Sensory Integration and Speech Therapy

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introduction

- How do we find out about the world around us?
- How do we develop skills?
- How do we learn?
- What determines whether we remember something…or not?

Sensory Integration

- Normal Sensory Integration
- Neurological process of organizing info from body and environment for use in daily life
- Central nervous system
- 80% of nervous system involves processing sensory info

Sensory Integration Dysfunction

- Inability to process sensations efficiently
  - Take in too much or too little information
    - Hypersensitive
    - Hyposensitive
  - Neurological disorganization
  - Inefficient motor, language, or emotional output

Sensory Spectrum

Seekers: Less sensitive/Active, seeking reflects high thresholds that need to be met through the surrounding environment, Seekers make noise, fidget, touch, feel, hang on others, and taste things.

Low Registration (Under responders): Less sensitive/Passive, do not notice what is going on around them, may seem bored, dull, uninterested, difficult to engage, easily exhausted, appear apathetic.

Sensitivity (Over responders): Very sensitive/Active, notice more things than their peers, easily upset, seem hyperactive, distracted, difficulty learning from experiences because their routine is often interupted.

Avoiding: Very sensitive/Passive, actively try to prevent sensory input, experience discomfort quickly, develop rituals control their sensory environment

The CNS

- Neurons
  - Sensory
    - Impulses from receptors in eyes, ears, skin, muscles, joints, organs
    - Motor
- Spinal Cord
  - Interprets sensory messages, sends motor messages
- The Brain

The Brain and Sensory Integration

- 4 Important Parts
  - Brainstem
  - Cerebellum
  - Diencephalon
  - Cerebrum

Brain Stem

- Receives messages from skin and muscles in head and neck
- Sensations switch to appropriate hemispheres
- Processes vestibular sensations
- Processes sensations from internal organs

Cerebellum

- Processes proprioceptive and vestibular sensations
  - Muscle tone
  - Balance
  - Fine motor skills

Diencephalon

- Basal ganglia
  - Coordinate vestibular sensations
    - Balance
    - Voluntary movement
- Hippocampus
  - Compares old and new stimuli
- Amygdala
  - Connects impulses from olfactory system

Diencephalon

- Hypothalamus
- Thalamus
  - Key relay station
  - All sensory data except smell pass through en route to cerebrum

Cerebrum

- **Occipital lobe**
  - Visual images
- **Parietal lobe**
  - Proprioceptive messages
  - Tactile messages
- **Temporal**
  - Hearing
  - Refining vestibular sensations
  - Memory
- Frontal
  - Voluntary body movements
  - Prefrontal

Who it effects

- 12-30% of all children
  - Some type
- 70% of children with learning disorders
  - Autism
  - ADHD
  - Premature infants
  - Anxiety
  - Head trauma
- Commonly seen in boys
  - 80%

Possible Causes

- Genetics
- Prenatal circumstances
- Prematurity
- Birth trauma
- Postnatal circumstances

Treatments

- Occupational Therapy
- Speech and Language Therapy
- Auditory Integration Therapy
- Vision Therapy
- Psychotherapy
  - Deal with effects of SID, not causes

Guiding Principles of Sensory Integration

- **Sensation is Essential**
- **Humans depend upon sensation to experience their world, to achieve comfort, and to learn skills**

Body Awareness Guiding Principles

- Beginning very early in life the senses of touch, movement and gravity provide information about one's body and its relationship to the environment and others.

Active Exploration Guiding Principles

- Early experiences lay the groundwork for complex sensory perceptions that integrate sights and sounds with the feelings that come from the body.

Novelty Guiding Principles

- Doing something new and doing familiar things in new ways are essential for successful interactions

  …adapting to challenges leads to new skills and success

Most Commonly Known Senses

- Vision
- Hearing
- Smell
- Taste
- Touch

Less Familiar Senses

- Proprioception
- Vestibular

Understanding the Sense of Touch

- **Tactile sensations** allow a child to feel

the shape, size and location of things

- Touch is essential for interacting intimately and comfortably with people and things in the environment

The Tactile Sense Affects Everyday Skills

- Recognize physical properties of objects without vision
- Body awareness helps us move purposefully and easily
- Motor planning allows us to execute new movement sequences
- Academic learning often requires hands-on manipulation
- Touching and being touched impacts social skills

Understanding the Sense of Position

- Knowledge about how and where the body is moving is gained through the proprioceptors, the sensory receptors in the muscles, tendons, and joints.

Proprioception

- Unconscious awareness of sensations coming from one's joints, muscles, tendons, and ligaments.
- Tells the brain when and how the muscles are contracting and stretching and how joints are bending, extending, being pulled, or compressed
- Deep pressure and joint compression/stretch are organizing

Proprioceptive Information Supports

Strength & endurance

Graded force and direction of movements without running into things or breaking something

Using appropriate force with hand grip or grasp

Gross motor coordination

Vestibular Sense

- Detects the pull of gravity and movements of the head, as well as the body moving through space.
- Helps us coordinate movement of our eyes, our head, and our bodies.
- Supports “extensor” tone-

  holding body up against gravity
- Helps us know up/down; right/left

Vestibular Information Supports

muscle tone

eye hand body coordination

balance & equilibrium

sitting still and upright

attention

speech & language

Tactile Information Supports

Attachment/Affection

Eating/feeding

Refined touch during fine motor activities

Exploration of environments

Attention

Hygiene/toileting

“ The integration of sensory input is necessary for a child to achieve a coherent percept and to plan and coordinate action”

- Iarocci & McDonald, p.81

Sensory Motor Interactions

- The core concepts of sensory integration include an understanding of how sensation and motor functions develop and work in tandem

Input/Ouput

Sensory Input ➔Brain ➔Adapted Response

Sensory Integration/Sensory Processing

Register sensory information through the nervous system

The brain modulates and interprets the input and organizes a response

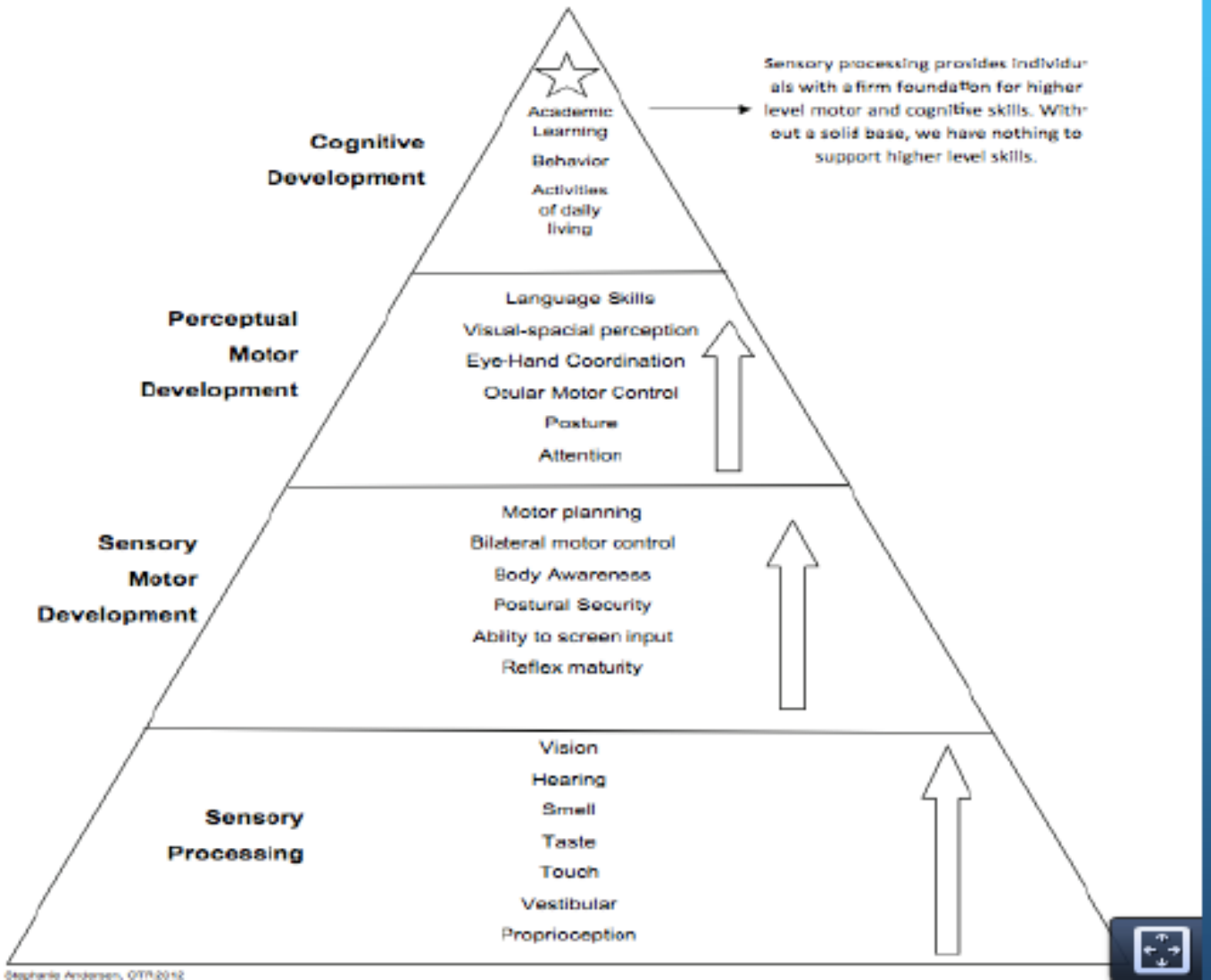
Person responds with an action, an emotion or a behavior

Steps to Sensory Integration (SI)

1. Registration -become aware of sensory input
2. Orientation -brain decides how to pay attention to input through modulation
3. Interpretation -brain decides the quality of the input
4. Organization of a response -is a response necessary; physical emotional, cognitive?
5. Execution of a response -an action results, physical, emotional, cognitive

The Sensory Processing Pyramid

Why is Sensory Processing Important?



Sensory processing provides individuals with a firm foundation for higher level motor and cognitive skills. Without a solid base, we have nothing to support higher level skills.

Stephanie Andersen, OTR/2012

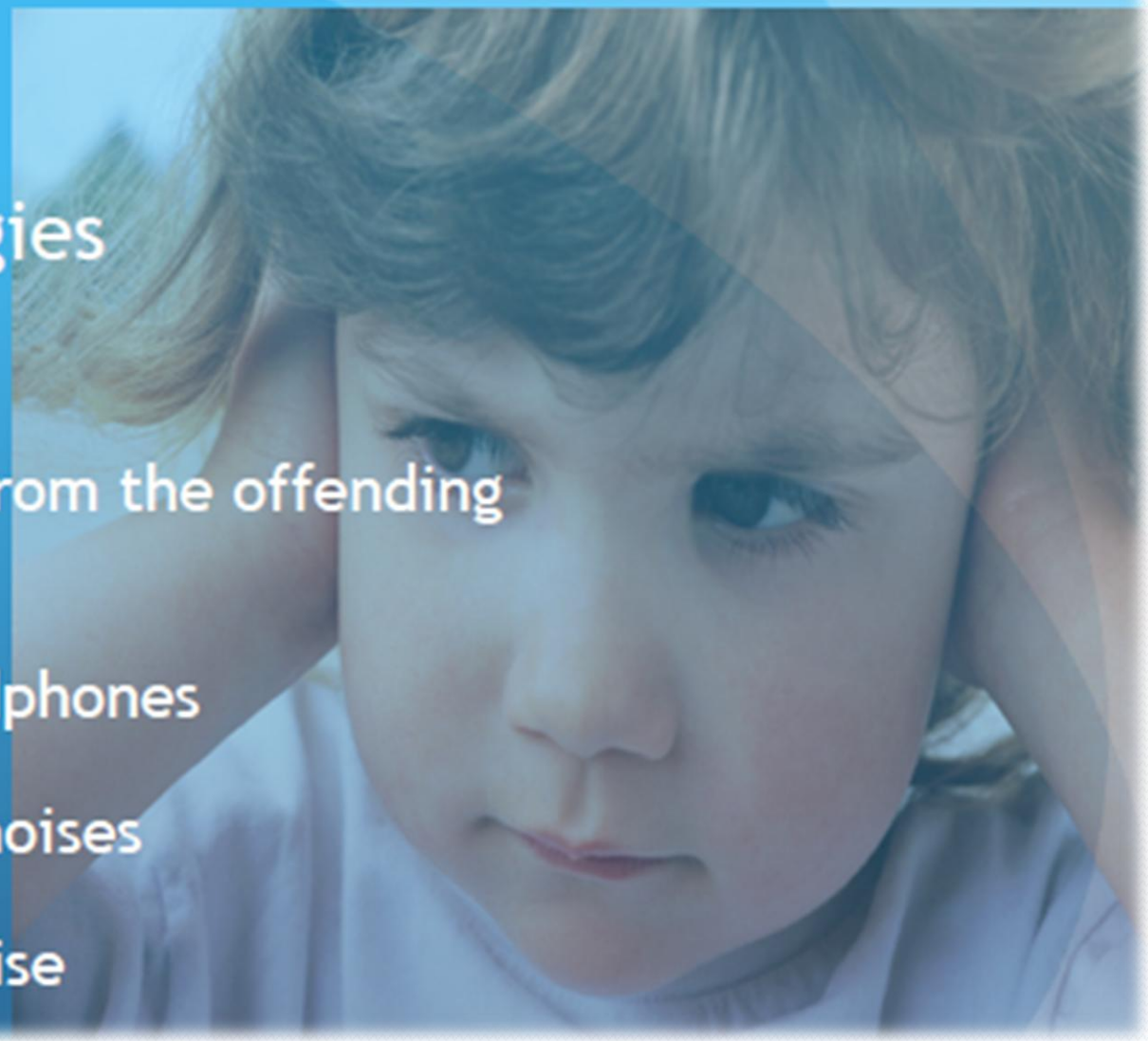
Some Ways Sensory Intervention Can Improve Learning

- Improve ability to attend; decrease distractibility
- Improve alertness level
- self regulation of emotions and behavior
- decrease anxiety
- increase social interaction
- improve play skills

How Does a Therapist Assess Sensory Integration Deficits?

- Standardized tests such as the Sensory Integration and Praxis Tests (SIPT)
- Parent and Teacher questionnaires
- Observations of the child in various settings
- Ongoing assessments and re-evaluations

Sound
Adaptive Strategies



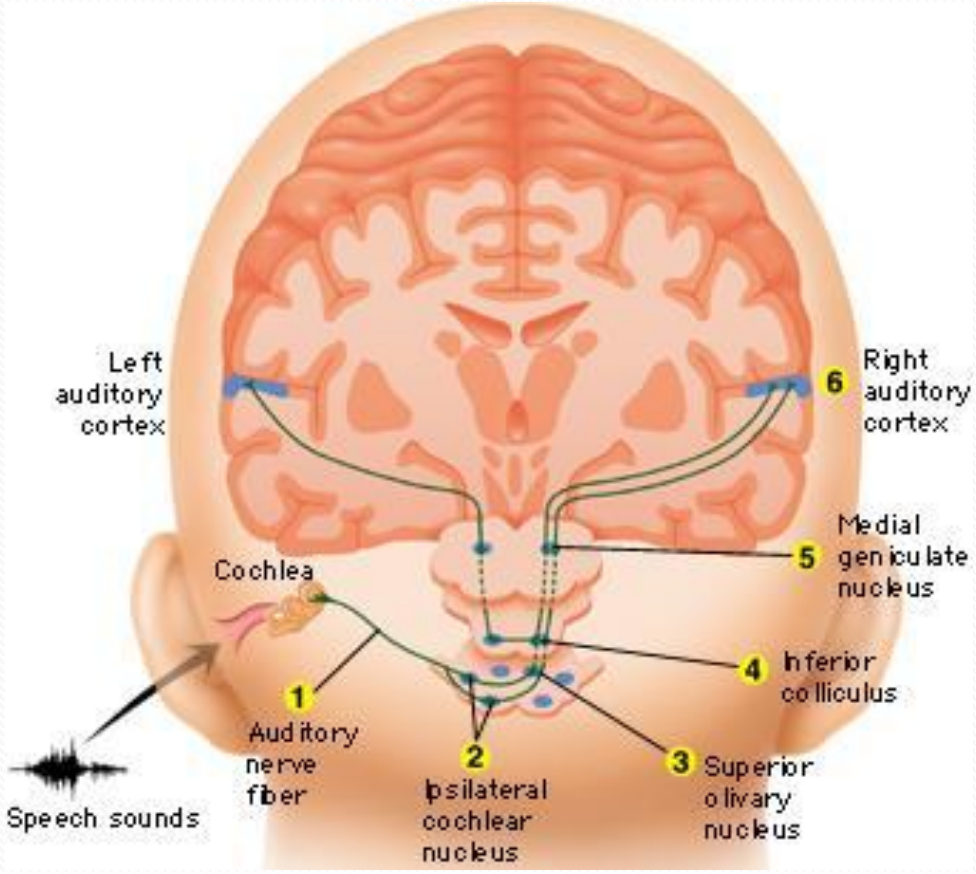
- Move the person away from the offending sound
- Offer earplugs and headphones
- Reduce environmental noises
- Background or white noise

FROM EAR TO BRAIN

- The ear contains three main parts**: the outer, middle, and inner ear**.

  - **Reflections of the sound** wave within the folds
  - **amplify** certain sounds
  - **converts** liquid-borne sound into neural impulses

  There **are four or five synapses** in the auditory pathway



“What” versus “where”

- there is **some degree of specialization** for “what” versus “where.”
- Rauschecker and Tian (2000) found that neural responses in the **anterior belt region** showed a high degree of specialization for monkey calls (irrespective of their location), whereas the **posterior belt region** showed greatest spatial selectivity

➢ **a dorsal route** involving the **parietal lobes** that is concerned with **locating sounds**.

➢ **a ventral route** along the **temporal lobes** concerned with **identifying sounds**

Oral/Taste

Adaptive Strategies

Picky Eaters

- Rewards for trying new foods
- Follow a new food with a preferred food
- Provide foods of the same consistency
- Provide foods of the preferred temperature

Alerting

- Sour, bitter and spicy foods

Calming

- Sweet and Bland foods

Signs and Symptoms of SI Disorder

- Speech and Language
  - Speech & Language development require the integration of auditory and visual stimuli, motor planning, knowledge of the body in space, and tactile input of the articulators
  - All sensory systems interact with each other to provide information that contributes to increasingly complex skills
  - If a child has difficulties integrating sensory experiences into meaningful outcomes, speech and language will be impacted

Signs and Symptoms of SI Disorder

- Speech and Language
  - From *Sensory Integration and the Child*:
    - "A delay in language development is a common problem and an early clue that all is not well in the brain. Some children do not listen well, although they do not have a hearing problem; it is as though the words entered their ears but got lost on their way through the brain. Other children know what they want to say but cannot direct their mouths to form the words."
  - Speech and language are an end product of adequate sensory integration, but are often one of the first noticed difficulties. Presentation may include:
    - Inconsistent response when spoken to
    - Imitation difficulties
    - Difficulty with appropriate social referencing
    - Difficulty learning in groups or contributing to group discussions
    - Difficulty with speech motor planning

The Sensory Systems

- Speech is a fine motor activity
  - Proprioception is crucial for fine motor coordination
  - The vestibular system works together with visual, auditory, and tactile systems to make interactions with our environment meaningful
- Therefore, if the sensory systems are impacted, how can we expect a child to make meaningful gains in a speech therapy session if he/she cannot regulate sensory input?

SLP's role in ASI Therapy

- What does this mean for speech-language pathologists?
  - First stop: look at child's occupational therapy report, or ask parents if there has been an occupational therapy evaluation
  - Look for a section detailing the child's sensory processing
    - This may or may not be in line with Ayres Sensory Integration, but something is better than nothing!
    - Take notes on the child's response to tactile, proprioceptive, and vestibular processing.
      - Are they over or under-responsive to tactile or vestibular?
      - Do they frequently use proprioceptive input for regulation (e.g., crashing, jumping, climbing?). If so, *what are they using proprioception to help regulate?*

SLP's role in ASI Therapy

- Try to contact the Occupational Therapist. They tend to be excited about using sensory integration in speech sessions and therefore open to collaboration.
- Questions to ask:
  - What sensory experiences help the child reach the optimal band of arousal?
  - What sensory experiences throw a child out of the optimal band of arousal?
  - Do you notice increased social engagement/functional communication with any particular sensory experiences/activities?

SLP's role in ASI Therapy

- When a child with SI difficulties walks into your room, the first observation to make is whether he/she is high arousal, low arousal, or already in the optimal band.
- High arousal may look like
  - Running/walking with heavy steps in the room
  - Attempted large movements in the chair
    - Spinning side to side
    - Kicking/moving legs
    - Suddenly standing up and jumping
- Low arousal may look like
  - Trouble sitting up (laying head on the desk)
  - Spinning/shaking head
  - Stomps when walking, pushes against objects/people
  - May seek out deep touch pressure
  - Attempts to spin, run, swing, or jump

SLP's role in ASI Therapy

High Arousal

- What is causing their arousal level to be (or appear to be) above the optimal band?
  - Hyporesponsive to vestibular
    - Behaviors include two opposites: sensation seeking (high arousal) vs low exploratory (low arousal)

Therapeutic Interventions	Therapeutic Interventions ctd.	Home Strategies
- Provide increased opportunities for movement - Decrease amount of time child is expected to sit still	- Use swings (within clinic or on playground), pausing movement to facilitate adaptive response - No swings? Try rotating desk chair on wheels, moving child on exercise ball, nystagmus board, sit & spin, etc.	- Take to the park to swing before long periods of structured activities - Sit & spin - Desk chairs that spin - Be sure to spin both ways in an equal and opposite manner

SLP's role in ASI Therapy

High Arousal

- What is causing their arousal level to be (or appear to be) above the optimal band?
  - Hyperresponsive to tactile

Therapeutic Interventions	Therapeutic Interventions Ctd.	Home
- Do not use light touch - Incorporate deep pressure and proprioceptive input into activities - Reduce sensory overload in the environment - Dim lights - Soothing sounds - Slow rocking	- Deep touch pressure (squishing in pillows, squeezes) - Heavy work w/ prop resistance (carrying heavy books, setting up equipment for obstacle course, pushing desks around) - Sucking/chewing	- If having a meltdown, try deep pressure under pillows - Lots of heavy work: lifting things, pushing things, etc. - Sucking/chewing: pudding through a straw, chewy tube, gum - Environmental modifications: dim lights, quiet time

SLP's role in ASI Therapy

High Arousal

- What is causing their arousal level to be (or appear to be) above the optimal band?
  - Using proprioception to modulate

Therapeutic Intervention	Therapeutic Intervention Ctd.	Home Strategies
- Give them more prop, combined with eliciting adaptive responses (e.g. functional communication)	- Make "sensory seeking" into appropriate behaviors (jumping to different colors, words, target phonemes/ phrases) - Encourage climbing/jumping/crashing in an organized way (e.g., a sequential obstacle course or as part of a game)	* Let child play outside before expected to participate in structured activities • Jumping on trampoline/bed • Heavy work: unloading groceries, carrying items up stairs, etc.

SLP's role in ASI Therapy

Low Arousal

- What is causing their arousal level to be (or appear to be) below the optimal band?
  - Hyporesponsive to tactile/proprioception (poor praxis)

Therapeutic Intervention	Therapeutic Intervention Ctd.	Home Strategies
•Encourage exploration of a variety of textures to improve discrimination, while providing input via vestibular/proprioceptive systems to increase arousal	- Light moving tactile input - Strong tastes or smells - Irregular/intense vestibular but be careful not to push the child out of optimal band - Use a variety of textured materials (wet/dry, smooth/rough, shaving cream, play dough, theraputty, etc.) - Vibration - Lots of prop: tug of war, heavy work - Bouncing on exercise ball	•Encourage messy play! •Use electric toothbrush to provide more input in the oral area •Jumping on trampoline/bed

SLP's role in ASI Therapy

Low Arousal

- What is causing their arousal level to be (or appear to be) below the optimal band?
  - Hyporesponsive to vestibular

Therapeutic Interventions	Therapeutic Interventions Ctd.	Home Strategies
- Need lots of movement, but may not be motivated to move	- Give rotary/orbital vestibular input and check for adaptive response - Irregular/intense vestibular - Couple vestibular with proprioception (e.g., pumping swing)	• Use swing set or park often • Sit & spin

The motor theory of speech perception

- speech perception involves matching an infinitely varying acoustic signal to a finite number of stored representations in the brain.
- One possibility is that the auditory signal is matched on to motor representations for producing one's own speech rather than matching to an acoustic template. **This is the motor theory of speech perception** (Liberman & Mattingly, 1985; Liberman & Whalen, 2000).

mirror neurons in the premotor and inferior frontal cortices (including parts of Broca's area) These neurons respond when the subject makes a gesture (e.g. a movement of the hands or mouth)

they have motor properties, but they can also respond to the sight and sound of gestures in other people, **so they have perceptual properties too** (Rizzolatti & Craighero, 2004).

Reference

Sensory Integration & the Child by A. Jean Ayres

Sensory Integration: Answers for Parents

Sensory Integration: Answers for Teachers

Sensory Integration: Answers about Autism

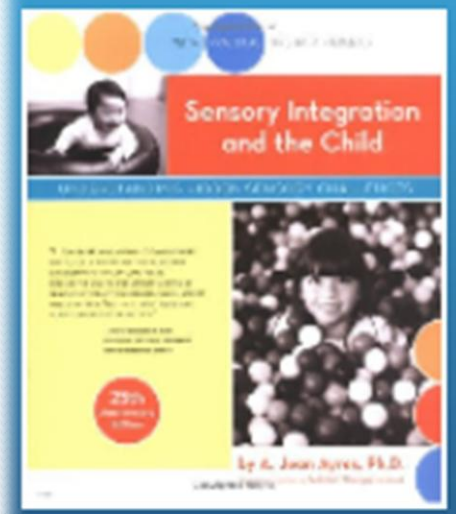
Sensory Integration: Answers for Mealtime Success

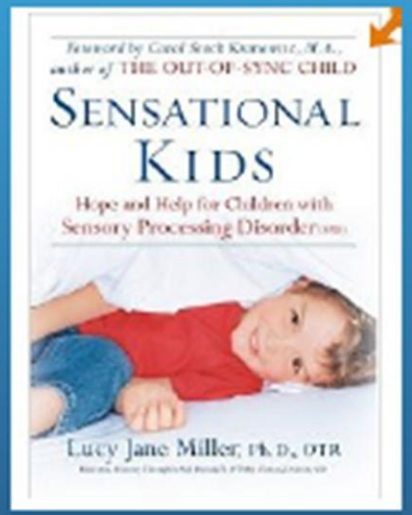
Applying Sensory Integration Principles Where Children Live, Learn & Play (DVD)

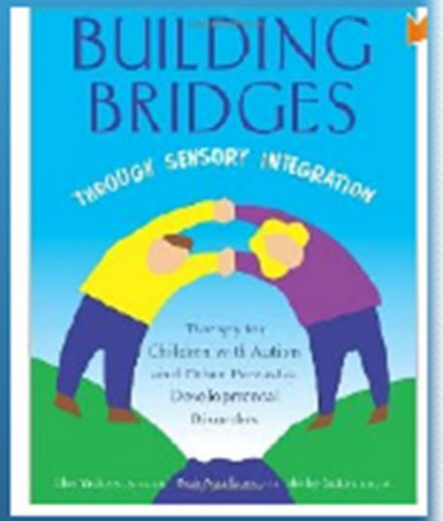
www.pediatrictherapynetwork.org

Ruzzano, S., Smith Roley, S., & Mailloux, Z. (2003). *Applying Sensory Integration Where Children Live, Learn, and Play (DVD).* Torrance, CA: Pediatric Therapy Network

My Resources







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