Sensory Integration and Processing Problems: Impact on Care

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The division planner and director have disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience

This course is designed for dental professionals involved in the care of patients with sensory processing dysfunction.

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Course Objective
The purpose of this course is to improve the quality of care administered to patients with sensory processing issues by providing dental professionals with information about sensory processing issues and health care from the point of view of the patient.

Learning Objectives
Upon completion of this course, you should be able to:

1. Describe the various components of the sensory system.
2. Identify categories of sensory processing dysfunction.
3. Discuss best practices for clinicians when caring for a patient with sensory processing difficulties.

Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

INTRODUCTION

Sensory integration and processing is a complex system, and issues related to these processes can occur in children and adults. As of 2020, sensory processing disorder is a diagnostic entity in the *Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood* (DC:0-3R), but it is not a formal diagnosis according to the most recent editions of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) and the *International Classification of Diseases* (ICD-11). As such, the term "sensory processing disorder" or SPD is generally used to refer to disordered or abnormal sensory integration or processing, regardless of diagnosis.

The number of children and adults identified with sensory processing issues and autism spectrum disorder is climbing each day. Sensory processing problems affect an estimated 5% to 16% of school-aged children and 5% of adults in the United States [1; 2] It is an issue that can span the lifetime of a patient, and a patient of any age and with any diagnosis can have sensory processing issues [3; 4]. It is important for clinicians to understand and know best how to deal with the fears and anxieties these patients experience so even the most routine health care can be suited to their needs [5; 6]. However, many clinicians have not had a chance to learn about the special needs of these patients [7; 8]. This course will assist healthcare providers to develop an appreciation for sensory processing difficulties and to deliver health care to these patients in a sympathetic and effective way.

The clinician's job is to meet the needs of the patient while also working to improve the patient's health. The patient with sensory processing dysfunction can often present a difficult clinical situation because of their specific deficits. This may be compounded if clinicians do not understand the underlying needs of someone with sensory processing challenges.

THE SENSES AND SENSORY PROCESSING DYSFUNCTION

The senses are used to gather information about the environment and the internal body, and most people are aware of the five main senses: visual (sight), olfactory (smell), gustatory (taste), auditory (hearing), and tactile (touch). There are also three more senses that are not generally known: vestibular, proprioception, and interoception. All eight of these senses are very important, and disruption can cause many issues for the person involved. When all of the senses are working together at an optimal level, an individual has a reliable picture of the environment and their internal status. Patients for whom any one of these systems is not processing stimuli accurately have a different experience than those around them.

VISUAL

The visual processing system consists of the eyes gathering information from the environment. This sense assists with balance and is useful for activities of daily living, socializing, and sports. A person who has a faulty visual system might have difficulty following directions involving visual discrimination (e.g., distinguishing one medication from another), interpreting body language (leading to decreased social skills), or following written directions for a home plan. Bright lights and bright colors can be agitating to patients with visual issues, and moving about in an unfamiliar office may cause anxiety.

OLFACTORY

The olfactory system is one of the first sensory systems to develop in utero [9]. Many patients with sensory processing disorder have issues with the olfactory system. This can affect eating behaviors, as food often has an offensive smell to them. It can also affect patients socially because they may avoid going anywhere with an offensive or intense smell or interacting with individuals with a strong smell (e.g., cologne, perfume). Most clinics, dental facilities, and hospitals have smells that can be a problem for patients with olfactory processing problems.

GUSTATORY

The gustatory sense provides information about the taste of foods and liquids. A disrupted gustatory system may cause severe feeding issues. Many patients with sensory processing dysfunction are "picky" eaters for a number of reasons, one of which might be a gustatory system disruption. When gustatory issues are worked on, feeding issues often improve.

AUDITORY

The auditory system processes and interprets information that is heard. This includes the skill of auditory discrimination—trying to determine if the sound is closer to the right or left ear, loud or soft, and the quality of the sound. In addition, one part of the cochlea is associated with the vestibular system [9]. A patient with auditory dysfunction might not have impaired hearing, but the quality of the sound could be such that the speaker sounds as if he or she is mumbling or speaking nonsense sounds. This can lead to difficulty understanding instructions or requests.

Hyperacusis occurs when a patient's auditory system is too sensitive, causing pain when a louder noise is noted (e.g., a fire truck goes by on the street). In the clinic, louder medical instruments may bother a person with a sensitive auditory system. It can be helpful to discuss the devise before it is used and/or to provide a quieter area or noise-canceling headphones to address these issues during health care.

A significant problem associated with auditory discrimination is difficulty following verbal directions. This occurs due to confusion over similar-sounding words (e.g., book and look). The patient might also have a difficult time focusing when background noises are present or become overstimulated when there is too much background noise [10]. This difficulty with communication can lead to frustration for both the clinician and the patient.

TACTILE

Disruptions in the tactile system are common in people with sensory processing challenges. The tactile system uses information gathered from the largest sensory organ—the skin—to establish a perception of one's environment. The skin is a constant source of information, and it helps determine the quality of objects in the external environment [3]. The skin receives information about pressure, texture, temperature, and pain. There are two subsystems of the tactile system: the protective system and the discriminatory system.

The protective system facilitates a response if a stimulus is perceived as harmful. In patients with sensory processing dysfunction, nonharmful things such as coarse fabric, clothing tags, and sock seams can trigger a protective reaction; this is called tactile defensiveness. Pain can feel unusually intense [3]. In the healthcare setting, this can translate to a patient having difficulty wearing and remaining comfortable in medical gowns, defensiveness with oral work, or anxiety with blood pressure cuffs. When this sensitivity is to items being introduced into the mouth, it is called oral defensiveness.

The second subsystem is the discriminatory system, which helps people determine the quality of the object they are touching. This system helps categorize things as hard or soft or smooth or rough. Dysfunction in this area can cause difficulties with such daily fine motor activities as buttoning a coat and handwriting. These persons might avoid certain textures of food, clothing, and surfaces [10]. Poor tactile discrimination is often a focus for sensory therapy.

Difficulty with social situations can also arise with tactile issues. People with tactile defensiveness may be too sensitive or not sensitive enough to touch. This can translate to shying away from a gentle touch or hug or not knowing when a push is too hard. In the healthcare setting, these patients may appear uncomfortable or shy away from the touch involved in a routine exam. This might offend or

confuse some clinicians if they are not aware of the patient's sensory issues. Patients who are under-responsive to touch may not be aware that the clinician is palpating for pain, which can result in skewed results due to lack of patient report.

EVIDENCE-BASED PRACTICE RECOMMENDATION

According to the American Occupational Therapy Association, Qigong sensory treatment, a massage protocol, is associated with significant improvements in self-regulatory behaviors, tactile abnormalities, autism symptoms, and parenting stress in children with sensory integration difficulties.

(https://ajot.aota.org/article.aspx?articleid=2666720. Last accessed April 24, 2020.)

Level of Evidence: Expert Opinion/Consensus Statement

VESTIBULAR

The vestibular system senses the position of the head in space (i.e., spatial orientation), including direction and speed of head movement. This system involves the structures of the inner ear in conjunction with vision and the auditory system. Difficulty in the vestibular system results in low muscle tone, poor balance, poor coordination, and improper reactions to movements [3; 10]. There is an anatomical association between the vestibular and auditory systems, and it is often found that a specific type of vestibular stimulation combined with auditory input results in an improved ability to communicate [9].

The vestibular system can be disrupted in several ways [9]. Gravitational insecurity causes a person to become very uncomfortable with changes in movement. They can become fearful of movements like climbing, jumping, leaning back, riding in a car, and falling. Over-responsiveness to movement can result in nausea and dizziness during or after movement. Disruption of the vestibular system can cause discriminative issues due to an inability to orient one's position in space. On the other end of the spectrum is an under-responsive system. This becomes apparent when a person is unaware of movements (e.g., rocking). Disturbances can also manifest as a need for more than the usual amount of movement. These patients may excessively run, fidget, spin, and continually re-adjust in order to satisfy their system. Vestibular issues are often very apparent in children with sensory processing dysfunction because much of play relies on an intact vestibular system [9].

PROPRIOCEPTION

The proprioceptive system is a very large system that orients an individual to the position of his or her body parts by detecting changes in the length of muscles and the position of joints. Most proprioception is done without conscious awareness. Difficulty in this area can cause problems in many daily activities, such as handwriting, fine motor and gross motor activities, and sports. Poor body awareness can result in clumsiness, difficulties with posture, and using too much or too little pressure for a task [10]. It may also result in sensory-seeking behaviors, such as crashing or excessive roughness [10].

INTEROCEPTION

Neural systems around the internal organs form the interoceptive system. These nerves detect and transmit information about internal regulation responses, such as thirst, waste elimination, and fullness. In a very young child, difficulty with interoception can lead to delayed toilet training success. Issues with interoception may result in a person reporting headache, stomachache, or other pain in confusion with other sensations, which could result in confused diagnosis [9].

PROCESSING INFORMATION FROM THE SENSES

As discussed, the sensory system relies on a continuous feedback loop of information from various senses to regulate and process sensory information in order to function. All individuals have different levels of sensory organization and tolerance [10].

After the senses receive information from the environment, this information must be processed in order for the body to react appropriately. This is the stage at which problems arise for patients with sensory processing issues. Often, the messages received by receptors in the sensing areas are misinterpreted by the brain. This misinterpretation results in the wrong messages being relayed/interpreted, and everyday routines and activities can become challenging. Some messages that are usually ignored by the brain (e.g., a shirt tag resting on the skin) suddenly become "high alert" messages of pain and discomfort that cannot be ignored. The patient's system must interpret messages from the senses based on this overload/deficit of information. Information from all of the senses is combined, which is difficult. An automatic response is then made based on missing or incomplete information, and impulses are sent to muscles and limbs to carry out the response. Functioning proprioception is required to know what the limbs are doing even before the new order to respond is put out by the system. If a patient's senses perceive misinformation, he or she must interpret and respond to that misinformation and then rely on body parts that are not responding correctly to carry out a response in the best way possible [11]. Because those with sensory processing dysfunction gather and process information differently than people with intact sensory systems, clinician-patient communication can be difficult [11].

DISRUPTION OF SENSES

Patients with sensory processing issues often experience disruption of many senses, though not all disruptions manifest in the same way. There may be two systems that are over-responsive and two systems that are under-responsive. A common combination is an over-responsivity to touch and sound (e.g., difficulty having ears checked, sensitive to the noise of dental equipment) but a craving for movement and proprioception (e.g., uses too much force when brushing teeth) [9]. The patient can easily feel off balance if put in new positions (e.g., tilted dental chairs), be clumsy with new movements (e.g., learning to use an inhaler), and be unable to distinguish normal body reactions from illness (e.g., stomach pain from worry).

SENSORY PROCESSING DISORDERS

According to Miller et al., SPD is commonly divided into three main categories: sensory modulation disorder (SMD), sensory discrimination disorder (SDD), and sensory-based motor disorder (SBMD) [12]. Each disorder has unique characteristics and requires different approaches to manage symptoms. Like many illnesses, the symptoms of SPD exist on a spectrum. Patients may not fall neatly into one of the subtypes [13].

SENSORY MODULATION DISORDER

SMD is characterized by a difficulty regulating sensory stimuli. Patients may be over-responsive, meaning they have the tendency to respond too much, too soon, or for too long to sensory stimuli most people find tolerable [14]. They often have a "fight-or-flight" response to sensation (e.g., being touched unexpectedly), which is sometimes called "sensory defensiveness" [14]. These patients are bothered by usually tolerable stimuli (e.g., the seams in a shirt).

Sensory under-responsiveness involves a delay or muted response to environmental cues. Patients may appear withdrawn, difficult to engage, or slow to process/respond because they do not detect the sensory input in their environment. These patients seem to require more stimuli to feel their environment [14]. This can also manifest as an unawareness of internal cues, such as fatigue or illness. Sensory-craving patients crave and constantly seek sensory stimulation, and the stimuli may not register correctly when it does occur. These patients may appear hyperactive (e.g., continuously jumping while waiting for an appointment) or may talk very loudly to create auditory stimulation.

A 2017 study explored subtypes of sensory processing disorder using data from the Sensory Processing 3-Dimension Inventory of 252 children. Three distinct cluster groups emerged [30]:

- Sensory over-responsivity
- Sensory under-responsivity
- Sensory craving

The authors recommend SP-3D as a tool for better identification of sensory dysfunction that can lead to more precise intervention [30].

SENSORY DISCRIMINATION DISORDER

Patients with SDD have difficulty interpreting subtle qualities of objects, places, people, or the environment. For example: Do I see a "P" or a "Q"? Do I hear "cat" or "cap"? Do I feel a quarter or a dime in my pocket? This can affect any of the senses alone or in combination (i.e., auditory DD, visual DD, gustatory DD, olfactory DD, tactile DD, vestibular DD, proprioceptive DD, or interoceptive DD), making SDD the most difficult category to identify [13; 14]. For the patient with SDD, interpreting ordinary demands and responding appropriately may require enormous effort and extra time [15].

SENSORY-BASED MOTOR DISORDER

Individuals with SBMD can regulate sensory input but have difficulty with balance, motor coordination, and the performance of skilled, not-habitual, and/or habitual motor tasks. SBMD is sometimes co-exhibited with SMD [16]. There are two subtypes of SBMD: postural disorder and dyspraxia [14; 16].

With postural disorder, patients have difficulty maintaining the optimal posture. Posture is important because it is the base from which all of our upper and lower limbs anchor their movements away from the body. Poor or weak postural muscles result in difficulty with scapular stabilization, which leads to difficulty with such milestones as handwriting and strength movements involving the legs. A weak core can have many implications for individuals with SBMD as they age.

The tactile and proprioceptive sensory systems are most affected by postural disorder. The patient may move slowly and cautiously, if at all; sedentary activities may be preferred. Moving on uneven (bumpy) surfaces is challenging and maintaining stability while performing simple actions, such as stepping on or off a curb, requires an enormous amount of effort. This decreased stability and poor muscle control causes the patient to compensate by increasing his or her "base of support" (e.g., standing with legs shoulder width apart). The patient with postural disorder fatigues quickly and may lean against furniture or slouch frequently. Being bumped by another person may trigger a "fight, flight, or freeze" reaction if the patient is forced to move; more often, however, the individual chooses not to move. Patients with postural disorder often feel unstable, insecure, and unsafe, and they often exhibit poor self-esteem and self-confidence [17].

Dyspraxia involves difficulty thinking of or generating new ideas, planning, and/or executing skilled movements, especially novel movement patterns [16]. These individuals are often seen as clumsy and awkward, as they have problems with gross and fine motor activities (e.g., climbing, playing ball games, handwriting, tying shoes, timing movements, dressing) [16]. They may prefer sedentary activities or try to hide their motor planning problem with verbalization or with fantasy play [14]. Early physical and occupational therapy can help immensely.

POTENTIAL CAUSES AND RISK FACTORS FOR SENSORY PROCESSING DYSFUNCTION

Although the cause of sensory processing dysfunction has not been identified, studies have shown that children with sensory processing issues have different neurophysiologic responses to sensory stimuli compared to typically developing controls [18; 19; 20]. For example, children with sensory processing challenges demonstrate less sensory gating (filtering out redundant, unnecessary stimuli) and more within-group variability than controls, and while sensory gating improves with age in typically developing children, the developmental trajectory in children with sensory processing

dysfunction is significantly different [21; 22]. A 2013 study found that boys with sensory processing issues have decreased white matter connectivity, particularly in the parietal regions of the brain, that distinguishes them from typically developing boys [1; 2]. This established a biologic cause for sensory integration difficulties.

A later study, the largest imaging study of sensory processing dysfunction, compared typically developing boys and girls with those with sensory processing issues [31]. Researchers found abnormal white matter tracts in the connections between auditory, visual, and tactile systems and abnormal connections between the left and right hemispheres in children with sensory processing dysfunction. It is believed these abnormalities most likely affect the timing of sensory transmission across multiple senses input, thus leading to difficulty, if not failure, in processing. In addition, less white matter was found in the back of the brain, the primary area for transmission of sensory motor information. This research supports the theory that SPD is a spectrum disorder and, with advanced imaging techniques, direct measurements may be used to diagnose the disorder and individualize treatment [31].

Children with sensory processing dysfunction also have different physiologic (electrodermal) responses to sensory stimuli compared to controls and children with autism spectrum disorders, suggesting that SPD and autism should be distinct diagnoses [23].

Several risk factors for sensory processing dysfunction have been suggested and are being investigated, including [24; 25; 26; 27; 28]:

- Low birth weight (<2,200 g)
- Prematurity (<36 weeks' gestation)
- Prenatal complications
- Maternal stress, illness, exposure to certain medications or other compounds/chemicals
- Delivery complications and/or assisted delivery methods
- Genetic susceptibility for tactile/auditory sensory over-responsivity

TIPS FOR CLINICIANS TREATING PATIENTS WITH SENSORY PROCESSING DYSFUNCTION

Clinicians treating patients with sensory processing dysfunction can take certain steps to ensure a better healthcare experience. It may seem as if these patients are over-reacting to normal procedures or are ignoring questions or conversations. However, reality for these patients is very different [11]. Taking steps to understand and adjust procedures can facilitate the best possible care.

One of the most important issues to be aware of when working with patients with sensory processing difficulties is that the condition may produce confusion or anxiety. These patients are dealing with a dysfunctional sensory system in an unfamiliar environment. As a clinician, it is important to work with patients to ensure they understand what will be involved in the visit. It is also important to provide structure and feedback to help patients understand their environment; patience and communication are paramount. The medical or dental office should be a compassionate and safe place [10].

Going to an unfamiliar place, like a medical office, can be overwhelming to the senses for individuals with sensory processing dysfunction. To these patients, it may feel as if they are being attacked on all sides, even before they see the clinician. Their system can be on high alert for danger or on such low alert that it is difficult to communicate.

Before a patient arrives at a clinician's office, he or she has often experienced a day's worth of sensory distress. The patient with sensory processing issues will see the waiting room in a different way than the typical patient. Coarse fabric on a chair can be an issue, as can temperature, the size of the waiting area, and the number of other people waiting. The patient is also often nervous about the visit, not knowing what to expect. A long wait in an uncomfortable waiting room with no distractions can increase anxiety even before the visit begins.

Clinicians should spend time in their own waiting rooms, seeing it through the eyes of a patient with sensory processing dysfunction to help address any issues that might be of concern.

The average treatment room is often problematic as well. If a gown is used, the material might be uncomfortable. Exposed skin can make patients overly sensitive or cause them to shut down. Treatment tables or chairs are normally cold and hard, and the instruments used are new and possibly frightening to the patient. Individuals may report pain out of proportion to that expected.

Involving patients with sensory processing dysfunction in their own care and explaining all procedures fully are the cornerstones of ensuring a positive experience. Patients may hold instruments or examine tools during or prior to procedures. For example, patients with sensory issues may "help" with teeth cleanings by putting their hands on the instrument or they may be allowed to squirt the water from a dental handpiece before a cleaning to help relieve anxiety about the strange objects.

Distraction is also an important tool. If a young patient will receive a reward at the end of the visit, he or she can be asked to pick it out first. Deep pressure often calms a patient with sensory issues, and a patient in the dental office might prefer to keep the weighted X-ray shield apron on during the visit to help calm the sensory system. Of course, it is important to consult with the patient and/or parent to determine if this would help [29].

Lights that shine in the eyes can be disarming and even painful to those with a sensitive visual system. If sunglasses and headphones are appropriate, they can help to shade sensitive eyes and ears and distract from the medical or dental work.

When a blood pressure cuff is being used, the squeezing sensation can be very alarming to someone with tactile defensiveness. Telling the patient what will happen with the cuff and giving a countdown until the time it will end will help decrease anxiety.

There are also a few key things that clinicians should avoid when dealing with patients with sensory processing issues. If the patient is a child, it is important not to exclude the parent. The parent can serve as a translator and filter for the child, and in some cases, patient report can come from the parent. Some medical offices prefer to take patients back without the parent, but this is not helpful for patients with sensory processing challenges unless the visit is for occupational or physical therapy. Instead, parents should be considered part of the healthcare team. Older patients should be acknowledged as being their own expert, with the knowledge of necessary steps to take to be more comfortable.

Sudden movements should also be avoided whenever possible. Patients with sensory processing dysfunction function better with an announced or visual schedule from which they can work. Discussing procedures beforehand and allowing patients to see and, if safe, handle equipment can be beneficial. Keeping patients advised on the next two or three steps that will occur in the visit will help decrease anxiety. Letting them know when the visit will be over is also good practice.

Some clinicians will downplay patients' fears and dismiss them as unnecessary, but this can add to anxiety. It is best to listen to the patient and validate his or her fears and pain while also explaining the purpose of the procedure at the appropriate cognitive level. Talk through motor activities using directional and spatial terms [10].

Clinicians should stay informed of the advances in the science of sensory processing and act as advocates for these patients. Advances in neurologic testing and brain function studies are providing more information about the causes and effects of disorders in sensory processing, allowing for more precise and individualized treatment. For example, brain training is now being used and studied as a therapeutic practice for those with sensory processing dysfunction [32]. This may include the use of video-based simulations, meditation, and yoga [33; 34; 35].

Patients and their caregivers have many strategies to cope with sensory issues, and establishing and maintaining normal daily routines (e.g., related to eating, bedtime) may help with new circumstances [36]. Preparation, anticipatory planning, and allowing the patient to have more control and choice in a new environment (to the extent possible) also help. Implementing sensory strategies (e.g., fidget toys, noise-cancelling headphones, dark glasses) can also facilitate comfort and participation.

Occupational performance challenges can also result from sensory issues. Research regarding the interaction of sensory integration and processing problems and the work environment is ongoing [37].

If a practice has a large number of patients with symptoms of sensory processing difficulties, continuing education may be beneficial. Some patients may show signs of sensory processing dysfunction, and if a referral to occupational or physical therapy has not been made, it may be necessary to start a conversation with him or her or a parent. Participation in physical and occupational therapy may be very helpful for individuals with sensory processing dysfunction.

CONCLUSION

For the patient with sensory processing dysfunction, a regular visit to a healthcare provider can be difficult and sometimes terrifying. For clinicians caring for patients with sensory processing issues, it can be confusing to understand and accommodate the patients' unique fears and anxieties. It is vital for clinicians to ask patients or their caregivers of the need for accommodation and strategies that may help the visit be more comfortable and successful. This course has explored the various aspects of sensory processing issues and how they affect the patient, with the goal of allowing healthcare professionals to see through the patient's eyes to identify potential triggers of fear or anxiety during a typical office visit. Through collaboration and understanding, patients with sensory processing challenges can be accommodated, ensuring that they have access to the best possible care with as little anxiety as possible.

RESOURCES

The following list of resources is intended to serve as an introduction to those available and is not exhaustive.

BOOKS

No Longer A Secret: Unique Common Sense Strategies for Children with Sensory or Motor Challenges by Doreit Bialer, MA, OTR/L, and Lucy Jane Miller, PHD, OTR

The Everything Parent's Guide to Sensory Integration Disorder by Terri Mauro

The Out-of-Sync Child Has Fun by Carol Stock Kranowitz, MA

The Sensory Processing Disorder Answer Book by Teri Delaney, MS, OTR/L

Too Loud, Too Bright, Too Fast, Too Tight by Sharon Heller, PhD

WEBSITES

STAR Institute for Sensory Processing Disorder
http://www.spdfoundation.net

SPIRAL Foundation: Sensory Processing Institute for Research and Learning
https://thespiralfoundation.org

Child Mind Institute
https://childmind.org

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