

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Sensory Integration Therapies for Children With Developmental and Behavioral Disorders

SECTION ON COMPLEMENTARY AND INTEGRATIVE MEDICINE and
COUNCIL ON CHILDREN WITH DISABILITIES

Pediatrics; originally published online May 28, 2012;
DOI: 10.1542/peds.2012-0876

The online version of this article, along with updated information and services, is
located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/early/2012/05/23/peds.2012-0876>

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2012 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™





POLICY STATEMENT

Sensory Integration Therapies for Children With Developmental and Behavioral Disorders

abstract

FREE

Sensory-based therapies are increasingly used by occupational therapists and sometimes by other types of therapists in treatment of children with developmental and behavioral disorders. Sensory-based therapies involve activities that are believed to organize the sensory system by providing vestibular, proprioceptive, auditory, and tactile inputs. Brushes, swings, balls, and other specially designed therapeutic or recreational equipment are used to provide these inputs. However, it is unclear whether children who present with sensory-based problems have an actual “disorder” of the sensory pathways of the brain or whether these deficits are characteristics associated with other developmental and behavioral disorders. Because there is no universally accepted framework for diagnosis, sensory processing disorder generally should not be diagnosed. Other developmental and behavioral disorders must always be considered, and a thorough evaluation should be completed. Difficulty tolerating or processing sensory information is a characteristic that may be seen in many developmental behavioral disorders, including autism spectrum disorders, attention-deficit/hyperactivity disorder, developmental coordination disorders, and childhood anxiety disorders. Occupational therapy with the use of sensory-based therapies may be acceptable as one of the components of a comprehensive treatment plan. However, parents should be informed that the amount of research regarding the effectiveness of sensory integration therapy is limited and inconclusive. Important roles for pediatricians and other clinicians may include discussing these limitations with parents, talking with families about a trial period of sensory integration therapy, and teaching families how to evaluate the effectiveness of a therapy. *Pediatrics* 2012;129:1186–1189

BACKGROUND: DEVELOPMENT OF THE SENSORY SYSTEM

Sensory integration is a framework first described by occupational therapist A. Jean Ayres, PhD, in the 1970s. It refers to the body's way of handling and processing sensory inputs from the environment.¹ Ayres felt that the sensory system develops over time, much like other aspects of development (language, motor, etc), and that deficits can occur in the process of developing a well-organized sensory system. A well-organized sensory system can integrate input from multiple sources (visual, auditory, proprioceptive, or vestibular). Ayres postulated that sensory integration dysfunction occurs when sensory neurons are not signaling or functioning efficiently, leading to deficits in development, learning, and/or emotional regulation.

SECTION ON COMPLEMENTARY AND INTEGRATIVE MEDICINE
and COUNCIL ON CHILDREN WITH DISABILITIES**KEY WORDS**

sensory integration, sensory processing, sensory integration therapy

This document is copyrighted and is property of the American Academy of Pediatrics and its Board of Directors. All authors have filed conflict of interest statements with the American Academy of Pediatrics. Any conflicts have been resolved through a process approved by the Board of Directors. The American Academy of Pediatrics has neither solicited nor accepted any commercial involvement in the development of the content of this publication.

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

www.pediatrics.org/cgi/doi/10.1542/peds.2012-0876

doi:10.1542/peds.2012-0876

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2012 by the American Academy of Pediatrics

The ability of the brain to process sensory information from the environment has been an expanding area of basic neuroscience research. Hubel and Wiesel were among the first to document the important effects of early experience (eg, deprivation) on the way visual sensory input is processed in the brain.²⁻⁵ Animal and human research is beginning to explore how other senses are processed and integrated⁶⁻¹⁰ and how those processes are disrupted in specific syndromes (eg, autism,^{11,12} schizophrenia^{13,14}) and by specific experiences (eg, institutionalization, international adoption^{15,16}).

STATEMENT OF THE PROBLEM

Since Ayres¹ described sensory integration dysfunction in the 1970s, sensory-based therapies have been used increasingly, mainly by occupational therapists (but sometimes other health professionals) to treat a range of symptoms seen in children presenting from across a variety of settings, including the home, community organizations, clinics, and schools. Sensory integration, sensory “diets,” and other sensory-based therapies typically are based on classic sensory integration theory but often do not use all of the originally described sensory integration protocols. Sensory-based therapies involve activities that are believed to organize the sensory system, by providing vestibular, proprioceptive, auditory, and tactile inputs, by using brushes, swings, balls, and other specially designed equipment to provide these inputs. Occupational therapists and other health professionals may also use a sensory processing approach when identifying and modifying barriers that limit the individual's ability to participate in everyday activities or occupations.

Proponents of sensory integration theory believe that inappropriate or deficient sensory processing is

a developmental disorder amenable to therapy and that treatment can improve developmental outcomes.¹⁷ A definition of sensory processing disorder has been proposed but has not been universally accepted.¹⁸ Standardized measures, such as the Sensory Profile,¹⁹ have been developed to classify a child's sensory deficits. The Sensory Profile provides a standard method for professionals to measure a child's sensory processing abilities and to provide a profile of the effect of sensory processing on functional performance in the daily life of a child.²⁰ Such standardized measures are commonly used by occupational therapists to quantify how much these developmental and behavioral differences affect the child's functional performance of the daily activities of childhood.

The possible diagnosis of sensory processing disorders remains a challenging clinical issue. In the sensory processing disorder classification system proposed by Miller et al,¹⁸ sensory processing disorders are subdivided into 3 specific patterns: sensory modulation disorder, sensory discrimination disorder, and sensory-based motor disability. These patterns are then categorized into subtypes. Sensory modulation disorder is subdivided into overresponsive, underresponsive, and sensory seeking/craving subtypes. Sensory discrimination disorder has no subtypes. Sensory-based motor disability is subdivided into postural disorder and dyspraxia.

Sensory processing disorder or a similar diagnosis has been included in Zero to Three's *Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood Revised*²¹ and the *Diagnostic Manual for Infancy and Early Childhood of the Interdisciplinary Council on Developmental and Learning Disorders*,²² where “regulatory-sensory processing disorder” in infants has also been classified as a developmental

difference for this group. For older children and adolescents, no commonly accepted definition of sensory processing disorder exists. Some experts have proposed that the definition of autism spectrum disorders in the forthcoming *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* be expanded to include definitions of associated sensory issues, such as under- and over-responsiveness; however, the committee that is preparing the textbook has requested that more studies be performed before sensory processing disorder can be officially recognized.²³

It remains unclear whether children who present with findings described as sensory processing difficulties have an actual “disorder” of the sensory pathways of the brain or whether these deficits represent differences associated with other developmental and behavioral disorders. Specifically, the behavioral differences seen in children with autism spectrum disorders,²⁴ attention-deficit/hyperactivity disorder,²⁵ and developmental coordination disorders²⁶ overlap symptoms described in children with sensory processing disorders. Studies to date have not demonstrated that sensory integration dysfunction exists as a separate disorder distinct from these other developmental disabilities. Furthermore, numerous challenges exist for evaluating the effectiveness of sensory integration therapy, including the wide spectrum of symptom severity and presentation, lack of consistent outcome measures, and family factors, which make response to therapy variable.²⁷⁻²⁹

Despite the challenges of defining and studying the effectiveness of sensory integration therapy, it is possible that the treatment of sensory processing difficulties is helpful to children who have problems identified in sensory processing measures. Some published case series and observational studies

have reported positive outcomes of sensory integration therapy for children with sensory processing disorders.^{27,29} Older meta-analyses^{30,31} and at least 2 more recent reviews^{32,33} have been published that suggested a positive trend in meeting occupational goals with the use of sensory integration therapy. However, the authors of the 1999 meta-analysis cautioned that most studies in the field were of insufficient scientific rigor to be included in a meta-analysis, studies varied in the use of outcome measures, and the ability to draw conclusions and detect a treatment effect was limited.³¹ Many of the more recent studies, unfortunately, share some of these traits.

One recent small study cautions health care practitioners about the possible negative behavioral effects of sensory integration therapy in certain populations. Devlin et al³⁴ reported on the comparative effects of sensory integration therapy and behavioral interventions on rates of challenging or self-injurious behavior in 4 children in whom autism spectrum disorder was diagnosed. A functional assessment was conducted to identify the variables maintaining the challenging behaviors. The sensory integration therapy was designed by an occupational therapist who was trained in sensory integration therapy. The sensory integration therapy and a behavioral intervention were compared within an alternating treatments design. Results from this study clearly demonstrated that the behavioral intervention was more effective in reducing challenging behavior and self-injurious behavior than was the sensory integration therapy. Finally, in the best treatment phase, only the behavioral intervention was implemented, and further reduction was observed in the frequency of challenging behavior and self-injurious behavior.

RECOMMENDATIONS

1. At this time, pediatricians should not use sensory processing disorder as a diagnosis. When these sensory symptoms are present, other developmental disorders—specifically, autism spectrum disorders, attention-deficit/hyperactivity disorder, developmental coordination disorder, and anxiety disorder—must be considered and thoroughly evaluated, usually by appropriate referral(s) to a developmental and behavioral pediatrician, child psychiatrist, or child psychologist. The American Academy of Pediatrics clinical report on the management of children with autism spectrum disorders is a useful resource to help with these referrals.³⁵
2. Pediatricians should recognize and communicate with families about the limited data on the use of sensory-based therapies for childhood developmental and behavioral problems.
3. If the pediatrician is managing a child whose therapist is using sensory-based therapies, the pediatrician can play an important role in teaching families how to determine whether a therapy is effective.
 - a. Help families design simple ways to monitor effects of treatment (eg, behavior diaries, pre-post behavior rating scales). Help the family be specific and create explicit treatment goals, designed at the onset of therapy, focused on improving the individual's ability to engage and participate in everyday activities (eg, ability to focus, tolerate foods, and be in a room with loud noises).
 - b. Set a time limit for seeing the family back to discuss whether the therapy is working to achieve the stated goals.

4. Pediatricians should inform families that occupational therapy is a limited resource, particularly the number of sessions available through schools and through insurance coverage. The family, pediatrician, and other clinicians should work together to prioritize treatment on the basis of the effects the sensory problems have on a child's ability to perform daily functions of childhood.

With input from the following committees/councils: COCWD, ASC, SOAI, COPACFH, SOAH, SODBP, SON, SOEH, and COCHF.

LEAD AUTHORS

Michelle Zimmer, MD
Larry Desch, MD

SECTION ON COMPLEMENTARY AND INTEGRATIVE MEDICINE EXECUTIVE COMMITTEE, 2011–2012

Lawrence D. Rosen, MD, Chairperson
Michelle L. Bailey, MD
David Becker, MD
Timothy P. Culbert, MD
Hilary McClafferty, MD
Olle Jane Z. Sahler, MD
Sunita Vohra, MD

LIAISON

Lt Col Della Livesay Howell, MD — *Section on Young Physicians*

STAFF

Teri Salus, MPA, CPC

COUNCIL ON CHILDREN WITH DISABILITIES EXECUTIVE COMMITTEE, 2011–2012

†Gregory S. Liptak, MD, MPH, Chairperson
Nancy A. Murphy, MD, Interim Chairperson
Richard C. Adams, MD
Robert T. Burke, MD, MPH
Sandra L. Friedman, MD
Amy J. Houtrow, MD, MPH
Miriam A. Kalichman, MD
Dennis Z. Kuo, MD, MHS
Susan Ellen Levy, MD
Kenneth W. Norwood Jr, MD
Renee M. Turchi, MD, MPH
Susan E. Wiley, MD

LIAISONS

Carolyn Bridgemohan, MD — *Section on Developmental and Behavioral Pediatrics*

Georgina Peacock, MD, MPH – *Centers for Disease Control and Prevention*
Bonnie Strickland, PhD – *Maternal and Child Health Bureau*

Nora Wells, MEd – *Family Voices*
Max Wiznitzer, MD – *Section on Neurology*

STAFF

Stephanie Mucha Skipper, MPH
† Deceased.

REFERENCES

- Ayres AJ. *Sensory Integration and the Child*. Los Angeles, CA: Western Psychological Services; 1979
- Hubel DH, Wiesel TN. Anatomical demonstration of columns in the monkey striate cortex. *Nature*. 1969;221(5182):747–750
- Hubel DH, Wiesel TN. The period of susceptibility to the physiological effects of unilateral eye closure in kittens. *J Physiol*. 1970;206(2):419–436
- Wiesel TN, Hubel DH. Effects of visual deprivation on morphology and physiology of cells in the cats lateral geniculate body. *J Neurophysiol*. 1963;26:978–993
- Wiesel TN, Hubel DH. Extent of recovery from the effects of visual deprivation in kittens. *J Neurophysiol*. 1965;28(6):1060–1072
- Hackett TA, Barkat TR, O'Brien BM, Hensch TK, Polley DB. Linking topography to tonotopy in the mouse auditory thalamocortical circuit. *J Neurosci*. 2011;31(8):2983–2995
- Polley DB, Hillyard AR, Spankovich C, Popescu MV, Royal DW, Wallace MT. Development and plasticity of intra- and intersensory information processing. *J Am Acad Audiol*. 2008;19(10):780–798
- Popescu MV, Polley DB. Monaural deprivation disrupts development of binaural selectivity in auditory midbrain and cortex. *Neuron*. 2010;65(5):718–731
- Störmer VS, McDonald JJ, Hillyard SA. Cross-modal cueing of attention alters appearance and early cortical processing of visual stimuli. *Proc Natl Acad Sci USA*. 2009;106(52):22456–22461
- Batterson VG, Rose SA, Yonas A, Grant KS, Sackett GP. The effect of experience on the development of tactual-visual transfer in pigtailed macaque monkeys. *Dev Psychobiol*. 2008;50(1):88–96
- Hardan AY, Minshew NJ, Melhem NM, et al. An MRI and proton spectroscopy study of the thalamus in children with autism. *Psychiatry Res*. 2008;163(2):97–105
- Gepner B, Féron F. Autism: a world changing too fast for a mis-wired brain? *Neurosci Biobehav Rev*. 2009;33(8):1227–1242
- Martínez A, Hillyard SA, Dias EC, et al. Magnocellular pathway impairment in schizophrenia: evidence from functional magnetic resonance imaging. *J Neurosci*. 2008;28(30):7492–7500
- Sehatpour P, Dias EC, Butler PD, et al. Impaired visual object processing across an occipital-frontal-hippocampal brain network in schizophrenia: an integrated neuroimaging study. *Arch Gen Psychiatry*. 2010;67(8):772–782
- Jacobs E, Miller LC, Tirella LG. Developmental and behavioral performance of internationally adopted preschoolers: a pilot study. *Child Psychiatry Hum Dev*. 2010;41(1):15–29
- Wilbarger J, Gunnar M, Schneider M, Pollak S. Sensory processing in internationally adopted, post-institutionalized children. *J Child Psychol Psychiatry*. 2010;51(10):1105–1114
- Ayres AJ. *Sensory Integration and Learning Disorders*. Los Angeles, CA: Western Psychological Services; 1972
- Miller LJ, Anzalone ME, Lane SJ, Cermak SA, Osten ET. Concept evolution in sensory integration: a proposed nosology for diagnosis. *Am J Occup Ther*. 2007;61(2):135–140
- Ermer J, Dunn W. The sensory profile: a discriminant analysis of children with and without disabilities. *Am J Occup Ther*. 1998;52(4):283–290
- Dunn W. *Sensory Profile*. San Antonio, TX: Psychological Corporation; 1999
- Zero to Three. Early childhood mental health. Available at: <http://www.zerotothree.org/child-development/early-childhood-mental-health/>. Accessed July 30, 2011
- Greenspan SI, Wieder S. The interdisciplinary council on developmental and learning disorders diagnostic manual for infants and young children - an overview. *J Can Acad Child Adolesc Psychiatry*. 2008;17(2):76–89
- American Psychiatric Association. DSM-5 development. Conditions proposed by outside sources. Available at: <http://www.dsm5.org/proposedrevision/Pages/Conditions-Proposed-by-Outside-Sources.aspx>. Accessed July 27, 2011
- Cheung PP, Siu AM. A comparison of patterns of sensory processing in children with and without developmental disabilities. *Res Dev Disabil*. 2009;30(6):1468–1480
- Hender K. Effectiveness of sensory integration therapy for attention deficit hyperactivity disorder (ADHD). Evidence Centre Critical Appraisal. Series 2001: Intervention. Clayton, Victoria, Australia: Centre for Clinical Effectiveness, Monash Medical Centre; March 21, 2001
- White BP, Mulligan S, Merrill K, Wright J. An examination of the relationships between motor and process skills and scores on the sensory profile. *Am J Occup Ther*. 2007;61(2):154–160
- Tochel C. Sensory or auditory integration therapy for children with autistic spectrum disorders. *STEER*. 2003;3(17). London, UK: Wessex Institute for Health Research and Development, University of Southampton
- Lane SJ, Schaaf RC. Examining the neuroscience evidence for sensory-driven neuroplasticity: implications for sensory-based occupational therapy for children and adolescents. *Am J Occup Ther*. 2010;64(3):375–390
- Miller LJ, Coll JR, Schoen SA. A randomized controlled pilot study of the effectiveness of occupational therapy for children with sensory modulation disorder. *Am J Occup Ther*. 2007;61(2):228–238
- Ottenbacher K. Sensory integration therapy: affect or effect? *Am J Occup Ther*. 1982;36(9):571–578
- Vargas S, Camilli G. A meta-analysis of research on sensory integration treatment. *Am J Occup Ther*. 1999;53(2):189–198
- Baranek GT. Efficacy of sensory and motor interventions for children with autism. *J Autism Dev Disord*. 2002;32(5):397–422
- May-Benson TA, Koomar JA. Systematic review of the research evidence examining the effectiveness of interventions using a sensory integrative approach for children. *Am J Occup Ther*. 2010;64(3):403–414
- Devlin S, Healy O, Leader G, Hughes BM. Comparison of behavioral intervention and sensory-integration therapy in the treatment of challenging behavior. *J Autism Dev Disord*. 2011;41(10):1303–1320
- Myers SM, Johnson CP; American Academy of Pediatrics Council on Children With Disabilities. Management of children with autism spectrum disorders. *Pediatrics*. 2007;120(5):1162–1182

Sensory Integration Therapies for Children With Developmental and Behavioral Disorders

SECTION ON COMPLEMENTARY AND INTEGRATIVE MEDICINE and
COUNCIL ON CHILDREN WITH DISABILITIES

Pediatrics; originally published online May 28, 2012;

DOI: 10.1542/peds.2012-0876

Updated Information & Services	including high resolution figures, can be found at: http://pediatrics.aappublications.org/content/early/2012/05/23/peds.2012-0876
Post-Publication Peer Reviews (P³Rs)	One P ³ R has been posted to this article: http://pediatrics.aappublications.org/cgi/eletters/peds.2012-0876v1
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): Therapeutics & Toxicology http://pediatrics.aappublications.org/cgi/collection/therapeutics_and_toxicology
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://pediatrics.aappublications.org/site/misc/Permissions.xhtml
Reprints	Information about ordering reprints can be found online: http://pediatrics.aappublications.org/site/misc/reprints.xhtml

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2012 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

