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

Elizabeth White

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

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Outline for Presentation

- Overview of Autism Spectrum Disorder
- Sensory & Motor Development
- Overview of Occupational Therapy (OT)
- Use of OT with Individuals on the Spectrum
- Overview of Physical Therapy (PT)
- Use of PT with Individuals on the Spectrum
- Proposed Future Directions for Research

Autism Spectrum Disorder

- Limited Social Interaction
- Delayed or Deficits in Language
- Behavioral Problems
- Sensory-Processing Difficulties- frequent focus of OT
- Proposed Motor Coordination Deficits- focus of OT/PT

Case-Smith, J. & Arbesman, M. (2008). Evidence-based review of interventions for autism used in or of relevance to occupational therapy. *The American Journal of Occupational Therapy, 62,* 416-429.

Sensory & Motor Development

- Empirical evidence suggests that sensory and motor difficulties are present for many children with ASD, especially during early development.
- However, empirical studies in this area are limited and primarily rely on parental report.
- Emerging evidence from retrospective video studies and clinical evaluations suggest differences in sensory & motor features for individuals with ASD and individuals with other developmental disabilities.
- These patterns may relate to core features of ASD, the development of other behaviors, and later prognosis for individuals with ASD.

Baranek, G. T. (2002). Efficacy of sensory and motor interventions for children with autism. *Journal of Autism and Developmental Disorders, 32,* 397-422.

Sensory Development

- Unusual sensory responses reported in 42-88% of older children with ASD
  - Hypo- & hyper-responses
  - Preoccupations with sensory features of objects
  - Perceptual distortion
  - Paradoxical responses to sensory stimuli

(Baranek, 2002)

Meta-Analysis of Motor Coordination

- Conducted a meta-analysis of motor coordination in ASD to provide evidence for motor deficits as a core feature.
- Inclusion criteria:
  - Quantitative evaluation of motor coordination, motor impairment, arm movement, gait, or postural stability.
  - Relevance to ASD and aforementioned areas of motor coordination.
  - Comparison to typically developing controls.
  - Necessary statistical information (means, standard deviations).
- 41 studies included in analysis

Fournier, Hass, Naik, Lodha, & Cauraugh (2010). Motor coordination in autism spectrum disorders: A synthesis and meta-analysis. *J Autism Dev Disord, 40*, 1227-1240.

Meta-Analysis Results

- Large standardized mean difference effect (1.20) between individuals with ASD and typically developing individuals.
- Indicates substantial motor coordination deficits and postural stability issues for individuals with ASD.
- Moderators:
  - Lower motor capabilities for individuals labeled with "autism", "ASD", and "Asperger's syndrome" compared to control group.
  - Large effect for both upper and lower extremities.
  - Large effect regardless of age of individuals.
- Provides evidence that motor deficits could be a potential core feature of ASD.
- Interventions in this area are needed.

(Fournier et al., 2010)

Motor Development

- Generally motor development is less affected than social or language skills for individuals with ASD. However, many still have atypical features:
  - Low muscle tone
  - Oral-motor problems
  - Repetitive motor movements
  - Dyspraxia
- Motor delays tend to become more pronounced with age.
- Motor skills provide means for learning other important skills.
  - Social Skills
  - Academics
- Motor planning deficits effect ability to mimic another's actions as well as to participate in goal-directed behavior.

(Baranek, 2002)

Funding of Community Based Services

- As many as 45% of children with ASD are insured through state Medicaid programs.
- The five most commonly reimbursed services for children with ASD through Medicaid are:
  - Individual therapy
  - Occupational and physical therapy
  - In-home supports
  - Speech therapy
  - Diagnostic assessment

Semansky, R. M., Xie, M., Lawer, L. J., & Mandell, D. S. (2013)

Occupational Therapy

- Healthcare specialty that helps individuals participate in activities across the lifespan.[1]
- Rather than "employment" occupational therapy focuses on everything that "occupies" a persons time. [2]
- Work, Play, Self-Care, School, other daily activities. [1,2]

- Areas of intervention:[2]
  - Fine Motor
  - Gross Motor
  - Visual Processing
  - Oral Motor/Oral Sensory
  - Sensory Processing
  - Social Interaction
  - Learning Challenges
  - Play Skills

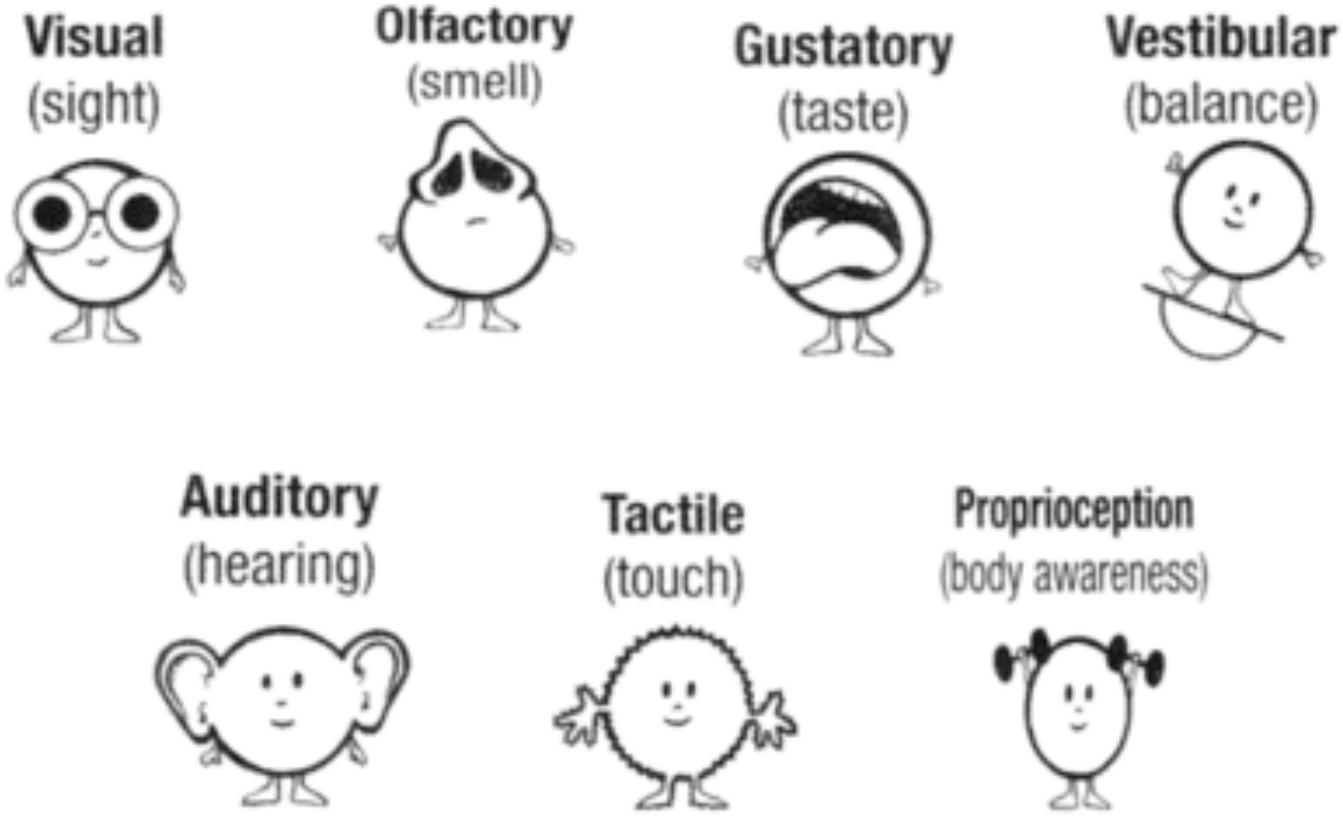
1. The American Occupational Therapy Association, Inc., 2015
2. University of Utah Health Care Life Skills Clinic, 2015

Sensory Integration (SI)

- Refers to the way the body handles and processes sensory inputs.
- Believed to develop over time. Deficits can occur.
- A well organized system integrates multiple sources of input (visual, auditory, proprioceptive, vestibular)
- Treatment depends on sensory profile
  - Sensory Seeking- Activities that provide sought after inputs
  - Sensory Avoidant- Identify & modify barriers to activities of daily life

American Academy of Pediatrics (2012)

Areas of Possible Sensory Intervention



Smith-Myles, B., Cook, K. T., Miller, N., Rinner, L., & Robins, L. (2000)

Sensory Processing Interventions

- Sensory integration therapy (SIT) is clinic-based, child-directed, and uses play activities to engage child participation and challenge sensory processing and motor planning skills.
- Sensory-based intervention (SBI) occurs within the child's daily routine (at home, in school, etc.), and is adult-directed to improve behaviors associated with sensory modulation disorders.
- Case-Smith, Weaver, & Fristad (2014) conducted a review of recent research on both SIT and SBI.

Ratings of Studies (Case-Smith et al., 2014)

- Studies included in review were assigned ratings based on study design following recommendations of Chambless & Hollon (1998) and Nathan & Gorman (2007)
  - Type 1 is the highest rating, it is allocated only to the most rigorous study designs.
    - Meets all criteria for randomized controlled trial (RCT): comparison group, blinded assessments, clear inclusion/exclusion criteria, standardized assessment, adequate sample size for statistical power, manualized, measure of fidelity, clearly described statistical methods, and follow-up measures.
  - Type 2 has at least one of the above RCT criteria missing.
  - Type 3 is methodologically limited, like a pilot study or open trial.
  - Type 4 is a review of published data (i.e. meta-analyses)
  - Type 5 is a review that without secondary data analysis
  - Type 6 is a case study, essay, or opinion paper.

Review of SIT (Case-Smith et al., 2014)

Study	Rating	Participants	Intervention(s)	Results/Interpretation
Pfeiffer et al. (2011)	Type 3	N=37, 6-12yo with ASD	**IV:** SI: 45 min. sessions, 3 times per week, for 6 weeks. Fine Motor: activities included drawing, crafts, etc. for fine motor improvement. **DV:** parent & teacher rating scales for adaptive behavior, social responsiveness	Low to moderate effects. Both groups improved, SI group improved more according to parent & teacher report. Limits: No follow up data.
Schaaf et al. (2012)	Type 6	N=1, 5 yo with ASD & ADHD	**IV**: Manualized SI/OT treatment 3 times a week for 10 weeks. **DV:** attainment of individualized goals.	Improvements in sensory motor performance and adaptive behaviors. Limits: No generalizability
Schaaf et al. (2013)	Type 3	N=32, 4-6yo with ASD	**IV:** Manualized SI/OT: treatment 3 times a week for 10 weeks. Usual Care: community-based OT services. **DV:** attainment of individualized goals.	Low to moderate effects for SI/OT group. Limits: Usual care group not described well. No follow up data.
Smith et al. (2005)	Type 3	N=7, 8-19yo with PDD	**IV:** SIT: 30 min. sessions, 5 sessions per week for 2 weeks. Control: activities related to educational program. **DV:** self-stimulatory & self-injurious behaviors	Low effects. Limits: Small sample size, no randomization.
Watling & Dietz (2007)	Type 3	N=4, 3-4 yo with ASD	**IV:** SIT: 40 min. sessions, 3 times a week. **DV:** observed engagement	No effects. Limits: Small sample size, short duration of phases (1 week ea.)

Review of SIT Cont. (Case-Smith et al., 2014)

- Several of the SIT studies from the previous table included random assignment of participants, but did not meet all criteria of a RCT.

- Generally, SIT interventions had low to moderate effects on scores from parent & teacher rating scales, attainment of individualized goals, and self-stimulatory & self-injurious behaviors across studies.

- Some limitations of these studies are that there was no collection of follow-up data and that sample sizes were generally small.

Manualized Sensory Integration Treatment

- 17 children with ASD were randomly assigned to the treatment condition and received 30 sessions of an OT intervention. 14 children were in the usual care control group, many of these children received speech and language therapy, behavioral interventions, and educational programming.
- The manualized OT intervention followed the principles of sensory integration outlined by the founder of SI, Ayres in the 1970s.
  - Assessment data collected by the OT was used to form hypotheses about the sensory motor factors impacting the child's behavior.
  - Individual sensory motor activities were developed that addressed these factors.
  - Treatment fidelity was checked and strong inter rater reliability (.99) and fidelity (mean= 90.1/100) were reported.
- The treatment group (M=56.53, SD=12.38) achieved significantly higher scores on Goal Attainment Scaling (a standardized way to capture diverse, meaningful, and functional outcomes) than the usual care control group (M=42.71, SD=11.21), ES=1.2.

Schaaf, R. C., Benevides, T., Mailloux, Z., Faller, P., van Hooydonk, E., Freeman, R., Hunt, J., Leiby, B., Sendecki, J., & Kelly, D. (2014)

Comparison of Behavioral Interventions and Sensory Integration Therapy

- 4 children with ASD received a randomized sequence of behavioral and sensory integration interventions over a period of 10 days, 1 session per day of either behavioral intervention or sensory integration therapy.
- Behavioral interventions were designed based on the results of a functional assessment conducted during phase 1 of the study.
  - A session was defined as a school day, lasting 6 hours in length. The behavioral intervention was implemented across the entire session.
- SIT interventions were designed by an OT, trained in SIT, who was familiar with the participants and had observed them over a 1-month period.
  - A session was defined as a school day, lasting 6 hours in length. Each participant had access to sensory-integration activities tailored for their needs, for 15 minutes approximately 6 times/day.
- SIT and behavioral interventions were designed independently of one another.
- The behavioral intervention was more effective at reducing the rate of challenging behaviors than the SIT intervention for all 4 participants.

Devlin, S., Healy, O., Leader, G., & Hughes, B. M. (2011)

Use of Therapy Balls (Case-Smith et al., 2014)

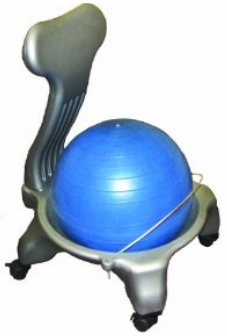
Study	Rating	Participants	Intervention(s)	Results/Interpretation
Bagatell et al. (2010)	Type 3	N=6, K-1st graders with ASD	**IV**: therapy balls during circle time, used sporadically for 4 weeks. **DV:** out of seat, nonattending	No positive effect. Limits: small sample, lack of consistent use of balls, short duration of study.
Schilling & Schwartz (2004)	Type 3	N=4, 3-4yo with ASD	**IV:** therapy balls **DV:** observed behaviors (sitting & engagement)	High effects. Limits: small sample size, lack of fidelity & follow up.
Van Rie & Heflin (2009)	Type 3	N=4, 6-7yo with ASD	**IV:** swinging or bouncing on exercise ball for 5 minutes before target activity. **DV:** correct responding for academics.	Mixed effects. 1 benefited from bouncing, 2 from swinging, 1 had no effects of either. Limits: small sample, short time frame.

Use of Therapy Balls Cont. (Case-Smith et al., 2014)

- Studies using therapy balls have shown mixed effects, ranging from no effects to high effects, on academic behaviors.
- All of the studies included in this review had very small sample sizes, did not include a control group, did not include random assignment, did not collect follow up data and had poor or no fidelity checks.

Therapy Ball Chairs

- Bagatell, Mirigliani, Patterson, Reyes, & Test (2010)
  - Therapy ball chairs or an exercise ball that is stabilized in a ring or with "feet" are low-cost alternatives to chairs that provide children with an opportunity to actively move and maintain an optimal arousal level.
  - 6 children with ASD sat on a therapy ball during "circle time". Children were allowed to bounce or move on the balls, as long as it was deemed safe by the classroom staff.
  - Results were mixed. Improvements on in-seat behavior was observed for the child who had the most balance (vestibular) and body positioning (proprioceptive) seeking behaviors. Children who had poor posture were less engaged when using the therapy ball.



- A similar study utilized inflated cushions that were secured to the regular classroom seats. This study did not find any effects of the therapy cushions on in-seat behavior for two kindergarten students (Umeda, C., & Deitz, J, 2011)

Use of Weighted Vests (Case-Smith et al., 2014)

Study	Rating	Participants	Intervention(s)	Results/Interpretation
Cox et al. (2009)	Type 3	N=3, 5-9yo with ASD	**IV:** Vests unweighted vest and weighted vest conditions **DV**: in-seat	No effects. Limits: small sample size, evaluation not blinded, no intervention manual.
Fertel-Daly et al (2001)	Type 3	N=5, 2-3yo	**IV:** Weighted vest **DV:** observed on-task, distractions, self-stimulatory behaviors.	Moderate effects. Limits: sample size, vest only worn in one setting.
Hodgetts et al. (2011)	Type 3	N=6, 4-10yo with ASD	**IV:** Unweighted vs weighted vests **DV:** observed stereotypy & heart rate.	No effects. Limits: small sample size.
Hodgetts et al. (2010)	Type 3	N=10, 3-10yo with ASD	**IV**: Unweighted vs weighted vests **DV:** observed off-task & time in seat.	Low effects. Limits: small sample size, only select behaviors investigated, homogenous sample.
Kane et al. (2004)	Type 3	N=4, 8-11yo with ASD	**IV**: Unweighted vs weighted vests **DV**: observed stereotypy & attention	No effects Limits: short intervention timeline (3 sessions), small sample.
Leew et al. (2010)	Type 3	N=4, 2yo with ASD	**IV:** weighted vest vs no vest **DV:** observed joint attention	No effects. Limits: small sample size, vests may no provide enough deep pressure
Reinchow et al. (2010)	Type 3	N=2, 5yo with ASD	**IV:** weighted vest, unweighted vest, no vest. **DV**: observed behaviors (engagement, stereotypy, problem behavior)	Mixed effects for 1 child, no effects for other. Limits: small sample size, lack of variance in behavior.

Use of Weighted Vests Cont. (Case-Smith et al., 2014)

- Mixed effects have been demonstrated for the use of weighted vests with children who have ASD.
- Many studies found no effects of this treatment, while a few have shown low to moderate effects.
- All of these studies were limited in that they had small sample sizes (N's ranging from 2-10) and did not include randomization of treatment conditions or a control group.

Weighted Vests

- Weighted vests are believed to provide deep pressure to the body, providing sensory input to the individual that they can respond to the environment rather than attend to obtaining sensory input by other means. The effects of weighted vests are believed to be immediate.
- 6 children with ASD who exhibited stereotypical behaviors that interfered with learning were assigned to wear a vest weighing either 5% or 10% of their body weight during a fine motor task.
- No differences in stereotypical behavior or heart rate were observed for the weighted vest condition compared to the control condition (or the unweighted vest condition).

Hodgetts, S., Magill-Evans, J., & Misiaszek, J. E. (2011)

Use of other SBI Techniques
(Case-Smith et al., 2014)

Study	Rating	Participants	Intervention(s)	Results/Interpretation
Davis et al. (2010)	Type 3	N=1, 4yo with ASD	**IV:** Brushing, 5 weeks of intervention, 6 month followup **DV:** observed stereotypy	No effects. Limits: ABA design.
Devlin et al. (2009)	Type 3	N=1, 10yo with ASD	**IV:** SBI, swinging, deep pressures with beanbags, rocking, jumping, crawling, chew tube, brushing & joint compression Behavioral intervention**:** functional analysis, requests, and reinforcement. **DV:** observed self-injurious behaviors	Behavioral intervention had greater effects than SBI. Limits: short-term (16 days)
Devlin et al. (2011)	Type 3	N=4, 6-11yo with ASD	**IV:** Same as Devlin et al. (2009) **DV:** observed challenging behavior, cortisol stress levels	Behavioral intervention more effective for reducing challenging behavior. Limits: short period of intervention (10 days), small sample.
Fazioglu & Baran (2008)	Type 3	N=30, 7-11yo with ASD	**IV:** The Sensory Diet, scheduled brushing & joint compression with individualized sensory activities. Combined with behavioral strategies (prompting, reinforcement, extinction). **DV:** sensory processing problems measured by checklist	Strong effects. Limits: limited description of intervention, lack of fidelity measures, no follow up.

Use of other SBI Techniques Cont.
(Case-Smith et al., 2014)

- The use of other SBI techniques has shown very limited effectiveness.
- These techniques include brushing, joint compressions (providing deep pressure), and swinging.
- Studies included within the Case-Smith et al. review that compared effects between these other SBI techniques and behavioral interventions, found that behavioral interventions have proven to be more effective.
- One study that included brushing and joint compressions in combination with behavioral strategies had very strong effects, however it is unclear as to what led to these effects.
- Similar to the other studies in this review, included studies were limited by no follow up, lack of fidelity measures, and small sample sizes.

Food Selectivity

- Cermak, S. A., Curin, C., & Bandini, L. G. (2010) conducted a review of 25 years of research on food selectivity in individuals with ASD.
  - Across various studies included in the review, findings suggested that as many as 83% of parents of children with ASD reported their child had a restricted repertoire of foods they would consume (Whiteley et al, 2000).
  - Overall, their review suggested that sensory sensitivity is a possible mechanism for the prevalence of food selectivity associated with ASD.
- In a review of interventions for feeding problems in children with ASD, Matson, J. L., & Fodstad, J. C. (2009), concluded that not much research has been done in this area, despite its prevalence among this population.
  - Their review found that applied behavior analysis was the treatment model most used for feeding problems in children with ASD.
  - They suggested that screening for feeding problems in children with ASD should occur more frequently and that existing screening measures, such as the Screening Tool of Feeding Problems (STEP) could easily be adapted for this population.

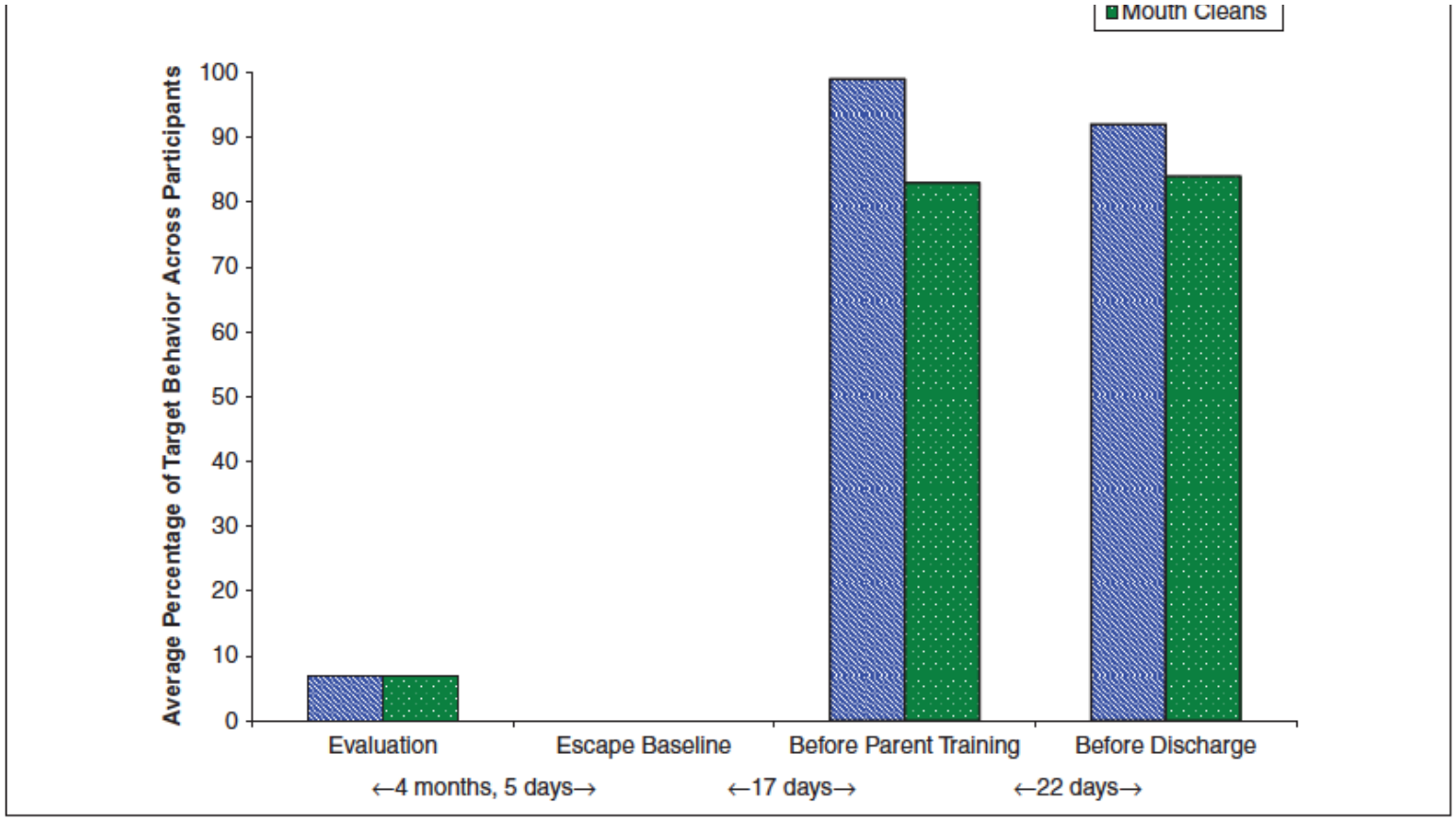
Meta Analysis of Feeding Interventions

- Marshall, J., Ware, R., Ziviani, J., Hill, R. J., & Dodrill, P. (2014) conducted a meta-analysis on feeding interventions.
- Participants in each of the 23 studies included in the review were children with ASD less than 6 years old who had feeding difficulties.
- Each of the studies that met the eligibility criteria included behavioral components like chaining and shaping.
- There was a medium-large effect size across all studies of .69 for increasing desirable behaviors (accepting bites of food).
- There was a negligible-small effect size across all studies of .39 for decreasing undesirable behaviors (tantrumming at meal time).

Day Treatment Program for Feeding

- 13 children with ASD (aged 2-7) were admitted to an intensive day-treatment program for severe food selectivity.
- Treatment was scheduled for 8 weeks (Monday-Friday), participants completed an average of 39 days. Each day included 4 therapeutic meals, lasting 30-45 minutes in length.
- During the therapeutic meals, a trained therapist, or the child's caregiver (if they had completed the training sequence) conducted the session in a room with a one-way mirror. A second clinician recorded mealtime performance during the session.
- Bites were presented with a spoon. All the children began without self-feeding, but more than half achieved this before discharge.
- Treatment involved individualized protocols and were designed to use the least intrusive means available while gradually shaping appropriate mealtime behaviors and decreasing atypical feeding habits.
- Caregivers were trained to help generalize improvements in feeding behavior after treatment ended.
- Sharp, W. G., Jacques, D. L., Morton, J. F., & Miles, A. G. (2011)

Results of Day Treatment Feeding Intervention (Sharp et al., 2011)



Results of Day Treatment Feeding Intervention Cont. (Sharp et al., 2011)

- Prior to treatment, participants only accepted and swallowed 7% of non-preferred food items presented.
- Following treatment, participants were accepting 90% of non-preferred food items and swallowing more than 80% of the time. This change in behavior represented a large effect.
- Phone interviews following treatment (average amount of time since treatment ended was 17 months) with parents indicated that effects of treatment were maintained, with some children continuing to make gains in the number of foods they would eat.

Social Skills

- 7 students (ages 15-21) identified as having high functioning autism (HFA) received a 3-phase movement based intervention program provided by graduate students in an OT program.
- The intervention program manual included the following topics: healthy self-care habits, social skills at school, developing & 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 to be relevant to each participant was addressed and modules could be addressed over multiple sessions.
- Participants were paired with a peer of similar age and social skill level, pairings changed over time due to participant withdrawal and changes in social skill functioning.
- Each session involved both warm up and role play activities. During warm up activities, participants practiced using movement to express and interpret emotions and thoughts (gesturing and facial expressions).
- Phases included a 2-week baseline, 7 weeks of intervention, and a 1 month follow up and were completed during Fall, Spring, and Summer semesters. Phases were separated by 2 months of no intervention.
- Results indicated that participants improved in verbal and nonverbal behaviors, the most improvement occurred during the first phase of the intervention, gains continued to be made through phases 2 and 3.
- Gutman, S. A., Raphael-Greenfield, E. I., & Rao, A. K. (2012)

Activities of Daily Living

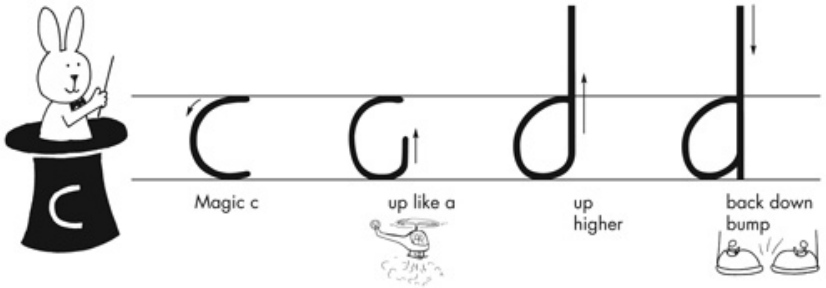
- Dunn, W., Cox, J., Foster, L., Mische-Lawson- L., & Tanquary, J. (2012) developed a parent coaching intervention based on the child's sensory processing patterns.
  - 20 families received 10 1-hour long intervention sessions with an OT.
    - Parents identified goals and settings in which support was needed (at home, at school, in the grocery store, etc.).
    - OTs linked sensory processing patterns that might affect child's participation and coached parents through problem solving and developing solutions to improve daily living.
  - Children improved in participation in everyday activities and parental competence increased following the intervention.

Activities of Daily Living Cont.

- Yonkman, J., Lawler, B., Talty, J., O'Neill, J., & Bull, M., (2013) did a review of patient charts and found that 74% of children with ASD were escaping their child safety seats. Additionally, 20% of parents reported that their child was aggressive or injured themselves during travel.
  - The authors suggest that OTs are in a position to assist families in obtaining special car seats for their children to reduce the chance of escape and aggression.
  - Additionally OTs can provide information related to behavioral strategies, such as positive reinforcement, differential reinforcement, distraction techniques, social stories, and obtaining referrals to other professionals as needed.

Handwriting

- The Handwriting Without Tears curriculum was developed by Jan Olsen, an OT, using 30 years of research on handwriting.
  - The program uses a developmental approach, teaching letters by difficulty, rather than alphabetically.
  - Correct grip, posture, and paper positioning are taught.
  - Children who were taught using this curriculum showed progress in both skill and speed of handwriting across the school year.
  - Handwriting Without Tears Video
  - Handwriting Without Tears Research Review



Current State & Future Directions for OT and ASD

- The American Occupational Therapy Association (2014) conducted a report on the current standing of research evidence of children with sensory processing and integration difficulties.
- The only area the report indicated as having sufficient research evidence was the consultative use of OT services.
- Areas requiring more research included: emotional regulation, communication and social skills, functional goals, motor and praxis goals, mental functions, sensory function and pain.

Physical Therapy

- Physical therapists work collaboratively with clients to expand, restore, and maintain mobility.
- Effective and more cost efficient alternative to surgery and pain medication for many conditions.
- Areas of intervention for ASD
  - Improve participation in activities of daily living.
  - Acquire new motor skills
  - Develop better coordination
  - Improve reciprocal play skills (throw & catch a ball)
  - Develop motor imitation skills
  - Increase fitness & stamina
- American Physical Therapy Association, 2015

Exercise

- Sowa & Meulenbroek (2012) conducted a meta-analysis on the effects of exercise for individuals with ASD.
  - Types of exercise included in studies were swimming, jogging, walking, horseback riding, cycling, and weight training.
- Individuals who participated in physical exercise programs improved in both motor and social ability.
- Those who received individual intervention improved significantly more than those in the group interventions in both domains (motor & social).

Table 3
Improvement rates (%) as a function of Type of Intervention and ASD problem area.

	Motor skills	Social skills	Other	Average
Individual	48.35	71.43	12.26	48.57
Group	35.98	26.37	24.74	31.54
Average	40.38	39.51	21.62	

Note: Scores reflect average improvement and do not necessarily add up to 100%.

Exergaming

- Exergames combine play and exercise.
- Exercise has been shown to support improvements in executive functioning (EF) in children.
- Hilton, C. L., Cumpata, K., Klohr, C., Gaetke, S., Artner, A., Johnson, H., & Dobbs, S. (2014) examined the effectiveness of Makoto arena training (motor response speed game) on EF and motor skills in 6 children (aged 6-13) with ASD.
  - Intervention involved 2 minute sessions, 3 times a week, totaling 30 sessions.
  - Goal of game is to strike lighted targets with a ball, speed of movement of targets increases when participants reach 95% accuracy.
  - Example of Makoto Arena training in practice
- Significant improvements in working memory, motor strength, motor agility, and running speed occurred following the intervention.

Swimming

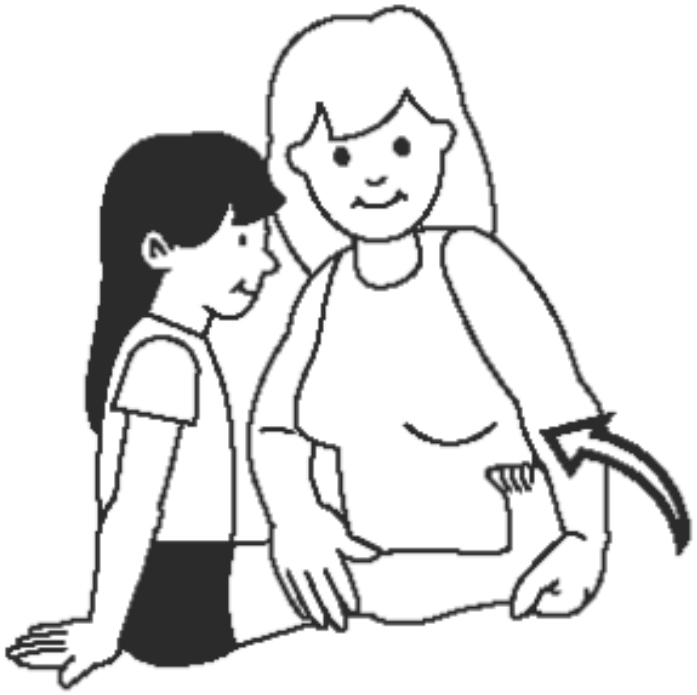
- Yilmaz, I., Yanardag, M., Birkan, B., & Bumin, G. (2004).
  - A case study investigated the effects of a swimming training program on physical fitness in a 9 year old child with ASD.
  - Physical fitness, including balance, speed, and agility increased. Additionally hand grip, upper and lower extremity muscle strength, flexibility, and cardio endurance improved following 10 weeks of swimming training.
  - The amount of stereotypical autistic movements decreased following treatment.
- Ennis, E., (2011).
  - 11 children with ASD received 10 weeks of aquatic physical therapy sessions. Parents were encouraged to participate.
  - Improvements were demonstrated in social, emotional, school, and physical functioning.

Toe Walking

- Toe walking can be caused by tightness in the Achilles and calf muscle, habit, merely liking how it feels, hypersensitive feet, poor proprioception (not recognizing where body is in relation to space), or inappropriate foot position.
- The exact cause of toe walking for individuals with ASD is unknown, although 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 it goes untreated.
- Yoell, C. (2001)

Toe Walking Cont. (Yoell, 2001)

- Treatment includes practicing stretching and for more severe cases (where there is significant heel tightening), Botox injections, temporary casting of the leg, and surgery.



Current State and Future Directions for PT and ASD

- Bhat, Landa, & Galloway (2011) reiterated that there is a greater likelihood of motor impairment for individuals with ASD.
- 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 have been cited in this presentation that show benefits of exercise for children with ASD and the benefits a PT can provide to a child who exhibits toe walking.
- They suggest that motor learning principles could be applied to interventions for individuals with ASD and motor impairment with some modifications, such as hand over hand if a child isn't able to replicate modeled movements.
- More PT interventions need to be studied with this particular population in order to identify what may work best for individuals with ASD or how interventions may need to be adjusted in order to be effective.

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.

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. & Arbesman, M. (2008). Evidence-based review of interventions for autism used in or of relevance to occupational therapy. *The American Journal of Occupational Therapy, 62,* 416-429.

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.

Cermak, S. A., Curtin, C., & Bandini, L. G. (2010). Food selectivity and sensory sensitivity in children with autism spectrum disorders. *Journal of the American Dietetic Association, 110*, 238-246.

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 disoders: 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.

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.

References Cont.

Handwriting Without Tears, (2015). *Why it works.* Retrieved from http://www.hwtears.com/hwt/why-it-works

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. R*esearch in Autism Spectrum Disorders, 3*, 455-461.

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. J*ournal 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.

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.

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.