

Definition

Sensory Integration

- The neurological process that organizes sensation from one's own body and the environment and makes it possible to use the body effectively within the environment (Ayres, 1972)

Sensory Processing

- The process of sensation detection and transmission through the central nervous system (Ayres, 1979)

Sensory Modulation

- Ability to monitor and regulate information in the interest of generating an appropriate response to particular stimuli (Dunn, 1997)



Addressing Sensory Integration and Sensory Processing Disorders Across the lifespan

- Deficits in sensory integration can pose challenges in performing Activities of Daily Living (ADL) in addition to development, learning, playing, working, socializing and exhibiting appropriate behavior.
- Without intervention, issues in sensory integration continue into adulthood and have reported to impact work performance, relationships and general functional abilities
- Therapists with advanced training in Sensory Integration are able to provide intervention that targets the underlying neurobiological processes involved in sensory processing



Identify and modify sensory and environmental barriers

- Entry-level therapists are able to address the immediate impact of sensory processing dysfunction on daily activities and behavior
- Collaborate with families and other professionals to determine the need for evaluation and intervention
- Modifications to the home and classroom environments may be recommended to assist children with participating in daily routines
- Adults of all ages with sensory processing disorders may benefit from support with identifying their sensory needs, address coping skills and modifications to promote engagement



Ayres® Sensory Integration (ASI)

- ASI is deeply rooted in systematic and methodical measurements and was the first theory for clinical application in occupational therapy.
- Beginning in the 1950s with research. Dr. Ayres discovered the role of sensory systems, tactile, proprioceptive and vestibular senses, which had not previously been commonly identified as factors in explaining function and dysfunction.
- Concepts that have now continued to develop, aiming toward "a powerful recognized science driven and evidence-based model."

(Pfeiffer, Koenig, Kinnealey, Sheppard & Henderson, 2011; Schaaf, Hunt & Benevides, 2012; Schaaf, Benevides, Kelly, Matloux-Maggio, 2012)



Evolution of a theory

- Ayres studied patterns of sensory integration in children with learning and other developmental concerns.
- She also measured efficacy of intervention
- "Improving academic scores through sensory integration" (Ayres, 1972) RCT showed significantly improved scores on achievement tests in comparison with matched group.
- Recent RCTs by Pfeiffer et al, 2011 and Schaaf et al. 2013 have demonstrated advancements made since Ayres early study but have also reflected a common foundation of theoretical constructs and outcomes focused in improved participation.



Understanding ASI

- Recent decades have seen substantial growth in the body of knowledge around ASI.
- Sensory Processing Disorders affects 5-16% of children in the general population. That is more than 1 child in every classroom. Typically these children are misunderstood.
- Instead assumptions is made that the child has “bad behavior”
- Neuro-anatomic studies have clearly demonstrated that various symptoms of ADHD and SPD are results of abnormalities in large-scale brain networks.



Learning objectives

- After this seminar you should be able:
 1. Recognize the sensory system
 2. Recognize why the term Ayres Sensory Integration (ASI) is trademarked
 3. Identify the core concepts of ASI in relation to typical development, patterns of sensory integration dysfunction and principles of intervention
 4. Learn about the Alert Program (AP) – understanding the basic theory of sensory integration related to arousal states



Terminology

- *Sensory Integration* – a theory and frame of reference and a process related to multimodal processing in the central nervous system.
- *Sensory integrative deficits*- may be identified through the use of standardized assessments, skilled observation
- *Sensory processing* – is a generic term used to describe the way in which sensation is detected and transmitted through the nervous system
- *Sensory-based strategies*- a variety of approaches that incorporate sensation for example, the Alert Program for self regulation, the Wilbarger approach etc. (not consistent with ASI)



Sensory Integration theory

- Sensory Integration is a framework first described by occupational therapist Jean Ayres, PhD, in the 1970s.
- It refers to the body's way of handling and processing sensory inputs from the environment.

A well-organized sensory system can integrate input from multiple sources (visual, auditory, proprioceptive, vestibular)

Ayres postulated that sensory integration dysfunction occurs when sensory neurons are not signaling or functioning efficiently, leading to deficits in development, and/or emotional regulation.



The hallmark of ASI is that it is done in the context of play

- Principles (examples 5/12):
- Intervention is delivered by a qualified professional
- The intervention plan is family centered and based on a complete evaluation in collaboration with significant persons in the clients life
- Therapy takes place in a safe environment that includes equipment that will provide vestibular, proprioceptive and tactile sensations
- Activities promote regulation of affect and alertness and provide the basis for attending to learning opportunities
- Intervention strategies provide the “just –right challenge”



Jean Ayres

- “Play is the work of children. Through play, children learn about themselves and the world around them. When all that they see, hear and feel makes sense to them, a process of sensory integration occurs”

- [Jean Ayres 1923-1988, California, USA](#)



Sensory inputs and end products of sensory integration

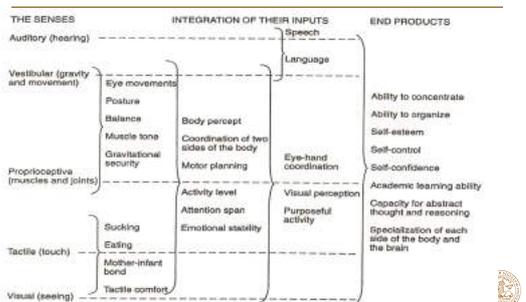


Figure 7.2 The senses, integration of their inputs, and their end products. Reprinted by permission of the publisher, Western Psychological Services, 12631 Wilshire Boulevard, Los Angeles, CA.



Sensory system

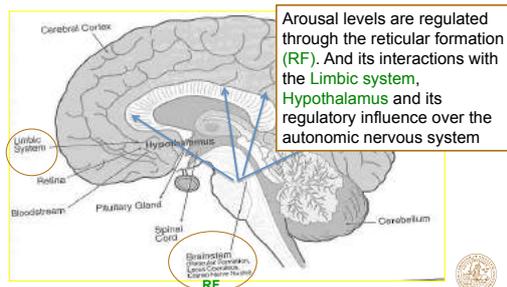
- A **sensory system** is part of the nervous system responsible for processing sensory information
- **Sensory system** is the gateway for all information to enter the brain
- A **sensory system** consists of sensory receptors, neuropathways and parts of the brain involved in sensory perception



Sensory receptors



Sensory processing



•Interoception - awareness of one's internal state (ie, hunger, tiredness, illness)

Exteroception - awareness of the world in relation to one's self: 'Distal' senses (sight, hearing, smell, taste, touch)

Proprioception - awareness of one's body in relation to the world (works with vestibular and tactile input): 'Proximal' senses - body scheme, movement, orientation

Sensory Processing Issues (Miller et al, 2007)

- **Sensory Modulation Disorder**
- Sensory Over-responding
- Sensory Under-responding
- Sensory Craving/Seeking
- **Sensory-Based Motor Disorder**
- Postural disorder
- Dyspraxia
- **Sensory Discrimination Disorder**
- Visual, Auditory, Olfactory, Gustatory, Vestibular, Proprioceptive, Tactile

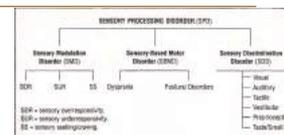
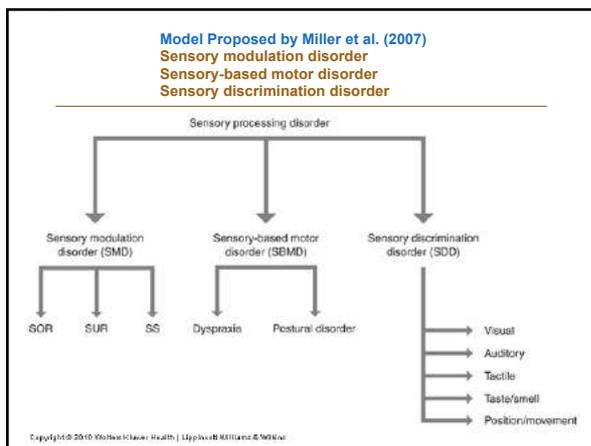


Figure 1. A proposed new taxonomy for sensory processing disorder.

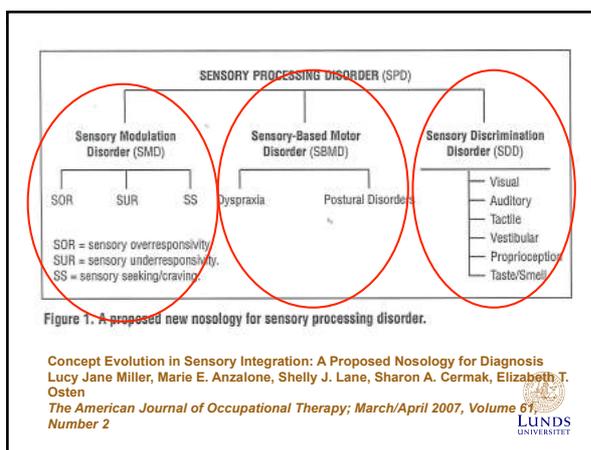




Lucy Miller



- SPD foundation www.spdfoundation.net
- Proposal to include Sensory Processing Disorder in DSM – V (2013). Results: “under review” for publication of DSM VI ~ 2022

Sensory Modulation

- The ability to **regulate and organize** the degree, intensity and nature of responses to sensory input in a graded and adaptive manner.
- Strongly influences arousal levels
- Allows people to maintain an optimal range of performance and to adapt to challenges in everyday life



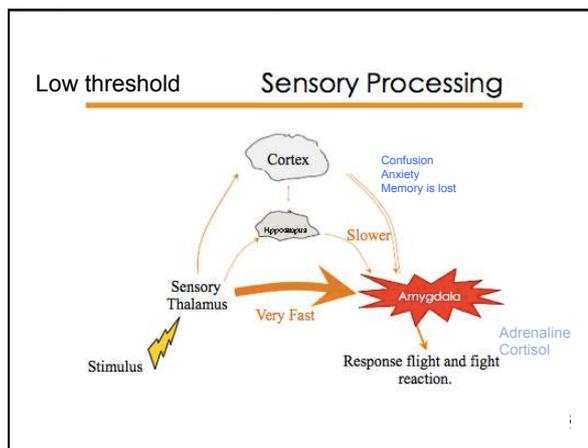
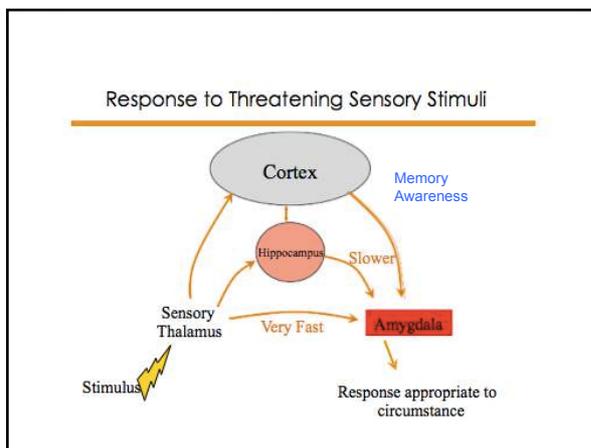
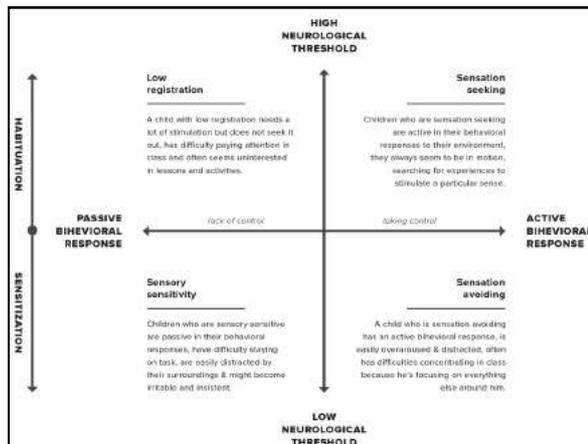
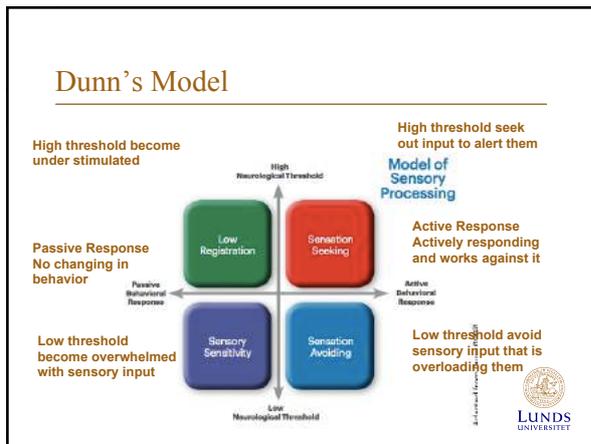
Two types of sensory processing disorder

- **Hyper-sensitive**
 - Low threshold for sensory input
 - Attend to all sensory input without filtering out non-essential
 - Input is too loud, too bright, too much!
 - Triggers high arousal, fight or flight
 - Causes stress
- **Hypo-sensitive**
 - High threshold for sensory input
 - Misses essential sensory input or requires more input to stay alert
 - Input is not enough to satisfy the body’s need
 - Triggers low arousal or sometimes seeking behavior in attempt to stay alert.



Low Neurological Threshold for Sensory Input

High Neurological Threshold for Sensory Input



SYMPATHETIC NERVOUS SYSTEM

- Heart rate increases
- Liver releases glucose
- Bronchioles are dilated
- Pupils dilate
- Adrenal glands secrete epinephrine and norepinephrine
- Digestion is inhibited
- Bladder is relaxed

Study.com

Sympathetic nervous system
Its general action is to mobilize the body's flight-or-flight response. Increases contractions, heart rate

Parasympathetic nervous system
Its general function is to control homeostasis and the body's rest and digest response. Decreases heart rate. Muscles relax

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Central Nervous System

Parasympathetic: Rest, Digest & Bond

Sympathetic: Fight, Flight & Freeze

Associated with:

- Receptivity
- Slowness
- Relaxation
- Scope
- Divergent thinking
- Process-oriented
- Presence
- Elaboration

Associated with:

- Activity
- Speed
- Tension
- Focus
- Convergent thinking
- Goal-oriented
- Agency
- Direction

Central Nervous System

Brain

Parasympathetic Division

Sympathetic Division

Contracts pupil

Dilates pupil

Stimulates tear glands

No effect on tear glands

Strong stimulation of salivary flow

Weak stimulation of salivary flow

Inhibits heart, dilates arterioles

Accelerates heart, constricts arterioles

Contracts bronchi

Dilates bronchi

Stimulates stomach motility and secretion, stimulates pancreas

Inhibits stomach motility and secretion, inhibits pancreas and adrenals

Stimulates intestinal motility

Inhibits intestinal motility

Contracts bladder

Relaxes bladder

Stimulates erection

Stimulates ejaculation

Spinal cord

LUNDS UNIVERSITET

The senses and Emotion

- Our senses can be used to help us
- relax / calm down
- be more alert / energised
- be in tune with our body and the world
- feel more organized
- Sensory preferences are individual, what calms some may irritate others.

Sensory input is especially helpful when our ability to think clearly is impaired (ie. when we are upset, distracted, stressed or ill).



The Powerhouses for calming

Tactile, vestibular and proprioceptive functions are the building blocks for emotional stability.

Touching and being touched is central to

- Sucking, eating, comfort & security
- Emotional attachment from bodily contact

Vestibular & proprioceptive input is essential for

- Development of eye movements
- Postural control
- Awareness of where body is in space



Characteristics of calming and Alerting sensations

Calming	Alerting
Slow	Quick paced
Simple	Complex
Soothing/relaxing	Irritating
Soft/mild intensity	High intensity
Rhythmic	Non-rhythmic
Positive association	Negative associations
Predictable	Unpredictable
Familiar	Novel



Proprioceptive input

- Receptors in muscles, tendons, ligaments, joints
- Sense of:
 - Where the various parts of the body are located in relation to each other
 - Whether the body is moving with required force



Proprioceptive input

Calming	Alerting
Isometric muscle contraction	Fast movement
Movement against resistance	Running
Heavy work- digging, sweeping	Jumping
Climbing – push-pull activities	Aerobics
Hiking, walking	Dancing
Exercise bands and equipment	
Stress ball – squeezing	
Weighted blankets	
Clay work / putty	
Kneading dough	
Yoga, Tai chi, Haka	



Vestibular inputs contributes to:

- Sense of body position in space
- Sense of acceleration/deceleration
- Posture and muscle tone
- Maintaining a stable visual field
- Balance
- Bilateral coordination



• <https://www.youtube.com/watch?v=pEblHuc1Pc>



Vestibular

Calming	Alerting
Linear input	Sudden acceleration / deceleration
Slow rhythmic movement	Angled movements
Rocking (slowly)	Spinning
Swaying	Uneven or unstable surface
Gliding	Rocking fast



Vestibuloocular reflex

Vestibulo-ocular reflex (VOR)

- Stabilize images on the retinas during head movement by producing eye movements in the direction opposite to head (in order to keep an object in focus)



Vestibulo-cervical

- Helps to maintain the head stable while moving, head righting
- Vestibular spinal reflex
- Maintains posture, keeps body upright



Touch

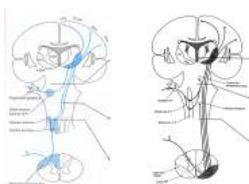
Skin - Light touch, pain, temperature (The spinothalamic tract)

Deep touch, vibration, stretch (Dorsal lateral tract)

Has protective and discrimination functions

Light touch is alerting – may provoke strong response

Deep touch is calming – slower and longer lasting input



Touch

Calming	Alerting
Deep pressure touch	Light touch
Strong hugs	Tickling
Firm touch on the shoulder	Light stroking
Massage	Unfamiliar or unexpected touch
Weighted blanket, vest, lap pad	Cool room
Squeezing a stress ball	Fiddling with a stress ball
Use of hand lotions	Snapping a rubber band on the wrist
Neutral warmth	Use of fidget items
Vibration	



Oral motor input

- Signals the vagus nerve to prepare to digest
- Supports sympathetic inhibition, thus dampening arousal and providing a calming effect
- Oral motor stimulation helps with comfort, attention and overall organisation



Oral motor

Calming	Alerting
Sucking thick liquid through straw	Crunching
Hard sweets	Yawning
Orange slices	popcorn
lollipops	pretzels
chewing	Raw vegetables
gum	Crunchy fruits and vegetables
Gummy bears	Crushed ice
Licorice sticks	Blowing
Dried fruits	Bubbles, pinwheel
	Abdominal breathing



Olfactory system

- Primitive, protective & powerful
- Directly connected to the limbic system
- Tastes that are generally pleasant and familiar
- Tastes such as mints, citrus and spice tend to be alerting



Smell

Calming	Alerting
Soothing, scented candles, vanilla	Citrus, peppermint
Lavender	Strong fragrances
Scented bath powder	Perfume
Pleasant smell	Noxious odour
Positive association	Room fragrance spray
	Negative associations



Taste

Calming	Alerting
Mild	Strong or spicy
Sweet	Sour or bitter
Lollipops	Lemon drop
Porridge and brown sugar	Strong peppermints
Apple juice, smoothie	Chili
Sweet fruits	Lemonade
Pleasant	Pickles

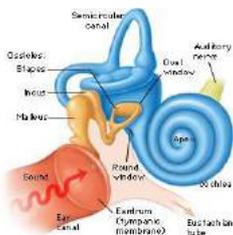


Auditory and Visual input

- Can help:
- Ease transition
- Reduce stress
- Increase organisation and directionality
- Provide distraction or a soothing focus
- Provide positive associations
- Affect muscle tone and equilibrium
- Affect biological rhythms (entrainment)



Hearing and arousal



- During fear, anger, rage, alarm (stress) muscles squeeze the ossicles together
- Under conditions of arousal we hear:
 - Low, rumbling noises
 - Sudden hi-pitched tones
 - Background sounds
- But not the human voice



Auditory

Calming	Alerting
Soft slow music	Offbeat, loud quick music
Classical or new age music	Whistling
Humming	Singing loudly
Simple melodic	Hand held instruments
Repetitive sounds, ocean waves	Rock music
Relax/meditation CD's	



Visual sensation

Calming	Alerting
Soft warm colors	Bright colors/ lights
Natural or dim lighting	Abstract art
Serene paintings	Complex visual images
Pleasant candle	Changing patterns of light
Fish aquarium	Video game
Bubble lamp	Sunshine
Clean and sparsely furnished room	Messy and cluttered room



Sensory Modulation intervention

- Sensory Modulation intervention uses the environment, activities and objects to help people regulate their physiological/ emotional arousal
- Identify individual sensory sensitivities and needs
- Provide education about sensory processing & arousal
- Identify individualised sensory strategies
- Build sensory strategies into crisis and recovery plans
- Use sensory strategies earlier rather than later
- Support self-management of arousal in daily life



Assesment

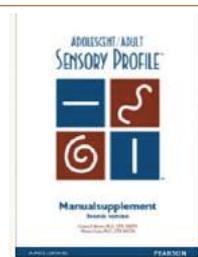
- Observation
- Interview
- Use interview, structured assessments and observation to help the client determine what their sensory system needs
- Sensory Profile
- SPM



Sensory-Focused Assessment

Sensory Profile (available from Pearson)

- Adolescent/Adult - 11 yrs plus (Dunn & Brown, 2004)
- Child - 3-14yrs (Dunn, 2012)
- Infant/Toddler - 0-3yrs (Dunn, 2012)



Sensory Processing Measure (SPM): Tweens, Teens, and Young Adults
 Diane Parham¹, PhD, OTR/L, FAOTA, Dana Henry², MS, OTR/L, FAOTA, Cheryl Eckel³, MA, OTR/L, Tara J. Gleason⁴, EdS, OTR/L, FAOTA, and Heather Miller Kuharek⁵, PhD, OTR/L, FAOTA

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Need for a Teen Assessment:

Adolescents, high schoolers and young adults have distinct sensory needs that may not be fully addressed by current assessment tools. The use of a purpose-built instrument can help identify the specific sensory processing needs of teens and young adults, which can then be used to inform intervention strategies.

Why Use Sensory Questionnaires with Teens?

Questionnaires provide a cost-effective, practical method for identifying sensory processing needs. They can be used in a variety of settings, including schools, clinics, and community centers. They also provide a standardized way to track progress over time.

TEEN CASE STUDY

17-year-old male with sensory processing difficulties. He experiences significant challenges with sensory input, including difficulty with transitions, changes in routine, and sensory overload. He also has difficulty with social interactions and maintaining attention in school.

Some Current Teen Assessment Tools:

Tool	Age Range	Format	Key Features
Sensory Profile 2	3-14 years	Parent/Teacher Report	Identifies sensory strengths and weaknesses
Sensory Processing Measure (SPM)	5-18 years	Self-report	Identifies sensory processing needs and provides intervention strategies
SPM-Preschool	3-5 years	Parent Report	Identifies sensory processing needs in young children

Process of Developing Teen Items:

- Identification of sensory processing needs in teens and young adults
- Development of a list of potential items to be included in the assessment
- Review of items by a panel of experts in the field of sensory processing
- Pilot testing of items with a group of teens and young adults
- Revision of items based on feedback from the pilot testing
- Final selection of items to be included in the assessment



Sensory Processing

- Difficulty tolerating or processing sensory information is a characteristic that may be seen in many developmental behavioral disorders, including autism spectrum disorders, attention-deficit/hyperactivity disorders, developmental coordination disorders and childhood anxiety disorders
- Studies have identified how sensory processes are disrupted in specific syndromes (autism, schizophrenia and early experience of deprivation)



Significantly more sensory-related behaviors than typically developing children

- Autism Spectrum Disorder (ASD) had more taste/smell sensitivity and sensory under-responsivity
- Sensory Modulation Disorder (SMD) had more atypical sensory seeking behavior
- Rates of sensory processing dysfunction may be as high as 45 - 90% in individuals with ASD
- Estimated to be 5% - 16% in the general population
- (Schoen, Miller, Brett-Green & Nielsen, 2009)



Sensory interventions

- Families report that these sensory difficulties create isolation, restrict participation in daily activities.
- Surveys in the USA report that over 60% of children with ASD receive some type of sensory intervention.
- ASI is an occupational therapy intervention that uses individually tailored sensory rich activities in a child-directed playful and interactive manner.
- A RCT showed children receiving ASI scored significantly higher improving in functional skills in daily life than the control group.
- (Schaaf & Case-Smith, 2014)



Common brain changes found in children with autism, ADHD and OCD

- Brain imaging of white matter in 200 children
- White matter is nerve fibers that connect cell bodies across the brain, enable communication between brain regions
- Impairments in white matter in the main tract connecting the right and left hemispheres of the brain
- This particular white matter tract, the corpus callosum, is the largest in the brain and among the first to develop
- This brain biology is linked to symptoms that occur in sensory processing, attention problems etc (Ameis et al., 2016)



New research shows how children with ADHD learn

- "Sit still and concentrate" is not useful
- The foot-tapping, leg-swinging and chair scooting are actually vital how they remember information and work out cognitive tasks (according Mark Rapport, University of central Florida)
- Facilitate their movement so they can maintain the level of alertness necessary for cognitive activities
- Therapy balls, exercise bikes, jumping, running etc.



Sensory Processing affect function

- If we receive false sensory information it completely changes our ability to respond and function
- All people need sensory input to function, but some people need assistance to use that sensory stimulation to promote function
- Need assistance to identify alertness level
- Select appropriate sensory stimulation to help affect alertness level
- Use sensory stimulation to focus and cope with daily challenges



Jean Ayres

- Adaptive Responses
- Brain inhibits or facilitates the flow of messages across nerve junctions and synapses
- The repeated use of nerve pathways in a sensorimotor function creates a neural memory or map of that function
- Our body uses sensory information to keep us alert or to comfort us when stressed



Intervention

- Occupational therapists use a sensory processing approach when identifying barriers that limit individuals ability to participate in everyday activities
- Limit overstimulating sensory input
- Provide stimulation that brings the person to a "just right" state of alertness and promote attention/focus



Alert Program (Williams & Shellenberger, 2012)

- Teach self awareness and self regulation
- "How does your engine run" a leader's guide introduces the *Alert Program* to occupational therapists, parents, teachers and other professionals
- *AP* promotes awareness of how we regulate our arousal state and encourages the use of sensorimotor strategies to manage our levels of alertness.
- *Alert Program* is an online course
- www.Alertprogram.com



AP is designed to:

- Teach children, parents, teachers how to recognize arousal states as they relate to attention, learning and behavior.
- Help children recognize and expand the number of self-regulation strategies they use in a variety of tasks and settings.
- Help parents and teachers understand that behavior may reflect both the current level of arousal and previous arousal states - "*Engine levels*"



Teach self-regulation

- By talking about your own engine.
- If your engine is in a low speed when you are trying to read a book, or it it goes up into a high speed when rushing or get to an appointment, share that with children/ adults.
- Empower children/adults to know what to do if their engines are in low gear and need to focus on learning a new math skill or if their engines are in high gear, what they can do to get ready to sleep at night.



What's all this talk about engines?

- By using engine analogy to teach self-regulation (changing how alert we feel) AP are helping children learn what to do if they are in a non-optimal state of alertness.
- AP teach children that there are five ways to change how alert we feel: put something in the mouth, move, touch, look, or listen.
- We all self-regulate throughout our day, but rarely do any of us talk about it.



Handbook

Understanding Your Child's Sensory Signals

Keep it Real. Keep it Simple. Keep it Sensory.

Plus Sensory in a Nutshell

Angie Voss, OTR
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