Brain Harmony...proven results

Why Brain Harmony?

With over 20 years' experience, Brain Harmony has created unique protocols when combined with Integrated Listening Systems' products, which produces accelerated results. This combined approach is based on changing our brain – we can essentially rewire it through specific and repeated stimulation, a concept known as neuroplasticity. As in building strength and endurance with physical exercise, we can also build neurological pathways and synaptic activity at any age or in any condition.

It's All About the Results

At Brain Harmony we pride ourselves on delivering results and we will work very hard to help your family. Our programs are customized to fit your unique needs in the convenience of your own home. Traveling to a clinic is not required.

Generally, we see positive results for our friends with most neurodevelopmental needs with two modalities:

The Safe and Sound Protocol (SSP) is a 5 day therapeutic modality that reduces auditory sensitivity but, more importantly, calms the parasympathetic nervous system. Often we find our friends with any type of neurodevelopmental issue, large or small, are in a constant state of fight or flight. They are constantly on edge or anxious. By starting with SSP, we calm the social and emotional state, thereby allowing our friends to be receptive to therapeutic modalities. Interestingly, when we "calm the nerves" we can see many gains after SSP. Gross motor and fine motor skills, eye contact, engagement and reduction of auditory sensitivities may all be exhibited, after listening for one hour a day for 5 days consectually. The total cost of SSP is $395 and includes a selfadministered pre test, post test, shipping to and from, and video conference support with a licensed therapist.

Focus System – *this is the real brain changer.* iLs retrains areas of the brain involved in learning, communication and movement. With this system, a listening program is crafted specific to you. The Focus System comes with over 240 hours of therapy. We will support your family listening through video conferencing with a licensed therapist. Typically, the cost of this program is $260 a month administered as a month to month lease that you may opt out of at any time.

Proven Results and Satisfied Families

Our web site contains a knowledge library which includes research, case studies and family success stories. Our program, when combined with these tools, changes standardized scores. We receive family reports of success on a daily basis. We have found no other modality that produces outcomes as quickly and efficiently as iLs' products.

Process

We ship your equipment and assign a licensed therapist. Included in your purchase is 6 hours of coaching via video or telephone conferencing. Your therapist will also be available to you via text and email for any questions or concerns throughout your listening program. The therapist will guide you step by step through using the equipment and finding the program that will best suit your needs.

How do I get started?

Call **Brain Harmony** at **888-272-4650**, to speak with a trained specialist today!

Autism Spectrum Disorders

Autism is one of the fastest growing developmental disorders in the U.S. According to the CDC, in 2018, 1 out of 59 children is diagnosed with an autism spectrum disorder (ASD). 1 out of 37 are boys and 1 out of 151 are girls. While the causes of the disorder are still being determined, there are genetic, environmental and cultural markers associated with ASD. Brain Harmony Occupational Therapists specialize in delivering the highest levels of outcomes with our therapeutic interventions when compared to traditional therapies such as Applied Behavior Analysis (ABA), pharmaceuticals and brick and mortar therapy centers. We have witnessed children stagnated and regressing in development, who are then able to communicate, perform on standardized testing, make and sustain friendships and attend traditional schools. Our modalities and home based programs are changing the state of the brain and neurological system with rarely witnessed outcomes such as: "Our son has been non-verbal his whole life and was diagnosed with Autism when he was very young. He was 25 years of age when we started with Brain Harmony. Within several weeks of their programs, he not only said his first words, he said a complete sentence "I WILL GO IN THERE!" My husband, myself and our nanny all heard it and looked at each other in shock. Shock then turned into unimaginable JOY."

iLs Autism Study

The purpose of the study was to examine the effectiveness of the iLs Focus program with 18 children, ages 4-8 years of age, with ASD. Results found significant gains in areas of social skills, emotional regulation, and overall functional adaptive behavior skills per the Spiral Foundation in Boston, MA.

Results found significant gains across multiple subjective and objective outcome measures in areas of:

- social skills and emotional regulation;
- quantity and quality of atypical and problem behaviors including behavior during treatment;
- number and severity of autistic behaviors; and overall functional adaptive behavior skills;
- visual, fine and gross motor skills including body functions and motor planning;
- auditory listening skills.

Effect sizes* of significant outcomes ranged from d = .28 to 1.45 with over half of the outcomes having effects of greater than .50 indicating the majority of outcomes demonstrated rather large, easily observable positive changes. Improvements in social skills on the Social Responsivity Scale were particularly notable with large significant effects in the areas of social awareness (d = .88), social cognition (d = 1.04), social communication (d = .98), autistic mannerisms (d = .77) and total score (d = .96). Overall, results demonstrated that the effects of the iLs program were significant, of generally large magnitude, easily observable, and sustained throughout the post-intervention baseline.

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Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years--Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012.

Christensen DL[1], Baio J, Van Naarden Braun K, Bilder D, Charles J, Constantino JN, Daniels J, Durkin MS, Fitzgerald RT, Kurzius-Spencer M, Lee LC, Pettygrove S, Robinson C, Schulz E, Wells C, Wingate MS, Zahorodny W, Yeargin-Allsopp M; Centers for Disease Control and Prevention (CDC).

- Errata: Vol. 65, No. SS-3. [MMWR Morb Mortal Wkly Rep. 2016]

PROBLEM/CONDITION:

Autism spectrum disorder (ASD).

PERIOD COVERED:

2012.

DESCRIPTION OF SYSTEM:

The Autism and Developmental Disabilities Monitoring (ADDM) Network is an active surveillance system that provides estimates of the prevalence and characteristics of ASD among children aged 8 years whose parents or guardians reside in 11 ADDM Network sites in the United States (Arkansas, Arizona, Colorado, Georgia, Maryland, Missouri, New Jersey, North Carolina, South Carolina, Utah, and Wisconsin). Surveillance to determine ASD case status is conducted in two phases. The first phase consists of screening and abstracting comprehensive evaluations performed by professional service providers in the community. Data sources identified for record review are categorized as either 1) education source type, including developmental evaluations to determine eligibility for special education services or 2) health care source type, including diagnostic and developmental evaluations. The second phase involves the review of all abstracted evaluations by trained clinicians to determine ASD surveillance case status. A child meets the surveillance case definition for ASD if one or more comprehensive evaluations of that child completed by a qualified professional describes behaviors that are consistent with the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision diagnostic criteria for any of the following conditions: autistic disorder, pervasive developmental disorder-not otherwise specified (including atypical autism), or Asperger disorder. This report provides ASD prevalence estimates for children aged 8 years living in catchment areas of the ADDM Network sites in 2012, overall and stratified by sex, race/ethnicity, and the type of source records (education and health records versus health records only). In addition, this report describes the proportion of children with ASD with a score consistent with

intellectual disability on a standardized intellectual ability test, the age at which the earliest known comprehensive evaluation was performed, the proportion of children with a previous ASD diagnosis, the specific type of ASD diagnosis, and any special education eligibility classification.

RESULTS:

For 2012, the combined estimated prevalence of ASD among the 11 ADDM Network sites was 14.6 per 1,000 (one in 68) children aged 8 years. Estimated prevalence was significantly higher among boys aged 8 years (23.6 per 1,000) than among girls aged 8 years (5.3 per 1,000). Estimated ASD prevalence was significantly higher among non-Hispanic white children aged 8 years (15.5 per 1,000) compared with non-Hispanic black children (13.2 per 1,000), and Hispanic (10.1 per 1,000) children aged 8 years. Estimated prevalence varied widely among the 11 ADDM Network sites, ranging from 8.2 per 1,000 children aged 8 years (in the area of the Maryland site where only health care records were reviewed) to 24.6 per 1,000 children aged 8 years (in New Jersey, where both education and health care records were reviewed). Estimated prevalence was higher in surveillance sites where education records and health records were reviewed compared with sites where health records only were reviewed (17.1 per 1,000 and 10.7 per 1,000 children aged 8 years, respectively; $p<0.05$). Among children identified with ASD by the ADDM Network, 82% had a previous ASD diagnosis or educational classification; this did not vary by sex or between non-Hispanic white and non-Hispanic black children. A lower percentage of Hispanic children (78%) had a previous ASD diagnosis or classification compared with non-Hispanic white children (82%) and with non-Hispanic black children (84%). The median age at earliest known comprehensive evaluation was 40 months, and 43% of children had received an earliest known comprehensive evaluation by age 36 months. The percentage of children with an earliest known comprehensive evaluation by age 36 months was similar for boys and girls, but was higher for non-Hispanic white children (45%) compared with non-Hispanic black children (40%) and Hispanic children (39%).

INTERPRETATION:

Overall estimated ASD prevalence was 14.6 per 1,000 children aged 8 years in the ADDM Network sites in 2012. The higher estimated prevalence among sites that reviewed both education and health records suggests the role of special education systems in providing comprehensive evaluations and services to children with developmental disabilities. Disparities by race/ethnicity in estimated ASD prevalence, particularly for Hispanic children, as well as disparities in the age of earliest comprehensive evaluation and presence of a previous ASD diagnosis or classification, suggest that access to treatment and services might be lacking or delayed for some children.

PUBLIC HEALTH ACTION:

The ADDM Network will continue to monitor the prevalence and characteristics of ASD among children aged 8 years living in selected sites across the United States. Recommendations from the ADDM Network include enhancing strategies to 1) lower the age of first evaluation of ASD by community providers in accordance with the Healthy People 2020 goal that children with ASD are evaluated by age 36 months and begin receiving community-based support and services by age 48 months; 2) reduce disparities by race/ethnicity in identified ASD prevalence, the age of first comprehensive evaluation, and presence of a previous ASD diagnosis or classification; and 3) assess the effect on ASD prevalence of the revised ASD diagnostic criteria published in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition.

Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2014.

Baio J, Wiggins L, Christensen DL, Maenner MJ, Daniels J, Warren Z, Kurzius-Spencer M, Zahorodny W, Robinson Rosenberg C, White T, Durkin MS, Imm P, Nikolaou L, Yeargin-Allsopp M, Lee LC, Harrington R, Lopez M, Fitzgerald RT, Hewitt A, Pettygrove S, Constantino JN, Vehorn A, Shenouda J, Hall-Lande J, Van Naarden Braun K, Dowling NF.

PROBLEM/CONDITION:

Autism spectrum disorder (ASD).

PERIOD COVERED:

2014.

DESCRIPTION OF SYSTEM:

The Autism and Developmental Disabilities Monitoring (ADDM) Network is an active surveillance system that provides estimates of the prevalence of autism spectrum disorder (ASD) among children aged 8 years whose parents or guardians reside within 11 ADDM sites in the United States (Arizona, Arkansas, Colorado, Georgia, Maryland, Minnesota, Missouri, New Jersey, North Carolina, Tennessee, and Wisconsin). ADDM surveillance is conducted in two phases. The first phase involves review and abstraction of comprehensive evaluations that were completed by professional service providers in the community. Staff completing record review and abstraction receive extensive training and supervision and are evaluated according to strict reliability standards to certify effective initial training, identify ongoing training needs, and ensure adherence to the prescribed methodology. Record review and abstraction occurs in a variety of data sources ranging from general pediatric health clinics to specialized programs serving children with developmental disabilities. In addition, most of the ADDM sites also review records for children who have received special education services in public schools. In the second phase of the study, all abstracted information is reviewed systematically by experienced clinicians to determine ASD case status. A child is considered to meet the surveillance case definition for ASD if he or she displays behaviors, as described on one or more comprehensive evaluations completed by community-based professional providers, consistent with the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) diagnostic criteria for autistic disorder; pervasive developmental disorder-not otherwise specified (PDD-NOS, including atypical autism); or Asperger disorder. This report provides updated ASD prevalence estimates for children aged 8 years during the 2014 surveillance year, on the basis of DSM-IV-TR criteria, and describes characteristics of the population of children with ASD. In 2013, the American Psychiatric Association published the Diagnostic and Statistical Manual of Mental

Disorders, Fifth Edition (DSM-5), which made considerable changes to ASD diagnostic criteria. The change in ASD diagnostic criteria might influence ADDM ASD prevalence estimates; therefore, most (85%) of the records used to determine prevalence estimates based on DSM-IV-TR criteria underwent additional review under a newly operationalized surveillance case definition for ASD consistent with the DSM-5 diagnostic criteria. Children meeting this new surveillance case definition could qualify on the basis of one or both of the following criteria, as documented in abstracted comprehensive evaluations: 1) behaviors consistent with the DSM-5 diagnostic features; and/or 2) an ASD diagnosis, whether based on DSM-IV-TR or DSM-5 diagnostic criteria. Stratified comparisons of the number of children meeting either of these two case definitions also are reported.

RESULTS:

For 2014, the overall prevalence of ASD among the 11 ADDM sites was 16.8 per 1,000 (one in 59) children aged 8 years. Overall ASD prevalence estimates varied among sites, from 13.1-29.3 per 1,000 children aged 8 years. ASD prevalence estimates also varied by sex and race/ethnicity. Males were four times more likely than females to be identified with ASD. Prevalence estimates were higher for non-Hispanic white (henceforth, white) children compared with non-Hispanic black (henceforth, black) children, and both groups were more likely to be identified with ASD compared with Hispanic children. Among the nine sites with sufficient data on intellectual ability, 31% of children with ASD were classified in the range of intellectual disability (intelligence quotient [IQ] <70), 25% were in the borderline range (IQ 71-85), and 44% had IQ scores in the average to above average range (i.e., IQ >85). The distribution of intellectual ability varied by sex and race/ethnicity. Although mention of developmental concerns by age 36 months was documented for 85% of children with ASD, only 42% had a comprehensive evaluation on record by age 36 months. The median age of earliest known ASD diagnosis was 52 months and did not differ significantly by sex or race/ethnicity. For the targeted comparison of DSM-IV-TR and DSM-5 results, the number and characteristics of children meeting the newly operationalized DSM-5 case definition for ASD were similar to those meeting the DSM-IV-TR case definition, with DSM-IV-TR case counts exceeding DSM-5 counts by less than 5% and approximately 86% overlap between the two case definitions (kappa = 0.85).

INTERPRETATION:

Findings from the ADDM Network, on the basis of 2014 data reported from 11 sites, provide updated population-based estimates of the prevalence of ASD among children aged 8 years in multiple communities in the United States. The overall ASD prevalence estimate of 16.8 per 1,000 children aged 8 years in 2014 is higher than previously reported estimates from the ADDM Network. Because

the ADDM sites do not provide a representative sample of the entire United States, the combined prevalence estimates presented in this report cannot be generalized to all children aged 8 years in the United States. Consistent with reports from previous ADDM surveillance years, findings from 2014 were marked by variation in ASD prevalence when stratified by geographic area, sex, and level of intellectual ability. Differences in prevalence estimates between black and white children have diminished in most sites, but remained notable for Hispanic children. For 2014, results from application of the DSM-IV-TR and DSM-5 case definitions were similar, overall and when stratified by sex, race/ethnicity, DSM-IV-TR diagnostic subtype, or level of intellectual ability.

PUBLIC HEALTH ACTION:

Beginning with surveillance year 2016, the DSM-5 case definition will serve as the basis for ADDM estimates of ASD prevalence in future surveillance reports. Although the DSM-IV-TR case definition will eventually be phased out, it will be applied in a limited geographic area to offer additional data for comparison. Future analyses will examine trends in the continued use of DSM-IV-TR diagnoses, such as autistic disorder, PDD-NOS, and Asperger disorder in health and education records, documentation of symptoms consistent with DSM-5 terminology, and how these trends might influence estimates of ASD prevalence over time. The latest findings from the ADDM Network provide evidence that the prevalence of ASD is higher than previously reported estimates and continues to vary among certain racial/ethnic groups and communities. With prevalence of ASD ranging from 13.1 to 29.3 per 1,000 children aged 8 years in different communities throughout the United States, the need for behavioral, educational, residential, and occupational services remains high, as does the need for increased research on both genetic and nongenetic risk factors for ASD.

Difficulties with language processing are common among people with autism spectrum disorder (ASD). While researchers are not certain what causes language delays, the problem may lie in the way autistic brains process sound. A new study from the Children's Hospital of Philadelphia confirms previous research that the brain's auditory processing abilities are abnormal in children with ASD. Specifically, the mechanism of auditory processing may mature slower in children with ASD. Although the results are not definitive, they do suggest that sound processing issues in autism play a role in other aspects of the disorder.
The researchers administered a battery of tests to 52 children with ASD and 63 typically developing children, all between the ages of 6 to 14 years. First, they used magnetoencephalography (MEG) to measure how quickly neurons on the right and left sides of the brain responded as the children listened to barely audible beeps. Next, they used structural magnetic resonance imaging (MRI) to locate the active neurons they identified in the MEG. Finally, they measured gamma rhythms, a type of high-frequency brain wave, which change in response to sound and are thought to be abnormal in autism.

Auditory processing in autistic brains lags compared to processing in typically developing children. The results confirm prior research that there is a delay of 11 milliseconds in auditory processing among older children with ASD. The auditory cortex typically becomes more efficient as people mature, responding in about 200 milliseconds after exposure to a stimulus in children under 10 years, in 130 milliseconds for older children, and in 100 milliseconds for adults. A slower response to auditory stimuli suggests that the auditory cortex develops slower in children with ASD, since auditory responses typically become more efficient with age.

The study also found that gamma rhythms were harder to detect in children with ASD than in typically developing children. This is consistent with previous research suggesting that gamma rhythms may be related to auditory processing issues in ASD.

"If it takes longer to process very basic auditory information like tones, this delay is going to become more prominent when you're trying to encode more complex information like words and sentences. So this delay starts to build up, and everything starts to be delayed

when you're dealing with complicated linguistic information," explained lead researcher J. Christopher Edgar, associate professor of radiology.

The researchers state that a longitudinal study is necessary to confirm whether the auditory cortex's development is truly slower in children with ASD.

Research

A SLEEP INTERVENTION FOR CHILDREN WITH AUTISM: A PILOT STUDY

INVESTIGATOR: Sarah Schoen, PhD, OTR, Assistant Research Director, SPD Foundation

STATUS: *The study has been accepted for publication in the peer reviewed Open Journal of Occupational Therapy and will appear in the Spring 2017 issue. The following is a summary.*

OBJECTIVE: The aim of this study was *to* examine the immediate, short-term effects of Integrated Listening Systems' (iLS) Dreampad™ on the sleep behaviors of children with Autism Spectrum Disorder (ASD). In addition, this study examined the effects of changes in sleep patterns on parent and family measures of stress and quality of life.

RATIONALE/BACKGROUND: Sleep problems have been reported in children/individuals with ASD for many years (Sung,Hiscock, Sciberras, & Efron, 2008; Vriend, Corkum, Moon, & Smith, 2011). Prevalence estimates of sleep problems for children with ASD range from 44- 83% (Konofal,Lecendreux, & Cortese, 2010; Reed et al., 2009; Weiss & Salpekar, 2010). Common problems include, difficulties initiating sleep, maintaining sleep, short night sleep duration, early morning waking, tiredness upon waking and daytime sleepiness.

It is likely that sleep problems in children with ASD exacerbate their daytime behavior problems. Reports indicate more stereotypical behaviors; social difficulties and emotional problems in ASD show greater impairments in social and academic functioning (Bendz & Scates, 2010; Reynolds & Malow, 2011). Additionally, their parents are at greater risk of sleep deprivation resulting in an increased rate of clinical depression or anxiety compared to caregivers of children without sleep problems (Sung,et al.,2008).

Given the association between sleep problems, reduced behavioral performance and parental stress, there is a need for effective sleep intervention programs for these populations. Behavioral methods and medications have some reported success but these approaches are time consuming and can produce negative side effects (Reed, et al., 2009; Weiss & Salpekar, 2010). Multiple case studies from parents using the Dreampad report changes in sleep behavior within days of initiating use; however, there is no published literature systematically examining this as a treatment for children with ASD.

METHOD: An ABA design was employed in this study. It is an experimental design in which participants are first introduced to a baseline condition (A). In the baseline condition, no treatment is initiated. Next participants receive the treatment (B), after which they return to the baseline condition (A). This study employs a 1-2-week baseline period, which precedes the intervention (A). Following the treatment condition, using the Dreampad is introduced daily for a period of 1-4 weeks (B). Effects are measured immediately following the intervention. The Dreampad intervention is then discontinued for the next 1-2 weeks (A) allowing for observation of a possible carry-over effect from the intervention.

PARTICIPANTS: A total of 15 children with ASD and their families participated in this study. They completed questionnaires at the start of the study, after use of the Dreampad and again after the Dreampad was returned to the clinic. Criteria include: age 3-18 years, diagnosis of ASD provided by a

qualified clinician (e.g. pediatrician, neurologist, psychologist), sleep disorder confirmed by parent report and completion of sleep screening questionnaire.

SETIING: The Dreampad was used in the child's home every night for a total of 3 weeks. The program was monitored by an occupational therapist.

DESIGN: An ABA multiple baseline repeated measures single subject design was employed with a 3-4 week no-treatment baseline, 3 weeks of nightly use of the Dreampad and a 2 week return to baseline period. Visual depiction was used to display and analyze the data.

MEASURES: The repeated measure used during baseline, intervention and return to baseline was the pediatric sleep diary. The pre/post outcome measures were the Pediatric Quality of Life Inventory (PedsQL) and the Child's Sleep Habits Questionnaire (CSHQ).

INTERVENTION: The Dreampad program delivers ambient sounds and music via transducers imbedded in the pillow. Families participating in the study were instructed in its use by a trained therapist. Each participant used the Dreampad for 2 hours at night when going to bed (the device can be programmed to turn off automatically), on consecutive nights for 3-4 weeks.

RESULTS/LIMITATIONS/CONCLUSIONS: Improvements were noted in sleep initiation, duration of sleep, reduction in night waking, and improved daytime behavior. All 15 children showed a decrease in sleep problems as noted in response to the sleep diary or the CSHQ. Similarly all 15 families had improved scores on the PedsQL, some of which persisted beyond the time they were actively using the Dreampad. Changes were most notable in emotional, social and school functioning.

All of the parents reported a positive reaction to using the Dreampad and were interested in continuing its use. Many said their children were going to bed/sleep more quickly, sleeping more soundly, waking up more easily and generally seemed more relaxed.

PROPOSAL IS IMPORTANT TO PRACTICE AND SCIENCE: This study suggests that the Dreampad may be an effective intervention for children with ASD who have sleep problems, either in conjunction with a comprehensive OT program or on its own. Given the association between sleep problems, reduced behavioral performance and parental stress, this may be an effective sleep intervention program for ASD populations.

REFERENCES:

Bendz, L. M., & Scates, A. C. (2010). Melatonin treatment for insomnia in pediatric patents with attention- deficit/hyperactivity disorder. *Annals of Pharmacatherapy,* 44(1), 185-191.

Konofal, E., Lecendreux, M., & Cortese, S. (2010). Sleep and ADHD. *Sleep Medicine,* 11(7), 652-658. doi: 10.1016/j.sleep.2010.02.012

Reed, H. E., McGrew, S. G., Artibee, K., Surdkya, K., Goldman, S. E., Frank, K., . . . Malow, B. A. (2009). Parent-based sleep education workshops in autism. *Journal of Child Neurology,* 24(8), 936-945. doi: 10.1177/0883073808331348

Research

Reynolds, A. M.,& Malow, B. A. (2011). Sleep and autsim spectrum disorders. *Pediatric Clinics of North America,* 58(3), 685--698.

Sung, V., Hiscock, H., Sciberras, E.,& Efron, D. (2008). Sleep problems in children with attention-deficit/hyperactivity disorder: Prevalence and the effect on the child and family. *Archives of Pediatrics & Adolescent Medicine, 162(4),* 336-342. doi: 10.1001/archpedi.162.4.336

Vriend, J. I., Corkum, P. V., Moon, E. C., & Smith, I. M. (2011). Behavioral Interventions for Sleep Problems in Children With Autism Spectrum Disorders: Current Findings and Future Directions. *Journal of Pediatric Psychology, 36(9),* 1017-1029. doi:10.1093/jpepsy/jsr044

Weiss, M. D.,& Salpekar, J. (2010). Sleep problems in the child with attention-deficit hyperactivity disorder: Defining aetiology and appropriate treatments. *CNS Drugs,* 24(10), 811-828. doi: 10.2165/11538990-000000000-00000

Associates Names:

Cindy Dawkins, OTR/L, Andrea Pointer, MS/CCC-SLP, Shannon Norris, OTR/L

Name of Organization:

Kids Kount Therapy

Age/Gender of Client:

Male, 8 years, 11 months old

Presenting Problems:

"H" was diagnosed with institutional autism, apraxia, auditory processing and visual processing deficits. He presented with an inability to interact with peers, frequent echolalia, stimming, negative behaviors and difficulty with transitions. He never participated in pretend play or parallel play. He could understand questions but would not participate in conversation, only repeat phrases over and over. He did not answer 'yes' or 'no' to any questions. He presented with low muscle tone and poor fine motor and gross motor skills. He was hypo-responsive with vestibular and tactile input, and would seek closed spaces prior to purposeful behaviors. He required deep pressure and used a neoprene vest for calming at home and school. He was unable to write a sentence with words in the correct order.

Client Background Information:

"H" was adopted at 7.5 months old from Guatemala and immediately diagnosed with failure to thrive, weighing 13.5 lbs. He received early intervention but a developmental specialist told the family that therapy services would be waste of money. When he was 3 years old, he was enrolled in a special needs preschool. "H" participated in clinic-based iLs Sensory Motor Program. He was seen 2x weekly for OT and iLs. He demonstrated improvements with attention and focus in school. His self-regulation improved and self-stimulatory behaviors decreased, but he continued to have behavior problems at school. Transitions from one place to another were very difficult for him. He presented as severely autistic.

iLs Program:

He began using the iLs Sensory Motor program at home 5 days a week for one hour a day with consultative Occupational Therapy once every 3 weeks. He received Speech Therapy services one day a week for the 12-week, 60-session iLs program. His parents incorporated many activities at home, went swimming every day during iLs, and participated in gymnastics.

Summary of Changes During and After the iLs Program:

- After 2 months of iLs, his mother came into the clinic crying because he was participating in pretend play with Toy Story characters for the first time.

- He is now writing paragraphs with full sentences with appropriate syntax (word order). He is reading more fluently with increased decoding although he still has weakness with auditory comprehension.
- He is initiating social greetings with others unprompted and maintaining conversation with at least 3 circles of communication whereas previously he was unable to complete one circle of communication. Some language is still scripted and requires redirection, but it is more voluntary.
- During conversation, he is maintaining eye contact and sustaining it throughout the duration of thought and expression.
- He now asks for self-regulatory strategies instead of behaviorally acting out. His mom reports he will manipulate people to get out of work, demonstrating behaviors to go to resource room but will confess why he is doing it.
- He is categorizing things and recognizing/using humor. Mom sees more parallel play now, and language has improved to the point they can ask him questions and get responses. He is asking for interaction with friends at home and is communicating with his brother now. He participates in Boy Scouts, soccer, basketball and church activities with greater participation.

Therapist's comment:

There was a dramatic difference in the results from receiving iLS 5 days a week at home with therapy support and having iLS 2 days a week during therapy. Increased frequency and duration made the difference.

Mom's reported BEST RESULT:

"Before he did not answer questions and now after waiting a few seconds, we get a completely appropriate answer! There are NO behavioral problems this year at school; he gets a "G" every day."

Ron Minson, MD, iLS Clinical Director, Comments:

This is not the same child as the one who entered therapy six months earlier. As noted by the clinician, the positive changes reflect the value of increased frequency and duration of therapy through a home program that followed the clinic program for the markedly improved outcomes. Note the emphasis was on improving subcortical function first. Thus, there are a number of cognitive improvements, such as increased attention, freedom from distractibility, improved writing and communication, increased social engagement, and, incredibly, a sense of humor. The improved eye contact most likely reflects improved auditory processing. There is also a marked improvement in self-awareness as evidenced by requests for help in self-regulation.

These improvements in cognitive function underscore the importance of the Sensory Motor Program to improved sub-cortical processing of the sensory systems (vestibular, motor, proprioceptive) to achieve the gains noted above. These gains will hold and continue to improve, because they are now built upon a stronger subcortical foundation. I am delighted the parents refused the egregious advice of the developmental specialist.

Changes in Sensorimotor Skills:

Postrotary nystagmus moved from off the charts to within normal limits. He no longer seeks out the swing for self-regulation, although it will always be an activity he enjoys. He showed a mild increase in muscle tone and now can co-contract with wheelbarrow walking. He can catch a ball 75% of the time in a static position. He showed marked improvement in gross motor skills with hopping on squares and doing hopscotch. His balance improved on each foot from 1 sec. to 7 sec. on each foot. He could not touch finger to nose, but overshot prior to iLs nor could he reciprocate arm movements. He is now able to touch finger to nose. He still has delayed protective reaction backward, but his lateral extensions have improved. "H' is now able to perform isolated finger touching. He could not close his eyes by himself, but can now close his eyes independently. His Dad's main goal was related to sports. His kick accuracy has improved with a moving ball; before he would kick at a 45-degree angle. He couldn't kick with his non-dominant foot, but now can kick with accuracy with each foot. **Note:** His family just donated his neoprene vest to the clinic since he no longer needs it.

Miller Function and Participation Scales (M-FUN)

The (M-FUN) is a developmental assessment tool designed to assist in "determining how a child's motor competency affects his or her ability to engage in home and school activities and to participate socially in his or her world." (Miller, 2006).

	Pretest				Post test•			
	Raw Score	**Scaled Score**	**Interpretation**	**Progress Score**	**Raw Score**	**Scaled Score**	**Interpretation**	**Progress Score**
Visual Motor	28		Average	283	40		Average	347
Fine Motor	40		Very Low/ Severe	292	37		Very Low/ Severe	281
Gross Motor	12		Very Low/ Severe	100	65		Very Low/ Severe	386
Test Observations	3	NA	Far Below Average	NA	30	NA	Far Below Average	NA
Home Observations (parent report)	99	NA	Far Below Average	NA	143	NA	Below Average	NA

SCAN3:C

The SCAN-3: C "is an individually administered battery of tests designed to identify auditory processing disorders in children." (Keith 2009)

	Pre test			Post test		
	Raw Score	**Scaled Score**	**Interpretation**	**Raw Score**	**Scaled Score**	**Interpretation**
Auditory Figure-Ground +8dB[1]	13	1	Disordered	31	4	Borderline
Competing Words-Free Recall	10	5	Borderline	18	8	Normal
Filtered Words'	13	5	Borderline	19	7	Normal
Competing Words - Directed Ear'	8		Disordered	21	4	Borderline
Competing Sentences'	10		Disordered	26	3	Disordered
Auditory Processing Composite	8	47	Disordered	18	64	Disordered

Test of Auditory Processing Skills {TAPS-3) The TAPS-3 "is an individually administered assessment of auditory skills necessary for the development, use, and understanding of language commonly utilized in academic and everyday activities" (Martin & Brownell, 2005).

	Pre test			Post test		
	Raw Score	**Scaled Score**	**Interpretation**	**Raw Score**	**Scaled Score**	**Interpretation**

Word Discrimination	15		Below Average	23	4	Below Average
Phonological Segmentation	2	1	Below Average	5		Below Average
Phonological Blending	12	7	Average	16	8	Average
- Phonological	9	65	Below Average	13	72	Below Average
Number Memory Forward	6	1	Below Average	6		Below Average
Number Memory Reversed	3	3	Below Average	8	9	Average
Word Memory	8	3	Below Average	12	6	Below Average
Sentence Memory	4		Below Average	10	3	Below Average
- Memory	8	60	Below Average	19	74	Below Average
Auditory Comprehension	0		Below Average	6	4	Below Average
Auditory Reasoning	0	3	Below Average	2	5	Below Average
- Cohesion	4	60	Below Average	9	73	Below Average
Overall	21	62	Below Average	41	73	Below Average

Sensory Processing Measure (SPM) - Questionnaire completed by parent. The 5PM is a measure of a child's sensory processing issues, praxis and social participation in school aged children.

	Pre test			Post test		
	Raw Score	**t score**	**Interpretation**	**Raw Score**	**t score**	**Interpretation**
Social	27	67	Some Problems	26	66	Some Problems
Vision	21	68	Some Problems	20	67	Some Problems
Hearing	15	66	Some Problems	13	63	Some Problems
Touch	17	61	Some Problems	16	59	Typical
Body Awareness	14	57	Typical	14	57	Typical
Balance and Movement	20	65	Some Problems	18	63	Some Problems
Planning and Ideas	23	67	Some Problems	20	64	Some Problems
Total Score	96	65	Some Problems	91	63	Some Problems

Clinician

Debo'rah Merritt, PhD, LPC, ABA Post-Graduate Certificate; Enid Counseling and Diagnostics Center

Background

Client was a nine-year-old male at time of evaluation; diagnosed with Autism at age three. Client had been receiving ABA therapy from this clinician for one year. Client has been diagnosed in the past with mild Mental Retardation (MR) and expressive speech delays. Additionally, he has difficulty with gross and fine motor skills. Since age five, client has received one hour of speech and one hour of OT per week at school.

Presenting Problems

- Self-injurious behavior and daily aggression toward others
- Tactile hyper-sensitivity; he screamed when touched
- Refusal to engage others unless he knew them well; he was unresponsive to his parents' and teacher's attempts to discipline; reacting instead by screaming, lashing out physically at self or others
- Expressive language limited to one to three word statements to communicate basic needs; not reciprocal
- Play was immature and little imaginative play was present
- A one-on-one aid at school was required; in a special education classroom throughout the day

Therapeutic Goals

Increase skills in language, play and socialization, while decreasing oppositional behaviors:

- Increase word statements to four to five to effectively communicate his needs without aggressive vocalizations or physical altercations 80% of the time;
- Engage other children and adults with appropriate greetings with 80% success rate;
- Engage in a minimum of three statement reciprocal languages with adults 80% of the time;
- Engage in reciprocal play with other children for 5 minutes per free play session;
- Engage in imaginative play when prompted by an adult 3 out of 4 attempts.

iLs Program Used

Sensory Motor, 60 sessions, three one-hour sessions per week, iLs Playbook (balance and visual exercises) used every session

Other Interventions Used

Applied Behavior Analysis - The Catalyst Data Collection Platform program was utilized to track behaviors. Behaviors were tracked bi-monthly over 10 trials per goal per one hour session. Behaviors were marked as independent or prompted with type of prompt used being designated. A baseline was gathered post six months of ABA treatment. These trials were completed while goal was rapport building and equipment familiarity only.

Data was then collected on each behavior every other week over 60 hours of iLs. A final data collection was completed two weeks post-treatment. Data was plotted using a graph tracking multiple data points for five different responses/behaviors utilizing discrete trial training. Two behaviors were tracked using frequency data.

Verbal, Physical, Gesture, Positional, and Demonstration prompts were utilized and documented for prompted behaviors. Independent behavior goals were then plotted on a graph as to percentage of successful trials per data tracking session. Reciprocal and Expressive Language skills were assessed including eye contact upon his name being called out, sharing of object for a minimum of one minute when asked to do so, following of direct commands by others within 30 seconds of request, use of simple statements to express needs/wants, and answering yes/no questions appropriately. Behaviors that were also tracked included screaming and self-harm.

Summary of Changes

Client was assessed one-month post completion of the iLs protocol. Initial assessments were completed by his parents and teachers, along with home, school and clinic observations toward completion of goals. Data was collected bi-monthly during the treatment stage using the iPad app Catalyst Data Collection Platform. The data was utilized to determine amount of progress toward goals. The final assessment utilized the Vineland Teacher Report form and the BASC-2 completed by his parents and his teachers along with a post observation utilizing data tracking.

Client's teacher was initially upset by the ABA counseling sessions taking place three times a week in the morning resulting in the client coming to school 45 minutes late. Two weeks after initiation of the new treatment combination of iLs simultaneously with ABA therapy, the teacher stated that she wished the therapy was every day. She stated that on the days he started with ABA/iLs therapy, he was less aggressive, followed directions more, required less prompts and was on task more often.

Within the first month, client's parents noticed a decrease in self-injurious behaviors, a decrease in screaming, improvements in sleep and more attempts at vocalizing needs.

Clinician noticed improved mood, decreased anxiety, sustained attention during sessions, improvement in gross motor skills, and decrease in aggression to self. A baseline was collected and then treatment data collection began at week two of ABA/iLs treatment, iLs session #5. Data was collected every two weeks.

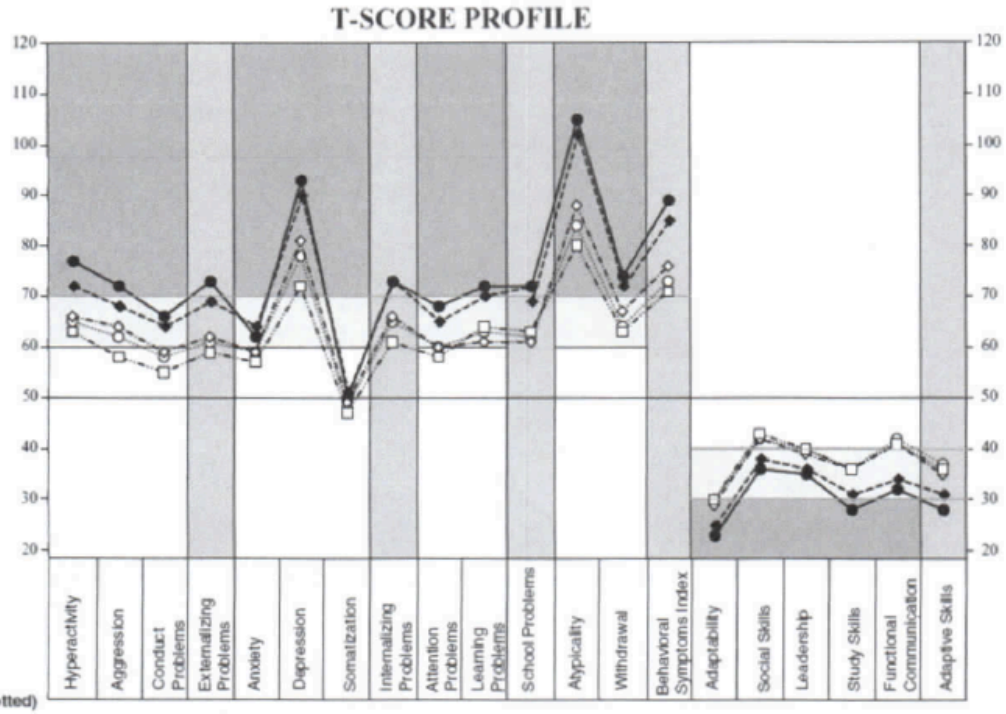
Pre/Post Assessments

Vineland Adaptive Behavior Scale

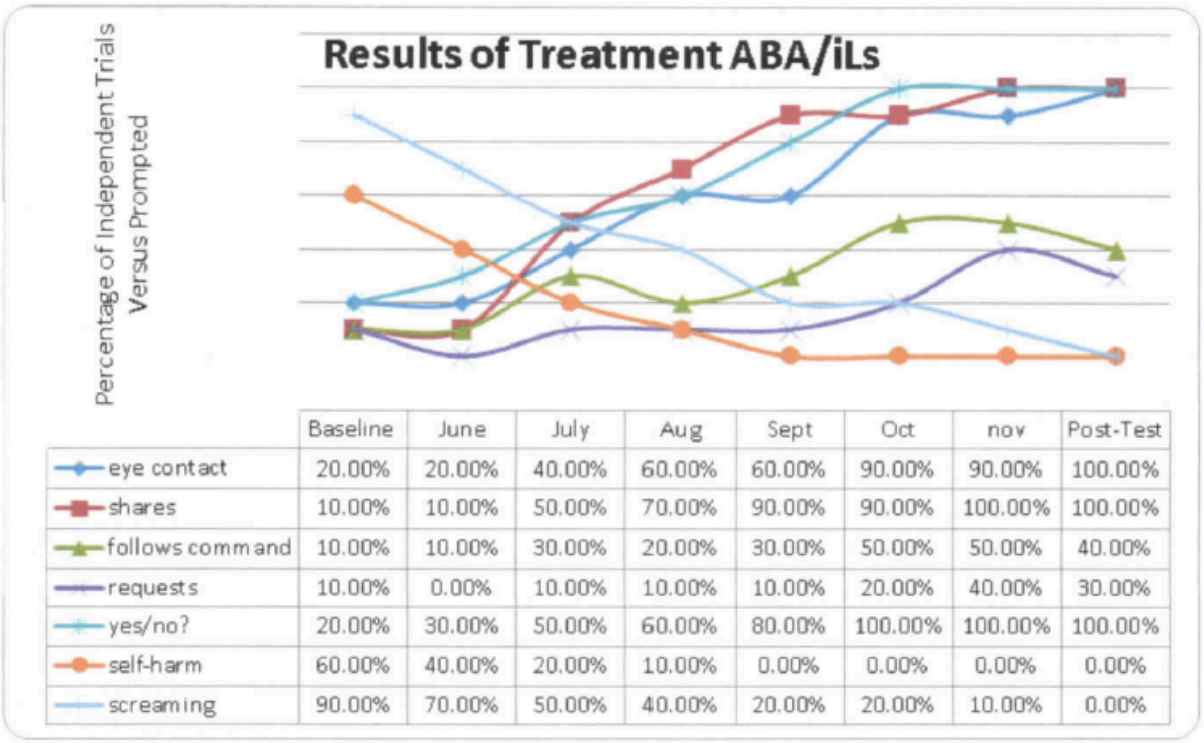
- Pre-therapy: Low Communication (1%), Daily Living skills (2%), Socialization (1%) and Motor Skills (1%).
- Post-therapy: increase of adaptive functioning across all Composite Scales. Communication skills increased from 55 65 to 79, Daily Living Skills increased from 55 68 to 75, Socialization increased from 55 64 to 80, and Motor skills increased from SS 63 to 82.

Test	Pre	Post	Change	Age appropriate	Work-in-progress
Scan-C composite score	96	112	16% points (100 age-norm)	✓	
Auditory digit span					
Forward	4	5	+1		✓
Reverse	5	5	no change		✓
Processing speed (BrainBoy order threshold)					
Personal Auditory+ Visual	397	67	490% faster - now age approp	✓	
Auditory	125	87	44% faster	✓	
Visual	140	58	141% faster	✓	
Hearing (Otoacoustic emission test)					
Right receptive dominance	44	61	38% stronger right		✓
Fishers auditory checklist	92	96	(100 age-norm)	✓	
AuditoryPerception (Listening Test)					
Divergence (dB)	7.4	4.5	39% improvement		✓
Inversion % (AC vs BC)	83	33	60% improvement	✓	
Bone Conduction (dB vs ideal)	-9.3	-0.36	Normalised	✓	
Air conduction (dB vs ideal)	-23	-8	65% improvement		✓
Pitch Discrimination (vs age-norm)	-6	-4	33% improvement		✓
Sensory Motor tests					
Finger test	Fail	Pass		✓	
Balance test	Fail	Pass		✓	
Oculo and Labrynthine head-righting test	Fail	Pass		✓	
ATNR, STNR, TLR	Pass	Pass		✓	

BASC-TRF pre/post assessments showed clinically significant finding in the following areas: Overall Behavior Index, Depression, Atypical, and adaptability (based on norms from a Learning Disability Separate Sex population). The BASC suggested a clinically significant decrease in Depression from clinically significant to within normal range (T-score 81 to 56) and atypicality decreasing by 18 points (T-Score of 88 to 72).



T Score (Plotted)	Hyperactivity	Aggression	Conduct Problems	Externalizing Problems	Anxiety	Depression	Somatization	Internalizing Problems	Attention Problems	Learning Problems	School Problems	Atypicality	Withdrawal	Behavioral Symptoms Index	Adaptability	Social Skills	Leadership	Study Skills	Functional Communication	Adaptive Skills
● Gen.-Comb. Sex	77	72	66	73	62	93	50	73	68	72	72	105	74	89	23	36	35	28	32	28
◆ Gen.-Sep. Sex	72	68	64	69	64	90	51	73	65	70	69	102	72	85	25	38	36	31	34	31
○ Clin.-Sep. Sex	65	62	58	61	59	78	48	65	60	63	62	84	64	73	30	42	40	36	42	37
◇ LD-Sep. Sex	66	64	59	62	59	81	49	66	60	61	61	88	67	76	29	42	39	36	41	35
□ ADHD-Sep. Sex	63	58	55	59	57	72	47	61	58	64	63	80	63	71	30	43	40	36	41	36



	Baseline	June	July	Aug	Sept	Oct	nov	Post-Test
eye contact	20.00%	20.00%	40.00%	60.00%	60.00%	90.00%	90.00%	100.00%
shares	10.00%	10.00%	50.00%	70.00%	90.00%	90.00%	100.00%	100.00%
follows command	10.00%	10.00%	30.00%	20.00%	30.00%	50.00%	50.00%	40.00%
requests	10.00%	0.00%	10.00%	10.00%	10.00%	20.00%	40.00%	30.00%
yes/no?	20.00%	30.00%	50.00%	60.00%	80.00%	100.00%	100.00%	100.00%
self-harm	60.00%	40.00%	20.00%	10.00%	0.00%	0.00%	0.00%	0.00%
screaming	90.00%	70.00%	50.00%	40.00%	20.00%	20.00%	10.00%	0.00%

Recommendations

The combining of iLs with ABA therapy suggests an increase in skill attainment over ABA therapy alone. iLs in combination with other therapies is a powerful combination in that it works on a bottom-up principle rather than top-down. iLs utilizes specifically treated music (and specially engineered auditory equipment) to engage the brain in the process of learning while reducing sensory and mood challenges. This sensory input allows the child to be grounded, present and available for the benefits of ABA therapies. It is recommended that more studies using this treatment combination be completed using an ABAB design in order to better document the increased therapeutic benefit of the use of iLs as a tool during ABA therapy.

In addition, it is recommended that the recently developed iLs Pillow be utilized before the ABA/iLs therapy is initiated. The iLs Pillow was not available at the time of the treatment provided during this case; however, it has become a standard protocol in this clinic. The protocol involves the utilization of this device at home when the client goes to bed. The iLs Pillow delivers music through vibration and serves to help those with auditory hyper-sensitivity acclimate to auditory input prior to beginning an iLs program. A secondary benefit is that it assists clients with falling and staying asleep, which of course has cognitive, emotional and social benefits.

Comments by Ron Minson, MD, iLs Clinical Director

The impressive results from a combined approach of ABA therapy and iLs speak for themselves. One can only imagine the relief to the parents, family and teachers that his screaming went from 90% of the time to 0%!

The clinician rightly emphasizes the importance of sub-cortical processing (the "bottom- up" effect of iLs) to support learning and cognitive function. I have often emphasized the importance of establishing a good sub-cortical foundation *before* addressing higher learning and conscious control of behaviors. However, this case beautifully illustrates that a multi-sensory sub-cortical approach may be done *simultaneously* with higher order learning and behavior therapies. I can see that doing so may further accelerate the speed at which learning and behavioral control is established as these approaches work hand- in-hand to improve brain function at all levels.

An important footnote: Taking a child out of school for an effective therapy is not a threat to their learning. This case strongly points out that fact. Often a child is not benefiting from the instructions in the classroom, yet teachers fret unnecessarily over losing class time. What is the value of leaving a child in the class where they will experience more frustration, embarrassment and emotional pain because they can't perform up to expectations?

Associate's Name:

Tim Engels, MA, Sports Psychology

Associate's Discipline:

Sports Psychology

Name of Organization:

Engels & Jones, Inc.

Comment by Ron Minson, MD, iLs Clinical Director

There is a great deal we can learn from this unique case presentation. To begin, the first two paragraphs in the history point to frontal lobe deficiency with a concurrent loss of inhibition resulting in a lack of impulse control, emotional regulation and poor decision making - highlighting a few of the consequences of low frontal lobe activation. In fact, the therapeutic goals as outlined are also clearly frontal lobe functions.

While the low IQ score of this case is outside the typical profile of iLs clients, keep in mind it should be taken with a grain of salt: it may or may not be accurate. Nevertheless, a perceived low IQ score should never discourage or prejudice us against what can be accomplished. The importance of parental/spousal support and the dedication of a skilled therapist are quite evident. As iLs was improving the function of the frontal lobes, the patient was then able to integrate the behavioral and emotional support from his environment.

Presenting Problem:

R is a 31 year-old male, diagnosed as developmentally disabled and with Asperger's Syndrome. On the WAIS-III, his verbal IQ was 61, performance IQ was 62, and Full Scale IQ was 58.

Therapeutic Goals:

Goals included emotional regulation, better decision-making in most daily life situations, and more mature interpersonal interactions.

Background:

R's mom approached me about working with him when he was 28 years old and had, in the past week, broken his cell phone, a window, and punched a hole in the wall during temper tantrums that he called "tornadoes" in his head. Financially, he would immediately spend any money he had and use a credit card indiscriminately, so his parents had to closely manage his money.

He had significant problems with frustration, reacted very strongly to criticism, and was impulsive, quick-tempered, and obsessive. Even minor changes to his schedule caused temper flare-ups.

R was employed in his parents' business, but needed very close supervision. He had failed to hold down any other job for more than a few months. His emotional outbursts would get him fired.

R had a strong fear of rejection and difficulty trusting others. He was living with his girlfriend. They had credit card debt, spent their money impulsively and unwisely, and needed lots of supervision caring for their one bedroom condominium. The friends they had were regularly taking advantage of them.

R was incapable of living on his own without significant supervision by his parents.

iLs Program used:

R has been using the Total Focus Program for four years. The family rented a system from me for several weeks, and quickly noticed so much improvement in emotional regulation that they purchased a system. He repeated the Sensory Motor Program three times in the first 18 months, then moved on to the Concentration and Attention Program, Reading and Auditory Processing Program, and recently, Optimal Performance I.

He's now using the Integrated Language Program. R is using the iLs Interactive Language Program to improve his voice tone, volume and modulation after his dad mentioned that he sounded angry frequently and "yelled." After renting a system for a few weeks, R's parents noticed a significant improvement in R's vocal quality, and a more relaxed presence. He has begun reading into the microphone {previously he wouldn't read at all because it was too hard and embarrassing). R is much more comfortable speaking in public, and is looking forward to working with clients of his dad's business one on one and unsupervised. They recently purchased their own iLs Interactive Language Program.

Summary of Changes:

Emotional Regulation: R's emotional outbursts resulted in three broken cell phones the year he began therapy. He would fight with his father daily, had temper tantrums on a regular basis, and his anxiety was evident in his tone of voice, which was loud and edgy. He now works well with his father and accepts direction from him. R handles changes in his life now with flexibility and accommodation, and his voice is quieter, more tempered and relaxed. He has had the same cell phone for four years.

Organization and Independence: Before the therapy, R's parents had to closely supervise his apartment cleaning and upkeep. He was only allowed to have $20 at a time and a credit card was not allowed because of his impulsive spending. Now, R and his wife take care of all shopping, cooking and cleaning. He manages his own finances and can be trusted to use the credit card only for emergencies.

Conclusions and Recommendations:

The regular use of Total Focus Programs in conjunction with regular psychotherapy and ongoing support from his parents has helped R reach his therapeutic goals of emotional regulation, better decision-making in most daily life situations, and more mature interpersonal interactions.

His parents are feeling much less worried about his long-term prognosis and how much he'll need their assistance. His progress has significantly reduced their care-taking responsibilities. R has an amazing ability to set challenging life goals and persevere in the face of others' doubts.

AUTHO RS: Julaine Tollison, OT, MA and Paul Atherton, PhD

NAM E OF ORGANIZATI ON: Kingsway Elementary School, Port Charlotte, FL

ABSTRACT: This controlled study measures the effect of an iLs school program on ten students diagnosed with ASD. Measures used in the study include the SCAN:3-C, a standardized assessment of auditory processing, and the Measure of Foundational Abilities (MFA), which measures change in five categories: motor, sensory, social/emotional, language and attention/organization. The iLs group received therapy 30 minutes per day, on an average of four days per week while the control group students continued to receive ABA, OT and Speech therapy on their regular weekly schedule. Auditory processing and behavioral changes were significant for the iLs group, with an average gain of 36 in the SCAN:3-C composite percentile rank scores, and a 32% average improvement in the MFA categories. Results for the control group include a change of -6 in the SCAN:3-C composite percentile rank scores and a 2% improvement in the MFA behavioral evaluation.

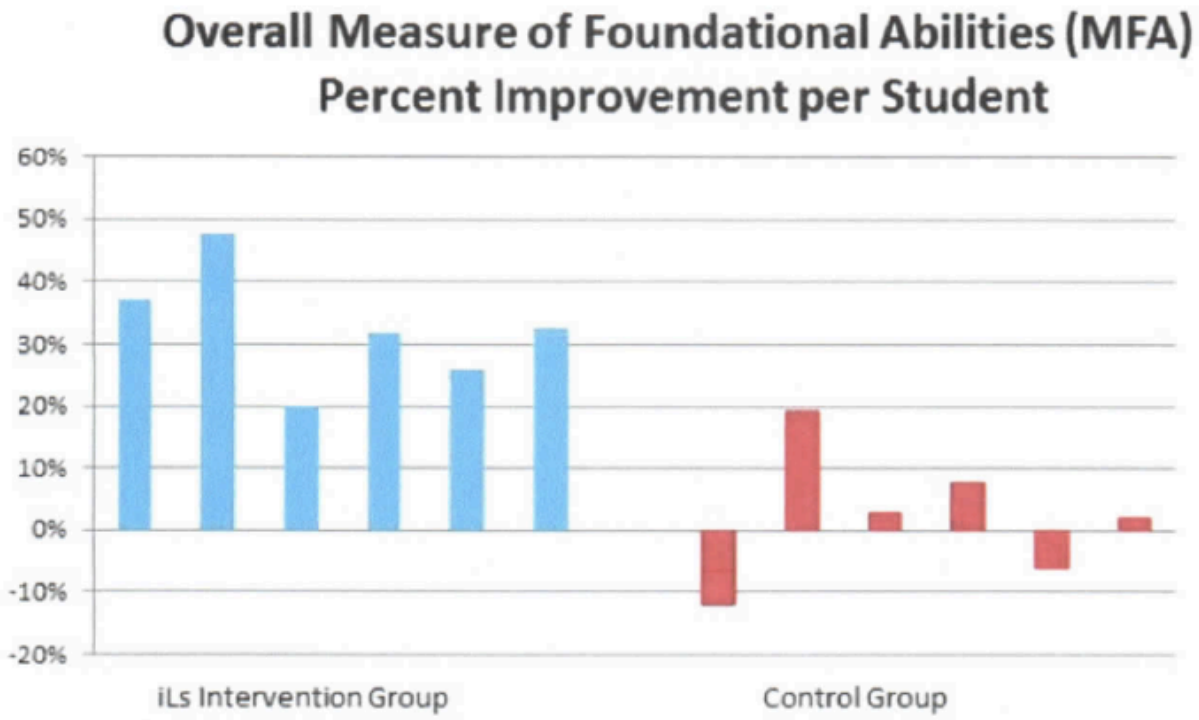
Kingsway Elementary School

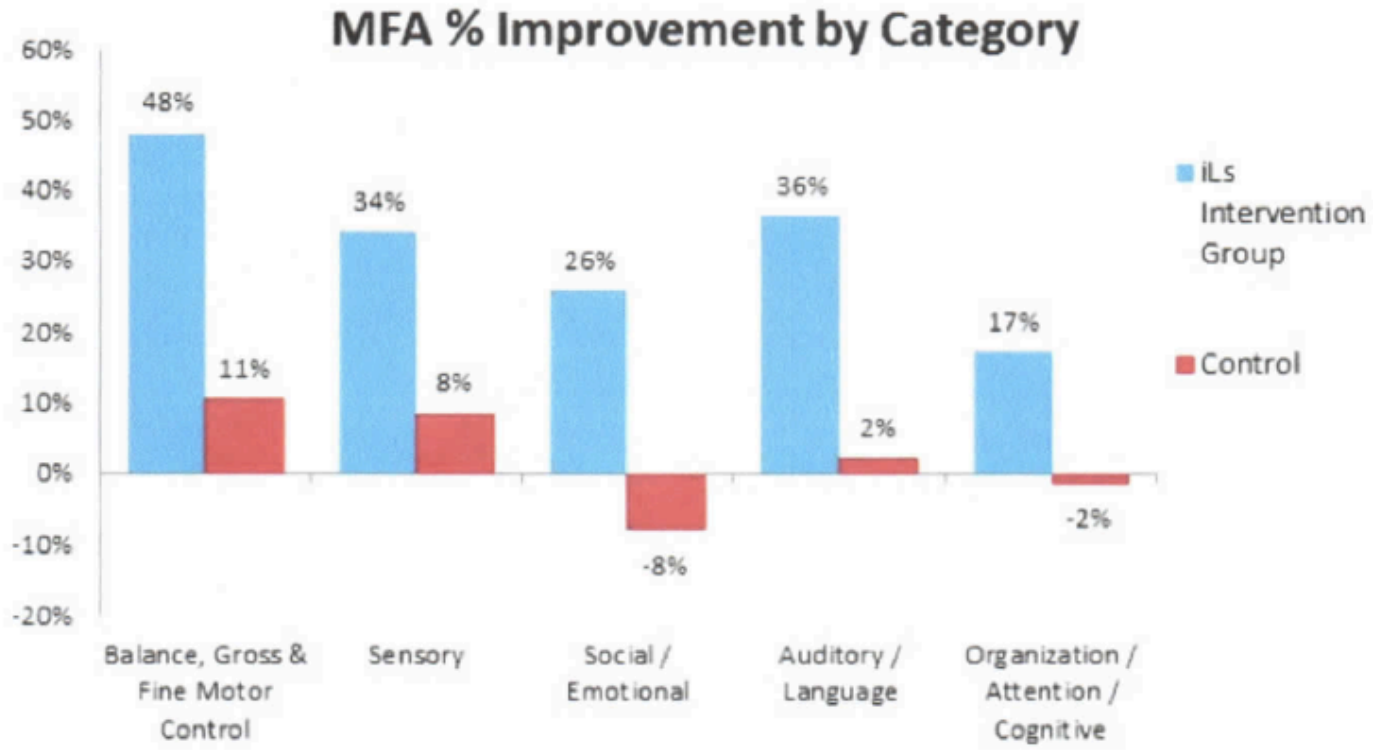
PROGRAM ADMINISTRATION AND IMPLEMENTAION: iLs was implemented in two groups. Group A received iLs Monday through Friday, first thing in the morning for half- hour sessions. Activities for this group were completed in a separate room to help minimize the distraction of morning announcements and opening routines. Group B followed the same half-hour session schedule 4-5 days per week within the classroom setting. Due to the behavioral complexities of several students in this class, scheduled times of implementation varied depending on the day/class needs. All students were very receptive to participating in iLs. On occasions when sessions were missed, students were asking for the program.

Challenges for implementing within the public school system included: student absences (especially around flu season), Thanksgiving, Christmas and Spring Break (totaling 4 weeks off), and testing schedules (for those students required to participate). Kingsway school administration was very supportive of the iLs therapy throughout the year. Following the first 20 sessions, and after seeing positive results, a paraprofessional was assigned to take over the program's implementation under the supervision of the Occupational Therapist. This allowed for less interruption to daily sessions due to meetings, absences, and teacher/therapist obligations.

PROGRAM RESULTS:

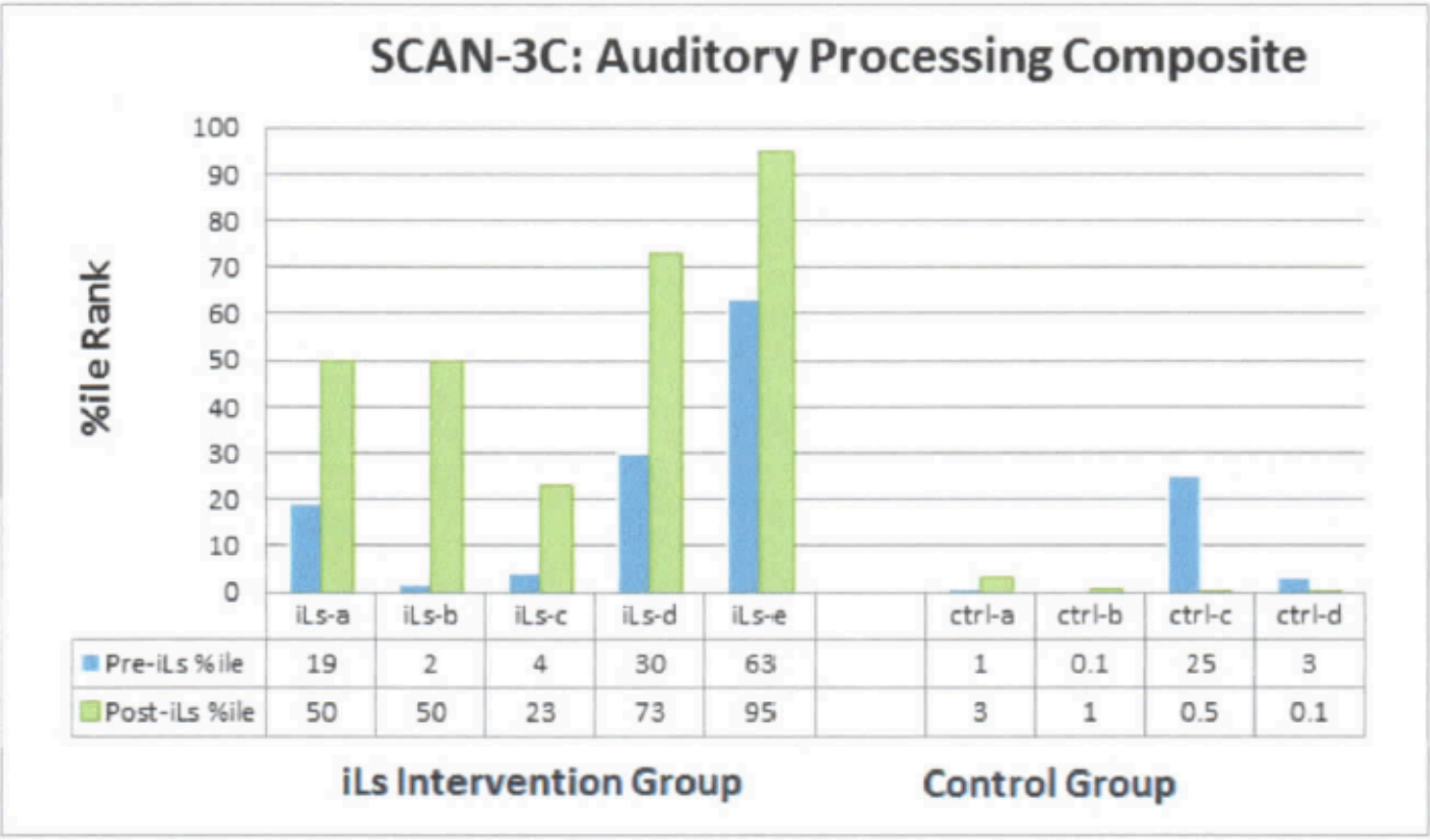
Discussion of Measure of Foundational Abilities (MFA) The data on the graphs below show pre/post results for both groups. All members of the iLs group showed significant improvement in most categories, most notably in the areas of Balance, Gross & Fine Motor Control, Sensory and Auditory/Language. Those in the control group made marginal, if any, improvement across all categories. In general, it is evident that the overall reductions of problems in these key areas were associated with the **iLs** therapy, especially since both iLs and control students were matched with similar difficulty levels in all areas and comparable Autism Spectrum Rating Scales scores.


Overall Measure of Foundational Abilities (MFA)
Percent Improvement per Student
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
iLs Intervention Group
Control Group


MFA % Improvement by Category
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
48%
11%
34%
8%
26%
-8%
36%
2%
17%
-2%
Balance, Gross & Fine Motor Control
Sensory
Social / Emotional
Auditory / Language
Organization / Attention / Cognitive
iLs Intervention Group
Control

SCAN-3: C: The SCAN-3: C is a battery of tests for screening and diagnosing auditory processing difficulties in children. In the auditory figure ground test, examinees hear words or sentences presented in background noise to simulate environments in which listening is difficult, such as listening to conversations at school, restaurants, or at sports events. The stimuli for the filtered words tests are filtered in a way that degrades the signal to simulate real-life conditions such as talking on a cell phone, or listening in class when the teacher is turned towards the chalkboard, away from the class.

Students who received **iLs** intervention consistently improved in all auditory processing categories. The control group remained at approximately the same levels before and after the 6-month period, during which they received OT, language and/or speech therapy, and ABA, (with a ratio of 3 adults to 12 students).



	iLs-a	iLs-b	iLs-c	iLs-d	iLs-e	ctrl-a	ctrl-b	ctrl-c	ctrl-d
Pre-iLs %ile	19	2	4	30	63	1	0.1	25	3
Post-iLs %ile	50	50	23	73	95	3	1	0.5	0.1

Conclusion: The data clearly shows significant changes in auditory processing, motor function and behavior for the students receiving **iLs.** Teachers and parents noted changes in social interactions and emotional regulation, which resulted in greater classroom participation, and interaction with peers. Stemming behaviors decreased, reciprocity in day-to-day interactions increased.

One child with echolalia was able to initiate relevant conversations with adults and answer "wh" questions by the end of the study. The same student now interacts with the other children during recess and plays on the equipment, neither of which he was able to do prior to the program. Since starting, iLs, there have been no behavioral outbursts or meltdowns at school at all. The iLs group students also saw reductions in or discontinuation of IEPs.

With these overall results and data, we applied for and were awarded a Century Link Technology grant for continued expansion of iLs services and equipment at Kingsway. At Kingsway School, we are excited to be able to expand the iLs program to students in the control group, as well as to others, for the 2015-2016 school year.

Organization:

Family Achievement Center

Associates Name & Discipline:

Rachel Kuenzli, SLP & Shawna DeHaan, OTR/L

Presenting Problem:

PDD-NOS (Pervasive Developmental Disorder - Not Otherwise Specified, or PDD-NOS, for short, is a condition on the spectrum that exhibits some, but not all, of the symptoms associated with classic autism.)

Client Background:

3-year-old male 'W" diagnosed with PDD-NOS. W met all his developmental milestones earlier than normal limits. At the time of his evaluation he presented with speech, language, gross motor, fine motor, and auditory processing delays.

Therapeutic Goals:

Speech Therapy:

1. W will follow simple, routine 1-2 step directions (sit down, stand up, etc) with 80% accuracy without cues over three consecutive sessions.
2. W will verbally request objects and actions in his environment with 80% accuracy with minimal cues.
3. W will use the Picture exchange communication system (PECS) to describe objects and answer simple wh-questions with 80% accuracy with minimal cues.
4. W will demonstrate understanding of and use of age appropriate verbs, pronouns, and adjectives while describing pictures with 80% accuracy when provided with minimal cues.
5. W will choose between 2-4 real objects or activities using real words or gestures in 8 out of 10 trails with minimal cues.
6. W will complete simple 3-step picture sequences with 80% accuracy with moderate cues.
7. W will answer simple wh- questions (what, where, who) given 3 picture choices with 80% accuracy with minimal cues.

Occupational Therapy:

1. W will demonstrate improved bilateral integration skills by button/unbutton *W'* buttons donned on self with minimal assistance 75% of trials. (Goal modified and increased due to progress while participating in **iLs)**

2. W will cut within a *Y.e"* of a straight line with adapted scissors (loop) with minimal assistance 75% of trials.(Goal modified and increase due to progress while participating in **iLs)**
3. W will engage in functional tasks that involve crossing midline to promote consistent hand use when engaging in age appropriate coloring tasks. (Goal written prior to participating in **iLs)**
4. W will consistently imitate pre-writing strokes (horizontal/vertical lines, cross, and circle) with minimal assistance in 75% of trials. (Goal revised from initial evaluation and prior to participating in **iLs)**
5. W will demonstrate improved fine motor and grasping skills by using a mature quadrupod grasp on a writing tool with minimal assistance 75% of trials. (Goal written while participating in **iLs)**

iLs Program Used:

Sensory Motor Program, 4.5 hours per week (two days a week he listened to 1.75 hours (7 songs total) and a third day was 1 hour). 12 weeks total.

Other Interventions Used:

Continued OT and ST during the program

Summary of Changes:

Potty Training: Mom commented that two of the biggest changes from iLs were that he potty trained and began communicating his wants and needs. W had never been interested in potty training and the family had not pushed it. During the first few weeks of iLs, he began showing interest and was potty trained within weeks.

Expressive Language & Emotional Regulation: She also stated that he began articulating his wants and needs, which he had never done before. It may have been only 1 word, but she finally knew what it was that was upsetting him. This resulted in a decreased number of tantrums and an increase in engagement with his family.

Transitions: Another major change was W's ability to transition between environments and various activities. Previously, W was easily brought to tears and meltdowns with any slight changes or transitions, such as going through a different door leading to the same place. During the **iLs** program, he was able to make these transitions with familiar people but continues to have difficulty with unfamiliar individuals.

Pretend Play: Finally, mom was excited about an increase in pretend play. Being a former early-education teacher, mom had worked on pretend play constantly but to no avail. Toward the end of the 60 sessions, W began creatively playing with toys and showed the desire to be social with peers but did not know how to.

Speech Therapy:

Click graph to view full size

Preschool Language Scale- 4th Edition (PLS-4)	Raw Score		Standard Score		Percentile Rank		Descriptive Category	
	7/29/10	11/9/10	7/29/10	11/9/10	7/29/10	11/9/10	7/29/10	11/9/10
Auditory Comprehension	26	38	53	86	1	18	Below Average	Average
Expressive Communication	36	37	78	80	7	9	Below Average	Below Average
Total Language Score	62	75	62	81	1	10	Below Average	Below Average

Prior to starting iLs, W displayed difficulty answering yes/no questions, understanding and following routine one-step directions (e.g., throw it away, stand up), transitioning between activities, completing simple sentences with nouns and verbs, and understand simple spatial concepts (e.g., in, on, off). When transitioning, he typically required a visual schedule, timer, and moderate cues. If something new was being introduced, he became confused and nervous, running away from the activity and crying.

During and after iLs, W began answering yes/no questions, understanding simple spatial concepts, labeling and using verbs, following 2-step related commands, and completing sentences. His MLU increased slightly, but the most drastic change was with transitions. He was able to transition between activities with minimal cues and no longer became frustrated and nervous when something new was introduced. He stayed with the activity and allowed the therapist to model.

Occupational Therapy:

Click graph to view full size

Peabody Developmental Motor Scales-Second Edition (PDMS-II)	Raw Score		Standard Score		Percentile Rank		Descriptive Category	
	07/29/10	11/16/10	07/29/10	11/16/10	07/29/10	12/10/10	07/29/10	12/10/10
Grasping	43	48	6	10	9	50	Below Average	Average
Visual-Motor Integration	110	125	7	9	16	37	Below Average	Average

W demonstrated improvements in grasping and visual motor integration skills since the implementation and completion of the Sensory Motor iLs program.

<u>Grasping Area:</u>

Prior to iLs, W frequently switched hands, demonstrated an inconsistent grasp pattern and had difficulty crossing his midline. After iLs, W demonstrated consistent use of his right with a consistent grasp pattern and demonstrated increased ability with crossing his midline. Prior to iLs, W was unable to manipulate buttons and after was able to unbutton.

Visual Motor Integration Area:

Prior to iLs, W was unable to imitate pre-writing strokes and shapes, cut paper in half or on a designated line, and lace holes on a strip. After iLs, W was able to imitate pre-writing stokes (horizontal and vertical lines), copy a cross and circle and attempted to copy a square. He was also able to cut paper in half and on a straight line, but was unable to cut out a circle or square. W was also able to motor plan the ability to lace 3 holes on a lacing strip.

Conclusions and Recommendations:

Discharged from OT one month after completion of iLs program. Recommended parent continue to work on pre-school readiness skills of coloring, cutting, shape imitation, grasping skills, and puzzles. Continue one-on-one ST as well as iLs Attention and Concentration program after 2-3 month break.

Associate's Name:

Lynn Schoeneck, OTR/L

Associate's Organization:

Porter Academy

Client:

7- year-old boy, Autism Spectrum Disorder, ADHD

Presenting Problem:

Difficulties with anxiety, social interactions, attention, expressive and receptive language, poor organization, fine motor coordination and gross motor coordination

Therapeutic Goals:

Improve social interaction with both peers and adults, decrease anxiety to enable participation in-group activities and changes in routine, improve motor skills, improve attention and organization

iLs Program Used:

Sensory Motor Program - 3 one-hour sessions per week; 30 hours in Fall Semester, 30 hours in Spring Semester

Other Interventions Used:

Client received Occupational Therapy (OT), Speech Therapy (ST) and music therapy within a group setting, all of which are part of the curriculum at Porter Academy. He also began receiving private OT and private speech therapy once a week.

Parent/Teacher Comments:

Parent: "Every morning he is excited to go to school. He loves learning, and his confidence in his work has excelled. He has made friends, and has turned into a happy, funny, content little kid."

Teacher: "He has gone from extremely anxious to the total opposite. He is very social and interacts with everyone, which is a total change since August. When he started, he did not recognize all his letters or their sounds; now he is the best reader in the class. He could not spell or write his name in August; today he is starting to write sentences and brief paragraphs. His letter orientation, spacing and sizing are greatly improved. He is now turned on to learning!"

Conclusions and Recommendations:

This child came in with huge deficits academically and socially. This year he has made great progress in both arenas, but he does still have a long way to go. I plan to utilize the iLs Sensory Motor Program again with him next year and continue to emphasize movement activities that cross the midline. I also will continue to incorporate activities that develop working memory and enhance processing speed.

Test Scores:

Diagnostic Achievement Battery (3rd Edition) - %ile ranking on nationally normed assessments

Story comprehension: <1% to 16%

Synonyms: 9% to 25%

Grammatical Completion: 16% to 25%

Alphabet/Word knowledge: 5% to 50%

Reading Comprehension: 5% to 63%

Capitalization: 16% to 37%

Punctuation: 9% to 63%

Spelling: 5% to 50%

Based on the BASC-2 Parent Rating Scale, the following improved significantly: hyperactivity, anxiety, atypical behaviors, withdrawal, attention problems and functional communication.

Based on the BASC-2 Teacher Rating Scale, the following improved significantly: hyperactivity, aggression, conduct problems, anxiety, somatization and withdrawal.

Subjective Observations of Motor Skills:

At the beginning of the year, he required full physical assist for any motor movement that crossed midline; he is now able to cross midline with initial physical prompts. To start, he was unable to catch a beanbag; he is now able to catch a beanbag while maintaining balance on a balance board for 10 consecutive catches.

iLs Associate:

Jodi Tucker, RDI ® Program Certified Consultant, Intensive Developmental Program Consultant

Organization:

Kids Matter Inc., British Columbia, Canada

Client:

"E" is a 17-year-old male

Background:

E is the oldest of three children living with his biological parents. Both parents speak Spanish and English with their children in the home. E is fluent is both languages. E is diagnosed with Asperger's Syndrome and had undergone various CBT (Cognitive Behavioral Programs) and social skills consultation as a young child. E was moved to a homeschool environment in his elementary years due to very negative experiences in the school environment. E's family chose to participate in a program called RDI ® (Relationship Development Intervention) and had been engaged in that program for over two years when the iLs program was started. E also received weekly appointments with an occupational therapist to address sensory needs prior to beginning the program.

Presenting Problem:

E presented as a high functioning, highly verbal young man. He has the capacity to be very pleasant and engaging with new people but would often become oppositional at home with his parents and hypersensitive to the behaviors of his siblings. This caused high tension in the home and emotional upset for all family members. E preferred to be in his room on his computer and required a high level of prompting and structuring to his day to engage in other activities in the home. E attends a local church function for youth every week and has a friendship with a few of the peers there; however, time spent with friends was limited to online or the group structure rather than seeking mutual engagement independently. Over time, the frequency and intensity of family discord was lessened by the RDI Program. However, E was still not able to identify strategies that would work for him to better manage his frustration tolerance and had a high level of externalization for problems and situations. E was identified as significantly at risk for mental health issues due to his high level of intelligence but low level of overall functioning. E had expressed to his parents that he wished to get a job and that he often felt bad about himself.

Therapeutic Goals:

E's goals were to address the above findings in his developmental profile.

- Academic - processing, organization, problem solving, write clearly
- Personal - adaptable, self- regulation, coordination, balance, nail biting, GI issues, sensory struggles
- Social - interrupting people in conversations, focusing only on what interests him, anxiety and sensory over-stimulation in community environments (lights, sound, smells and textures)

Mom and dad expressed their desire that E feel less stress about sensory stimulation and be more aware of others' feelings and interests.

iLs Program Used:

40 one-hour-sessions of the Sensory Motor Program, no less than three days a week. Sessions were conducted in the family home by a supervised technician who had been trained in the Guided Participation methods of the RDI Program, and occupational therapy appointments were discontinued.

E presented with strong resistance at the beginning of the program. He would frequently talk for the duration of the session in the initial few days. RDI Program strategies were used to increase engagement. Although E continued to talk/argue he responded to redirection and engagement increased.

Other adjustments to the iLs program included lowering the bone conduction volume (iLs equipment delivers music via both air and bone conduction) in response to E's vestibular sensitivity. Additionally, around the 20th session, E also expressed that he felt awkward around his friends and that he wanted to stop. Using RDI Program strategies E and his technician discussed how positive changes were taking place and though he might "feel weird" for a while, it was ok and the feeling would pass.

Other Interventions Used:

E and his parents continued to receive ongoing RDI Program consultation for the duration of the iLs program. No other therapies were used.

Summary of Changes:

BASC-2 - the *BASC-2* is a standardized behavioral assessment

Pre and Post-Program Comparison Charts *Percentile Rankings*

BASC-2 ***Percentile Rankings***

	Pre-Program	*Post-Program (3 months later)*
Negative or Undesirable Behaviors (decrease denotes improvement)		
Hyperactivity	90	*53*
Aggression	99	72
Conduct Problems	97	*30*
Anxiety	77	*54*
Depression	99	*51*
Somatization	98	95
Atypicality	93	11
Withdrawal	99	*36*
Attention Problems	99	*47*

Positive Behaviors (increase denotes improvement)

Adaptability	1	*60*
Social Skills	2	*22*
Leadership	1	*49*
Activities of Daily Living	1	*56*
Functional Communication	1	*83*
Adaptive Skills	1	*63*

Composite Score Summary Percentile Ranking Comparison

BASCS-2 Composite Score Summary

	Pre-Program	Post-Program *(3 months later)*	
Externalization	99	45	>70 = Clinically significant levels of maladaptive behavior
Internalization	99	81	
Behavioral Symptoms Index	99	41	
Adaptive Skills	1	63	<30 = Clinically significant levels of maladaptive behavior.

Conclusions and Recommendations:

The findings indicate a dramatic improvement in problem areas. All areas of concern dropped out of the clinically significant/at-risk range with the exception of somatization. In all other areas Post-Program scores indicate E is within range of his same age/gender peers. The results also show a dramatic improvement in adaptability, social skills, leadership, activities of daily living, functional communication and adaptive skills. There remain on-going programming needs; however, the frequency and intensity of problems associated with low skills in these areas has been significantly lessened. E's parents report that previous issues around helping with chores, expressing frustration effectively and demonstrating sensitive insight towards family members have been some of the most enjoyable changes they have experienced. E has also been able to successfully apply for and secure two part-time jobs. He went through the application process independently. E was hired in both instances. He was able at a later date to identify the better working environment and made a decision to resign from one of the positions. E handled these situations independently with no parental involvement at the workplace.

Six-Month Check-in with the Family:

"Our son, now 18, started RDI when he was 14 and then iLS when he was 17. Both experiences have been life changing for our son and for us as a family. Now, he has become more flexible. He can share his feelings and shows that he cares for others. He can better self-regulate himself and even help us regulate ourselves! One important improvement is to be able to start a new school assignment without frustration. Problem solving has become an easier task. Both RDI and iLS have helped him to switch from the static and frightening world to a more dynamic and enjoyable one. Managing unexpected situations without a meltdown has been one of the major improvements. Engaging in different conversations without bringing his favorite subject up is a great accomplishment. He has also become more independent. He can get ready and plan his day including taking the bus to go to the library and mall and even get a job without our intervention. Now, his future looks brighter and full of hope." - E's Parents

It is recommended that E and his family continue to engage the RDI Program as their foundation for engagement and learning with E. It has been suggested that ongoing iLS programming be considered to further advance specific issues as they arise.

Comments by Ron Minson, MD, iLs Clinical Director:

There are two factors that have contributed greatly to E's progress with the addition of iLs to his ongoing RDI Program. One is the marked reduction in anxiety and the other is the improvement in communication and social engagement. Those familiar with Dr. Stephen Porges' Polyvagal Theory will recognize immediately that these improvements are exactly what his research supports as due to the activation of the anterior vagal system. And iLs has direct input into this important anatomical and physiological system for emotional regulation and communication.

With the lessening of anxiety, E was liberated from the constricting chains of ongoing anxiety, with all its reactive behaviors, to be more available to the therapist and to fully participate in his RDI program. Feeling more relaxed, he was able to see options and opportunities for self-improvement. He then drew upon support from the frontal lobes for the initiative and desire to pursue them. Combining the auditory program with the movement activities sends input to the pre-frontal lobes, fostering their maturation and function for the motivation, planning, organization and initiation of action that may have helped E to seek out and obtain a job on his own.

The documented improvement in this young man with Asperger's Syndrome is much appreciated, as there are many who hold that these improvements are unlikely, if not impossible, with this population and at the relative late age of 17. Hopefully, others will be encouraged to add iLs to their practice to improve communication and social engagement where these skills may be sorely lacking.

AUTHORS: Julaine Tollison, OT, MA and Paul Atherton, PhD

NAM E OF ORGA N I ZATION: Kingsway Elementary School, Port Charlotte, FL

ABSTRACT: This controlled study measures the effect of an iLs school program on ten students diagnosed with ASD. Measures used in the study include the SCAN:3-C, a standardized assessment of auditory processing, and the Measure of Foundational Abilities (MFA), which measures change in five categories: motor, sensory, social/emotional, language and attention/organization. The iLs group received therapy 30 minutes per day, on an average of four days per week while the control group students continued to receive ABA, OT and Speech therapy on their regular weekly schedule. Auditory processing and behavioral changes were significant for the iLs group, with an average gain of 36 in the SCAN:3-C composite percentile rank scores, and a 32% average improvement in the MFA categories. Results for the control group include a change of -6 in the SCAN: 3-C composite percentile rank scores and a 2% improvement in the MFA behavioral evaluation.

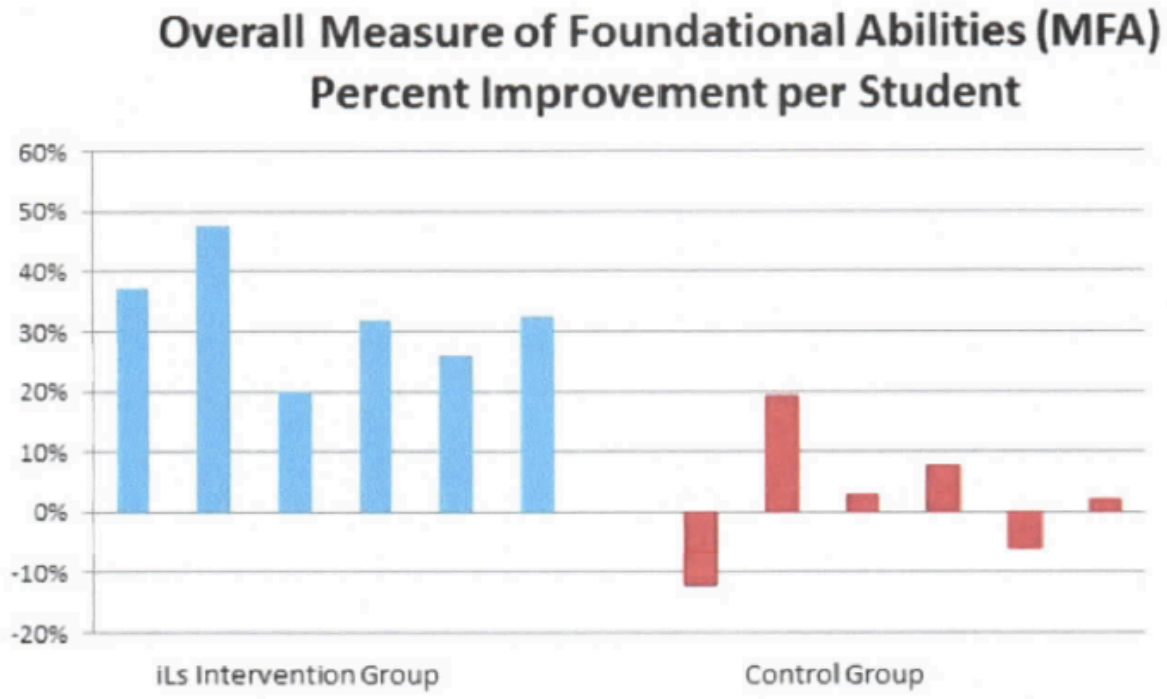
Kingsway Elementary School

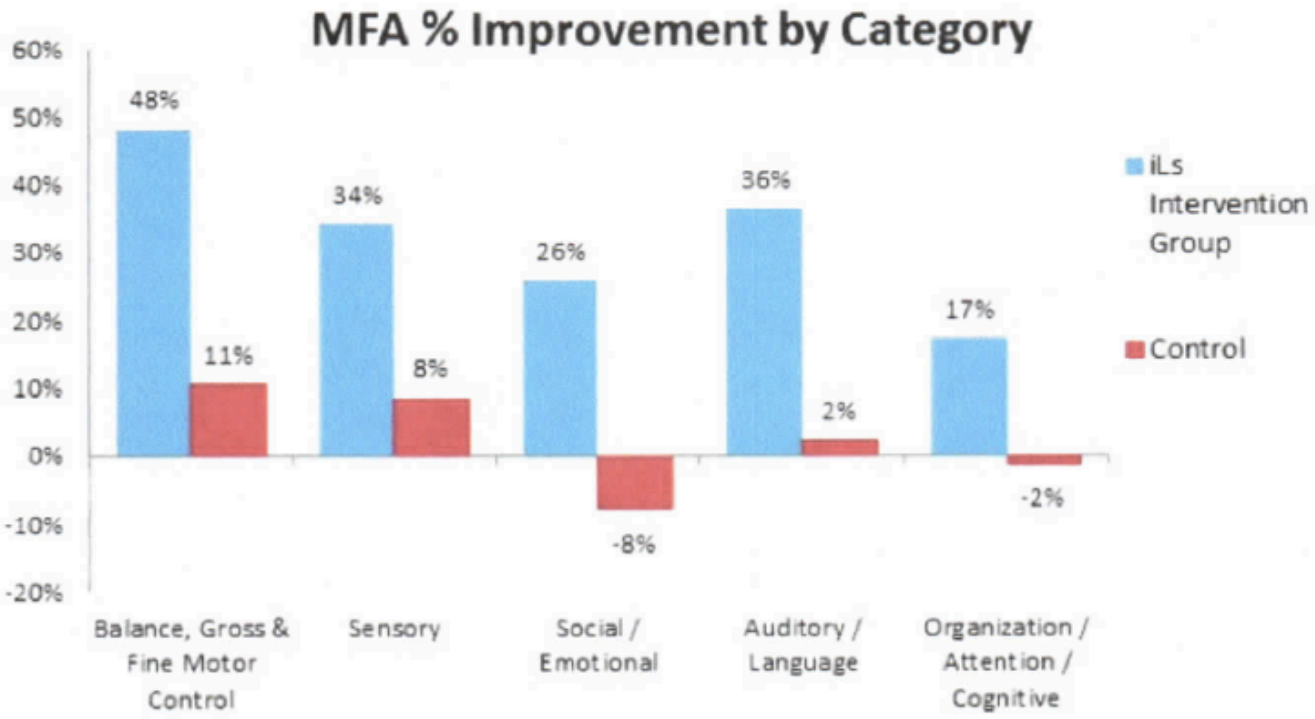
PROGRAM ADMINISTRATION AND IMPLEMENTATION: iLs was implemented in two groups. Group A received **iLs** Monday through Friday, first thing in the morning for half- hour sessions. Activities for this group were completed in a separate room to help minimize the distraction of morning announcements and opening routines. Group B followed the same half-hour session schedule 4-5 days per week within the classroom setting. Due to the behavioral complexities of several students in this class, scheduled times of implementation varied depending on the day/class needs. All students were very receptive to participating in **ils.** On occasions when sessions were missed, students were asking for the program.

Challenges for implementing within the public school system included: student absences (especially around flu season}, Thanksgiving, Christmas and Spring Break (totaling 4 weeks off}, and testing schedules (for those students required to participate). Kingsway school administration was very supportive of the **iLs** therapy throughout the year. Following the first 20 sessions, and after seeing positive results, a paraprofessional was assigned to take over the program's implementation under the supervision of the Occupational Therapist. This allowed for less interruption to daily sessions due to meetings, absences, and teacher/therapist obligations.

PROGRAM RESULTS:

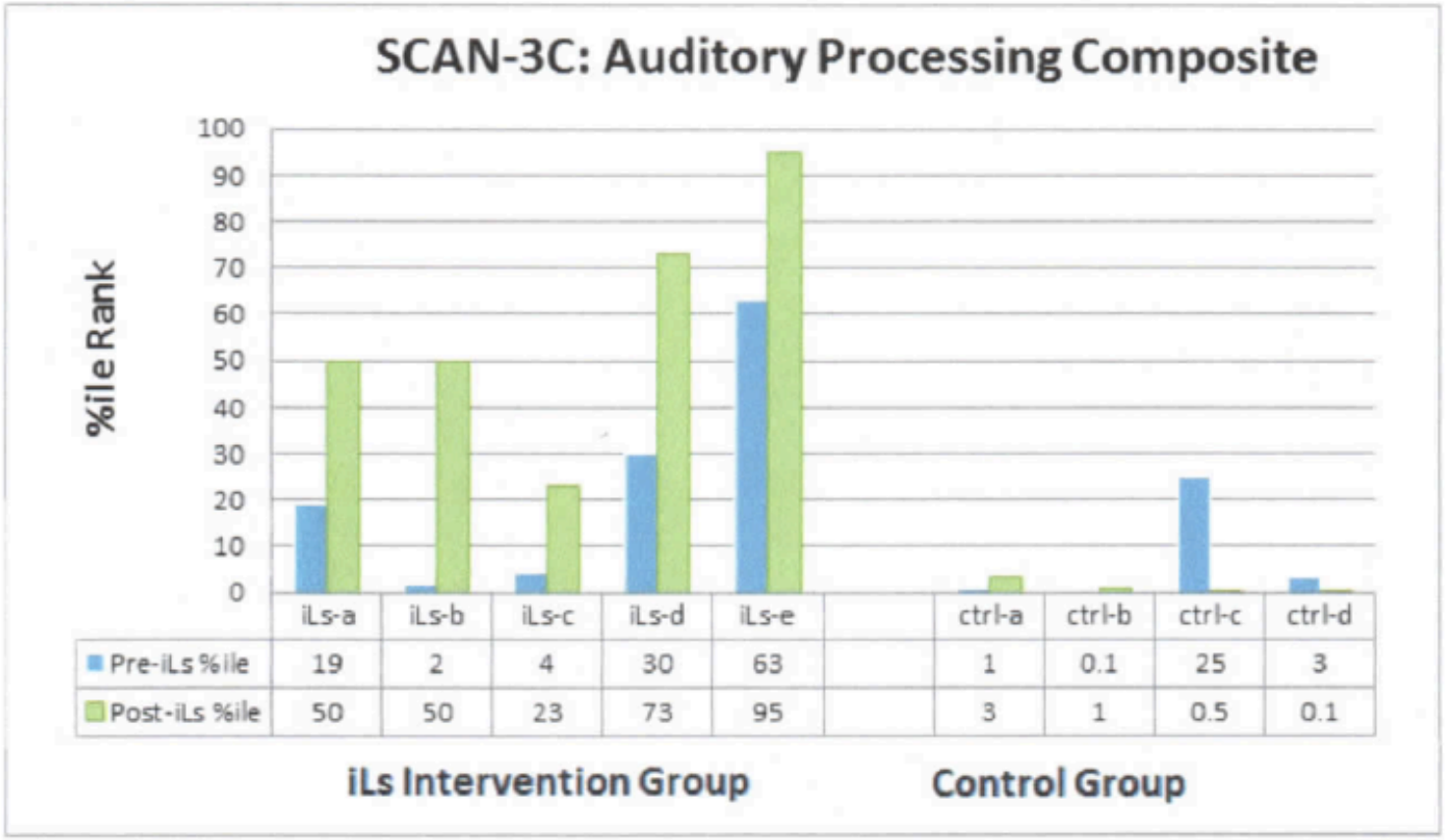
Discussion of Measure of Foundational Abilities (MFA) The data on the graphs below show pre/post results for both groups. All members of the **iLs** group showed significant improvement in most categories, most notably in the areas of Balance, Gross & Fine Motor Control, Sensory and Auditory/Language. Those in the control group made marginal, if any, improvement across all categories. In general, it is evident that the overall reductions of problems in these key areas were associated with the **iLs** therapy, especially since both **iLs** and control students were matched with similar difficulty levels in all areas and comparable Autism Spectrum Rating Scales scores.


Overall Measure of Foundational Abilities (MFA)
Percent Improvement per Student
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
iLs Intervention Group
Control Group


MFA % Improvement by Category
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
48%
11%
34%
8%
26%
-8%
36%
2%
17%
-2%
Balance, Gross & Fine Motor Control
Sensory
Social / Emotional
Auditory / Language
Organization / Attention / Cognitive
iLs Intervention Group
Control

SCAN-3: C: The SCAN-3:C is a battery of tests for screening and diagnosing auditory processing difficulties in children. In the auditory figure ground test, examinees hear words or sentences presented in background noise to simulate environments in which listening is difficult, such as listening to conversations at school, restaurants, or at sports events. The stimuli for the filtered words tests are filtered in a way that degrades the signal to simulate real-life conditions such as talking on a cell phone, or listening in class when the teacher is turned towards the chalkboard, away from the class.

Students who received **iLs** intervention consistently improved in all auditory processing categories. The control group remained at approximately the same levels before and after the 6-month period, during which they received OT, language and/or speech therapy, and ABA, (with a ratio of 3 adults to 12 students).



Conclusion: The data clearly shows significant changes in auditory processing, motor function and behavior for the students receiving **iLs.** Teachers and parents noted changes in social interactions and emotional regulation, which resulted in greater classroom participation, and interaction with peers. Stemming behaviors decreased, reciprocity in day-to-day interactions increased.

One child with echolalia was able to initiate relevant conversations with adults and answer "wh" questions by the end of the study. The same student now interacts with the other children during recess and plays on the equipment, neither of which he was able to do prior to the program. Since starting, iLs, there have been no behavioral outbursts or meltdowns at school at all. The iLs group students also saw reductions in or discontinuation of IEPs.

With these overall results and data, we applied for and were awarded a Century Link Technology grant for continued expansion of iLs services and equipment at Kingsway. At Kingsway School, we are excited to be able to expand the iLs program to students in the control group, as well as to others, for the 2015-2016 school year.

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

Roseann C. Schaaf, Joanne Hunt, Teal Benevides

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.

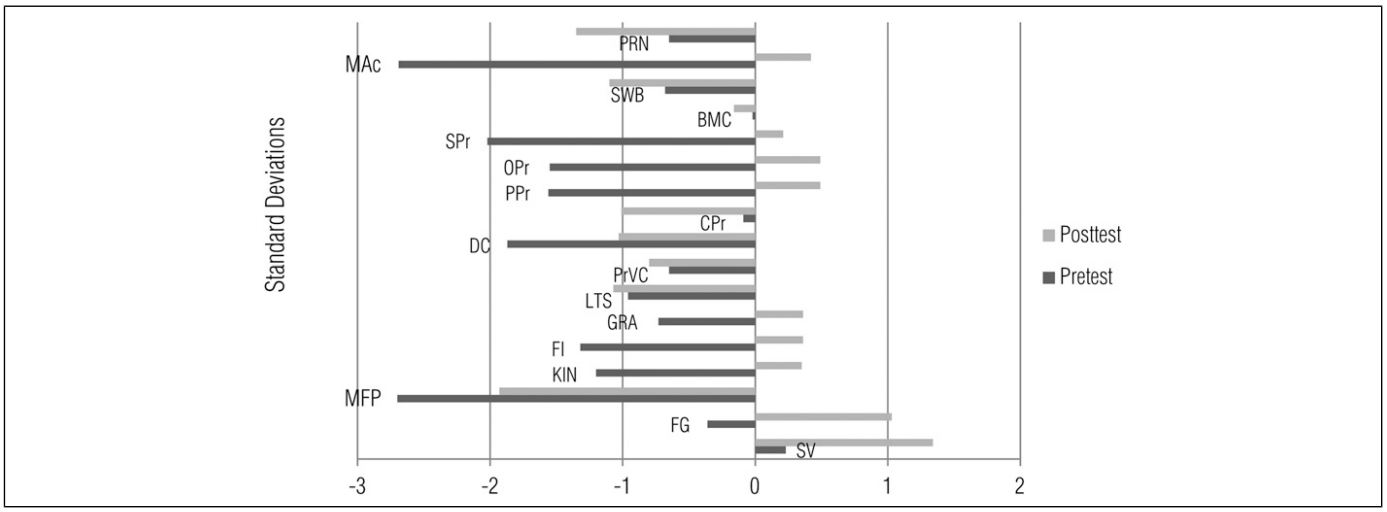

Figure 1. Pretest and posttest scores on the Sensory Integration and Praxis Tests (SIPT).

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.

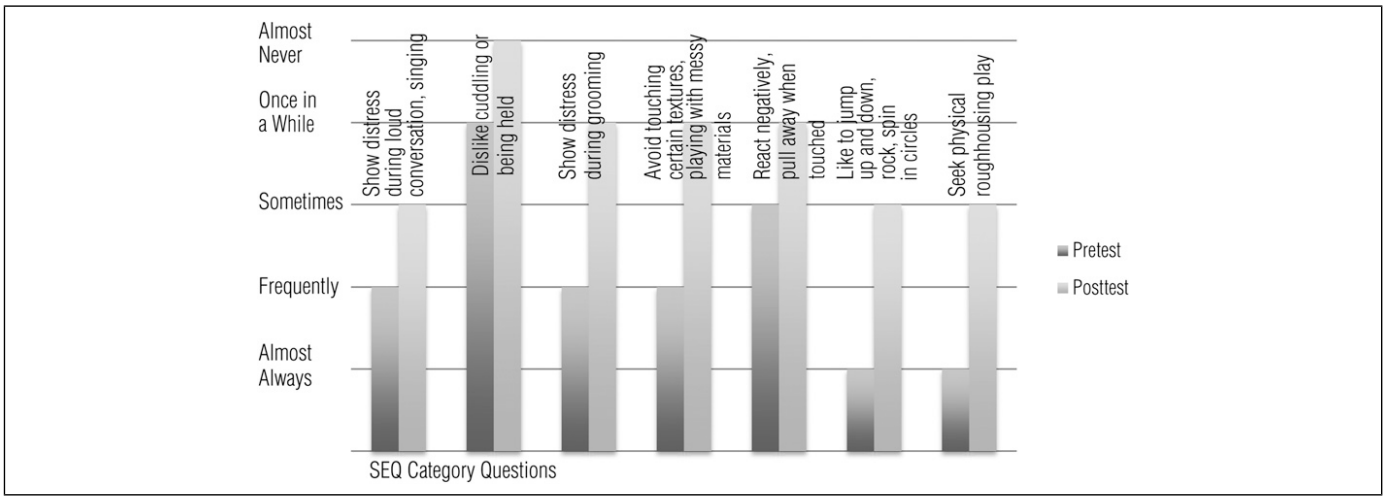

Figure 2. Preintervention and postintervention scores on the Sensory Experiences Questionnaire (SEQ).

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.

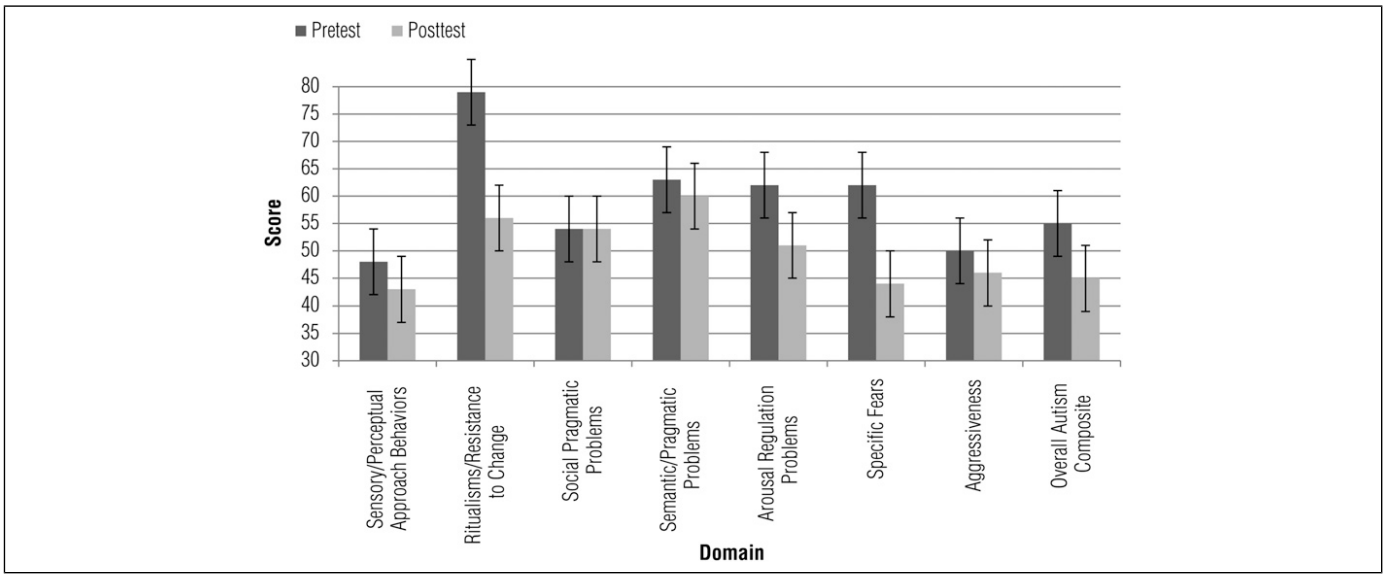

Figure 3. Pretest and posttest scores on the Pervasive Developmental Disorder Behavior Inventory (PDDBI).
Note. PDDBI approach/withdrawal problems; lower scores = better performance.

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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References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Ayres, A. J. (1972). *Sensory integration and learning disorders.* Los Angeles: Western Psychological Services.

Ayres, A. J. (1989). *Sensory Integration and Praxis Tests.* Los Angeles: Western Psychological Services.

Ayres, A. J. (2005). *Sensory integration and the child* (25th anniversary ed.). Los Angeles: Western Psychological Services.

Baranek, G. T., David, F. J., Poe, M. D., Stone, W. L., & Watson, L. R. (2006). Sensory Experiences Questionnaire: Discriminating sensory features in young children with autism, developmental delays, and typical development. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 47,* 591–601.

Blanche, E. I. (2001). *Clinical observations for sensory integration.* Torrance, CA: Pediatric Therapy Network.

Blanche, E. I. (2006). Clinical reasoning in action: Designing intervention. In R. C. Schaaf & S. Smith Roley (Eds.), *Sensory integration: Clinical reasoning for diverse populations* (pp. 91–106). Austin, TX: Pro-Ed.

Cohen, I. L., & Sudhalter, V. (2005). *Pervasive Developmental Disorder Behavior Inventory.* Lutz, FL: Psychological Assessment Resources.

Dunn, W. (1999). *The Sensory Profile.* San Antonio, TX: Psychological Corporation.

Gotham, K., Pickles, A., & Lord, C. (2009). Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39,* 693–705. http://dx.doi.org/10.1007/s10803-008-0674-3

Kiresuk, T. J., Smith, A., & Cardillo, J. E. (1994). *Goal attainment scaling: Applications, theory and measurement.* Hillsdale, NJ: Erlbaum.

Little, L. M., Freuler, A. C., Houser, M. B., Guckian, L., Carbine, K., David, F. J., et al. (2011). Brief Report—Psychometric validation of the Sensory Experiences Questionnaire. *American Journal of Occupational Therapy, 65,* 207–210. http://dx.doi.org/10.5014/ajot.2011.000844

Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Leventhal, B. L., DiLavore, P. C., et al. (2000). The Autism Diagnostic Observation Schedule–Generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders, 30,* 205–223.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview–Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24,* 659–685.

Mailloux, Z., May-Benson, T. A., Summers, C. A., Miller, L. J., Brett-Green, B., Burke, J. P., et al. (2007). Goal attainment scaling as a measure of meaningful outcomes for children with sensory integration disorders. *American Journal of Occupational Therapy, 61,* 254–259. http://dx.doi.org/10.5014/ajot.61.2.254

Mailloux, Z., & Smith Roley, S. (2010). Sensory integration. In H. Kuhaneck & R. Watling (Eds.), *Autism: A comprehensive occupational therapy approach* (3rd ed., pp. 469–507). Bethesda, MD: AOTA Press.

May-Benson, T. A., & Koomar, J. A. (2010). Systematic review of the research evidence examining the effectiveness of interventions using a sensory integrative approach for children. *American Journal of Occupational Therapy, 64,* 403–414. http://dx.doi.org/10.5014/ajot.2010.09071

Miller, L. J., Coll, J. R., & Schoen, S. A. (2007). A randomized controlled pilot study of occupational therapy for children with sensory modulation disorder. *American Journal of Occupational Therapy, 61,* 228–238. http://dx.doi.org/10.5014/ajot.61.2.228

Mulligan, S. (1998). Patterns of sensory integration dysfunction: A confirmatory factor analysis. *American Journal of Occupational Therapy, 52,* 819–828. http://dx.doi.org/10.5014/ajot.52.10.819

Parham, L. D., Cohen, E. S., Spitzer, S., Koomar, J. A., Miller, L., Burke, J. P., et al. (2007). Fidelity in sensory integration research. *American Journal of Occupational Therapy, 61,* 216–227. http://dx.doi.org/10.5014/ajot.61.2.216

Parham, L. D., Roley, S. S., May-Benson, T. A., Koomar, J., Brett-Green, J. P., Burke, J. P., et al. (2011). Development of a fidelity measure for research on the effectiveness of the Ayres Sensory Integration® intervention. *American Journal of Occupational Therapy, 65,* 133–142. http://dx.doi.org/10.5014/ajot.2011.000745

Perry, A., Flanagan, H. E., Geier, J. D., & Freeman, N. L. (2009). Brief report: The Vineland Adaptive Behavior Scales in young children with autism spectrum disorders at different cognitive levels. *Journal of Autism and Developmental Disorders, 39,* 1066–1078. http://dx.doi.org/10.1007/s10803-009-0704-9

Pfeiffer, B. A., Koenig, K., Kinnealey, M., Sheppard, M., & Henderson, L. (2011). Research Scholars Initiative—Effectiveness of sensory integration interventions in children with autism spectrum disorders: A pilot study. *American Journal of Occupational Therapy, 65,* 76–85. http://dx.doi.org/10.5014/ajot.2011.09205

Roid, G. (2003). *Stanford–Binet Intelligence Scales, Fifth Edition.* Hoboken, NJ: John Wiley & Sons.

Schaaf, R. C. (2010). Interventions that address sensory dysfunction for individuals with autism spectrum disorders: Preliminary evidence for the superiority of sensory integration compared to other sensory approaches. In B. Reichow, D. Cicchetti, P. Doehring, & F. Volkmar (Eds.), *Evidence-based practices in autism spectrum disorders* (pp. 245–273). New York: Springer.

Schaaf, R. C., & Blanche, E. I. (2012). From the Desk of the Guest Editors—Emerging as leaders in autism research and practice: Using the data-driven intervention process. *American Journal of Occupational Therapy, 66,* 503–505. http://dx.doi.org/10.5014/ajot.112.006114

Schaaf, R. C., Blanche, E., Mailloux, Z., Bodison, S., Benevides, T., Burke, J. P., et al. (2010). *Sensory motor activities in daily routines and tailored to the individual intervention manual (SMART).* Manuscript in preparation.

Smith, T., Scahill, L., Dawson, G., Guthrie, D., Lord, C., Odom, S., et al. (2007). Designing research studies on psychosocial interventions in autism. *Journal of Autism and Developmental Disorders, 37,* 354–366. doi:10.1007/s10803-006-0173-3

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2005). *The Vineland Adaptive Behavior Scales II: Survey forms manual, 2nd edition.* Circle Pines, MN: American Guidance Service.

Sugai, G., Lewis-Palmer, T., & Hagan-Burke, S. (2000). Overview of functional behavioral analysis process. *Exceptionality, 8,* 149–160. http://dx.doi.org/10.1207/S15327035EX0803_2

Sensory Processing, Problem Behavior, Adaptive Behavior, and Cognition in Preschool Children With Autism Spectrum Disorders

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KEY WORDS
- adaptation, psychological
- autistic disorder
- child development disorders, pervasive
- behavior
- sensation disorders

OBJECTIVE. This retrospective study explored sensory processing characteristics in preschool-age children with autism spectrum disorders (ASD); the relationships between sensory processing and problem behavior, adaptive behavior, and cognitive function; and the differences in sensory processing between two subgroups (autism and pervasive developmental disorder–not otherwise specified).

METHOD. Study measures included the Short Sensory Profile (SSP), Aberrant Behavior Checklist–Community, Vineland Adaptive Behavior Scales, and Mullen Scales of Early Learning.

RESULTS. Most of the children with ASD had sensory processing challenges, and a significant relationship was found between SSP total scores and problem behavior scores; however, no significant relationships were found between SSP total scores and adaptive behavior and cognitive functioning. Although all the children had low Vineland scores, approximately one-quarter of the children had typical SSP scores. No significant differences in SSP scores were found between the subgroups.

CONCLUSION. The findings highlight the importance of comprehensive evaluations for children with ASD.

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Participation in daily life is often challenging for children with autism spectrum disorders (ASD). ASD affects 1 in 110 children in the United States (Centers for Disease Control and Prevention, 2009) and ranges in severity from autistic disorder to milder subtypes, such as Asperger's disorder and pervasive developmental disorder–not otherwise specified (PDD–NOS; American Psychiatric Association [APA], 1994). Children with ASD may have difficulty engaging in typical occupations of childhood, such as activities of daily living (ADLs), social participation, play, and education (American Occupational Therapy Association, 2008). Meaningful participation in home and community activities is an intervention priority for children with ASD, a priority that occupational therapists support by promoting engagement in childhood occupations.

Participation and skill in everyday activities can be influenced by many factors, one of which is sensory processing. The term *sensory processing* refers to the receiving, organizing, and interpreting of sensory stimuli using the seven sensory systems (e.g., tactile, vestibular, auditory; Miller & Lane, 2000). Although not diagnostically a core feature of ASD, sensory processing differences in children with ASD have been well documented (Ben-Sasson et al., 2009; Huebner, 2001; Kern et al., 2006). Symptoms may include unusual responses to sensory stimuli, such as overresponsivity or underresponsivity (Dahlgren &

Gillberg, 1989; Dawson & Watling, 2000; Gabriels, Cuccaro, Hill, Ivers, & Goldson, 2005; Lord, 1995). For example, "over-responsivity behaviors such as resistance to touch and sensitivity to noise may limit the child's participation above and beyond his/her core social deficits" (Ben-Sasson et al., 2008, p. 823).

Although not specific to ASD, limited participation in sensory experiences significantly hinders a child's active exploration of the environment. Children may have difficulties performing ADLs and engaging with others because of atypical sensory responses. Moreover, behavioral and emotional problems have been associated with sensory processing differences (Baker, Lane, Angley, & Young, 2008), and sensory symptoms have been significantly related to stereotyped interests and repetitive behaviors in ASD (Chen, Rodgers, & McConachie, 2009; Rogers, Hepburn, & Wehner, 2003; Wiggins, Robins, Bakeman, & Adamson, 2009).

Occupational therapists use several methods to gather information about a child's sensory history and sensory characteristics, including parent interviews, clinical observations, and questionnaires. One questionnaire is the Sensory Profile (Dunn, 1999), a standardized parent-report measure. Using the Sensory Profile, many studies have documented significant differences in the way children with ASD respond to sensory experiences compared with typically developing peers. Dunn, Myles, and Orr (2002) compared Sensory Profile scores between children aged 8–14 yr with Asperger syndrome and children without disabilities. Children with Asperger syndrome had lower scores than children without disabilities in auditory processing and modulation factors related to hyporesponsiveness and hyperresponsiveness, suggesting difficulty responding appropriately to stimuli and regulating emotional responses.

In another study, researchers found that 85% of the Sensory Profile items differentiated children with ASD from typically developing children (Kientz & Dunn, 1997). Differences were evident in the way children with ASD responded to touch and auditory input. Children with ASD also scored differently from typically developing peers on 17 of 20 emotional–social items, such as "poor frustration tolerance" and "needs more protection from life than other children." Watling, Deitz, and White (2001) found that 85% of young children with ASD aged 3–6 yr scored lower than children without autism on at least one of the following Sensory Profile factors: Sensory Seeking, Emotionally Reactive, Low Endurance/Tone, Oral Sensitivity, Inattention/Distractibility, Poor Registration, Fine Motor/Perceptual, and Other.

Additionally, many studies have focused on sensory responsivity in children with ASD. In a meta-analysis of 14 studies (Ben-Sasson et al., 2009), the differences between ASD groups and typically developing groups were more pronounced for underresponsivity. This finding is similar to that of Schoen, Miller, Brett-Green, and Nielsen (2009), who reported that children with ASD aged 5–15 yr were less reactive to sensory stimuli than typically developing peers. Similarly, Baker et al. (2008) reported that children with autism aged 2–9 yr scored more than 2 standard deviations (*SD*s) below the mean on the Short Sensory Profile (SSP; McIntosh, Miller, & Shyu, 1999) domain of Underresponsive/Seeks Sensation.

Researchers have recently become interested in the relationship between sensory processing and both problem and adaptive behaviors (Jasmin et al., 2009; Liss, Saulnier, Fein, & Kinsbourne, 2006; Rogers et al., 2003; Wiggins et al., 2009). In a study of young children aged 17–45 mo, Wiggins and colleagues (2009) reported a significant correlation between the SSP and the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999) stereotyped interest and behavior score, but not the ADOS social and communication score. Similarly, Rogers and colleagues (2003) reported that sensory processing scores as measured by the SSP were significantly correlated with the ADOS repetitive and restricted behavior score, but not the ADOS social and communication score in children with autism ($n = 26$). They also found that sensory responsivity was more strongly associated with levels of adaptive behavior than with severity of autism symptoms.

Commonly used measures of problem or aberrant behavior and adaptive behavior are the Aberrant Behavior Checklist–Community (ABC–C; Aman & Singh, 1994) and the Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla, & Cicchetti, 1984), respectively. Using the ABC–C, Green, O'Reilly, Itchon, and Sigafoos (2005) reported that many aberrant behaviors were persistent and highly prevalent in their study of preschool children with developmental disabilities. Using the VABS, Jasmin and colleagues (2009) explored the relationship between sensory processing and daily living skills in children with autistic disorder aged 3–4 yr. Findings indicated that sensory avoiding was significantly correlated with daily living skills.

In summary, the literature suggests that a high prevalence of children with ASD have sensory processing differences and that these differences are associated with deficits involving problem behavior and adaptive behavior. Because sensory processing differences can affect participation in childhood occupations, along with problem and adaptive behaviors, these areas are relevant topics of research in occupational therapy. Additionally, as research

continues to delineate symptoms among ASD subgroups (e.g., autism, PDD–NOS), the sensory processing characteristics of ASD subgroups should be considered.

Purposes of the Study

The purposes of this retrospective study of children with ASD aged 3 through 4 yr were to describe their sensory processing characteristics, problem behavior, adaptive behavior, and cognitive functioning; to examine the relationships between the scores of these children on the SSP and on measures of problem behavior, adaptive behavior, and cognitive functioning; to compare levels of sensory processing to levels of adaptive behavior; and to explore the sensory processing differences between two subgroups of these children. Group 1 was children with autism, and Group 2 was children with PDD–NOS. Measures of sensory processing, problem behavior, and adaptive behavior were based on parent report.

Method

Research Design

In this retrospective study, we used data from a subgroup of participants in a larger Early Development Study at the University of Washington (UW) Autism Center. The larger study was funded by the National Institute of Child Health and Human Development. We described and compared the data related to sensory processing, problem behavior, adaptive behavior, and cognitive ability. This study was approved by the UW Human Subjects Review Board.

Participants

Participants for the UW Early Development Study were recruited from local parent advocacy groups, public schools, the Division of Developmental Disabilities, clinics, hospitals, and the UW Infant and Child Subject Pool. For the subgroup of participants in the current study, inclusion criteria consisted of having a diagnosis of ASD; having a complete SSP at 3 or 4 yr of age; and not having a diagnosis of Rett syndrome or Fragile X syndrome or a concomitant diagnosis of cerebral palsy, Down syndrome, deafness, or significant prematurity (28 wk gestation or less).

Diagnosis

Diagnostic clinicians at the UW Autism Center Research Program evaluated each participant. The clinicians, who included doctoral-level clinical psychologists and qualified graduate students in clinical psychology, administered two assessments to evaluate the symptoms of autistic disorder as defined in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV;* APA, 1994). Symptoms include qualitative impairments in communication and social interaction and the presence of restricted behavioral patterns and interests. The clinicians administered the Autism Diagnostic Interview–Revised (ADI–R; Lord, Rutter, & Le Couteur, 1994) to parents and the Autism Diagnostic Observation Schedule–Generic (ADOS–G; Lord et al., 2000) to the child participants. In addition, clinical judgment was part of the diagnostic process to identify the presence or absence of autism symptoms in the *DSM–IV*. The autism diagnosis was defined as meeting criteria for autistic disorder on both the ADOS–G and ADI–R, along with meeting *DSM–IV* criteria for autistic disorder on the basis of clinical judgment. If a participant scored within 2 points of meeting ADI–R criteria and met *DSM–IV* and ADOS–G criteria, the participant was also given the diagnosis of autistic disorder. A diagnosis of PDD–NOS was made when participants qualified for PDD–NOS on the ADOS–G, met criteria for autistic disorder on the ADI–R or missed qualifying on the ADI–R by 2 or fewer points, and at least met the *DSM–IV* criteria for PDD–NOS on the basis of clinical judgment.

Instruments

The SSP is a standardized parent questionnaire developed as a screening instrument to identify children with sensory processing difficulties and associated behaviors. The SSP differs from the complete Sensory Profile Caregiver Questionnaire (125 items) in that it consists only of items related to sensory events. Behaviors, such as social–emotional and fine motor abilities, are excluded. A Likert scale ranging from 1 to 5 is used to score 38 SSP items; a score of 1 is given for behaviors "always" occurring, and a score of 5 is given for behaviors "never" occurring. The raw scores are used to produce seven section scores for Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Underresponsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak, and Visual/Auditory Sensitivity. The total score ranges from 38 to 190, with cutoff points available for classification categories (typical performance = raw scores ≥155; probable difference [−1 to −2 *SD*s] = raw scores of 142–154; definite difference [>2 *SD*s below the mean] = raw scores ≤141).

The most reliable score is the SSP total score. Internal reliabilities for the SSP, calculated using Cronbach's alphas, ranged from .70 to .90; internal validity was measured by looking at the intercorrelations of the SSP total and section scores, and correlations were in the low to

moderate range (.25–.76; Dunn, 1999). Construct validity was examined by comparing SSP scores with physiological response data (i.e., electrodermal response [EDR]). Using the Sensory Challenge Protocol, a procedure used to measure an individual's response to 50 sensory stimuli, Miller et al. (1999) recorded the electrodermal activity of 15 children and found that children with abnormal EDR had lower SSP scores on all sections than children with EDR in the normal range ($p \leq .05$), thus supporting the construct validity of the SSP.

The ABC–C is a 58-item measure of maladaptive or problem behaviors known to occur in people with moderate to profound mental retardation. Although the ABC–C was designed for children aged 6–18 yr, it has been used by researchers (Green et al., 2005) to examine problem behaviors in children aged 35–55 mo with developmental delays. Each item is scored on a scale of 0–3 (0 = *not at all a problem* and 3 = *problem is severe in degree*); higher ABC–C scores indicate more severe behaviors. Summed total scores range from 0 to 174. The scale includes five factors: (1) Irritability, Agitation, Crying; (2) Lethargy, Social Withdrawal; (3) Stereotypic Behavior; (4) Hyperactivity, Noncompliance; and (5) Inappropriate Speech. Green et al. (2005) reported that the ABC–C items are nearly identical to the original Aberrant Behavior Checklist (ABC; Aman & Singh, 1986) items, but the Community version relates to naturalistic settings instead of residential institutions, making it appropriate for rating the severity of behaviors in preschool-age children living in the community. Neither the manual for the ABC (Aman & Singh, 1986) nor the supplemental manual for the ABC–C (Aman & Singh, 1994) discusses the reliability or validity for this age group. However, in a study of preschool-age children with developmental delays (mean age = 51 mo), Sigafoos, Pittendreigh, and Pennell (1997) identified the ABC as a reliable instrument for assessing challenging behaviors in young children.

The VABS measures four domains of adaptive behavior—Communication, Daily Living Skills, Socialization, and Motor Skills—yielding scores for each of the domains and a Vineland Adaptive Behavior Composite score (V–ABC). Consisting of 297 items, the VABS Survey Form is a caregiver interview applicable for children and youth from birth to 18 yr, 11 mo. The standardization sample included approximately 3,000 children and youth in various types of educational programs (e.g., regular classroom, speech impaired program, learning disabled program). When readministered 2 to 4 wk later to children 3 yr to 4 yr, 11 mo ($n = 74$), the test–retest reliability coefficient for the V–ABC score was .89 (Sparrow et al., 1984). The manual reports VABS criterion-related validity using correlations between VABS scores, scores from other adaptive behavior scales, and measures of intelligence (Sparrow et al., 1984).

The Mullen Scales of Early Learning: AGS Edition (Mullen, 1995) is an individually administered, standardized measure of cognitive functioning in young children. The Early Learning Composite (ELC) is calculated using scores from four cognitive scales: Visual Reception, Receptive Language, Expressive Language, and Fine Motor. The ELC is derived from the *T* scores for the four cognitive scales. The median internal reliability of the ELC is high, at .91, using Guilford's formula to compute the coefficients (Mullen, 1995). For children aged 25–44 mo, interscorer reliabilities on the Mullen scales ranged from .98 to .99 using the intraclass correlation coefficient (K. Allen, personal communication, August 1, 2011). Concurrent validity was established with the Bayley Scales of Infant Development (Bayley, 1969). The ELC correlated highly ($r = .70$) with the Bayley Mental Development Index (K. Allen, personal communication, August 1, 2011).

Data Analyses

Data analyses were completed using SPSS 14.0 (SPSS, Inc., Chicago). Descriptive statistics were used to describe children's scores on measures of sensory processing, problem behavior, adaptive behavior, and cognition, and frequency counts were used to compare SSP category scores to categories of V–ABC scores. Descriptive statistics also were used to determine whether score distributions met the assumptions for the use of parametric statistics. Because the scores generally were not normally distributed, nonparametric statistics were used.

Spearman rank-order correlation coefficients were used to examine relationships between scores on the SSP and the other three measures. To explore the sensory processing differences between the two subgroups of children with ASD (autism and PDD–NOS), we used the Mann–Whitney *U* statistic. Results having a probability value of $p < .05$ (two-tailed) were considered statistically significant. Consequently, the possibility of a Type 1 error was increased for analyses involving multiple comparisons; therefore, the findings should be interpreted with caution and regarded as exploratory. Last, for exploratory purposes, we determined percentages of children in each of three SSP classification categories—typical, probable difference, and definite difference—both for the ASD group as a whole and for the autism and PDD–NOS subgroups.

Results

Description of Sample

Forty-two of the 75 children with ASD in the University of Washington Autism Center Early Development Study met inclusion criteria for the current study. Of the 42 children with ASD, 28 had a diagnosis of autism and 14 had a diagnosis of PDD–NOS. The mothers' ages ranged from 19 to 42 yr (median = 32 yr) at the time of birth, and the length of pregnancy ranged from 31 to 44 wk (median = 39.5 wk). Forty-one of the children with ASD had birth weights greater than 5 lb, 8 oz. The birth weights of the children ranged from 4 lb, 12 oz, to 11 lb, 8 oz (median = 8 lb, 4 oz). At the time of administration of the SSP and ABC–C, the children's ages ranged from 36 mo to 59 mo (median = 45.5 mo).

Findings

First, we examined scores on multiple measures for the whole group of 42 children with ASD. Descriptive statistics for the SSP total scores were as follows: Mean = 140.1, median = 140.5, low/high = 90/174, and *SD* = 20.2, indicating that more than half of the children had scores in the definite difference range (≤141). Table 1 displays descriptive statistics and the relationships between SSP total scores and problem behavior, adaptive behavior, and IQ. With the exception of the ABC–C, higher scores relate to better performance on the measures. Higher levels of sensory processing difficulties were consistently associated with higher levels of behavior challenges across the categories of behavior problems. Although higher levels of sensory processing difficulties tended to be mildly associated with lower levels of adaptive behavior (r_s = .30), the relationship was not significant. Differences in sensory processing were not associated with level of cognitive ability. Children with fewer sensory challenges did not tend to have higher cognitive ability.

Next, we examined the relationship between degree of sensory processing difference and level of adaptive behavior to see the extent to which children scored either low on both measures (e.g., low on the SSP and low on the V–ABC) or high on one measure and low on the other (e.g., typical on the SSP and low on the V–ABC). Table 2 shows the number of children with no, probable, and definite sensory processing impairment according to their level of adaptive behavior. For 3 of the 42 children in the ASD group, the VABS was not complete. Of the 39 children with complete V–ABC scores, all had scores more than 1 *SD* below the mean, indicating a limited score range that reflected consistent deficits in adaptive behavior. Although a majority of children had SSP scores indicative of probable or definite sensory differences, 26% had SSP scores in the typical performance range.

In Table 3, the SSP total score and each of the seven section scores for the children with autism are compared with scores for the children with PDD–NOS. Higher scores on the SSP indicate fewer sensory processing challenges. Although the PDD–NOS group median scores for total score and four of seven section scores were slightly higher than those for the autism group, no significant differences on SSP total or section scores between the autism and PDD–NOS groups were found.

Last, Table 4 reports the percentage of children who scored in each SSP category (typical, probable difference, definite difference) for each of the seven SSP section scores and the SSP total score. Relative to the group as a whole, 35 (83%) of the 42 children with ASD had one or more section scores in the definite difference range. For the total score and each of the section scores, a higher percentage of children in the PDD–NOS group than in the autism group had scores in the typical range.

Table 1. Descriptive Statistics and Relationships Between SSP Total Scores and Measures of Problem Behavior, Adaptive Behavior, and IQ

		Scores				Relationship to SSP Total Score	
Measure	*n*	*M*	Median	Low/High	*SD*	r_s[a]	*p* (2-tailed)
ABC–C Total Score[b]	42	44.3	41.0	2/126	26.3	−.54	<.001
ABC–C Irritability, Agitation, Crying[b]	42	11.8	9.5	1/35	8.4	−.41	.007
ABC–C Lethargy, Social Withdrawal[b]	42	9.8	8.5	0/33	7.2	−.46	.002
ABC–C Stereotypic Behavior[b]	42	4.8	4.0	0/18	4.5	−.38	.012
ABC–C Hyperactivity, Noncompliance[b]	42	15.3	13.0	1/41	9.9	−.45	.003
ABC–C Inappropriate Speech[b]	42	2.7	2.0	0/9	2.5	−.35	.023
Vineland Adaptive Behavior Composite[c]	39	61.1	59.0	48/84	9.9	.30	.062
Mullen Early Learning Composite[d]	42	60.4	51.5	49/106	15.9	.07	.673

Note. ABC–C = Aberrant Behavior Checklist–Community; *M* = mean; *SD* = standard deviation; SSP = Short Sensory Profile.
[a]Spearman rank order correlation coefficient. [b]Aberrant Behavior Checklist–Community (no appropriate normative values available). [c]Vineland Adaptive Behavior Scales (*M* = 100, *SD* = 15). [d]Mullen Scales of Early Learning (*M* = 100, *SD* = 15).

Table 2. Number of Children in Each SSP Classification Category, by V–ABC *SD* Score ($N = 39$)

	No. of Children in Each SSP Total Score Category		
V–ABC Score	Typical	Probable Difference	Definite Difference
−1 *SD* to mean	0	0	0
−2 *SD* to −1 *SD*	5	1	4
Greater than −2 *SD*	5	8	16

Note. *SD* = standard deviation; SSP = Short Sensory Profile; V–ABC = Vineland Adaptive Behavior Composite.

Discussion

According to parent reports, a majority of the preschool children aged 3 through 4 yr with ASD in our sample had sensory processing challenges, and we found a significant relationship ($p < .001$, two-tailed) between degree of sensory processing impairment and level of problem behavior as indicated by the ABC–C total score. This finding held true across different types of behavior challenge, including irritability, lethargy, stereotypic behavior, hyperactivity, and inappropriate speech. Lane, Young, Baker, and Angley (2010) reported similar findings and found a strong predictive association between sensory processing dysfunction and problem or maladaptive behaviors.

All of the children with ASD had challenges in adaptive behavior. When V–ABC scores were correlated with SSP total scores, however, the relationship was weak ($r = .30$, $p = .06$). This result partially reflects the limited score range for the V–ABC for this sample ($SD = 9.9$), which was expected given that all of the children scored more than 1 *SD* below the mean.

From a clinical perspective, the most relevant data are reported in Table 2, which shows that 26% of children

Table 3. Comparisons Between the Autism Group ($n = 28$) and PDD–NOS Group ($n = 14$) on SSP Section Scores and Total Scores

	Raw Scores				p[a]
SSP Section	*M*	Median	Low/High	*SD*	(2-tailed)
Tactile Sensitivity					.46
Autism	26.9	27.5	15/34	5.0	
PDD–NOS	28.1	29.0	18/35	5.5	
Taste/Smell Sensitivity					.78
Autism	12.3	11.5	4/20	4.4	
PDD–NOS	12.4	9.5	6/20	5.7	
Movement Sensitivity					.27
Autism	12.9	13.5	9/15	2.2	
PDD–NOS	13.6	14.5	9/15	2.0	
Underresponsive/Seeks Sensation					.09
Autism	23.9	25.0	14/33	4.7	
PDD–NOS	26.3	27.5	9/33	6.2	
Auditory Filtering					.78
Autism	18.7	19.0	12/25	4.0	
PDD–NOS	18.8	18.5	7/26	5.2	
Low Energy/Weak					.97
Autism	26.1	29.0	12/30	5.5	
PDD–NOS	27.4	28.0	22/30	2.8	
Visual/Auditory Sensitivity					.52
Autism	17.2	18.0	9/24	3.9	
PDD–NOS	17.7	18.5	7/25	5.0	
Total SSP					.29
Autism	137.9	137.5	105/173	17.8	
PDD–NOS	144.4	145.0	90/174	24.3	

Note. ASD = autism spectrum disorder; *M* = mean; PDD–NOS = pervasive developmental disorder–not otherwise specified; *SD* = standard deviation; SSP = Short Sensory Profile.
[a]Mann–Whitney *U* test.

Table 4. Percentage of Children in the ASD Group ($n = 42$) and the Autism ($n = 28$) and PDD–NOS ($n = 14$) Subgroups Who Scored in Each SSP Classification Category

	SSP Classification Category (%)		
SSP Section	Typical	Probable Difference	Definite Difference
Tactile Sensitivity			
ASD	40.5	19.0	40.5
Autism	35.7	25.0	39.3
PDD–NOS	50.0	7.1	42.9
Taste/Smell Sensitivity			
ASD	30.9	16.7	52.4
Autism	25.0	25.0	50.0
PDD–NOS	42.9	0.0	57.1
Movement Sensitivity			
ASD	71.4	7.1	21.4
Autism	64.3	10.7	25.0
PDD–NOS	85.7	0.0	14.3
Underresponsive/Seeks Sensation			
ASD	38.1	28.6	33.3
Autism	25.0	35.7	39.3
PDD–NOS	64.3	14.3	21.4
Auditory Filtering			
ASD	23.8	19.1	57.1
Autism	21.4	25.0	53.6
PDD–NOS	28.6	7.1	64.3
Low Energy/Weak			
ASD	69.0	14.3	16.7
Autism	64.3	17.9	17.9
PDD–NOS	78.6	7.1	14.3
Visual/Auditory Sensitivity			
ASD	42.9	33.3	28.8
Autism	39.3	35.7	25.0
PDD–NOS	50.0	28.6	21.4
Total SSP			
ASD	23.8	23.8	52.4
Autism	21.4	17.9	60.7
PDD–NOS	28.6	35.7	35.7

Note. Because of rounding error, not all percentages add up to 100. ASD = autism spectrum disorder; PDD–NOS = pervasive developmental disorder–not otherwise specified; SSP = Short Sensory Profile.

whose level of adaptive behavior was >1 *SD* below the mean did not have sensory processing differences. This finding suggests that a subgroup of children with ASD and adaptive behavior challenges do not have sensory processing challenges as reported by parents. Even so, the majority of the children in the study did have sensory processing differences, and this finding is consistent with other studies (Lane et al., 2010; Wiggins et al., 2009). Also, the finding of a high prevalence of adaptive behavior challenges in this group is consistent with the work of Baker et al. (2008).

Results related to cognitive function indicate that the children studied had highly variable scores that ranged from >2 *SD*s below the mean to above the mean and that their level of sensory impairments was not correlated with level of cognitive ability. This result suggests that cognitive functioning is not predictive of sensory processing difficulties as reported by parents and vice versa.

When we explored differences in SSP scores between the two subgroups of children (autism and PDD–NOS), although scores for the PDD–NOS group tended to be higher, we found no significant differences for SSP total scores or for the seven section scores. However, as can be seen in Table 4, for the SSP total score and for all seven section scores, a higher percentage of children in the PDD–NOS group scored in the typical range. Although this finding suggests a trend, because of the small sample size, these results are inconclusive and further study is merited.

Limitations and Strengths

The study has two primary limitations. First, we performed numerous analyses on small samples. Because the probability value was set at $p < .05$, the possibility of a Type 1 error was increased for analyses involving multiple comparisons. The second issue was that information is limited regarding the reliability and validity of the ABC–C when used with preschool-age children.

The main strength of this study was that consistent diagnostic criteria were used. Unlike many studies in the literature, for our study the children completed comprehensive diagnostic evaluations.

Future Research

Recommendations for future research include replicating this study with a larger sample. Additionally, the validity of future research may be enhanced by using a wider range of assessments, including observational measures of behavior across different contexts, parent reports, and electrodermal response measures.

Implications for Occupational Therapy Practice

The findings of this study suggest that occupational therapists have an important role in the interdisciplinary team process of evaluating preschool children with ASD.

- Because a majority of the children in the study presented with sensory processing differences and a significant relationship was found between levels of sensory processing and problem behaviors, it is important that a comprehensive evaluation include a focus on identifying a child's sensory processing characteristics and a consideration of how these characteristics might influence a child's behavior.
- The findings related to the heterogeneity of the children with ASD in this study and the existence of a subgroup of children with ASD who have typical sensory processing highlight the importance of comprehensive evaluations focused on identifying a child's strengths and challenges to inform intervention. ▲

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References

Aman, M. G., & Singh, N. N. (1986). *Aberrant Behavior Checklist (ABC).* East Aurora, NY: Slosson Educational Publications.

Aman, M. G., & Singh, N. N. (1994). *Aberrant Behavior Checklist–Community: Supplementary manual.* East Aurora, NY: Slosson Educational Publications.

American Occupational Therapy Association. (2008). Occupational therapy practice framework: Domain and process (2nd ed.). *American Journal of Occupational Therapy, 62,* 625–683. http://dx.doi.org/10.5014/ajot.62.6.62

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Baker, A. E. Z., Lane, A., Angley, M. T., & Young, R. L. (2008). The relationship between sensory processing patterns and behavioural responsiveness in autistic disorder: A pilot study. *Journal of Autism and Developmental Disorders, 38,* 867–875. http://dx.doi.org/10.1007/s10803-007-0459-0

Bayley, N. (1969). *Bayley Scales of Infant Development.* San Antonio, TX: Psychological Corporation.

Ben-Sasson, A., Cermak, S. A., Orsmond, G. I., Tager-Flusberg, H., Kadlec, M. B., & Carter, A. S. (2008). Sensory clusters of toddlers with autism spectrum disorders: Differences in affective symptoms. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 49,* 817–825. http://dx.doi.org/10.1111/j.1469-7610.2008.01899.x

Ben-Sasson, A., Hen, L., Fluss, R., Cermak, S. A., Engel-Yeger, B., & Gal, E. (2009). A meta-analysis of sensory modulation symptoms in individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39,* 1–11. http://dx.doi.org/10.1007/s10803-008-0593-3

Centers for Disease Control and Prevention. (2009). Prevalence of autism spectrum disorders—Autism and Developmental Disabilities Monitoring Network, United States, 2006. *MMWR Surveillance Summaries, 58,* 1–20. Retrieved from www.cdc.gov/mmwr/preview/mmwrhtml/ss5810a5811.htm

Chen, Y. H., Rodgers, J., & McConachie, H. (2009). Restricted and repetitive behaviours, sensory processing and cognitive style in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39,* 635–642. http://dx.doi.org/10.1007/s10803-008-0663-6

Dahlgren, S. O., & Gillberg, C. (1989). Symptoms in the first two years of life: A preliminary population study of infantile autism. *European Archives of Psychiatry and Neurological Sciences, 238,* 169–174. http://dx.doi.org/10.1007/BF00451006

Dawson, G., & Watling, R. (2000). Interventions to facilitate auditory, visual, and motor integration in autism: A review of the evidence. *Journal of Autism and Developmental Disorders, 30,* 415–421. http://dx.doi.org/10.1023/A:1005547422749

Dunn, W. (1999). *Sensory Profile: User's manual.* San Antonio, TX: Psychological Corporation.

Dunn, W., Myles, B. S., & Orr, S. (2002). Sensory processing issues associated with Asperger syndrome: A preliminary investigation. *American Journal of Occupational Therapy, 56,* 97–102. http://dx.doi.org/10.5014/ajot.56.1.97

Gabriels, R. L., Cuccaro, M. L., Hill, D. E., Ivers, B. J., & Goldson, E. (2005). Repetitive behaviors in autism: Relationships with associated clinical features. *Research in Developmental Disabilities, 26,* 169–181. http://dx.doi.org/10.1016/j.ridd.2004.05.003

Green, V. A., O'Reilly, M., Itchon, J., & Sigafoos, J. (2005). Persistence of early emerging aberrant behavior in children with developmental disabilities. *Research in Developmental Disabilities, 26,* 47–55. http://dx.doi.org/10.1016/j.ridd.2004.07.003

Huebner, R. A. (2001). *Autism: A sensorimotor approach to management.* Gaithersburg, MD: Aspen.

Jasmin, E., Couture, M., McKinley, P., Reid, G., Fombonne, E., & Gisel, E. (2009). Sensori-motor and daily living skills of preschool children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39,* 231–241. http://dx.doi.org/10.1007/s10803-008-0617-z

Kern, J. K., Trivedi, M. H., Garver, C. R., Grannemann, B. D., Andrews, A. A., Savla, J. S., et al. (2006). The pattern of sensory processing abnormalities in autism. *Autism, 10,* 480–494. http://dx.doi.org/10.1177/1362361306066564

Kientz, M. A., & Dunn, W. (1997). A comparison of the performance of children with and without autism on the Sensory Profile. *American Journal of Occupational Therapy, 51,* 530–537. http://dx.doi.org/10.5014/ajot.51.7.530

Lane, A. E., Young, R. L., Baker, A. E. Z., & Angley, M. T. (2010). Sensory processing subtypes in autism: Association with adaptive behavior. *Journal of Autism and Developmental Disorders, 40,* 112–122. http://dx.doi.org/10.1007/s10803-009-0840-2

Liss, M., Saulnier, C., Fein, D., & Kinsbourne, M. (2006). Sensory and attention abnormalities in autistic spectrum disorders. *Autism, 10,* 155–172. http://dx.doi.org/10.1177/1362361306062021

Lord, C. (1995). Follow-up of two-year-olds referred for possible autism. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 36,* 1365–1382. http://dx.doi.org/10.1111/j.1469-7610.1995.tb01669.x

Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Jr., Leventhal, B. L., DiLavore, P. C., et al. (2000). The Autism Diagnostic Observation Schedule–Generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders, 30,* 205–223. http://dx.doi.org/10.1023/A:1005592401947

Lord, C., Rutter, M., DiLavore, P., & Risi, S. (1999). *Autism Diagnostic Observation Schedule–WPS edition.* Los Angeles: Western Psychological Services.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview–Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24,* 659–685. http://dx.doi.org/10.1007/BF02172145

McIntosh, D. N., Miller, L. J., & Shyu, V. (1999). Development and validation of the Short Sensory Profile. In W. Dunn (Ed.), *Sensory Profile manual* (pp. 59–73). San Antonio, TX: Psychological Corporation.

Miller, L. J., & Lane, S. J. (2000). Toward a consensus in terminology in sensory integration theory and practice: Part 1. Taxonomy of neurophysiological processes. *Sensory Integration Special Interest Section Quarterly, 23*(1), 1–4.

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. http://dx.doi.org/10.1002/(SICI)1096-8628(19990402)83:4<268::AID-AJMG7>3.0.CO;2-K

Mullen, E. M. (1995). *Mullen Scales of Early Learning: AGS edition.* Circle Pines, MN: American Guidance Service.

Rogers, S. J., Hepburn, S., & Wehner, E. (2003). Parent reports of sensory symptoms in toddlers with autism and those with other developmental disorders. *Journal of Autism and Developmental Disorders, 33,* 631–642. http://dx.doi.org/10.1023/B:JADD.0000006000.38991.a7

Schoen, S. A., Miller, L. J., Brett-Green, B. A., & Nielsen, D. M. (2009). Physiological and behavioral differences in sensory processing: A comparison of children with autism spectrum disorder and sensory modulation disorder. *Frontiers*

in Integrative Neuroscience, 3, 29. http://dx.doi.org/10.3389/neuro.07.029.2009

Sigafoos, J., Pittendreigh, N., & Pennell, D. (1997). Parent and teacher ratings of challenging behaviour in young children with developmental disabilities. *British Journal of Learning Disabilities, 25,* 13–17. http://dx.doi.org/10.1111/j.1468-3156.1997.tb00003.x

Sparrow, S. S., Balla, D. A., & Cicchetti, D. V. (1984). *The Vineland Adaptive Behavior Scales: Survey form manual.* Circle Pines, MN: American Guidance Service.

Watling, R. L., Deitz, J., & White, O. (2001). Comparison of Sensory Profile scores of young children with and without autism spectrum disorders. *American Journal of Occupational Therapy, 55,* 416–423. http://dx.doi.org/10.5014/ajot.55.4.416

Wiggins, L. D., Robins, D. L., Bakeman, R., & Adamson, L. B. (2009). Brief report: Sensory abnormalities as distinguishing symptoms of autism spectrum disorders in young children. *Journal of Autism and Developmental Disorders, 39,* 1087–1091. http://dx.doi.org/10.1007/s10803-009-0711-x