



Understanding and Supporting Differences in Sensory Integration in the School Setting

Part III



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“Sensory Integration is the organisation of sensory input for use.”
Ayres 1979, p. 184

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What is in a name?

- Multi-Sensory Integration
- Sensory Integration
 - Diagnosis, Treatment, Theory, and Assessment
- Sensory Processing Disorder/Challenges
 - Label for the condition
- STAR PROCESS describes the treatment
- AOTA suggests....Sensory Processing and Integration Challenges

What's in a Name?

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Theoretical Models of Sensory Integration

- Models of Function

- Models of Dysfunction

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Theoretical Models of SI

FUNCTION

- **Ayres 1979, 2005**
 - **Classic Model of Sensory Integration and typical development**
- **Dunn, 1999**
 - Sensory Modulation – Relationship between behaviour and threshold
- **Smith Roley, 2006**
 - Analysis of Sensory Integration Functions
- **Smith Roley & Spitzer, 2001**
 - Model of SI and development relative to occupational science and therapy
- **Miller et al, 2001**
 - An Ecological Model of Sensory Modulation

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Theoretical Models of Sensory Integration

DYSFUNCTION

- **Bundy, Murray, & Lane, 2002, 2019**
 - Patterns of SI and praxis deficits
- **Miller et.al., 2007**
 - Sensory Processing Disorder proposed nosology
- **Smith Roley, 2006; revised 2011 based on Mailloux, et.al., 2011**
 - Analysis of Patterns of SI Dysfunction

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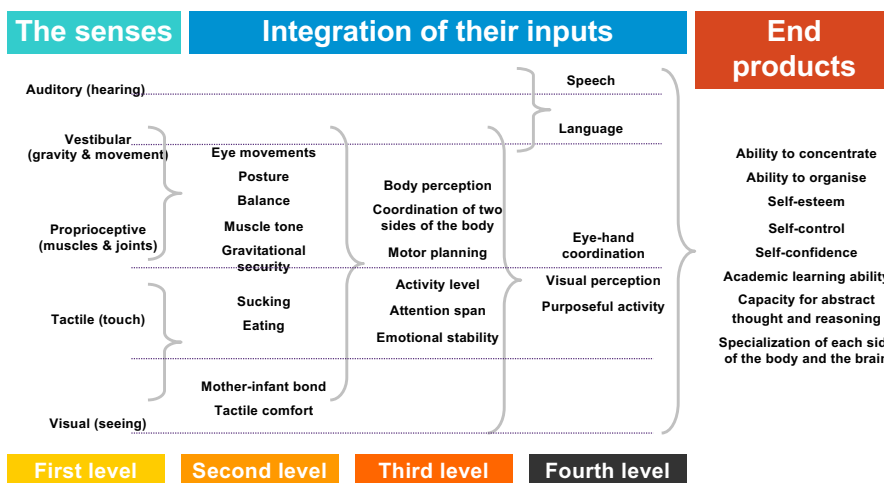
Models of Sensory Integration Function

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Sensory Integrative Process

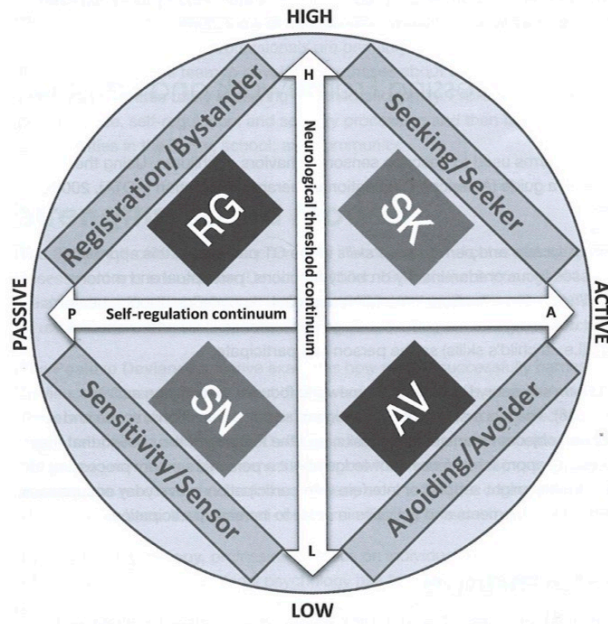


Published by WPS® 1979, 2005

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Dunn



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Theoretical and Evidence-Based Model of SI Analysis of Sensory Integrative Functions

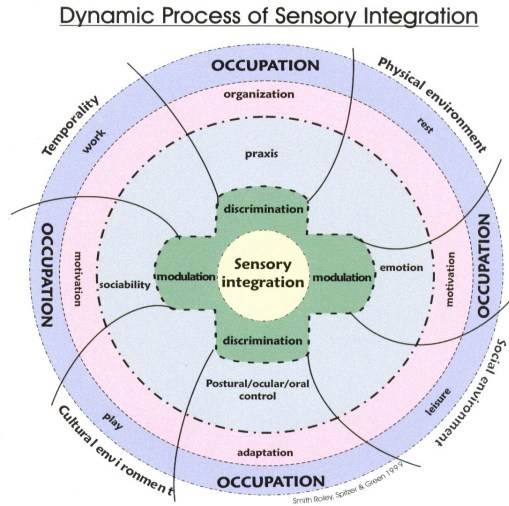
Visual	Vestibular	Proprioception	Tactile	Interoception Modulation
Visual motor	Postural control	Gross motor skills	Praxis	Regulation Arousal Affect Activity Level
Visual construction	Bilateral coordination Sequencing	Fine motor skills	Language Organization of behavior	Attention

(c) Smith Roley 2015

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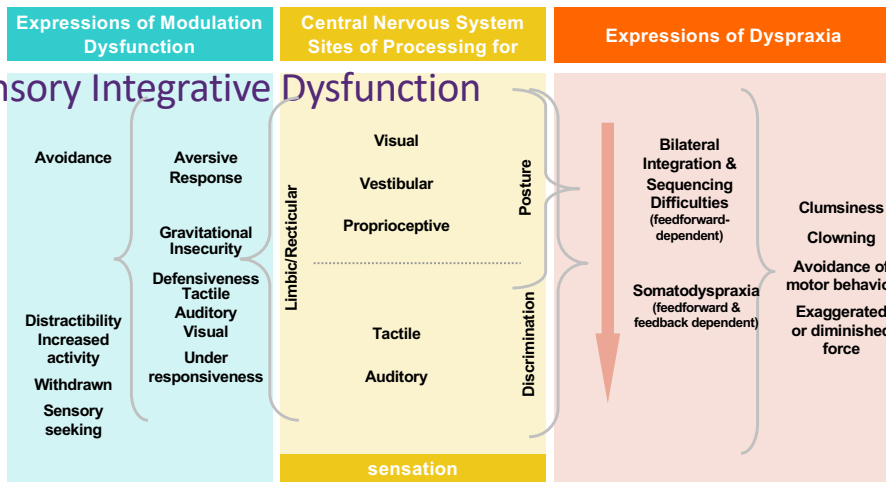
Model of Sensory Integration



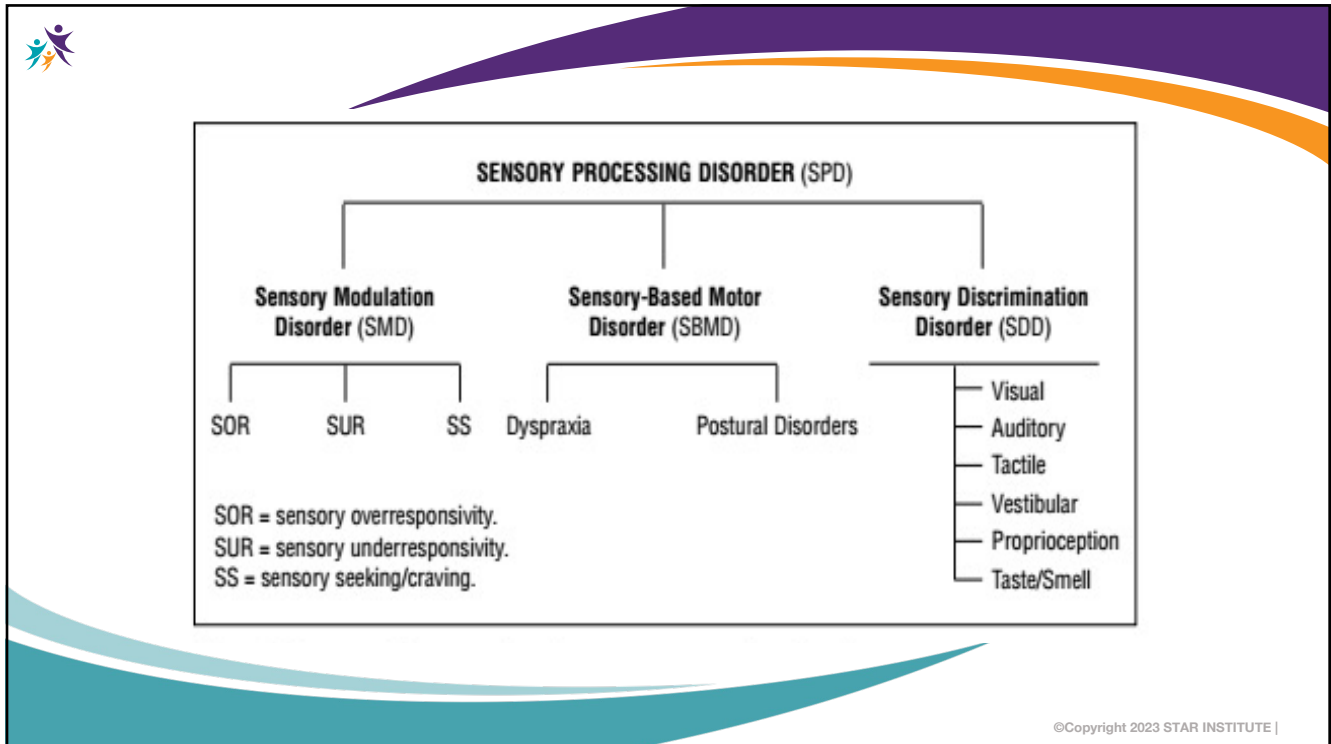
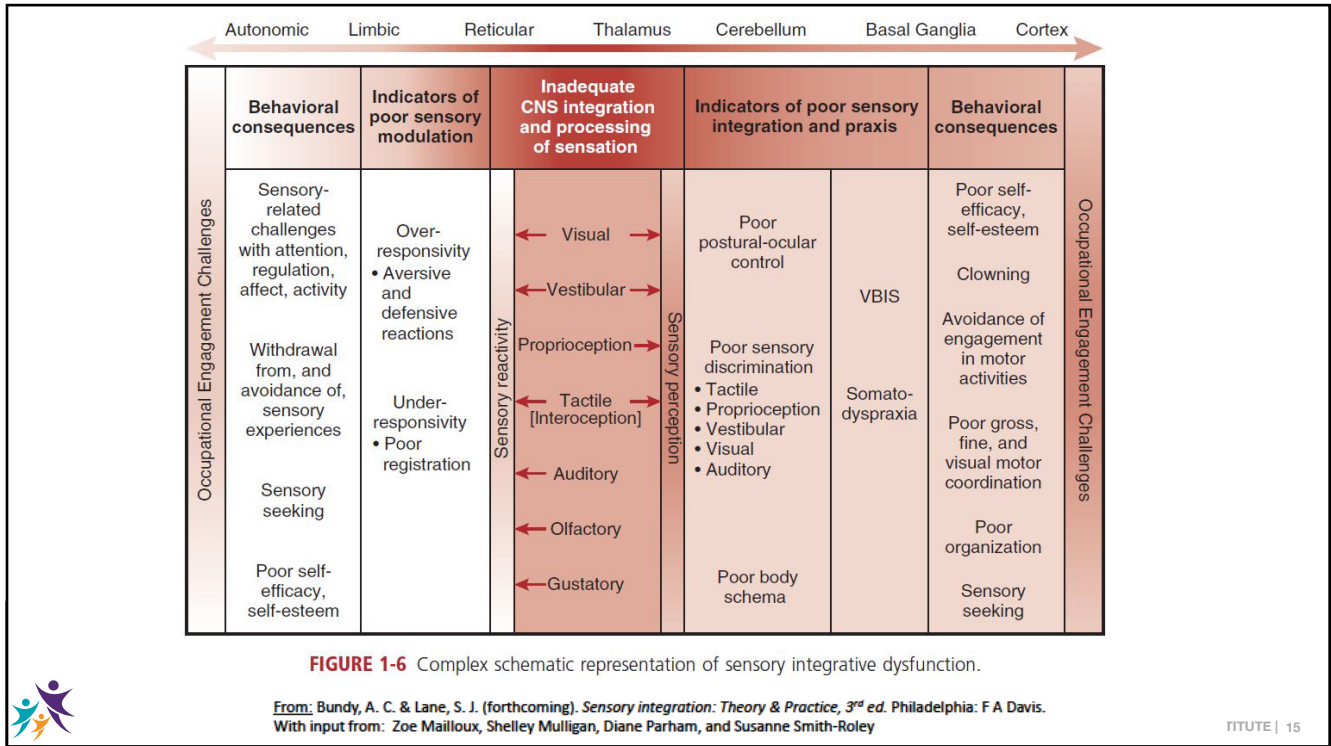
(c) Smith Roley 2015

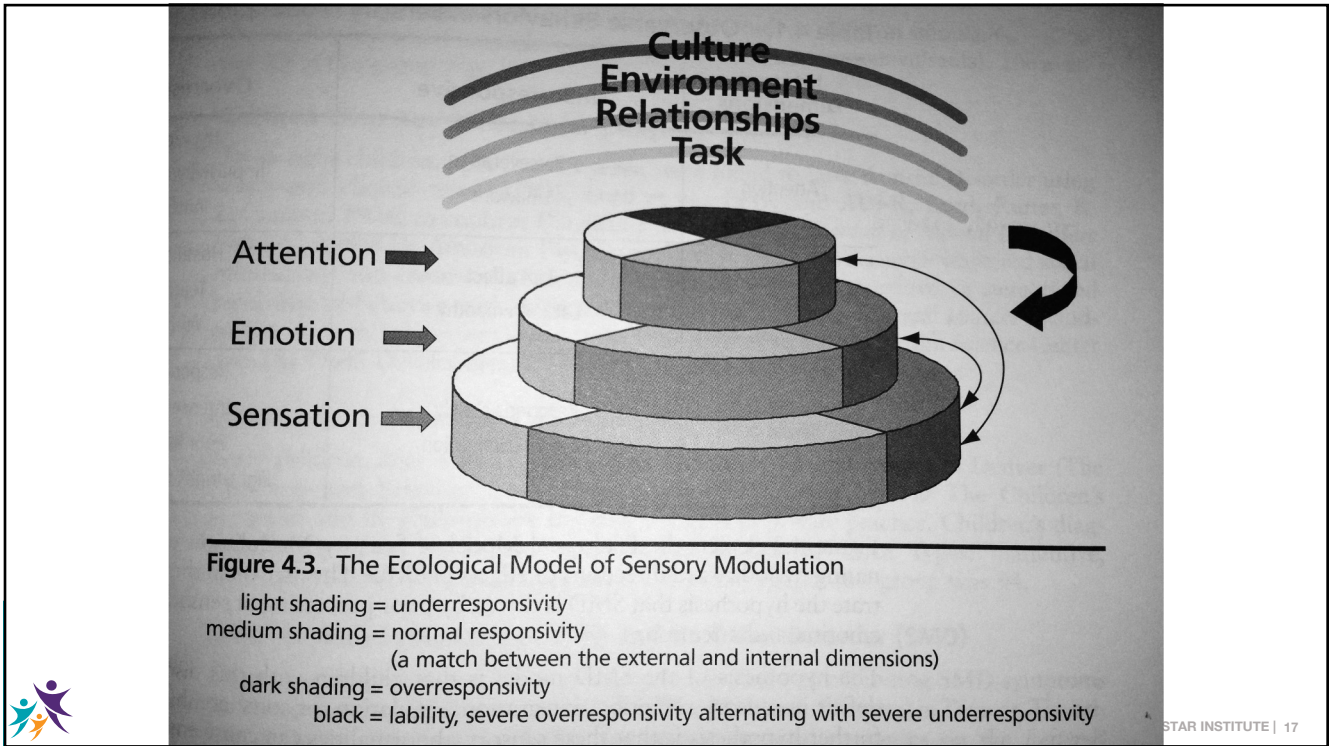
Figure 1: The relationship of sensory integration to engagement in daily occupations can be likened to a rolling wheel. In this case, sensory integration is the hub. The spokes are sensory modulation, supporting social engagement and emotional well-being and sensory discrimination, supporting practical skills and postural, ocular, and oral control. These spokes link to a rim of adaptation, motivation, and organization. The wheel supports the tire of occupations—work, play, leisure, and rest. This wheel spins in an occupational context of the physical, social, and cultural environment. The wheel (in its entirety and in its parts) and the environment are in constant interaction, exerting forces on each other. In the case of the sensory integrative wheel, the degree of flexibility and interaction with the occupational context may be much greater than that of a literal wheel rolling through physical space.

• Sensory Integrative Dysfunction



Bundy, Lane, Murray, 2002





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Behavioral Observation	Underresponsive	Overresponsive
Attention	Perseveration Unaware	Hyperactivity Impulsivity/disinhibition Inattention
Emotion	Flat affect Alexithymia	Fight/flight Tearfulness Immobilization
Sensation	Responds slowly Poor discrimination	Hypervigilant Intense responses Poor habituation

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What should assessment tell you?

- The child's strengths and needs
- What the results mean in the context of practical, functional, everyday terms
- Scores that are meaningful and truthful.

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Hypothesis Generation

- Reason for referral
- Areas of strength
- Areas of weakness
- Conclusion – does this child have difficulty processing and integrating sensory information?
- ***How does this relate to function? To reason for referral?***
- Robust profile of individual needs

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Evaluation Types

- Clinical Interview
- Questionnaires
- Standardised Assessments
- Clinical Observations
- Free Play
- Home visit / video review
- School visit / video review
- Teacher interview

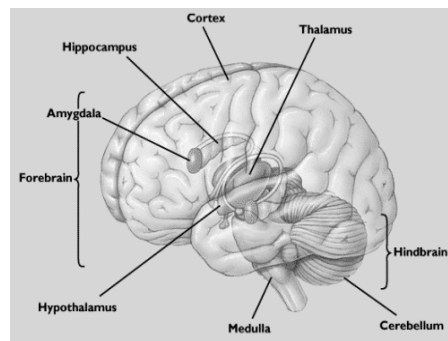
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Sensations and Brain Development



“While a theoretical framework is essential... it is important to always keep in mind what is assumption and what is fact.”

Ayres, 1972, p. 4

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Always Keep Regulation In Mind



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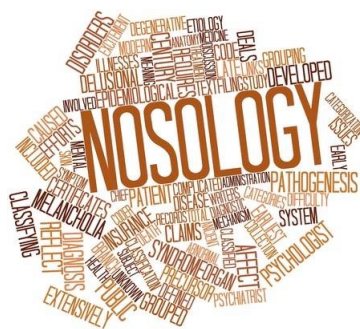
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Why have a nosology

- Describes the clinical presentation
- Improves clarity of communication
- Provides a common language for families, physicians, educators, clinicians and researchers



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Pros and Cons of the Nosology (a living document)

- **Pros**
 - Offers support to families
 - Popularizes sensory processing as a dimension
 - Highlights individual differences
- **Cons**
 - Lack of agreement in terminology
 - SPD is not an actual “diagnosis”
 - SPD is not in the DSM-V



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Clarification Regarding Subtypes



- Not mutually exclusive
- Variation exists across the sensory domains
- Combinations of symptom presentation exists

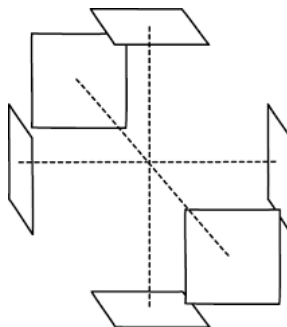
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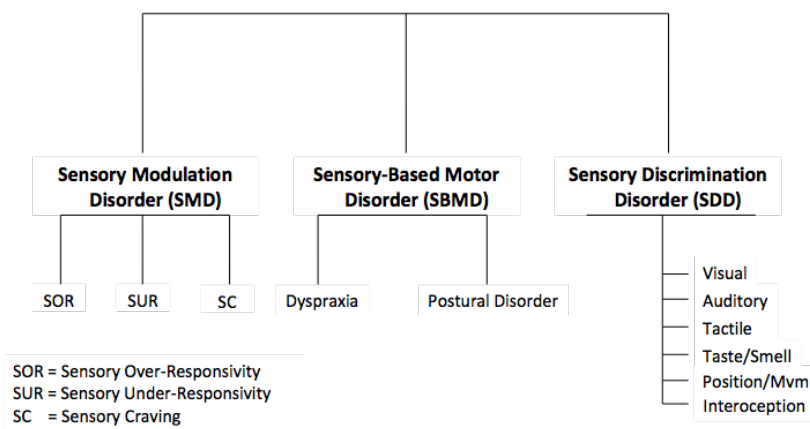
Dimensional Thinking

- ☐ Broaden the impact of our knowledge of sensory processing differences
 - in the home
 - in the classroom
 - in the community
 - in the workplace
 - across the lifespan



A Proposed Nosology (2007)

Sensory Processing Disorder (SPD)



Miller, Anzalone, Lane, Cermak, & Osten, 2007



Some notes regarding the Nosology



- Inclusion of Interoception
- Distinction between Sensory Craving, Sensory Seeking and Sensory Under Responsivity
- Theories regarding underlying mechanism
- Recognition of associated social emotional challenges



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What is the relation between sensory processing and arousal dysregulation

- Sensory modulation challenges can produce behavioral dysregulation
- Sensory discrimination challenges can produce behavioral dysregulation
- Sensory-based motor challenges can produce behavioral dysregulation
- Not all dysregulation is due to a modulation problem
- Not all strategies for dysregulation are 'sensory'

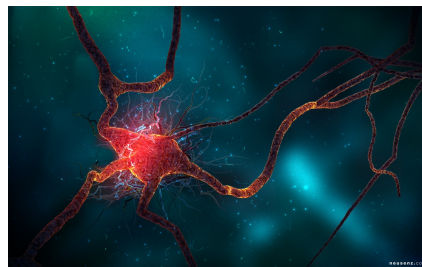
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Sensory Modulation (SMD)

- Difficulty adjusting responses to sensory input - responses are not graded to/do not match the situation
- Can be SOR, SUR, or combination
- Terminology challenge



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Heightened Sensory Responsivity

- “Sensory Over Responsivity” (SOR)
- Responds **too much, too frequently** or for **too long** to sensory stimuli
- Bothered by.....
 - touch - clothing, haircut
 - smell - food being cooked, bath and body products
 - movement - playground equipment, being in a car
 - auditory - volume of speaking voice, music in the background
 - visual - bright colored patterns, bright lights/daylight

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Sensory Over-Responsivity (SOR) cont.

What we see...

- Avoids group activities
- Upset by unexpected changes
- Excessively cautious
- Anxious
- Aggressive or impulsive

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Dampened Sensory Responses

- **“Sensory Under Responsive” (SUR)**
- **Less aware, less reactive, does not notice** sensory experiences
- Slow to respond or muted responses to
 - touch - being hurt, or knowing that one was touched
 - auditory - loud noises
 - interoceptive - bowel or bladder needs
 - gustatory - spicy foods
 - temperature - being hot or cold
 - visual - lights turning on or off

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Sensory Under Responsivity (SUR) cont.

What we see...

- Passive, quiet, withdrawn in presence of sensation
- Excessively slow to respond to verbal directions
- Appears uninterested in exploring games or objects or world around him/her

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What do Sensory Modulation challenges look like



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Sensory Discrimination Differences

- Ability to accurately perceive and interpret the temporal and spatial qualities of sensory information
- Ability to recognize the qualitative and quantitative features of objects and experiences
- Compare similarities and differences between sensory features



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Sensory Discrimination Differences



What we see...

- Visual
- Tactile
- Vestibular
- Proprioceptive
- Auditory
- Interoception

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Postural Differences

- Difficulty with balance, coordination of movement especially against gravity and endurance
- May slump in standing or sitting
- Tires easily
- Appears weak or limp
- Difficulty sustaining muscle activation for daily life activities
- Difficulty adjust body positions for efficient and successful task performance

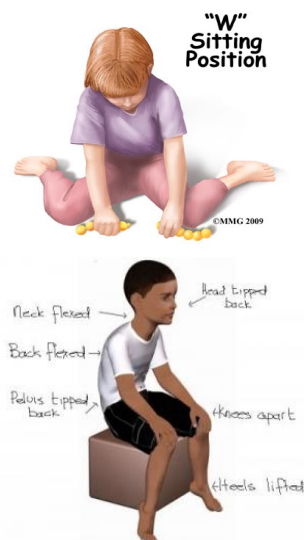
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Postural Disorder

- What we see....
- Give up when physically challenged
- Appears lazy, unmotivated or indifferent
- Awkward or uncoordinated
- Difficulty with physical endurance
- Lack of variety of movements
- Poor bilateral coordination
- Impaired visual motor or oculomotor control



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What do Postural challenges look like



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The Dyspraxias

The many many ways that motor planning can look different:

- Difficulty conceptualizing, planning, sequencing and/or executing motor actions
- Difficulty learning sequences of movement, poor feedback
- Difficulty with anticipatory control, poor feedforward
- Difficulty judging time and space
- Difficulty projecting forward in time to complete a task.
- May be slow to initiate and position their bodies effectively for motor tasks

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Types of developmental dyspraxia

- Somatodyspraxia: reflecting challenges with sensory discrimination, particularly using **tactile** and proprioceptive data to inform motor action.
- Visuodyspraxia: reflective challenges with visual perception and visually directed praxis.
- Language based dyspraxia: reflecting challenges with following the spoken directions of others.
- Bilateral Integration and Sequencing: reflecting challenges with vestibular, proprioceptive and visual integration. Unable to generate projected action sequences.
- Ideational dyspraxia: reflecting challenges in conceptualizing motor actions.

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'Classic' dyspraxia or DCD

- What we might see
 - Destructive in play, tends to break toys
 - Clumsy and or accident prone
 - Difficulty keeping personal space organized
 - Difficulty learning new motor tasks/skills
 - Poorly coordinated fine and gross motor skills

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Praxis -

A learned function that requires interaction with the external world.



Dewey, D. (1995). What is developmental dyspraxia. *Brain and cognition*, 29(3), 254-274.

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Praxis

- A neurological process by which cognition directs motor actions
- Motor or action planning is the bridge between generating an idea and motor execution of the action



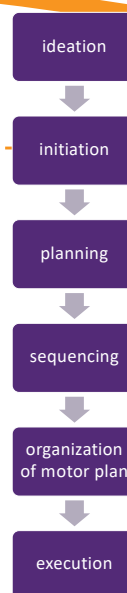
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What is praxis?

- The ability of the brain to conceive of, organize, and carry out a sequence of unfamiliar actions.
- When a motor pattern becomes habitual (automatic), it does not reflect praxis.
- Typically assessed through verbal instruction (put your finger on your nose), through imitation (requesting a client to adopt the same position as you) and through tool/object use.



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Dyspraxia

- Delays in attaining motor milestones
- Difficulty with learning new motor skills
- Difficulty with multi-step tasks
- Long time to learn routines
- Difficulty keeping personal space organized
- Prefers sedentary, not active play
- Difficulty with ideas (play and problem solving)
- Emotional Dysregulation

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Splinter Skills

- Skills learned before readiness was achieved (before foundational skills were mastered)
- Often a result of imposed developmental curriculums that disregard neuromotor maturity
- A skill that can be performed in one context – not generalized
- Often involving compensatory techniques that make up for absent postural or motor foundation
- May be adaptive within one setting but often becomes maladaptive in broader context

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- “Although a child may not have developed the sensory integrative foundation for a function, society still demands that he perform that function. Therefore, as the child with sensory integrative dysfunction grows older, he learns **splinter skills** that compensate for his poor sensory processing.”
- Ayres, Sensory Integration and the Child

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Dyspraxia of Speech

- Motor based speech disorder.
- Difficulty accurately coordinating and organizing the oral motor musculature to produce speech sounds.
- Generating sounds: pronunciation, articulation, consistency.
- Sequencing sounds: stringing sounds together to produce words, and words together to produce sentences etc.
- Commonly seen in children with dyspraxia.
- Also referred to as childhood apraxia of speech.

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What does this mean?

- Don't make assumptions based on past behaviors and vocalizations
- Prioritize provision of communication aids
- **Do not judge cognition based on motor outputs**
- **NOT all behavior is communication**

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Developmental Apraxia in Autism

- *A disorder of learned movement in which the difficulty with the movement is not caused by paralysis, weakness, or spasticity/incoordination caused by brain injury*
- Differences in production of purposeful motor movement *are* likely tangible via neuroimaging/wearable biosensory devices**
- Reflection of significance of motor differences
 - Absence of error-correction based learning
 - Where motor noise and randomness disrupt clarity of sensory motor data
 - Motor disinhibition interrupts purposeful action (spontaneous, involuntary, reflexive motor)

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Excess Reafferent Noise in Autism

- You learn based on error correction
- i.e., I reach and point/touch and retract from the purposeful movement
- In autism during the retraction there is elevated noise and randomness
- This noise and randomness impedes the creation of predictive code

Torres et al 2013

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What do Praxis challenges look like



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Praxis and Learned Motor Plans

- Learned motor plans are automatic schemes of action that do not require conscious attention.
- Praxis refers to nonhabitual conceptualization, planning and execution of action (motor plans).
- However, generating increasingly complex motor actions requires an internal database of learned motor actions. These are called motor engrams.

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