Occupational Therapy Using Sensory Integration to Improve Participation of a Child With Autism: A Case Report

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KEY WORDS
- activities of daily living
- adaptation, psychological
- autistic disorder
- interpersonal relations
- occupational therapy
- sensation disorders

In this case report, we describe the changes in adaptive behaviors and participation of 1 child with autism during a 10-wk program of intensive occupational therapy using a sensory integrative approach (OT–SI) following a manualized protocol. This case is part of a larger study examining the efficacy of the OT–SI approach. We found improvement in sensory processing, as measured by the Sensory Integration and Praxis Tests, as well as enhanced participation in home, school, and family activities, as indicated on parent-rated goal attainment scales.

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Autism spectrum disorders (*ASD*) are a group of developmental disorders characterized by social impairment, verbal and nonverbal communication difficulties, restricted interests, and repetitive and stereotypical behaviors (American Psychiatric Association, 2000). In addition to the core features, people with ASD often present with difficulty processing and integrating sensory information (Baranek, David, Poe, Stone, & Watson, 2006; Mailloux & Smith Roley, 2010), which has an impact on their adaptive behavior and participation in daily activities. Thus, occupational therapists often use a sensory integrative approach as part of their intervention strategy.

However, more evidence for using occupational therapy with a sensory integrative approach for people with ASD is needed (May-Benson & Koomar, 2010), including systematic case reports and randomized controlled trials (RCTs). Schaaf (2010) reviewed seven studies (published from 1980 to 2008) that used a sensory integrative approach and concluded that although the studies provided promising evidence, design and methodological flaws (small sample sizes, inadequate characterization of the sample, lack of an intervention protocol with a fidelity measure and sensitive outcome measures) suggested that caution should be taken with regard to practice implications. Two RCTs (Miller, Coll, & Schoen, 2007;[1] Pfeiffer, Koenig, Kinnealey, Sheppard, & Henderson, 2011) that included the use of a fidelity measure and specific outcome measures showed positive outcomes of sensory integrative intervention. In this case report, we describe a child with an ASD and difficulty in sensory processing and the changes after 10 wk of occupational therapy using a sensory integrative approach (OT–SI).

[1]Miller et al. (2007) studied children with sensory processing disorders but not autism.

Participant

D.Y. is a 5-yr, 5-mo-old boy who has been diagnosed with ASD and attention deficit hyperactivity disorder (ADHD). Autism diagnosis was confirmed using the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) Module 3 (Fluent Speech) as part of screening for this study. On the Gotham, Pickles, and Lord (2009) severity index, he rated a severity score of 7 out of possible 10, and he had a Full Scale IQ of 106 on the Stanford–Binet, fifth edition (Roid, 2003). He was randomized to the treatment group for this study. D.Y.'s mother provided parental permission for him to participate in this study in accordance with Thomas Jefferson University institutional review board procedures. His initials have been changed to maintain confidentiality.

A detailed history gathered from the child's mother revealed that D.Y. was born by cesarean section after a full-term uncomplicated pregnancy. His medical history is nonsignificant, and his overall health is described as good. D.Y.'s ADHD-related symptoms have been managed with 10 mg methylphenidate hydrochloride extended release (Metadate CD) taken daily. He also takes 5 mg of melatonin nightly to help manage sleep difficulties. D.Y. resides with both of his parents and older brother in a suburban area. He attends public school with a half-day placement in an autism program and a half-day in a mainstream classroom with a 1:1 aide for behavioral support.

D.Y.'s mother was interviewed to determine areas of strength and need related to participation in home, school, and community activities. D.Y.'s mother described him as "very affectionate and super smart" but expressed concerns about his high activity level, distractibility, impulsivity, and clumsiness, stating that he was a safety risk at home and on the playground. She also described him as being "rigid," getting "stuck" in activities, and having a hard time shifting his focus to engage in other activities, characteristics that make it difficult for him to play with his brother or other children. She indicated that he had difficulty generating ideas for play, stating that "he likes to play with other kids, but he doesn't seem to know how" (D.Y.'s mother, personal communication, September 3, 2010). Moreover, she reported difficulty with his bedtime routine, stating that he engaged in rigorous rocking in a rocking chair for 20–30 min to help him fall asleep. He was also unable to dress himself, especially managing fasteners and orienting clothing.

Assessments

In addition to performing the detailed parent interview, an independent evaluator completed a series of assessments, as described in the sections that follow. The assessments included measures of sensory processing to determine whether D.Y.'s difficulties were related to poor sensory processing and praxis as well as behavioral assessments to evaluate adaptive skills and behaviors. All assessments, except for the Sensory Profile, were completed before randomization as well as within 2 wk after finishing treatment.

Measures of Sensory Processing

The Sensory Integration and Praxis Tests (SIPT; Ayres, 1989), the gold standard for assessing sensory integration and praxis in children ages 4 yr through 8 yr, 11 mo, were administered. The SIPT measures a child's ability to integrate sensory input for perception, motor planning, and spatial actions and provides standard scores (ranging from −3.0 to 3.0) for normative age groups on each of the 17 subtests. Any score of less than 1.0 indicates performance below normative age level. Interrater reliability ranges from .94 to .99, test–retest reliability over 1–2 wk ranges from .33 to .94 (Ayres, 1989), and construct validity has been demonstrated in more than 10 factor and cluster studies (Ayres, 1989; Mulligan, 1998).

The Sensory Profile (Dunn, 1999) was used to assess D.Y.'s current responses to sensory events in everyday life. The Sensory Profile's internal consistency ranges from .47 to .91. Content validity was evaluated by expert review of items, and 83% of the raters agreed on the category placement of 63% of the items. Construct validity is reported to be moderate (Dunn, 1999).

The Sensory Experiences Questionnaire (SEQ; Baranek et al., 2006) was also used to measure D.Y.'s sensory processing patterns of hyporesponsiveness and hyperresponsiveness to sensation. The SEQ is used to characterize the sensory features of children with autism and other developmental disabilities that may affect their engagement in their physical and social environments (Baranek et al., 2006). Recent findings regarding the psychometric properties of the SEQ have indicated excellent test–retest reliability over 2–4 wk for the total score (intraclass correlation coefficient [ICC] = .92). Internal consistency is also high (α = .80; Little et al., 2011).

Behavioral Measures

The Parent Rating Form of the Vineland Adaptive Behavior Scales, Second Edition (VABS–II; Sparrow, Cicchetti, & Balla, 2005), was used to assess D.Y.'s adaptive behaviors. The VABS–II yields a standard score for each domain (Communication, Daily Living Skills, and Motor Skills) and an adaptive behavior composite score. Standard scores between 85 and 115 are considered adequate (between −1 and 1 standard deviation). The VABS–II has good

reliability and has been validated for use with children with autism. The VABS–II has moderate to high internal consistency (α for domains ≥.75), moderate test–retest reliability over 13–32 days for the adaptive behavior composite (ICC = .72–.87), and moderate to high interrater reliability (ICC = .81–.83). The VABS–II has established construct, content, and discriminant validity (Perry, Flanagan, Geier, & Freeman, 2009; Sparrow et al., 2005).

The Pervasive Developmental Disorder Behavioral Inventory (PDDBI; Cohen & Sudhalter, 2005) is a parent rating scale that assesses children with autism specifically and compares their patterns of behavior with same-age normative data of other children with autism and pervasive developmental disorder. Normative results do not compare the child with typically developing children. This tool is designed to be used as a sensitive outcome measure for children with ASD. This assessment captures behavior in two areas: approach and withdrawal problems and receptive and expressive social communication abilities. Concurrent validity was assessed through a comparison with several standardized behavioral assessments, and clinical validity was assessed through comparison with the Autism Diagnostic Observation Interview–Revised (Lord, Rutter, & Le Couteur, 1994), the ADOS–Generic, and the VABS–II Adaptive Functioning Level (Sparrow et al., 2005). Test–retest reliability was .65–.99 over an average 2-wk interval for teacher ratings and .38–.91 over a 12-mo interval for parent ratings (Cohen & Sudhalter, 2005).

Assessment Findings

Results from the pretest and posttest SIPT and SEQ are displayed in Figures 1 and 2. These results, along with the findings on the pretest Sensory Profile, confirmed the hypothesis that deficits in sensory processing and praxis were affecting D.Y.'s ability to participate in social, play, home, and community activities. Briefly, D.Y. demonstrated hyperresponsivity to auditory, tactile, and oral–tactile sensory inputs (startles easily; shows distress during loud conversations; shows distress with grooming of the face, touching certain textures, and being touched by another person; is described as a picky eater, almost always refusing new foods). He also showed poor auditory filtering (difficulty responding to his name when called; frequently tunes out loud noises in his environment), hyporesponsivity to painful tactile input (frequently does not respond to painful stimuli), and seeking of vestibular input (seeks out movement activity that interferes with daily routine). SIPT scores indicated difficulty with tactile and kinesthetic processing, in particular Manual Form Perception (–2.70). He also demonstrated difficulty in motor planning ability as measured by Design Copy (–1.87), Postural Praxis (–1.56), Oral Praxis (–1.55), Sequencing Praxis (–2.02), and Motor Accuracy (–2.69). On the VABS–II, the subdomains of Receptive Communication, Personal Daily Living Skills, Play and Leisure Time Skills, and Gross and Fine Motor skills were rated as low, and Expressive Communication, Interpersonal Relationships, and Coping Skills were rated as moderately low.

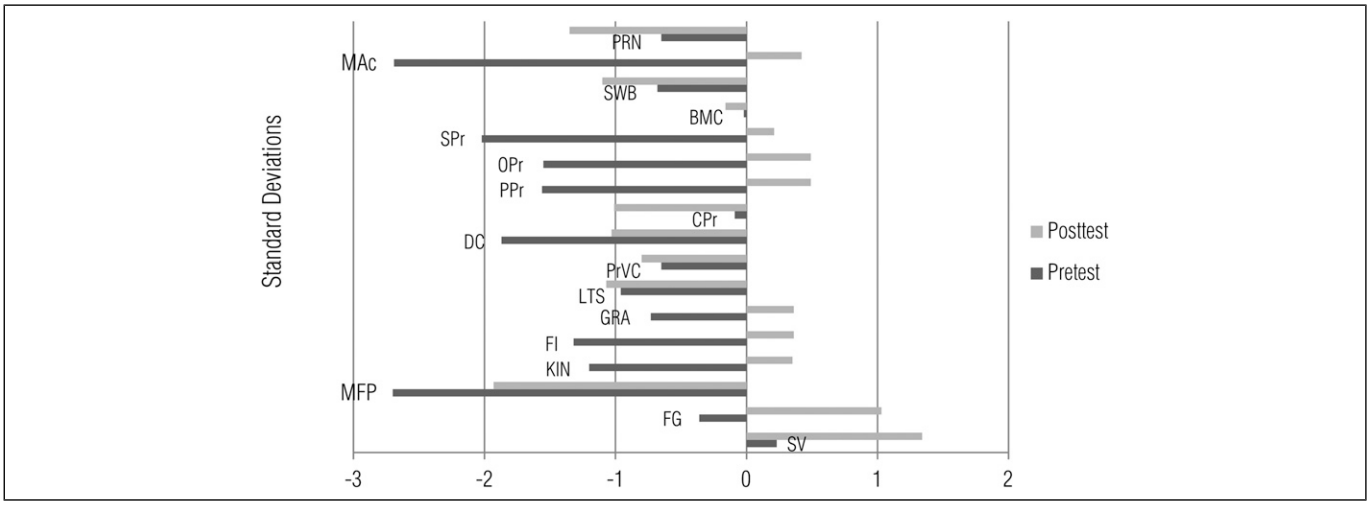

Figure 1. Pretest and posttest scores on the Sensory Integration and Praxis Tests (SIPT).

Note. Interpretation of standard deviation score ranges: *Severe dysfunction* = −3.0 to −2.5; *definite dysfunction* = −2.5 to −2.0; *mild dysfunction* = −2.0 to −1.0; *typical functioning* = −1.0 to 1.0; *above-average functioning* = 1.0 to 2.0; *advanced functioning* = 2.0 to 3.0. BMC = Bilateral Motor Coordination; CPr = Constructional Praxis; DC = Design Copy; FG = Figure Ground; FI = Finger Identification; GRA = Graphesthesia; KIN = Kinesthesia; LTS = Localization of Tactile Stimuli; MAc = Motor Accuracy; MFP = Manual Form Perception; OPr = Oral Praxis; PPr = Postural Praxis; PRN = Postrotary Nystagmus; PrVC = Praxis on Verbal Command; SPr = Sequencing Praxis; SV = Space Visualization; SWB = Standing Walking Balance.

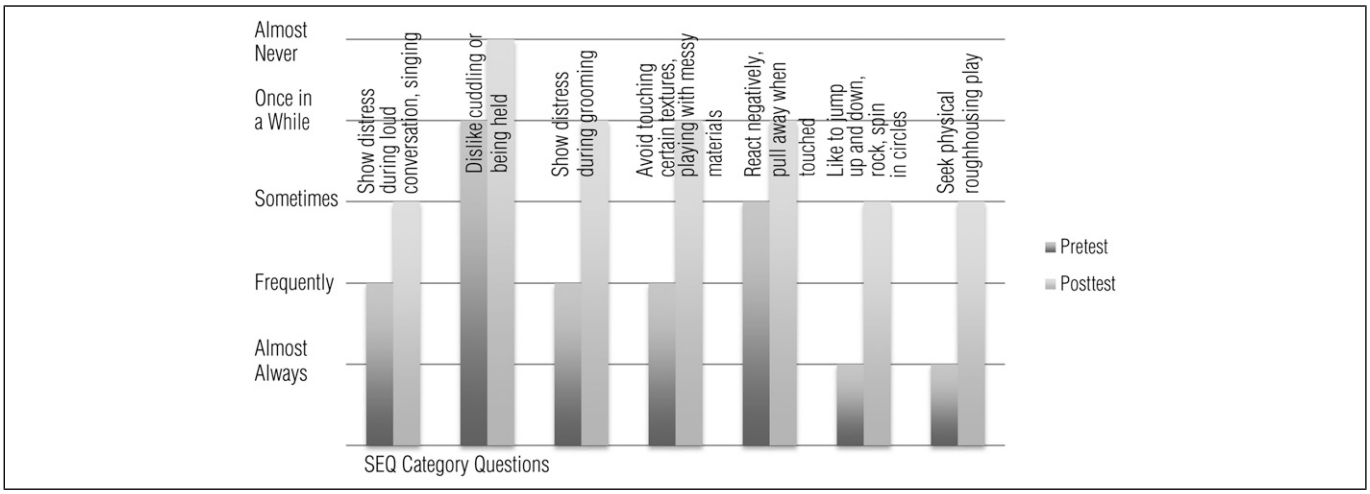

Figure 2. Preintervention and postintervention scores on the Sensory Experiences Questionnaire (SEQ).

Individual Goals

Goals for D.Y. were established using standardized goal attainment scaling (GAS) as described by Kiresuk, Smith, and Cardillo (1994) and Mailloux et al. (2007). GAS is a quantitative alternative to traditional goals and objectives that allows for individualized goal setting and measurement. The independent evaluator was trained in the GAS methodology and, to increase objectivity for the posttest parent interview, was blinded to the intervention. The GAS process was implemented using the following guidelines:

1. D.Y.'s records and evaluation findings were reviewed before meeting with the parent.
2. A semistructured interview with the parent was conducted to ascertain parent goals.
3. Five goals were established.
4. The goals were reviewed with the parent to validate the expected level of performance and ensure they captured the parent's concerns.
5. The goals were then scaled with equal intervals.[2]
6. A semistructured postintervention interview was conducted with the parent to determine D.Y.'s rating for each goal.
7. An overall goal attainment T score was calculated following the methodology outlined by Kiresuk et al. (1994). The goals established for D.Y. are displayed in Table 1, and proximal and distal (functional) outcomes are identified. A unique feature of each goal was that it identified the underlying sensory deficits hypothesized to be affecting participation on the basis of the formalized assessment data.

Intervention

The intervention followed a manualized protocol (Schaaf et al., 2010) based on sensory integration principles (Ayres, 1972, 2005) that is structured to guide the therapist through the assessment and intervention process. The 10 key principles that guided intervention are detailed in the manual and are as follows (Parham et al., 2007):

1. Ensure physical safety.
2. Present sensory opportunities.
3. Facilitate the child's self-regulation of arousal level, attention, and emotion.
4. Challenge postural, ocular, and bilateral motor development.
5. Promote praxis and organization of behavior.
6. Tailor activities to provide the just-right challenge.
7. Collaborate with the child on activity choices.
8. Ensure success.
9. Create a context of play.
10. Foster a therapeutic alliance with the child.

The intervention was delivered by two registered and licensed occupational therapists with advanced training and certification in sensory integration and who were trained to competence on the approach.

Treatment integrity was measured using the Ayres Sensory Integration® Fidelity Measure (Parham et al., 2011). The measure has 10 items rated on a Likert scale ranging from 1 to 5, with 5 indicating strong agreement that the therapist used a particular component of the approach. A score of 100 indicates perfect adherence to interventions, and a score of ≥80 is

[2]D.Y.'s goals were ranked and scaled according to the following scale: −2 = *much less than expected outcome;* −1 = *less than expected outcome;* 0 = *expected level of performance;* 1 = *better than expected outcome;* 2 = *much better than expected outcome* (Kiresuk et al., 1994; Mailloux et al., 2007).

Table 1. Goals and Hypothesis Generation and Testing Table for D.Y.

Goal	Hypothesized Sensory–Motor Mechanisms	Treatment Strategies From Manual	Proximal and Distal Outcome Measures
Improved nighttime routine—decrease of excessive rocking: D.Y. will improve self-regulation for nighttime routine by decreasing sensory seeking of intense vestibular input. *Current performance:* D.Y. rocks himself in a chair for >20 min then falls asleep in the chair.	Hyporesponsiveness to vestibular input Input seeking to modulate arousal level	Improve sensory modulation. Provide opportunities for movement experiences; examples include swinging in prone while propelling on the floor or by pulling a rope, working in prone on the mat.	*Proximal outcome:* Improved score on PRN and SWB subtests of SIPT *Distal outcome:* Improved nighttime routine for better sleeping as reported by parent
Complete a 3-step dressing task: D.Y. will improve his ability to process sensory and tactile input as a basis for improved praxis needed to complete a 3-step dressing task. *Current performance:* D.Y. is unable to complete a 3-step morning dressing routine and requires adult supervision and redirection.	Poor somatosensory awareness Poor praxis	Improve sensory discrimination and body awareness. Introduce sensory challenges that the child needs to interpret to discriminate body sensations (e.g., find objects in the ball pit).	*Proximal outcome:* Improved scores on tactile discrimination subtests of SIPT *Distal outcome:* Improved self-dressing skills as reported by mom Improvement in VABS–II Daily Living Skills domain
Improved participation in play with peers: D.Y. will demonstrate improved sensory modulation and self-regulation for enhanced participation in play with peers; D.Y. will play with at least one peer or sibling in an age-appropriate activity for ≤10 min with 2 or fewer adult redirections. *Current performance:* D.Y. does not participate in age-appropriate play activities with his sibling or peers.	Poor sensory modulation Poor praxis	Active, resistive sensory–motor activities such as climbing up rock wall to access trapeze swing, swing on trapeze swing and jump into ball pit, and prone in net swing while pushing self with upper extremities. Introduce challenges in gross motor performance and motor planning such as obstacle courses, climbing rock wall to obtain toys.	*Proximal outcomes:* Improved scores on SEQ Improved scores on praxis subtests of SIPT
Improved safety awareness in play and community: D.Y. will demonstrate improved sensory modulation and self-regulation as a basis for improving his safety awareness in community and home environments. *Current performance:* D.Y. is very active and likes to run, swim, and play on the playground. He requires constant supervision because he often unexpectedly runs away toward an object or activity of interest without regard for safety. He is especially unsafe at the playground, often engaging in risky activities with the playground equipment.	Poor sensory modulation Poor praxis	As above	*Proximal outcomes:* As above *Distal outcomes:* Improved participation in safe play as reported by parent
Improved fine motor skills: D.Y. will demonstrate improved tactile, proprioceptive, and kinesthetic processing for improved fine motor skills such as coloring for 10 min without redirection. *Current performance:* D.Y. requires frequent adult redirection to participate in a fine motor activity such as coloring for 0–4 min.	Poor somatosensory discrimination Poor praxis	As above	*Proximal outcomes:* As above *Distal outcome:* Improved participation in coloring as reported by parent

Note. Blanche (2001, 2006); Schaaf and Blanche (2012). PRN = Postrotary nystagmus; SEQ = Sensory Experiences Questionnaire; SIPT = Sensory Integration and Praxis Tests; SWB = Standing Walking Balance; VABS–II = Vineland Adaptive Behavior Scales, Second Edition.

considered acceptable adherence to OT–SI principles (Parham et al., 2007). This measure has been found to have an interrater reliability of .98 for total fidelity score, with individual item interrater reliabilities ranging from .94 to .99. Validity has been found to be strong because raters are able to accurately identify and distinguish OT–SI sessions from other intervention approaches with 92% accuracy. All of D.Y.'s treatment sessions were videotaped ($N = 30$), and independent evaluators who were trained in use of the instrument evaluated a random selection of 20% of available tapes ($n = 6$).

Results

As shown in Figure 1, D.Y. showed improvements on four of five SIPT tactile discrimination tasks (Finger Identification: pretest = −1.32, posttest = 0.36; Graphesthesia: pretest = −0.73, posttest = 0.36; Manual Form Perception: pretest = −2.70, posttest = −1.93; Kinesthesia: pretest = −1.20, posttest = 0.35). In addition, he improved on five of five praxis tests (Design Copy: pretest = −1.87, posttest = −1.03; Postural Praxis: pretest = −1.56, posttest = 0.49; Oral Praxis: pretest = −1.55, posttest = 0.49; Sequencing Praxis: pretest = −2.02, posttest = 0.21; Motor Accuracy: pretest = −2.60, posttest = 0.42).

SEQ item scores (see Figure 2) showed improvement in D.Y.'s ability to regulate and organize his responses to auditory, vestibular, tactile, and oral sensory input and movement. On the VABS–II, D.Y.'s Motor Skills standard score improved from a score of low to moderately low (from 61 to 75), and his Communication standard score changed from moderately low to adequate (from 78 to 87). His Adaptive Behavior composite score changed from low to moderately low (from 69 to 75). Socialization and daily living standard scores were unchanged.

As shown in Figure 3, all PDDBI scores on the Approach/Withdrawal Problems Scale decreased, indicating positive changes in these behaviors. Specifically, notable decreases (improvements) occurred in two subdomains: Ritualisms and Resistance to Change and Specific Fears. Specific Fears includes items such as fear responses to sensory input (e.g., auditory noises in the environment).

Parent postintervention rating of D.Y.'s GAS yielded a *T* score of 68, indicating better-than-expected achievement on goals.[3] The outcome (rating = 2) on his second goal (play with peers) was much better than expected, and the outcomes on the other four goals (rating = 1) were better than expected. Average fidelity ratings were 95.5 of a possible 100, indicating that the therapist's intervention had high fidelity to OT–SI principles (Parham et al., 2011).

A parent interview conducted at the end of the 10-wk intervention by an evaluator blind to D.Y.'s treatment condition indicated parent-perceived improvement in D.Y.'s adaptive behaviors and participation. D.Y.'s mother described him as a happier child with less-rigid behaviors and increased tolerance of unexpected changes in the routine. She reported being able to go places without having to tell D.Y. ahead of time (more flexibility in his behavior) and being able to make unexpected stops during their outings without him becoming upset. D.Y.'s mother reported a decrease in his activity level, distractibility, and impulsivity, with better safety during play and daily activities. She also reported that D.Y. improved in his play skills, stating that

> D.Y. started to play trucks and cars with the other kids at school and could focus long enough to play a board game with the family. . . . He can sit and play for up to 30 minutes. . . . D.Y. goes bowling every week, for 1 hour a week. . . . Two other children are with him. . . . He will give verbal encouragement to another child who is upset.

D.Y. was reported to be able to participate more successfully in dressing, requiring less help from a parent. His bedtime routine changed, and he no longer engaged in excessive rocking before falling asleep. On a few occasions, D.Y.'s mother reported that she was now able to tuck him in his bed and read a book with him before he fell asleep, which was a welcome improvement. Moreover, D.Y.'s teacher reported to his mother that "D.Y.'s attention in the classroom was so much better that he did not need the aide at all for his schoolwork." D.Y. was reported to be doing well socially at school and was not having any difficulty interacting with his peers (D.Y.'s mother, personal communication, December 30, 2010).

Discussion

Ayres' (1972, 2005) Theory of Sensory Integration claims that adequate processing and integration of sensory information is an important foundation for learning and behavior. Following this theory, occupational therapists often use the principles of sensory integration to address the underlying sensory–motor mechanisms that may be affecting adaptive behaviors and participation in daily activities. However, the evidence linking changes in these proposed mechanisms to the observed changes in behaviors is limited. This case report describes one child's changes in adaptive behaviors; individualized, participation-focused goals; and concurrent changes in objective tests of sensory processing and praxis. Given that the literature has called for systematic investigation of interventions for people with autism—specifically the development and testing of a manualized protocol beginning with case reports (Smith et al., 2007)—this case report provides preliminary data supporting the use of this manualized intervention protocol and its fidelity measure to guide future studies. More important, this study links changes in behavior and participation to changes in the ability to process and integrate sensory information for improved praxis and, as such, provides preliminary evidence for this approach.

[3]Any *T* score >50 indicates achievement above expected level.

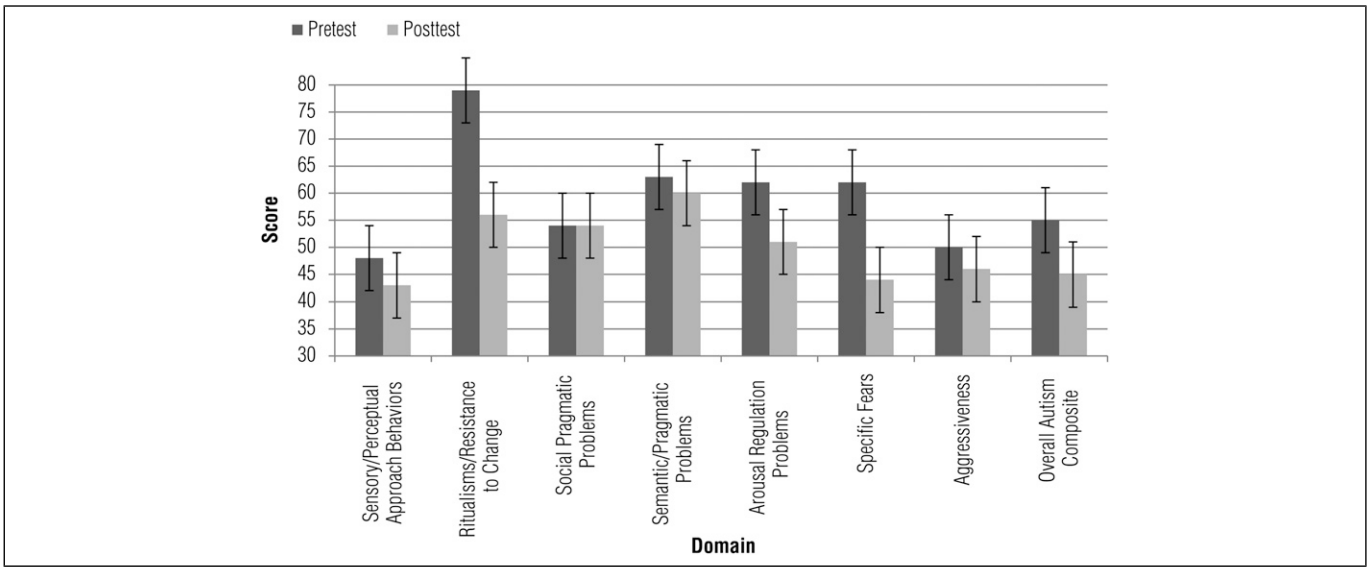

Figure 3. Pretest and posttest scores on the Pervasive Developmental Disorder Behavior Inventory (PDDBI).
Note. PDDBI approach/withdrawal problems; lower scores = better performance.

A second important contribution of this study is the explication of a systematic method of clinical reasoning that builds on the work of Sugai, Lewis-Palmer, and Hagan-Burke (2000) and Blanche (2001, 2006) and can be used as a model for best practice. Standardized assessment findings and sensory integration theory can be used to generate and test hypotheses about the potential underlying sensory and motor mechanisms contributing to participation limitation. Once the hypotheses and potential underlying mechanisms are identified, the manualized protocol can be used to develop treatment strategies. Finally, measurement of proximal (sensory and motor) and distal (participation-oriented) outcomes provides a strategy for hypothesis testing and validation. This method is displayed in Table 1 and clearly links the changes in D.Y.'s behavior and participation to the sensory–motor mechanisms hypothesized to underlie his difficulties.

Regarding outcome measures, this study builds on the existing evidence showing that GAS is a useful method for quantifying individual outcomes (Mailloux et al., 2007). Not only does GAS provide a means to link proposed mechanisms affecting goal attainment, but it also provides a measure of change on individualized, functional, parent-generated goals. Although the VABS–II and the PDDBI did capture some of these behavioral changes, GAS allowed specific documentation and quantification of changes in these individualized goals and may thus be a useful supplement to other assessments when measuring behavioral outcomes of an intervention for people with ASD.

The SIPT is an objective, standardized assessment of sensory integration and praxis with adequate test–retest reliability (Ayres, 1989). It is important that the SIPT did detect changes postintervention that were consistent with parent-reported behavioral improvements and thus shows promise as an outcome measure for detecting changes in sensory processing and praxis ability that may affect behavioral outcomes. Many of the measures of sensory processing that are available today use parent report and thus may compromise the rigor of the study findings.

Finally, an interesting note is that D.Y. improved in his motor skills as reflected in the VABS–II Motor domain scores. This finding is consistent with the literature that has shown that sensory interventions affect motor skills. For example, in a review of intervention studies using sensory approaches, May-Benson and Koomar (2010) found evidence that motor skills were a positive outcome of sensory integration interventions. This case study further supports their finding and points to the need to measure motor skills as an outcome in future studies.

Although the limitations of a case report include lack of generalizability or ability to distinguish treatment effects from maturation effects, this case report represents 1 child in a larger RCT that is currently ongoing. By highlighting the importance of the systematic data collection processes, the hypothesis generation, and the tailored therapeutic approach to parent and child goals, we have detailed the nuances of the occupational therapy process used in OT–SI.

Implications for Occupational Therapy Practice

The results of this study have the following implications for occupational therapy practice:

- An intensive program of occupational therapy using sensory integration (30 sessions over 10 wk) may be useful for children with autism whose participation challenges are related to difficulty processing and integrating sensory information.
- Following a systematic intervention protocol of OT–SI and its accompanying Ayres Sensory Integration® Fidelity Measure may be an important strategy for children with autism whose participation challenges are related to difficulty processing and integrating sensory information.
- This case provides a model for treatment for children with autism and difficulty processing and integrating sensory information.

Conclusion

This case report provides preliminary evidence of the efficacy of occupational therapy using a manualized protocol based on the principles of sensory integration for a child with autism. Given the relatively brief intervention period of 10 wk, these findings are particularly interesting and may be strengthened even further with a longer intervention period. In addition, this report demonstrates the implementation of a manualized protocol with hypothesis generation and testing and fidelity measurement as a model for best practice. ▲

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