

## **SENSORY PERCEPTION DEFICITS IN SCHOOL AGE CHILDREN**

**Christine K. McFall**

*Eastern New Mexico University, USA*

### **ABSTRACT**

*The ability to receive, process, interpret, then react to stimuli is the primary function of the sensory perception system; a component of the individual's neurological system. Deficits in a student's sensory perception system affect his or her ability to function in numerous environments, including school. The literature reviewed in this paper will explore the sensory perception concept as it applies to school age children. Auditory and visual perceptions are known and understood by many professional school staff. Therefore, knowledge regarding the other senses will be explored at more length in this paper. Limited interventions for students with sensory perception deficits and sensory processing disorders will be suggested, but need to be customized to the educational needs of the child.*

**Keywords:** *environment, stimuli, senses, sensory perception, interventions, sensory processing disorder*

The definition of sensation is the ability to perceive stimulation through the sensory organs. The definition of perception is the process of how a person receives, organizes, and interprets that sensation. Therefore, the sensory perception concept is broad and complex but for brevity this author will review the basic human senses, discuss their impact on functioning and learning, and include interventions to assist students who have deficits with sensory perception (Giddens, 2013).

The nine human senses include: vision (sight), audition (hearing), olfaction (smell), gustation (taste), tactician (touch), thermoregulation (heat, cold), nociception (pain), equilibrioception (balance, gravity), and proprioception (spatial awareness). Other animal species may possess fewer, or additional senses. The acuity of their senses may be weaker or stronger than the human species. An example of an additional sense is echolocation in bats, and the lateral lines and pit organs in sharks which sense movement in the water. An example of animals with stronger olfactory senses include dogs and sharks. It becomes apparent that being able to sense and perceive the environment is essential in all species for safety, functioning, and ultimately survival.

The author acknowledges the belief by many that there also exists extrasensory perception (ESP) commonly referred to as the *6<sup>th</sup> Sense*. Twenty-one senses have been documented in various websites but, upon review, this author believes some are instincts instead of senses. The scope of this paper will focus on the nine senses that are primarily known to influence the educational process.

The ability to identify, understand, and intervene on behalf of the student with SP (sensory perception) challenges will assist caregivers, primarily parents and school staff, in providing proper interventions with the best possible outcomes for the student. Students with SP challenges vary from not noticeable to significantly impaired. The level of and complexity of the disability, along with its impact on learning, determine the amount of intervention required for the student. Many times SP challenges are identified then addressed for the first time when the student begins school.

Interventions include modifications and accommodations to the student's environment along with various teaching strategies and therapies. The student may require an individualized health care plan, an individualized education plan, and possibly a 504 plan to meet his or her needs while attending school. Educators and caregivers may refer to the *Individuals with Disabilities Education Act, 2004* (IDEA) that ensures that all students, regardless of disabilities, are entitled to a free and appropriate education (Yonkaitis & Shannon, 2017).

## **SENSORY PERCEPTION REVIEW**

### **1. Vision (sight)**

Vision screening may occur annually at a well-child checkup. It also occurs routinely in schools and is performed by the school nurse. If the student fails vision screening a referral is made for an eye exam to determine if glasses or other intervention is necessary. The student's near and far distance is screened along with depth perception and color. School nurses also check students for eye muscle imbalance. According to the Centers for Disease Control statistics (<https://www.cdc.gov/nchs/nhis.htm>), in 2016 the percentage of girls aged 6–17 years who wore eyeglasses or contact lenses was 36.2% and boys 29.1% (<https://www.cdc.gov/nchs/nhis.htm>).

### **2. Audition (Hearing)**

Hearing screening is done in the hospital on newborns, then later is included in a child's well child checkup. The school nurse performs routine audiometric screening following the state's recommended guidelines for range of sound

intensity (loudness) and pitch. Students who fail hearing screening are referred for an audiology exam. CDC statistics indicate 14.9% of children have a low or high-frequency by at least a 16 decibels hearing loss in one or both ears. The CDC also reports 1.4 per 1,000 children have a 40-decibel bilateral hearing loss. According to the CDC (<https://www.cdc.gov/nchs/nhis.htm>) the most common developmental disability to co-occur with hearing loss is intellectual disability (23%), followed by cerebral palsy (10%), autism spectrum disorder (7%), and/or vision impairment (5%).

### 3. Olfaction (smell)

Olfactory screening is not routinely performed at the pediatrician's office or in the school. Olfactory deficits in children are rare. Should they occur it is usually secondary to a temporary medical condition such as tonsillitis, rhinitis, sinusitis, or possibly a side effect of medication. Interestingly, olfactory neurons are continuously produced throughout life (Durwin, Reese-Weber, 2017). If an olfactory deficit persists without a known underlying cause; the student should be evaluated by a qualified health professional.

### 4. Gustation (taste)

Gustatory screening is not routinely performed at the pediatrician's office or in the school. Although questions about eating habits and nutrition may lead into further evaluation and referral if necessary. Gustatory deficits usually coexist with olfactory deficits - they are temporary and secondary to inflammation, infection, or side effect of medication. Important to note, the normally developing child experiences stages of texture and taste preferences along with food aversions. If inability to taste is persistent, especially if the child is losing weight or showing signs of malnutrition, a medical evaluation is recommended.

### 5. Tactician (touch)

Tactile assessment is part of a neurological exam the school nurse or child's PCP perform if indicated. The ability to discriminate between sharp and dull touch, along with the ability to discriminate between light and deep touch can be easily assessed. A tactile deficit is usually the result of a neurological condition or injury; but can also indicate numerous medical conditions. Childhood tactician deficits may be symptoms associated with cerebral palsy, paralysis, stroke, nerve damage from a trauma such as burn, fracture, or laceration.

## 6. Thermoreception (heat, cold)

Thermoreception or thermoception assessment is part of a neurological exam that is performed when indicated. It is not routinely performed by the school nurse or part of the routine well child checkup. The inability to discriminate between hot and cold temperatures may accompany tactician deficits. Thermoreception should not be confused with thermoregulation which is the body's ability to regulate its inner core temperature. One cause of thermoreception deficits is peripheral neuropathy commonly found with people with a long history of diabetes or conditions which impair circulation.

## 7. Nociception (pain)

Nociception screening and assessments are not routinely done by the child's pediatrician or school nurse. The inability to feel any physical pain would likely indicate an underlying neurodevelopmental or neurological condition. An example of a probable nociception deficit is observed in students with severe autism. The lack of pain response is apparent when they bite themselves or display self-injurious behaviors. Their reaction to painful stimuli is absent or atypical.

A student's response to injuries at school should be observed. Sensory integration disorders may be suspected if a child displays a disproportionate response to the injury. Minimal or no response to pain may be an indication of possible abuse. Over or under reaction to an injury may indicate the child has SP challenges or may possibly be a result of conditioned responses to pain or injury. Many children enjoy the consoling, sympathy and hugs they receive from caregivers if they become injured. A medical referral may be necessary for children with unexplainable nociception deficits.

## 8. Equilibrioception (balance, gravity)

Balance can be quickly assessed by observing a student's gait and performing the Romberg test, which involves standing with arms out and eyes closed. If gait is unsteady or significant swaying occurs, further medical evaluation is recommended. Some balance deficits may be related to abnormal vestibular functioning, Vitamin B12 deficiency, musculoskeletal abnormality, neurological condition, or numerous other medical conditions. Undetermined imbalance requires further medical evaluation.

## 9. Proprioception (spatial awareness)

Proprioception is the ability to sense stimuli from within the body regarding position, motion, and equilibrium. Proprioception assessment is included in a neurological exam and not part of routine screening in a well-child checkup or school nurse screening. Short-term proprioception deficits may accompany growth spurts, acute illness, sleep deprivation, or fatigue. A long-lasting proprioception deficit needs medical follow up to determine a possible underlying cause. A proprioception deficit is most likely to accompany neurological conditions. This can be observed in some children with neurodevelopmental disabilities when they exhibit a strong startle reflex upon movement.

### **SENSORY PERCEPTION DEFICITS IMPACT ON LEARNING**

All learning occurs through interactions with the environment. Evidence shows the brain changes both biochemically and structurally from the external stimuli it receives (Reynolds et al., 2017). The student's brain is responsible for cognition, producing and understanding speech, reading, writing, motor skills, memory, problem solving, and analyzing thoughts. It is also responsible for emotions like anger, fear, joy, anxiety, aggression, appropriate or inappropriate behaviors (Durwin & Reese-Weber, 2017).

The brain receives its information from neurons, which are nerve cells located throughout the body. The neuron transmits information, also known as stimuli, from the sensory organ to the brain by impulses. The process of synaptogenesis occurs as active neuronal connections become stronger and underused neurons become eliminated. Different lobes of the brain grow in response to the stimuli received by neurons. The parietal lobe is responsible for spatial processing and the integrating information from the senses (Durwin & Reese-Weber, 2017). Therefore, the parietal lobe's ability to develop, along with other lobes in the brain, is dependent upon receiving and processing messages from the senses.

The school age child's brain is genetically programmed to receive information from the senses and learn during certain periods of their childhood. This concept is referred to as plasticity. Experience-expectant plasticity is dependent on receiving environmental stimuli to form and strengthen the synapses necessary for learning. The brain's plasticity decreases with age. Therefore, prime learning, especially for language, occurs during these windows of opportunity when the brain is most plastic (Durwin & Reese-Weber, 2017).

Executive functioning also is influenced by the information received by the brain via the senses. Executive functioning controls the perceiving and reacting to

the stimuli the brain receives. Metacognition, planning, organizing, attention, memory, and the ability to self-regulate assist the child to perform in school, and other environments.

Premature infants are at increased risk for developing atypical SP profiles possibly from lack of contact (Wickremasinghe, Rogers, Johnson, Shen, Barkovich, & Marco, 2013). Through the senses, parent-child bonding begins immediately after birth. Maternal bonding may begin while the baby is in utero. The lack of receiving touch in infancy may lead to SP deficits as well as attachment disorders. A cross sectional study assessing children born before 32 weeks, at 1 to 8 years of age, indicated 39% of them had an atypical Sensory Profile score obtained by a parent questionnaire (Wickremasinghe, et al., 2013). The study cited is limited to one school district but children with premature birth histories are more at risk for other health concerns and learning disabilities.

## INTERVENTIONS

If a child is displaying academic or behavioral difficulties he or she may be referred by a parent, teacher, health care provider, school nurse, or member of the school support team who believes the student needs evaluation for educational support services. The child's evaluation must be comprehensive, non-discriminatory, multifactorial, and conducted by qualified professionals to ensure all areas related to a child's suspected disability are evaluated. The parent or guardian must consent for evaluation and any subsequent special education services. A diagnosis alone does not qualify as an evaluation. The student's health and medical condition must indicate that it adversely affects the child's ability to learn and what barriers to education can be reduced (Yonkaitis & Shannon, 2017). Therefore, many students with mild SP deficits may need no provisions made while others may need many. An individualized health plan (IHP) is usually necessary for mild to moderate SP deficits. Students with moderate to severe SP deficits may need an individualized education plan (IEP), or 504 accommodations. This author listed some commonly used accommodations for SP deficits. The listed accommodations are not inclusive as IEP's are individualized for each student.

- Most visual and auditory deficits may be identified and adaptive devices such as corrective lenses and hearing devices improve the student's ability to function in the school environment. For hearing impaired students, accommodations in the classroom include preferential seating to best see and hear the instructor. Technologic interventions include FM systems, hearing aids, cochlear implants, and bone-anchored hearing aids. FM stands for *frequency modulation*. It is a device that helps the student with hearing loss hear reduced background noise and

hear the instructor more clearly. The FM systems send sound from a microphone used by the speaker to a person wearing the receiver. This system is sometimes used with hearing aids. An extra piece is attached to the hearing aid that works with the FM system (<https://www.cdc.gov/ncbddd/hearingloss/facts.html>).

- A student with one or more SP deficits involving olfaction, gustation, tactician, thermoregulation, nociception, equilibrioception, and proprioception would most likely have an IHP to notify staff of the condition and the necessary accommodations that need to be implemented primarily for the student's safety. It may also be necessary to develop an IEP or 504 Plan.

### **SENSORY PROCESSING DISORDER**

SP deficits may include a broad range of students with sensory processing and integration challenges. Sensory processing disorders (SPD) can negatively affect the student's development, and functional abilities in behavioral, emotional, movement, and cognitive functioning (Ahn, Miller, Milberger, & McIntosh, 2004). Allied health professionals working with children with challenging behaviors associated with SP disorders were not able to identify the causes of the behaviors (Samayan, Dhanavedan, Nachiketa, 2015). Understanding the behaviors associated with SPD may assist caregivers, therapists, and educators to work collaboratively and support the student.

SPDs may accompany many medical diagnoses such as Autism, Down Syndrome, ADHD, or may exist in children with no known medical contributors. Among students without disabilities the prevalence of SPD ranges from 10% to 55% (Critz, Blake, Nogueira, 2015). The sensory processing theory was identified by an occupational therapist, Dr. A Jean Ayers, in 1972. She identified and studied students who appeared to have challenges integrating multiple sensory stimuli. Her theory explained the relationship between deficits in interpreting sensory stimuli from body sensations and the environment; and the associated difficulties they encountered with academic or motor learning. The SPDs are believed by Ayers to have neurologic origins related to the brain's inability to integrate the sensory input with effective responses. Sensory processing challenges may be labeled as disorder or a cluster of symptoms that are part of a neurodevelopmental disorder (Critz, et al., 2015).

Numerous health care professionals, and early childhood specialist are familiar with sensory processing disorders. It is the occupational therapists(OTs) who are specifically trained in sensory integration therapy (SIT). OTs are

responsible for assessing and designing therapeutic interventions to address the student's SPD (Schaaf, et al., 2015).

The American Occupational Therapy Association presented a SPD position paper in 1982. Their position paper supported a full spectrum of interventions and approaches to treat SPDs. The publication of *Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood, Revised*, was published in 2005 with criteria to identify SPD early, in efforts to start the student in a Child Find program (Critz, et al., 2015).

The diagnosis of SPD may accompany many known neurodevelopmental disorders as one of its features. It may also be considered a diagnosis in children with atypical or unusual responses to stimuli. It is frequently categorized into two broad constructs: (1) abnormal sensory responsivity, potentially causing poor modulation of sensory information from the environment, and (2) difficulty in sensory perception and discrimination, potentially leading to deficits in postural stability, visual-motor control, and coordination (Reynolds et al., 2017).

Pediatric occupational therapists use three broad types of intervention when working with SPD children. The intervention categories include: environmental supports and adaptations, caregiver-focused interventions designed for parents and teachers, and lastly, child-focused and therapist led interventions to increase skill and improve neurological functioning (Reynolds, et al 2017).

- Environmental Supports and Adaptations matches the child's needs with provision of appropriate supports and removal of barriers that decrease functioning, modifying the environment to either reduce or enhance sensory stimulation (Reynolds, et al 2017). Examples of environmental interventions to enhance sensory stimulation include ball chairs, air cushions, rocker chairs, compression or snug clothing, fidget toys and weighted tools. Environmental interventions to reduce sensory stimuli include the application of headphones, sunglasses, study carrels, light covers, and work surfaces that are quiet. Classroom seating placement is an additional support that may improve the environment for a student with SPD.
- Caregiver focused interventions are included in the multifaceted approach to treatment of children with SPD. The interventions provided by teachers and parents assist in scaffolding the student. Resources caregivers can access include reference or children's books and information from the Sensory Processing Disorder Foundation ([www.spdnpw.org](http://www.spdnpw.org)).
- Child focused interventions include numerous SIT approaches primarily to increase or decrease environmental stimuli.



## CONCLUSION

Applying the sensory perception concept to the educational process of school age children will assist educators and other allied professionals better understand the role of the SP system as it contributes to learning. The additional understanding of sensory processing theory and its application to SPDs, along with the use of SIT, will assist in meeting the needs of children with this disorder.

Pediatricians do not use SPD as a diagnosis because there is no universal framework to support it. Pediatricians do however refer to, support, and accept recommendations and treatment plans from occupational therapist for the treatment of SPD (Critz, et al., 2015). There is not a diagnosis or SPD in the *DSM-5*. However, SPD is one of the criteria used for diagnosis of autism. Although, the etiology of SPD may not be clearly understood in all students, its impact on the student's education is acknowledged by educators, health professionals, caregivers, and parents.

## REFERENCES

- 1) Ahn, R., Miller, L., Milberger, S., & McIntosh, D. (2004). Prevalence of parents' perceptions of sensory processing disorders among kindergarten children. *American Journal of Occupational Therapy, 58*(3), 287-293.
- 2) National Health Interview Survey, National Center for Health Statistics, 2016 retrieved from: <https://www.cdc.gov/nchs/nhis.htm>.
- 3) National Center for Health Statistics, 2016 retrieved from: <https://www.cdc.gov/ncbddd/hearingloss/facts.html>
- 4) Critz, C., Blake, K., & Nogueira, E. (2015). Sensory Processing Challenges in Children. *Journal for Nurse Practitioners, 11*(7), 710-716. doi: 10.1016/j.nurpra.2015.04.016
- 5) Durwin, C. C. & Reese-Weber, M. (2017). *Ed Psych Modules third ed.*, SAGE Publications
- 6) Giddens, J. F. (2013). *Concepts for Nursing Practice*, St. Louis Missouri: Mosby Elsevier
- 7) Reynolds, S., Glennon, T. J., Ausderau, K., Bendixen, R. M., Miller Kuhaneck, H., Pfeiffer, B., & Bodison, S. C. (2017). Using a Multifaceted Approach to Working with Children Who Have Differences in Sensory Processing and Integration. *American Journal of Occupational Therapy, 71*(2), 1-10. doi:10.5014/ajot.2017.019281
- 8) Samayan, K., Dhanavendan, K., & Nachiketa, R. (2015). Research. Allied health professionals' perceptions of the role of sensory integration

therapy in managing challenging behaviours. *International Journal of Therapy & Rehabilitation*, 22(4), 167-172.

- 9) Schaaf, R. C., Schoen, S. A., May-Benson, T. A., Parham, L. D., Lane, S. J., Smith Roley, S., & Mailloux, Z. (2015). State of the Science: A Roadmap for Research in Sensory Integration. *American Journal of Occupational Therapy*, 69(6), 1-7. doi:10.5014/ajot.2015.019539
- 10) Sensory Processing Disorder Foundation [www.spdnpw.org](http://www.spdnpw.org)
- 11) Wickremasinghe, A. C., Rogers, E. E., Johnson, B. C., Shen, A., Barkovich, A. J., & Marco, E. J. (2013). Children born prematurely have atypical Sensory Profiles. *Journal of Perinatology*, 33(8), 631-635. doi:10.1038/jp.2013.12
- 12) Yonkaitis, C. F., & Shannon, R. A. (2017). The Role of the School Nurse in the Special Education Process: Part I: Student Identification and Evaluation. *NASN School Nurse*, 32(3), 178-184. doi:10.1177/1942602X17700677