SENSORY PROCESSING PEDIATRICS AND BEYOND

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Humans are sensory beings seeking a sense of physical, emotional and mental balance. When sensory systems function efficiently, we are able to stay on task, complete assignments or activities, communicate with others and enjoy our environment. When sensory systems function inefficiently, we struggle to complete tasks or to have the energy to stay focused. We may have difficulty communicating how we feel and may ultimately experience frustration with or discomfort in our environment.

Children today are bombarded with visual and auditory input, are more engaged in computer assisted education and communicate using social media. Increased auditory and visual stimulation from TV, gaming systems and videos paired with decreased daily physical activity affects the ability to process sensory information efficiently and productively. Children diagnosed with attention deficit disorder with or without hyperactivity or autism spectrum disorder often experience sensory dysfunction.

Sensory integrative dysfunction is a developmental disorder that is hypotheorized to result in disruption of the spiral process of self-actualization. While many other disorders also may disrupt this spiral process, sensory integration theory is intended to explain mild-to- moderate problems in learning and behavior in children, especially those problems associated with motor incoordination and poor sensory processing that cannot be attributed to frank central nervous system damage or abnormalities. … The theory is not intended to explain the neuromotor deficits associated with such problems as cerebral palsy (e.g. spasticity), Down syndrome (e.g. hypotonicity), or stroke (e.g. decreased tactile perception)[1]

Today, Sensory Integrative Dysfunction (SID) is often referred to as Sensory Processing Disorder (SPD), but not without controversy. SPD is not recognized in any medical manuals. Three types of SPD have been identified:

Type I: Sensory Modulation disorders (SMD): The person is over or under responsive to stimulation or may seek out stimulation. Behaviors may include being fearful or anxious, stubborn or self absorbed and may have difficulty being creative or engaging in activities

Type II: Sensory Based Motor Disorder (SBMD): The person is disorganized motor output and may have difficulty with postural challenges or have difficulty motor planning.

Type III: Sensory Discrimination Disorder (SDD): The person has difficulty processing information resulting in disorganization, limited attention to tasks or activities and difficulty performing in school. Sensory discrimination of auditory and visual information is primary to SDD.[2]

Sensory Integration Theory addresses childhood development, however sensory processing occurs over the lifetime. Processing sensory information changes during a life time and the efficiency of processing is related to changes in health, the process of aging, or acquired disability. In a study by Pohl, Dunn, and Brown as reported in an article by

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[1] Fisher, A.G., Murray, E.A., and Bundy, A.C. (1991). *Sensory Integration: Theory and Practice.* F.A. Davis Company, Philadelphia. 22.

[2] Sensory processing disorder from Wikipedia, retrieved from http://en.wikipedia.og/wiki/Sensory_porcessing_disorder on 5/30/11.

May-Benson, "no significant differences in sensory sensitivities in younger versus older adults; however, older adults were less responsive to sensory inputs and sought less sensory input suggesting discrimination of sensory input may diminish with aging but sensory modulation problems may not."[3]

Sensory systems and aquatics

Vestibular integration affects balance and movement, muscle tone, bilateral coordination, auditory language processing, visual spatial processing, motor planning, gravitational security, and emotional security.[4] Gravity stimulates the receptors in the inner ear (semicircular canals) as the head moves in different planes. Linear and circular water movement stimulates the vestibular system by way of the visual input. Head position changes during transitions from vertical to horizontal or horizontal to vertical provides strong vestibular input. Adding linear and rotary movements to exercise or therapeutic activities facilitates vestibular processing. Use of rotary movement must be carefully planned and closely monitored to prevent over-stimulation. In shallow water, movement games and activities (circle games, moving to music, limbo) are used to provide vestibular stimulation and promote socialization skills. Deep water calms the nervous system (proprioception/deep pressure) and allows for movement exploration. Individuals with inefficient processing of vestibular input typically prefer maintaining a vertical head position and will float with the neck in forward flexion when supine and neck in hyperextension when prone. Use of mechanical assists (kickboards, noodles for example) or physical assists (handling) offers visual or tactile support and allows an individual feel more comfortable in changing head position for floating or for changing head and body position as in rolling prone and supine. Flotation attached to the body (life jackets, flotation belts) alters the perception of body scheme and spatial orientation by increasing buoyancy in the upper half of the body and disrupting equilibrium. This vestibular/proprioceptive disruption can lead to increased anxiety. By using flotation not attached to the body, independent control of balance is enhanced, equilibrium is maintained leading to more independent exploration of movement.

Proprioception contributes to the development of body awareness, motor control and motor planning, assists with postural security and emotional security as well as grading of movement. Proprioceptive receptors are located around the joints, tendons, ligaments and connective tissue. When the tactile and proprioceptive systems work together, it is called the somatosensory system. The somatosensory system assists the person in moving smoothly in the water. Input from hydrostatic pressure (proprioception) and resistance created by the speed of movement and length of the moving lever arm (vestibular/tactile) stimulates the somatosensory system resulting in more controlled movement.

The proprioceptive system also works closely with the vestibular system. Active movement of the head and body provides vestibulo-proprioceptive information to be processed. In daily living, we use vestibulo-proprioceptive input when we carry objects, go up and down stairs or ramps, use transitional movements to sitting, standing, or laying down. In shallow water, proprioception can be enhanced when pushing barbells, kickboards or noodles in and out at chest level, out to the sides and back, or up and down

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[3] May-Benson, T.A. (2011). Understanding the Ocupational Therapy Needs of Adults With Sensory Processing Disorder. *OTPractice,* 16(10). 13.

[4]Kranowitz, C.S. (1998). *The Out of Sync Child.* Skylight Press, Berkley Publishing Group, NY, NY

and alternating or by using long lever actions and the increasing the speed of movement. Walking in chest deep water offers visual vestibular stimulation and proprioceptors are activated as a person walks forward, backward or sideways. Transitioning to horizontal positions (prone or supine) in shallow or deep water requires vestibulo-proprioceptive processing. Bobbing in shallow water provides linear vestibular stimulation (similar to bouncing on a trampoline on land) and adds proprioceptive processing to interpret water depths and to grade the amount of flexion and extension of the extremities required to submerge and recover. Once breath control is achieved, rhythmic breathing in prone is taught, which again requires vestibulo-proprioceptive input in order to turn the head to the side to get a breath, and then return the head to a face down position to exhale.

The **tactile system** is initially protective, responding to light touch and allowing the infant to respond to pain, pressure or discomfort. During childhood, the protective (light touch) system becomes integrated and discrimination (deep touch) develops. Touch receptors most concentrated in the hands, feet, and mouth. Touch receptors allow the individual to discriminate between light and deep touch, perceive size, shape, temperature, density and texture. "Tactile defensiveness*"* is the tendency to react negatively and emotionally to touch sensations.[5] Observable behaviors associated with tactile defensiveness include avoidance of touch from others, resistance to self care tasks such as dressing, hygiene and grooming, preference for certain types of clothing, minimal use of the arms in functional tasks, increases in tone, heart rate, and respirations as a result of the body's response to increased emotional arousal, emotional changes in response to touch, and a greater fear of being approached from behind. Aquatic considerations are: Physically handle the client only as needed and limit the number of points of contact, avoid undesired splashing, use snugly fitting and smooth bathing suit material when possible, increase proprioceptive input that may neutralize the effect of light touch input.

Gravitational insecurity occurs when the vestibular, proprioceptive, and tactile systems are working ineffectively. Gravitational insecurity is an inability to modulate sensory input and is characterized by emotional reactions or extreme fear that an actual threat exists or danger arises from stimulation or movement in space. Reactions can be manifested as nausea, aggression, anger or resistance, negativity or defiance, avoidance of movement, or inflexibility. For individuals with gravitational insecurity, creating and maintaining a stable base is achieved by keeping at least two extremities in contact with a supporting surface. Disorientation in space through movement (vestibular) creates anxiety, increasing muscle tension (proprioception), which distorts an individual's perception of position. Land based activities to assist an individual with gravitational insecurity may include both vestibular and proprioceptive activities such as swinging, scooter board activities, trampoline, pushing, pulling or carrying weighted objects. In the therapy pool, walking on inclines, bouncing/jumping in shallow water, transitioning to supported horizontal positions, and use of various entries (steps, ramps, deck) may be incorporated. Jumping can be slowly introduced by jumping or stepping off into deep water from varying water depths; starting by jumping in chest deep water, then waist

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[5]Ayres, J.A. (1983). *Sensory Integration and the Child.* Western Psychological Services, Los Angeles, CA.

deep, knee deep, ankle deep and finally from the deck. Using Halliwick mental adjustment techniques encourages an individual to explore transitions to reduced support. Incorporating Ai Chi, Halliwick Sense-Able aquatics, adapted Yoga, music, or games can promote improvement in sensory processing. Minor modifications to well known games may increase sensory comfort and improve social interactions. For more ideas contact ATRI for upcoming presentations.

RESOURCES

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