



2012

Improving Dental Visits for Individuals with Autism Spectrum Disorders through an Understanding of Sensory Processing

Heather Miller Kuhaneck
Sacred Heart University, kuhaneckh@sacredheart.edu

Elizabeth Cipes Chisholm, DMD

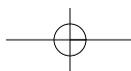
Follow this and additional works at: http://digitalcommons.sacredheart.edu/ot_fac

 Part of the [Dentistry Commons](#), and the [Special Education and Teaching Commons](#)

Recommended Citation

Kuhaneck, H. M. & Chisholm, E. C. (2012). Improving dental visits for individuals with autism spectrum disorders through an understanding of sensory processing. *Special Care in Dentistry* 32(6), 229–233. doi: 10.1111/j.1754-4505.2012.00283.x

This Peer-Reviewed Article is brought to you for free and open access by the Occupational Therapy at DigitalCommons@SHU. It has been accepted for inclusion in Occupational Therapy Faculty Publications by an authorized administrator of DigitalCommons@SHU. For more information, please contact ferribyp@sacredheart.edu, lysobeyb@sacredheart.edu.



ABSTRACT

The increasing prevalence of autism spectrum disorder (ASD) suggests that dental practices will be seeing patients with this diagnosis more frequently. Although patients with ASD have similar dental needs to other patients, the symptoms of the disorder may influence the ability of dental practitioners to provide necessary care. Dental professionals may be unaware of the difficulties with sensory processing common to patients with ASD. However, awareness of sensory processing issues and knowledge of strategies to improve the sensory experience for individuals with ASD may improve dental visits for these patients and allow for enhanced dental care provision.

KEY WORDS: autism, autism spectrum disorder, sensory processing, special care dentistry, sensory strategies

Improving dental visits for individuals with autism spectrum disorders through an understanding of sensory processing

Heather Miller Kuhaneck, PhD OTR/L, FAOTA;* Elizabeth Cipes Chisholm, DMD

Sacred Heart University, Occupational Therapy, Fairfield, Connecticut.
*Corresponding author e-mail: kuhaneckh@sacredheart.edu

Spec Care Dentist XX(X): 1-5, 2012

Introduction

Autism is a neurodevelopmental disorder with an unknown etiology and a wide-ranging functional impact. Autism is categorized as a Pervasive Developmental Disorder in the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (DSM).¹ The vastly differing abilities and difficulties evident in individuals diagnosed with autism, and the unclear boundaries around subtypes of the disorder, have led to the common usage of the term autism spectrum disorder (ASD), which will be the terminology used in the next DSM.² Individuals with ASD have impairments in the areas of social interaction, language, nonverbal behaviors, play and peer relationships, and stereotyped and repetitive behaviors.¹ Once considered a rare disorder, the prevalence of ASD has increased significantly. The most recent report from the Centers for Disease Control suggests a prevalence of 1 in 88 children.³ Similarly, a recent report from the American Academy of Pediatrics suggested a prevalence of 1 in 91 in children between the ages of 3 and 17.⁴ Therefore, dental practices that serve patients with special needs may frequently encounter people with ASD.

Although patients with ASD have similar dental needs to other patients, their unusual responses to sensation can disrupt a dental visit and make proper care difficult to provide.⁵

A growing body of evidence documents the atypical sensory processing associated with ASD.⁶⁻¹⁵ A thorough understanding of sensory defensiveness in particular may help make the dental visit more pleasant for the patient, more satisfying for the family, and more productive for the staff. The purpose of this paper is to help dental providers recognize behaviors associated with sensory processing difficulties in individuals with ASD, and provide appropriate and potentially effective interventions.

Sensory processing difficulties in individuals with ASD

Consideration of sensory processing among people with ASD is not new. As early as 1943, Kanner¹⁶ described individuals with fear of noises from machines, who repeatedly watched bowling pins fall, who sought out movement on swings, and who mouthed objects and flicked lights. Bergman and Escalona¹⁷ described in 1949 the first sensory-based hypothesis of autism whereby they believed children were overly sensitive and therefore developed defenses to the social world. In the 1960s, Rimland¹⁸ developed an under-arousal

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56



SENSORY PROCESSING AND DENTAL VISITS

hypothesis suggesting that the reticular activating system was functioning improperly and was impairing the ability of the child with autism to learn through pairing current and past experiences via sensation. A growing body of research⁶⁻¹³ suggests that people with ASD do have a variety of sensory processing difficulties. Although the prevalence of sensory processing difficulties in a community sample appears to be between 3.4% and 15.6% depending upon the criteria used,⁸ in samples of individuals with autism, sensory processing difficulties have been reported as high as 80–100%.⁶⁻¹⁵ In one study of the early characteristics of autism,¹⁹ 82.7% of parents noted that their child was “upset by particular sensations.” In self-reports,²⁰ individuals with autism report that touch aversions are common, certain types of sounds are frightening or uncomfortable, and auditory input may block the perception of other inputs. Some individuals speak of issues such as “channels getting crossed” when for example a sound is perceived as a color, and some speak of being overloaded by sensations.^{19,21,22} These difficulties are so commonly reported that the next version of the DSM will include atypical reactions to sensory input as a diagnostic feature of the disorder.²

Understanding sensory processing

Sensory integration²³ refers to the way the nervous system processes and organizes sensations from the body and the environment, to respond appropriately and interact effectively. The term *sensory processing*^{24,25} is often used interchangeably with the term *sensory integration*. Sensory processing refers to actions in the nervous system that allow interpretation of sensory input from the environment and the body. Components of sensory processing include receipt of sensory stimuli by sensory receptors, transmission of those inputs to and through the central nervous system via electrical impulses and chemical transmission, modulation, discrimination/perception, and multisensory integration. The outcome of

adequate sensory processing is an appropriate motor or behavioral response to the input. One specific type of sensory processing difficulty is sensory defensiveness, which is a behavioral overreaction to or extreme avoidance of common sensory experiences that others find tolerable.^{23,24} Sensory defensiveness can occur in any of the seven sensory systems: tactile (touch), vestibular (sense of movement in relation to gravity), auditory (sound), visual (sight), proprioceptive (position of our body parts, joints, and muscles as well as the amount of force being used with movement), gustatory (taste), and olfactory (smell).

Typical overreactions to sensations that others might not find noxious range from mild to severe, depending on the stimuli received and the child’s overall amount of exposure to the stimuli.^{6,7,9,23} An individual may be able to tolerate one type of stimulus but become more and more agitated if multiple stimuli are added.^{6,7,9,23} Responses may appear inconsistent, as they will depend upon the individual’s exposure to other stimuli throughout the day, before the current event.

Typically, an individual with sensory processing difficulties will demonstrate “flight or fight” behaviors.²³ First, the individual will try to escape from the distressing stimuli; if escape is not possible, the individual will likely become more and more physically reactive in an attempt to remove himself or herself from the input. Early fear or avoidance responses may escalate to physical aggression if the fear or discomfort is not respected and attended to.²³ The range of possible behaviors includes gaze aversion, physical withdrawal or hiding, pulling away, crying, blocking of the stimuli with arms or hands (i.e., covering ears or eyes), and vocal outbursts.²³ Extreme behaviors can include hitting, kicking, biting, pushing, tantrums, severe gagging, and vomiting.^{6,7,9,23}

Individuals with ASD and dental needs

The patient with ASD has dental needs similar to those of any other patient, but

these needs are often not being met.²⁶ Although parents reported that children with ASD and without ASD had similar occurrences of carious lesions, broken teeth needing repair, pain, misaligned teeth, hygiene, discoloration, enamel problems, and bruxism, they were more likely to report that their child with ASD had teeth that were in fair to poor condition.²⁶ Patients with ASD also have a significantly higher caries index in the primary dentition on initial examination when compared to controls, but no difference in the permanent dentition or on recall examinations.²⁷ A recent study²⁸ suggests that individuals with ASD are at high risk for caries. Another study²⁹ demonstrated that caries prevalence and severity was lower in a group with ASD than an unaffected group. However, more patients in the group with ASD required restorative and surgical dental treatment. According to the United States Department of Health and Human Services, many of the oral health problems faced by patients with ASD are due to damaging oral habits such as bruxism, tongue thrust, and self-injurious behavior; caries due to consumption of soft, sticky or sweet foods and difficulty with oral hygiene; periodontal disease, in particular gingivitis; and trauma and injury.³⁰ As a group, the dental needs of people with ASD are similar to the nonautistic population, but they are not being met, perhaps in part because of difficulties during dental examinations and procedures.

The reported level of cooperation of patients with ASD during the dental examination varies widely. One study²⁶ reported that 65% of patients with ASD had uncooperative behavior, with only 35% being cooperative. Predictors of limited cooperation were nonverbal behavior or minimal use of language, echolalia, inability to understand language at an age-appropriate level, inability to follow multi-step instructions, inability to read at 6+ -year-old level, attending special education, and attending a specialized classroom.²⁸ Another study²⁹ found that 55.2% of patients with ASD (vs. 25.4% of the group without ASD) showed uncooperative behavior with only 9.2%

SENSORY PROCESSING AND DENTAL VISITS

exhibiting definite positive behaviors (vs. 46.6% of unaffected group). A successful initial oral examination and bitewing radiographs were achieved for 50% of the patients with ASD.²⁷ Reported cooperation levels vary but it can be inferred that patients with ASD have lower levels of cooperation compared to their nonautistic counterparts.

The dental environment poses many challenges to patients with ASD. It presents the patient with sensory-stimulating activities, possible discomfort, and loss of control in an unfamiliar environment.³⁰ The invasive nature and extensive sensory stimulation of dental care must be taken into account to successfully treat these patients as many exhibit sensory processing difficulties.³¹

Sensory processing and the dental visit

The dental environment provides many sensory challenges to the patient with ASD. The dental provider needs to be cognizant of the sensory stimuli that the dental visit involves and be able to recognize the behaviors that may be evoked by those stimuli. However, many dentists report that they feel unprepared by their education to treat patients with autism.³² A patient with sensory defensiveness may exhibit the following behaviors during a dental visit.

Reaction to touch

1. Overreaction to unanticipated touch, particularly touch to the face and inside the mouth, which is an extremely sensitive area
2. Oversensitivity to the dental prophylaxis
3. Extreme dislike of the texture and grittiness of the polishing paste
4. Unusual responses to dental tools, X-ray materials, or gloved fingers in the mouth; may gag frequently or excessively.

Reaction to motion

1. Extreme fear responses as the dental chair reclines, including gripping the chair arms, reaching to hold the

hygienist or parent, or attempting to get up or turn around in the chair. Patients with defensiveness to motion will often be more sensitive to moving backward than forward.

Reaction to visual stimuli

1. Difficulty tolerating bright light
2. Fear of the hygienist and dentist when their faces are covered with a mask (wearing the mask highlights the eyes and covers the mouth, an area that many with autism look at when speaking with others, as they often avoid direct eye contact.)

Reaction to smells/tastes

1. Responses to the smell of the glove materials or the taste of the glove in the mouth
2. Refusal to allow paste to be used, due to taste or smell
3. Overreaction to the odors of perfumes or soaps used by staff members or other patients

Reaction to sounds

1. Fear responses to the sounds of the dental equipment, especially the polishing brush, suction, and high-speed handpieces. Fear responses to unexpected office noises such as intercoms, door alarms, and beeps
2. Aversive responses to other people talking or laughing in the dental clinic

How to improve the dental visit by altering the sensory experience

A variety of techniques and strategies may be used to help patients with ASD better deal with dental visits. First, procedures and environments can be modified to reduce sensory stimuli; second, the application of specific intervention strategies may help the patient to better handle uncomfortable sensations.²² There are a variety of strategies to attempt with each patient, and a discussion with the caregiver should help the dental professional narrow down which

methods to try first. Each patient will respond differently and different strategies will work for different patients.

Modifications to procedures and environments:

1. Verbal preparation: A patient with sensory defensiveness will best be able to handle discomforting inputs when they are expected and predictable.²³ Therefore, using verbal preparation can be very helpful. Before doing anything that involves distressing sensory input, warn the patient that it is about to occur so they can be prepared and not startled. Also, giving a set amount of time that the input will occur may also be helpful (i.e., "We are going to do this until the count of 20."). Do not assume that a non-verbal patient does not understand. Assume each patient understands everything that you say.
2. Provide a timetable or a visual indication of when you will be done. Visual timers are widely available (e.g., http://www.therapyshoppe.com/therapy/index.php?main_page=index&cPath=23_1131&products_id=1886&zenid=d8e12c04d6d053229be2abd99eb151cf).
3. Taste and smell
 - a. Alter the gloves used or the paste used to reduce unpleasant smells, tastes, and textures. This may vary from patient to patient in terms of which types are preferred.
 - b. Ask staff members to refrain from wearing perfume and using shampoo with a strong smell.
 - c. Choose unscented soaps for office washrooms.
 - d. Refrain from highly scented cleaners and air fresheners in the office area.
4. Touch
 - a. Use as little touch to the patient's face as possible.
 - b. Use firm, deep touch rather than light touch.
 - c. Alter the texture or grit of the paste.
 - d. Allow more frequent rinsing of the paste.

SENSORY PROCESSING AND DENTAL VISITS

- 1 5. Visual
- 2 a. Allow the patient to wear some-
- 3 thing that blocks the lights
- 4 (sunglasses, goggles, etc.).
- 5 b. Avoid positioning the light so that
- 6 it shines directly into the patient's
- 7 eyes.
- 8 c. Dim the overhead lights, if possible.
- 9 d. Avoid direct eye contact.
- 10 e. Use transparent face shields
- 11 (e.g., [http://www.amerdental.com/safety-eyewear-and-magnifiers/](http://www.amerdental.com/safety-eyewear-and-magnifiers/face-shields)
- 12 [face-shields](http://www.amerdental.com/safety-eyewear-and-magnifiers/face-shields)) rather than face
- 13 masks that cover the lower half
- 14 of the face.
- 15 6. Movement: Have the chair in the fully
- 16 reclined position before the patient
- 17 gets into the chair, to avoid the
- 18 patient experiencing backward
- 19 motion.
- 20 7. Auditory
- 21 a. Allow the patient to listen to
- 22 music using headphones.
- 23 b. Provide a "white noise" machine
- 24 in the room to mask the noises
- 25 from adjacent areas.
- 26 c. Minimize outside noises and talk-
- 27 ing of others, and close the door if
- 28 possible. See the patient in a
- 29 closed operatory or quiet room.
- 30
- 31

Specific interventions to reduce discomfort

In addition to modifying environments to reduce unpleasant sensation, sensory defensiveness is often treated by occupational therapists with two specific types of sensory input: deep touch pressure and heavy work.²² Deep touch pressure is firm touch provided to the skin by way of massage, vibration, Lycra clothing, elasticized wraps, weighted clothing, or having the patient lay under something heavy. Heavy work includes any activity that provides resistance to the muscles and joints of the body. Activities such as pushing or pulling something heavy, jumping, lifting or carrying heavy items, or squeezing something against resistance can all be considered heavy work. Using deep touch pressure and/or heavy work before and during distressing sensory events can help a patient with sensory defensiveness. Although there are currently no studies that examine the

efficacy of these strategies for improving dental visits in particular, a growing number of studies³³⁻⁴⁰ support the use of deep pressure and heavy work activities for individuals with sensory processing difficulties. However, not all studies have found positive effects and thus more research is needed to determine when the strategies are appropriate and for whom.⁴¹⁻⁴³ For dental practitioners who wish to attempt these strategies, a collaborative approach with the family of the individual with ASD may help guide the choice of strategies and help determine their worthiness for each specific patient.

A variety of strategies may provide deep touch pressure or heavy work during the dental visit or immediately beforehand. These include:

1. Having the patient wear the heavy X-ray vest during the entire appointment to provide extra weight and deep pressure.
2. Having the caregiver do oral deep pressure or vibration with an electric toothbrush, a mini massager, or by rubbing with an oral swab prior to the appointment.
3. Allowing the patient to have a fidget toy that provides "heavy work" during the session. A squeeze exercise ball or stretch toy may work.
4. Having the patient wear a heavy or tight hat before and during the appointment.

Conclusion

Dental visits can be extremely distressing for patients with ASD. Their dental needs often go unmet, perhaps due to high rates of poor cooperation during procedures. Understanding sensory processing and the sensory aspects of the dental visit may improve the patient's cooperation and allow for better results. The dental professional must work with the caregiver to determine which events are distressing and decide which strategies might work best for each particular child. Although determining the proper strategies can require some trial and error, having a dental professional who is understanding, who attempts to make the experience as comfortable as possible

by respecting the patient's fears and reducing the level of distressing stimuli, may make the difference between a visit that is successful and one that is not.

Acknowledgement

The authors have no financial interest in the specific products for which links were provided. They are merely examples of products that might be helpful. For more information about sensory integration and sensory processing, visit <http://www.siglobalnetwork.org/> and <http://www.spdfoundation.net/>.

References

1. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-IV-TR) (Text revision)*. 4th ed. Washington, D.C.: American Psychiatric Press, Inc; 2000.
2. American Psychological Association. DSM-5 Development: 299.0 Autism Spectrum Disorder, <http://www.dsm5.org/ProposedRevisions/Pages/proposedrevision.aspx?rid=94#>. Accessed June 28, 2010.
3. Centers for Disease Control. New data on Autism Spectrum Disorders (ASDs), <http://www.cdc.gov/features/countingautism/>. Accessed August 10, 2012.
4. Kogan MD, Blumberg SJ, Schieve LA, et al. Prevalence of parent-reported diagnosis of Autism Spectrum Disorder among children in the US, 2007. *Pediatrics* 2009;124:1395-1403.
5. Lai B, Milano M, Roberts MW, Hooper SR. Unmet dental needs and barriers to dental care among children with autism spectrum disorders. *J Autism Dev Disord* 2012;42:1294-303.
6. Baker AE, Lane A, Angley MT, Young RL. The relationship between sensory processing patterns and behavioural responsiveness in autistic disorder: a pilot study. *J Autism Dev Disord* 2008;38:867-75.
7. Ben-Sasson A, Cermak SA, Orsmond GI, et al. Extreme sensory modulation behaviors in toddlers with autism spectrum behaviors. *Am J Occup Ther* 2007;61:584-92.
8. Gouze KR, Hopkins J, LeBailly S, Lavigne JV. Re-examining the epidemiology of sensory regulation dysfunction and comorbid

SENSORY PROCESSING AND DENTAL VISITS

- psychopathology. *J Abnorm Child Psychol* 2009;37:1077-87.
9. Baranek GT, Parham LD, Bodfish JW. Sensory and motor features in autism: Assessment and intervention. In: *Handbook of autism and pervasive developmental disorders: Assessment, Interventions and Policy. Volume 2.* 3rd ed. Volkmar FR, Paul R, Klin A, Cohen D, eds. Hoboken, NJ: John Wiley & Sons; 2005:831-57.
 10. Dahlgren SO, Gillberg C. Symptoms in the first two years of life: a preliminary population study of infantile autism. *Eur Arch Psychiatry Neurol Sci* 1989;238:169-74.
 11. Kientz MA, Dunn W. A comparison of the performance of children with and without autism on the Sensory Profile. *Am J Occup Ther* 1997;51:530-7.
 12. Chen YH, Rodgers J, McConachie H. Restricted and repetitive behaviours, sensory processing and cognitive style in children with autism spectrum disorders. *J Autism Dev Disord* 2009;39:635-42.
 13. Ben-Sasson A, Hen L, Fluss R, Cermak SA, Engel-Yeger B, Gal E. A meta-analysis of sensory modulation symptoms in individuals with autism spectrum disorders. *J Autism Dev Disord* 2009;39:1-11.
 14. Talay-Ongan A, Wood K. Unusual sensory sensitivities in autism: a possible crossroads. *Int J Disabil, Develop Educ* 2000;47:201-12.
 15. Tomchek SD, Dunn W. Sensory processing in children with and without autism: a comparative study using the Short Sensory Profile. *Am J Occup Ther* 2007;61:190-200.
 16. Kanner L. Autistic disturbances of affective contact. *Nervous Child* 1943;2:217-50.
 17. Bergman P, Escalona SK. Unusual sensitivities in very young children. *Psychoanal Stud Child* 1949;4:333-52.
 18. Rimland B. *Infantile autism: The syndrome and its implications for a neural theory of behavior.* New York: Appleton-Century-Crofts; 1964.
 19. Young RL, Brewer N, Pattison C. Parental identification of early behavioural abnormalities in children with autistic disorder. *Autism* 2003;7:125-43.
 20. Sensory Processing Disorder Foundation. About SPD. <http://www.spdfoundation.net/about-sensory-processing-disorder.html#emotional>, Accessed August 10, 2012.
 21. Cesaroni L, Garber M. Exploring the experience of autism through firsthand accounts. *J Autism Dev Disord* 1991;21:303-13.
 22. Jones R, Quigney C, Huws J. First-hand accounts of sensory perceptual experiences in autism: A qualitative analysis. *J Intellect Dev Disabil* 2003;28:112-21.
 23. Ayres AJ. *Sensory integration and the child.* Los Angeles: Western Psychological Services; 1979.
 24. Lane SJ, Miller LJ, Hanft BE. Toward a consensus in terminology in sensory integration practice: Part 2: sensory integration patterns of function and dysfunction. *American Occupational Therapy Association's Sensory Integration Special Interest Section Quarterly* 2000;23:1-4.
 25. 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;61:135-40. Available online at http://www.spdfoundation.net/pdf/Miller_Anzalone.pdf.
 26. Kopycka-Kedzierwaski DT, Auinger P. Dental needs and status of autistic children: results from the National Survey of Children's Health. *Pediatr Dent* 2008;30:54-8.
 27. Lowe O, Lindermann R. Assessment of the autistic patient's dental needs and ability to undergo dental examination. *ASDC J Dent Child* 1985;52:29-35.
 28. Marshall J, Sheller, B, Williams BJ, Mancl L, Cowan C. Cooperation predictors for dental patients with autism. *Pediatr Dent* 2007;29:369-76.
 29. Loo CY, Graham RM, Hughes CV. The caries experience and behavior of dental patients with autism spectrum disorder. *J Am Dent Assoc* 2008;139:1518-24.
 30. U.S. National Institutes of Health, National Institute of Dental and Craniofacial Research. Practical Oral Care for People with Autism, <http://www.nidcr.nih.gov/OralHealth/Topics/DevelopmentalDisabilities/PracticalOralCare/PeopleAutism.htm>. Accessed August 10, 2012.
 31. Stein LI, Polido JC, Mailloux Z, Coleman GG, Cermak SA. Oral care and sensory sensitivities in children with autism spectrum disorders. *Spec Care Dentist* 2011;31:102-10.
 32. Weil TN, Inglehart MR. Dental education and dentists' attitudes and behavior concerning patients with autism. *J Dent Educ* 2010;74:1294-307.
 33. Pfeiffer BA, Koenig K, Kinnealey M, Sheppard M, Henderson L. Effectiveness of sensory integration interventions in children with autism spectrum disorders: a pilot study. *Am J Occup Ther* 2011;65:76-85.
 34. 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;61:228-38.
 35. Schilling DL, Washington K, Billingsley FF, Deitz J. Classroom seating for children with attention deficit hyperactivity disorder: therapy balls versus chairs. *Am J Occup Ther* 2003;57:534-41.
 36. Schilling DL, Schwartz IS. Alternative seating for young children with Autism Spectrum Disorder: effects on classroom behavior. *J Autism Dev Disord* 2004;34:423-32.
 37. Bagatell N, Mirigliani G, Patterson C, Reyes Y, Test L. Effectiveness of therapy ball chairs on classroom participation in children with autism spectrum disorders. *Am J Occup Ther* 2010;64:895-903.
 38. Edelson SM, Edelson MG, Kerr DC, Grandin T. Behavioral and physiological effects of deep pressure on children with autism: a pilot study evaluating the efficacy of Grandin's Hug Machine. *Am J Occup Ther* 1999;53:145-52.
 39. Kimball JG, Lynch KM, Stewart KC, Williams NE, Thomas MA, Atwood KD. Using salivary cortisol to measure the effects of a Wilbarger protocol-based procedure on sympathetic arousal: a pilot study. *Am J Occup Ther* 2007;61:406-13.
 40. Olson LJ, Moulton HJ. Use of weighted vests in pediatric occupational therapy practice. *Phys Occup Ther Pediatr* 2004;24:45-60.
 41. Hodgetts S, Magill-Evans J, Misiaszek JE. Weighted vests, stereotyped behaviors and arousal in children with autism. *J Autism Dev Disord* 2011;41:805-14.
 42. Leew SV, Stein NG, Gibbard WB. Weighted vests' effect on social attention for toddlers with Autism Spectrum Disorders. *Can J Occup Ther* 2010;77:113-24.
 43. Watling RL, Dietz J. Immediate effect of Ayres's sensory integration-based occupational therapy intervention on children with Autism Spectrum Disorders. *Am J Occup Ther* 2007;61:574-83.