Sensory System in Action: Defining and Debunking Myths
Gina Freeman, OTR

Ayres Sensory Integration
Defined by Jean Ayres, PhD, “Sensory integration is the organization of sensation for use. Our senses give us information about the physical coordination of our body and the environment around us.”

Sensory Integration
- Jean Ayres goes on to describe our brain as directing traffic, the brain organizes all sensations received to move, learn and behave normally. Sensation nourishes the brain giving it the information it needs to direct the body and mind.
- Sensory Integration, “puts it all together, gives meaning, takes parts to whole and back again.”

The Whole Picture

Sensory Integration
- Peel an orange
- HMMMMM
- Smell the orange
- Feel the orange
- Know its an orange
- Move your fingers
- Coordinate your hands
- Enjoy

Basic neuro structure
- Sensations are received by the brain as electrical impulses, they travel through the nervous system through biochemicals. Information is received, responded to and integrated at various levels of our nervous system and eventually perceived and given meaning to by the brain’s cortex. The cortex then responds and we interact with the world.
Sensory integration begins in utero as the baby feels, floats, hears and responds with movement.

Sensory integration continues exponentially during birthing process and first year of life.

Sensory integration continues to drive the child’s movement, play, and interaction with the world.

Sensory integration and Play

- When the sensory integration capacity of the brain is sufficient to meet the demands of the environment the child displays beautiful adapted responses and efficient, creative, satisfying results.
- The child plays and has fun!!
- The child intrinsically continues in play with curiosity, intrigue, exploration and motivation to continue.

Development continued

- When the child’s responses are purposeful, goal directed and successful, following sensory experiences, development occurs in a very positive adapted way.
- The foundation is set – sensory perception touch, movement, hearing, vision, taste and smell.
- Then Response – movement, cognition/meaning, environment and social interaction.

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Senses

Visual
Auditory
Tactile
Taste and Smell
Vestibular
Proprioceptive

THE SENSES

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SENSES

- Visual
  Our visual system registers what we see, discriminates objects detail, color, and light, and our nervous system coordinates and gives meaning to this information.
- Auditory
  Our auditory system registers sound and our nervous system provides meaning to what we hear. The auditory system warns us of danger such as a dog barking or car horn beeping. It helps us understand the space we are in.
**Taste** – registers sweet, sour, bitter, and salty tastes through the receptors of the tongue

**Smell** – registers smells from the environment and warns of dangers such as smoke.

The sense of touch provides information about our body in relationship to the environment. The tactile system has discriminative, protective, and emotional functions.

- Protective touch allows us to respond with alert or guarding
- Discriminative touch informs us about texture, size, shape and feel of an object.
- Important contributor of body schema which is important for praxis and motor planning.

The proprioceptive sense determines the limb’s position in space from active movement, stretch or tension of the muscles, joints and tendons of the body.

- Helps the body determine the amount of force and pressure needed in order to grade movements and perform activities.
- Responsible for providing the child with a sense of body awareness, important for praxis and motor planning

The vestibular system refers to our sense of balance and movement.

- It coordinates the movement of our eyes, head and body and informs us where our body is in relation to gravity; for example, whether our head is upright or tilted. It tells us if we are moving straight or spinning.

**Neurophysiology**

- Touch, pain, temperature, pressure
- Receptors – mechanoreceptors
- Pathways – spinothalamic tract, dorsal column medial lemniscal tract, trigeminothalamic tract, spinocerebellar tract
- Influences the output from the motor and premotor cortex
**Proprioceptive System**

- Includes concepts of proprioception and kinesthesia including the afferent information that comes from movement
  - Receptors – muscle spindles, golgi tendon organ, joint receptors
  - Pathways – Connection to Somatosensory cortex integrating through vestibular nuclei and thalamas for body mapping
  - Pathways – to the Cerebellum for posture, balance
  - Pathways – With the tactile system through dorsal column medial lemniscal pathway to thalamus and somatosensory cortex

**Vestibular System**

- Orientation in 3 dimensional space, modification of muscle tone, balance
  - Receptors – utricle/saccule – gravity receptor, head position in space, changes to gravity, linear acceleration
  - Pathways – vestibular ganglion, vestibular nuclei, vestibulo-ocular, vestibulo–cerebellar
  - Connection through vestibular nuclei and thalamus to sensory area of cortex for body mapping and body position then to motor output

**Oral Sensory Perception**

**Tactile/prop**

1. Cranial nerves
2. Trigeminal nucleus and others in midbrain
3. Thalamus
4. Somatosensory areas of cortex mostly in the parietal lobe
5. Motor and cognitive outputs

**Modulation**

- Maintaining attention, appropriate arousal, body homeostasis
  - Reticular formation
  - Limbic system
  - Autonomic Nervous system

**ASI Theory Base**

- ASI theory is based on principles of child development and neurophysiology
- ASI theory is defined by the fidelity measure and applied using the data driven decision making process for clinical reasoning
- ASI theory emphasizes assessment data to create a hypothesis for treatment based on patterns of sensory dysfunction and patterns of sensory dysfunction in autism
- ASI has growing evidence to support it

**Fidelity Measure**

- The fidelity measure is a manualized protocol (Schaaf et. al. 2010) that provides structured 10 step guide through assessment and intervention in Ayres Sensory Integration Theory. The measure provides a score of the treatment process out of a possible 100 indicating adherence to the Ayres SI intervention.
Assessment and Data Driven Decision Making

- “DDDM provides a framework for reasoning through the occupational therapy process with a focus on utilization of assessment data to guide intervention and outcome measurement” (Schaaf, 2015)

Steps in Data Driven Decision Making

- Identifying the Child’s strengths and participation challenges
- Conducting the comprehensive assessment
- Generating a hypothesis
- Developing and scaling goals
- Identifying outcome measures
- Setting the stage for intervention
- Conducting the intervention
- Measuring outcomes and monitoring progress

Assessments in Sensory Integration

- History and Occupational profile
- Sensory Integration and Praxis Test
- EASI
- Sensory Processing Measure
- Sensory Profile
- MFUN

Patterns of sensory dysfunction

- Problems in Vestibular bilateral integration
- Problems in somatopraxis
- Problems in visuopraxis
- Praxis & motor related functions
- Problems in Sensory reactivity

Patterns of Sensory Dysfunction in Autism

- The 2015 study by Roley et al. found that using a sample of 89 SIPT tests of children with Autism and supporting information from the Sensory Processing Measure the following areas of difficulty were found:
  - imitation praxis
  - vestibular bilateral dysfunction
  - somatosensory perception
  - sensory reactivity
  - The study found strengths in visual perception and visual construction
  - Noteworthy lowest scores fell in standing and walking balance reflecting difficulty with vestibular related issues and postural control

Evidence

Three small but rigorous RCT’s showed that OT using SI principles with children with autism had positive outcomes

- Iwanaga et al., 2014
- Pfeffer, Koenig, Kinnealey, Sheppard & Henderson, 2011
- Schaaf et al., 2014

Schaaf et al. (2014) found that children who received 30 sessions of OT using ASI scored significantly higher on goal attainment scales and scored significantly better on measures of caregiver assistance in self-care and socialization than the control group using the Pediatric Evaluation of Disability Inventory.
Schaaf et al. 2012 presents a case study using Ayres SI with a child with autism demonstrating the application of the fidelity measure and the DDDM process and improves child’s participation in areas of sleep, play, dressing and safety in community using outcomes of goal attainment scaling, improves on SIPT and SEQ and achieved fidelity rating of 95.5/100.

Faller et al. 2016 presents a case study using the Data Driven Decision Making process with a child with Autism. The DDDM used a systematic process for assessment using SIPT and Sensory Profile. The hypothesis derived dysfunction in sensory seeking behavior, somatosensory perception and praxis. The intervention followed the fidelity measure. The child gained participation in sleep, play, self care and community integration measured by goal attainment scaling and the PEDI (pediatric evaluation of disability inventory).

Sensory Perception and Behavior

Things to think about:
- Sensation drives movement
- Sensation drives responses
- Responses are behaviors
- So, can you disassociate them

Understanding the Lingo

- Sensory
- Sensory diet
- Sensory modulation vs self regulation
- Sensory reactivity
- Proprioception and kinesthesia
- Vestibular
- Praxis and motor learning
- Adapted responses
- Just right challenge

Myths and facts

- Sensory diets
- Sensory profile information
- Passive input vs active input
- Reactivity vs perception
- The chicken or the egg – sensation drives response
- Measurement of change

Commonalities in OT using ASI and ABA

- Structured assessment and observations
- Using standardized tools for measurement of child’s responses
- Understanding importance of using environment to enhance function
- Understanding importance of integrating into the child’s role, family structure and home and community
- Unified goal to improve children with autism’s ability to interact and participate in their day to day tasks
Share assessment data and observations
Share observed participation areas of dysfunction
Share hypothesis as to physiological root cause of the participation dysfunction
Consider environmental enhancements to improve participation
Consider strategies that provide organizing sensory experiences
Consider strategies that provide organizing responses or behaviors


Ayres Sensory Integration is a defined, measurable, manualized approach, based on neurophysiology with a growing body of evidence to be used during occupational therapy for children with Autism. Defining the terms and concepts within the approach and the neurophysiology behind it increases the understanding of its use across medical practitioners. The approach uses the fidelity measure and the Data Driven Decision Making process to drive the clinician through assessment and clinically reasoned treatment development.

"Sensory Integration organizes sensation from one’s own body and from the environment and makes it possible to use the body effectively within the environment." A. Jean Ayres. Literature review indicates children with Autism show dysfunction in many aspects of sensory integration. The body of evidence supporting using ASI to improve participation areas in children with Autism is emerging. Partnerships across therapy disciplines and shared theories and evidence will continue to improve the function of children with Autism.

References


Abstract

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