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# Using Sensation in Pediatric Occupational Therapy

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Using Sensation in Pediatric Occupational Therapy

May 2017

This evidence project, submitted by

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has been approved and accepted  
in partial fulfillment of the requirements for the degree of  
Master of Science in Occupational Therapy from the University of Puget Sound.

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Key words: Ayres Sensory Integration<sup>®</sup>, Sensory Based Interventions, Pediatrics

### Abstract

Molly McBroom, OTR/L, of Mary Bridge Children's Therapy Unit (CTU) requested University of Puget Sound occupational therapy (OT) graduate students research the following question: "What is the effectiveness of using sensory based intervention (SBI) or Ayres' sensory integration® (ASI) and neurodevelopmental treatment (NDT) approach with children with sensory processing disorder (SPD), autism spectrum disorder (ASD), and/or attention-deficit/hyperactivity disorder (ADHD) on behavior?" A systematic review of the literature resulted in eight out of 12 studies reporting positive findings. Four of the studies examined ASI and four examined SBI. The other four studies showed inconclusive or negative results. Overall, no clear conclusions could be drawn about the effectiveness of either ASI or SBI. Student researchers recommend assessing a client's sensory functions to individualize interventions to the client's specific sensory processing needs.

Upon completion of the research, a knowledge translation process was implemented. This included development of a booklet called *Using SENSATION in Pediatric OT*, an educational resource for parents of children with sensory processing needs. Based on feedback from pilot testing with parents, the booklet was found to be beneficial in providing a comprehensive outline of sensory processing dysfunction and the two interventions used to address related concerns in children. We recommend that Mary Bridge Children's OT practitioners place the booklet in their outpatient rehabilitation clinics' lobbies for parents and caretakers who are new to sensory processing dysfunctions.

### **Executive Summary**

In September 2016, our research team met with a collaborating community clinician to define the clinical question, and discuss clinical setting information. The clinician expressed interest in research on sensory and neurodevelopment treatment (NDT) intervention approaches for early intervention age children (i.e., birth to three years old) with sensory processing disorder (SPD) and effects of these treatments on their behavior. After searching databases for peer-reviewed literature, only a couple of articles meeting the two criteria (e.g., early intervention age children and sensory approaches) were found. No articles were found examining use of NDT with children with SPD. As a result, we expanded our search to include all children from birth to eighteen and ASI interventions. Additionally, we further modified our research question, separating interventions into two categories: ASI and SBI. We divided our critically appraised topic (CAT) table and our summaries based upon which approach was utilized. Initially, we included studies completed in the school setting, but then excluded these articles to maintain relevance to our clinician's setting. Furthermore, we added inclusion criteria to specify three diagnoses: SPD, ASD, and ADHD. We also excluded case studies. After revision of our inclusion and exclusion criteria, our CAT table was drastically changed, leaving the CAT table with half of its original articles, and including a few new articles.

Our findings were limited by the lack of evidence currently addressing our clinical question. The limited findings for ASI did indicate the intervention has benefits, especially when individualized to the child. These findings should be taken with caution as the studies had small sample sizes, contributing to their low generalizability. The diversity of interventions and outcome measures used in the SBI articles made it difficult to discern patterns in the results. The majority of SBI studies did show benefits, but a lack of repetition with studies made it difficult to form conclusions.

A recommendation for consumers, practitioners and researchers would be to keep up-to-date on sensory processing-related evidence-based practice. This would allow consumers to better understand the reasoning behind their child's sensory processing treatment in order to more effectively advocate for their treatment. By being knowledgeable about current research, clinicians could ensure their practice is evidence-based, and their treatments are individualized. The greatest implications for researchers would be conducting more rigorous research with uniform protocols and larger sample sizes.

For our involvement plan, our collaborating clinician and team agreed to create a booklet about sensory processing dysfunction to be shared with parents of clients seeking care at Mary Bridge Children's outpatient clinics. The booklet's objective was to educate parents about sensory processing dysfunction, its manifestations in different environments, and evidence-based intervention, which might be used by their occupational therapist. To ensure our booklet was comprehensive, we created a survey with both qualitative and quantitative questions to be distributed to a convenience sample of parents whose children with sensory processing dysfunction received OT services at University of Puget Sound's OT onsite clinic. Based on parents' feedback, the booklet was clear and easy to understand, but was not as beneficial to parents who already had knowledge about sensory processing dysfunction.

**CRITICALLY APPRAISED TOPIC (CAT) PAPER****Focused Question:**

What is the effectiveness of using sensory based intervention (SBI) or Ayres' sensory integration® (ASI) approach and neurodevelopmental treatment (NDT) approach with children with sensory processing disorder (SPD), autism spectrum disorder (ASD), and/or attention-deficit/hyperactivity disorder (ADHD) on behavior?

**Collaborating Occupational Therapy Practitioner:**

Molly McBroom, OTR/L

**Prepared By:**

Sydney Anderson, Kaitlin Gaspich, Emiline Gonzalez, Cate Terhune

**Chair:**

Renee Watling, PhD, OTR/L, FAOTA

**Course Mentor:**

Renee Watling, PhD, OTR/L, FAOTA

**Date Review Completed:**

1/30/17

**Clinical Scenario:**

The OTRs at CTU, an outpatient, multidisciplinary clinic serving children of all ages and diagnoses, use skilled observation, SBI, ASI, and NDT to treat their clients with SPD. However, currently they are lacking evidence to support the use of these approaches. Therefore, our clinician would like us to research the effectiveness of these approaches with the above mentioned population so that their practice will be more evidence-based.

**Review Process****Procedures for the selection and appraisal of articles****Inclusion Criteria:**

- Peer-reviewed articles published after 1999
- Sensory-based interventions
- Ayres' sensory integration® interventions
- Neurodevelopmental treatment interventions
- Children with SPD and/or ASD and/or ADHD
- Ages: birth – 18

Exclusion Criteria:

- Articles were excluded if they were published before 2000.
- Books
- Not published in English
- Studies conducted in schools/academic environments
- Studies with  $n < 2$
- Studies using hippotherapy as an intervention
- Systematic reviews

*Search Strategy*

Categories	Key Search Terms
Patient/Client Population	children with sensory processing disorder, sensory deficits, sensory integration disorder, sensory integration dysfunction, sensory modulation disorder, sensory discrimination disorder, sensory-based motor disorder, sensory processing dysfunction, impaired or poor sensory processing
Intervention (Assessment)	sensory based interventions, Sensory-based therapies, sensory interventions for children, Ayres’ sensory integration interventions, OT-sensory integration interventions, sensory diet, sound therapy, weighted vests, dynamic seating, tactile input, vestibular input, neuro-developmental treatment, patient handling, sound-based interventions, auditory interventions, Bobath
Comparison	N/A
Outcomes	behavior, conduct, demeanor, manner, aggression, disruption, social, social participation, emotional

Databases and Sites Searched
<i>PubMed</i>
<i>CINAHL</i>
<i>ERIC</i>
<i>PsycInfo</i>
<i>OTSeeker</i>
<i>Primo</i>
<i>Cochrane Library</i>
<i>American Journal of Occupational Therapy</i>

***Quality Control/Review Process:***

During the initial article review process we attempted to find articles with participants diagnosed with SPD and NDT as the treatment but had to eliminate this part of the inclusion criteria as we found no articles meeting these specifications. As few articles were found, we broadened our search criteria to include individuals with sensory deficits, specifically ADHD and ASD. We also expanded our study to any article that discussed SBI as an intervention. We created an ASI checklist to verify studies' interventions met checklist criteria for ASI so that we could appropriately identify studies examining ASI.

After refining our inclusion criteria, we searched through a vast body of literature. 7,571 articles were found during our search. Of these articles, 7,559 were rejected for not meeting inclusion criteria. 8 articles were reviewed and excluded because they did not have an intervention and 14 articles were excluded because they were duplicates. All 5 systematic reviews and meta-analyses critiqued were excluded because at least 1 of the articles was already used in the CAT table. These review articles were excluded as the research team wanted to draw their own conclusions from the individual articles. The review articles were hand-searched for articles meeting the inclusion criteria and 6 were found. Reference and citation tracking were utilized to find articles that had not turned up in the initial searches, resulting in 1 additional article being found.

**Results of Search****Table 1. Search Strategy of databases.**

<b>Search Terms</b>	<b>Date</b>	<b>Database</b>	<b>Initial Hits</b>	<b>Articles Excluded</b>	<b>Total Selected for Review</b>
Sensory based interventions	10/22/16	AJOT	315	315 (1 was duplicate)	0
Vestibular input and sensory processing disorder	10/22/16	AJOT	47	47	0
Weighted vests	10/22/16	AJOT	21	19	1
Sensory processing disorder and neurodevelopmental treatment	10/22/16	AJOT	0	0	0
Sensory processing disorder and tactile input	10/22/16	AJOT	58	58	0
Sensory deficits and NDT	10/22/16	AJOT	1	1	0
Neurodevelopmental treatment	10/22/16	AJOT	62	62	0
Schaaf	11/10/16	AJOT	25	22	1
Lucy Jane Miller	11/10/16	AJOT	16	15 (1 was duplicate)	1



“Sensory processing disorder” AND “behavior”	10/8/16	CINAHL	27	25	0
Sensory Processing Disorder AND early intervention AND Sensory based approach	10/22/16	CINAHL	0	0	0
"Sensory Processing Disorder" AND "early intervention"	10/22/16	CINAHL	1	1	0
"Sensory Processing Disorder"AND interventions	10/22/16	CINAHL	4	4	0
Sensory integration disorder	10/22/16	CINAHL	23	23	0
Sensory modulation disorder	10/22/16	CINAHL	34	34	0
Sensory Processing Disorder AND sensory based intervention	10/22/16	CINAHL	16	16 (2 were duplicates)	0
Sensory integration disorder AND early intervention AND sensory based intervention	10/22/16	CINAHL	0	0	0
sensory processing disorder AND sound therapy	10/22/16	CINAHL	0	0	0
sensory processing disorder AND SBI	10/22/16	CINAHL	1	1 (1 was duplicate)	0
sensory based interventions	10/22/16	CINAHL		2 (2 were duplicates)	0
Sensory Processing Disorder AND sensory based intervention	10/22/16	ERIC	3	2	0
Sensory integration disorder AND early intervention AND sensory based intervention	10/22/16	ERIC	0	0	0
Sensory processing disorder AND neurodevelopmental treatment	10/22/16	ERIC	0	0	0
Sensory processing disorder AND sensory based treatment	10/22/16	ERIC	0	0	0
Sensory based interventions	10/22/16	OTSeeker	17	16	0
Sensory modulation	10/22/16	OTSeeker	1	1	0

sensory integration disorder	10/22/16	OTSeeker	2	2	0
Sensory Processing Disorder and Sensory Based Intervention	10/06/16	Primo	50	49	0
early intervention sensory processing disorder interventions	10/22/16	Primo	4483	4483	0
Neuro-developmental treatment and sensory processing disorder	10/22/16	Primo	4	4	0
Neuro-developmental treatment and autism	10/22/16	Primo	73	73	0
Sound based interventions	10/22/16	Primo	1466	1466 (2 were duplicates)	0
sensory integration and sensory processing disorder	11/8/16	Primo	441	441	0
Ayres sensory integration and sensory processing disorder	11/8/16	Primo	22	22	0
Sensory processing disorder and sensory based interventions	10/22/16	PsycINFO	4	4 (4 were duplicates)	0
Sensory integration dysfunction and sensory based interventions	10/22/16	PsycINFO	1	1	0
Sensory processing disorder AND sensory based therapies	10/22/16	PsycINFO	2	1 (1 was duplicate)	1
“Sensory Processing Disorder” and “Sensory Based Intervention”	10/06/16	PubMed	0	0	0
“Sensory processing disorder”	10/06/16	PubMed	35	35	0
Sensory integration occupational therapy and sensory based interventions	10/22/16	Pubmed	20	20	0
sensory processing disorder interventions children	10/22/16	Pubmed	25	24	0
Ayres sensory integration intervention	11/8/16	Pubmed	8	7	1
sensory integration and sensory processing disorder	11/8/16	Pubmed	249	249	0

sensory integration intervention and sensory processing disorder	11/8/16	Pubmed	14	14	0
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**Table 2. Articles from hand-searching.**

Article Searched	Initial Hits	Articles Excluded	Total Selected for Review
A systematic review of sensory processing interventions for children with autism spectrum disorders	19	14(4 were duplicates)	1
Systematic review of the research evidence examining the effectiveness of interventions using a sensory integrative approach for children	27	26 (1 was duplicate)	1
Effectiveness of Ayres Sensory Integration® and Sensory-Based Interventions for People With Autism Spectrum Disorder: A Systematic Review	23	19 (3 were duplicates)	4
Total number of articles used in review from hand searching = 6			

**Table 3. Articles from reference tracking.**

Article	Date	Articles Referenced	Articles Excluded	Total Selected for Review
Effectiveness of sensory integration interventions in children with autism spectrum disorders: a pilot study	11/8/16	8	7	1
Total number of articles used in review from reference tracking = 1				

Total number of articles used in review from database searches = 5

Total number of articles used in review from citation tracking = 0

Total number of articles used in review from Hand-searching = 6

Total number of articles used in review from reference tracking = 1

Total number of articles used in review from UPS Master’s Thesis = 0

Total number of articles used in CAT = 12

*Summary of Study Designs of Articles Selected for the CAT Table*

<b>Pyramid Side</b>	<b>Study Design/Methodology of Selected Articles</b>	<b>Number of Articles Selected</b>
Experimental	<u>0</u> Meta-Analyses of Experimental Trials <u>6</u> Individual Randomized Controlled Trials <u>2</u> Controlled Clinical Trials <u>2</u> Single Subject Studies	10
Outcome	<u>  </u> Meta-Analyses of Related Outcome Studies <u>  </u> Individual Quasi-Experimental Studies <u>  </u> Case-Control Studies <u>2</u> One Group Pre-Post Studies	2
Qualitative	<u>  </u> Meta-Syntheses of Related Qualitative Studies <u>  </u> Small Group Qualitative Studies <u>  </u> Brief vs prolonged engagement with participants <u>  </u> Triangulation of data (multiple sources) <u>  </u> Interpretation (peer & member-checking) <u>  </u> A posteriori (exploratory) vs priori (confirmatory) interpretive scheme <u>  </u> Qualitative Study on a Single Person	
Descriptive	<u>  </u> Systematic Reviews of Related Descriptive Studies <u>  </u> Association, Correlational Studies <u>  </u> Multiple Case Studies (Series), Normative Studies <u>  </u> Individual Case Studies	
Comments: AOTA Levels I - 6 II - 2 III - 2 IV - 2 V - 0		<i>TOTAL = 12</i>

ASI Articles by AOTA Level

Author, Year, Journal Abbreviation	Study Objectives	Study Design/ Level of Evidence	Participants: Sample Size, Description Inclusion and Exclusion Criteria	Interventions & Outcome Measures	Summary of Results	Study Limitations
Miller, Coll, & Schoen, 2007, AJOT	Measure effectiveness of ASI approach on children w/ SMD	Randomized Controlled Trial, E1, I	<p>N = 24, Males = 18: OT tx group: age mean = 6.09 yo. AP tx group: age mean = 6.88 yo. NT group: age mean = 6.67 yo. All 24 w/ SMD &amp; screened w/ SNAP-IV</p> <p>Inclusion: SMD, Hyperreactive EDR in <math>\geq 2</math> sensory domains, SSP <math>\geq -3</math> SD, <math>&gt; -2.5</math> SD on 2 or more subtests, <math>&gt; -4</math> SD on 1 subtest</p> <p>Exclusion: Dx except: ADHD, LD, or anxiety symptoms. <math>&lt; 3.0</math> or <math>&gt; 11.6</math> yo, IQ <math>&lt; 85</math>, previous OT tx, special ed., or serious confounding life events</p>	<p>I = 3 tx groups. 2x/wk for 10 wks. Exp. OTSI: large OT room w/ sensory activities &amp; toys. Active placebo: variety of tabletop play activities. No tx: passive ctrl, 10 wk wait list for OTSI</p> <p>O = Leiter-R, Parent Rating Scale, SSP, CBCL, VABS, GAS, EDR</p>	<p>ASI sig. more effective on GAS, Attention subtest &amp; Cogn./ Social Composite of the Leiter-R than 2 other tx groups.</p>	<p>Some scales were not usable (incomplete data, missing score sheets) so # of participants varies slightly in the tables, 54% of data unusable on EDR, small sample size &amp; lack of statistical power</p>
Pfeiffer, Koenig, Kinnealey, Sheppard, & Henderson, 2011, AJOT	Examine effectiveness of ASI in children w/ ASD	Randomized controlled trial, E1, I	<p>N= 37, Males = 32, ages 6:0-12:0, 20 received ASI int., 17 received FM int.</p> <p>Inclusion: children dx of ASD or PDD-NOS, identified w/ a SPD by <math>T \geq 60</math> on SPM</p> <p>Exclusion: children diagnosed w/ Asperger syndrome or another PDD</p>	<p>I = 45 min sessions, 3 sessions /wk over 6-wks. ASI int. individualized w/ 10 key strategies in fidelity tool in 3 areas, FM int. involving constructional activity, drawing &amp; writing, &amp; FM tasks provided in separate room.</p> <p>O = SPM, SRS, QNST-II, GAS, VABS-2</p>	<p>Sig. changes occurred in ASI group compared to FM in goal attainment, rated by parents <math>p &lt; .05</math>, effect size = 0.125, sig. <math>\downarrow</math> in autistic mannerisms in ASI group compared to FM group, <math>p &lt; .05</math>, effect size = 0.131</p>	<p>Convenience sample, 1 child only had 17 tx(s) due to absence, heterogeneous variables may have affected outcome</p>

<p>Piravej, Tangtrongchitr, Chandarasiri, Paothong, &amp; Sukprasong, 2007, JACM</p>	<p>Assess effect of TTM on behavioral &amp; emotional disturbances in children w/ ASD</p>	<p>Randomized controlled trial, E1, I</p>	<p>N = 60, Ctrl = SI: 30, Exp = SI + TTM: 30, 49 boys, ages 3:0-10:0, mean age 4.67 Inclusion: ASD Exclusion: Contraindications for TTM, inability to complete 80% of tx or 13 massages, pts w/ non-cooperative parents</p>	<p>I = SI w/ TTM 2 sessions/wk for 8 wk, Ctrl = SI, 2 sessions/wk for 8 wks O = Conners' Rating Scales @ 0 &amp; 8 weeks, sleep diary, sleep assessed every week</p>	<p>TTM group had less hyperactivity, hyperactivity index, &amp; sleep-related problems, sig. improvements in both groups for sleeping beh., but TTM group had improved anxiety &amp; conduct problems</p>	<p>Teacher's observations limited to during school where children act differently versus home, parents not blinded, short duration of tx</p>
<p>Schaaf et al., 2014, JADD</p>	<p>Evaluate a manualized intervention for sensory difficulties for children w/ ASD</p>	<p>Randomized controlled trial, E1, I</p>	<p>N = 32, 26 boys, 29 White, tx = 17, ages 4:0-8:0. Inclusion: dx of ASD, ages 4:0-7:11, non-verbal cog. Level &gt; 65, difficulty processing &amp; integrating sensory info., parents willing to participate in entire study</p>	<p>I = 30 sessions ASI, 1 hour sessions, 3x/wk for 10 wks. by OTs w/ exp. w/ children w/ ASD = mean 15 yrs. O = GAS, PEDI, PDDBI, VABS-II</p>	<p>Tx scored sig. higher on GAS w/ caregiver assistance in self-care &amp; socialization</p>	<p>Convenience sample, no direct observational measures, short intervention period, little ethnic diversity</p>
<p>Bundy, Shia, Qi, &amp; Miller, 2007, AJOT</p>	<p>To investigate SP dysfunction &amp; playfulness &amp; int.'s effect on playfulness</p>	<p>Controlled clinical trial, E3, II</p>	<p>N = 40, n = 20, Ctrl: 11 boys, ages 4:7-11:7, typically developing Exp.: 16 boys, ages 4:4-9:8, SP deficits, all SMD, some w/ dyspraxia. Inclusion: SSP &gt;3.0 SD below mean, &amp; sig. symptoms in ≥ 2 SSP domains Exclusion: Cerebral palsy, fetal alcohol syndrome, ASD, motor/beh. problems w/ intact sensation, Fragile X syndrome, Tourette's</p>	<p>I = ASI 20 1-hour individual tx O = SSP by parents, ToP version 4, 6 of 7 SIPT's praxis tests</p>	<p>Sensory modulation possible direct effect on playfulness. SIPT praxis scores less direct effect on playfulness. Exp. &amp; ctrl initial TOP scores differed significantly, but no ↑ post-int ToP &amp; SSP: positive correlations (p &lt; .0005) ToP &amp; SIPT: negative correlation, 2 of 4 subtests statistically sig. Children not more playful post-int.</p>	<p>Pilot study, observation-based measurement of free play lacking standard format &amp; threatening reliability, small sample #s &amp; children's nonrandomized recruitment for ctrl &amp; exp. affecting statistical power &amp; generalizability.</p>

<p>Watling &amp; Dietz, 2007, AJOT</p>	<p>Assess immediate effectiveness of ASI on improving behavior &amp; task engagement in children w/ASD</p>	<p>ABAB single subject design, E4, IV</p>	<p>N = 4, ages = 3:0-4:4, boys Inclusion: dx of ASD Exclusion: seizures, comorbid conditions, other OT services during study, change in medication/therapy during study</p>	<p>I = 3 phases: familiarization, baseline, tx Phase: 40 min ASI 3x/wk. O = Undesired behaviors &amp; engagement from videotapes. Data analyzed through visual inspection. Subjective caregiver report also used</p>	<p>Conclusions cannot be drawn on undesired behaviors btwn phases. All 4 boys showed high rates of engagement during the phases. Subjective data: ↑ in desired behaviors &amp; ↓ in undesired behaviors. Caregiver reports: ↑ in desired behaviors &amp; ↓ in undesired behaviors</p>	<p>Definition of engagement &amp; trying to distinguish engagement could have led to ↑ documented engagement. Sample size: small, all male. A2 phases: short. Subjective measures: could have been biased</p>
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**SBI Articles by AOTA Level**

<p>Fazlioglu &amp; Baran, 2008, PMS</p>	<p>To compare ASI to no tx for children w/ASD</p>	<p>Randomized controlled trial, E1, I</p>	<p>N = 30, n = 15, ages 7:0-11:0, males = 24 Inclusion: dx of ASD, low functioning, attended Trakya University research/training program for handicapped. Exclusion: Previous participation in SI program, epileptic seizures</p>	<p>I = SI program: 68 activities based on sensory diet, individual tx, 45 min sessions 2 days/wk, total sessions = 24 O = Sensory Eval. Form for Children w/ ASD</p>	<p>Statistically sig. results found for main effect of total scores &amp; test time. SI problems ↓ for the group receiving tx.</p>	<p>Small sample size, majority boys, only low functioning individuals tested.</p>
<p>Woo &amp; Leon, 2013, Beh. Neuroscience</p>	<p>To compare behavioral therapies to</p>	<p>Randomized controlled trial, E1, I</p>	<p>N = 28, all males, ages 3:0-12:0, exp. n = 13 Inclusion: dx of ASD</p>	<p>I = 6 months of at-home daily multi-stimuli exposure</p>	<p>42% of tx group &amp; 7% of ctrl group participants had statistically sig.</p>	<p>Parent variability in administering tx, mood @ time of assessments,</p>

	behavioral therapies & a sensory enrichment program for children w/ASD		Exclusion: “Syndromic ASD”, psychotropic medications, starting anticonvulsants w/in 3 months of study, ASI tx, school behavioral therapy w/in 1-2 months of study. Receiving therapy w/physical restraint	occurring 2x a day for 15-30 min. O = CARS, Leiter-R, Expressive One-Word Picture Vocabulary Test, Parent report	improvements on CARS score. Tx group statistically sig. higher scores on Leiter-R. Expressive One-word Picture Vocabulary test did not show differences btwn groups. Parent reports statistically sig. for tx group only.	small sample size, all males
Pekçetin, Akı, Üstünyurt, & Kayıhan, 2016, PMS	Examine effectiveness of individualized SI tx on preterm infants compared to term infants	Controlled clinical trial, E3, II	N = 68, n = 34, Ctrl: born >36 wks, 7 mo Exp.: born <37 wks, 7 mo corrected age Inclusion: live w/ family, hearing & vision intact Exclusion: MCA, systemic diseases, neuro. deficits, phy. & mental DD.	I = 8 wks total, 1 session/wk, 45 min individualized SBI sessions, eliciting active participation by presenting different toys & activities, chosen specifically to sensory responsivity profiles. O = TSFI	Both groups showed sig. improvements in TSFI total score. Int. group had a significantly higher TSFI total score than ctrl ( $p < .001$ ).	Examiner not blinded. Eval. process was not structured & could have lead to bias in the results. Exp. group had lower total TSFI scores than the ctrl group prior to int. Study had high attrition: 33 of 101 dropped from study.

Leew, Stein, & Gibbard, 2010, CJOT	To examine the effects of weighted vests on joint attention & competing beh in toddlers w/ ASD & measure any change in parenting morale	Multiple baseline single subject design, E4, IV	N= 4, ages 27-32 mo, all males Inclusion: ASD, may present w/ delayed lang. & social communication development & possible sensory integration dysfunction, ITSP indicated possible benefit from weighted vest Exclusion: Not mentioned	I = Weighted vest during semi-structured 20-min mother & toddler play sessions in the home 4x/wk. O = Video recordings coded for rates of joint attention & competing beh.	No observable tx effect of vests on competing beh. for 2 children, & data ambiguity for the 2 other toddlers. Weak confidence of tx effect on competing beh. No replicated tx effect on joint attention across toddlers. Weak confidence in tx effect for joint attention. 3 of 4 mothers scored higher on a measure of parenting morale after the study	Small sample size, all male, vests may not have provided optimal amount of pressure needed for the toddler, no follow-up, inconsistent interaction style or engagement across mothers during play sessions
Burch et al., 2015, AJOT	Measure effectiveness of EASE app in	One group pre-post study, O4,	N = 13, ages 13:0-27:0, Convenience sample Inclusion: SP deficits,	I = EASE app, 30 min, 2x/day, for 30 days	COPM scores: not statistically sig. EASE IQ formula: Strong correlations within the music	Unknown if 30-day int. is sufficient to show change. EASE IQ



	improving sound sensitivities in people w/ SP deficits	III	access to headphones & iDevice Exclusion: Using another auditory program or hearing impairment	O = COPM, EASe IQ formula, qualitative reports on experiences	modules	formula did not account for difference btwn modules, small sample size, convenience sample could have biased results.
Hall & Case-Smith, 2007, AJOT	Effects of sensory diet & sound-based int. on children w/ SPD & visual-motor delays	One group pre-post study, O4, III	N = 10, ages 5:0-11:0, Convenience sample, Inclusion: dx of SPD & visual-motor delays Exclusion: not mentioned	I = 12 wks. 4 wks. of daily sensory diet w/ tactile stimulation, rocking, etc. 8 wks combined sensory diet & therapeutic listening 2x/day 20-30 mins. O = Sensory Profile, DAP, VMI, ETCH	64% of Sensory Profile scores sig. diff. post tx. DAP no sig. VMI visual & ETCH scores statistically sig., parents indicated ↓ auditory hypersensitivities for 4 of 5 participants.	Lack of ctrl group, convenience sample, home program int. implemented by parent, sound-based tx typically 3-6 months, not 8 wks

**Key to Abbreviations**

<b>Abbreviation</b>	<b>Full Phrase</b>
@	at
&	and
>	greater than
#	number
≥	greater than or equal to
<	less than
≤	less than or equal to
↑	increased/increase/increasing
↓	reduced/reduction/reduce/decreased/decrease
/	per
AP	activity protocol group
ASD	autism spectrum disorder
ASI®	Ayres’ sensory integration®
b/c	Because
beh.	behavior/behavioral
btwn	between
CARS	Childhood Autism Rating Scale
CBCL	Child Behavior Checklist
Cochrane Database Syst Rev.	Cochrane Database of Systematic Review
cogn.	cognitive/cognition
COPM	Canadian Occupational Performance Measure
CPRS	Conner’s Parents Rating Scale
CRS	Conners’ Rating Scale
Ctrl	Control
CTRS	Conners’ Teacher Rating Scale
DAP	Draw-A-Person
DD	developmental delays
dx	diagnosis/diagnoses
EASe app	Electronic auditory stimulation effect application
ed.	Education
EDR	Electrodermal activity
ETCH	Evaluation Tool of Children’s Handwriting
eval.	evaluation
exp.	experimental
FM	fine motor
GAS	Goal Attainment Scaling
id	identify
info	information
int.	intervention
IQ	Intensity quotient
ITSP	Infant/Toddler Sensory Profile
lang.	language
ld	learning disability
Leiter-R	Leiter International Performance Scale–Revised
MCA	Major congenital anomaly
min	minute(s)
mo	months old
neuro.	neurological
NT	no treatment group
OT	occupational therapy
OT-SI	Occupational Therapy – Sensory Integration
particip.	participation
PDDBI	
PDD-NOS	Pervasive development disorder Behavioral Inventory

perf.	Pervasive development disorder, not otherwise specified
Phy.	performance
PMS	physical
SBI	Perceptual and Motor Skills
SCP	sensory based intervention
SI	Sensory Challenge Protocol
sig.	sensory integration
SIPT	significant
SMD	Sensory Integration and Praxis Test
SP	sensory modulation disorder
SPD	sensory processing
SPM	Sensory processing disorder
SRS	Sensory Processing Measure
SSP	Social Responsiveness Scale
SD	Short Sensory Profile
stim.	standard deviation
ToP	Stimulation/Stimulatory
TSFI	Test of Playfulness
TTM	Test of sensory functions in infants
tx	Thai Traditional Massage
VABS-II	treatment
VMI	Vineland Adaptive Behavior Scales, 2 <sup>nd</sup> Edition
w/	Developmental Test of Visual Motor Integration
w/in	with
wk(s)	within
yo	week(s)
yrs	years old
	years

### Summary of Key Findings:

#### Summary of Ayres' Sensory Integration Studies

There were a total of six articles found meeting inclusion criteria for ASI. All six articles were experimental studies, four RCTs, one controlled clinical trial, and one single subject design. Four of these articles examined children with a diagnosis of ASD, while the other two included children with SMD and SP dysfunction. ASI treatment interventions focused on improving a variety of behaviors across all studies. Four of the six studies reported positive results. Three studies reported positive participant outcomes on individualized goals using GAS scoring. In Miller et al. (2007), ASI was significantly more effective than tabletop activities at improving areas of attention, cognition/social behavior, and individual goals. In Pfeiffer et al. (2011), 18 sessions of ASI produced significant positive changes in individualized goals focusing on sensory processing/regulation, functional fine motor skills, and social-emotional skills. A decrease in autistic mannerisms was also found. In Watling and Dietz (2007) conclusions could not be drawn regarding undesirable behaviors or task engagement which was consistently high during all the phases, however, subjective data and caregiver reports identified an increase in desired behaviors and a decrease in undesired behaviors. Intervention was provided for in 40-minute sessions for 3 times a week. In Bundy et al. (2007), ASI treatment provided engagement with materials with enhanced sensation during challenging activities. There was no increase in playfulness post-intervention. In Piravej et al. (2007), traditional Thai massage implemented alongside ASI, resulted in improvements in conduct problems and anxiety that were not shown in the control group. Both groups receiving ASI improved on the hyperactivity index and sleep-related problems. In Schaaf et al. (2014), the ASI treatment group scored significantly higher on individualized goals with decreased caregiver assistance in increased self-care and socialization following 30 one-hour sessions of ASI.

#### Summary of Sensory Based Interventions Studies

There were a total of six articles found meeting inclusion criteria for SBI. Of the six articles, two were RCTs, one controlled clinical trial, one single subject design, and two group pre-and post-studies. Three of these six articles examined children with ASD. The other three articles examined different groups: preterm infants, SPD, and sensory processing deficits. The SBI treatment interventions focused on improving behaviors, decreasing auditory hypersensitivities, and improving joint attention with competing behaviors. Four of the six studies reported positive results. All six studies, however, used different outcome measures, therefore, were not intercomparable. The Pekcetin et al. (2016) study reported statistically significant improvements in the responsivity of infants with poor sensory processing function when introduced to different toys and activities during sensory sessions. Similarly, the Fazliog̃lu and Baran (2008) study resulted in statistically significant improvements for low-functioning children with ASD in their sensory processing abilities by gradually progressing their sensory diet-related activities after mastery. Woo and Leon (2013) reported clinically significant improvements in the severity of autistic symptoms, including cognition, when a sensory enrichment kit was implemented in the home for six months. Leew et al. (2010) reported weak to no effect for improved joint attention of toddlers with ASD while wearing weighted vests for 20-minute sessions. The final two studies both had auditory

interventions for children with SPD but with differing results. Burch et al. (2015) reported no statistically significant findings for decreasing auditory sensitivities with the EASe app. Hall and Case-Smith (2007) reported statistically significant improvements for decreasing auditory sensitivities with an initial four-week sensory diet later combined with a therapeutic listening program for eight weeks.

**Implications for Consumers:**

The consumers are the children and the children's caregivers. The research population was children birth through 18 years old, diagnosed with SPD or ASD. Consumers should be aware of the options available regarding interventions and the differences between SBI and ASI. They could advocate for themselves by being aware of the current evidence that supports or does not support an intervention. This includes the fact that evidence was not found for using an NDT approach as intervention for children with the above diagnoses. There were also no articles found that explored using either an SBI or ASI approach for children with ADHD. It is recommended that consumers ask for the reasoning behind the selection of intervention approaches used given their particular diagnosis. Consumers should also ask for or seek out treatments requiring individualization and an established protocol and procedure. Goals need to be individualized and tailored to each individual's unique sensory needs as sensory processing deficits vary widely. Consumers should be aware that not all information is evidence-based and/or reliable. Therefore, they should search for information from experts in the field or other reliable sources.

**Implications for Practitioners:**

Practitioners should be aware of current evidence for SBI and ASI. Eight of 12 studies demonstrated improvement or positive findings however, due to the specificity of our inclusion and exclusion criteria, these findings should be interpreted with caution outside of our criteria. Practitioners should also be utilizing research to inform treatment frequency, duration, and lengths and use those that showed the best participant results. Furthermore, when reading research articles practitioners need to critically evaluate the duration, protocol, and frequency of application in the methods section. Evidence for NDT was not found for individuals with sensory processing disorders or sensory processing deficits. If clinicians have a case study where NDT improved sensory deficits, they should pursue publishing this study. For program development, it is recommended that practitioners start collecting their own data and doing their own research on interventions they find useful with clients. It is also recommended that there is at least one practitioner certified in ASI in a clinic where ASI is utilized. The ASI literature and two studies of SBI meeting several fidelity measures of ASI indicate this structure of intervention may show better results than SBI. Practitioners should also consider including sensory enrichment kits with essential oils and massage and individualized sensory diets with therapeutic listening as two of the SBI therapies had promising research showing potential benefit of these methods. Overall, practitioners should be aware of the individual needs of their clients and tailor intervention to meet their needs when using ASI or addressing sensory concerns.

**Implications for Researchers:**

Researchers need to consider conducting more studies with larger sample sizes as generalizability was low in most of the studies examined. When practitioners perform research, practitioners should focus on having large and heterogeneous samples. Research needs to be conducted in the area of NDT, particularly in relation to using it in combination with SBI or ASI. Many of the current SBI lacked consistent protocol and procedures which could have increased the studies' rigor. When conducting research longer duration, stricter protocols, and more frequent application should be followed to yield more positive results or improvement. Researchers should examine these treatment methods in studies with strong designs. The number of studies from the body of literature focusing on sensory deficits with SBI and ASI is limited. More research and evidence is needed. Specific SBI can vary from sound therapy to weighted vests and the amount of evidence for each specific intervention is minimal. There was a multitude of outcome measures that were used to monitor change and also a myriad of behaviors that were examined. It is recommended that there is more consistency in regards to outcome measures and types of behaviors. Replication of studies with favorable results will lead to increased consistency and stronger evidence. Researchers should strive to conduct higher level studies as funding allows. This will allow the research to be more readily comparable, thus easier to form conclusions.

**Bottom Line for Occupational Therapy Practice/ Recommendations for Better Practice:**

The research behind ASI and SBI tends to only be generalizable to small samples of the population decreasing its relevancy. Therefore, in order for clinicians to meet the specific sensory needs of each client, utilizing individualized outcome measures is necessary. For better practice at the CTU when working with children with SPD and ASD, the research indicated that ASI shows promise in improving behavioral issues including attention, cognition/social behavior, sleep-related problems, anxiety, and conduct behaviors. SBI research indicated improvements on scores for CARS, Leiter-R, TSFI, as well as decreased auditory sensitivities. Children with a diagnosis of ADHD should be treated with careful consideration if using either SBI or ASI due to the lack of literature findings. We would currently not recommend an NDT approach to address sensory issues due to a lack of studies providing evidence. We recommend OT practitioners using ASI should provide intervention that adheres to the Fidelity checklist (Parham et al., 2011). Before treating with an ASI or SBI approach, we recommend assessment of sensory functions through caregiver report and performance-based methods. With a wide variety of interventions under the umbrella of an SBI approach, therapists are encouraged to individualize their interventions to find the best fit for their client's specific sensory processing needs.

## References

- Bundy, A. C., Shia, S., Long, Q., & Miller, L. J. (2007). How does sensory processing dysfunction affect play? *American Journal of Occupational Therapy, 61*, 201-208. doi:10.5014/ajot.61.2.201
- Burch, E., Allison, J., Cook, D. L., Wolkow, N., Stockton, J., Espino, I., & Alvarado, M. I. (2015). The effect of the electronic auditory stimulation effect application (EASe app) with individuals 11 to 27 years of age with sensory processing deficits. *American Journal of Occupational Therapy, 69*(Suppl.\_1), 6911515233p1. doi:10.5014/ajot.2015.69S1-PO7082
- Fazliog˘lu, Y., & Baran, G. (2008). A sensory integration therapy program on sensory problems for children with autism. *Perceptual and Motor Skills, 106*, 415–422. doi:10.2466/pms.106.2.415-422
- Hall, L., & Case-Smith, J. (2007). The effect of sound-based intervention on children with sensory processing disorders and visual–motor delays. *American Journal of Occupational Therapy, 61*, 209–215. doi:10.5014/ajot.2014.011411
- Leew S. V., Stein, N. G., & Gibbard, W. B. (2010) Weighted vests' effect on social attention for toddlers with autism spectrum disorders. *Canadian Journal of Occupational Therapy 77*, 113–124. doi:10.2182/cjot.2010.77.2.7
- Miller, L. J., Coll, J. R., & Schoen, S. A. (2007). A randomized controlled pilot study of the effectiveness of occupational therapy for children with sensory modulation disorder. *American Journal of Occupational Therapy, 61*, 228–238. doi:10.5014/ajot.61.2.228
- Pekçetin, S., Akı, E., Üstünyurt, Z., & Kayıhan, H. (2016). The efficiency of sensory integration interventions in preterm infants. *Perceptual and Motor Skills, 123*: 411-423. doi:10.1177/0031512516662895

- Pfeiffer, B. A., Koenig, K., Kinnealey, M., Sheppard, M., & Henderson, L. (2011). Effectiveness of sensory integration interventions in children with autism spectrum disorders: A pilot study. *American Journal of Occupational Therapy, 65*, 76–85.  
doi:10.5014/ajot.2011.09205
- Piravej, K., Tangtrongchitr, P., Chandarasiri, P., Paothong, L., & Sukprasong, S. (2009). Effects of Thai traditional massage on autistic children's behavior. *Journal of Alternative and Complementary Medicine, 15*, 1355–1361. doi:10.1089/acm.2009.0258
- Schaaf, R. R., Benevides, T., Mailloux, Z., Faller, P., Hunt, J., van Hooydonk, E., . . . Kelly, D. (2013). An intervention for sensory difficulties in children with autism: A randomized trial. *Journal of Autism and Developmental Disorders, 44*, 1493–1506.  
doi:10.1007/s10803-013-1983-8
- Watling, R. L., & Dietz, J. (2007). Immediate effect of Ayres's sensory integration-based occupational therapy intervention on children with autism spectrum disorders. *American Journal of Occupational Therapy, 61*, 574–583. doi:10.5014/ajot.61.5.574
- Woo, C. C., & Leon, M. (2013). Environmental enrichment as an effective treatment for autism: A randomized controlled trial. *Behavioral Neuroscience, 127*, 487–497.  
doi:10.1037/a0033010



### **Involvement Plan**

When we met with our collaborating clinician, Molly McBroom, she expressed interest in us making a booklet about sensory dysfunction in children. This booklet would include signs and symptoms of sensory dysfunction and how these signs and symptoms manifest in different settings. This booklet would be aimed at parents with children who have suspected sensory dysfunction or those children who already have a diagnosis. Currently, CTU does not have research-based literature to give to parents about sensory dysfunction. Molly stated that it would be very helpful to have a booklet that she could give to parents as a resource.

Molly also discussed the main interventions she uses during her sensory treatment sessions. The interventions discussed were brushing, therapy balls, weighted blankets, chewing gum, and therapeutic listening programs. We collaborated with Molly to decide to add cards at the end of the booklet describing the available research on the treatments she regularly uses such as weighted blankets, therapy balls, and therapeutic listening programs. The booklet will be provided to Molly in a printed and digital format.

When we met with our project chair, Renee Watling, she gave us guidance on what would be appropriate to include in our booklet. She suggested that we begin by detailing a general overview of sensory dysfunction and then have sections explaining the principles of ASI and SBI. At the end of the booklet, as mentioned above, we would have a few cards that detail intervention activities that the CTU uses. The cards would explain the intervention activity and current research on the intervention.

Facilitators to our booklet include Multicare's large system of resources and Molly's many years of experience as an occupational therapist. A facilitator toward our information being distributed is Multicare's marketing team, who can produce our booklet and redesign it to fit future network needs. Additionally, Multicare employs translators who will be able to translate

the booklet into Spanish making it more widely accessible to clients served by their organization including other clinics and facilities such as doctors' offices or other therapy offices. Our clinician, who is a very experienced therapist at the CTU, will be able to share the information with her colleagues there and at Mary Bridge Children's Hospital. As an experienced occupational therapist, Molly may have a large network, which could allow for easier dissemination of the knowledge. This experience could also ensure the facility and other occupational therapists trust her as a source of knowledge.

The Multicare system is additionally a barrier to our knowledge being distributed. Molly was not clear on what would need to be done for our information to be published by Multicare. She only mentioned that we could not use images that were copyrighted. Due to Multicare's large size, there might be many people we need to interface with besides Molly to have the booklet published. Additionally, we do not know how the booklet will be distributed once it is published. It could be that Molly is the sole distributor, and therefore, it would only reach a portion of all of Multicare's clients with sensory processing dysfunction. Further, Molly did not specify where the pamphlet would be kept. If it was kept in the lobby with other pamphlets, parents might have better access. If the pamphlet is kept in an office and handed out directly to parents, that could be the best way to ensure parents receive the information, but Molly would need to recruit other therapists to hand out the booklet. If the pamphlet was stored on a shelf or in an office with no plan for distribution, it might not be as accessible to therapists or parents. The knowledge would have a harder time reaching its audience.

The following table contains the timeline for the different steps of the involvement plan. The booklet had multiple components and each step was addressed separately. Deadlines were allotted for the components to ensure the involvement plan was completed on time. The research

based cards on specific interventions were created per the deadlines listed but discarded from the booklet.

<b>Task/Product</b>	<b>Deadline Date</b>	<b>Steps and Dates achieved</b>
Booklet with signs/symptoms in different settings	4/30/2017	<ol style="list-style-type: none"> <li>1. Reviewed parent education books about sensory processing by 4/4/17</li> <li>2. Write up of introduction of sensory processing completed by 4/4/17</li> <li>3. Researched signs/symptoms in schools by 4/4/17</li> <li>4. Researched signs/symptoms at home by 4/4/17</li> <li>5. Researched signs/symptoms while out in the community by 4/4/17</li> <li>6. Organized research into booklet form by 3/31/17</li> <li>7. Created booklet by 4/14/17</li> <li>8. Printed booklet by 4/30/17</li> </ol>
Research based cards to be added to the booklet	4/30/2017	<ol style="list-style-type: none"> <li>1. Organized information from chosen studies into card format.               <ol style="list-style-type: none"> <li>a. Card on weighted vests completed by 3/11/17</li> <li>b. Card on therapeutic listening programs completed by 3/18/17</li> <li>c. Card on therapy balls completed by 3/25/17</li> </ol> </li> <li>2. Created cards by 4/8/17</li> </ol>

**Knowledge Translation**

For the knowledge translation of this project, an educational booklet for parents of children with sensory processing dysfunction, *Using SENSATION in Pediatric OT* (See Appendix A), was created for distribution at CTU. The booklet contains a description of sensory processing, the seven senses, possible signs/symptoms of sensory processing issues in school, at home, and in the community, and descriptions of ASI and SBI. Providing parents with a booklet

or brochure was discussed with our clinician during our first meeting. The clinician wanted a booklet or brochure to provide parents with information about current clinical practices in the CTU regarding sensory processing. Our research group later met with our faculty mentor/ project chair to finalize our involvement plan idea to discuss with our collaborating clinician. After meeting with the collaborating clinician again, a booklet was settled on as the knowledge translation project and she specified wanting signs/symptoms of sensory processing issues at school, home, and in the community, along with a brief description of both ASI and SBI interventions covered in the booklet.

In order to incorporate our CAT evidence into the booklet, we further discussed developing three card inserts to be included in the booklet addressing sensory based interventions researched in our CAT. The card inserts were based on several studies we researched as well as sensory interventions utilized by our collaborating clinician. It was decided the card inserts would include information on an auditory intervention called Therapeutic Listening, weighted blankets, and therapy balls. The three card inserts were created, but after review and discussion with our faculty mentor/project chair, it was concluded the card inserts be discarded due to the limited research available on these sensory based interventions.

In the development process of the booklet, we used printed and online resources to obtain information. After we had a first draft of our booklet, we submitted it to our faculty mentor/project chair for review. She provided us with valuable feedback on how to improve our booklet and, upon her recommendations, we made revisions. We encountered unforeseen technical difficulties while we utilized unfamiliar software, Adobe InDesign. These difficulties were mainly related to formatting and included font sizing, word spacing, and unexpected format changes when exporting content from InDesign into other file types (i.e., Adobe PDF and Word doc).

Several other unforeseen difficulties were experienced. First was defining ASI and SBI in the booklet in terms understandable to parents unfamiliar with medical terminology. ASI is particularly hard to discuss without using medical terminology as the underlying process is complex. Another struggle pertained to clearly differentiating one intervention from the other as they can appear very similar to those unfamiliar with sensory interventions. As graduate students not being certified in ASI, it was difficult to ascertain the properties of ASI to further simplify for parents in our booklet. Time restrictions existed for completing the booklet and distributing to parents before the end of the on-site occupational therapy clinic to obtain feedback on the booklet, and to further make revisions to the booklet based on feedback from parents.

Uncertainty continues to exist with regard to how CTU will print and distribute the booklet. The preferred electronic format that CTU uses to print materials remains unclear. Therefore, it is possible that the CTU will not be able to use our booklet in its current format and will need to work on reformatting the document to fit their printing requirements. We also do not know Multicare’s protocol for distributing printed materials.

Overall, our knowledge translation project had many challenges pertaining to performing research on a difficult and complex topic like sensory processing dysfunction and its related sensory treatments.

**Dates of Completion**

<b>Task/Product</b>	<b>Deadline Date</b>	<b>Steps to achieve final outcome</b>
Booklet with signs/symptoms in different settings	4/30/17	<ol style="list-style-type: none"> <li>1. Reviewed parent education books about sensory processing by 3/4/17</li> <li>2. Wrote introduction of sensory processing by 3/4/17</li> <li>3. Researched signs/symptoms in schools by 3/4/17</li> <li>4. Researched</li> </ol>

		<p>signs/symptoms at home by 3/4/17</p> <ol style="list-style-type: none"> <li>5. Researched signs/symptoms while out in the community by 3/4/17</li> <li>6. Organized research into booklet form by 3/31/17</li> <li>7. Submitted booklet for review to chair 4/11/17</li> <li>8. Corrected edits from chair 4/13/17</li> <li>9. Resubmitted edited booklet to chair 4/14/17</li> <li>10. Created survey to measure outcome of booklet by 4/14/17</li> <li>11. Distributed booklet to clinic parents on 4/17/17 and 4/19/17</li> <li>12. Printed final booklet by 5/10/17.</li> </ol>
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**Outcome Monitoring of our Activities**

We created a survey with both quantitative and qualitative questions to evaluate readability of the booklet by parents of children with possible sensory processing dysfunction and determine if reading the booklet increased parent understanding of the dysfunction. We used a Likert scale ranging from *strongly disagree* to *strongly agree*. We asked five quantitative questions and two qualitative questions. The quantitative questions specifically addressed: the booklet’s readability, gaining increased understanding of sensory processing dysfunction, the booklet’s organization, amount of information, and the adequacy of information for increasing understanding of the dysfunction. The qualitative questions asked the parents to describe what

was most helpful about the booklet and what could be improved about the booklet. The survey is provided in Appendix B.

Our target sample was a convenience sample of parents with children identified as having sensory processing dysfunctions who attended the University of Puget Sound's OT Onsite Pediatric Clinic. We obtained verbal consent from the parents to complete the survey, asking them to return the survey to their student therapist. Due to time restraints, the survey was distributed once without follow-up.

### **Evaluation of the Task and Products Effectiveness**

According to parent feedback, the booklet effectively described the basics of sensory processing dysfunction, its symptoms, and intervention types. However, as discovered from our survey's results, parents with prior knowledge of sensory processing dysfunction did not benefit as greatly from the booklet. Providing a basic outline of sensory processing dysfunction, the booklet was strictly meant for parents who are new to its concept. Additionally, the research from our CAT table was not included in our booklet due to inconsistency between our clinician's and our CAT table's intervention activities, which kept the content of the booklet at an introductory level. Based on our survey results, we believe our booklet will be effective as a basic resource about sensory processing for parents who are unfamiliar with the model and its interventions for dysfunction.

A limitation of our outcome measure was that our convenience sample might not represent the parents at the CTU as the demographics of the onsite clinic parents might be significantly different from those parents at the CTU. Furthermore, the parents might have created a bias in the data by not disclosing their true feelings about the booklet out of consideration to their child's student therapist. Due to limited time and resources, we distributed and collected five booklets and surveys from five onsite clinic parents, creating a small sample

size. This small sample size could limit the generalizability of our results. Another limitation of our survey was that we, the research team, had potentially conflicting roles: distributors of the booklets and surveys and analyzers of the survey results. This could have introduced bias into our analysis of the data.

The results from our survey indicated that parents wanted more information about symptoms in school, community, and home. Parents also indicated it would have been helpful to have information about resources and follow up steps; for example, obtaining a doctor's referral and qualifying for school-based services. One parent indicated it would be helpful to have more information differentiating ASI and SBI.

We appreciated the feedback obtained from the parents as it provided valuable insight into what could be included in our booklet. However, due to the time restraints of this project, we were not able to fully revise the booklet before our project deadline. As our booklet was in an electronic format, it could be revised by the CTU administrative staff to better match the demographics of their clients and their clients' families. Additionally, this booklet could be further expanded upon by future knowledge translation groups; for example, including our sample's survey recommendations and more specifics related to intervention activities. If a future research group investigated sensory processing dysfunction intervention activities, they could include activities adhering to best research to better inform parents on best practice in pediatric OT.

Lastly, this booklet will only be effective if approved, printed, and distributed by the CTU, which to-date, had not been confirmed by the facility. We are currently unaware of how our clinician will distribute the booklet and/or if other CTU clinicians will be able to distribute it to parents they work with. There might be a possibility that our booklet will never reach our target population.



### **Process Reflection**

Our project involved a very complicated, highly controversial topic of sensory processing dysfunction. There is little consensus among clinicians about effective sensory processing interventions, and many clinicians use ASI without following strict fidelity protocols. SBI is often implemented with varying protocols, due to lack of protocol consensus. The terminology surrounding ASI, SPD, and SBI is also controversial for example, ASI is often called Sensory Integration, and SPD is not collectively accepted as a valid diagnosis as it is not included in the DSM-V.

Another hardship of our project was having to modify our research question several times due to lack of research pertaining to our clinician's initial question. Specifically, we had to expand our question from early intervention age children to all children from birth to eighteen years old. We also expanded our population from only children with SPD to children with SPD, ADHD or ASD. Originally, we sought only SBI-related interventions, but, due to few results, we expanded our interventions to include ASI. These modifications increased our project's scope, resulting in a high variability of research. This high variability made it difficult to draw conclusions and deduct patterns that we could discuss in the summary and implication portion of our CAT table. This variability also made it difficult for the research to remain applicable in addressing our clinician's initial question.

Analysis was difficult due to high variability, making our research difficult to translate into the knowledge translation project. Overall, while challenging, the project was a useful learning experience about not only learning to critically analyze and synthesize information from research articles, but also to understand the process of knowledge translation and the supports and barriers to implementation.

### **Recommendations**

Our recommendations for a follow-on project would be to focus on either one intervention activity (e.g. hippotherapy, weighted vests) or one sense (e.g. auditory, tactile). Part of the difficulty of our topic was that it covered all seven senses and we included all sensory interventions that matched our population and setting requirements. Focusing on one sense or one intervention would increase the likelihood that similar outcome measures would be used and results would be more readily comparable. Our research topic was so broad that it was difficult to compare results across studies.

It would also be more feasible to only research interventions that are ASI or SBI. Researching ASI and SBI resulted in studies with almost nothing in common. ASI has a rigorous protocol and fidelity criteria, while SBI includes anything from weighted vests to a therapeutic listening program. The two types of intervention studies were difficult to compare.

It would also be beneficial to focus on one or two intervention activities that the clinician already uses and the most common diagnosis treated by the clinician to make the research more applicable to their practice. A more specific research question that only focuses on a few intervention activities would also facilitate a more cohesive knowledge translation project. Our knowledge translation project had to be supplemented with additional research to match our clinician's needs at her setting. Researching three different diagnoses increased variability and decreased comparability of the research. Therefore, a future group could only research the most common diagnosis in the clinician's treatment setting. It would also be recommended that the diagnosis not be SPD, as SPD is not a recognized diagnosis within the DSM-5.

Appendix A



**Using SENSATION**  
In Pediatric OT



## Sensory Processing

The human body receives sensory input from the outside world through seven senses. The sensory input is then sent directly to the brain, which acts as an interpreter, and uses the input to produce motor, emotional, and social responses. Due to constant sensory input from the environment, sensory processing is a necessary part of daily functioning which occurs spontaneously.

Examples of children with typical sensory processing:

- Child does not startle or avoid using public restrooms due to the sound of the automatic flushing toilet or the sound of the hand dryer.
- Child eats a variety of textured foods and does not avoid foods of a certain texture.
- Child does not avoid hugging or other physical contact (e.g., high fives, pats on the back).
- Child is able to maneuver through environments without bumping into objects or people.

## Seven Senses

The seven senses are:

Sight, smell, touch, taste, hearing, and two lesser known senses:

- Proprioceptive = body awareness in space, for example, knowing you placed your arm in front of you instead of behind you without using your vision
- Vestibular = Body awareness of static, linear, & circular movement helping you have a sense of your balance and coordinate movement

## Sensory Processing Dysfunction

Sometimes the sensory information sent to the brain is not organized properly. As a result, atypical or ineffective behavioral responses occur to stimuli. These may include: hyporeactive responses (underreacting), hyperreactive (overreacting), and paradoxical responses (a mix of underreacting and overreacting). Children with sensory processing dysfunction may have behaviors that escalate quickly when demands or requests are not immediately met.



Sensory processing dysfunction can take on different forms. While one environment may not trigger one individual, that same environment may trigger another individual. Some examples are described on the following pages.



## **Signs of Sensory Dysfunction at Home:**

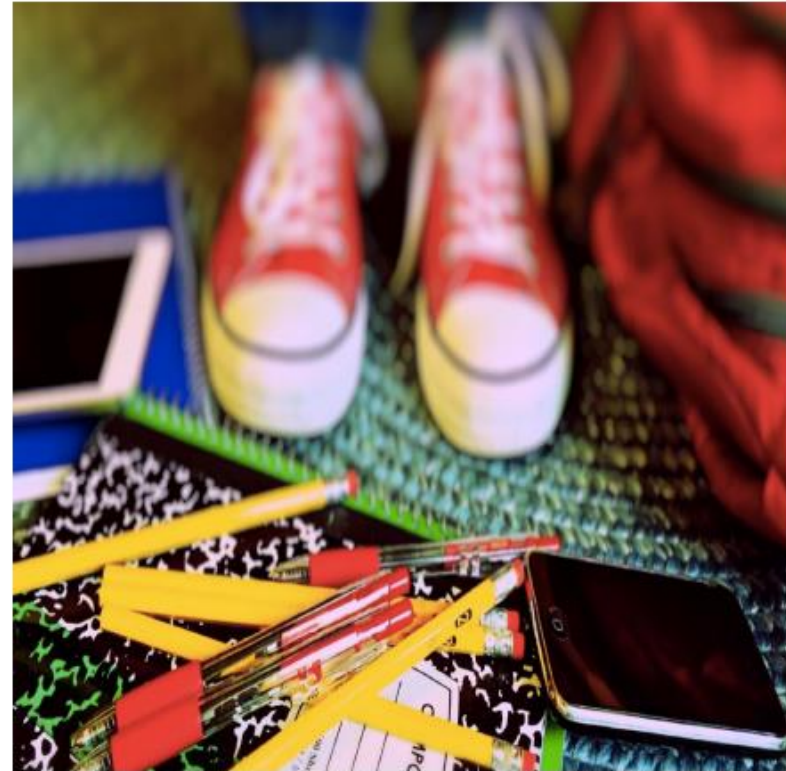
Life at home provides opportunities for children to play, care for self, and be a part of a family. Signs of sensory dysfunction at home could be:

- Bumping into furniture or appearing clumsy
- Overly sensitive to clothing textures and/or fit of clothing (e.g., irritable)
- Excessive pickiness about clothing choices & preferring to wear the same clothing day after day, even if not seasonally appropriate (e.g., wearing winter snow boots in summer)
- Avoiding becoming messy
- Having difficulty sitting at the table with family members during mealtimes
- Strong avoidant reactions to grooming activities (e.g., brushing hair, clipping nails, brushing teeth)

## Signs of Sensory Dysfunction at School:

The school environment gives kids the opportunity to learn and play as part of a larger group. In this environment, the following behaviors might be evidence of sensory dysfunction:

- Fidgets continuously:
  - \* Knees bouncing
  - \* Feet tapping
  - \* Eyes darting
  - \* Frequently getting out of seat
- Disruptive:
  - \* Engaging in conversations when should be listening
  - \* Frequently touching objects even when inappropriate to do so
  - \* Frequently requesting the teacher to repeat what they said
  - \* Being overly forceful or aggressive with words or behavior
- Easily distracted by auditory and visual stimulation (e.g. looking out the window instead of watching teacher)
- Difficulty distinguishing between what the teacher is saying from outside noise
- Being a dare devil or fearful around playground equipment
- Prone to accidents and injury





## Signs of Sensory Dysfunction in the Community:

As children grow, they increasingly interact in community settings and social situations. Children with sensory dysfunction may demonstrate behaviors such as:

- Avoiding unfamiliar situations
- Avoiding crowds
- Being easily distracted by auditory and visual stimulation:
  - \* Does not want to go to a birthday party due to noise sensitivities.
  - \* During the holidays, decorations may be visually overwhelming and the child may become overstimulated.
- Range of sensitivities to movement:
  - \* Becoming car sick or nauseous with certain movements
  - \* Not seeming to register movement (e.g., spinning in a circle without feeling dizzy or nauseous).



## **Sensory-Based Intervention (SBI)**

When sensory processing functions aren't supporting an individual's daily life functions, interventions may be recommended. Intervention types can take two forms: sensory-based intervention or Ayres' Sensory Integration® (ASI). Sensory-based interventions consist of a large variety of "sensory" interventions that aim to address behavioral issues in children caused by dysfunction in sensory processing.

"Treatment may involve providing enhanced vestibular and proprioceptive sensation throughout daily routines to prepare the child for engagement, support his or her ability to focus on learning activities, and regulate his or her behavior as task demands change (Tomchek & Case-Smith, 2009).

The goal of sensory-based interventions is to produce a short-term improvement in the child's behavior through the use of touch, hearing, taste, vision, movement, smell or resistance by modifying activities or environments (Yunus, Liu, Bissett, Penkala, 2015).

Some sensory-based intervention methods include weighted lap pads, stretchy bands, massage, and sensory diets. Sensory diets involve exposing children to different sensation(s) and practicing specific movements (Case-Smith, Weaver, & Fristad, 2015).



**“... better sensory integration  
cannot be forced; only  
cultivated”  
~ A. Jean Ayres**

## **Ayres' Sensory Integration® (ASI)**

ASI is an intensive treatment method developed by A. Jean Ayres that requires specialized training, equipment, and environments. ASI is provided in a clinic-based setting by facilitating sensory rich experiences which enable the child to become more skilled, proficient, and successful in using sensation to meet daily life challenges. The goal of ASI is to produce deliberate long-term effects that change the nervous system.

With the child actively participating in play activities, ASI targets multiple “sensory-related” impairments to improve a child's growth, development, learning, and behavior.

ASI provides the child with opportunities for sensory rich play that incorporates touch, vestibular, and proprioceptive sensations to promote organization in the nervous system necessary for functional activities.


A therapy activity example: Having a child ride a scooter board, balance on a beam, and maneuver through an obstacle course, challenging their coordination, timing and sequencing of movements. The obstacle course itself facilitates path finding, problem solving, and self regulation to help coordinate limbs, eyes, and hands together.

Please talk with your child's occupational therapist if:

- You think your child might benefit from intervention for sensory processing difficulties.
- You would like more information about sensory processing.



This booklet was prepared in 2017 by Kaitlin Gaspich, OTS, Sydney Anderson, OTS, Cate Terhune, OTS, and Emiline Gonzalez, OTS, in partial fulfillment of the requirements for a master's degree in occupational therapy.



**Mary Bridge Children's Therapy Unit (CTU)**  
[www.marybridge.org](http://www.marybridge.org)  
Tacoma T. 253-403-1400/Puyallup T. 253-697-5200  
Contact an occupational therapist for more information.

Appendix B

## Using Sensation in Pediatric OT

We've created a booklet on sensory processing dysfunction, its signs and symptoms and a few treatment options. We would like to obtain feedback from parents in order to ensure that our booklet is clear and easy to understand. Please fill out this survey below that should take less than 5 minutes and then return it to your student therapist.

Please rate your degree of satisfaction with each of the below statements.

1 = strongly disagree    2 = disagree    3 = neutral    4 = agree    5 = strongly agree

	1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1. I felt the booklet was easy to understand.					
2. I have a better understanding of sensory processing dysfunction after reading this booklet.					
3. The booklet was laid out in an organized manner.					
4. The amount of information included was not overwhelming.					
5. The amount of information was adequate to increase my understanding of sensory processing dysfunction.					

**Please describe what was most helpful about the booklet:**

**Please describe what could be improved about the booklet:**

**Thank you for your participation!**

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Name: \_\_\_\_\_ Date: \_\_\_\_\_

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