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Sensory Integration

More than thirty years after the term *sensory integration* first appeared in the literature (Ayres, 1972) controversy continues to swirl around both the theory and its application. Many occupational therapists use sensory integration theory to guide their practice with children with a variety of developmental disorders. They firmly believe, along with many parents, that sensory integration therapy is effective and that it makes an important difference to the lives of these children. Critics of sensory integration argue that the assumptions upon which treatment is based are flawed. They question the existence of disorders in sensory integration and point to the growing body of research evidence that demonstrates a lack of treatment efficacy (Gresham, Beebe-Frankenburger, & MacMillan, 1999; Hoehn & Baumeister, 1994; Smith, Mruzek, & Mozingo, 2005). It has been five years since our last review and the use of sensory integration and the controversy continues, so we felt it was timely to update our review of the evidence.

What is Sensory Integration?

Sensory integration is defined as "the organization of sensory information for use" (Ayres, 1972). It is a process occurring in the brain that enables us to make sense of our world by receiving, registering, modulating, organizing and interpreting information that comes to our brains from our senses. We typically think of five senses; vision, hearing, smell, taste and touch. These senses give us information about the world around us, and how we are interacting with our environment. There are also some internal senses, however, that tell us about:

- the position of different parts of our bodies (proprioception);
- how our bodies are moving (kinesthesia);
- our position in space and in relation to gravity (vestibular).

The brain processes all the information received by our senses, usually at an unconscious level, organizes it, and allows us to respond appropriately, for example, to move efficiently, to attend and listen, to learn new skills.

Jean Ayres, an American occupational therapist, described this process in the 1950s and called it sensory integration. Since that time, much work has been done by Dr. Ayres and others, to try to understand the process, to understand what happens when the information is not integrated properly and to develop treatment methods to help children who experience problems in this area.

How does Sensory Integrative Dysfunction present in children?

Because we cannot actually see how the brain is processing information, we rely on observations of a child's behaviour to try to determine what that suggests about what is happening in the brain. Children with developmental disorders such as autism, learning disabilities, or attention deficit disorders, sometimes present with one or more of the following behaviours: over or under sensitivity to touch and/or movement experiences, easy distractability, clumsiness, trouble organizing themselves and their work, emotional reactivity, trouble learning new skills, low frustration tolerance, and/or difficulty making transitions between activities or situations. Many of these behaviours are also seen occasionally in typically developing children. It is hypothesized however, that some of these behaviours may be a reflection of difficulties processing sensory information. A child may react inappropriately because he/she is understanding information differently. What may feel like a light touch to someone else, may feel threatening to a child. If he can't feel where his body is positioned, he will have a hard time swinging a bat and connecting with a baseball. If she is irritated and distracted by the sensation of her shirt sleeves on the skin of her arms, she won't be able to listen for the instructions in class.

Parents of children who have a variety of developmental disorders describe behaviours in their children that could be reflective of difficulties processing sensory input. A variety of checklists, observational assessments and questionnaires exist to measure these behaviours. The Sensory Profile (Dunn, 1999) is a recently developed tool that assesses children's responses to sensory input through a variety of sensory channels. The Sensory Profile does not diagnose children, but rather shows their profile of responses to sensory input. This measure has been rigorously designed and tested and indicates that children with ADHD (Dunn & Bennett, 2002), aspergers (Dunn, Myles, & Orr, 2002) and autism (Keintz & Dunn, 1997) appear to have differences from typically developing children in their responses to sensation. Some therapists continue to use the Sensory Integration and Praxis Tests (Ayres, 1989) which are a series of 17 standardized tests that are designed to identify sensory integrative dysfunction. More recently, some researchers have used the measurement of electrodermal activity (changes in the conductivity of the skin related to nervous system activity) to identify differences between typically developing children and those with developmental disorders (Mangeot et al., 2001; Miller et al., 1999; Schaaf, Miller, Seawell, & O'Keefe, 2003). Some authors argue however, that, despite the development of these assessment tools, there are "currently no objective, validated methods for identifying sensory integrative dysfunction." (Smith et al., 2005, p.334). Heilbroner (2005) suggests these sensory processing differences do not represent a distinct disorder but are markers of neurodevelopmental immaturity or symptoms of anxiety. In addition to clinically-based assessments, there has also been a proliferation of information on websites and a number of books have been published over the past few years which are designed to help parents understand their child's sensory processing issues (Biel & Peske, 2005; Heller, 2002; Kranowitz, 1998; 2003; Myles, Cook, Miller, Rinner, & Robbins, 2000; Smith & Gouze, 2004). Clearly, from the perspective of parents, something about this topic resonates.

What is Sensory Integration Therapy?

If children are experiencing a sensory integrative dysfunction, the next logical question is "how can we treat the problem?" Sensory integration therapy (SIT) is a treatment approach, originally developed by Jean Ayres (1972) that aims to provide the child with graded sensory experiences. These experiences are matched during therapy with a "just right" challenge, an activity that requires the child to give an adaptive response. It is typically carried out by an occupational therapist who has training and expertise in sensory integration. SIT is an active therapy. The child must be motivated by and engaged in the activities; hence, play is the medium of choice. Activities usually involve the use of large pieces of equipment such as big rolls and balls, trampolines, swinging hammocks, which provide intense proprioceptive, vestibular and tactile experiences. The child is encouraged to explore the equipment and the therapist sets up the activities and the environment to challenge the child to use his/her sensory input to organize an adaptive response. This form of SIT is now referred to as "classical" SIT (Parham & Mailloux, 2005). It typically involves one-to-one direct intervention in an environment that has a variety of specialized equipment.

Occupational therapists may use other forms of intervention which are based on sensory integration theory, but which differ from these classical methods. Some therapists, for example, use a sensory integration framework to help explain children's behaviour or to work with parents and school personnel to adapt the child's environment in ways that will facilitate the child's ability to participate. This approach may include modifications to the child's clothing, altering room configurations, noise or light levels, or experimenting with food textures. Other methods

may be more direct, including those developed by Wilbarger (1995) that promote the use of a specific type of sensory input to reduce hypersensitivity. Williams and Shellenberger (1996) developed a program that combines a cognitive-behavioural approach with sensory integration to help children to learn to regulate their behaviour. These approaches are designed to help children function to the best of their ability given their sensory processing capabilities as opposed to trying to change their underlying neurological functioning. In this way, they are distinct from classical SIT.

Is Sensory Integration Therapy effective?

Over the past 30 years a number of research studies have been conducted to investigate whether SIT is effective with children and adults (Daems, 1994). The majority of studies have focused on the use of "classical" SIT with children with learning disabilities and have aimed at improving motor skills, academic performance, behavioural performance and/or sensory and perceptual skills. The results from studies published in the 1970s and early 1980s were very promising; however as research methodologies have become more rigorous, the results have been less favourable for SIT. One study using meta-analysis (a method for combining the results from many different studies) confirms this finding (Vargas & Camilli, 1999). Analysis of more recent, and better-designed studies that compared SIT to a no-treatment control group did not find any significant effects. In other words, children receiving SIT improved no more than children who received no treatment at all. When SIT has been compared to alternative treatments such as perceptual motor therapy and academic tutoring, there has been no difference in effect (Vargas & Camilli, 1999).

The effectiveness research over the past few years has focused on children with autism spectrum disorders and issues related to sensory processing problems. Recent studies, using single-subject research designs, have shown some positive effects that resulted from efforts to decrease the child's hyper-responsiveness to sensory input through classical SIT (Case-Smith & Bryan, 1999; Linderman & Stewart, 1999) and deep pressure techniques (Edelson, Edelson, Kerr, & Grandin, 1999). The use of weighted vests (a technique to provide deep pressure sensation) has been evaluated, using single-subject designs, in a few children with ADHD and pervasive developmental disorders: results showed some increase in on-task behaviour and a decrease in self-stimulatory behaviours (Fertel-Daly, Bedell, & Hinojsa, 2001; Smith, Press, Koenig, & Kinnealey, 2005;VandenBerg, 2001).

Sensory integration literature continues to be produced and studies conducted primarily in the field of occupational therapy. Descriptive articles (Olson & Moulton, 2004), research reviews (Mulligan, 2003; Schaaf & Miller, 2005) case reports (Kinnealey, 1998) and anecdotal parent reports support the idea that behavioural changes can result from the use of sensory integration techniques. Changes such as increased engagement, more goal-directed play, improved sleep patterns, reduced anxiety and increased tolerance for change have been reported (Cohn, 2001; Stonefelt & Stein, 1998). Quasi-experimental research where pre-post measurement has been completed to evaluate change in participants after sensory integration based programming has been published since our last review (Candler, 2003; Paul et al., 2003). These studies have shown positive changes, but given the limitations of the research design, they cannot make a significant contribution to the body of knowledge on treatment efficacy. There have been no large scale, rigorously designed effectiveness studies conducted in the past 10 years.

Research findings are of concern to those therapists and parents who believe that they see positive changes in the children treated using SIT and to those who want to base their practices on strong evidence. Certainly there are limitations in the research and there is room for some criticism. Sample sizes of most studies remain quite small, treatment protocols and therapist approaches vary. Individual gains may be masked within group designs and the distinction between SIT and alternative therapies may be blurred. Nonetheless, the decision to provide sensory integration therapy should be carefully considered. SIT is a resource-intensive intervention and the time and resources devoted to this therapy mean that the child is not receiving another type of intervention during that time. Without solid evidence that SIT is more effective than alternative therapies, it is difficult to support its usage.

What are the implications for clinical practice?

In summary, the topic of sensory integration dysfunction remains contentious. Its theoretical underpinnings, its existence as a distinct disorder and the effectiveness of treatment approaches based on the theory are still under

debate. Given the current state of the evidence, it is important for clinicians to clearly explain the evidence to families so they are making an informed choice. The following guidelines should be considered:

1) If parents and therapists decide to go ahead and use SIT, it should always be approached as a trial. Clear, measurable, functional outcomes should be established.
2) A baseline period of measurement should be undertaken prior to the initiation of treatment.
3) Education of families, teachers and other team members should always accompany the therapy.
4) Attention should be given to adapting the child's environment to maximize his/her performance.
5) Re-assessment using the pre-established outcomes should take place after 8 - 10 weeks of intervention. If SIT is going to be an effective intervention, positive benefits will be evident by then. If these benefits are not apparent, another approach should be investigated.

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References

1. Ayres, A. J. (1972). *Sensory integration and learning disorders.* Los Angeles, CA: Western Psychological Services.
2. Ayres, A. J. (1989). *Sensory integration and praxis test.* Los Angeles, CA: Western Psychological Services.
3. Biel, L., & Peske, N. (2005). *Raising a sensory smart child: The definitive handbook to helping your child with sensory integration issues.* New York, NY: Penguin.
4. Candler, C. (2003). Sensory integration and therapeutic riding at summer camp: Occupational performance outcomes. *Physical and occupational therapy in pediatrics*, *23*, 51-64.
5. Case-Smith, J, & Bryan, T. (1999). The effects of occupational therapy with sensory integration emphasis on preschool age children with autism. *American Journal of Occupational Therapy, 53,* 489-497.
6. Cohn, E. S. (2001). Parent perspectives of occupational therapy using a sensory integrative approach. *American Journal of Occupational Therapy, 55,* 285-294.
7. Daems, J. (1994). *Reviews of research in sensory integration*. Torrance, CA: Sensory Integration International.
8. Dunn, W. (1999). *The Sensory Profile.* San Antonio, TX: Psycorp.
9. Dunn, W., & Bennett, D. (2002). Patterns of sensory processing in children with attention deficit hyperactivity disorder. *Occupational Therapy Journal of Research, 22,* 4-15.

10. Dunn, W., Myles, B., & Orr, S. (2002). Sensory processing issues associated with aspergers syndrome: A preliminary investigation. *American Journal of Occupational Therapy, 56,* 97-102.

11. Edelson, S. M., Edelson, M.G., Kerr, D., & Grandin, T. (1999). Behavioural and physiological effects of deep pressure on children with autism: A pilot study evaluating the efficacy of Grandin's hug machine. *American Journal of Occupational Therapy, 53,* 145-152.

12. Fertel-Daly, D., Bedell, G., Hinojsa, J. (2001). Effects of a weighted vest on attention to task and self-stimulatory behaviors in preschoolers with pervasive developmental disorders. *American Journal of Occupational Therapy, 55,* 829-840.

13. Gresham, F.M., Beebe-Frankenburger, M.E., & MacMillan, D. L. (1999). A selective review of treatments for children with autism: description and methodological considerations. *School Psychology Review, 28,* 559-576.

14. Heilbroner, P.L. (2005). *Why "sensory integration disorder" is a dubious diagnosis*. Retrieved February 7, 2006 from http://www/quackwatch.org

15. Heller, S. (2002). *Too loud, too bright, too fast, too tight: What to do if you are sensory defensive in an overstimulating world*. New York, NY: Harper Collins.

16. Hoehn, T., & Baumeister, A. (1994). A critique of the application of sensory integration therapy to children with learning disabilities. *Journal of Learning Disabilities, 27,* 338-350.

17. Keintz, M.A., & Dunn, W. (1997). Comparison of the performance of children with and without autism on the Sensory Profile. *American Journal of Occupational Therapy, 51,* 530-537.

18. Kinnealey, M. (1998). Princess or tyrant: A case report of a child with sensory defensiveness. *Occupational Therapy International, 5,* 293-303.

19. Kranowitz, C. S. (1998). *The out-of-sync child.* New York, NY: Penguin Putnam Inc.

20. Kranowitz, C. S. (2003). *The out-of-sync child has fun.* New York, NY: Penguin Putnam Inc.

21. Linderman, T, & Stewart, D. (1999). Sensory integrative-based occupational therapy and functional outcomes in young children with pervasive developmental disorders: A single subject study. *American Journal of Occupational Therapy, 53,* 145-152.

22. Mangeot, S.D., Miller, L.J., McIntosh, D.N., McGrath-Clarke, J., Simon, J., Hagerman, R.J., & Goldson, E. (2001). Sensory modulation dysfunction in children with attention-deficit hyperactivity disorder. *Developmental Medicine and Child Neurology, 43:* 399-406.

23. Miller, L.J., McIntosh, D.N., McGrath, J., Shyu, V., Lampe, M., Taylor, A.K., et al. (1999). Electrodermal responses to sensory stimuli in individuals with Fragile X syndrome: a preliminary report. *American Journal of Medical Genetics, 83,* 268-279.

24. Mulligan, S. (2003). Examination of the evidence for occupational therapy using a sensory integration framework with children: Part two. *Sensory Integration Special Interest Section Quarterly, 26(2),* 1-5.

25. Myles, B. S., Cook, K.T., Miller, N.E., Rinner, L., & Robbins, L.A. (2000). *Asperger syndrome and sensory issues: Practical solutions for making sense of the world*. Shawnee Mission, Kansas: Autism Asperger Publishing Co.

26. Olson, L.J., & Moulton, H.J. (2004). Occupational therapists' reported experiences using weighted vests with children with specific developmental disorders. *Occupational Therapy International, 11,* 52-66.

27. Parham, L.D., & Mailloux, Z. (2005). Sensory Integration. In J. Case-Smith (Ed.) *Occupational therapy for children (5th edition)* pp 356-411. St. Louis, MO: Elsevier Inc.

28. Paul, S., Sinen, P., Johnson, J., Latshaw, C., Newton, J., Nelson, A., & Powers, R. (2003). The effects of a sensory motor activities protocol based on the theory of sensory integration on children with preprimary impairments. *Occupational Therapy in Health Care, 17,* 19-34.

29. Schaaf, R.C., Miller, L. J., Seawell, D., & O'Keefe, S. (2003). Preliminary study of parasympathetic functioning in children with sensory modulation dysfunction and its relation to occupation. *American Journal of Occupational Therapy, 57,* 442-449.

30. Schaaf, R.C., & Miller, L. J. (2005). Occupational therapy using a sensory integrative approach for children with developmental disabilities. *Mental Retardation and Developmental Disabilities, 11,* 143-148.

31. Smith, K.A., & Gouze, K.R. (2004). *The sensory sensitive child: Practical solutions for out-of- bounds behaviour.* New York, NY: Harper Collins.

32. Smith, T., Mruzek, D. W., & Mozingo, D. (2005). Sensory integrative therapy. In J.W. Jacobson, R.M. Foxx, J.A. Mulick (Eds.) *Controversial therapies for developmental disabilities*. (pp.331-350) Mahwah, NJ: Lawrence Erlbaun Assoc.

33. Smith, S.A., Press, B., Koenig, K.P., & Kinnealey, M. (2005). Effects of sensory integration intervention on self-stimulating and self-injurious behaviours. *American Journal of Occupational Therapy, 59,* 418-425.

34. Stonefelt, L., & Stein, F. (1998). Sensory integrative techniques applied to children with learning disabilities: An outcome study. *Occupational Therapy International, 5,* 252-272.

35. VandenBerg, N. (2001). The use of a weighted vest to increase on task behavior in children with attention difficulties. *American Journal of Occupational Therapy, 55,* 621-628.

36. Vargas, S., & Camilli, G. (1999). A meta-analysis of research on sensory integration treatment. *American Journal of Occupational Therapy, 53,* 189-198.

37. Wilbarger, P. (1995). The sensory diet: Activity programs based on sensory processing theory. *Sensory Integration Special Interest Section Newsletter, 18(2),* 1-4.

38. Williams, M.S., & Shellenberger, S. (1996). *How does your engine run? A leader's guide to the Alert program for self-regulation.* Albuquerque, NM: Therapy Works.

Other studies reviewed and related reading

1. Greenspan, S. & Wieder, S. (1997). Developmental patterns and outcomes in infants and children with disorders in relating and communicating: A chart review of 200 cases of children with autism spectrum disorders. *Journal of Developmental and Learning Disorders, 1,* 87-142.

2. Humphries, T., Snider, L., & McDougall, B. (1993). Clinical evaluation of the effectiveness of sensory integrative and perceptual motor therapy in improving sensory integrative function in children with learning disabilities. *Occupational Therapy Journal of Research, 13,* 163-182.

3. Humphries, T., Wright, M., McDougall, B., & Vertes, J. (1990). The efficacy of sensory integration therapy for children with learning disability. *Physical and Occupational Therapy in Pediatrics, 10(3),* 1-17.

4. Kaplan, B., Polatajko, H., Wilson, B., & Faris, P. (1993). Reexamination of sensory integration treatment: A combination of two efficacy studies. *Journal of Learning Disabilities, 26,* 342-347.

5. Polatajko, H., Law, M., Miller, J., Schaffer, R., & Macnab, J. (1991). The effect of a sensory integration program on academic achievement, motor performance, and self-esteem in children identified as learning disabled: Results of a clinical trial. *Occupational Therapy Journal of Research, 11,* 155-176.

6. Wilson, B., Kaplan, B., Fellowes, S., Gruchy, C., & Faris, P. (1992). The efficacy of sensory integration treatment compared to tutoring. *Physical and Occupational Therapy in Pediatrics, 12 (1),* 1-36.

7. Ziviani, J., Poulsen, A., & O'Brien, A. (1982). Effect of a sensory integrative/ neurodevelopmental programme on motor and academic performance of children with learning disabilities. *Australian Occupational Therapy Journal, 29,* 27-33.