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A Review of the Evidence for Sensory Interventions in the Treatment of ASD

By

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Abstract

It is estimated that Autism Spectrum Disorder (ASD) affects 1 in 88 children (CDC, 2012). Given this rapid and little understood increase in prevalence, the study of ASD and the search for effective treatments has become an area of intense interest. While there are many treatments available, controversy abounds as to which approach is most effective. Occupational therapists have long endorsed Sensory Integration Therapy (SIT) as the vehicle for helping children with ASD regulate sensory experiences and thus alleviate the symptoms of ASD. While SIT is a commonly used intervention and evidence exists to suggest that SIT is effective, it has not reached a level of consensus in the scientific community. The goal of this paper is to review the evidence for and against using SIT for the treatment of ASD and to discuss the role of the occupational therapist in the future research of this methodology.

Keywords: Autism Spectrum Disorders (ASD), Sensory Integration Therapy (SIT), Occupational Therapy

A Review of the Evidence for Sensory Interventions in the Treatment of ASD

Autism Spectrum Disorder (ASD) is a type of Pervasive Developmental Disorder that is normally diagnosed in childhood around age 3. At this age, parents often start to notice some of the characteristic features of ASD, which can be generalized as marked impairments in social interaction and communication (American Psychiatric Association [DSM-IV-TR], 2000). Children with ASD can experience a wide variety of symptoms. Oftentimes language is either underdeveloped or nonexistent which leads to complications in forming meaningful friendships. Many children with ASD also fail to recognize and respond to nonverbal forms of communication so changes in body language and facial expressions often go unnoticed. In many cases, children diagnosed with ASD seem uninterested in communicating with others and they possess deficits in shared attention and theory of mind. Restricted and repetitive (stereotyped) behaviors are also among the diagnostic criteria (DSM-IV-TR). Children with this disorder can often be seen clapping their hands or flapping their arms. During play, children with ASD may engage similar stereotyped behaviors in which the normal function of the toy or activity is ignored. They may attend to only some parts of objects to the exclusion of others. Another easily recognizable symptom of ASD is preoccupation with rituals and routines.

Given the nature of ASD and its variety of symptoms and intensities, it is easy to see that this disorder does not just affect the person diagnosed with it but their families and communities as well. Aside from the symptoms mentioned above, children with ASD can also display many forms of challenging behaviors (Schaaf, Toth-Cohen, Johnson, Outten, & Benevides, 2011). There are sensory-processing difficulties associated with ASD such as under-responsivity or over-responsivity which can lead to challenging behaviors, especially because the cause of the behavior can be very difficult to pinpoint (Ben-Sasson, Hen, Fluss, Cermak, Engel-Yeger, Gal,

2009). Disruptions in every-day routines or failing to give in to demands may lead to tantrums. Also, because of their preoccupation with rituals and their aversion to transitions and change, it can be very difficult for children with ASD to participate in their family's normal routines or activities (Schaaf et al., 2011). Parents are often forced to choose which one will stay home with the child that has ASD and which one will go to a sporting event for another child or a meeting of some kind. The family's social life can also be affected because they often fear taking their child with ASD to places like someone else's home or to church where their behaviors might draw unwanted attention. For these reasons and many others, parents of children with ASD often report a higher level of stress and burden than parents of children without disabilities (Larson, 2006).

Therefore, finding effective treatments for children with ASD is not only a priority for the child affected by the disorder, but also for their families and communities. The best approach to treatment is to use evidence-based practices. Evidence-based practice is a term that refers to a treatment strategy that has been verified by numerous empirical studies and represents the highest standard and most recent developments in that field. It is important to use evidence-based practices because treatments for ASD and other disorders is costly and time-consuming and as such it is necessary to use both in a manner that will yield the most benefits.

Occupational therapists often play a central role in the treatment of children with ASD and the most popular method occupational therapists use to treat them is Sensory Integration Therapy (SIT) (Devlin, Healy, Leader, Hughes, 2011). SIT was originally developed by Ayres in 1972 with the goal of improving the ability of people to process and integrate sensory information which would also lay a foundation for increased independence in daily life, play and school tasks (Schaaf & Miller, 2005). The theory of SIT asserts that effective processing and

integration of sensory information is an important precursor to adaptive behavior. The theory follows some basic assumptions from the fields of neuroscience, developmental psychology, occupational therapy, and education. The basic assumptions are: 1) sensorimotor development is an important precursor to learning; 2) interactions between the environment and the individual shape brain development; 3) the nervous system has the ability to change; and 4) meaningful sensorimotor activity is a crucial mediator of neural plasticity (Schaaf & Miller, 2005). Ayres herself designed the Southern California Sensory Integrative tests to measure sensory processing, sensory motor and perceptual motor skills (Ayres, 1989). She also delineated 4 key principles that the Sensory Integrative Approach should follow.

The first principle is the Just Right Challenge. This refers to the therapist creating playful activities with achievable challenges. The goal is that the child continues to be faced with new and demanding situations but that they also achieve success at every step. The second principle is The Adaptive response. This is the natural result of the first principle as the child learns and uses new strategies to meet the Just Right Challenge. The third principle is Active Engagement. Active Engagement involves the therapist creating challenging but playful sensory environments in which the therapist plays with the child and encourages them to use new and advanced abilities. The final key principle of the Sensory Integrative Approach is that it is child-directed. Being child-directed means that the therapist pays close attention to the child and follows their lead while making sure the environment is enriched with highly preferred items. The therapist must also use the observed behavioral cues that the child gives to continue to adapt the environment to incorporate the other three principles (Schaaf & Miller, 2005).

While the original intention of SIT was to treat general disruptions in sensory processing, in recent years it has been beneficial to divide Sensory Processing Disorders into three sub-

groups: Sensory Modulation Disorder (SMD), Sensory-based Motor Disorders (SBMD), and Sensory Discrimination Disorder (SDD) (Schaaf & Miller, 2005). SMD is characterized by under- or over-responding to sensory stimuli or actively seeking sensory stimulation which can lead to considerable problems with daily routines, as mentioned above (Miller, 2006). SBMD is evidenced by motor output that is disorganized as a result of incorrectly processing sensory information that in turn affects postural control or dyspraxia. SDD is the incorrect processing of visual or auditory input and can often be mistaken for inattentiveness, lack of motivation and general disorganization.

The purpose of breaking Sensory Processing Disorder into subgroups is to allow easier grouping of subjects into homogenous units for research and application of treatments. Without breaking them down farther from their original state, it would be very difficult to determine whether or not the populations being studied or treated using different modalities could be meaningfully compared (Schaaf & Miller, 2005). It may also be the case that the three sub-groups will respond differently to various interventions. Indeed the heterogeneity of groups in efficacy studies has historically been one of the main deficits of the research on SIT since its beginning and there are even some in the field that argue against the original studies conducted by Ayers that lay the foundation for her diagnostic procedures and subsequent treatment programs.

One such author conducted a study in 1991 that reexamined eight papers published by Ayers (Cummins, 1991). In these papers, Ayers conducted ten multivariate analyses that influenced her formulation of sensory integration. Cummins (1991) argued that Ayres did not cross-validate the factors she found in her analyses and thus there have been different views about exactly what symptoms or factors are associated with sensory integrative dysfunction (the

earlier name for sensory processing disorder). Ayres was also inconsistent in her own work over her career. Over 12 years Ayers compiled a list (see Figure 1) of factors supposedly associated with poor sensory processing but very few of the factors were repeated. Despite the long list of different factors, Ayres chose five factors that were supposed to summarize her findings. Her list included: 1) Disorder in postural, ocular and bi-lateral integration; 2) Apraxia; 3) Disorder in form and space perception; 4) Auditory-language problems; and 5) Tactile defensiveness. At first glance the list seems plausible but the issue at hand is that Ayres did not consistently measure or use these labels across her analyses and therefore their grouping into these five categories may not be an accurate representation of the data. This prompted Cummins (1991) to use the information in Figure 1 to examine similar factors to determine if their content could be meaningfully grouped in a way that Ayres failed to do. Cummins (1991) concluded that "no core group of variables could be detected that allowed the similarly named factors to be reliably identified by their content" which brings Ayres theory of sensory integration into question and by extension sensory integration therapy.

Hoehn and Baumeister (1994) raised other questions about the theory and efficacy of SIT. Their first contention was that the meta-analysis conducted by Ottenbacher (1982) was not strict enough about which studies they chose to include. There were several potential shortfalls in those studies including poor subject sampling and group assignment procedures. There was also question as to whether or not the studies used blinding procedures during their evaluations. Another criticism of Hoehn and Baumeister against Ottenbacher (1982) concerns the form of the meta-analysis. Because Ottenbacher (1982) only included the data from SIT and no-treatment control groups even though the studies also had alternative treatment groups, there is a

possibility that placebo and other non-specific factors played a role in the positive results of SIT found in those earlier studies.

TABLE 2
Factor Labels or Descriptions

Labels/ Descriptions	1965 DR	1965 NR	1966a NR	1966c NR	1969 DI	1972b DR	1972b DI	1977 DR
Praxis (or apraxia)	x		x			x	x	x
Form and space perception	x					x	x	
Tactile defensiveness	x			x			x	
Bilateral integration	x							
Figure-ground discrimination	x	x						
General perceptual-motor and cognitive ability		x						
Body balance		x						
Visual perception			x					
Visual motor				x				
Interaction of sides of body with tactile perception				x				
Auditory, language, and sequencing					x			
Postural and bilateral integration					x			
Left-side coordination, posture, and bilateral integration					x			
Academic achievement and sensory perception						x		
Auditory/visual association and horizontal perception						x		
Auditory, language, and intelligence						x		
Postural and ocular mechanisms						x	x	x
Reading, spelling, and intelligence						x	x	
Eye-hand dominance and left-eye dominance						x		
Left-hand vs. right-hand coordination						x		
Auditory-language problems							x	x
Kinesthesia							x	
Somatosensory								x
Use of one hand in contralateral space						x		
Auditory-perception						x		
Uninterpreted factor				x			x	

Note. D = Learning disabled; N = Normal; R = Raw scores; I = Ipsative scores.

Figure 1 (From Cummins 1992)

With those limitations in mind, Hoehn and Baumeister (1994) conducted a search using the same criteria as Ottenbacher (1982) but only included studies published after that meta-analysis. Seven studies were found that met the criteria (see Figure 2 for a summary). Subjects in the studies were 5 to 11 years old and were diagnosed with both learning disabilities and

Sensory Integrative Dysfunction. Most of the participants were receiving special education services during the time of the studies. All of the studies addressed the question of whether SIT was effective in general and examined the effects of treatment over multiple sessions, but they each chose their own specific outcomes measures. In all seven studies participants in each condition were randomly assigned to SIT or other conditions while being matched for sex, age, and ability levels. The SIT therapy used in every study involved techniques that supplied vestibular, proprioceptive and tactile stimulation within a self-directed activity. Therapy was provided by trained occupational therapists (or other trained professionals depending on the other treatment conditions) in many sessions over a long period of time.

TABLE 1
Characteristics of the Reviewed SI Therapy Outcome Studies

Study	*N*	Design	Treatment	Outcome areas
Carte et al. (1984)	87	Two groups: SI treatment and no-treatment control; pre/posttests	Two or three 45-min sessions per week over 9-month period (66 sessions total)	PRN; perceptual processing; academic abilities
Humphries et al. (1990)	30	Three groups: SI treatment, PM treatment, and no-treatment control; pre/posttests	One 1-hr session per week for 24 weeks	Sensorimotor functioning (including PRN); cognitive, language, and academic abilities
Humphries et al. (1992)	103	Three groups: SI treatment, PM treatment, and no-treatment control; pre/posttests	Three 1-hr sessions per week for approximately 8 months (72 sessions total)	Sensorimotor functioning (including PRN); cognitive, language, and academic abilities; attention; self-concept
Morrison & Sublett (1986)	47	Same experiment as in Carte et al. (1984)	Same experiment as in Carte et al. (1984)	Vestibular functioning (including PRN)
Ottenbacher (1982a)	3	Single-subject methodology: 5 weeks of baseline, followed by 20 weeks of SI treatment intervention	Three 50-min sessions per week	PRN
Polatajko et al. (1991)	67	Two groups: SI treatment and PM treatment (no-treatment control dropped midway); pretest, 6- and 9-month posttests	One 1-hr session per week for 6 months	Motor skills; academic abilities; self-esteem
Wilson et al. (1992)	29[a]	Two groups: SI treatment and tutoring treatment; pretest, 6-month midtest, 12-month posttest	Two 50-min sessions per week for approximately 12 months (75–80 sessions total)	PRN; motor skills; academic abilities; self-esteem; behavior

Note. SI = sensory integration; PRN = postrotary nystagmus; PM = perceptual–motor.
[a]Four discontinued treatment after midtest.

Figure 2 (From Hoehn and Baumeister, 1994)

After reviewing each of the seven studies in Figure 2 and their results, Hoehn and Baumeister (1994) reported serious doubts as to whether SIT was a useful and appropriate treatment for children with learning disabilities. Although they admit that the studies they reviewed were relatively free of any major methodological or analytical flaws, they still report a lack of convincing evidence that SIT can do anything to improve sensorimotor neural organization. It is also of note that SIT had no discernable or unique effects on academic performance. All this evidence taken together leads the authors to conclude that, "the current fund of research findings may well be sufficient to declare SI therapy not merely an unproven, but a demonstrably ineffective, primary or adjunctive remedial treatment for learning disabilities and other disorders" (Hoehn and Baumeister, 1994, pg. 348).

Although Hoehn and Baumeister (1994) were very critical of SIT and clearly were of the opinion that it was a pseudoscientific endeavor, research continued. In 1999 Vargas and Camilli conducted a meta-analysis to test the efficacy of sensory integrative approaches in general. Their literature search ranged from 1972 to 1995 and included four inclusion criteria: 1) the study must have investigated the effects of treatment using a sensory integrative approach; 2) the study must have reported a comparison of at least two conditions; 3) the findings and results must have been reported in a manner that allowed quantitative analysis; and 4) outcome measures in academic skills, motor function, behavior, language function, and sensorimotor function must have been reported. The operational definition of sensory integration treatment provided by Vargas and Camilli (1999) was "a treatment that aimed to enhance development of basic sensory integration processes with activities that provide vestibular, proprioceptive, tactile, or other somatosensory inputs as modalities to elicit adaptive body responses" (pg. 191). Sixteen studies were chosen to compare SIT with no treatment (SI/NT) and sixteen were chosen to compare SIT

with alternative treatments (SI/ALT). Due to the high number of different outcome measures used across these studies, Vargas and Camilli (1999) simplified them into five categories: psychoeducational (cognition, IQ, and academic performance), behavior (behavioral function, attention, social and personal interaction, activity level, self-esteem, and coping skills), language (language measures and speech function), motor (fine and gross motor function), and sensory-perceptual (visual-perception, visual-motor integration, praxis, somatosensory and vestibular function).

Upon completing their analysis, Vargas and Camilli (1999) arrived at the conclusion that while sensory interventions were found effective when compared to no treatment groups in older studies, newer studies of the same kind failed to find a significant effect for sensory integration. In addition, when compared with alternative treatments SIT was found to have a statistically equal effect as the alternative methods. As was the case with the SN/NT studies, earlier studies that compared SIT and alternative methods tended to report more positive and significant results than newer studies. When the authors examined the supposed categories for improvement, they found that earlier studies that compared SIT and no-treatment groups reported improvements in psychoeducational and motor performance. When comparing SIT and alternative treatments the effects were equal in all areas for both methods and no improvements were seen in the sensory-perceptual areas for either form of treatment. The authors also compared length and fidelity of treatment and found that neither longer treatments nor stricter adherence to the SIT methodology produced any advantages. The only positive conclusion for those who favor SIT provided in this meta-analysis was that these authors sought to include studies whose SIT was based on the original technique and therefore these findings do not necessarily represent the most current form of SIT being practiced by occupational therapists.

In 2002, Baranek published a review paper that summarized the sensory and motor difficulties experienced by children with ASD and evaluated the evidence for several different interventions, including SIT in its classical sense, and more recent forms of SIT. The first goal of Baranek was to reiterate that sensory and motor difficulties do exist in many children with ASD and that they pose significant challenges for those children. Although the author admitted the weaknesses of many studies done on this topic, she stated that, "Empirical evidence converges to confirm the existence of sensory and motor difficulties for many children with autism at some point in their early development" (Baranek, 2002, pg. 397).

Baranek (2002) found it helpful in reviewing the literature on SIT to differentiate between "interventions for sensory and motor deficits" and "sensory and motor interventions." The author created three criteria to help distinguish which methods could be considered true SIT: 1) remedial interventions designed to target specific sensorimotor components, broader outcomes that are a direct result of sensory-motor treatment, or both; 2) compensatory skills training approaches; and/or 3) task/environmental modifications designed to address sensory and motor difficulties.

Furthermore, Baranek (2002) sought to delineate different types of SIT that were popular with parents and practitioners. The first method is classical SIT. This is the method of intervention originally proposed by Ayres (1972). It involves the Just Right Challenge and other concepts previously discussed. It is traditionally planned and provided by a trained occupational therapist in a clinical environment with 1-3 sessions per week, each an hour long. In many cases, the therapy is provided for a several month to several year duration. Swings, trampolines and other related equipment is often used. The cost of SIT is similar to other forms of therapy typically provided to children with ASD, however the author noted that this approach typically

does not translate well to schools or other settings because of space or equipment cost constraints.

Another category of SIT reviewed by Baranek (2002) involved approaches that borrowed from the theory of SIT but that were distinguishable from classical SIT by one of the following criteria: a) somatosensory and vestibular activities were provided but suspended equipment was not used; b) treatment was more adult-structured or passively applied; and/or c) treatment was focused more on cognitive elements than a classical SIT approach (Baranek, 2002). The example provided of such an intervention is the "Sensory Diet." Using this method, children diagnosed with ASD and other disabilities are provided with a home and, oftentimes, classroom program of sensory activities like brushing on the skin and joint compressions. The goal of these interventions is to meet the child's sensory needs throughout their day, which may provide benefits like increased capacity to focus during schoolwork or a decrease in challenging behaviors. These methods are often provided in one-on-one sessions but they can also be done in groups. They are very common in schools, homes, and clinical settings. Due to the large number of different treatments that can be included in this category it is difficult to generalize the length and cost of treatment but both are assumed to be roughly equivalent to classical SIT.

Upon completing a review of the literature on these two categories of SIT (as well as other methods not discussed in the current paper because they are not as closely related to the theory of SIT), Baranek (2002) reported that the findings were mixed and, like previous studies, cited the difficulty in coming to meaningful conclusions using this data because so many of the studies reviewed had important methodological flaws like the use of small and convenience samples, uncontrolled designs, and observer bias. Another flaw, which may be the most important deficiency, is that many studies fail to demonstrate a direct link between the changes

in the dysfunction with changes in behavior. This is in part due to the current lack of understanding of the actual mechanisms for change in these therapies. There is also a lack of consensus about which outcome measures are the most probable or most important areas of change so even if the studies did have adequate designs they would still be difficult to compare. The possibility also exists that there are different patterns of reactivity that different individuals may experience during the course of treatment which complicates the research further because, at this point, researchers are still trying to discern which treatments will be the most effective for different individuals and under what conditions.

Baranek (2002) also considered the lack of follow-up and generalizability reported in the research up until that point to be major concerns. Without thorough follow-up on individuals who have received treatment, researchers will not know whether the positive gains are permanent or whether maintenance programs are required to preserve gains once they are made. It was also the case across the studies reviewed by Baranek (2002) that gains were greatest in areas that directly related to the context of the therapy such as mastery play and engagement (Case-Smith & Bryan, 1999) while other important areas like peer interaction and academic performance remained unchanged. This failure of therapeutic outcomes to generalize to other areas and across contexts is problematic because the theory of sensory integration postulates that learning to regulate and organize sensory information should help the brain to be more efficient with other tasks, which would in turn provide academic and social benefits but so far the research has not been supportive of this claim. Baranek (2002) remained optimistic however, because she reasoned that the lack of convergence of the empirical data does not necessarily mean that therapy is ineffective, but rather that current professionals in the field lack the sophisticated level of understanding required to determine how and when it will be effective.

Pfeiffer, Koenig, Kinnealey, Sheppard, and Henderson (2011) conducted a recent pilot study to examine more closely and scientifically the effects that SIT had on children with ASD. The goal, as stated by the authors was, "to implement a high-level design to establish a model for randomized controlled trial (RCT) research, identify appropriate outcome measures with this population, and address the question of effectiveness of SI interventions in children with ASD" (Pfeiffer, et al., 2011, pg. 77). The participants in this pilot study were 32 boys and 5 girls ages 6 to 12. Each of the participants had a DSM IV-TR diagnosis of ASD (21 children) or Pervasive Developmental Disorder (PDD) not otherwise specified (NOS) (16 children) and attended a summer program that provided therapeutic activities. These participants were then randomly assigned to either the sensory integration (SI) group or the fine motor (FM) group. Parents and researchers responsible for pre- and post-testing were blind to group assignment. The researchers also conducted common occupational therapy evaluations to determine if the participants had sensory processing disorder. The therapists then worked with parents to develop measurable goals used in the Goal Attainment Scaling system (GAS; Mailloux et al., 2007).

All participants received the same amount of therapy; 18 interventions for 45 minutes over a 6-week period. The SI intervention was built around 10 strategies identified in a fidelity tool by Parhem, Cohn, Spitzer, Koomar, Miller, and Burke (2007): 1) arranging the room to entice engagement; 2) ensuring physical safety; 3) presenting sensory opportunities; 4) attaining and maintaining optimal arousal levels; 5) modifying activities to present the just-right challenge; 6) ensuring that activities were successful; 7) guiding the self-regulation of behavior; 8) creating a playful environment; 9) collaborating in activity choice; and 10) fostering therapeutic alliance.

The FM intervention followed a fidelity measure developed for this study which dictated that the intervention must focus on three main activity areas: constructional, drawing and writing, and FM crafts. In addition, there were five characteristics these activity areas needed to include which were: 1) appropriate supports for the child to successfully complete the task while still challenging their FM and visual-motor skills; 2) interventions based on the therapeutic needs of the child in the areas of visual and FM skills; 3) interventions based on the child's interests; 4) seating and positioning of the child adapted to address their specific size and motor support needs; and 5) activities that do not provide full-body proprioceptive, vestibular, or tactile sensory input. Measurement tools used in both conditions included the Sensory Processing Measure (SPM)(Home Version), the Social Responsiveness Scale (SRS), The Quick Neurological Screening Test 2nd Edition (QNST-II) (Mutti et al., 1998), Goal Attainment Scaling (GAS), and the Vineland Adaptive Behavior Scales, 2nd Edition.

The results of this pilot study showed significant post intervention differences between the SI group and the FM group with children in the SI group showing fewer autistic mannerisms according to the Social Responsiveness Scale. Children in the SI group who were unable to complete the QNST-II at pretest were better able to complete parts of the test than children who could not complete the QNST-II at pretest but were assigned to the FM condition. There were also significant improvements in both groups using GAS, but the SI group performed better using this measure as well. There were no significant changes found with the other measures. The authors cite issues of generalizability and the fact that some of the measures used have not yet been proven effective with this population as reasons that results may have been difficult to detect. Pfeiffer et al. (2011) conclude that while more research is needed, GAS has at least shown promise as a useful tool for measuring changes in children with ASD and PDD-NOS

because it is able to address the individual needs of different people while still maintaining its utility as a research tool.

Another tool that is important for research on SIT is a fidelity measure. Up until this point, there had not been a consistent way to measure how strictly a method claiming to be SIT adhered to the original model and theory as proposed by Ayres. For that reason, a group of occupational therapists and researchers collaborated on a study to design a fidelity instrument that could be used to measure the structural and process aspects of Ayres Sensory Integration (ASI) intervention (Parham, Smith Roley, May-Benson, Koomar, Brett-Green, Burke, Cohn, Mailloux, Miller, & Schaaf, 2011)

Parham et al. (2007) originally identified the structural and process elements measured by this fidelity instrument. Parts 1-4 of the instrument address the structural elements of ASI, which encompass aspects like the therapist's credentials, and the results of assessments (for a complete list of measured components see Figure 3). Part 5 of the instrument seeks to measure how closely the intervention aligns with the key components of ASI (see Figure 4). Twenty occupational therapists with expertise in ASI assessed the fidelity measure for content validity. The rating scale used to determine whether the occupational therapists agreed that the item contents were representative of ASI ranged from 1 (strongly disagree) to 5 (strongly agree). The mean ratings for each of the items are recorded in Figures 3 and 4.

Table 1. Content Validity Expert Ratings of Agreement for Items Measuring Structural Elements

Part No., Item, and Item Components[a]	*M* (*SD*)
Part 1: Therapist qualifications	
Postprofessional training in sensory integration—certification in SI/SIPT (minimum of 50 education hr in SI theory and practice, e.g., postprofessional SI or SIPT certification or university course)	4.63 (0.83)
Supervision (minimum of 1 hr/mo by an expert or 5 yrs of experience providing occupational therapy using SI intervention)	4.11 (1.20)
Part 2: Components of the occupational therapy assessment report	
Historical Information (e.g., medical, educational, and therapeutic, as appropriate; developmental history; occupational profile)	4.67 (0.59)
Reason for referral	4.84 (0.38)
Performance patterns (e.g., activities child currently seeks out and enjoys)	4.84 (0.38)
Sensory processing: modulation and discrimination	4.84 (0.69)
Postural ocular control	4.95 (0.23)
Visual–perceptual and fine motor skills	4.84 (0.38)
Motor coordination, gross motor skills, and praxis	4.95 (0.23)
Organization skills	4.84 (0.38)
Performance (e.g., influence of sensory integration, multisensory processing on performance)	4.89 (0.46)
Summary interpretation (e.g., interpretation of the effects of sensory integration and praxis on referring problems)	4.95 (0.23)
Part 3: Physical environment	
Adequate space for flow of vigorous physical activity	4.79 (0.42)
Flexible arrangement of equipment and materials for rapid change of the intervention environment.	4.84 (0.38)
No less than 3 hooks for hanging suspended equipment, minimal distance between hooks 2.5 to 3 ft (i.e., enough room to allow for full orbit on suspended equipment)	4.21 (1.08)
One or more rotational devices attached to ceiling support to allow 360° of rotation	4.79 (0.42)
Quiet space (e.g., tent, adjacent room, or partially enclosed area)	4.68 (0.48)
One or more sets of bungee cords for suspended equipment	4.42 (0.84)
Mats, cushions, pillows (available to be used to pad floor underneath all suspended equipment during intervention)	4.95 (0.23)
Equipment adjustable to child's size	4.69 (0.48)
Therapist monitors accessible equipment for safe use	4.95 (0.23)
Unused equipment stored or placed so children cannot fall or trip	4.74 (0.45)
Documentation of routine monitoring of equipment safety (e.g., ropes and bungee cords not frayed)	4.78 (0.43)
Variety of equipment available (e.g., bouncing equipment such as trampoline; rubber strips or ropes for pulling; therapy balls; swings [platform swing, square platform, glider swing, frog swing, flexion disc, bolster swing, tire swing, net swing]; scooter and ramp; weighted objects such as balls or bean bags in a variety of sizes; inner tubes; spandex fabric; crash pillow; ball pit; vibrating toys, massagers, tactile material; visual targets; ramps; climbing equipment; barrel for rolling; props to support engagement in play, e.g., dress-up clothes, stuffed animals, and dolls; materials for practicing daily living skills, e.g., school supplies, clothing, and shoes with laces)	4.78 (0.43)
Part 4: Communication with parents and teachers	
Goal setting	
Goals and objectives as defined by team including child, family, or significant others	4.74 (0.45)
Therapist defines areas to be addressed that will improve engagement.	4.63 (0.60)
Family or teacher education (e.g., ongoing interchange to direct the course of intervention)	
Discuss the potential influence of sensory integration and praxis on performance of valued and needed activities.	4.78 (0.43)
Discuss the child's sensory integration and praxis abilities and their influence on the child's and family's participation in the home, school, and community.	4.78 (0.43)

Note. Content validity ratings are made on a 5-point scale, with 5 indicating *strong agreement*. *M* = mean; SI = sensory integration; SIPT = Sensory Integration and Praxis Tests; *SD* = standard deviation.

[a]Item components are from *Ayres Sensory Integration® Fidelity Measure*, by L. D. Parham, S. Roley, T. May-Benson, J. Koomar, B. Brett-Green, J. Burke, et al., 2008, unpublished instrument. Copyright © 2008 by the authors. Reprinted with permission.

Figure 3 (From Parham et al. 2011)

Table 2. Content Validity Expert Ratings of Agreement for Items Measuring Process Elements

Item No. and Item[a]	Item Description[b]	*M* (*SD*)
1. Ensures physical safety.	The therapist anticipates physical hazards and attempts to ensure that the child is physically safe through manipulation of protective and therapeutic equipment and the therapist's physical proximity and actions. An existing safe room is important, as is the therapist's attention to the child's abilities and potential dangers.	4.95 (0.23)
2. Presents sensory opportunities.	The therapist presents the child with ≥2 of 3 types of sensory opportunities—tactile, vestibular, and proprioceptive—to support the development of self-regulation, sensory awareness, or movement in space.	5.00 (0.00)
3. Helps the child to attain and maintain appropriate levels of alertness.	The therapist helps the child to attain and maintain appropriate levels of alertness and an affective state that supports engagement in activities.	4.95 (0.23)
4. Challenges postural, ocular, oral, or bilateral motor control.	The therapist supports and challenges postural control, ocular control, or bilateral development. At least 1 of these types of challenges is intentionally offered: postural challenges, resistive whole-body challenges, ocular–motor challenges, bilateral challenges, oral challenges, projected action sequences.	4.95 (0.23)
5. Challenges praxis and organization of behavior	The therapist supports and presents challenges to the child's ability to conceptualize and plan novel motor tasks and to organize his or her own behavior in time and space.	4.95 (0.23)
6. Collaborates in activity choice.	The therapist negotiates activity choices with the child, allowing the child to choose equipment, materials, or specific aspects of an activity. Activity choices and sequences are not determined solely by the therapist.	4.95 (0.23)
7. Tailors activity to present just-right challenge	The therapist suggests or supports an increase in complexity of challenge when the child responds successfully. These challenges are primarily tailored to the child's postural, ocular, or oral control; sensory modulation and discrimination; or praxis developmental level.	4.95 (0.23)
8. Ensures that activities are successful	The therapist presents or facilitates challenges that focus on sensory modulation or discrimination; postural, ocular, or oral control; or praxis in which the child can be successful in making an adaptive response to challenge.	4.89 (0.46)
9. Supports child's intrinsic motivation to play.	The therapist creates a setting that supports play as a way to fully engage the child in the intervention.	4.95 (0.23)
10. Establishes a therapeutic alliance	The therapist promotes and establishes a connection with the child that conveys a sense of working together toward one or more goals in a mutually enjoyable partnership. Therapist and child relationship goes beyond pleasantries and feedback on performance such as praise or instruction.	4.95 (0.23)

Note. Content validity ratings are made on a 5-point scale, with 5 indicating *strong agreement*. *M* = mean; *SD* = standard deviation.
[a]Items and item descriptions are from *Ayres Sensory Integration® Fidelity Measure*, by L. D. Parham, S. Roley, T. May-Benson, J. Koomar, B. Brett-Green, J. Burke, et al., 2008, unpublished instrument. Copyright © 2008 by the authors. Reprinted with permission.
[b]Item descriptions are abridged in this table. A full copy of the instrument with detailed item descriptions is available from Susanne Smith Roley, with permission from the copyright owners.

Figure 4 (From Parham et al. 2011)

Overall, the Ayres Sensory Integration Fidelity Measure developed in this study by Parham et al. (2011) proved very promising. The content validity and internal consistency were both high. When pooled, all scores for interrater reliability were high, however three items (presents sensory opportunities, challenges praxis and organization of behavior, and establishes therapeutic alliance) failed to meet the intraclass correlation coefficients (ICC) criterion of .70 for individual rater reliability. It is also noteworthy that reliability was only examined for the

process section and not for the structural elements section. The Total Fidelity score also differentiated ASI from other forms of therapy, like perceptual-motor training. The authors posit that the Ayres Sensory Integration Fidelity Measure is a reliable and valid instrument that will assist future research and practice by providing a consistent definition and form of measurement for ASI. This in turn will allow researchers to perform more formidable efficacy studies than have been done to date.

Past research on SIT, especially with children diagnosed with ASD, has been plagued with inconsistent findings and passionate arguments from supporters and opponents alike. The nature of ASD is one of the most challenging aspects of this research because of the known symptoms of ASD and the difficulty in testing children with this diagnosis. This leaves the option of family interviews and observational studies but these are often unreliable and subject to bias. Thus, there is a great need for new ways of measuring outcomes in children with ASD that are both useful for data analysis but also able to be tailored to individual needs, such as GAS. There is also a great need to standardize the practice of SIT so that its outcomes can be effectively measured. This process has begun with the development of the Ayres Sensory Integration Fidelity Measure but this will only be a useful tool if more research is done following its principles. That research, according to Parham et al. (2011) needs to be done by occupational therapists since they are, as of now, the professionals with the most training in this area. However, it is well known in the field of occupational therapy that its practitioners are notorious for their lack of data collection, making it difficult to measure the effects of therapy. This must change in the future as the need to provide evidence-based practices becomes paramount through social and financial pressures. This will also drive the need for therapists with the skills and level of education sufficient to conduct research in their own domain, which is another notorious

weakness of occupational therapy (Schaaf & Miller, 2005). This is in part due to a lack of rigorous research training in occupational therapy programs but also because there is little incentive for potential students to reach the doctorate level since compensation for occupational therapists with masters and doctorate degrees is roughly even. Other fields related to psychology have their own treatments and strategies for helping individuals with ASD achieve their full potential, therefore it will fall to occupational therapists to produce their own evidence to support their perspectives and advocate for the necessity of their services. The standards for such evidence within the field need to be raised to produce a level of sophistication that accurately represents not only the outcomes but also the mechanisms for change brought about with SIT. It is the responsibility of all occupational therapists to continue to strive to discover, refine, and implement evidence-based practices to best support the populations they serve.

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