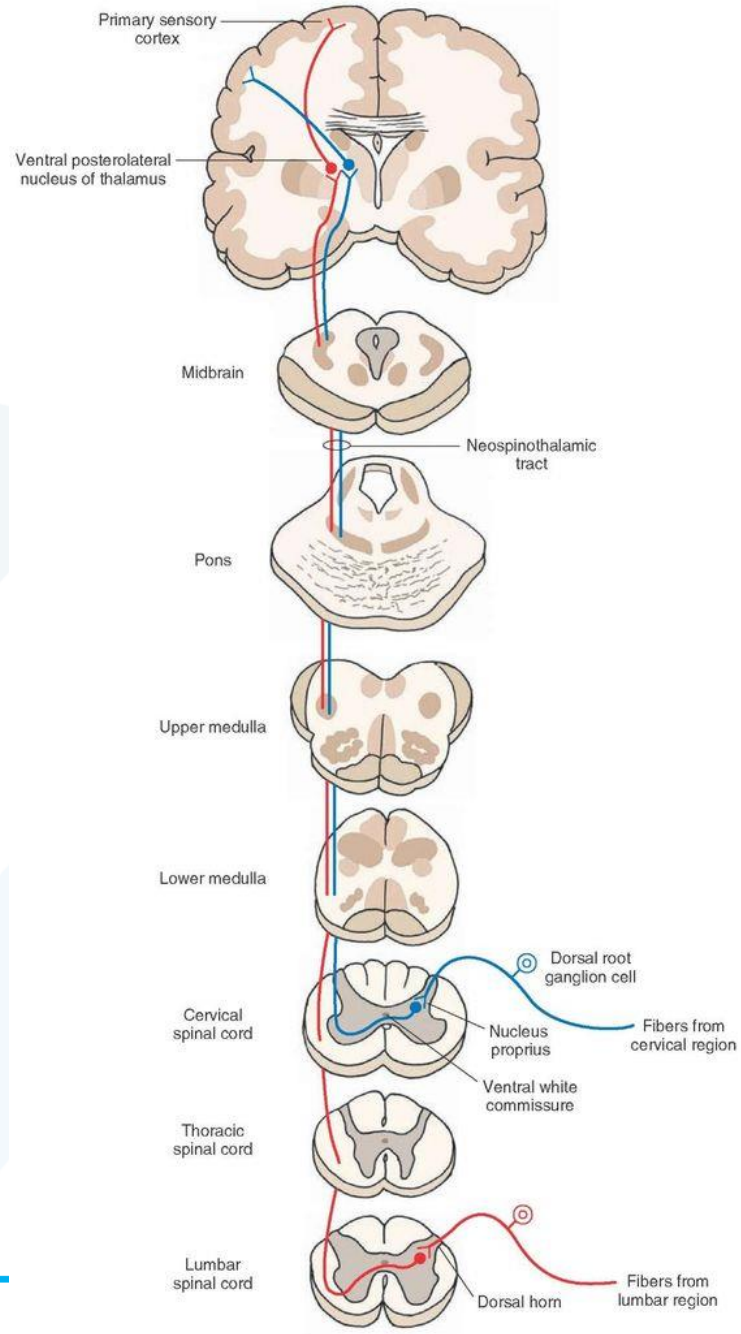
SOR = Sensory Over -Responsivity
SUR= Sensory Under -Responsivity
SS= Sensory Seeking / Craving

- Disorders in sensory modulation are reflected in behaviour. Disorders can be present in one or more of the sensory systems and can involve responses from internal or external sensations.
- The common grounds between the works of Dunn (1999) and Miller et al. (2007) are high neurological thresholds and under-responsivity and low neurological thresholds and over-responsivity. The ‘category’ of SS is described in the work of both authors and is seen by researchers as a need for sensory input that is much more than that of the typical child.

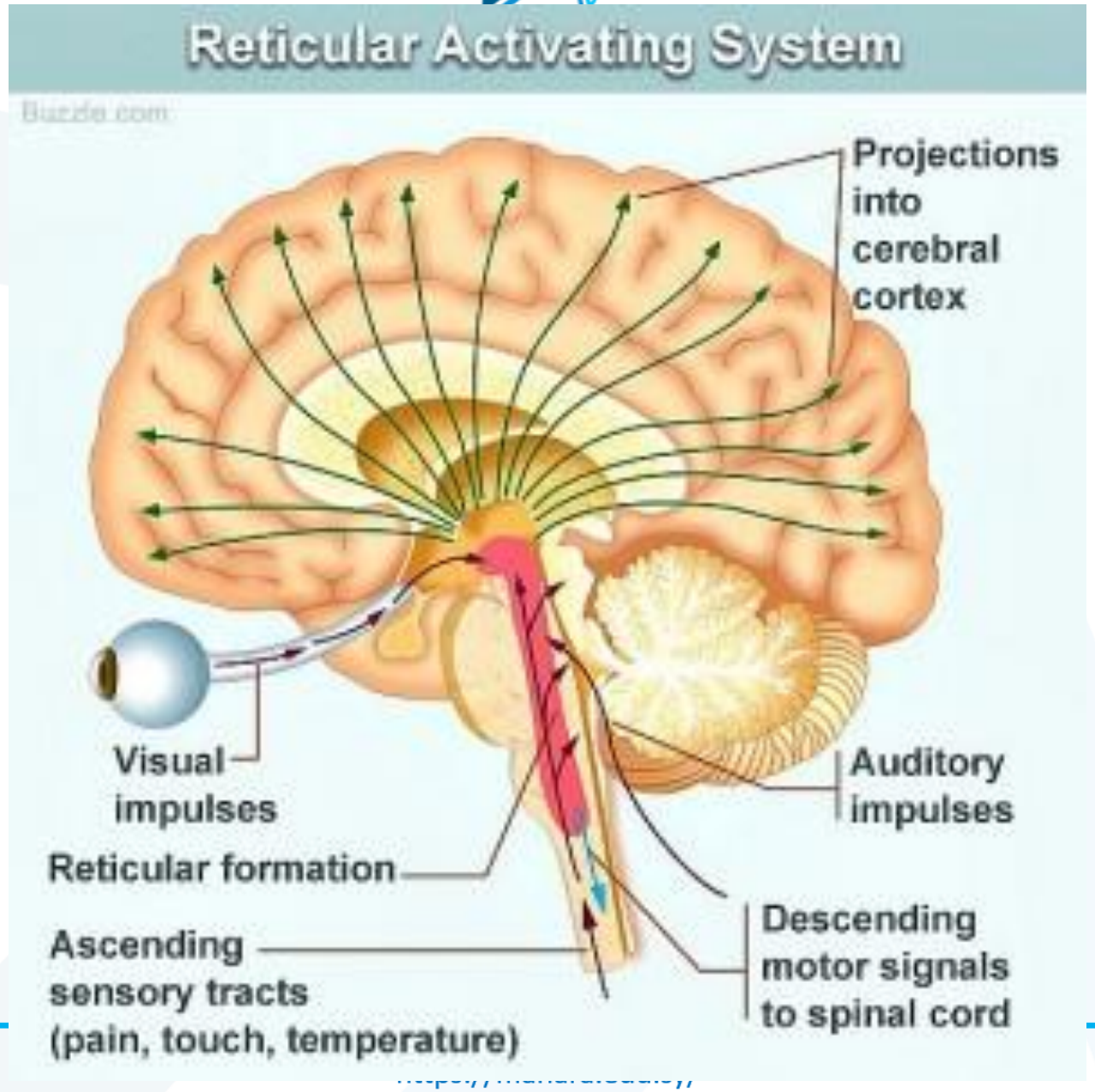
- Tactile defensiveness is linked to poor limbic or reticular processing within the brain and fight-or-flight reactions that are elicited by tactile sensation that others would consider non-noxious.
- This type of dysfunction is attributed to the anterolateral system of the central nervous system. This system is responsible for the mediation of pain, crude touch, light touch and temperature. Most of the fibres of the anterolateral system terminate in the reticular formation.




1st order neurones
2nd order neurones
3rd order neurones
Thalamus
Lateral spinothalamic tract
Temperature and pain
Anterior spinothalamic tract
Crude touch and pressure
Substantia gelatinosa
© TeachMeAnatomy

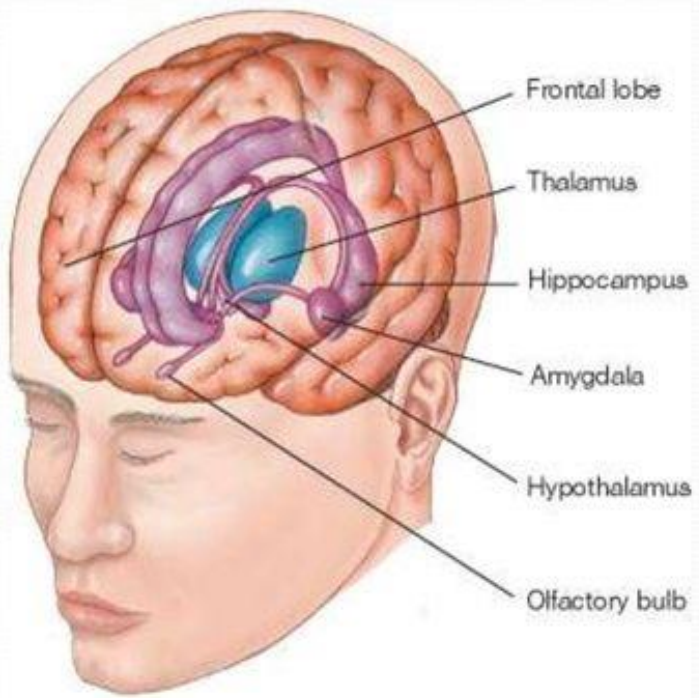

Primary sensory cortex
Ventral posterolateral nucleus of thalamus
Midbrain
Neospinothalamic tract
Pons
Upper medulla
Lower medulla
Dorsal root ganglion cell
Cervical spinal cord
Nucleus proprius
Fibers from cervical region
Ventral white commissure
Thoracic spinal cord
Lumbar spinal cord
Dorsal horn
Fibers from lumbar region

- The reticular formation is responsible for arousal, emotional tone and autonomic regulation. Projections are sent from the reticular formation to the thalamus. The thalamus is also an integrating centre that assists with the coordination of information.
- From there, information is relayed to the cortex and the limbic system. The limbic system is responsible for emotional tone and motivational aspects of behaviour, arousal, attention and regulation.


Reticular Activating System
Buzzle.com
Projections into cerebral cortex
Visual impulses
Reticular formation
Ascending sensory tracts (pain, touch, temperature)
Auditory impulses
Descending motor signals to spinal cord

LIMBIC SYSTEM

- **HIPPOCAMPUS** – plays an important role in emotion, learning and memory.
- **AMYGDALA** – plays role in aggression, eating, drinkin g and sexual behaviors.
- **HYPOTHALAMUS** – monitors blood levels of glucose, salt, blood pressure and hormones.



- **Defensiveness** can occur in any of the sensory systems, and sensory defensiveness is an overresponse to sensory stimulation causing the child to experience anxiety, fear and aggression. The sensory defensive child thus avoids these sensory stimulating activities.
- **Gravitational insecurity**: The child becomes fearful when their feet leave the ground or on an unstable, raised surface or when their head is tilted into 'unfamiliar' positions, especially into backward space.

- Another type of dysfunction, described by Ayres, is that of **intolerance to movement** where the child is disorganised by any movements that are unfamiliar.
- Although both dysfunctions are related to low neurological thresholds (over-responsivity) within the vestibular system, the difference is that the child that experiences problems with gravitational insecurity likes movement but his/her body needs to be secure in terms of gravitational pull. The child with aversion/intolerance to movement problems dislikes movement and is in general overwhelmed by movement.

- Children experiencing SMD can demonstrate hyper-responsivity, hypo-responsivity or fluctuations in response to sensory stimuli. Children with SMD are not only restricted in terms of processing sensory information but also in terms of their ability to attend and concentrate, their emotional control and activities of daily living such as toileting dressing, feeding, bathing and socialising.
- Their levels of arousal do not only impact on their ability to engage in occupations, but it also influences their emotions. Emotions that are seen include anxiety, lability, fear, aggression, depression and hostility.

- **Sensory discrimination and perception level 2a and level 2b:**
- Sensory discriminatory abilities are abilities that are supported by and dependent on all the different sensory systems. Discriminatory abilities allow for the individual to ‘interpret and differentiate between the spatial and temporal qualities of sensory information’.
- Sensory discriminatory abilities add meaning to sensations and support the forming of perceptions.

- An example of discriminatory abilities within the tactile system would be when a child is able to identify where he/she has been touched, what is it that touched him/her and when did it touched him/her. In the process of discrimination, past experiences and memories need to be utilised to form associations about the spatial and/or temporal qualities of what he/she is experiencing and then act on that information.

- Discrimination within the auditory system can vary from basic discrimination abilities such as knowing from which direction a sound came to abilities such as a soft or a hard sound or hearing a ‘b’ or ‘d’.
- Visual discrimination is the foundation of form and space discrimination and in the development of visual perception skills and visual-motor skills.

- Within the vestibular system, there are two discriminatory processes occurring:

1. Otolithic processing that is concerned with the pull of gravity and provides types of discrimination that has to do with postural accommodations, together with where the body is in space when vision is excluded, for example, whether vertical or horizontal when in a swimming pool.
2. Semi-circular canal processing that is concerned with the detection of head movements through space. This type of processing contributes to three-dimensional (3D) spatial experiences and spatial orientation.

- Proprioceptive discrimination is concerned with aspects where muscles, tendons and joints are working and where the brain needs to decide on actions such as adjusting posture when sitting in a chair, how hard to press when writing with a pencil or how far to stretch the elbow to pick up something.
- Discrimination within the tactile system is complex and can range from identifying where touched to manipulation of a small bead to be able to thread it. Within the mouth area, tactile discrimination ranges from the food's texture to finding a small piece of bone in food that is in the mouth.

- Taste and smell discrimination also ranges from basic discriminatory abilities to very refined discrimination, memories often playing an important role in function. A child who is a fussy eater and who has had a bad experience with the taste and smell of a certain food will become anxious just by visually seeing the food.
- Discriminatory functions can depend on only one sensory system but can also be dependent on combinations of sensory systems such as the visual and vestibular systems that together provide a stable visual field during head movements.

- Postural–ocular control involves the activation and coordination of muscles ‘in response to the position of the body relative to gravity and sustaining functional positions during transitions and while moving’. Here, the combination of the visual, vestibular and proprioceptive systems supports function.
- Poor processing of vestibular–proprioceptive input is believed to impede the development of postural and ocular control. A postural–ocular disorder is described as the behavioural manifestation of a vestibular–proprioceptive processing disorder and is hypothesised to be the basis for the bilateral integration and sequencing (BIS) disorder.

- Difficulties with postural-related demands like righting and equilibrium reactions, flexion and extension postures, postural stability and lateral flexion and rotation are experienced by these children. Poor ocular control impacts on activities where a stable visual field is needed.
- When following an object with the eyes, visual fixation is needed with dissociation of the eyes from the head movements. Poor ocular control will also delay the development of form and space perception and eye–hand coordination.

- In the literature, it is assumed that posture is the observable manifestations of vestibular and proprioceptive processing. There are also schools of thought that postural dysfunctions reflect the basis for deficits in BIS and sometimes for somato-dyspraxia (Bundy et al. 2002).
- Observable postural indicators include extensor muscle tone (observed in a standing position), prone extension, proximal stability, ability to move the neck into flexion against gravity (part of supine flexion), equilibrium and post-rotary nystagmus. This cluster of indicators is referred to in some cases as ‘postural–ocular’ components.

- Postural control and stability are usually problematic for these children described by Bundy et al. and they experience problems such as maintaining their posture and relying on their environment to support them with the postural demands. These children will lean against a wall when in the upright position, curl their legs and feet around chair legs or assume a ‘lying’ position in a chair.

- **Motor skills level 3:**
- Although postural–ocular abilities are seen as discriminative abilities, it is difficult to draw a line where the abilities end and motor skills start. More advanced postural–ocular abilities such as those used when riding a bicycle can also be viewed as skill.
- There is currently a debate on whether or not BIS are motor skill functions or functions supported by praxis abilities. The latest research indicates that a BIS dysfunction is a separate type of dysfunction to the visuo- and somato-praxis factors that are identified in current research

There is however consensus on what these functions entail and what it allows for:

- The effective use of the two sides of the body whether on a level of navigating the body through space or on a more skilled level
- Similar use of the two hands, skilled in each, for example, skilled hand function and good hand function relative to hand skill
- Cooperative use of hands together
- Symmetrical rhythmic movements of arms, hands and feet
- Coordinated bilateral asymmetric movements of limbs
- Ability to coordinate rhythmic sequences of movements

- Children experiencing problems with BIS will have difficulties in using the two sides of the body in a coordinated manner, crossing of their midline and adequate establishment of dominance.
- Difficulties with the sequencing of motor actions, and specifically anticipatory projected movements, can be experienced. Anticipatory projected actions are very much feed forward dependent, meaning that they depend on past experiences and the ability to anticipate what is coming.

- Vestibular and proprioceptive system functions are the basis for adequate BIS actions, and the visual system also plays an important role in directing motor actions.
- Children with BIS dysfunctions also suffer emotionally because of their inability to experience success. They usually have a low self-esteem and their motivation is low.
- The important question is whether a child can perform skilled motor actions related to his/her age norm and to what extent it influences their function and engagement in occupations.

- **Praxis level 4:**
- Ayres defined developmental dyspraxia as a ‘motor planning disorder’ and as a ‘disorder of sensory integration interfering with ability to plan and execute skilled or non-habitual motor tasks’.
- Praxis was also described by Ayres (1989) as the process that includes conceptualisation or ideation, motor planning and execution of a novel or new motor action.
- Praxis abilities are crucial in successful interaction with the environment to execute action plans and adapt/correct motor actions to achieve the desired outcomes

- Praxis was also described by Ayres (1989) as the process that includes conceptualisation or ideation, motor planning and execution of a novel or new motor action. Praxis abilities are crucial in successful interaction with the environment to execute action plans and adapt/correct motor actions to achieve the desired outcomes.
- They also state that ‘ideation underlies planning, sequencing and organization of actions and ideational abilities may influence how a child engages in activities and occupations’. Difficulties with ideation will present itself in a child’s inability to know or make use of the affordances of objects in 3D space.

- Visuo-praxis is mainly dependent on the visual system but also relies on the vestibular system in terms of providing a stable visual field. Somatopraxis is dependent on the support of the proprioceptive and tactile systems.
- Visuo- and somato-dyspraxia have been described in Ayres' original work on the Sensory Integration and Praxis Test (SIPT). This is also one of the 'clusters' of dysfunctions that are described in the SIPT Manual. These two types of dyspraxia are still seen as factors evolving from current research.
- A child affected by poor SI abilities will experience difficulties with engaging in daily occupations during play, school, personal independence, recreation, sleep and interpersonal relations.

- The degree of difficulties can and will depend on the level/levels of difficulties or dysfunction.
- A generalised SI dysfunction is also described in research as a combination of dysfunction where a child obtains below-average scores on tests involved in BIS, visuo-dyspraxia and somato-dyspraxia.
- Children with praxis dysfunction can experience difficulties with body scheme, gross and fine motor skills and oral-motor control. They appear clumsy in performing motor actions, are accident-prone, mouth objects or drool and depend on using their vision for successful completion of tasks. Their behaviour varies from controlling and demanding to apathetic. Emotions that they frequently have to deal with include frustration, aggression or apathy. Academic problems such as perceptual and visual-motor difficulties (inclusive of reading and writing) can also be a direct result of these disorders.

- Visuo-dyspraxia is a deficit in visual perception abilities that affects constructional skills. The visual as well as the proprioceptive systems are involved in this dysfunction. Children with visuo-dyspraxia experience difficulties with visually planning space on 3D and two-dimensional (2D) levels, which impacts on mapping space and organising their own personal space (Lane 2012). Drawing and writing are usually problematic and can be observed in their management of their working space.

- Somato-dyspraxia causes children to have difficulty with motor tasks in terms of creating ideas of the how or what is possible, the planning of the actions and the execution of it. They do not receive feedback from their body and the environment after the action is completed, namely, its success or lack of success. The quality of their feedforward mechanisms is also poor (before an action is carried out, information is needed from the nervous system on the ‘how’ of the actions, e.g. in an action like catching a ball, the individual needs to get his/her limbs to a particular place in time to catch it). Any activity that depends on intact somatosensory feedback, for example, identifying shapes by touch without seeing them, will pose problems for a child with dyspraxia. Fine motor abilities are often also affected.

- **Functional, organised behaviour and occupation**
- Developmentally appropriate, organised behaviour and motor actions relative to time and space are what Ayres has termed ‘end products’ of SI. This includes the ability to concentrate, ability to organise, good self-esteem, self-control and self-confidence, academic learning abilities, capacity for abstract thought and reasoning as well as specialisation of each side of the body and the brain.
- This implies that when a child is able to participate meaningfully and developmentally appropriately in daily activities and occupations, SI processes in the brain are supporting function. This is represented in the top section of the model in Figure

Sensory integration difficulties and dysfunctions in child psychiatric conditions

- If functional difficulties of children with child psychiatric conditions are considered, through reasoning, it becomes clear that the processing and integration of sensory information contribute to the clinical picture that is seen.
- Schaaf and Smith-Roley (2006) specifically mention the areas of academic achievement, personal identity, behaviour, social participation and activities of daily living, as all of these areas are dependent on adequate processing of sensory information and motor abilities dependent on the different sensory systems.

- For a child to perform optimally, he/she needs to process a lot of sensory information during a day and modulate all the different sensory information to attend and concentrate on all the activities throughout the day. To participate in activities, he/she needs motor function and skills and, when challenged with new motor actions or sequences, needs to be able to ideate, plan and execute.

Behaviour/functional difficulties	Possible contributing to SI problem
Poor sleep–wake cycles that interfere with day routines and activities	May experience difficulties to self-regulate; cannot implement self calming strategies and remains acutely aware of all the sensory information in his/her own body and in the environment
Poor attention abilities, always on the move	Modulation difficulties; use movement extensively in an attempt to modulate self, has a high threshold for vestibular input
Difficulty in sustaining postures and poor physical endurance	Poor vestibular–proprioceptive processing that does not support muscle tone and postural mechanisms
Poor use of tools such as eating with a knife and fork	Poor development of the coordinated use of the upper extremities due to BIS dysfunction caused by insufficient integration of proprioceptive and vestibular functions
Engage with play materials in a restricted and repetitive way, does not engage in novel or new play situations	Praxis dysfunction; contributes to poor ability to recognise affordances of play materials (ideation difficulties) as well as problems with planning and execution of motor actions during play

Intellectual disability

- Intellectual disability involves the impairments of general mental abilities having an impact on the functioning in three domains, which determine how the individual copes with activities of daily life. This includes:
  - ❑the conceptual domain (language, reading, writing, math, reasoning, knowledge, memory)
  - ❑the social domain (empathy, social judgement, interpersonal communication skills, making and sustaining friendships and similar capacities)
  - ❑the practical domain (self-management in the personal and school/work context, job responsibilities, money management and recreation)

- Children with intellectual disability experience a wide variation of SI difficulties and dysfunction, which include sensory modulation difficulties/ dysfunction, discriminatory difficulties/dysfunction, difficulties and problems with motor skills as well as praxis dysfunction. The degrees of the SI difficulties/dysfunction vary from child to child. The functional outcomes of poor SI are prevalent in these children's performance in activities, and they are very dependent on their environment and human support for optimal functioning.

- Because of the limited cognitive abilities, these children do not necessarily explore their environment optimally on a sensory level. The importance of the contribution of sensory experiences to development cannot be emphasised enough. A sensory-rich environment and the exploration and use thereof are crucial elements in the intervention plan for these children.
- Optimal motor function and skills are important outcomes for these children as they cannot rely on their intellectual abilities for later employment, but they can rely on their motor abilities to participate in occupations that can be fulfilling and in some cases also provide a form of income. Sensory modulation and motor difficulties/dysfunction based on poor SI can thus be addressed through SI therapy.

Autism spectrum disorders

- The latest prevalence of ASD on the website Autism Speaks indicates that 1 in 88 children in the USA is diagnosed with an ASD, with boys affected four to five times more than girls.
- In recent research, it is reported that the prevalence of SI dysfunctions among children with ASD can be as high as 88%.
- Functional difficulties of children with ASD are often related to SI difficulties/dysfunctions.
- They often experience difficulties with regulating responses in relation to sensations (often very specific stimuli), and they may use self-stimulation to compensate for limited input or to avoid overstimulation.

- Self-stimulatory behaviours that occur include repetitive movements that serve no perceptible purpose in the environment; have social, personal and educational implications; and often limit the child's ability to engage or participate in daily activities. Sensory processing in children with an ASD is often confusing, as it is often a source of distress but also a source of fascination and interest for these children.

- Ayres had already in the 1980s written on the SI difficulties that children with autism experienced . She described the sensory dysfunction they experienced both in terms of their SS and sensory-avoiding behaviour. She stated that they would often engage themselves in rocking or rhythmic motions (considered to be calming or organising) or twirling and swinging motions (considered to be alerting and activating). Her objectives of SI therapy for the autistic child were then described as improving sensory processing to enhance registration and modulation of sensations, so that the child would be able to form simple adaptive responses as a means of helping the child to learn to organise his/her behaviour.

- Recent research has indicated that individuals with ASD show more than one type of SI disorder as well as prominent sensory modulation symptoms across the ages and the spectrum of severity.
- These disorders involve challenges in modulation, integration, organisation and discrimination of sensory input to such an extent that the person does not respond appropriately to the input and experiences disruptions in daily activities and emotional/behavioural patterns.

- Schaaf and Smith-Roley view the key considerations when using an SI approach with children with ASD as follows:

✓Their inability to cope with unexpected or intense sensory input

✓Their difficulty to register and attend to salient sensory information

✓Their heightened sensory sensitivities

✓Their variability in reactions to sensory input

✓Their gravitational insecurity

- ✓Their seeking and avoidant behaviours in relation to movement, auditory input, touch, smell and taste
- ✓Their self-stimulatory behaviours
- ✓Their difficulties with processing tactile input
- ✓Their praxis difficulties
- ✓Their strengths in visual memory and ability to visually manipulate objects

- The known fact that children with ASD often have difficulty making eye contact can have its origin in more than one cause, including neurological and behavioural issues (Schaaf & Smith-Roley 2006). Schaaf and Smith Roley advise that difficulty with processing multi-sensory information should always be considered, as adults living with ASD have described their difficulty with maintaining eye contact whilst having to deal with visual and auditory input at the same time.
- The challenge of putting meaning to more than one sensory system's input at a time is a reality for children with ASD.

- The main objectives when using an SI approach with children with ASD are to improve their ability to engage purposefully and successfully in daily activities, including the forming of meaningful social interactions and relationships. The aims of occupational therapy will include:

❑To help them in organising sensory information so that it has meaning for them and to help them to experience enhanced sensory feedback about their bodies

- To support their sensory discrimination abilities so that the perceptions they form have better meaning
- To broaden their motor skills that are supported by vestibular, proprioceptive and tactile functions
- To enhance their praxis abilities by providing enhanced opportunities for forming ideas, planning motor actions and executing them
- Ensuring that their daily sensory needs are addressed will be crucial. This will also include human and environmental adaptations in those environments where they function on a daily basis.

Attention deficit hyperactive disorders

- Sadock and Sadock describe attention deficit disorder (with hyperactivity) as a disorder that ‘is characterised by a pattern of diminished sustained attention and higher levels of impulsivity in a child or adolescent than expected for someone of that age and developmental level’. These children experience perceptual motor impairments, distractibility and difficulties in completing tasks, organisational skills, motor and cognitive learning and controlling emotions. When using an SI approach with these children, it will be important to assess which of the mentioned difficulties are caused by, or amplified by SI difficulties.

- Schaaf and Miller (2005) reported that in studies of children diagnosed with attention deficit disorders, a range of responses of processing of sensory information were demonstrated in about 66% of children that participated. SI dysfunction that was mentioned in their report included different sympathetic markers of sensory reactivity and decreased responses of inhibition in the presence of typical sensory habituation, both indicative of sensory modulation difficulties.

- Budding (2012) discussed the poor timing of behaviour that children with attention disorders experience. It is difficult for these children to know when to act and when not to. This could be attributed to difficulties with regulation of intensity of stimuli and timing in a specific context. It also appears that they have limited ability to learn from experience.
- The question that needs to be answered is to what extent are these difficulties the result of sensory and motor systems that do not develop optimally.

- Lane (2012) reported that high co-morbidity (50%) exists between children with attention Deficit hyperactive disorder who also struggle with praxis dysfunction. Poor working memory is a common secondary underlying concern in children with attention deficit hyperactive disorder.
- One of the questions that is currently being asked is whether visuospatial working memory deficits underlie the poor behavioural inhibition of these children.
- It is clear from current work being done on children with attention disorders that they do experience problems related to sensory modulation, sensory discrimination as well as praxis difficulties.

Developmental coordination disorder

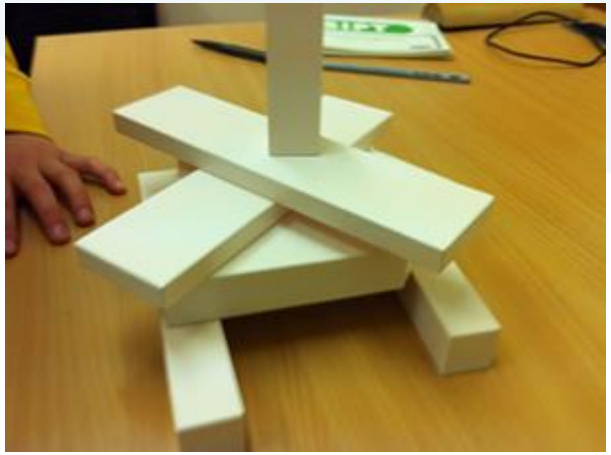
- DCD is a serious impairment in the development of motor coordination that is not exclusively explainable in terms of general mental retardation or any specific congenital or acquired neurological disorder. Neurodevelopmental immaturity may be present, although no diagnosable neurological disorder is present, as well as definite signs of gross and fine motor problems (Sadock & Sadock 2003).
- A criterion for diagnosis is that scores on a standardised test of fine or gross motor coordination must be at least two standard deviations below the level expected for the child's chronological age. These problems must also interfere significantly with the child's academic performance. Poor performances in visuospatial cognitive tasks are also associated with DCD.

- According to Mauro (no date), children with DCD experience difficulties performing daily activities. They are clumsy, have a higher risk for language and learning disorders and are often ostracised by peers for poor performance in sports activities. This leads to difficulties with peer relationships. There is a large overlap among dyspraxia and DCD from an SI perspective. Delay of motor milestones, lack of motor abilities in sports and problems with handwriting are commonly seen in both children with SI disorder with dyspraxia and DCD.

Assessment

- When using an SI frame of reference, the occupational therapist will collect information on the child's occupational profile. Depending on the child's age, abilities and context, decisions will be made regarding assessment instruments. The Sensory Integration and Praxis Test (SIPT) (Ayres 1989) remains one of the best assessment tools to identify SI and praxis dysfunction.
- It is not always possible to use this instrument for various reasons such as lack of training (formal training in the use of the SIPT is required), the age and/or intellectual abilities of the child, anxiety levels and also resources available.

The 17 SIPT tests. fall, roughly, into four overlapping types: (1) motor-free visual perception, (2) somatosensory, (3) praxis, and (4) sensorimotor.



- The Sensory Profile (Dunn 1999) or the Sensory Processing Measure (SPM) (Parham et al. 2006) can be used to assess modulation abilities of a child. For babies, the Test of Sensory Functions in Infants (DeGangi & Greenspan 1993) can be administered, and for toddlers, the DeGangi-Berk Test of Sensory Integration (Berk & DeGangi 1994) can be used.
- There are also various sensory checklists available. Clinical observations are valuable assessments to assist in concluding the difficulties/dysfunction of a child.

- Clinical reasoning remains one of the critical components in the use of an SI framework, especially where standardised tests cannot be used and the therapist has to rely on history taking, checklists and clinical observations. The child's functional problems need to be related to the underlying sensory systems that are not supporting the child's functioning, in order to make conclusions on possible difficulties or dysfunction and to plan intervention.

Intervention

- The overarching goal of SI intervention is to improve the ability of processing and integrating sensory information in order to provide a basis for improved independence and participation in daily life activities, play and school tasks.
- Providing successful ASI clinical reasoning is a vital component for a therapist to apply.
- An important part of SI intervention is to assist the significant others (parents, caregivers, siblings, teachers, etc.) in a child's life in understanding his/her behaviour from a sensory perspective. This can be done by discussing behaviour/challenges as they relate to the child's sensory systems.

- Guidance can be provided in terms of environmental changes as well as with day planning. It is important that the child is not only supported where he/she lives but also where he/she plays and learns. The necessary sensory and motor experiences need to be provided for the child's daily environment. There needs to be carry-over from the therapeutic environment to the daily environment so that the child can be as functional as possible in all occupational performance areas.

Possible questions, ‘mind actions’ and strategies as part of the ASI clinical reasoning process

Level of SI	Questions that can be asked	‘Mind actions’ in the clinical reasoning process
Modulation of sensory information (level 1)	• Is the child registering the sensory information? • Is the child’s behaviour indicative of a child that is able to modulate the sensory information?	Run through the sensory systems Visual: is he/she able to attend visually? Vestibular: how is he/she responding to actions where head and body are moving through 3D space? Proprioception: to what extend is the child aware of his/her body’s position and movements in 3D space? Tactile: how is the child responding to tactile input? Auditory: is the child attending and responding to verbal/auditory input? Does all the input he/she is receiving at that moment allow him/her to focus and attend to the ‘demands’ at hand?
Strategy: if yes is answered to all of the aforementioned, move on to next ‘level’ of SI		
Strategy: if no is answered, the occupational therapist needs to use clinical reasoning to decide on which sensory system is not supporting the child in his/her modulation of sensory input and also what changes/adaptations can be made to support the child’s modulation abilities.		

- It will be important to know the child's sensory profile as it directly influences the strategies that a therapist needs to implement. With high thresholds (under responsive children/sensory craving), the general 'rule' will be to enhance the sensory input by changing, for example, the frequency, duration or quality of input. When a child is of a low neurological threshold (over-responsive), the general 'rule' will be to reduce the sensory input, namely, reduce noise level, reduce visual input and use vestibular slow rhythmic movements to lower activity levels Children who are over-aroused by sensory input (no matter what their neurological thresholds are) will benefit from inhibiting sensory input such as slow rhythmic vestibular and/or tactile input. Tactile input needs to be deep pressure. Reduce the amount of visual and auditory sensory input and avoid multi-sensory environments Avoid multi-sensory input as it is activating to the nervous system
- Note: a child that is not modulated and able to attend to an activity will not be able to participate optimally in an activity that demands higher levels of brain processes such as discrimination and praxis

Discrimination (level 2)	Is the child's behaviour indicating that he/she is discriminating sensory information?	• Visual: is he/she able to discriminate visually (e.g. does he/she see differences and similarities)? • Vestibular: can the child make postural–ocular adaptations while moving through 3D space (e.g. balance reactions)? • Proprioception: what is the quality of movements where joints and muscles need to work together (e.g. motor control exerted during movements of limbs)? • Tactile: what is the quality of actions that are dependent on the tactile system (e.g. tool use)? • Auditory: is the child responding appropriately to verbal requests? • Do his/her sensory systems support him/her with tasks/activities that have inherent requirements of discrimination?
Strategy: if the answers are yes, the occupational therapist can move on to the next level of SI		
Strategy: if no is answered, the occupational therapist needs to use clinically reasoning to determine which systems are not supporting the child in discriminatory tasks and make necessary changes/adaptations, for example, enhance proprioceptive input to help the child with experiencing where and how his/her body and/or limbs are moving through 3D space and enhance tactile experiences so that the child is more aware of his/her body's position in space as well as qualities/characteristics of objects		

Refined use of sensory information (level 3)	Is the child showing behaviour of skilled use?	Ask the following question: • which systems contribute to skilled use required for that specific activity? Run through systems once again. • Skilled use will start where limbs are required to assist the child in the execution of a task, for example, riding in prone on a scooter board will require skilled bilateral use of the upper limbs (vestibular and proprioceptive systems) and will advance to very precise skilled use such as cutting with a scissor (tactile and proprioceptive systems)
Strategy: developing adequate skills will remain a focus area of intervention as all occupational performance areas (play, school, personal independence and interpersonal relationships) depend on adequate skills. The occupational therapist needs to ensure that a child is as independent as possible within all the areas of occupation. Reasoning on which sensory systems support which skill needs to be done and addressed accordingly; for example, poor posture in sitting can be attributed to poor extensor muscle tone, poor prone extension and poor proximal stability. The vestibular and proprioceptive systems are thus not supporting the child's postural abilities and will need to be addressed during intervention		

Strategy: if praxis is a problem for the child as well, the occupational therapist will start working on praxis abilities once skilled use is becoming evident. In the clinical reasoning process of a child with praxis dysfunction, it will be important to know which sensory systems are supporting the child in his/her praxis functions and which do not and then to use those systems accordingly during intervention

Level of praxis	All three areas of praxis need to be addressed during intervention:	
	(1) The first question will be as follows: is the child's use of his/ her body and affordances in the environment indicative of abilities to form ideas/plans that are realistic according to the situation?	(1) If the child is struggling for ideation abilities, the focus of the intervention strategies will be allowing the child to experience his/her body in 3D space with different equipment and their affordances. Verbal feedback and prompting for ideas will form part of this strategy
	(2) The second question will be as follows: is the behaviour of the child demonstrating motor planning abilities (does the child know how to use his/her body to achieve certain goals)?	(2) If the child is struggling with the motor planning part, it will also be important to let the child experience his/her body in 3D space with different equipment, and verbalisation by the therapist will focus on what the child's body is doing and how his/her body is doing it
	(3) The third question will be on the quality of the motor actions observed, namely, is the execution of novel/new actions performed by the child in line with the child's abilities and skills? Sequential actions and projected actions will form part of these questions	(3) When the child is experiencing problems with the quality of the motor actions, it will be important for the occupational therapist to allow for learning opportunities by repeating movements/actions so that 'strong' neuronal models of movement/actions can be built. Verbal feedback can be used, and the skills of a child can play animportant role here

General sensory integration treatment principles reviewed

- When using activities that provide vestibular input, angular movement stimulates the semicircular canals and facilitates phasic, fleeting postural reactions. Linear movements (up and down and forward and backwards) stimulate the utricle hair cells and facilitate tonic postural extension and increased muscle tone, which is needed in maintaining antigravity extensor postures. Whilst linear vestibular movements facilitate postural extension, only heavy work can promote postural flexion. First work for total flexion through phasic fleeting movements and then grade to activities that promote tonic sustained flexion.

- Always work for an adaptive response; if only sensory stimulation is provided without active participation and adapted responses from the child, no integration and learning will take place.
- Where applicable, use short concrete language as processing of verbal information places extra demands on the sensory systems. Both the mentally retarded child and the child with ASD experience language difficulties.

- Routine and structure provide a lot of security to both the mentally retarded child and the child with ASD, who especially experience challenges with change/transitions.
- Decrease anxiety as far as possible by allowing the treatment session to flow, keeping activities familiar (challenges within the activity could vary), and support children in anticipating change. This is especially applicable for children with ASD.

- Notes must be kept on the child's responses to treatment and progress. Feedback on the child's progress should be given regularly to parents/ caregivers and other members of the team.
- Sensory processing needs to be experienced in a meaningful way for learning to take place.

Precautions for Ayres Sensory Integration therapy

- ✓A child can never be left unattended to in an SI area. Apparatus used without supervision and guidance could cause serious injuries.
- ✓Doctors, other staff members and parents/caregivers should always be informed that a child is exposed to SI treatment. Doctors should also be consulted about any condition that might be aggravated by especially vestibular stimulation (e.g. epilepsy and ventricular shunts). Feedback received from them plays a valuable part not only in the adaptation of the program but also in the success of the program.

- ✓SI equipment must always be kept in a good condition, and mattresses should always be placed under suspension apparatus to reduce the chance of injury. Polystyrene chips should be changed regularly as they disintegrate easily, and the chances of ingesting pieces or getting them stuck in body cavities are a strong possibility.
- ✓SI activities are never forced onto a child. A golden rule of SI therapy is that if a child does not enjoy it, his nervous system is not integrating, and thus, no learning will take place.

- ✓As many children with more severe child psychiatric conditions are not able to communicate effectively, it is of the utmost importance to observe them very closely, this observation should be continued by caregivers for at least two hours after treatment. Any signs of distress, which indicate autonomic nervous system reactions, should be reported and treated accordingly. Signs of stress include the following: paleness, sweating, tachycardia, nausea or vomiting, extreme fear and/or agitation, constant yawning, overexcitement, constant crying, falling asleep or losing consciousness.

Depending on the symptoms, the necessary intervention should be made by either exposing the child to inhibitory or excitatory activities. If a child loses consciousness because of over-inhibition of the brainstem, give excitatory stimulation such as light touch applied to the soles of the feet and face or ice applied to the face. It must always be remembered that these children's nervous systems can be much more sensitive to sensory stimulation and adverse reactions can easily occur.

Sensory seeking and self-stimulation behaviors

- Stereotypic, disruptive and self-stimulatory behaviors can be characteristic of children with ASD but are also observed in children with intellectual disability (especially institutionalized children as effects of institutionalization). Typical behaviors of children who are SS or self-stimulatory include head banging, shaking of extremities, finger or ear flicking, scratching, biting (self or others), mouthing or chewing, grinding of teeth, rubbing of hands, rocking, spinning, scratching, humming (or any other form of vocalization), smelling and sniffing of objects.

- There are many reasons why a child will engage in these types of behaviors, but one of the reasons is that the child has a sensory integrative dysfunction, and the cause of the behavior could vary, for example:

(1) It could be that the sensation derived from the behavior provides the child with enhanced sensory input.

(2) It may be a way for the child to communicate with his/her environment in terms of attention received, obtained or avoided.

(3) It could provide the child with a manner to indicate his/her needs in terms of sensory input that is wanted (touch, vestibular, proprioceptive, auditory, visual, olfactory or smell).

(4) It could be due to an already identified sensory integrative disorder, for example, somatosensory or tactile discrimination disorder.

- The role of the occupational therapist will be to use clinical reasoning to analyze these behaviors by first identifying the reason for the behavior as mentioned earlier. The behavior also needs to be analyzed to identify which sensory systems are involved, for example, where movement is involved like rocking, spinning and running, the child is providing himself/herself with vestibular input.
- The type of vestibular input should also be identified (linear, rotatory, angular, fast, slow). A child that hangs upside down or positions himself with his head in an inverted position seeks intense vestibular input.

- Where behaviors such as jumping, crashing, hitting, pinching, teeth grinding and chewing are involved, the child is providing himself/herself with proprioceptive stimulation (some of the mentioned behaviors also have an element of vestibular stimulation). The type of proprioceptive input should also be identified, for example, light proprioceptive or deep proprioceptive.

- Where behaviors such as scratching, biting, masturbating and head banging are involved, the child is providing himself/herself with touch and proprioceptive input. The type of touch stimulation should also be identified (light touch or deep touch). Where the child engages in activities such as finger or hand flicking and spinning himself/herself with open eyes, there is an element of visual stimulation involved that needs attention.
- Behaviors which involve smelling and sniffing provide olfactory stimulation. Behaviors involving sounds provide auditory stimulation.

- All of these types of stimulation in which the child engages are usually dysfunctional and disruptive; therefore, the occupational therapist will, depending on the sensory reason for the behavior, plan intervention. The main goal of intervention in these types of behaviors is to diminish the behavior by providing the child with a ‘sensory diet’ that will provide the stimulation that his/her nervous system needs. It is also done in a manner to actively engage the child (requiring adaptive responses) and is functional.

Self-injurious behavior

- Although self-injurious behavior is also a form of self-stimulation as described earlier, it is more severe and disruptive. Varney-Blackburn (1985) described a treatment protocol for the treatment of self-injurious behavior in children with intellectual disability and autistic behavior that is still used today. Varney-Blackburn (in Crouch & Alers 1997) describes a treatment session as follows: start with a tactile rubdown (except if the child is tactile defensive), which has a primal, pervasive, preparatory influence and which can last for up to 30 minutes.

- This has an alerting effect on the nervous system and allows for maximum response to further sensory input. Various textured articles (e.g. sponges, cotton wool, loofahs, brushes, hand cream and body lotions) are applied according to sensory modulation principles. Tactile stimulation has always thought to be applied in the direction of the hair growth and not across the midline; however, Wilbarger has found this not to be a limiting factor. The development of eye contact and auditory stimulation is encouraged, and naming the body parts where the stimulation is applied also encourages body concept.

- Excitatory stimulation as well as a vibrator will then be applied to the areas which the child self injures. A vibrator should always be used with great caution, particularly on the facial area. Vibration provides a potent form of touch–pressure and proprioception. When ice is applied, it should be done fast and with light strokes (slow icing has an inhibitory influence).

- The child could also be placed in a snow box (large box filled with shell-sized polystyrene pieces) at any time during the session as this provides a great deal of tactile input and warmth.
- There are definite precautionary measures that should be noted: a child who has problems with bladder and sphincter control should wear a nappy as the warmth and comfort provided by the snow box tends to relax the bladder and sphincter muscles. The child could be asked to find objects hidden in the snow box (adaptive response is then required).

- Vestibular equipment can be used to either calm or alert a child depending on the need. Varney- Blackburn (1997) emphasizes that random vestibular stimulation has a disorganizing effect. Careful observation is necessary throughout the session to make sure that the input has an organizing effect, and if necessary, adaptations need to be made. It is also recommended that vestibular stimulation can be used to enhance language and communication.

- The use of singing is also recommended especially action songs that describe what is taking place and describe movements and body parts. Language is processed in the left hemisphere and music in the right hemisphere, so for the child who has language difficulties, music can be used to enhance communication.

- Treatment sessions for reducing self-injurious behavior usually last for approximately three quarters of an hour daily and should be continued for a few months. The child could then be included in a maintenance program, twice or three times a week. Research by Varney-Blackburn, during 1985, showed that most children show a positive response after two to four months. Some children respond very quickly and others take longer before decreasing self-injurious behavior is seen.

Drooling

- Drooling is often present in the profoundly mentally retarded child, and by exposing the child to an oral stimulation program, combined with an SI program, the drooling can be greatly reduced or eliminated.
- The oral stimulation program should be applied as follows: the occupational therapist sits with the child on her lap, facing away from her. If possible, the child should be looking into a mirror.

- A block of ice wrapped in a cloth is used to apply stimulation around the mouth area. Movements should be light and fast. This is repeated five times, the mouth area is then dried, and the application is repeated. Next, a vibrator (electric toothbrush wrapped in a cloth is very effective) is used to provide stimulation to the facial prominences (chin, cheekbone and jawbone).

- A vibrator should once again be used with caution. After this, a few drops of lemon juice/essence are dropped onto the child's tongue (an eyedropper can be used). The production of saliva is stimulated, and the child can now use the tone that has been built up in the previous steps to swallow the saliva. Flavored lip balm can be applied to the child's lips to enhance the awareness of the mouth area. It is also suggested that textured finger food such as biltong and finger foods can be given to the child to eat.

Hyperactive behavior

- Hyperactivity is often seen in mentally retarded children as well as in the ASD child. The reticular formation in the brain plays an important role in organizing and promoting alertness (Ayres 2010) and helps to keep activity levels within the normal range. Hyperactivity caused by poor sensory registration/processing or poor inhibition of the reticular formation can be treated successfully with SI therapy and could be seen and approached as a Sensory Modulation Disorder (SMD).

Seizures

- Seizures may be overt and easy to observe, or they can be masked as momentary inattentiveness, change in muscle tone with no obvious reason, fluttering of eyes, drooling or sudden change in behavior. If a child does have seizures, the occupational therapist must be extra cautious during therapy, but there is no reason why children with seizures could not be exposed to SI strategies.
- It is true that vestibular stimulation can elicit a seizure, but it depends where in the brain the lesion is that causes the seizure, as it could be situated in any one of the many different areas. Therefore, it cannot be assumed that vestibular or any other type of sensory stimulation will aggravate the epilepsy.

- The occupational therapist, using SI strategies, should just be extremely cautious; if any signs are observed that may suggest that the treatment has an aggravating effect on the seizure, the treatment should be terminated immediately, and intervention used must be analyzed and the necessary adaptation should be made to the program. Children with registration, attention and arousal difficulties are specifically at a higher risk for seizures because they have medical-neurological problems

Institutionalization

- Although institutionalization is not a factor within the child, it is a factor within the environment that can cause sensory deprivation and aggravate already existing SI dysfunctions. A great percentage of the children with intellectual disability and ASD are found in institutions in third world countries, and therefore, it should be taken into account when intervention is planned, especially in terms of the sensory world the child is exposed to within an institution. Within this deprived sensory world, the child has to still develop despite the already existing pathology.

- Recent research on the effects of institutionalization indicates that not all children in institutions show problems with SI, these children are at significant risk. Extensive research has been done on the effects of institutionalization on the development of a child.
- The importance of sensory experiences (especially touch and movement) in development is well described in the literature. Children living in an institution are not only deprived of sensory experiences but are also exposed to infrequencies of interaction (also on a sensory level) by caregivers.

- Intervention studies discussed by Cermak indicate that the effects of deprivation and institutionalization can be reduced but it must be multifaceted and interdisciplinary.
- The provision of SI treatment should definitely be one of the ‘parts of the puzzle’ that is built towards the minimization of the effects of institutionalization on the development of children.

Use of groups in sensory integration treatment

- Factors such as cost, patient numbers, manpower and facilities often force the occupational therapist to make use of groups in treating children with SI dysfunctions.
- Although not the ideal, it is better treating children in groups than excluding children from treatment that could help them to be more functional. The following are a few guidelines that could be implemented when treating children in SI groups:

- Include children with similar dysfunctions in the same group.
- Include children that could benefit from the same types of stimulation activities in the same group.
- Include children with similar arousal levels in the same group (not under-aroused children together and over-aroused children together because the nature of the stimulation will differ vastly between the two groups).

- Group children according to their level of creative ability (du Toit 1991). The adaptive responses made by children that function on the different levels of creative ability will vary because of their differences in action, volition, handling of tools and materials, relating to people and task concept. The planning of activities in terms of the adaptive responses required will be much easier when the children in the group function on the same level of creative ability.

- Support staff are essential when working in groups. If the staff have received additional training in SI, they could really be of great value and could help to make the group session more effective. The more capable hands available in group treatment, the better the chance to address individual needs within the group.
- If available, a video of a group session could help the therapist to plan intervention more effectively. By viewing the tape, the therapist could look at individual children's needs and make the necessary adaptations to the program.

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Thank you