

Sensory Integration

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Locating Evidence for Practice of Occupational Therapy Using a Sensory Integration Frame of Reference

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Occupational therapists must ensure that their clinical practice incorporates and implements evidence-based practice (EBP) principles. This article focuses on locating and evaluating the evidence supporting the core activities that comprise EBP of the sensory integration frame of reference.

The concept of EBP originated more than 20 years ago, and is based on three areas of knowledge: the best research evidence, clinical expertise and reasoning, and the patient's values and perceptions (Straus, Richardson, Glasziou, & Haynes, 2005). In addition to evidence regarding intervention, it also refers to the evidence in key areas of practice that support the theory and assessment practices of a frame of reference. Specific areas of evidence include (a) etiology of dysfunction, (b) clinical manifestation of dysfunction, (c) differential diagnosis, (d) selection and interpretation of diagnostic tests, (e) prognosis, (f) intervention, (g) prevention, and (h) patient experience and meaning.

The American Occupational Therapy Association (AOTA) has conducted several projects related to EBP. The Practitioners section's Children & Youth page (www.aota.org/Practitioners/PracticeAreas/Pediatrics.aspx) on the AOTA Web site features practice-related resources. On the page for the Evidence-Based Practice and Resources for Children and Youth are additional resources on EBP in general as well as information specific to the sensory integration frame of reference. This includes a series of systematic reviews on sensory integration in the *American Journal of Occupational Therapy* (AJOT); related Critically Appraised Topics (CATs), Evidence Briefs, Evidence Bytes, and other materials. The Evidence-Based Practice Resource Directory includes other resources and databases, such as AOTA's new Evidence Exchange.

As the systematic reviews only include articles up to 2007, it is important to find additional current information. At press time, the search term "sensory integration" recovered 255 new articles in AJOT spanning 2007 through available issues of 2012. Searching the AOTA Press products produces the *Occupational Therapy Practice Guidelines for Children and Adolescents with Autism* (Tomchek & Case-Smith, 2009) and *Children with Challenges in Sensory Processing and Sensory Integration* (Watling, Koenig, Davies, & Schaaf, 2011). The book entitled *Sensory Integration: A Compendium of Leading*

Scholarship (Royeen & Luebben, 2009) contains reprints of some of the most significant articles pertaining to sensory integration.

Clinicians new to this frame of reference may find it useful to obtain an introduction to sensory integration theory by reading *Sensory Integration and Learning Disabilities* (Ayres, 1972) and *Ayres Dyspraxia Monograph* (Cermak, Ayres, Coleman, & Smith Roley, 2011). Additionally, *Sensory Integration: Theory and Practice* (Bundy, Lane, & Murray, 2002) and the sensory integration frame of reference chapter in Kramer and Hinojosa's (2010) *Frames of Reference for Pediatric Occupational Therapy* provide updated information.

Evidence for Etiology, Clinical Manifestation, and Differential Diagnosis

Evidence for the etiology of dysfunction, the clinical manifestations of dysfunction, and differential diagnosis is critical to determining the validity of sensory processing and sensory integration problems as a distinct disorder. Important articles in AJOT and the SIS Quarterly newsletters help clarify the terminology around sensory integration, as the field is in the midst of a terminology shift. The term *sensory processing* is used frequently in regards to the underlying neurological processes subserving sensory integration theory so as to be more in alignment with current neuroscience terminology.

While specific terminology varies somewhat from one author to another, the literature describes essentially the same subgroups of children Ayres originally identified. The systematic review by Davies and Tucker (2010) supports subtypes of sensory modulation (most often sensory over-responsivity), praxis deficits in areas of somatodyspraxia and in bilateral coordination and sequencing, and deficits in processing of sensory discrimination skills.

There is a great deal of research specifically supporting sensory over-responsivity as a unique disorder. Reynolds and Lane (2008) conducted a review of neurophysiological research on sensory over-responsivity and found numerous examples of children with sensory over-responsivity responding differently than children in other diagnostic groups. Their findings were supported with three prospective case studies of children demonstrating sensory over-responsivity and no other diagnoses. While not all subtypes identified as part of the sensory integration frame of reference have been examined, this is compelling information.

Epidemiological studies that investigated the incidence of sensory processing and sensory integration problems found a

conservative estimate of 5% incidence of sensory modulation problems in a kindergarten population (Ahn, Miller, Milberger, & McIntosh, 2004). A larger, district-wide study found an incidence of 16.5% (Ben-Sasson, Carter, & Briggs-Gowan, 2009; Carter, Ben-Sasson, & Briggs-Gowan, 2011). This incidence is even higher for children with autism, with estimates over 90% (Ben-Sasson et al., 2007).

Studies examining the etiology of sensory processing problems identify a genetic component to sensory over-responsivity to touch and auditory information (Keuler, Schmidt, Van Hulle, Lemery-Chalfant, & Goldsmith, 2011; Van Hulle, Schmidt, & Goldsmith, 2012). Other articles indicate possible prenatal and early childhood markers that might help with early identification of sensory processing and sensory integration issues (May-Benson, Koomar, & Teasdale, 2009). These authors found multiple risk factors which included maternal stress, birth and delivery factors, early health issues, and delayed developmental milestones. Prognosis can only be inferred from reports of adults with sensory processing and sensory integration problems, which suggest higher amounts of anxiety, depression, social isolation, and reduced quality of life (Kinnealey, Koenig, & Smith, 2011; May-Benson, 2011).

Selection and Interpretation of Assessments

Selection and interpretation of assessments, important for accurately identifying the disorder, helps establish a link between sensory processing issues, function, and performance of occupations. Practice guidelines by Watling et al. (2011) provide information in this area. AOTA's systematic review on performance challenges for children with difficulty processing and integrating sensory information (Koenig & Rudney, 2010) documents more than 35 articles of children with sensory processing challenges demonstrating difficulties in key areas of occupational performance, including play and leisure, social participation, activities of daily living, instrumental activities of daily living, rest and sleep, education, and work. However, the link between specific sensory and motor issues and specific functional outcomes is not fully established (Bar-Shalita, Vatine, & Parush, 2008; Cosbey, Johnston, & Dunn, 2010).

The most common assessment used to evaluate sensory processing and sensory integration problems is the Sensory Integration and Praxis Tests (SIPT; Ayres, 1989). More than 45 articles have appeared in *AJOT* after the initial publication of the SIPT test manual that examine aspects of the test's reliability and validity. Surprisingly, only three articles were published in the past 5 years (Asher, Parham, & Knox, 2008; Bundy, Shia, Qi, & Miller, 2007; Mailloux et al., 2011).

Parent, teacher, or caregiver questionnaires often supplement standardized tests and clinical observations. Numerous articles are available on the Sensory Profile (Dunn, 1999) as well as an article on the newer Sensory Processing Measure (Miller-Kuhaneck, Henry, Glennon, & Mu, 2007). In addition, assessments in development include an examiner-administered scale of sensory modulation (Schoen, Miller, & Green, 2008), an assessment of ideational praxis (May-Benson & Cermak, 2007) and of gravitational insecurity (May-Benson & Koomar, 2007). These tools are useful in identifying the patterns of dysfunction identified in sensory integration theory.

Evidence for Sensory Integration Intervention

The neuroscience evidence for sensory integration theory and intervention, beginning with the work of Ayres, is quite strong and is well summarized in the AOTA systematic review on the neuroscience foundations of sensory integration (Lane & Schaaf, 2010). This report cites multiple animal studies that provided enhanced sensory experiences resulting in increased neuronal growth and brain activity. Findings were replicated in humans across the age span and supported through neuroimaging techniques.

Sensory integration intervention as originally identified by Jean Ayres is now identified as Ayres Sensory Integration® (ASI; Smith Roley, Mailloux, Miller-Kuhaneck, & Glennon, 2007). A fidelity instrument defines key components of ASI (Parham et al., 2011). Care must be taken when reviewing the literature, as many investigators are not in fact providing sensory integration intervention. Ten core components need to be present for the intervention to be called sensory integration. Therapists are encouraged to use the fundamental concepts of the fidelity instrument to evaluate their own therapy sessions. This tool may also be helpful to therapists when trying to articulate to other professionals what we do in practice.

AOTA systematic reviews on interventions for challenges in sensory processing and sensory integration provide essential information regarding the positive outcomes obtained when using this frame of reference (Case-Smith & Arbesman, 2008; May-Benson & Koomar, 2010). Areas highlighted include sensorimotor skills and motor planning; socialization, attention, and behavioral regulation; reading and reading-related skills; and individualized goals. Practice guidelines for children with sensory processing problems (Watling et al., 2011) and with autism (Tomchek & Case-Smith, 2009) are helpful in implementing sensory integration interventions. A systematic review of other interventions for sensory processing problems supports the use of alternative sensory-based and cognitive approaches, which might help school-based practitioners (Polatajko & Cantin, 2010).

Several qualitative articles on parent perceptions of their children's sensory integration-based occupational therapy services (Cohn, 2001; Cohn, Miller, & Tickle-Degnen, 2000) suggest that parents most value their child's ability to participate in home, school, and social activities and that they believe increased participation is a major area of improvement following therapy services. A relation between a parent's sense of competence and the child's challenges with sensory integration has also been reported (Cohn, May-Benson, & Teasdale, 2011). The literature clearly supports that a child's sensory integration and sensory processing difficulties affect the parents and the family, especially if the parent also has sensory integration problems (Turner, Cohn, & Koomar, in press).

Applying Research to Clinical Practice

The application of sensory integration principles within the occupational therapy framework is well articulated for practice models across different settings (AOTA, 2009, 2010; Polcyn & Bissell, 2005). Useful educational materials from AOTA for parents and teachers

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include fact sheets and FAQs (Bissell, Watling, Summers, Dostal, & Bodison, 2008; Bodison, Watling, Miller-Kuhaneck, & Henry, 2008) as well as a PowerPoint presentation on sensory integration (Watling & Schefkind, 2010).

Reflecting on the research evidence, it can be concluded that occupational therapists using the sensory integration frame of reference are engaged in the core activities of EBP. Neurobiological foundations of sensory integration theory and intervention are supported directly and indirectly from animal studies, and the foundations of sensory integration are well documented in the literature. Research on intervention supports the outcomes clinicians see in practice. Additional well-designed studies are needed to fully establish the efficacy of sensory integration-based occupational therapy, but with the establishment of a fidelity measure, the awareness of the need for individual outcomes focused on participation and function, and the increased rigor of recent intervention studies, the efficacy literature for this intervention will continue to move forward. ■

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