

The Use of Occupational and Physical Therapies for Individuals with Autism Spectrum Disorder

Elizabeth White  
Summer 2015

Superheroes social skills training, Rethink Autism internet interventions, parent training, EBP classroom training, functional behavior assessment: An autism spectrum disorder, evidence based practice (EBP) training track for school psychologists

US Office of Education Personnel Preparation Project:  
H325K12306

Principal Investigators:

William R. Jenson, PhD  
Elaine Clark, PhD

Grant Director:

Julia Hood

University of Utah  
Department of Educational Psychology  
School Psychology Program

## The Use of Occupational and Physical Therapies for Individuals with Autism Spectrum Disorder

According to the Centers for Disease Control and Prevention (2014), Autism Spectrum Disorder (ASD) affects an estimated 1 in 68 children in the United States. Data collected in 2011-2012 by the U. S. Department of Education (2015) identified that 0.9% of all children in US public schools receive special education services under the educational classification of Autism; this proportion represents approximately 455,000 children between 3 and 21 years of age. It is important to note that these numbers only represent those children who are receiving specialized instruction under an Individualized Education Plan (IEP) and that only the child's primary classification is recorded. Therefore, a child who has both Intellectual Disability (ID) and ASD may be represented under the ID classification but not the Autism classification. Also, a child who has a diagnosis of ASD but who does not require specialized instruction would not be represented in any category at all. Additionally, students with an educational classification of Autism might not have a formal diagnosis of ASD. Given the proportion of children who have ASD, it is important to understand what treatments these children are receiving.

Semansky, Xie, Lawer, and Mandell (2013) conducted an archival review of state Medicaid data to determine which services are commonly reimbursed through Medicaid for children with ASD. They found that as many as 45% of all children with ASD are insured through state Medicaid programs. Individual therapy, occupational and physical therapy, in-home supports, speech therapy, and diagnostic assessment were found to be the most commonly reimbursed services for these children with ASD insured by Medicaid. There was no service that was reimbursed for children with ASD in all 50 states. Occupational and physical therapy services were reimbursed services for children with ASD in 42 states.

Given the high incidence of ASD and the proportion of children with ASD that receive occupational and physical therapy services, the remainder of this paper will describe in more detail the ASD diagnosis and treatment of this condition, with a focus on the currently available research evidence for the use of occupational and physical therapies for individuals with ASD. Numerous interventions will be reviewed that are implemented by OTs and PTs including sensory integration therapy, sensory based interventions (such as weighted vests and therapy ball chairs), feeding interventions, exercise interventions, and toe-walking interventions, among others. Finally, extent of the available research evidence as well as limitations to the research will be discussed to highlight what work still needs to be done.

### **Autism Spectrum Disorder**

According to the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5, 2013), diagnostic criteria for ASD include:

- A. persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history . . . . 1. Deficits in social-emotional reciprocity . . . . 2. Deficits in nonverbal communicative behaviors used for social interaction . . . . 3. Deficits in developing, maintaining, and understanding relationships . . . .
- B. restricted, repetitive behavior, interests, or activities, as manifested by at least two of the following . . . . 1. Stereotyped or repetitive motor movements, use of objects, or speech . . . . 2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior . . . . 3. Highly restricted, fixated interests that are abnormal in intensity or focus . . . . 4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment . . . . (p. 50)

Additionally, the aforementioned symptoms must be present in the early developmental period, must cause clinically significant impairment in an important area of functioning, and can not be better explained by intellectual disability or global developmental delay (work, school, social, etc.) to qualify for a diagnosis of ASD (American Psychiatric Association, 2013).

Due to changes in diagnostic criteria from the fourth edition of the DSM to the current DSM-5, a note is present within DSM-5 that “individuals who had well-established DSM-IV diagnosis of autistic disorder, Asperger’s disorder, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder.” (American Psychiatric Association, 2013, p. 51). This provision assures for the continuation of services for individuals who may not otherwise meet criteria for ASD as defined by the DSM-5. It is important to keep in mind that many of the subsequent studies that will be discussed throughout the remainder of this paper included participants who had been diagnosed under the DSM-4 criteria and may have received diagnoses of Asperger’s disorder or pervasive developmental disorder not otherwise specified, however for the purposes of this paper, they will be referred to as individuals with ASD.

### **Sensory and Motor Development**

According to Baranek (2002), empirical evidence suggests that sensory and motor difficulties are present for many children with ASD, especially during early development. It is important to note that most studies in this area have been limited in that they have relied solely on parental report. However, retrospective video studies and clinical evaluations have corroborated the presence of differences in both sensory and motor features between individuals with developmental disabilities, including ASD, and typical peers. Demonstrated areas of weakness for individuals with ASD include low muscle tone, oral-motor problems, and

dyspraxia. Baranek suggests that this pattern of differences in motor and sensory development might be related to core features of ASD, development of other behaviors, and later outcomes for individuals with ASD.

**Sensory Development.** Unusual sensory responses have been reported in 42-88% of older children with ASD (Kientz & Dunn, 1997; LeCouteur et al., 1989; Ornitz et al., 1977; Volkmar, Cohen, & Paul, 1986, as cited in Baranek, 2002). Unusual sensory responses include both hypo-responses (lack of responding to sensory stimuli) and hyper-responses (overstimulation to sensory stimuli). Interestingly, both hypo- and hyper-responses can occur within the same child for the same stimuli at different times, this is often described as paradoxical response because it is difficult to predict what response a child may have to a stimulus. Unusual sensory responses are also related to preoccupations with sensory features of objects, such as a child with ASD who repeatedly spins the wheels on a toy car while viewing it out of the corner of his or her eye, as well as perceptual distortion (seeing things as they aren't). To reiterate, hypo- and hyper-reactivity to sensory stimuli or unusual interest in sensory aspects of the environment is one of the criteria that can be used for diagnosis of an ASD.

**Food Selectivity.** Cermak, Curin, and Bandini (2010) reviewed 25 years of research on food selectivity in individuals with ASD. They found that as many as 83% of parents of children with ASD reported that their child had a restricted repertoire of foods that they would consume. Additionally, their review identified sensory sensitivity as a possible mechanism for the prevalence of food selectivity that is associated with ASD. In spite of the large prevalence of feeding problems in children with ASD, Matson and Fodstad (2009) found a lack of intervention research in this area. They also suggested that children with ASD should undergo screening for feeding problems due to the high prevalence amongst this population.

**Motor Development.** The DSM-5 (American Psychiatric Association, 2013) states that motor deficits are often present in individuals with ASD, these deficits include odd gait, clumsiness, and walking on tip toes (referred to as toe-walking). Fournier, Hass, Naik, Lodha, and Cauraugh (2010) conducted a meta-analysis of motor coordination in ASD in order to provide evidence that motor deficits are a core feature of ASD. Inclusion criteria for the meta-analysis included quantitative evaluation of motor coordination, motor impairment, arm movement, gait, or postural stability; relevance to ASD and aforementioned motor coordination areas; comparison to typically developing controls; and inclusion of necessary statistical information (means and standard deviations) to be able to conduct analyses. A total of 41 studies met these criteria and a large standardized mean difference effect ( $d=1.2$ ) was found between individuals with ASD and typically developing individuals indicating substantial motor coordination deficits and postural stability issues for individuals with ASD. This large effect was found for both upper and lower extremities and regardless of the age of the individual. The authors concluded that their findings provide evidence that motor deficits could be a potential core feature of ASD and that more interventions in this area and with this population, are needed.

Bhat, Landa, and Galloway (2011) reiterated that there is a greater likelihood of motor impairment for individuals with ASD. However in spite of this need, they found no major research studies that evaluated the effects of motor interventions on motor and social communication outcomes, several smaller scale studies are included later on in this review. They suggest that motor learning principles could be applied to interventions for individuals with ASD and motor impairments with some modification, such as incorporating hand over hand teaching if a child isn't able to replicate modeled movements. There is a need for more PT intervention

studies with individuals who have ASD to identify areas that need adjustment in order to be effective.

### **Occupational Therapy**

According to the American Occupational Therapy Association (2015), Occupational Therapy (OT) is a healthcare specialty that helps individuals participate in activities across the lifespan, including work, play, self-care, school, and any other daily activities. A master's degree is required to be an OT, as well as licensure by the state in which an individual practices (OTPlan, 2015). The University of Utah Health Care Life Skills Clinic website (2015) advertises OT interventions that target fine motor, gross motor, visual processing, oral motor/oral sensory, sensory processing, social interaction, learning challenges, and play skills. Clearly, OT services have the potential to benefit children with ASD, who as previously discussed, often have difficulties in several of the areas OT's are able to target through intervention.

**Sensory Processing Interventions.** The American Academy of Pediatrics (2012) says that sensory integration refers to the way the body handles and processes sensory inputs. Integration of input is believed to develop over time, deficits in this development can occur. A sensory system that is well organized can integrate multiple sources of input simultaneously. Sensory treatments depend on the sensory profile (whether a person seeks or avoids sensory input). For example, intervention for an individual with sensory seeking behaviors would participate in activities that provide the input they seek. Whereas a therapist working with a person who avoids sensory input, would work to identify and modify barriers to that individual's ability to participate in activities of daily living. Areas of possible sensory intervention include visual (sight), olfactory (smell), gustatory (taste), auditory (hearing), tactile (touch), vestibular

(balance), and proprioception (body awareness) (Smith-Myles, Cook, Miller, Rinner, & Robins, 2000). These potential areas of intervention are visually represented in Appendix A.

Case-Smith, Weaver, and Fristad (2014) state that sensory processing interventions fall under one of two categories: sensory integration therapy (SIT) or sensory-based intervention (SBI). SIT occurs in a clinic setting, utilizes specialized equipment, is child-directed, and services are provided by a trained professional (like an OT). SBI can occur within the child's regular routine (in school or at home), is adult-directed, and may be provided by a child's caregiver or a teacher (usually under the supervision of an OT). The aim of both types of sensory processing intervention is to improve behaviors that are associated with sensory processing.

***Sensory Integration Therapy.*** According to Rolley, Mailloux, Miller-Kuhaneck, and Glennon (2007), SIT was first developed by Ayres, an OT, in the 1950s. It is one of the most cited and applied theories within OT. This theory is used to explain behavior, plan interventions, and predict how behavior will change through intervention. Three main components of SIT include typical sensory integration development, defining sensory integrative dysfunction, and guiding intervention programs.

Typical sensory integration functioning centers on the idea that sensory systems do not develop independently and that sensory information is not processed in isolation. Ayres documented patterns of sensory integrative dysfunction that provided construct-related evidence that sensory integrative deficits exist. Principles deemed essential to the delivery of intervention using a sensory integration approach include that the intervention is delivered by a qualified professional; the intervention plan is family centered; therapy takes place in a safe environment with the proper equipment; activities offer opportunity for integrating information from multiple sources; activities promote alertness; strategies provide the just right challenge; intrinsic

motivation is used to interact through play; activities are negotiated, not planned; and the activities are their own rewards.

Case-Smith et al. (2014) indicate that SIT is clinic based and typically occurs one-on-one with a therapist and child. The goal of SIT is to increase the child's ability to integrate sensory information so that they have more organized and adaptive behaviors. Therapists also reframe the child's behaviors to the parent using a sensory processing perspective so that caregivers can develop different approaches to accommodate their child's sensory needs. These approaches can easily include modifications to the environment or daily routines and usually provide a balance between active and quiet activities and give the child an opportunity to participate in preferred sensory experiences. An image of a sensory integration clinic room is provided in Appendix B. Common equipment within a sensory integration clinic room includes swings, textured pillows and blankets, and objects that spin and rock. As sensory integration is child-directed, sensory integration clinic rooms have lots of different equipment that the child can choose to use. OTs may model how a piece of equipment works or guide a child to explore it, but the decision is made by the child.

Schaaf et al. (2014) randomly assigned 31 children with ASD to either a manualized SIT condition or a usual care control group. Treatments for the usual care control group included speech and language therapy, behavioral interventions, and educational programming. The treatment group was assessed by an OT who formed hypotheses about the sensory motor factors impacting the child's behavior. Individual sensory motor activities were developed based on these hypotheses. Goals for each child were identified by independent evaluators using a standardized interview with parents to determine child's current level of functioning prior to the intervention. Additional data was collected using the Pediatric Evaluation of Disability

Inventory, a measure of child's independent and need for caregiver assistance or modifications for areas of self-care, mobility, and social function skills; the Pervasive Developmental Disorders Behavior Inventory, a standardized assessment of a child's autism behaviors; and the Vineland Adaptive Behavior Scales-II, a measure of adaptive behaviors required to participate in home, school, and community activities.

Schaaf et al. (2014) give an illustrative example of an activity that might occur as a part of the intervention, a child may use a scooter board in a prone position to pull themselves up a ramp, turn the scooter board around to ride down the ramp and land in a cushioned area covered with pillows of varying texture. This sequence of events would give the child "total body tactile and proprioceptive sensation" experiences to increase body awareness and plan body movements (p. 1497). The same interview was used with parents following intervention by evaluators blinded to study conditions to rate improvement in child's goals. The treatment group ( $M=56.53$ ,  $SD=12.38$ ) achieved significantly higher scores on Goal Attainment Scaling than the usual care control group ( $M=42.71$ ,  $SD=11.21$ ), representing a large effect of treatment ( $d=1.2$ ).

As demonstrated in the following table (Figure 1) from Schaaf et al. (p. 1501), the treatment group also significantly improved on scales measuring need for caregiver assistance for self-care ( $d=0.9$ ) and social ( $d=0.7$ ) as compared to the control group. There were no other differences in change scores between groups on any of the other measures.

Figure 1.

**Table 3** Group differences on change in standard scores on pediatric evaluation of disabilities inventory

	Control			Experimental			Significance	Effect Size <sup>a</sup>
	Median	Mean	SD	Median	Mean	SD		
<b>Functional skills<sup>b</sup></b>								
Self-care	1.7	1.12	5.6	3.7	10.2	22.6	0.198	0.5
Mobility	0	6.38	15.1	0	6.57	23.8	0.69	0.0
Social	1.1	4.4	13.8	4	9.3	17.4	0.097	0.3
<b>Caregiver assistance</b>								
Self-care	1.3	-0.43	8.6	12.2	16.6	23	0.008**	0.9
Mobility	0	0.22	11.8	0	4.8	24.1	0.68	0.2
Social	0	-1.8	19	13.5	14.4	23.4	0.039*	0.7

<sup>a</sup> Mean and standard deviations are based on raw scores. Effect size is presented using the difference in means divided by the pooled standard deviation

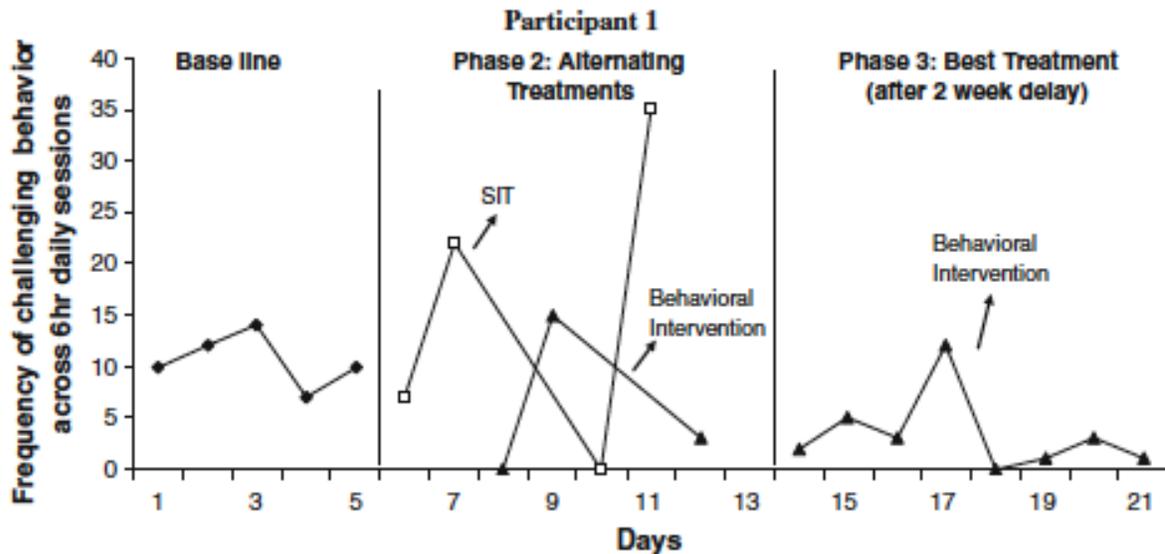
<sup>b</sup> Functional Skills represent actual skills completed by child whereas caregiver assistance represents the amount of assistance that the caregiver provides

\*\*  $p < 0.001$ ; \*  $p < 0.05$

In a comparison of behavioral interventions and SIT conducted by Devlin, Healy, Leader, and Hughes (2011), four children with ASD received a randomized sequence of behavioral interventions and SIT over a period of 10 days. Behavioral interventions were designed based on the results of a functional assessment conducted during the baseline phase. On days in which the behavioral intervention was implemented, the behavioral intervention was implemented across the entire school day. SIT interventions were designed by an OT who was trained in SIT and was familiar with the participants following a one-month long observational period. On days in which the SIT intervention was implemented, SIT was conducted for 15-minute sessions approximately six times over the course of the school day. Results indicated that all four participants had greater reductions in the rate of challenging behaviors during the behavioral intervention than during the SIT intervention, for this reason the behavioral intervention was continued in Phase 3 of the intervention for all participants. A graph with frequency of challenging behavior for one participant is included below (Figure 2, Devlin et al., 2011, p. 1314). Additionally, salivary

cortisol levels during both treatment conditions for signs of stress and very low cortisol levels were found across conditions, indicating very little stress responsivity.

Figure 2.



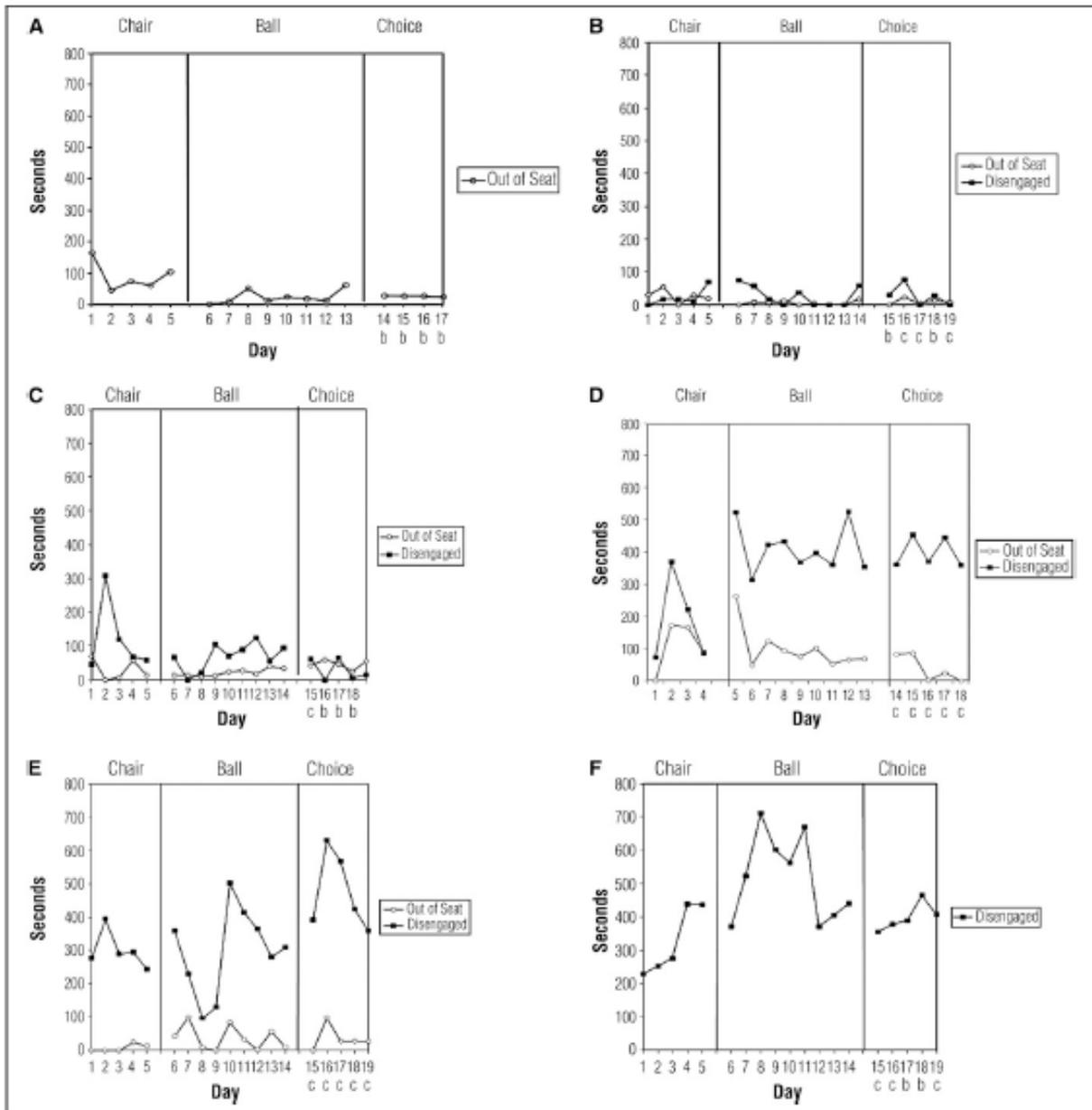
In a large review of studies by Case-Smith et al. (2014), SIT had low to moderate effects on a variety of outcome measures including scores on parent and teacher rating scales, attainment of individualized goals, self-stimulatory behavior, and self-injurious behaviors. The studies included in the review all had relatively small sample sizes. Many of the studies did not have a control group for comparison, but rather used a pre/post design or single subject design. Overall, more research is needed to assess the efficacy of SIT for children with ASD, but SIT may be a promising treatment approach for this population.

**Sensory Based Interventions.** SBIs are adult-directed and applied to the child to improve behaviors associated with sensory modulation disorders. They require less engagement from the child and are designed to fit into the daily routine (Case-Smith et al., 2014). SBIs are based on a similar hypothesis as SIT, that the efficiency of the child's nervous system for interpreting and using sensory information can be improved by systematic application of sensation to promote

change in arousal state. SBIs are often used to lower a high arousal state (like agitation). Rather than implemented by OTs and PTs, family members, teachers and aids can implement SBIs, usually with consultation from an OT.

An example of a SBI includes the use of therapy ball chairs. Therapy ball chairs are also marketed towards adults as a replacement for a typical desk chair and sitting on one is thought to improve core (abdominal) strength. Therapy ball chairs are exercise balls that are modified by placing the ball in a ring or on “feet” so that it is stabilized (see Appendix C). They allow children to actively move and maintain an optimal arousal level. It’s believed that if children are able to maintain their optimal arousal level that they will be better able to attend and interact. Bagatell, Mirigliani, Patterson, Reyes, and Test (2010) provided therapy balls to six children with ASD during circle time. The children could move or bounce on the balls as long as classroom staff deemed it safe. Results from this study were mixed, one child who had vestibular (balance) and proprioceptive (body positioning) seeking behaviors, improved on in-seat behavior. However, some children had negative effects including those who had poor posture; these children were less engaged when using the therapy balls, perhaps because more of their attention was required in order to stay seated on the ball. Please see Figure 3 for a graphical representation of data collected (Bagatell et al., 2010, p. 899). In a similar study conducted by Umeda and Deitz, inflated cushions (see Appendix D) were secured to regular classroom seats for two kindergarten students (2011). This study did not find any effects of therapy cushions on in-seat behavior (see Figure 4 for in-seat behavior for participant 1). Both therapy balls and therapy cushions can easily be located for purchase by doing an online search and can be purchased and shipped for under \$100.

Figure 3.



**Figure 1.** Time students spent out of seat or disengaged. (A) Total number of seconds Alex was out of seat each session. (B) Total number of seconds Jack was out of seat and disengaged each session. (C) Total number of seconds Roland was out of seat and disengaged each session. (D) Total number of seconds Samuel was out of seat and disengaged each session. (E) Total number of seconds Omar was out of seat and disengaged each session. (F) Total number of seconds Ricardo was disengaged each session. c = chair; b = therapy ball chair.

Figure 4.

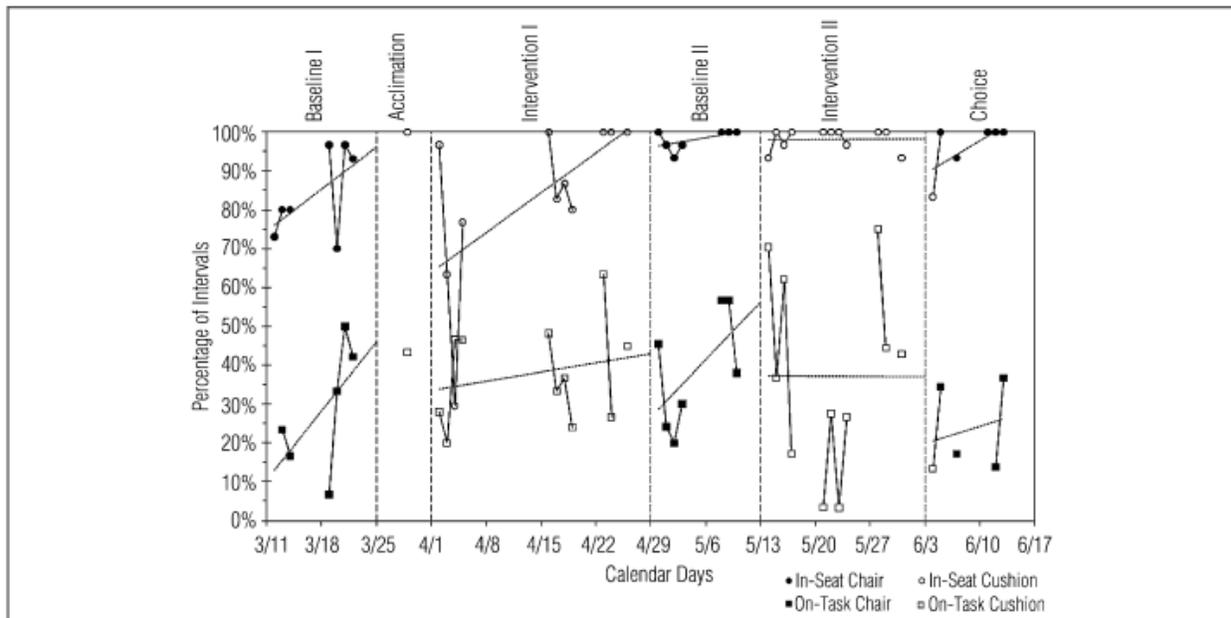


Figure 1. In-seat and on-task behavior by session for Participant 1.

Another SBI that has been researched frequently is weighted vests. According to Hodgetts, Magill-Evans, and Misiaszek (2011), weighted vests (see Appendix E) are believed to provide deep pressure to the body, this provides sensory input to the individual so that they can respond to the environment rather than focus on obtaining similar sensory input through other means. The effect of weighted vests is theorized to occur immediately, so studies that have used weighted vest are able to be conducted over relatively few sessions. There is no standard for the amount of weight that a weighted vest should be in relation to the individual wearing it, although 5-10% of the individual's weight seems to be pretty standard across the literature. In Hodgetts et al.'s study, six children with ASD who exhibited stereotypical behaviors that interfered with their learning were assigned to wear a vest weighted to either 5% or 10% of their body weight during a fine motor activity. There was also a control condition and a non-weighted vest control condition, to assess whether just the presence of a vest would change behavior regardless of weight. There were no differences in stereotypical behavior or heart rate observed for the

weighted vest condition compared to the control condition (or the non-weighted vest control condition). Heart rate data was also collected in order to assess whether weighted vests had a calming effect. No participants experienced a decrease in heart rate while wearing the vest, but one participant experienced an increase in heart rate, which may be due to the physical burden put on the individual associated with wearing a weighted vest. Results are summarized in Figure 5, a table from Hodgetts et al. (2011, p. 809). Weighted vests are available by doing a simple search online and can be purchased for under \$50.

Figure 5.

**Table 2** Data summary

	Change in stereotyped behaviors	Average % intervals stereotyped behaviors	Change in heart rate between weighted/unweighted phases	Average heart rate per phase (bpm); SD
Adam	No effect (PND = 40%)	No weight: 27% Weight: 20%	Increase 7 bpm (PND = 70%)	No weight: 104 (5.45) Weight: 111 (3.68)
Bobby	No effect (PND = 0%)	No weight: 34% Weight: 32%	No effect (PND = 10%)	No weight: 111 (8.83) Weight: 111 (7.86)
Connor	↓ 18% (PND = 60%)	No weight: 35% Weight: 17%	n/a	
Hailey	No effect (PND = 0%)	No weight: 11% Weight: 19%	No effect (PND = 20%)	No weight: 108 (11.10) Weight: 111 (16.37)
Ian	No effect (PND = 0%)	No weight: 26% Weight: 21%	No effect (PND = 10%)	No weight: 117 (7.98) Weight: 119 (10.04)
Jack	No effect (PND = 20%)	No weight: 43% Weight: 38%	n/a	

PND 90%+ = very effective; 79–90% = effective; 50–70% = questionable effect; <50% = ineffective (Scruggs and Mastropieri 1998)

SBIs reviewed by Case-Smith et al. (2014) included therapy ball chairs, weighted vests, brushing, joint compressions, and swinging. Studies using therapy ball chairs and weighted vests had mixed results but the use of other SBI techniques was generally not effective. Two studies investigated the effects of therapy balls, only one found positive effects (Schilling & Schwartz, 2004 as cited in Case-Smith et al. 2014). Of seven studies that examined the effects of weighted vests, only one demonstrated a positive effect (Fertel-Daly et al., 2001 as cited in Case-Smith et al., 2014). It is easy to see how these interventions, that are relatively cheap and simple to implement would be popular among educators and parents who are desperate for solutions to

behavioral challenges that individuals with ASD may present, however current research evidence is not supportive of the efficacy of these treatments. Studies reviewed had numerous limitations including that there was no follow-up data collected, participants were not randomized to treatment conditions, and sample sizes were generally very small.

**Feeding Interventions.** Sharp, Jacques, Morton, and Miles (2011) conducted a study of thirteen children with ASD, aged 2-7, who were admitted for an intensive day-treatment program for severe food selectivity. To illustrate how limited participants diets' were prior to treatment, a table from Sharp et al.'s study (2011, p. 39) is included below in Figure 6.

Figure 6.

**Table 1. Sample Characteristics**

Participant	Diagnosis	Age at admission	Gender	Admission weight for height percentile (z score) <sup>a</sup>	Foods consumed prior to treatment
1	autistic disorder	5 years	M	95th (+1.64)	white bread; dry cereal; crackers (Goldfish® only); potato chips; pudding
2	autistic disorder	3 years, 10 months	M	11th (-1.23)	crackers (Goldfish® & Ritz® only)
3	PDD-NOS	3 years, 6 months	M	26th (-0.64)	rice cereal; pasta noodles; mashed potatoes; pudding; pureed green beans; yogurt
4	Asperger syndrome	6 years, 11 months	M	8th (-1.4)	rice cereal; pudding
5	autistic disorder	4 years, 10 months	M	10th (-1.28)	chicken nuggets; French fries; pasta; cereal; banana; waffles
6	PDD-NOS	2 years, 11 months	M	< 3rd (-2.2)	potato chips; rice cereal; pureed fruit
7	autistic disorder	4 years, 1 month	M	76th (0.71)	French fries; potato chips
8	autistic disorder	7 years, 8 months	M	96th (1.75)	chicken nuggets; French fries; crackers (Goldfish® only)
9	autistic disorder	4 years, 5 months	F	65th (0.38)	yogurt
10	autistic disorder	3 years, 7 months	F	23rd (-0.72)	pureed porridge (rice, vegetables, chicken, yogurt); yogurt; pudding
11	autistic disorder	4 years, 1 month	M	76th (0.71)	dry cereal; waffles; chips; cookies; French fries
12	autistic disorder	3 years, 10 months	M	39th (-0.27)	pudding
13	PDD-NOS	6 years, 1 month	M	< 3rd (-2.54)	crackers (Goldfish® only); popcorn; dry cereal; cream of wheat; potato chips

Note: F = female; M = male; PDD-NOS = pervasive developmental disorder—not otherwise specified.

<sup>a</sup>Based on CDC Growth Charts, 2000.

As can be seen from the table, many of the foods consumed were starch and carbohydrate-based.

The focus of treatment was to increase the variety of foods consumed by the participants, when

children made variety goals, additional goals were made to increase the number of different textures and the volume of food a child would consume.

Treatment for Sharp et al.'s (2011) study was scheduled Monday through Friday for 8 weeks; on average, participants completed 39 days of treatment and each day of treatment included four therapeutic meals. A trained therapist (or the child's caregiver if they had completed the training sequence) implemented the therapeutic meals, with a second clinician recording mealtime performance in vivo in a room separated by a one-way mirror. The therapist presented the child with bites on a spoon. Behavioral elements of the intervention included escape extinction, noncontingent access, differential reinforcement, and stimulus fading. Individualized protocols were designed that used the least intrusive means to gradually shape appropriate mealtime behavior and decrease atypical feeding habits. To illustrate the treatment's procedure, the therapist would put a small bite of food on a spoon and hold the spoon up to the child's lips until the child accepted the food or engaged in refusal behaviors. If the child accepted the food they were praised highly. If the child refused the food they were ignored for the rest of the interval. Parents were trained in order to generalize improvements in feeding following the treatment program. Before treatment, participants swallowed on average only 7% of non-preferred food items presented. After treatment, participants accepted 90% of non-preferred food items and swallowed more than 80% of the time. The change in feeding behavior represented a large effect of treatment. Phone interviews with parents, conducted on average 17 months following treatment, indicated the effects of treatment were maintained.

Marshall, Ware, Ziviani, Hill, and Dodrill (2014) conducted a meta-analysis on feeding interventions for individuals with ASD. Twenty-three studies were included in the review and all studies included had participants that were under 6-years old. Additionally, all of the studies

incorporated behavioral components within the feeding intervention, such as chaining or shaping of behavior. Overall, there was a medium to large effect size across all studies ( $d= 0.69$ ) for increasing desirable behaviors, which was typically accepting bites of food. There was a negligible to small effect across all studies ( $d= 0.39$ ) for decreasing undesirable behaviors, like tantrumming, at mealtime. Due to the presence of behavioral components within feeding interventions, it is difficult to determine whether effects of these treatments are related to sensory aspects, behavioral components of treatment, or a combination of the two.

**Social Skills Interventions.** Difficulties in social communication and reciprocal conversation are hallmarks of ASD. As any intervention that occurs will have a social interaction component (between the client and the therapist), it is only natural that implementing interventions with individuals with ASD could have an impact on social interaction. Gutman, Raphael-Greenfield, and Rao (2012) conducted a study with seven students with ASD. Students received a movement-based intervention that was provided by graduate students in an OT program. The manualized treatment included healthy self-care habits, social skills at school, developing and maintaining friendships, social skills and family relationships, social skills and membership on a sports team, social skills in the community, and dating. Only areas considered relevant to each participant were addressed and some modules were addressed over multiple sessions. Participants were paired with a peer of similar age and social skill level, these pairings were fluid and changed as participants withdrew or changed in social skill functioning. Each session included warm up and role-play activities that used movement to express and interpret emotions and thoughts, such as gesturing and facial expressions. The intervention was provided over three phases that occurred in Fall, Spring, and Summer semesters, each phase included a two week baseline, seven weeks of intervention, and a one month follow up and were separated

by two months of no intervention. Participants improved in verbal and nonverbal behaviors, with the most improvement occurring during the first phase, although gains continued to be made through subsequent phases, results are illustrated in Figure 7 (Gutman et al., 2015, p. 534).

Figure 7.

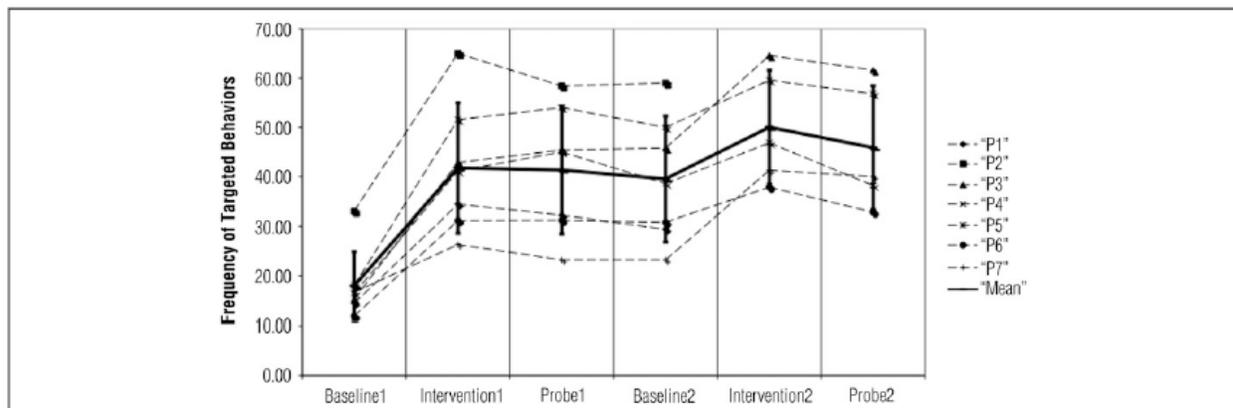


Figure 3. Individual participant data (dashed lines) and group mean (solid line) for the first two intervention phases.

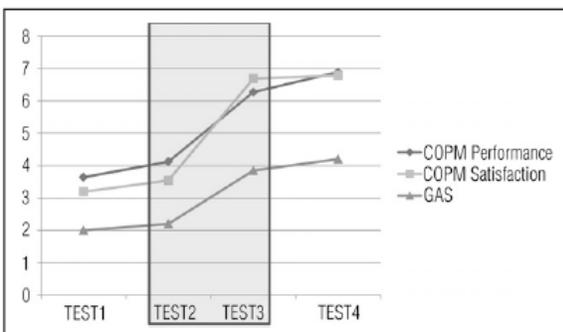
**Fine Motor Interventions.** Handwriting is a crucial skill for success in school and lifelong communication. Fuentes, Mostofsky, and Bastian (2009) studied handwriting samples from children with and without ASD and found that children with ASD had overall worse handwriting performance than both age and intelligence-matched peers. Participants with ASD were specifically worse with forming letters than peers but did not differ in sizing, alignment, or spacing of letters.

Jan Olsen, an OT, developed the Handwriting Without Tears curriculum using 30 years of research on handwriting (Handwriting Without Tears, 2015). This program uses a developmental approach and teaches letters by difficulty, rather than alphabetically (see Appendix F). The program focuses on teaching correct grip, posture, and paper positioning. Children who were taught using this curriculum showed progress in both skill and speed of handwriting over the course of the school year; however, research conducted with this program

has not used a comparison group so it is unclear whether this program is more effective than traditional methods used by classroom teachers.

**Interventions for Daily Living Activities.** Basic daily living activities include being able to move around in one's environment, bathing and grooming, dressing, and self-feeding. These activities are crucial to quality of life, safety, and independent living for an individual. If an individual is not able to care for themselves, they are a burden on their families and they are at greater risk of being placed in residential treatment, which is incredibly costly. Dunn, Cox, Foster, Mische-Lawson, and Tanquary (2012) developed a parent coaching intervention that was based on the child's sensory processing patterns and developed to improve quality of life. Parents identified goals and settings (home, school, in the grocery store, etc.) in which they needed support. The OT linked sensory processing patterns that might affect the child's participation in the activities identified and coached the parents through problem solving and developing solutions to improve daily living. Twenty families participated in the study and each received ten, one-hour long intervention sessions delivered by an OT. Results, as illustrated in Figure 8 (Dunn et al., 2012, p. 524), indicated that children improved in participation in everyday activities and parental competence increased following the intervention.

Figure 8.



**Figure 3. Mean scores for child outcomes across testing periods (n = 20 children, 44 goals).**

*Note.* COPM = Canadian Occupational Performance Measure; GAS = Goal Attainment Scaling.

Yonkman, Lawler, Talty, O'Neill, and Bull (2013) conducted a review of patient charts and found that 74% of children with ASD were escaping their child safety seats. They also found that 20% of parents reported that their child was aggressive or injured themselves during travel. The authors suggested that OTs could assist families in obtaining special car seats for children with ASD to reduce the chance of escape and aggression. One product, the Angel Guard (2014), is recommended by Autism Speaks and is a seat belt release cover that simply acts as a barrier that keeps a child from disengaging the seat belt buckle, it is available online and costs only \$20 for two devices (see Appendix G). Additionally they stated that OTs are in a position to provide information related to behavioral strategies (positive reinforcement, differential reinforcement, distraction techniques, social stories, etc.) and professional referrals for families who are having difficulty transporting their child (see Appendix H for an example of a car safety social story).

An American Occupational Therapy Association (2014) report on the current standing of research evidence for children with sensory processing and integration difficulties concluded that the only area that has sufficient research evidence is the consultative use of OT services. Areas that require more research according to the report included emotional regulation, communication and social skills, functional goals, motor and praxis goals, mental functions, sensory function, and pain. This report corroborates results of individual studies discussed previously, as results were often mixed, had limited effects, or study design was problematic.

### **Physical Therapy**

According to the Move Forward website (2015), physical therapists (PTs) work collaboratively with clients to expand, restore and maintain mobility. To become a PT, an individual needs a graduate degree and to pass a national licensure exam. PT services are effective and can be a more cost efficient alternative to surgery and pain medication for many

different conditions. Potential areas of PT intervention for ASD include improving participation in activities of daily living, acquiring new motor skills, developing better coordination, improving reciprocal play skills (like throwing and catching a ball), developing motor imitation skills, and increasing fitness and stamina.

**Exercise Interventions.** Exercise is an effective means to reduce many health risks and to improve quality of life, however it is often overlooked as a treatment. In addition to reducing health risks such as diabetes and heart disease, some types of exercise can provide peace of mind to parents. If a child is comfortable in water and knows how to swim, they are more likely to enjoy themselves on summer vacations and less likely to drown from a water-related accident.

Yilmaz, Yanardag, Birkan, and Bumin (2004) developed a case study that investigated the effects of a swimming training program on physical fitness for a nine-year-old child with ASD. Intervention followed the Halliwick Method, which includes four phases: adjustment to water, rotations, control of movement in water, and movement in water. Three one-hour-long sessions occurred weekly over the course of ten weeks. Improvements were seen for balance, speed, agility, hand grip, upper and lower extremity muscle strength, flexibility, and cardio endurance following ten weeks of swimming training. Additionally, stereotypical autistic movements decreased during the 45-minute period following treatment.

Ennis (2011) conducted a study on the effectiveness of aquatic physical therapy sessions with eleven children with ASD. Participants received ten weeks of intervention and parents were encouraged to participate when appropriate. Intervention components included various activities including swimming, blowing bubbles in the water, sequenced breathing, reciprocal activity with another child, floating, jumping and push-off activities, mat/balance activities, diving underwater, and free play. Support was provided based on child's needs. Following treatment,

improvements in social emotional, school and physical functioning were demonstrated for four of the six participants.

An intervention study by Hilton, Cumpata, Klohr, Gaetke, Artner, Johnson, and Dobbs (2014) examined the effectiveness of Makoto arena training (see Appendix I) on executive functioning and motor skills in six children with ASD. Makoto arena training is a form of exergaming, a combination of play and exercise. The goal of Makoto arena training is to strike lighted targets with a ball, the speed of movements of targets increases when participants reach 95% accuracy. Each participant received 30 sessions of treatment over the course of ten weeks with each session lasting two minutes. Significant improvements in working memory, motor strength, motor agility, and running speed occurred following the intervention, results can be seen in Figure 9 from Hilton et al. (2014, p. 63).

Figure 9.

**Table 1. Pre- and Postintervention Scores ( $N = 7$ )**

Test	Preintervention, $M$ ( $SD$ )	Postintervention, $M$ ( $SD$ )	$p$	$d$
Makoto Average Speed, 6th and 30th trial, s	1.40 (0.33)	1.10 (0.14)	.018*	1.18
BRIEF, $t$ score ( $M = 50$ , $SD = 10$ )				
Inhibit	62.00 (11.17)	63.86 (14.37)	<i>ns</i>	0.14
Shift	63.86 (10.22)	60.14 (10.27)	<i>ns</i>	-0.36
Emotional control	59.57 (7.91)	58.71 (10.92)	<i>ns</i>	-0.11
Behavioral regulation index	63.14 (7.99)	62.71 (11.40)	<i>ns</i>	-0.04
Working memory	64.57 (9.25)	55.14 (10.79)	.027*	-1.01
Plan-organize	56.43 (8.77)	53.43 (9.16)	<i>ns</i>	-0.33
Organization of materials	51.86 (12.86)	48.29 (13.76)	<i>ns</i>	0.28
Monitor	61.86 (7.82)	58.86 (12.97)	<i>ns</i>	-0.38
Metacognition index	60.43 (9.74)	54.86 (11.38)	.027*	-0.53
Global executive composite	61.43 (8.96)	58.29 (10.56)	<i>ns</i>	-0.32
BOT-2, standard scores ( $M = 50$ , $SD = 10$ )				
Fine manual control	47.71 (13.38)	46.14 (12.48)	<i>ns</i>	-0.12
Manual coordination	42.29 (10.08)	44.57 (4.65)	<i>ns</i>	0.31
Body coordination	49.00 (10.95)	48.29 (8.38)	<i>ns</i>	0.00
Strength and agility	42.71 (9.50)	46.71 (8.06)	.017*	0.46
Total motor composite	43.71 (13.25)	44.57 (8.68)	<i>ns</i>	0.08

*Note.* BOT-2 = Bruininks-Oseretsky Test of Motor Proficiency-Second Edition; BRIEF = Behavior Rating Inventory of Executive Function;  $M$  = mean; *ns* = nonsignificant;  $SD$  = standard deviation.

\* $p < .05$ .

Sowa and Meulenbroek (2012) conducted a meta-analysis on the effects of exercise for individuals with ASD. Exercise type varied by study and included swimming, jogging, walking, horseback riding, cycling, and weight training. Individuals who participated in physical exercise programs improved in both motor and social ability, with an average improvement of approximately 40% across both domains. Those who received intervention individually improved significantly more in both domains (motor and social) than those who received intervention in a group setting.

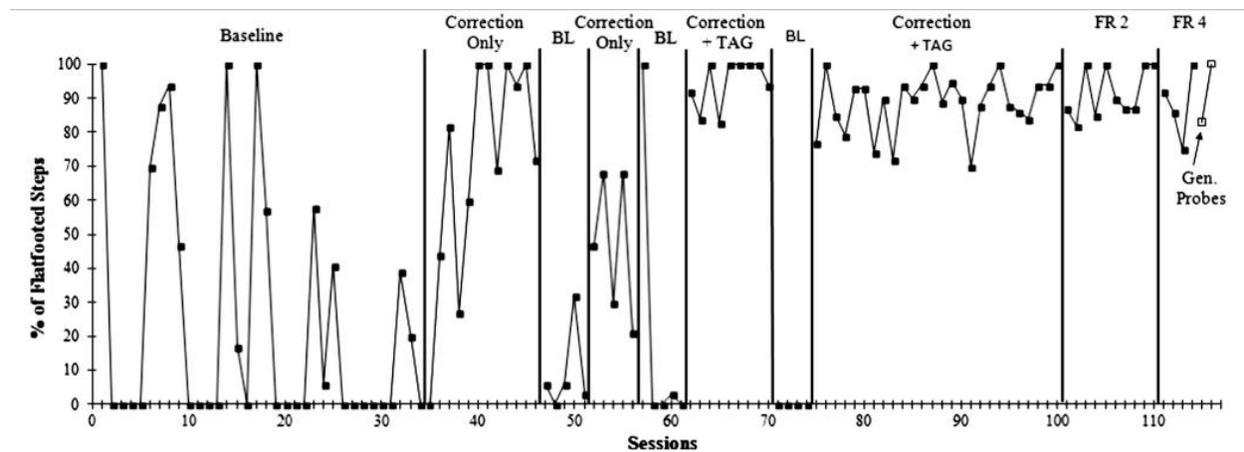
**Toe-Walking Interventions.** According to Yoell (2001), toe-walking can be caused by tightness in the Achilles and calf muscles, habit, liking how it feels, hypersensitive feet, not recognizing where the body is in relation to space (poor proprioception), or inappropriate foot positioning. The exact cause of toe-walking for individuals with ASD is unknown, but it happens in an estimated 20% of individuals with ASD. Toe-walking can lead to tightening of the heel cords and incorrect foot position if left untreated. Depending on severity of the toe-walking, treatments range from practicing stretching, Botox injections, temporary casting of the leg in the correct position, or surgery.

Persicke, Jackson, and Adams (2014) utilized Teaching with Acoustical Guidance (TAG), a method for teaching behaviors through positive reinforcement with a conditioned auditory stimulus (a “click” sound), to decrease toe-walking in a four-year-old with ASD. TAG pairs the auditory stimulus with an already established reinforcing item to condition the “click” sound. Pairing of the preferred item (potato chip) and auditory click had begun prior to the study during applied behavior analysis therapy sessions (unrelated to toe-walking behavior). Toe-walking intervention phases were conducted in a hallway that was 20 feet long during regularly scheduled programming hours. The child got a preferred item (potato chip) at the end of each

session to reinforce compliance. Approximately five sessions were conducted each day. The child's footsteps were recorded with a video camera and flat-footed steps were coded by observers.

During the correction only phase, the child walked with an assistant from one end of the hallway to the other (Persicke et al., 2014). If the child took two consecutive steps on his toes, the assistant would stop his forward movement and apply pressure on his shoulders until his heels were flat on the floor. Once his heels were on the floor, the assistant would release pressure and allow him to keep moving forward. The child didn't have any resistance to this procedure. During the correction + TAG phase, differential reinforcement of an incompatible response was added to the correction procedure. The "click" was presented on every flat-footed step. After the last correction + TAG phase, the "click" was faded to every two flat steps and finally every four flat steps. Combining TAG and correction was most effective at reducing toe-walking behavior for this participant, results are displayed in Figure 10 (Persicke et al., 2014, p. 968).

Figure 10.



**Fig. 1** Percentage of flat-footed steps during each session across baseline, correction only, correction + TAG, two fading sessions (FR-2 and FR-4), and two generalization settings

### **Conclusion**

With the high prevalence of ASD and the likelihood of OT and PT being used to serve these individuals, it is important to review the efficacy of these interventions with this population. Interventions reviewed in this paper included sensory integration treatments; sensory based interventions; feeding intervention; social skills interventions; activities for daily living; fine motor interventions; exercise interventions; and toe-walking interventions. Some of these interventions had positive results for participants, but many of the studies included had small sample sizes, did not conduct follow-up data, and did not include a control group. Additionally, many of the interventions incorporated behavioral components as a core feature of the intervention so it is unclear whether the intended component (for example swimming) or the behavioral component was responsible for positive effects demonstrated.

A review of sensory interventions (both SIT and SBI) conducted by Case-Smith et al. (2014) unveiled the methodological limitations of studies in this area and highlighted the discrepancy of results between studies. Both have the same goal, to improve the interpretation and use of sensory information, but use different means to accomplish this goal. SITs are typically conducted in a clinic-based setting and are implemented by an OT. Whereas SBIs occur as a part of the child's day, for example at home or in school, and are implemented by an adult or teacher under supervision of an OT. Overall, their review suggested that SIT has low-moderate effects of various behavioral outcomes measured, but that SBI had limited effectiveness with some studies showing low effects and others showing no effects of this type of treatment.

The American Occupational Therapy Association (2014) reiterated findings from Case-Smith et al. (2014), that there is limited evidence for the effectiveness of OT interventions for individuals with sensory processing difficulties. This is not to say that OT interventions are not

effective, just that further research needs to be conducted to understand the effectiveness of these interventions, especially with those individuals who have ASD. Many of the studies that did find positive effects for the interventions had behavioral components that may have been partially or entirely responsible for those outcome effects. However, this also provides indication that OTs are capable of effectively implementing behavioral components to interventions. Individuals with ASD are more likely to have difficulties with activities of daily living, including self-grooming and self-feeding, OTs are in an excellent position to assist individuals and families with the provision of effective services in these areas, as OTs are trained to assist individuals in any activity that occupies their time.

Much less research is available for the effectiveness of interventions implemented by PTs for individuals with an ASD. According to the American Physical Therapy Association (2015), PT is more effective and cost efficient than surgery and pain medication. Exercise has been shown, through numerous studies, to be an effective intervention for individuals with ASD. Another area of intervention where PTs can be instrumental is toe-walking, which occurs in approximately 20% of individuals with ASD. Once again, an effective treatment for toe-walking incorporated behavioral components. As individuals with an ASD are more likely to have motor impairment than neuro-typical peers, PTs are in an important position to provide effective services.

In summary, OT and PT are often used in the treatment of symptoms associated with ASD. These medical specialties have the potential to help increase independence and quality of life for individuals with ASD and their family members. To date, there have not been many well-designed intervention studies to establish the efficacy of these interventions with individuals who have an ASD. It is likely that these interventions would be effective with individuals who have

autism, but may need some modifications, such as imbedded behavioral components. Future studies of the effectiveness of PT and OT with individuals who have an ASD should utilize more stringent experimental methods.

## References

- American Academy of Pediatrics (2012). Sensory integration therapies for children with developmental and behavioral disorders. *Pediatrics, 129*, 1186-1189.
- American Occupational Therapy Association (2014). Research opportunities in the area of children and adolescents with challenges in sensory processing and sensory integration. *American Journal of Occupational Therapy, 68*, 242-244.
- American Occupational Therapy Association (2015). *Children and youth*. Retrieved from <http://www.aota.org/About-Occupational-Therapy/Patients-Clients/ChildrenAndYouth.aspx>
- Angel Guard (2014). *Angel Guard*. Retrieved from <http://angelguardbuynow.com>
- Move Forward (2015). *Physical therapist's guide to Autism Spectrum Disorder*. Retrieved from <http://www.moveforwardpt.com/SymptomsConditionsDetail.aspx?cid=a6482e75-65c6-4c1f-be36-5f4a847b2042#.VaMMwGANqgR>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Bagatell, N., Mirigliani, G., Patterson, C., Reyes, Y., & Test, L (2010). Effectiveness of therapy ball chairs on classroom participation in children with autism spectrum disorders. *American Journal of Occupational Therapy, 64*, 895-903.
- Baranek, G. T. (2002). Efficacy of sensory and motor interventions for children with autism. *Journal of Autism and Developmental Disorders, 32*, 397-422.
- Bhat, A. N., Landa, R. J., & Galloway, J. C. (2011). Current perspectives on motor functioning in infants, children, and adults with autism spectrum disorders. *Physical Therapy, 91*, 1116-1129.

- Case-Smith, J., Weaver, L. L., & Fristad, M. A. (2014). A systematic review of sensory processing interventions for children with autism spectrum disorders. *Autism*, 1-16.
- Centers for Disease Control and Prevention. Prevalence of Autism Spectrum Disorder among children aged 8 years- Autism and developmental disabilities monitoring network, 11 sites, United States, 2010. *MMWR 2014*; 63 (No. SS-2): 1-21.
- Children's Specialized Hospital (2009). *Wearing my safety belt*. Retrieved from <http://www.childrens-specialized.org/CSRedesign/media/Autism/MFWA-2014/Make-Friends-with-Autism---Social-Story-Wearing-Car-Safety-Belt.pdf>
- Devlin, S., Healy, O., Leader, G., & Hughes, B. M. (2011). Comparison of behavioral intervention and sensory-integration therapy in the treatment of challenging behavior. *Journal of Autism and Developmental Disorders*, 41, 1303-1320.
- Dunn, W., Cox, J., Foster, L., Mische-Lawson, L., & Tanquary, J. (2012). Impact of a contextual intervention on child participation and parent competence among children with autism spectrum disorders: A Pretest-posttest repeated-measures design. *American Journal of Occupational Therapy*, 66, 520-528.
- Ennis, E., (2011). The effects of a physical therapy-directed aquatic program with children with autism spectrum disorders. *Journal of Aquatic Physical Therapy*, 19, 4-10.
- Fournier, K. A., Hass, C. J., Naik, S. K., Lodha, N., & Cauraugh, J. H. (2010). Motor coordination in autism spectrum disorders: A synthesis and meta-analysis. *Journal of Autism and Developmental Disorders*, 40, 1227-1240.
- Fuentes, C. T., Mostofsky, S. H., & Bastian, A. J. (2009). Children with autism show specific handwriting impairments. *Neurology*, 73, 1532-1537.

- Fun and Function (2015). *Modern ball chair*. Retrieved from <https://funandfunction.com/modern-ball-chair-3219.html>
- Fun and Function (2015). *Sit-a-round cushion*. Retrieved from <https://funandfunction.com/sit-a-round-cushion.html>
- Fun and Function (2015). *Weighted vest*. Retrieved from <https://funandfunction.com/weighted-vest-pink-3656.html>
- Gutman, S. A., Raphael-Greenfield, E. I., & Rao, A. K. (2012). Effect of a motor-based role-play intervention on the social behaviors of adolescents with high-functioning autism: Multiple-baseline single-subject design. *American Journal of Occupational Therapy, 66*, 529-537.
- Handwriting Without Tears. (2013). *Letters and numbers for me*. Retrieved from <http://cdn.hwtears.com/downloads/ln.pdf>
- Handwriting Without Tears. (2015). *Research review*. Retrieved from <http://www.hwtears.com/files/HWT%20Research%20Review.pdf>
- Hilton, C. L., Cumpata, K., Klohr, C., Gaetke, S., Artner, A., Johnson, H., & Dobbs, S. (2014). Effects of exergaming on executive function and motor skills in children with autism spectrum disorder: A pilot study. *American Journal of Occupational Therapy, 68*, 57-65.
- Hodgetts, S., Magill-Evans, J., & Misiaszek, J. E. (2011). Weighted vests, stereotyped behaviors and arousal in children with autism. *Journal of Autism and Developmental Disabilities, 41*, 805-814.
- Marshall, J., Ware, R., Ziviani, J., Hill, R. J., & Dodrill, P. (2014). Efficacy of interventions to improve feeding difficulties in children with autism spectrum disorders: A systematic review and meta-analysis. *Child: Care, Health, and Development, 41*, 278-302.

- Matson, J. L., & Fodstad, J. C. (2009). The treatment of food selectivity and other feeding problems in children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 3*, 455-461.
- Motion Fitness (2010). *Makoto II exergame arena*. Retrieved from <http://www.motionfitness.com/Makoto2-p/makoto-ii.htm>
- OTPlan (2015). *How to obtain your occupational therapy degree*. Retrieved from <http://www.otplan.com/articles/how-to-obtain-your-occupational-therapy-degree.aspx>
- Persicke, A., Jackson, M., & Adams, A. (2014). Brief report: An evaluation of TAGteach components to decrease toe walking in a 4-year-old child with Autism. *Journal of Autism and Developmental Disorders, 44*, 965-968.
- Rolley, S. S., Mailloux, Z., Miller-Kuhaneck, H., & Glennon, T. (2007). Understanding Ayres Sensory Integration. *OT Practice, 12*, CE-1- CE-8.
- Schaaf, R. C., Benevides, T., Mailloux, Z., Faller, P., van Hooydonk, E., Freeman, R., Hunt, J., Leiby, B., Sendecki, J., & Kelly, D. (2014). An intervention for sensory difficulties in children with autism: A randomized trial. *Journal of Autism and Developmental Disorders, 44*, 1493-1506.
- Semansky, R. M., Xie, M., Lawer, L. J., & Mandell, D. S. (2013). How states use Medicaid to fund community-based services to children with autism spectrum disorders. *Psychiatric Services, 64*, 1051-1055.
- Sensory Integration Global Network (n.d.). *Pictures of sensory integration clinics*. Retrieved from <http://www.siglobalnetwork.org/#!si-clinics/c48t>
- Sharp, W. G., Jacques, D. L., Morton, J. F., & Miles, A. G. (2011). A retrospective chart review of dietary diversity and feeding behavior of children with autism spectrum disorder

- before and after admission to a day-treatment program. *Focus on Autism and Other Developmental Disabilities*, 26, 37-48.
- Smith-Myles, B., Cook, K. T., Miller, N., Rinner, L., & Robins, L. (2000). *Asperger Syndrome and sensory issues: Practical solutions for making sense of the world*. Shawnee Mission, KS: Autism Asperger Publishing Company.
- Sowa M., Meulenbroek R. (2012). Effects of physical exercise on autism spectrum disorders: a meta-analysis. *Research in Autism Spectrum Disorders*. 6, 46–57
- Umeda, C., & Deitz, J. (2011). Effects of therapy cushions on classroom behaviors of children with autism spectrum disorder. *American Journal of Occupational Therapy*, 65, 152-159.
- University of Utah Health Care (2015). *Pediatric occupational therapy*. Retrieved from <http://healthcare.utah.edu/life-skills-clinic/services/pediatric-occupational-therapy.php>
- U.S. Department of Education, National Center for Education Statistics. (2015). *Digest of Education Statistics, 2013* (NCES 2015-011).
- Yilmaz, I., Yanardag, M., Birkan, B., & Bumin, G. (2004). Effects of swimming training on physical fitness and water orientation in autism. *Pediatrics International*, 46, 624-626.
- Yoell, C. (2001). *Toe walking in children with autism*. Centre for Ability. Retrieved from <http://www.therapybc.ca/eLibrary/resources.php#EBPST>
- Yonkman, J., Lawler, B., Talty, J., O'Neill, J., & Bull, M. (2013). Brief Report- Safely transporting children with autism spectrum disorder: Evaluation and intervention. *American Journal of Occupational Therapy*, 67, 711-716.

**Appendix A: Areas of Sensory Intervention (Smith-Myles et al., 2000)**

**Visual**  
(sight)



**Olfactory**  
(smell)



**Gustatory**  
(taste)



**Vestibular**  
(balance)



**Auditory**  
(hearing)



**Tactile**  
(touch)



**Proprioception**  
(body awareness)



**Appendix B: Sensory Integration Clinic Room (Sensory Integration Global Network, n.d.)**



**Appendix C: Therapy Ball Chair (Fun and Function, *Modern ball chair*, 2015)**



**Appendix D: Therapy Cushion (Fun and Function, *Sit around cushion*, 2015)**



**Appendix E: Weighted Vests (Fun and Function, *Weighted vests*. 2015)**



**Appendix F: Sample Sheet (Handwriting Without Tears, 2013)**

Copy the words.

Words for Me

out

us

cut 

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Copy the sentence.

Sentence for Me

Gus got out.



Check cut

\_\_\_\_\_

Check Sentence

**Appendix G: Angel Guard (2014)**



Appendix H: Car Safety Social Story (Children's Specialized Hospital, 2009)

# Wearing My Safety Belt



**KOHL'S**  
Autism Awareness  
**Make Friends**  
with **Autism**



---

Sometimes I go for a ride in a car or van. There are different types, colors and sizes of cars and vans.

Riding in the car is fun.

There are many places we can go. Some trips may be short rides. Other places may take a while to get there.

I wear a seat belt every time I ride in the car. Seat belts keep me safe.



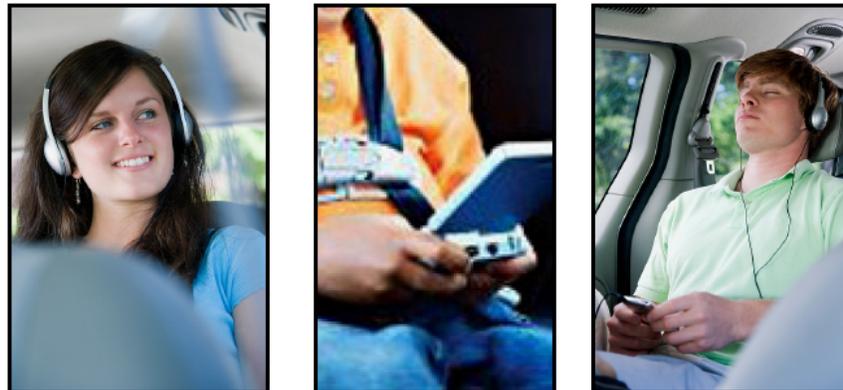
Different cars have different colors and types of seat belts.

The person I am riding with will know the correct way to put on my seat belt.

The seat belt might feel uncomfortable. Seat belts must be secure on my body to keep me safe.

If it is too tight, I tell a person in the car. He or she may be able to adjust it for me.

2



I can listen to music, sing, sleep, watch a DVD, or play a handheld game to keep me busy during the ride.

I can look out the window at the scenery.

When I talk, I should talk quietly so that I don't disturb the driver of the car.

3



---

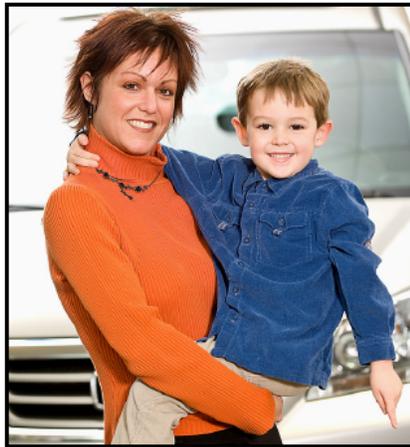
I do not take off my seat belt until the driver tells me it is safe to do so.  
I want to be safe in the car.

I should not play with my seat belt or anyone else's seat belt in the car.

When the car stops I keep my seat belt on. The driver will let me know  
when it is safe to remove my seat belt.

If I can't take it off myself, I ask for help.

4



---

I feel good about myself for keeping safe.

5

**Appendix I: Makoto Arena Training (Motion Fitness, 2010)**

