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SENSORY PROCESSING DISORDERS

A child's response to touch, movement, visual and auditory stimuli as well as taste and smell can impact them in many ways. It can influence behavior, attention, impulse control, postural control and success in motor control and related functional skills. The sensory systems are our basic source of communication with our environment. **The tactile or touch (skin)** sensory system has many important functions, including providing us with the ability to know what an object is without looking (tactile discrimination) and identifying temperature and pain. Tactile sensation also plays a crucial role in the development of fine motor abilities and overall body awareness. **Movement or the vestibular proprioceptive system** consists of parts of the inner ear and related central nervous system structures which perceive and interpret changes in head position. It automatically coordinates movements of one's eyes, head, and body. The proprioceptive system provides information related to the muscular and skeletal systems and therefore the position of one's body. These perceptual systems are essential for the development of body awareness and body and space abilities and in perceiving and adapting movement of the body. **Vision** consists of both the motor function of the eye as well as perception of visual information. The **auditory system** consists of hearing, speech and language, the child's response to sound and their ability to perceive the spoken word and follow directions. **Taste and smell** consist of the child's response to the stimulus as well as the impact this may have on functions such as eating and response to environments**.**

SENSORY MODULATION

Difficulty in the processing and perception of sensory stimuli may affect attention and focus. This can be described as a sensory modulation difficulty. **Sensory modulation** is the description of the continuum of sensory registration and responsivity that enables one to arouse, alert and attend to stimuli. Within this continuum there is orientation at one end and failure to orient at the other end. Sensory registration with related arousal and attention undergoes normal variation in the course of a day or in an hour in all individuals. It is when the variation is extreme, when an individual spends excessive time at one end of the continuum or the other, or shifts from one extreme to the other, that a problem is indicated. Many children with difficulty in sensory registration and responsivity seem to swing to either or both ends of this continuum (failure to orient or under attend or over orient and over attend). These individuals have difficulty attaining or maintaining the mid-range or selective attention (homeostasis). A child with a sensory modulation difficulty has more frequency and intensity of responses than a typically developing child. This contributes to variation in attention with over or under attention to stimuli in the environment.

- **Focused Attention or Homeostasis:** The optimum response to sensory stimuli is to maintain an alert, attentive state to focal stimuli in concert with the ability to habituate to or inhibit responses to extraneous stimuli. This is described as homeostasis. When an individual

has difficulty in this area of processing sensory stimuli it is described as a sensory modulation disorder. The range of response to sensory stimuli can be from a state of heightened registration or response to low registration or a depressed response. This range includes:

- Defensive >Withdraw (extremely heightened response)
- Defensive > Protective; fight and flight; approach/avoidance (extremely heightened response)
- Defensive > Escalated - giggle; talkative; tangential; intense play; lack safety (heightened response)
- Hyperfocus; overattentive (mildly heightened response)
- Attentive - focused attention to salient stimuli with habituation to extraneous stimuli (homeostasis).
- Lack attention, low registration, hyporesponsive, excessive habituation - to body, to environment; to cues from those around them (mild to moderate low registration)
- Shutdown (extremely low registration)

- **Sensory Defensiveness:** The extreme of sensory modulation difficulties is overattention to the point of hypersensitivity. The processing and perception of a sensory stimulus may then contribute to defensive behavior. **Sensory defensiveness** is a descriptor of the aversive or defensive reactions that one may exhibit to sensory stimuli that is not usually considered noxious or overwhelming. A sensory defensive response is an "emotional" or "visceral" reaction to a stimulus (tactile, auditory, movement, visual, olfactory, and or gustatory) that elicits a "fight and flight" or "protective response" in a child. The child may respond protectively even though they may consciously know that the stimulus is not a threat. This response to a stimulus usually reflects a misinterpretation of sensory events. In some individuals, symptoms are subtle, the child may appear to be "fussy", have a "very definite personal space" or maintain firm restrictions to activities and social interactions in order to avoid offending sensations. In more extreme cases the child may be aggressive in response to a gentle touch or may cry excessively or withdraw when there is too much noise or activity around them. This can be very challenging as a parent as you may be "walking on eggshells" in anticipation of the next unknown event that may "push your child over the edge."

  It is important to be aware that one's response can vary during the day, and the response to one type of stimuli can be heightened, while it can be depressed to another. For example a child may be highly sensitive to light touch and hit (fight and flight) in response to your touching them and yet may be unaware of how high they are when climbing the railing of the banister (low registration to vestibular stimuli) or a child may be very fearful of movement experiences such as being on an escalator (heightened, approach/avoidance to vestibular), may hyperfocus on the lines in the escalator (overattentive to visual stimuli) as a way of coping with this and may stumble as they move off the escalator (low registration to change in proprioceptive stimuli).

Sensory Modulation Continuum

Shutdown/W=draw<>LackAttention<>Habituate<>Orient<>Attend<>Hyperfocus<>Escalated<>Approach/Avoid<>Fight/Flight<>Shutdown/W=draw

<Arousal/Alerting/Attention> ***<Sensory Defensive Responses>***

- **Self-regulation:** Self-regulation refers to the strategies a child uses to increase their attention to a task, to self-calm and for impulse control. During early development, the parent or caregiver in their interaction provides sensory stimulation to the child. This sensitive stimulation (touch, movement, visual and auditory) helps the child develop control, to calm, to attend to salient stimuli, and to organize their own body. This then contributes to the child developing their own strategies to develop control, to calm, to attend to salient stimuli and to organize their own body. This enables the child to develop internal regulation and to control their behavior. Thus, self-regulation is the ability to achieve, monitor and change a state of attention and behavior to match the demands of the environment or situation. Self-regulation enables the child to initiate and cease activities in relation to the task and situational demands and to comply with a request of another (e.g., parent, teacher, or friend).

  The child's regulatory strategies may include tactile (e.g. constantly touching objects, one's face or hands); visual (e.g. stares out the window, stares at objects in their hand); proprioceptive (e.g. jumps , pushes, bounces, drums; vestibular (e.g. seeks movement in linear planes with pacing, lateral with rocking , or orbital with spinning); auditory (e.g. squeals, hums, repeats directions; oral (e.g. sucks a pacifier, their thumb, a blanket; eats food, chew on objects or their clothing, oral motor overflow); olfactory (e.g. smells or sniffs objects, make comments re smell).

  The parent or caregiver may also assist a child with regulatory strategies. These may include tactile (e.g. touches or rubs the child); visual (e.g. exaggerating one's action to gain the child's visual attention; drawing a sequence; distracts with visual; provides calming visual objects; avoids settings that are visually "busy"); proprioceptive (e.g. touch pressure, trampoline); vestibular (e.g. swings set at home, rocking chair; auditory (e.g. gives clear verbal cues, verbal warnings; provides structure- "first this then," sings, avoids settings that are loud; oral (e.g. provides food to chew, pacifier to suck; bottle to suck and comfort); olfactory (e.g. provides objects to smell).

  In assessment the methods the therapist used to assist the child to attend or to calm may include tactile (e.g. touch with the palm of the hand, contouring against the body, with the fingers extended and adducted, the thumb extended and abducted; visual (e.g. remain static, use slow movement; proprioceptive (e.g. provide touch pressure, show the child how to hold static positions to decrease the need to constantly move, increase the awareness of the

base of support with handling); vestibular (e.g. provide movement in linear, lateral or orbital planes; auditory e.g. wait up to 20 seconds between a comment or request to allow time for processing, expand the vowel in a word to increase attention to the key word, use action words, sing); oral (e.g. provide food to chew or suck; provide a water bottle, provide compression to oral structures); olfactory (e.g. provide objects or aromas to smell).

SENSORY DISCRIMINATION

Sensory Discrimination contributes to the development of motor control and success in functional skills. This depends on the perception of information from a singular sensory system as well as multisensory perception. Efficient sensory discrimination also contributes to the ability to **motor plan and sequence**. Praxis or motor planning is the ability to conceive of, organize (plan), and carry out or execute an unfamiliar motor activity. Praxis is that ability by which we figure out how to use our hands and body in skilled tasks like playing with toys, using a pencil or fork, building a structure, straightening up a room, or engaging in many occupations. Motor planning is the instinctive "know-how" in approaching a novel motor task, the ability to automatically make your body do what you want it to do, without having to consciously think out every step of the task. The child's ability to accurately perceive and process sensory information from their body's interaction with the environment is essential for motor planning. The components of motor planning include ideation, motor sequencing, motor innovation and adaptability. **Ideation** has a strong cognitive component and requires the ability to associate previously experienced activities with what is currently presented. **Motor sequencing**, which reflects the child's ability to determine what action needs to be done first, second and third in order to achieve success with a motor task, depends on an adequate sense of body scheme. **Motor execution** impacts the quality of one's motor planning. Mild hypotonia as well as poor cocontraction and balance difficulties impact the quality of motor execution and, therefore, motor planning. Finally, **adaptability** is essential in being able to generalize and adjust a motor plan based on the changes that occur within the environment. Development of independence in functional skills such as dressing skills, fine motor abilities such as pencil use, manipulation of toys and eating utensils and gross motor skills such as bike riding and climbing reflect a child's sensory discrimination and motor planning.

Functional skills impacted by sensory discrimination and motor planning difficulties include dressing skills, fine motor abilities such as pencil use, manipulation of toys and eating utensils and gross motor skills such as bike riding, climbing and other age-appropriate skills. Organization, approach to tasks and following directions contributes to success with functional skills.