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Sensory-Based Interventions in Schools

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This evidence project, submitted by

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has been approved and accepted
in partial fulfillment of the requirements for the degree of
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Key words: sensory-based interventions, behavior, attention, academic performance, school

Abstract

Dr. Jamie Palmer, DrOT/L of Central Kitsap school district requested that University of Puget Sound occupational therapy (OT) students research the impact of sensory-based interventions (SBIs) on attention, behavior, and academic performance for children in preschool to high school with or without diagnoses. Based on a systematic review of 33 studies, the evidence for the use of SBIs in the classroom to improve academic performance, behavior and attention is preliminary and ranges from limited to moderate depending on the specific type of SBI. The use of those specific SBIs with limited to moderate evidence is recommended for students whose demographic profiles match those of the study participants.

The knowledge translation process consisted of two primary components: developing and delivering an in-service to share findings of the present study with Dr. Palmer and other professionals in her school district, and developing and disseminating an evidence-based movement program called Break 5. School district professionals reported being highly satisfied with the in-service and reported that the program was moderately effective for regulating student behaviors. The principal and occupational therapy team expressed interest in expanding the movement program throughout the school. Given that Break 5 has only been trialed on an informal basis, research is needed to determine its efficacy. Break 5 and those SBIs with the strongest evidence should only be implemented by OTs with strong rationale, systematic outcome monitoring, and adjustment to meet individual needs.

Executive Summary

In the initial meeting with the project collaborator, Dr. Jamie Palmer, DrOTR/L, the efficacy of multisensory rooms in educational settings was chosen as a preliminary topic. After a preliminary search revealed a lack of literature and the inherent challenges of operationalizing this topic, the research question was broadened to include any sensory-based intervention (SBI) with the exception of Ayres Sensory Integration® (ASI®), dynamic seating and weighted vests. ASI was excluded due to practical limitations within the school setting, and dynamic seating and weighted vests were excluded because they were already in use in the school district. Studies retained for critical analysis met the following inclusion and exclusion criteria: study outcomes included attention, behavior or academic performance; study participants were between preschool and high school age; and the intervention studied had to be feasible for implementation in a school setting. A literature search of 12 databases produced 9,064 initial hits. From both these hits and the reference and citation tracking of 15 systematic reviews, 239 articles were retained for in-depth review, and 33 of these articles met inclusion criteria for critical analysis.

The following six categories of SBIs emerged from the literature: single-sensory interventions, multisensory interventions, tactile fine motor activities, cognitive interventions, movement/proprioception/vestibular interventions, and environmental modification. Across all categories, a majority of studies were single-subject research design (SSRD). A SSRD scale developed by Logan, Hickman, Harris, and Heriza (2008) was used to determine the strength of each SSRD study. The PEDro scale, AOTA's Hierarchy of Evidence (Arbesman, Scheer, & Lieberman, 2008), and Tomlin and Borgetto's (2011) Research Pyramid were also used to determine the strength of evidence for all studies. Based on the present literature analysis there is limited to moderate evidence for nine SBIs.

One primary implication of the present findings is that future research on SBIs should include replication of existing studies, implementation of new studies concerning the efficacy of SBIs in general education classrooms, as well as studies with larger sample sizes, more thorough statistical analysis, and more detailed descriptions of interventions to allow for translation into practice. The primary implication for practitioners is that SBIs with limited to moderate evidence may improve classroom outcomes for specific populations. It is essential that these interventions be implemented with a strong rationale and with systematic monitoring of outcomes to inform intervention adjustments based on individual needs. The populations most studied in the current literature are children with autism, attention deficit hyperactivity disorder (ADHD), and developmental disabilities. It is recommended that families of children with these diagnoses advocate for SBIs that have been found to be effective for the populations whose diagnostic and age characteristics match that of their child.

The knowledge translation process consisted of two components: (1) the creation of a movement program designed to regulate classroom behavior through the use of proprioceptive and vestibular input, and (2) the delivery of an in-service for occupational therapists in the Central Kitsap school district, as well as a kindergarten teacher who agreed to informally trial Break 5 in her classroom. The two main objectives of the in-service were to share the findings of the present study, as well as provide instruction for the use of Break 5. Positive feedback was received in a follow-up survey regarding both the in-service presentation and the successful use of the movement program by the kindergarten teacher and two occupational therapists. Additionally, the authors are currently in collaboration with the principal of the elementary school who is interested in implementing Break 5 school-wide.

Sensory-Based Interventions for a School Setting

Focused Question:

What is the impact of sensory-based interventions (SBIs), besides dynamic seating, weighted vests and Ayres Sensory Integration®, on attention, behavior, and academic performance for children with or without diagnoses from preschool to high school?

Collaborating Occupational Therapy Practitioner:

Jamie Palmer, DrOT

Prepared By:

Ashley Davies, Leilani Jones, Katrina LaRossa, Julia Shure

Chair:

Renee Watling, PhD, OTR/L, FAOTA

Course Mentor:

Renee Watling, PhD, OTR/L, FAOTA

Date Review Completed:

10/27/17

Clinical Scenario:

An occupational therapist working for a local school district treats children from preschool through high school using both pull out and push in intervention methods. She would like to know more about the evidence for different SBIs on behavior, attention, and academic performance. She most commonly sees children diagnosed with sensory processing disorder, autism spectrum disorder (ASD), oppositional defiant disorder, attention deficit hyperactivity disorder (ADHD), and developmental delays, but is interested in evidence including children both with and without these diagnoses. Her district already supports dynamic seating and weighted vests, but she is interested in other SBIs outside of these, including hand tools, heavy work tasks, or deep pressure input through tools like a Lycra sleeve. This knowledge would inform her decisions regarding whether or not to support the implementation of SBIs in a school setting, as well as help her determine which particular interventions may be most effective.

Review Process

Procedures for the selection and appraisal of articles

Inclusion Criteria:

- Outcomes related to attention, behavior and/or academic performance
- Children between preschool and high school age
- Multi-sensory and single-sensory based interventions
- All levels of evidence

Exclusion Criteria:

- Ayres Sensory Integration® as the sole intervention or if Ayres Sensory Integration® training is required for intervention
- Outcomes that focused exclusively on stereotypic or self-stimulatory behaviors
- Dynamic seating as the sole intervention
- Weighted vests as the sole intervention
- Population limited to children with blindness or deafness
- Multisensory teaching approaches for specific academic areas such as handwriting and/or reading
- If special training is needed to implement intervention
- Intensive programs that are not practical in school setting due to extensive training, time or equipment demands
- Non-peer reviewed research literature
- Theses

Search Strategy

Categories	Key Search Terms
Patient/Client Population	Children with or without diagnosis from preschool to high school
Intervention (Assessment)	Sensory based interventions (not including dynamic seating, weighted vests, and Ayres Sensory Integration®)
Comparison	To other interventions or to a control group (absence of sensory based interventions)
Outcomes	Attention, behavior and academic performance

Databases and Sites Searched

ERIC, Teacher Reference Center, Academic Search Premier, PsycINFO, CINAHL, OTSearch, PubMed, ProQuest Central, AJOT, AOTA Sensory Integration SIS Quarterly, AOTA School Systems SIS Quarterly, Psychology and Behavior Sciences Collection (PBSC)

Quality Control/Review Process:

The development of our research question began with an in-person meeting with our collaborating occupational therapist, and was refined through in-person and email discussion with our course mentor and through peer feedback and discussion. We developed our inclusion and exclusion criteria based on our collaborating occupational therapist's interest, our course mentor's advice, and the body of literature about this topic.

Once our research question was finalized, we developed a comprehensive search strategy. We created a table of key search terms including synonyms for all categories of terms such as population, intervention, comparison, and outcomes. We then selected the databases to be searched, divided them up among ourselves and searched each database using a consistent set of search terms to ensure all relevant articles were found in each database (Table 1). We continued searching until we felt we had reached a point of saturation. We determined whether or not an article was a duplicate by consulting a shared master article list to see if the article in question had been found yet. If not, we added it to the master list and noted the number of duplicates within our search strategy row (Table 1). Out of 9,064 initial hits, 606 articles were selected as relevant based on title and quick screen of abstract. After filtering out 392 duplicates, 214 articles remained. At this stage, we reviewed each individual article and found that 28 met our inclusion criteria. Those that were not included were excluded for the following reasons:

- Inability to access full text and thus could not review (27),
- Involving Ayres' Sensory Integration®, dynamic seating, or weighted vests (23),
- Multisensory teaching approach (21),
- Did not fully meet inclusion criteria due to irrelevant outcomes, population, or intervention (49),
- Intensive or highly specialized interventions not feasible in school setting (16),
- Theses (7),
- Not peer-reviewed (5), and
- Conceptual rather than research-based (35).

15 systematic and literature reviews were not included in the CAT table, but were used for reference and citation tracking. These were divided up among the group of students. This resulted in 4 additional articles selected for inclusion (Table 2). We also completed citation tracking for the 4 included articles and selected 1 article for inclusion (Table 3). Overall, our CAT table contains 33 articles, 28 from database searches, 4 from reference tracking, and 1 from citation tracking.

Key players in our review process include all four students, peers who offered feedback, our course mentor and chair, and our university's science library liaison.

Results of Search

Search term table.

Search #	Search Terms
	Sensory Words + Intervention Words + Population
1. Behavior Outcomes	(behavior* OR impuls* OR "self-harm* OR self-injur* OR aggress*) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND (intervention* OR treatment* OR management* OR strateg* OR approach*) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
2. Attention Outcomes	(focus OR alert* OR engagement OR on-task OR distract* OR orient* OR in-seat) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND (intervention* OR treatment* OR management* OR strateg* OR approach*) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
3. Academic Outcomes	("academic performance" OR "school performance" OR "school work" OR "class work" OR "work completion" OR "academic outcomes" OR grades OR "grade point average" OR "academic achievement" OR handwriting OR legibility OR productivity OR "school-related abilities" OR reading) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND (intervention* OR treatment* OR management* OR strateg* OR approach*) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
	Sensory Words + Equipment + Population
4. Behavior Outcomes	(behavior* OR impuls* OR "self-harm* OR self-injur* OR aggress*) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND ("sensory equipment" OR fidget* OR foot-fidget* OR chew* OR trampoline OR swing* OR "body sock" OR "sensory sock" OR "sensory tool" OR "sensory tools" OR lycra) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)

5. Attention Outcomes	(focus OR alert* OR "sensory engagement" OR on-task OR distract* OR orient* OR in-seat) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND (equipment OR fidget* OR foot-fidget* OR chew* OR trampoline OR swing* OR "body sock" OR "sensory sock" OR "sensory tool" OR "sensory tools" OR lycra) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
6. Academic Outcomes	("academic performance" OR "school performance" OR "school work" OR "class work" OR "work completion" OR "academic outcomes" OR grades OR "grade point average" OR "academic achievement" OR handwriting OR legibility OR productivity OR "school-related abilities" OR reading) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND ("sensory equipment" OR fidget* OR foot-fidget* OR chew* OR trampoline OR swing* OR "body sock" OR "sensory sock" OR "sensory tool" OR "sensory tools" OR lycra) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
	Specific Sensory Interventions + Population
7. Behavior Outcomes	(behavior* OR impuls* OR "self-harm* OR self-injur* OR aggress*) AND ("sensory-based interventions" OR sensory-based intervention" OR "sensory room" OR "sensory rooms" OR "multisensory room" OR "multisensory rooms" OR "multi-sensory rooms" OR "snoezelen room" OR "snoezelen rooms" OR "heavy work" OR "deep pressure" OR "sensory diet" OR "sensory diets" OR "sensory break" OR "sensory breaks" OR "oral sensory" OR "sound therapy" OR "therapeutic listening") OR (sensory OR propriocep* OR vestibular OR multisensory OR multi-sensory OR somatosensory OR tactile OR auditory AND stimulation) OR (sensory OR propriocep* OR vestibular OR multisensory OR multi-sensory OR somatosensory OR tactile OR auditory AND input) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)

8. Attention Outcomes	(focus OR alert* OR engagement OR on-task OR distract* OR orient* OR in-seat) AND ("sensory-based interventions" OR sensory-based intervention" OR "sensory room" OR "sensory rooms" OR "multisensory room" OR "multisensory rooms" OR "multi-sensory rooms" OR "snoezelen room" OR "snoezelen rooms" OR "heavy work" OR "deep pressure" OR "sensory diet" OR "sensory diets" OR "sensory break" OR "sensory breaks" OR "oral sensory" OR "sound therapy" OR "therapeutic listening") OR (sensory OR propriocep* OR vestibular OR multisensory OR multi-sensory OR somatosensory OR tactile OR auditory AND stimulation) OR (sensory OR propriocep* OR vestibular OR multisensory OR multi-sensory OR somatosensory OR tactile OR auditory AND input) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
9. Academic Outcomes	("academic performance" OR "school performance" OR "school work" OR "class work" OR "work completion" OR "academic outcomes" OR grades OR "grade point average" OR "academic achievement" OR handwriting OR legibility OR productivity OR "school-related abilities" OR reading) AND ("sensory-based interventions" OR sensory-based intervention" OR "sensory room" OR "sensory rooms" OR "multisensory room" OR "multisensory rooms" OR "multi-sensory rooms" OR "snoezelen room" OR "snoezelen rooms" OR "heavy work" OR "deep pressure" OR "sensory diet" OR "sensory diets" OR "sensory break" OR "sensory breaks" OR "oral sensory" OR "sound therapy" OR "therapeutic listening") OR (sensory OR propriocep* OR vestibular OR multisensory OR multi-sensory OR somatosensory OR tactile OR auditory AND stimulation) OR (sensory OR propriocep* OR vestibular OR multisensory OR multi-sensory OR somatosensory OR tactile OR auditory AND input) AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
	Specific Interventions Paired with Sensory Words + Population
10. Behavior Outcomes	(behavior* OR impuls* OR "self-harm* OR self-injur* OR aggress*) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND ("system support" OR "system supports" OR "system wide-support" OR "system wide-supports" OR "environmental modification" OR environmental modifications" OR brushing OR "brushing protocol") AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)

11. Attention Outcomes	(focus OR alert* OR engagement OR on-task OR distract* OR orient* OR in-seat) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND ("system support" OR "system supports" OR "system wide-support" OR "system wide-supports" OR "environmental modification" OR environmental modifications" OR brushing OR "brushing protocol") AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)
12. Academic Outcomes	("academic performance" OR "school performance" OR "school work" OR "class work" OR "work completion" OR "academic outcomes" OR grades OR "grade point average" OR "academic achievement" OR handwriting OR legibility OR productivity OR "school-related abilities" OR reading) AND (sensory OR multisensory OR multi-sensory OR somatosensory) AND ("system support" OR "system supports" OR "system wide-support" OR "system wide-supports" OR "environmental modification" OR environmental modifications" OR brushing OR "brushing protocol") AND (children OR school-age OR preschool OR "primary school" OR "secondary school" OR kid* OR student* OR adolescent* OR "middle school" OR "junior high" OR "high school" OR teen* OR child* OR classroom*)

Note. This is a table of the search term combinations that were used for each database.

Table 1. Search of databases with term combinations above.

CINAHL

Search Terms (search #, see above)	**Date**	**Database**	**Filters Applied (e.g. abstract only)**	**Initial Hits**	**Articles Excluded**	**Total Selected (includes duplicates)**	**Duplicates**
1.	10/14/17	CINAHL	Abstract Only	207	182	16	3
2.	10/15/17	CINAHL	Abstract Only	151	147	4	2
3.	10/15/17	CINAHL	Abstract Only	61	53	8	3
4.	10/15/17	CINAHL	Abstract Only	5	4	1	0
5.	10/15/17	CINAHL	Abstract Only	3	3	0	0
6.	10/15/17	CINAHL	Abstract Only	1	1	0	0
7.	10/16/17	CINAHL	Abstract only (parts1,3) & Title only (part 2)	164	147	17	13
8.	10/16/17	CINAHL	Abstract only	8	7	1	0

9.	10/16/17	CINAHL	Abstract only (parts1,3) & Title only (part 2)	32	26	6	5
10.	10/16/17	CINAHL		4	4	0	0
11.	10/16/17	CINAHL		8	8	0	0
12.	10/16/17	CINAHL		3	3	0	0
Total				647		53	

PubMed

1.	10/16/17	PubMed	Title/Abstract & English	598	576	22	16
2.	10/16/17	PubMed	Title/Abstract & English	245	239	6	4
3.	10/16/17	PubMed	Title/Abstract	113	106	7	4
4.	10/16/17	PubMed	Title/Abstract	11	9	2	2
5.	10/16/17	PubMed	Title/Abstract	5	5	0	0
6.	10/16/17	PubMed	Title/Abstract	2	2	0	0
7.	10/16/17	PubMed	Title/Abstract	25	25	0	0

8.	10/16/17	PubMed	Title/Abstract OR Title	47,812 0	?	?	?
9.	10/16/17	PubMed	Title/Abstract OR Title Title & Review	22,891 2,773 70	70	0	0
10.	10/16/17	PubMed	Title/Abstract & NOT (tooth OR teeth OR hair OR hygiene)	0	0	0	0
11.	10/16/17	PubMed	Title/Abstract & NOT (tooth OR teeth OR hair OR hygiene)	448	439	9	7
12.	10/16/17	PubMed	Title/Abstract & NOT (tooth OR teeth OR hair OR hygiene)	276	265	11	8
Total				1,793		57	

OTSearch

1.	10/16/17	OTSearch	Words and phrases (simplified terms)	107	90	17	7
2.	10/16/17	OTSearch	Words and phrases (simplified terms)	97	63	14	11

3.	10/16/17	OTSearch	Words and phrases (simplified terms)	45	36	9	6
4.	10/17/17	OTSearch	Words and phrases (simplified terms)	16	11	5	5
5.	10/17/17	OTSearch	Words and phrases (simplified terms)	12	10	2	2
6.	10/17/17	OTSearch	Words and phrases (simplified terms)	13	12	1	1
7.	10/17/17	OTSearch	Words and phrases	76	68	8	6
8.	10/17/17	OTSearch	Words and phrases	20	14	6	4
9.	10/17/17	OTSearch	Words and phrases	11	8	3	3
10.	10/17/17	OTSearch	Words and phrases	0	0	0	0
11.	10/17/17	OTSearch	Words and phrases	0	0	0	0
12.	10/17/17	OTSearch	Words and phrases	0	0	0	0

Total				397		65	

PsychINFO

1.	10/15/17	PsychINFO	AB/TI/TI/AB	53	35	18	10
2.	10/16/17	PsychINFO	AB/TI/TI/AB	33	26	7	5
3.	10/16/17	PsychINFO	AB/TI/TI/AB	16	2	14	8
4.	10/16/17	PsychINFO	AB all	21	17	4	2
5.	10/16/17	PsychINFO	AB all	20	16	4	2
6.	10/16/17	PsychINFO	AB all	1	1	0	0
7.	10/16/17	PsychINFO	AB/TI/AB	504	Not searched		
8.	10/16/17	PsychINFO	0	0	0	0	0
9.	10/16/17	PsychINFO	MODIFIED SEARCH TERMS ; SEE BELOW*	11	4	7	6
10.	10/16/17	PsychINFO	None	5	5	0	0
11.	10/16/17	PsychINFO	None	2	1	1	0
12.	10/16/17	PsychINFO	None	0	0	0	0
Total				666		55	

Psychology and Behavior Sciences Collection (PBSC)

1.	10/16/17	(PBSC)	AB/TI/TI/AB	7	2	5	5

2.	10/16/17	PBSC	AB/TI/TI/AB	2	1	1	1
3.	10/16/17	PBSC	AB/TI/TI/AB	3	1	2	2
Total				12		8	

ProQuest Central

1.	10/15/17	ProQuest Central	Outcomes in title, all other terms in abstract; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	76	63	13	12
2.	10/15/17	ProQuest Central	All terms in abstract; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	198	184	14	11
3.	10/15/17	ProQuest Central	Sensory in title, other terms in abstract; Source type Dissertations & Theses, Reports, Scholarly Journals,	42	35	7	7

			Standards & Practice Guidelines, Trade Journals				
4.	10/15/17	ProQuest Central	Broad sensory words, outcomes, and population in abstract, equipment words anywhere Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	121	87	34	20
5.	10/15/17	ProQuest Central	Broad sensory words and outcomes in abstract, other terms anywhere; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	139	135	4	3
6.	10/14/17	ProQuest Central	Broad sensory words and outcomes in abstract, other terms anywhere;	39	28	11	4

			AND Sensory Equipment in abstract, all other terms anywhere *; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals				
7.	10/14/17	ProQuest Central	All search terms in title; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	98	80	18	4
8.	10/14/17	ProQuest Central	Outcome in title, other terms in abstract; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	133	121	12	2
9.	10/14/17	ProQuest Central	Intervention and outcome words in title, population in	183,460 before filter;	83 (out of 94)	11	0

			abstract; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	94 after			
10.	10/13/17	ProQuest Central	Abstract Only for sensory and outcome terms; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	117 after filter	95	22	2
11.	10/13/17	ProQuest Central	Abstract Only for sensory and outcome terms; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards & Practice Guidelines, Trade Journals	4,189 initially, 45 after filter	41	4	4
12.	10/13/17	ProQuest Central	Abstract Only for outcome terms; Source type Dissertations & Theses, Reports, Scholarly Journals, Standards &	3,470 initially; 162 after filter	162	0	0

			Practice Guidelines, Trade Journals				
Total				1,264		150	

ERIC

1.	10/13/17	ERIC	N/A	522	503	19	0
2.	10/14/17	ERIC	No books or magazines	495	483	12	9
3.	10/14/17	ERIC	No books or magazines	575	564	11	2
4.	10/14/17	ERIC		7	5	2	1
5.	10/14/17	ERIC		4	3	1	1
6.	10/14/17	ERIC		2	2	0	0
7.	10/14/17	ERIC	AB for outcomes and pop, TI for intervention	120	102	18	13
8.	10/14/17	ERIC	AB for outcomes and population, TI for interventions	141	123	18	14
9.	10/14/17	ERIC	AB- outcomes and population, TI for interventions	171	166	5	5
10.	10/14/17	ERIC		1	1	0	0

11.	10/14/17	ERIC		0	0	0	0
12.	10/14/17	ERIC		0	0	0	0
Total				2,179		86	

Academic Search Premier

1.	10/15/17	Academic Search Premiere	Abstract only, academic journals, full text	115	110	5	3
2.	10/15/17	Academic Search Premiere	Abstract only, academic journals, full text	122	199	2	1
3.	10/15/17	Academic Search Premiere	Abstract only, academic journals	134	131	3	3
4.	10/15/17	Academic Search Premiere		21	17	4	2
5.	10/15/17	Academic Search Premiere		13	11	2	2
6.	10/15/17	Academic Search Premiere		0			
7.	10/15/17	Academic Search Premiere	AB for outcome and population, title for intervention Full text, academic journals	434	426	8	4
8.	10/15/17	Academic Search Premiere	Title only for outcome and intervention, AB for	62	61	1	1

			population, full text				
9.	10/15/17	Academic Search Premiere	AB only, full text	236	233	3	3
10.	10/15/17	Academic Search Premiere		2	1	1	0
11.	10/15/17	Academic Search Premiere		1	1	0	0
12.	10/15/17	Academic Search Premiere		0	0	0	0
Total				1,140		29	

Teacher Reference Center

1.	10/17/17	Teacher reference center		95	92	3	3
2.	10/17/17	Teacher reference center		43	42	1	1
3.	10/17/17	Teacher reference center		43	41	2	2
4.	10/17/17	Teacher reference center		0	0	0	0
5.	10/17/17	Teacher reference center		0	0	0	0
6.	10/17/17	Teacher reference center		0	0	0	0
7.	10/17/17	Teacher reference center		84	81	3	3
8.	10/17/17	Teacher reference center		122	120	2	2
9.	10/17/17	Teacher reference center		108	108	0	0

10.	10/17/17	Teacher reference center		0	0	0	0
11.	10/17/17	Teacher reference center		0	0	0	0
12.	10/17/17	Teacher reference center		0	0	0	0
Total				495		11	

AJOT/AOTA (sensory integration & school sections special interest section)

1.	10/15/17	AJOT/AOTA	Abstract only all terms	16	10	6	5
2.	10/15/17	AJOT/AOTA	Outcomes in abstract, all other terms anywhere	34	30	4	4
3.	10/15/17	AJOT/AOTA	Outcomes in abstract, all other terms anywhere	23	21	2	2
4.	10/15/17	AJOT/AOTA	none	65	50	15	6
5.	10/15/17	AJOT/AOTA	none	59	45	14	13
6.	10/15/17	AJOT/AOTA	none	36	23	13	13
7.	10/15/17	AJOT/AOTA	Outcomes and SBI synonyms in abstract	37	29	8	7
8.	10/15/17	AJOT/AOTA	Outcomes in abstract	39	33	6	4
9.	10/15/17	AJOT/AOTA	Outcomes in abstract	27	24	3	2
10.	10/15/17	AJOT/AOTA	none	53	8	6	0
11.	10/15/17	AJOT/AOTA	none	47	39	8	8
12.	10/15/17	AJOT/AOTA	none	35	28	7	7

Total				471		92	

Total initial hits =	9,064
Total duplicates =	392
Total number of articles retained for in depth review =	214

Note. Numbers in the search column correspond with this those in the Search Terms Table to indicate which search combination was used.

Table 2. Articles from reference tracking.

Article	**Date**	**Articles Referenced**	**Articles Excluded**	**Total Selected for Review**	**Duplicates (of total selected, number already found)**
Wan Yunus, Liu, & Bissett (2015)	10/20/17	65	57	8	8
Case-Smith & Arbesman (2008)	10/21/17	65	64	1	0
Polatajko & Cantin (2010)	10/22/17	31	31	0	0
Hoy, Egan, & Feder (2011)	10/23/17	69	69	0	0
Watling and Hauer (2015)	11/4/17	181	177	4	4
Worthen, (2010)	11/4/17	13	8	4	4
American Occupational Therapy Association (2015)	11/4/17	93	90	3	3
Scheerer (1992)	11/5/17	44	44	0	0
Case-Smith, Weaver, Fristad, M. (2015)	11/5/17	81	74	7	6
Pagano (2005)	11/7/17	46	44	2	2
Lotan & Shapiro (2005)	11/7/17	42	41	1	0
Barton, Reichow, Schnitz, Smith, & Sherlock (2015)	11/1/17	60	57	3	3
Ashburner, Rodger, Ziviani, & Hinder (2014)	11/1/17	67	64	3	2
Baranek (2002)	11/1/17	96	95	1	1
Brondino, Fusar-Poli, Rocchetti, Provenzani, Barale, & Politi (2015)	11/1/17	147	145	2	2
Total number of articles used in review from reference tracking = 4					

Table 3. Articles from citation tracking.

Article	Date	Database	Initial Hits	Articles Excluded	Total Selected for Review	Duplicates (of total selected, number already found)
Watling and Hauer (2015)	11/4/17	ProQuest	5	5	0	0
Scheerer (1992)	11/4/17	ProQuest	2	2	0	0
Lotan, & Shapiro (2005).	11/8/17	PsyInfo	3	2	1	0
Pagano (2005)	11/8/17	ERIC	0	0	0	0
Total number of articles used in review from citation tracking =1						

Total number of articles used in review from database searches = 28
Total number of articles used in review from reference tracking = 4
Total number of articles used in review from citation tracking = 1
Total number of articles used in CAT = 33

Summary of Study Designs of Articles Selected for the CAT Table

Pyramid Side	Study Design/Methodology of Selected Articles	Number of Articles Selected
Experimental	___ Meta-Analyses of Experimental Trials 1 Individual Randomized Controlled Trials 1 3 Controlled Clinical Trials 2 20 Single Subject Studies	24
Outcome	___ Meta-Analyses of Related Outcome Studies 2 Individual Quasi-Experimental Studies 1 Case-Control Studies 3 One Group Pre-Post Studies	6

Qualitative	___ Meta-Syntheses of Related Qualitative Studies 2__ Small Group Qualitative Studies 2__ prolonged engagement with participants 1__ triangulation of data (multiple sources) 1__ interpretation (peer & member-checking) ___ a posteriori (exploratory) vs a priori (confirmatory) interpretive scheme ___ Qualitative Study on a Single Person	2
Descriptive	___ Systematic Reviews of Related Descriptive Studies ___ Association, Correlational Studies __ Multiple Case Studies (Series), Normative Studies 1__ Individual Case Studies	1
AOTA Levels I- 1 II- 6 III- 3 IV- 20 V- 3 Comments: 20 of the 33 included studies were experimental single-subject research designs (SSRD). Two studies are qualitative and so are not classifiable in AOTA's levels of evidence but are included in the count under AOTA level V.		*TOTAL* = 33

Table Summarizing QUANTITATIVE Articles

Author, Year, Journal, Country	Study Objectives	Study Design/ Level of Evidence/ Pedro scale/ Quality of SSRD	Participants: Sample Size, Description Inclusion/ Exclusion Criteria	Interventions & Outcome Measures	Summary of Results	Study Limitations
SINGLE-SENSORY INTERVENTIONS						
Abikoff 1996 *J of Learn Diasab* US	Evaluate impact of auditory stimulation on arithmetic performance	Case-Controlled study Level II O3 5/6	*N* = 40, grades 2-6, 40 males Tx: *n* = 20 w/ ADHD, *M* age = 10.08 Ctrl: *n* = 20 w/o dx, *M* age = 9.78 In: average arithmetic performance Ex: additional dx	Tx implemented during math test. Two groups matched and randomized to 6 sequences. A: 10 mins music of individual's choice B: 10 mins background speech C: 10 mins silence O: # problems attempted, # correct, rate of correct answers	Tx group had more correct answers w/ A $F(2, 76) = 5.36$ $p < .01$ than w/ C ($p < .05$) or B ($p < .01$) Tx group w/ A first had more correct answers than children in all other sequences ($p < .05$) Tx group who had A first attempted more problems than all other sequences except for typical children w/ A last Ctrl group had no sig difference across conditions	Small sample, potential novelty effect, no mention of blinding, children struggling in arithmetic not included

Kassinove 1972 *J Edu Psych* US	Determine whether auditory stim has an effect on child's arithmetic performance	Quasi-experimental w/ Covariate Level II O2 6/10	*N* = 80, *n* = 40 3rd graders, *n* = 40 4th graders, 40 males In = 3rd or 4th grade Ex = special ed class, having repeated yr of school, hearing difficulties	Each student received 1 of 5 tx conditions during one 45-min session Tx: No stim, stories, music, music + stories same physical source, music + story opposite physical source Covariates: prior arithmetic achievement levels, task difficulty levels, & grade level O: *M* duration per response, # correct responses, # of "time-outs"	Type of auditory stim did not have impact on any O measures on arithmetic performance ($p < .05$) No sig interactions btwn auditory stim conditions and covariates ($p < .01$)	Participants not randomized to tx; limited generalizability to gen ed classroom; duration of time-outs not included
Nwora & Gee 2009 *Occup. Ther. Int.* US	Explore the impact of TLP on active participation & functional behavior	Individual Case Study D4 Level V 1/3	*N* = 1, 5 yo, male w/ PDD-NOS In/Ex: not specified	Tx: TLP; two 15-min sessions/day for 20 wks O: Listening Checklist (LC); active participation in music class based on qualitative observations of video footage taken pre & post-intervention; 45-60 min duration	Improvements noted in some areas of LC related to functional behavior "Marked improvement" in active participation according to video observations; improved social interactions w/ peers & teacher, & improved attention.	Limited generalizability; SLP simultaneous; no stat analysis; vague description of I frequency, operationalization of outcomes, and specific setting of tx
Field, et al. 1997 *J of Autism & Dev Disord* US	Investigate effects of touch therapy on inattentiveness, touch aversion, & withdrawal	RCT E2 Level I 5/10	*N* = 22, *M* age = 4.5 yo, w/ ASD	Tx: Touch therapy in preschool classroom by student volunteer 15 mins/day, 2 days/wk, 4 wks Ctrl: Student volunteer sat w/ child in lap w/ arms around child while playing a game. 15 mins/day, 2 days/wk, 4 wks O: Frequency of off-task behavior	Off-task behavior decreased in both groups $F(1, 20) = 7.18$, $p < .05$; no difference btwn groups.	Small sample; tx & ctrl similar in terms of deep pressure and one-on-one attention; unclear tx location, no mention of # of participants in each group

MULTISENSORY INTERVENTIONS						
Thompson 2011 *J of Spec Edu* US	Determine whether multi-sensory space impacts sustained focus, engagement level and SIB	One-group pre/post test Level III O4 4/6	*N* = 50, age = 6 - 17 yo, 24 males, students w/ "severe developmental disabilities"	Tx: exposure to multi-sensory space O: *M* sustained focus, engagement and SIB measured by observed frequency of associated facial expressions, body language, and vocal cues; measured before, during and after tx	Following tx: *M* sustained focus level increased by 14% ($p <$ .001), *M* engagement level increased by 13% ($p <$ .05), *M* SIB decreased by 98%	Lack multi-sensory room description; did not specify duration of exposure to tx; lack of control group; no blinding; potential for hawthorne effect
Tunson & Candler 2010 *Phys. Occup. Ther. in Pediatr.* US	Compare behavioral states of children w/ and w/o a MSE	Single-Subject ABAB Design E4 Level IV 3/7 Moderate	*N* = 3, age = 3-10 yo, 2 males w/ severe multiple impairments, medically fragile, nonambulatory, no conventional communication skills, dependent on others for basic needs Ex: visual impairment, ventilator-dependent, in vegetative state, contagious illness	8 wks, 3 days/wk for 30 min w/ recordings at 10 min intervals A: Baseline, bare classrooms B: Multisensory equipment provided O: observation of behavioral states (asleep, awake/agitated, awake/inactive, self-directed, visually attentive, active reaching)	Visual analysis of variability indicates: 1 participant increased visual attentiveness & reaching behaviors during B phases 2 participants showed no distinct differences in responsiveness between A & B phases	Small sample size; no comparison of other changes in environment or activity; no stat analysis completed

Shapiro et al. 1997 *The Brit J of Dev Disabilities* UK	Investigate short term efficacy of Snoezelen room on adaptive and maladaptive behaviors	Experimental crossover design Level II E2 6/10	*N* = 20, ages 5-10, mean age 7.5 years, 15 males, mod or severe ID Randomly assigned to Group A (*n* = 10) & Group B (*n* = 10)	Group A tx then ctrl; Group B ctrl then tx Tx: 20 mins in Snoezelen room, 2x Ctrl: 20 mins in playroom, 2x O: frequency of adaptive or maladaptive behaviors during tx & ctrl	Both groups had higher *M* # (*F* = 7.12) & duration (*F* = 72.94) of adaptive behaviors in tx than ctrl (*p* < .001) Both groups had lower *M* # (*F* = 38.13) & duration (*F* = 56.43) of maladaptive behaviors in tx than ctrl (*p* < .001)	Small sample, no baseline, no follow-up
Benson et al. 2011 *J of OT, Schools, & EI* US	Explore effects of DPPT & child-guided brushing program	One-group pre/post test Level III O4 3/6	*N* = 2, age = 5 yo, 2 males, 1 w/ ASD, 1 w/ PDD-NOS In: appearance of sensory modulation difficulties as judged by school occupational therapist	Tx (Subject 1): DPPT brushing protocol 3x/day, 21 days w/ individualized sensory diet Tx (Subject 2): child-guided brushing program 1x/day or as needed/requested for 22 days O: SFA	Scores on SFA improved in both subjects after tx; subject 1 improved in task behavior/completion (4% increase) subtest; subject 2 improved in following adult directives (11% increase) & school rules (6% increase)	Small sample; both children observed to have positive response to somatosensory input prior to tx; no blinding.
Bongatt & Hall 2010 *ETADD* US	Evaluate effects of sensory integration-based activities on on-task behaviors	Single-Subject Alternating Tx BCBC Design w/ counterbalancing E4 Level IV 4/7 Moderate	*N*= 3, males, 4 yo, 2 w/ developmental delay, 1 w/ ASD	B: DPPT & hammock swing for 10 min. C: Attention ctrl w/ non-sensory activity for 10 min. O: frequency of on-task behavior during independent and 1:1 activities, frequency of disruptive behaviors	Visual analysis of trend change indicated: 3 students showed no difference in O btwn tx conditions	Limited time frame; low generalizability; no baseline established; sampling method not documented

Devlin et al. 2009 *Res Autism Spec Disord* US	Compare effects of sensory diet and behavioral interventions on rates of SIB	Single-Subject Alternating Tx BCBCD Design w/ final best tx phase. E4 Level IV 4/7 Moderate	*N* = 1, age = 10 yo, male, dx of ASD & epilepsy	10 days, final best tx phase - 7 days B: DPPT, joint compression, and individualized sensory diet, 30mins/2 hrs/school day or during challenging behaviors C: Behavioral I consisting of variable schedule of reinforcement: verbal praise & tangibles, physical blocking, redirection, fading D: tx associated w/ greatest reduction of SIBs O: # of incidence/day of SIB by direct observation	Visual analysis of level and trend indicated: Behavioral tx associated w/ decrease of SIB No trend observed in sensory diet tx	Variable data points; Did not analyze function of SIB; SIB may have provided positive reinforcement of behaviors; SIB provided non-contingently; vague baseline data
Aronoff et. al 2016 *Neural Plasticity* US	Determine impact of daily sensory enrichment on attention span, learning and behavior.	One-group pre/post test Level III O4 5/6	*N* = 1,002, age = 1-18 yo (*M* = 7.37 yo), 796 males 630 w/ ASD, 31 w/ PDD, 18 w/ ADHD, 10 w/ developmental delay, 271 no formal dx	1-2x/day, 10-15 min/session plus additional 30-60 sec/day olfactory, tactile stimuli exposure. Tx: Individualized sensory diet, customized by online software based on a parent questionnaire, w/ verification of occupational therapists; administered by parents O: *M* composite attention span, learning and behavior scores from parental questionnaire responses.	Improvements in: attention span $t(955) = -19.12$, $p < .00001$, learning $t(935) = -22.77$, $p < .00001$, behavior $t(970) = -20.28$, $p < .00001$ Children across all dx categories improved in all 3 outcomes ($p < .00001$ - $p < .003$). No sig differences in improvement btwn genders, age, initial symptom severity.	No ctrl group; telehealth and parent implementation limits generalizability; potential threats to validity inherent in parental reported O

Devlin et al. 2011 *J of Autism & Dev Disord* US	Compare effects of sensory diet & behavioral interventions on challenging behaviors	Single-Subject Alternating Tx ABCBCD Design w/ counterbalancing, baseline & final best tx phase. E4 Level IV 4/7 Moderate	*N* = 4, age = 6-11 yo, 4 males In: Hx of challenging behavior, aggression, or SIB	10 days BC, 8 days D A: Baseline, no tx, withdrawal B: Individualized sensory diet consisting of vestibular, proprioceptive, oral-motor, & tactile input, brushing, & joint compression for 15 mins, 6x/day every 5 mins C: Behavioral I consisting of variable schedule of reinforcement: verbal praise & tangibles, physical blocking, redirection, fading D: Best tx phase: condition associated w/ greatest reduction of challenging behaviors O: # of challenging behavior incidents/day by direct observation	Visual analysis of level indicated: 3 participants decreased *M* frequency of challenging behaviors in both tx conditions *M* frequency of challenging behaviors lower for behavioral tx than sensory diet tx for all 4 participants Challenging behaviors reduced to zero levels in best tx phase (D) for all 4 participants	Did not analyze function of challenging behaviors; sensory diet may have provided positive social reinforcement of behaviors; small sample size; vague tx locations
Schoen et al. 2016 *AJOT* US	Examine effectiveness of iLs Focus Series sensory-motor program	Single-Subject ABA Design Level IV E4 4/7 Moderate	*N* = 7, age = 5-12 yo males In: sensory processing impairment measured by Sensory Processing Scale Inventory interfering w/ function at home or school, ages 4-18, WNL on school aptitude tests, parent report of auditory processing problems & normal hearing, parent/child willingness Ex: comorbid disorders, participation in other	A: Baseline, no tx B: iLs program w/ visual motor activities A: Return to baseline, no tx 1hr, 5 days/wk, for 8 wks; 4x at home w/ parent and 1x at clinic w/ research assistant O: Individual goals using VAS- included following directions, completing homework and reducing emotional outbursts	Visual analysis of level, trend, and variability and statistical analysis showed significant progress toward individual goals in all 7 participants; (p<.001)	Results not generalizable; not blinded; no follow up

			therapy, inability to wear headphones for hr			
Demanche & Chok 2013 *J of Dev & Phys Disabilities* Germany	Examine effectiveness of wrist weights and vibratory stimulation on SIB	Single-Subject w/ Multiple Tx ABACADCEFE Design E4 Level IV 4/7 Moderate	*N* = 1, 12 yo, male w/ ASD & mod ID, hx of frequent SIB, lack of success w/ previous tx to decrease SIB	Tx provided daily throughout 5-6/hr school day for 286 days Type and intensity of tx contingent on individual's SIB; vibratory stim activated hourly or upon request A: Baseline, included physical blocking of SIB by teacher B: Wrist weights w/ varying weights C: Vibratory stim to back; wrist weights D: Vibratory stim to back E: Vibratory stim to back and head; wrist weights F: Vibratory stim to back and head O: Rate of # of SIB/hr.	Visual analysis of level indicated: *M* SIB rate decreased w/ wrist weights *M* SIB rate reduced w/ weights and 2 massagers *M* SIB increased when weights removed Teachers report increase in participation as SIB decreased	Tx included in baseline measures for safety reasons; inconsistent length of phases; did not measure adaptive behavior; sensory tx did not affect body areas involved in typical SIB
TACTILE FINE MOTOR ACTIVITY						
Emmert, et al. 2009 *J of the Am. Acad of Sp. Ed. Professionals*	Compare effectiveness of tactile and auditory stimulation on math problem solving	Single-Subject Alternating Tx ABCBCD Design Level IV E4	N = 3, 1 female, 4th and 5th graders in gen ed classroom In: Hx of attentional difficulties identified by parents and teachers	Tx: Total of 24 sessions; 20 min each A: Baseline; 5 sessions B: FM tactile stim (Tangle Puzzle-Jr.) available during completion of math problems; 6 sessions	Visual analysis of level indicated: 3 students improved in on-task performance in all three stimulation conditions (B, C & D) 2 students had slight improvement in math performance w/ auditory	Small sample size; short duration for choice tx phase; music genre not chosen by students; highly variable performance for

US		3/7 Moderate		C: Auditory stim (CD player w/ classical music & headphones); 6 sessions D: Tx of choice between B & C; 3 sessions O: # correct answers to math problems, # off-task behaviors per session	stim & 1 student had slight improvement in math performance w/ tactile stim In choice phase, all students chose tx associated w/ increased on-task performance	each student in each phase
Kercood et al. 2007 *J of Behav Edu* US	Examine effectiveness of FM activity and tactile stimulation on motor movement and math performance	Single-Subject Alternating Tx BCBC Design Level IV E4 3/7 Weak	*N* = 4, 4th graders, 3 males, no current meds, gen ed classroom Comorbid dx: 3 w/ LD, 1 w/ spina bifida In: reported attention & hyperactivity challenges, Parent & teacher ratings of +1 SD in cognitive/inattention, hyperkinesis, or ADHD on Conner's Rating Scale	B: Completion of math worksheet in empty classroom; twenty 20 min sessions C: Use of FM tactile stim (Tangle-Puzzle Jr) during completion of math worksheet in empty classroom; twenty 20 min sessions O: # correct answers, # attempted problems, observations of off-task behavior every 10 sec	Visual analysis of level change indicated: 2 students increased # correct answers during tx 3 students increased # attempted problems during tx 4 students decreased in off-task behavior during ctrl	Lack of stat analysis; reading level and processing speeds not accounted for in written word-problem format
Kercood & Grskovi Study 1 2010a *Aust J of Learn Disabil* Australia	Examine impact of FM activity on math problem solving	Single-Subject AB Design Level IV E4 2/7 Moderate	*N* = 3, age = 10 yo, 3 males, all take stimulant meds In: dx ADHD	10 sessions/phase, 20 audio recorded problems/session, given 20 sec/problem A: Baseline, math problems, no tx B: FM tactile stim (Tangle-Puzzle Jr toy) concurrent w/ math problems O: # correct verbal answers to 20 recorded math problems	Visual analysis of level indicated: 2 students increased # correct answers during tx	Lack of return to baseline; lack of other children present limits generalizability to typical classroom; lack of stat analysis

Kercood & Grskovi Study 2 2010b *Aust J of Learn Disabil* Australia	Examine the impact of FM activity and auditory distractions on math problem solving	Single-Subject AB (B+C)C Design w/ counterbalancing. Level IV E4 2/7 Moderate	*N* = 3, age = 10 yo, 2 males, all take stimulant med Comorbid dx: 2 w/ LD In: dx ADHD	5 sessions/phase, 25 written projected math problems/session, given 40 sec/problem A: Baseline, math problems, no tx B: auditory distractions for 30 sec, every 2 min, concurrent w/ math problems B+C: auditory distractions & FM tactile stim (Tangle-Puzzle Jr toy), concurrent w/ math problems C: FM tactile stim (Tangle-Puzzle Jr Toy), no auditory distractions, concurrent w/ math problems O: # correct verbal answers to math problems	Visual analysis of level for 2 of 3 students indicated: Decreased # correct answers from A to B Increased # correct answers from B to B+C # correct answers remained constant from B+C to C	Lack of baseline phases post tx phases; time limited written problem format does not account for differences in reading level and processing speeds.
Voytecki 2005 *Scholar Commons* US	Explore the effects of hand fidgets on on-task behaviors	Single-Subject ABAB Design Level IV E4 5/7 Strong	*n*(for data analysis) = 1, 8th grade, male w/ ADHD dx In (for data analysis): had IEP or Section 504 plan indicating mild disability, in inclusive gen ed classroom, nominated by teacher as presenting off-task behaviors in class Ex: parent/caregiver or individual consent not obtained	55 sessions of 50 min for 11 weeks A: Baseline, no tx B: use of hand fidget (stress ball) during the class session O: observations of on-task behaviors every 5 sec during A and B	*M* score of on-task behavior during B phases increased ($p<.05$)	Findings can not confidently be attributed to tx due to lack of experimental control; generalizability; variability in teacher implementation (substitute)

COGNITIVE INTERVENTIONS						
Barnes et al. 2008 *Phys. Occup. Ther. in Pediatr.* US	Evaluate the use of Alert Program in a classroom setting to address self-regulation and behavioral adjustment	Quasi-experimental pretest/post test Level II E3 5/10	*N* = 12 children w/ emotional disturbance & sensory processing difficulties; 9-11 yo Tx: *n* = 7; 5 male Ctrl: *n* = 5; 5 male	Tx: 2 classrooms received 8 wks of Alert Program w/ fidelity to manual; 3 sessions/wk for 3 wks; then decreased by 1 session every 2 wks Ctrl: 2 classrooms received routine classroom activities w/ a researcher present for same amount of time as in tx classrooms O: Behavioral adjustment as measured by DBRS; self-regulation per child self-report & teacher report	Improvement in behavioral adjustment for 6 children in tx group; Sig increase for 2 (p<.10). Decreased behavioral adjustment for 1 child (p<.10). Decrease in behavioral adjustment for all 5 children in ctrl group; 4 sig decreases (p<.10) 3 children in tx group & 2 children in ctrl group self-reported better self-regulation. Teachers rated children in ctrl group as sig lower (p=.04) for self-regulation.	Small sample; self-contained classroom not generalizable to other types of classrooms; no ctrl for family environment or differing med profiles
Marr et al. 2007 *Phys. Occup. Ther. in Pediatr.* US	Determine effectiveness of sensory stories on behaviors that interfere w/"circle time"	Single-Subject ABA Design Level IV E4 4/7 strong	*N* = 4, age = 4 yr 3 mo - 5 yr 2 mo, 3 males w/ ASD In: hyperresponsive sensory modulation determined by SP, can understand simple story, no visual or hearing impairments, receiving same amount of therapy as other participants, displays 1 behavior interfering w/ ed activities	A: Baseline, children were read non-sensory story one-on-one 1-3x/day for 5 days, 3-5 circle time sessions observed/child B: Children were read individualized sensory stories one-on-one 1-3x/day for 12 days, 8-9 circle time sessions were observed/child O: Observed frequency of in-seat behavior using 10 sec momentary time sampling	3 children increased seated behavior during tx (p < .05) 3 children decreased in seated behavior during post tx baseline phase (p < .05)	Varying seating arrangements for "Circle time"; data not collected on # of times nonsensory & sensory stories read daily to each child; lack of blinding; potential for researcher bias

Mere-Cook 2016 *Doctoral Dissertations.* US	Examine effects of embedding SDC within a gen ed classroom routine on transitions and participation	Single-Subject ABCB design w/ modified withdrawal phase Level IV E4 4/7 Strong	N = 6 kindergarteners w/ and w/o disabilities, 4 male; age range = 5y 9m-6y 4m In: identified by teacher as having possible sensory regulation concerns OR records show sensory regulation concerns that limit student's access to curriculum	All phases in gen ed classroom; tx based on Alert program, individualized for students A: Baseline, existing classroom routines (7 data collection days spanning over 3 wks) B: Embedded SDC (10 data collection days spanning over 3 wks) C: Modified baseline/withdrawal, embedded SDC w/ teacher verbal cues & modeling removed (6 data collection days spanning over 2 wks) O: (1) transition btwn tasks; (2) participation (3) self-evaluation of arousal & engagement via engine descriptors (high, medium, low)	Transition time btwn tasks decreased for all students btwn baseline & tx phases, w/ effect size (NAP) ranging from small-medium Participation increased for all students in BC phases compared to A, w/ effect size (NAP) small or medium for 5 students; large for 1 student 5 students, showed a trend of rating their body engines *medium* as the study progressed	Additional sensory strategies used by 2 students; no withdrawal phase; self-evaluation may have been influenced by internalized values; small & homogenous sample
Thompson & Johnston 2013 *Phys. Occup. Ther. in Pediatr.* US	Examine the impact of sensory stories combined w/ SBIs impact on self-regulatory behavior.	Multiple Baselines AB Design w/ maintenance phases Level IV E4 4/7 Moderate	*N* = 2, age = 3-5 yo, 2 males, w/ ASD characteristics In: "definite difference" range on one SPSC subtest, free of uncorrected visual or hearing impairments, interest in books, engage in at least one behavior that interferes w/ classroom activities	15 min observations, 2x/day, 4 days/wk A: Baseline, no tx Tx: Individualized sensory story read to child, followed by discussion & practice of the individualized, sensory-based, self-regulatory strategy including sensory objects B: objects for self-regulation strategy available, no prompts Maintenance phase: 1x/wk, 5 wks O: appropriate seated-behavior, utilized self-regulatory sensory strategy	Subjects 1 & 2: Directly following tx - *M* seated-behavior increased by 19.2% (S1) and 38.4% (S2) ($p < .05$), *M* use of strategies increased by 44.9% (S1) and 69.2% (S2) 5 wks following tx-maintained seated-behavior *M* = 98.6% (S1), *M* = 98.8% (S2), and maintained use of strategies *M* = 59.4% (S1), *M* = 48.8% (S2)	Individualized tx limits generalizability; lack of blinding; variability during baseline

MOVEMENT/PROPRIOCEPTION/VESTIBULAR INTERVENTIONS						
Lopez & Swinth 2008 *J Occup Ther, School, & Early Interv* US	Examine effectiveness of a proprioceptive-based group exercise program on physically aggressive behaviors	Mixed method Multiple Single-Subjects AB Design & Interview Level IV E4 4/7 Strong	*N* = 3 males, age = 9 yo, 1 w/ ADHD & prenatal drug exposure, 1 w/ ADHD & possible ODD, 1 dx unknown In: physically aggressive behavior at least 2x in past mo, in classroom for children w/ behavioral disorders, scored in definite difference range on SSP Ex: orthopedic disability, receiving home school services	30 min observation/session, 2 sessions/day (AM/PM) for 8 days/phase A: Baseline, no tx B: class engaged in 5-min author-led proprioceptive exercise program consisting of 5 exercises designed to isolate proprioceptive input through prolonged muscle co-contraction and contraction against gravity. O: # physically aggressive incidents, # of aggressive acts, duration of aggressive incidents, teacher report of program effect	Decrease in aggressive behavior incidents in tx phase occurred for all 3 students, not sig for 1 student (p >.05), and sig could not be determined for 2 students. Decrease in *M* duration of aggression for 2 students (p <.05) Decrease in *M* aggressive acts for 1 student (p < .05) Teacher reported positive impact on behavior of class and all participants. At 1 mo follow-up teacher reported continued use of program	Lack of baseline phases post tx phase; small sample size; limited generalizability; lack of blinding; potential for researcher bias
Mancil & Haydon 2016 *ETADD* US	Evaluate effectiveness of sensory related interventions on performance of academic related tasks	Single-Subject, Alternating Tx ABCDEBCDE Design w/counterbalancing E4 Level IV 3/7	*N*= 3, aged 8-10 yo, all males, ASD, had difficulties completing academic tasks	Tx: 5 min, 2x/wk for 15 sessions A: Baseline, no tx B: Slow linear swinging on sling-seat swing C: Fast bouncing on Hippity hop ball D: Slow spinning on sit and spin E: Ctrl- Research assistant read a book to subject	Visual analysis of trend and level of change indicated: Participants increased in academic performance after tx Subject 1- Linear swing "highly effective" (100% correct responses) Subject 2 & 3- Sit and spin "highly effective"	Complex implementation; heterogeneity of sample; variable O; difficult to distinguish tx from physical activity; small sample size; one subject did not use swing properly

		Moderate		O: % of correct responses on academic tasks		
Mills, Chapparo & Hinitt 2016 *British J Occup Ther* UK	Determine the impact of a sensory activity schedule (SAS) on classroom task performance	Single-Subject AB Design Level IV E4 4/7 Strong	*N* = 4, age = 5-6 yo In: ASD dx, teacher referral indicating movement-seeking behaviors disrupting classroom performance	Data collected 3/4 terms during school yr, frequency not specified A: Baseline; ACAE B: Individualized SAS w/ movement on therapy ball & deep pressure, implemented in classroom for approx 10min O: Errors in task performance for desk work tasks as measured by PRPP Stage One at least 4x during both phases A & B	Improvement in task performance for 3 children ($p < .05$), w/ 1 child demonstrating non stat-sig improvement	Pilot study; SAS used in addition to ACAE-a specialized curriculum for children w/ ASD; potential influence of social reinforcement
Murdock et al 2014 *Focus on Autism & Develop Disabil* US	Measure effects of swinging on independent work behaviors	Randomized Pretest Posttest w/ control group Level II E2 7/10	*N* = 30, age = 30-77 mo, 26 males, 22 w/ ASD, 8 w/ PDD-NOS Tx: *n* = 15 Ctrl: *n*=15 In: ASD or PDD-NOS dx, SP score of Probable or Definite Difference in at least one area	Each child completed two 5-min intervals of independent work in a private tx room; in between they received: Tx: One 5-min sensory treatment consisting of slow, linear motion on platform swing Ctrl: One 5-min non-sensory treatment (watching a movie) O: Frequency of on-task behavior, engagement, & out-of-seat behavior as observed during independent work pre and post tx via recorded 10 sec intervals	No sig effect on on-task behavior or out-of-seat for tx group Additional analyses showed SP scores, age, and dx did not predict behavior	Lack of generalizability; participants not used to 5 min of independent work; dosage may have been insufficient; private therapy room used instead of classroom

Van Rie & Heflin 2009 *Res Autism Spec Disord* US	Examine effect of two sensory activities on correct responses	Single-Subject, Alternating Tx BCDBCD Design w/ counterbalancing E4 Level IV 3/7 Moderate	*N*= 4, aged 6-7 yo, 4 males, ASD dx In: N/A	Each phase 5 min, author-led activity B: Slow linear swinging on sling-seat swing C: Fast bouncing on exercise ball D: Ctrl, author read a book to child O: % of correct responses to identify images on flash cards post tx	Subject 1- effects of phases unclear Subject 2- swinging was "highly effective" (*d*=.97) Subject 3- swinging was "highly effective" (*d*= .93), bouncing "ineffective" (*d*= .54) Subject 4- bouncing was "effective" (*d*= .84), swinging was "ineffective" (*d*=.3)	Time constraints (interruptions); some subjects could not verbally communicate effectively; no formal measure of sensory deficit, tx not individualized
ENVIRONMENTAL MODIFICATION						
Kinnealey et al. Part 1 2012 *AJOT* US	Examine effects of sound-absorbing walls and halogen lighting on attention to learning tasks	Mixed method Single-Subject AB(B+C) Design & student journaling/interview Level IV E4 3/7 Moderate	*N* = 4, age = 13-20 yo, 4 males, 3 w/ ASD, 1 w/ dyspraxia In: demonstrate school defined classroom ready behaviors, no health concerns, cognitive impairment or psychiatric conditions	Phases= 2wks each A: Baseline, typical classroom B: Sound-absorbing wall (B+C): Halogen light and sound-absorbing walls O: frequency & percentage of observed non-attending behavior during tx phases, interview questions & journaling student perspective on modifications post tx	Visual analysis of level change and variability indicated: Decrease in non-attending behaviors w/ sound-absorbing wall for all students 3 students decreased in non-attending behavior w/ halogen light & sound-absorbing walls Increased stability of non-attending behaviors across phases for all students 3 students reported improvement in school	Lack of return baseline phases; small sample size; limited generalizability; lack of stat analysis

					performance following modification.	
Mostafa 2008 *Internat. J Architec.Res.* Egypt	Examine the impact of room sound proofing on attention span	Mixed methods Quasi-experimental & One-group pre/post test Level II/III O3/4	*N* = 12, age = 6 - 10 yo, 9 males, students w/ ASD Tx: *n*= 6, *M* age =8.3 yo Ctrl: *n*= 6, *M* age =7.5 yo	45 min observations every 4 wks, 12 wk/phase Pre-tx: Typical SLP room Tx: Sound-proofing SLP room Ctrl: SLP room w/o sound proofing O: attention span = *M* # sec students remained on task w/o distraction	Tx group showed gradual increase in attention span following tx *M* attention span of tx group sig higher than ctrl group at wks 4, 8, 12 ($p < .05$, $p < .01$, $p < .01$ respectively)	Vague description of ctrl condition and baseline phase; progression of school yr potential confound; lack of blinding
Stern-Ellran et al. 2016 *Frontiers in Psych* Israel	Compare impact of non-colorful to colorful surface in play engagement	Single-Subjects Alternating Tx BCBC Design w/counterbalancing, no baseline Level IV E4 2/7 Weak	*N*= 15, aged 38-52 mo In: signed parent consent form, did not wear glasses, assumed normal vision, cooperation during sessions	B: Play surfaces covered w/ white paper C: Play surfaces covered w/ colorful paper. O: observations of behaviors indicating disruption (head approach, eye relaxation, frustration, dropping a piece, missing a piece, and manual search) in completing 3 play tasks	Significant increase in frequency of interfering behaviors in the colorful condition ($p<.01$)	Small sample size; less control in school setting; experimenter was not blinded; children not screened for color blindness; not generalizable

Key to Abbreviations (Alphabetical)

#=number; ACAE= Aspect Comprehensive Approach to Education; ASD=Autism Spectrum Disorder; btwn=between; ctrl= control group; CP= cerebral palsy; DBRS= Devereux Behavior Rating Scale; DPPT= deep pressure proprioceptive technique; dx= diagnosis; Ex= exclusion criteria; ed= education; FM= fine motor; gen ed= general education; hr= hour; hx= history; I= intervention; ID= intellectual disability; ILS= Integrative Listening System; In= inclusion criteria; LD= learning disability; *M*= mean; min= minute(s); med= medication; mo= month; mod= moderate; NAP = non-overlap of all pairs (a measure of effect size); O= outcome; OT= Occupational Therapy; ODD= Oppositional Defiant Disorder; PDD= Pervasive Development Disorder; PDD-NOS= Pervasive Development Disorder- Not otherwise specified; PPRP= perceive,

recall, plan, perform; Rx= prescription/prescribed; SD= standard deviation; SDC = Sensory Diet Curriculum; SFA= school function assessment; SIB= self-injurious behavior; sig= significant; SP= sensory profile; SSP = Short Sensory Profile, SPD= sensory processing disorder; SPSC = sensory profile school companion; stat= statistical; stim= stimulation; TLP= Therapeutic Listening Program; Tx= treatment; w/=with; WNL= within normal limits; yo= year(s) old; yr= year; sec = second; w/o = without

Table Summarizing QUALITATIVE Articles

Author, Year, Journal, Country	Study Objectives	Study Design, Level of Evidence	Participants: Sample Size, Description Inclusion and Exclusion Criteria	Intervention and Methods for Enhancing Rigor	Themes and Results	Study Limitations
MOVEMENT/PROPRIOCEPTION/VESTIBULAR INTERVENTIONS						
Schnieders-Laber 2011 *Proquest Dissertation Pub* US	Explore the impact of movement program on classroom engagement	Action research study AOTA Level N/A Q3	*N*= 5, 2nd graders, bottom 20% of readers in class In: 2nd grade students, parent approval, teacher permission	Tx= 8-10 activities/session, 3x/wk MINDS-In-MotionMAZE-fine/gross motor activities supervised by researcher Prolonged engagement in classroom; triangulation; code-recode	Increase in behavioral, cognitive, and emotional engagement post tx observed by CHAMPS protocol Teacher reports of improvements in student engagement	Small sample size; lack of control group; no stat measures or analysis; potential for researcher bias
ENVIRONMENTAL MODIFICATION						
Menzinger & Jackson 2009 *Support for Learning*	Examine behavioral response to light & sound intensity and to observe coping	Action research model AOTA Level N/A Q3	*N* = 3 male children w/ Asperger syndrome aged 6, 11, & 14 yo; 2 residential students, 1 day student	Observations in classroom for 3 7-week terms; Observed reactions to changes in light and sound intensity for 45 min each session	Changes in color and light intensity had no observable effect on classroom behavior Unexpected noises such as telephone, high-pitched vocalization, or sudden increase in normal activity sounds	Lack of transferability; small sample

US	strategies used			Member checking: observer's notes checked by classroom teachers and therapists; prolonged engagement	resulted in physical/verbal aggression in all students "Safe space" away from aversive stimuli identified as effective strategy for self regulation	

Key to Abbreviations (Alphabetical)

CHAMPS= Conversation, Help, Activity, Movement, Participation; In= inclusion criteria; stat= statistical; w/=with; yo= year(s) old

Summary of Key Findings:

Single-sensory interventions

Auditory stimulation

There is limited evidence that auditory stimulation through music may improve math performance in elementary schoolers with attention difficulties or ADHD (Abikoff, Courtney, Szeibel, & Koplewicz, 1996; Emmert, Kercood, & Grskovic, 2009), but insufficient evidence that this intervention impacts on-task behavior in these students (Emmert, et al. 2009). There is also moderate evidence that auditory stimulation in the form of either music or words has no significant impact on math performance for elementary aged students in a general education classroom without a diagnosis (Abikoff, et al., 1996; Kassinove, 1972). Finally, there is insufficient evidence that auditory stimulation through listening program protocols may improve classroom behaviors. In a single case study by Nwora and Gee (2009) a 5-year-old male with PDD-NOS received the therapeutic listening program and showed improvement in functional classroom behaviors.

Tactile stimulation

A study by Field et al. (1997) offers limited evidence that tactile stimulation through both static and moving touch may significantly reduce off-task behavior in preschoolers with ASD. There was no significant difference between the treatment group of students who received moving tactile stimulation through a touch therapy protocol, and the control group of students who received static tactile stimulation through being held in the laps of classroom volunteers. However, both the treatment and control groups' off-task behavior decreased significantly following both static and moving tactile stimulation (Field et al., 1997).

Tactile Fine Motor Activity

Hand Tools

There is moderate evidence that fine motor activity through the use of a handheld toy may improve on-task behavior in elementary and middle schoolers with attention difficulties or ADHD (Emmert, et al. 2009; Kercood, Grskovic, Lee, & Emmert, 2007; Voytecki, 2005). There is also limited evidence that tactile fine motor activity through the use of a hand tool may improve math performance in 4th and 5th grade students with attention difficulties or ADHD (Emmert, et al., 2009; Kercood, et al., 2007; Kercood & Grskovic, 2010).

Multisensory interventions

Multisensory environments (MSEs)

Findings from one level II (Shapiro, Parush, Green, & Roth, 1997), one level III (Thompson, 2011) and one level IV (Tunson & Chandler, 2010) study provide moderate evidence that exposure to an MSE may decrease a variety of challenging behaviors in children aged 3-17 with severe developmental disabilities. There is limited evidence from one level III study (Thompson, 2011) and one level IV study (Tunson & Chandler, 2010) supporting the use of MSEs to improve attention outcomes for children aged 3-17 with severe developmental disabilities.

Deep pressure proprioceptive technique (DPPT) with sensory diets
There is mixed evidence regarding the use of DPPT and individualized sensory diets to improve on-task behavior and decrease disruptive behavior. For children with ASD, PDD-NOS, or developmental delay, a combination of DPPT with a sensory diet was found to improve on-task behavior in one level III study (Benson, Beeman, Smitsky, & Provident, 2011), but was found to have no effect on on-task or disruptive behavior in a level IV study (Bongatt & Hall, 2010). Another level IV study demonstrated that DPPT and an individualized sensory diet had no significant effect on the frequency of self-injurious behavior for a boy with ASD and epilepsy (Devlin, Healy, & Leader, 2009).

Sensory diets
There is limited evidence that individualized sensory diets may improve attention and behavior of children with a wide variety of diagnoses. One large scale level III study (Aronoff, Hillyer, & Leon, 2016) demonstrated that an individualized sensory diet significantly improved the attention span, learning, and behaviors of children aged 1-18 years with a variety of conditions including ASD, PDD, ADHD, DD, and no diagnosis. Another level IV study demonstrated an association between the use of a sensory diet and a decrease in challenging behaviors for elementary aged students with a history of aggression (Devlin, Healy, & Leader, 2011).

Other multisensory intervention
One level IV study (Demanch & Chok, 2013) provides insufficient evidence supporting the use of multisensory intervention involving wrist weights and vibration/massage to decrease self-injurious behavior for a 12-year-old boy with ASD and moderate intellectual disability (ID) . Another level IV study (Schoen, Miller, & Sullivan, 2015) provided insufficient evidence that the combination of a sensorimotor program with Integrated Listening Systems helped elementary aged students with sensory processing impairments make progress on individual goals including homework completion, following directions, and reducing emotional outbursts.

Cognitive interventions

There is moderate evidence that integrating sensory-cognitive strategies into classroom routines can lead to improvements in behavior for preschoolers and elementary students (Barnes,Vogel, Beck, Schoenfeld, & Owen, 2008; Marr, Mika, Miraglia, Roerig, & Sinnott, 2007; Mere-Cook, 2016; Thompson & Johnston, 2013). Specifically, two level IV studies (Marr et al., 2007; Thompson & Johnston, 2013) offered limited evidence that individualized sensory stories can significantly increase in-seat behavior for preschoolers with ASD. One level II study (Barnes et al., 2008) and one level IV study (Mere-Cook, 2016) found that the Alert program or a similar individualized sensory diet curriculum may lead to significant improvements in classroom behavior and self-regulation for elementary aged students.

Movement/proprioceptive/vestibular interventions

Movement or exercise programs

There is limited evidence that supports the use of a movement or exercise program to provide sensory input in an elementary general education classroom to improve behaviors. One qualitative study (Schnieders-Laber, 2011) indicated that a movement program with activities to provide vestibular and proprioceptive input may increase behavioral, cognitive, and emotional engagement of 2nd graders. One level IV study (Lopez & Swinth, 2008) indicates that a proprioceptive exercise program decreases physically aggressive acts in elementary aged children with ADHD.

Activity with sensory equipment

Three level IV studies (Mancil & Haydon, 2016; Mills, Chapparo & Hinitt, 2016; Van Rie & Heflin, 2009) provide moderate evidence that sensory activities which use equipment to provide proprioceptive and/or vestibular input improve academic performance of elementary aged students with ASD. The sensory activities that are supported in these studies include slow, linear swinging on platform swing, spinning on Sit and Spin, and bouncing on therapy balls. One level II study (Murdock, Dantzler, Walker, & Wood, 2014) provides limited evidence that slow, linear swinging has no effect on engagement, on-task, or in-seat behavior of preschoolers with ASD.

Environmental modification interventions

Overall, there is limited evidence for the use of environmental modifications to improve behavior and attention for elementary, middle, and high school students.

There is moderate evidence that installation of sound-absorbing walls may result in significant improvements in attention for high school students with ASD (Kinnealey, 2012; Mostafa, 2008), with one level IV study (Kinnealey, 2012) demonstrating a positive effect of halogen lighting on attention. A single qualitative study (Menzinger & Jackson, 2009) with elementary and middle school children with Asperger's syndrome found that changes in light intensity had no observable effect on classroom behavior, but found that sudden increase of noise led to more aggressive behavior. One level IV study (Stern-Ellran, Zilcha-Mano, Sebba, & Levit Binnun, 2016) offers insufficient evidence that use of a colorful play surface compared with a white surface may lead to significantly more frequent disruptive behaviors in preschoolers.

Implications for Consumers:

The consumers are school-aged children and their families. The most research was found relating to children with diagnoses of developmental disabilities, ASD, and ADHD.

- Families with children with severe developmental disabilities should advocate for multisensory spaces in their children's schools. Access to these spaces may improve behavior for these children.
- Families with school-aged children with ASD may consider advocating for sound-absorbing wall installation in classrooms, which have been shown to improve attention for children with ASD. For preschoolers with ASD, families should talk

with their child's school therapist and teacher about incorporating sensory stories into the school day to improve their child's in-seat behavior.

- Elementary and middle-school children with ADHD or attentional difficulties may benefit from the use of hand tools that provide fine motor activity to improve on-task behavior. These students and their families may need to advocate for access to these accommodations in a general education classroom.

Implications for Practitioners:

There are implications for school occupational therapists to provide SBIs through pull-out and push-in services, as well as through school-wide programs. Use of the following interventions should be contingent on the individual needs of each child. Therapists should carefully track outcomes to determine treatment effectiveness and respond accordingly.

- **Pull-out services.** Occupational therapists should consider incorporating both individualized sensory diets and movements that provide vestibular and proprioceptive stimulation into pull-out services to improve behavior, attention and academic performance for school-aged children, particularly those with ASD. These proprioceptive and vestibular movement activities can be facilitated by equipment such as swings, Sit and Spins, and therapy balls. Therapists should trial various sensory activities for each client to determine which is the most appropriate. Additionally, these interventions should be implemented directly preceding academic instruction to improve outcomes in academic performance. While vestibular and proprioceptive input with sensory equipment is supported by moderate evidence, the other aforementioned interventions should be implemented with caution since their effectiveness is supported by limited evidence.
- **Push-in services.** Occupational therapists can recommend hand tools that provide fine motor activity for school-aged children with attentional difficulties or ADHD in order to improve on-task behavior. For some students, background music may improve math performance. Given the potential for these interventions to create distraction for other children, music may need to be provided through headphones in the classroom. Occupational therapists will need to collaborate with teachers to find appropriate timing for the use of these interventions during the school day.
- **School-wide programs.** Occupational therapists should advocate for classroom and school wide implementation of cognitive sensory self-regulation programs, such as the Alert Program, to improve self-regulation and classroom behavior in school-aged children. Movement or exercise programs that are focused on providing students with proprioceptive or vestibular input may also be beneficial to implement in a general education classroom to improve students' engagement, although the evidence to support this is currently limited.

Implications for Researchers:

There is a significant need for more research in this area of occupational therapy practice.

- Due to the need for SBIs to be highly individualized, the vast majority of studies in this area use a single-subject research design (SSRD). While this design allows for individualization of interventions, it has very limited generalizability. Thus, replication of these studies with multiple subjects or more studies with higher levels of evidence and larger sample sizes are needed. Additionally, for researchers that do use a SSRD, determining statistical significance of their results using a celeration line and two-band deviation method would greatly strengthen these findings.
- Additional studies should include more detailed descriptions of the interventions to enable replication for other researchers and allow practitioners to implement similar interventions in practice.
- Homogeneity of participants and larger samples might help link specific kinds of SBIs to specific diagnoses, behaviors, ages, and outcomes.
- More research is needed regarding the effectiveness of SBIs in a general education classroom, in order to better understand the benefits and challenges of implementing sensory strategies in least restrictive environments. Cost effectiveness of these types of strategies should also be examined.
- Some SBIs are already being implemented in the school system and elsewhere, despite limited or insufficient evidence. More research needs to occur regarding these interventions that are already in use, including sensory diets, DPPT, tactile stimulation through touch, listening protocols, movement programs, auditory stimulation through music, and fine motor hand tools in order to truly know whether occupational therapists are implementing evidence-based practice.

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

The evidence that currently exists for the use of SBIs in classrooms to improve academic performance, behavior and attention outcomes is preliminary.

The following interventions can be implemented with confidence for students whose demographic profile matches that of the participants in the studies:

1) Multi-sensory environments can be used to decrease challenging behavior and may also improve attention for children aged 3-17 with severe developmental disabilities (Shapiro, et al., 1997; Thompson, 2011; Tunson & Chandler, 2010).
2) Sensory-cognitive interventions can be used to improve classroom behavior for both preschool and elementary school children (Barnes, et al., 2008; Marr, et al., 2007; Mere-Cook, 2016; Thompson & Johnston, 2013). Specifically, individualized sensory stories may improve in-seat behavior in preschoolers with ASD (Marr et al.,

2007; Thompson & Johnston, 2013), while Alert based programs may improve self-regulation and classroom behavior in elementary schoolers in general education classrooms (Barnes et al., 2008; Mere-Cook, 2016).

3) The use of fine motor hand tools can be used to improve on-task behavior, and may also improve math performance for elementary and middle school aged children with attentional difficulties or ADHD (Emmert, et al. 2009; Kercood, et al. 2007; Kercood & Grskovic, 2010; Voytecki, 2005).
4) Individualized sensory activities that use equipment to provide vestibular and proprioceptive input can be used to improve academic performance in elementary school aged children with ASD (Mancil & Haydon, 2016; Mills, et al., 2016;Van Rie & Heflin, 2009).
5) Sound-absorbing walls can be installed in classrooms to improve attention and behavior in high school students with ASD (Kinnealey, 2012; Mostafa, 2008).

The following interventions should be implemented with caution and outcomes should be monitored for individual effectiveness:

1) Auditory stimulation through music may improve math performance in elementary aged children with attention difficulties or ADHD (Abikoff et al., 1996; Emmert et al., 2009). However, music may have no impact on math performance for elementary aged students in a general education classroom with no diagnosis (Abikoff et al., 1996; Kassinove, 1972).
2) Tactile stimulation through static and moving touch may reduce off-task behaviors in preschoolers with ASD (Field et al., 1997).
3) Individualized sensory diet may improve attention and behavior for children aged 1-18 with a wide variety of diagnoses (Aronoff et al., 2016; Devlin et al., 2011).
4) Movement or exercise program designed to provide proprioceptive or vestibular input may improve classroom behavior in elementary school aged children in general education classrooms, as well as those with ADHD (Lopez & Swinth, 2008; Schnieders-Laber, 2011).

Occupational therapists may need to experiment with and trial several different SBIs in order to find the most effective strategies to fit the unique sensory needs of their clients. Interventions should be implemented with a good rationale in response to individual assessment results; therapists must be intentional with their treatment choices and devote time and thought to matching them with client needs and goals. Lastly, given that most research related to SBIs include relatively few children and are highly individualized, clinicians who implement SBIs have a responsibility to collect systematic data to determine treatment effectiveness and make the best choices for their clients.

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"*" before a reference indicates one that appears in the CAT table itself.

Involvement Plan

The team informed Dr. Palmer of the interventions that were best supported by the research in our revised CAT. Considering Dr. Palmer's interest in interventions for general education classrooms, the team developed two broad ideas for knowledge translation.

The first option was to create an informational handbook describing a variety of sensory based interventions and the populations and client factors for which they had been demonstrated to work. Dr. Palmer expressed an interest in an electronic version of this, which would be more accessible for her team. The second thought was to introduce a cognitive sensory program, such as the Alert Program, to a particular classroom. This program could include sensory stories and a kit with sensory strategies for the classroom. We also discussed the potential for including movement exercises in this program. Dr. Palmer instantly thought of a kindergarten teacher who might be receptive to a program like this, as she was already using movement breaks in her classroom. Dr. Palmer recommended two groups that might be interested in an in-service. The therapy team included occupational and physical therapists who could serve as information brokers. The second group was the special education roundtable, which could have had a broader reach than the therapy team alone, as each representative member reported back to a particular team. Either meeting could have included coordinators and co-directors as well.

Project and Rationale

After meeting with our chair and reporting back to Dr. Palmer, we decided to collaborate with the kindergarten teacher to implement a sensory based movement program that involves proprioceptive and vestibular input in the classroom, as well as to deliver an in-service to the therapy team. We designed an in-service with two parts. The first part was an introduction to the movement program and its use, which was primarily aimed at the kindergarten teacher, school

administrators, and occupational therapists. The second part included the overall findings of our first semester research and was aimed primarily at Dr. Palmer and other occupational therapists in the district.

We chose not to pursue an electronic intervention handbook given that the nature of the evidence at the time was somewhat limited, and that the majority of the studies lacked clear instruction for implementation. There are existing movement programs, however, that have been manualized for classroom use. Thus, choosing this type of intervention and being directly involved in its initial implementation enabled us to ensure fidelity.

Our rationale for choosing a movement intervention was a balance between choosing an intervention that was both supported by the evidence and that met the needs of a classroom teacher. The evidence that movement programs may improve classroom engagement and behavior is limited (Schnieders-Laber, 2011; Lopez & Swinth, 2008). However, the evidence to support this intervention was strengthened by ensuring that the movement program used for our project included proprioceptive and vestibular input, both of which have moderate evidence suggesting that activities using equipment to provide proprioceptive and vestibular input may improve academic performance (Mancil & Haydon, 2016; Van Mills, et al., 2016, Rie & Heflin, 2009). There is also no evidence to suggest that either of these interventions has a negative impact on behavior, attention or academic performance (Mancil & Haydon, 2016; Mills, et al., 2016; Murdock, Dantzler, Walker, & Wood, 2014; Lopez & Swinth, 2008; Schnieders-Laber, 2011; Van Rie & Heflin, 2009). While other interventions with moderate evidence exist, these were not selected for the project due to either limits in feasibility (e.g. sound absorbing wall installation), or requiring an individualized rather than classroom-wide approach (e.g. sensory cognitive interventions). From the outset Dr. Palmer expressed the need for classroom-wide,

teacher-friendly SBIs. A simple movement program that included movements for both stimulating and calming classroom arousal was ideal for meeting this need, and has some support in the literature.

Context

There were a number of contextual factors within the school district that affected our knowledge translation process. Many of the team members who were involved in this process had limited time and were already overloaded with responsibilities. We demonstrated respect for their time by being responsive and considerate when coordinating meetings and scheduling the in-services and by communicating efficiently and succinctly. Due to the difference between the school district's academic calendar and ours, as well as a limited timeframe to complete the knowledge translation process, scheduling and coordinating implementation and in-services was at times challenging and required some back-and-forth communication.

The teacher with whom we collaborated was already implementing movement breaks into her classroom routine. We thought that the teacher and student familiarity with some of the exercises and the general concept of taking movement breaks would support adoption of our movement program. Dr. Palmer stated that in her experience, many teachers throughout the school district were interested and engaged in learning about SBIs and excited to implement them. This attitude supported our knowledge translation process. However, the knowledge among teachers about sensory systems and how sensory processing needs may impact their classroom environment (and vice versa) may be limited. This highlighted a potential need for education about the basics of SBIs and why and how this movement program in particular could be helpful.

The collaborating teacher typically had 1-2 paraeducators in her classroom which will also support implementation. Additionally, there were consistent team communications in the form of monthly team meetings for both the special education teachers and staff and the therapy team. Dr. Palmer seemed confident about her influence within the school and her ability play a role in supporting adoption of the program and helping to ensure responsiveness to surveys.

Lastly, we learned that staff members in this school district primarily access resources online, and this is preferable to paper handouts and communications. We kept this in mind throughout the process, when formulating handouts and educational materials, our in-service presentation, surveys for data collection, and communication in general, prioritizing electronic materials whenever possible. The educational materials we developed were meant to summarize key points from the in-service regarding how and when to use the movement program. Physical copies were provided during the in-service and electronic copies were given to Dr. Palmer to distribute throughout the school where appropriate.

Tasks/Products and Target Dates

Task/Product	**Deadline Date**	**Steps to Achieve the Final Outcome**
Conversation with teacher	Wed 2/28	Contact teacher - Fri 2/23 Conversation with teacher (phone call or in-person) - Wed 2/28
Proprioceptive, vestibular movement program	Fri 3/5	Review articles - Fri 2/23 Design program - Mon 2/26 (Group) Create handouts - Fri 3/2 Handouts to Dr. Watling - Mon 3/5
In-service - OT/PT/Admin meeting	Thurs 3/15	ID Date/Time/Place Dr. Palmer - Wed 2/21 Create Powerpoint - Fri 3/2 Powerpoint to Dr. Watling - Mon 3/5 Group Prep - Wed 3/14 Deliver in-service - Thurs 3/15
Classroom pilot	Fri 3/15 - Fri	ID Date/Time/Place teacher -Wed 2/28

implementation	3/30 (ideally 3/15 prior to in-service)	Group Prep - Mon 3/19 Implementation - Tues 3/20 - Fri 3/30?
Post-intervention teacher and para-educator survey		Create electronic survey - Wed 3/14? Post-intervention survey (1) - directly after implementation Follow-up intervention survey (2) - Wed 4/11 (at the latest, depends on implementation date) Evaluate Data - Fri 4/13
Final Paper - CAT, background, involvement plan and its evaluation, reflection on process	Wed 4/25	

Activity Outcomes, Monitoring and Evaluation

The outcomes that were monitored during the knowledge translation process were focused on the in-service attendees' perception of the program. This was evaluated through an electronic survey which was sent approximately two weeks after the in-service and program implementation. The survey included questions regarding the efficacy of the program with use of Likert scale, multiple choice and short answer questions to report the frequency and circumstances around which the program was implemented as well as perceptions regarding ease of implementation, fidelity to the program, and effectiveness of the program. The survey also addressed the attendees' opinions on the strengths and areas for improvement in the movement program in open-ended questions. Maintenance was also addressed through asking if the attendees had used the program and if they anticipated continuing to use the program. From this measure, numerical data from the Likert scales and multiple choice questions as well as qualitative data from the short answer questions were evaluated.

Knowledge Translation

The knowledge translation portion of the present study consisted of two components. The first was the development of a movement program based on our research and collaboration with Dr. Palmer which was to be implemented in a kindergarten classroom in her district. The second component was the delivery of an in-service in two parts: an introduction to the movement program and its use which was primarily aimed at the kindergarten teacher, school administrators, and occupational therapists. The second part included the overall findings of our first semester research and was aimed primarily at Dr. Palmer and other occupational therapists in the district.

Movement Program: Break 5

Development and design. The sensory-based movement program, Break 5, was developed over the course of several meetings during which format and content were discussed. Several studies that included movement programs were reviewed (Anderson, 2016; Lopez & Swinth, 2008; Schneiders-Laber, 2011) in order to better understand the nature of vestibular and proprioceptive input. It was initially determined through discussion that it was important to design a program that could serve to either alert or calm students depending on their state and the needs of a classroom at a given time. This resulted in the development of the "Calming" and "Alerting" pathways within Break 5.

Based on the evidence (Lopez & Swinth, 2008; Mancil & Haydon, 2016; Mills et al., 2016; Schnieders-Laber, 2011; Van Rie & Heflin, 2009) that proprioceptive and vestibular input specifically may be effective for improving classroom outcomes, the exercises in Break 5 were designed to provide these types of input. Exercises that primarily provided proprioceptive input were selected for the calming pathway, and exercises with a greater emphasis on vestibular input

were selected for the alerting pathway. To enhance the intended effects, exercises in the calming pathway were designed to be done slowly, while exercises in the alerting pathway were designed to be done more quickly. The exercises were also designed based on their simplicity and their ability to be done in a small space.

After deliberation, exercises to transition in and out of the program were also incorporated at the beginning and end of each pathway. The "Transition In" exercises were designed to match the current behavioral state of the student or classroom, and support them to transition into the contrasting behavioral state of the chosen pathway. The "Transition Out" exercises were designed to provide proprioceptive input and to be done in the seated position, so as to help students to transition out of the program and into the next learning activity.

Outcomes. To aid program implementation, instructional materials were created to help teachers and therapists understand how and when to use Break 5. These included lists of commonly observed student behaviors that indicate a need for alerting or calming, a chart to clearly illustrate the pathways, an illustrated guide to the exercises, and an overview regarding the program development and further resources. These materials were printed for in-service attendees and sent electronically to Dr. Palmer to distribute within the school district for educational purposes. The primary objective of this portion of the knowledge translation project was to develop a product that was rooted in research and relatively simple to implement in a school setting. The intention was to create a product that united stronger evidence with ease of use that could be implemented by occupational therapists directly or by teachers with occupational therapists in a consulting role.

Challenges. During development of our program and consideration of how to implement it, two areas of concern arose. One related to determining whether or not IRB involvement was

needed. With input from Dr. Watling, we decided to refrain from collecting formal data from the kindergarten classroom in order to ensure that IRB involvement would not be necessary. Another area of concern related to the legal implications of creating our program. We had initial uncertainties about similar elements of the existing programs we consulted during development. We consulted a number of individuals and took active measures to address our copyright concerns. To avoid copyright infringement and protect our intellectual property, we used either original or well-established exercises, cited our sources carefully, designed a unique program structure, and selected an original title.

In-service Delivery

Process. The in-service delivery went relatively smoothly. The program and the research findings were presented to Dr. Palmer, the kindergarten teacher, and approximately seven occupational therapists in the district. The school principal took the printed resources but did not stay for the full in-service. The in-service lasted about 45 minutes and occurred in the occupational therapy room at an elementary school in Silverdale, WA.

Challenges. Given that administrators did not attend as planned, the audience was primarily practicing occupational therapists and the kindergarten teacher who already had experience incorporating movement breaks into her classroom routine. This created an unexpected challenge in that some portions of the presentation may have been too simplistic considering the knowledge level base of the audience.

Outcomes. The primary outcomes for the in-service were to introduce and explain how to use the movement program, explain the evidence for other SBIs, and equip professionals with the knowledge and resources needed to begin using the movement program their schools.

Completion of Task/Products and Interim Steps

Task/Product	**Projected Deadline Dates**	**Projected - Interim Steps/Dates**	**Actual Completion Dates**	**Actual - Interim Steps/Dates**
Conversation with teacher	2/28	Contact teacher - 2/23 Conversation with teacher (phone call or in-person) - 2/28	3/7	Contacted/communicated with teacher over email - 3/7
Proprioceptive, vestibular movement program	3/5	Review articles - 2/23 Design program - 2/26 (Group) Create Handouts - 3/2 Handouts to Dr. Watling - 3/5	3/5	Reviewed articles - 2/23 Designed program - 2/26 Created handouts - 3/2 Handouts to Dr. Watling - 3/5
In-service for OT/PT/Admin	3/15	ID Date/Time/Place Dr. Palmer - Wed 2/21 Create Powerpoint - Fri 3/2 Powerpoint to Dr. Watling - Mon 3/5 Group Prep - Wed 3/14 Deliver in-service - Thurs 3/15	3/15	ID Date/Time/Place Dr. Palmer - Wed 2/21 Create Powerpoint - Fri 3/2 Powerpoint to Dr. Watling - Mon 3/5 Group Prep - Wed 3/14 Deliver in-service - Thurs 3/15
Classroom pilot implementation	3/15 - 3/30 (ideally 3/15 prior to in-service)	ID Date/Time/Place teacher -Wed 2/28 Group Prep - Mon 3/19 Implementation - Tues 3/20 - Fri 3/30	3/15 - 3/30	ID Date/Time/Place teacher - 3/21 Classroom visit: 3/23 **Changes:** Given schedule constraints, teacher began implementing program independently directly after in-service without a classroom visit. A classroom follow-up and observation visit was

				conducted after one week of implementation.
Post-intervention teacher and para-educator survey	Send survey 4/11	Create electronic survey - Wed 3/14 Post-intervention survey (1) - directly after implementation Follow-up intervention survey (2) - Wed 4/11 (at the latest, depends on implementation date) Evaluate Data - Fri 4/13	Survey sent 3/28	Create electronic survey - 3/24 **Changes:** Rather than having both an initial and follow-up survey, a follow-up survey was sent 1.5 weeks following the in-service to all attendees. Surveys sent - 3/28 Evaluate data - 4/4
Final Paper - CAT, background, involvement plan and its evaluation, reflection on process	4/25			4/23

Monitoring Outcomes

In the week following the in-service, we emailed the teacher who had agreed to trial our evidence-based movement program to ask her if she had begun implementation and if she had any questions or concerns. At this time, arrangements were made for two student researchers to visit her classroom for approximately one hour in order to observe implementation of the program during classroom transitions. This allowed direct observation of how the teacher was implementing the program in practice, how the children were responding to it, and how she had incorporated it into her daily schedule.

Two weeks after the in-service, an electronic survey was distributed to obtain feedback on the in-service and use of the Break 5 movement program. The first section of the survey consisted of six Likert scale and short answer questions pertaining to the in-service. These questions were designed to obtain attendee satisfaction ratings and insight into how likely they were to apply the new evidence to practice. The second section of the survey contained eleven multiple choice, Likert scale and short answer questions regarding use of the Break 5 program. The objective of these questions was to elicit general feedback on the program, learn how many times it had been used in the two weeks following the in-service, the setting in which it was used, the fidelity of its use, and the users' perspective on its effectiveness. Two weeks after the in-service, the survey was sent via email directly to the teacher, as well as to the project collaborator to distribute to those who had attended the in-service or used the program. Responses to the survey were automatically uploaded through google drive, eliminating the need for the surveys to be emailed back. After one week, a total of three respondents had completed the survey in full.

Evaluation of Outcomes

Classroom Observation

During the classroom observation, the authors noted that each of the 19 students present could perform several of the program exercises with a verbal prompt alone. This demonstrates that the exercises can be memorized by young children in less than a week. Rather than using a chosen exercise pathway in its entirety and using the movement program as a separate activity, the teacher selected individual exercises from the movement program and embedded them into a movement break typical of her classroom. The teacher recorded the exercises she had used each day, indicating that she had been using the exercises regularly. Both teacher notes and observations indicated that individual exercises were being used from both alerting and calming

pathways simultaneously instead of as specified by program guidelines. These observations indicate that the teacher might have experienced difficulty adhering to the precise steps of the program in lieu of her usual classroom routine. It is also possible that she selected activities she preferred or felt would most benefit her students, based on her extensive experience with similar activities.

Survey Responses

Response rate. Three of ten in-service attendees responded within five days following the survey's distribution. One of these respondents was the kindergarten teacher who had implemented the program, and two were occupational therapists. Due to the low return of surveys, the outcomes evaluated from the responses may not be reflective of all who attended the in-service.

General feedback. Overall, the feedback on both the in-service and the movement program was very positive. All respondents reported that they were very satisfied with both parts of the in-service which included a presentation of our movement program in part I and a summary of our research process and results in part II. Two respondents answered that they were very likely to apply the new evidence of SBIs to their practice and one respondent answered that they were somewhat likely (4 out of 5). When asked what the attendees liked best about our presentation, they reported that the visual aids, demonstrations, and handouts were all very helpful. It was specifically indicated that the hand-outs were reader friendly and that they appreciated the clear instructions with pictures to support the description of exercises. The authors also received feedback that the transition between speakers and between the two parts of the in-service could have been more clearly defined and that this would have allowed those attendees not interested in staying for the research portion to leave.

Response to feedback and classroom observation. The authors were informed through the open-ended survey questions that the elementary school in which the program was trialed was interested in holding an in-service for the whole school and using the program throughout the school. To meet this request, the authors have made arrangements with Dr. Palmer to hold a second school-wide in-service on May 31, 2018. Based on observations of the program use in the classroom, as well as feedback from Dr. Palmer, the authors made a few adjustments to the materials to ensure program fidelity. The updated resources were provided electronically to Dr. Palmer, and will be utilized at the school-wide in-service in May. Specifically, an additional slide was added to the presentation, along with a new note in the instructions, which provided the following guidelines:

1. Complete a chosen pathway in its entirety (i.e. all five selected exercises).
2. Complete exercises from only one pathway in a given session (i.e. do not mix the pathways together).
3. Lead the calming pathway in a calm manner and ensure that the exercises are completed slowly.
4. Lead the alerting pathway in an energetic manner.

Use of movement program in practice. All three respondents also reported that they have used the movement program, Break 5, in practice. One person reported using the program ten times or more, while the other two reported using the program 4-6 times in the two weeks following the in-service. It was reported that Break 5 had been used in a classroom setting led by a teacher, as well as during pull-out service led by an occupational therapist. The way in which the program was used varied. Two people reported using the entire pathways while another indicated that they generally used the exercises individually. All three respondents gave ratings

of 4 out of 5 for the effectiveness of each pathway having its intended effect on behavior. However, given the classroom observations described above, the program may not have always been used as it was intended. Given that we did not conduct a true pilot study, we cannot evaluate the effectiveness of Break 5.

There were mixed reviews regarding the continued use of Break 5 in practice. Two people responded that they were very likely to continue to use it while one person responded that they were neutral. The program users reported the best aspects of the program to be its quick and easy implementation, its benefits for attention and smoother transitions, and the included breakdown of behaviors which indicate when to use the program. All respondents indicated that their favorite exercise from Break 5 was the lobster arms. The lobster arms exercise was one of the unique exercises created by the authors specifically for Break 5, therefore, the novelty of the exercise may have been most appealing to the users. Respondents also indicated a few ways in which the program may be improved. This included adding a sample classroom schedule with breaks built in as a resource for users, packaging using a flip ring for exercise ideas, and additional choices for exercises. A final piece of feedback that was received through the survey was a request for the authors to spread Break 5 to more schools.

Analysis of Overall Process

Distinct from a traditional research study, this project was uniquely designed to facilitate development of the practical skills needed to become evidence-based practitioners. Through the process of building and summarizing our CAT table, we learned both how to conduct a thorough literature search, as well as how to critically analyze the rigor and findings of the studies found. Not only will we use these skills as future occupational therapists, but we also had the opportunity to learn them in the context of answering a real-life clinical question. Through the

knowledge translation portion of the project we had the opportunity to experience translating evidence into practice and gain first hand insight into the challenges that can arise in this translation.

The project was demanding on several dimensions. Coordinating the massive amount of detail that this project requires across a group of four people was a challenge, particularly when it came to conducting a consistent and comprehensive literature review, and sorting the resulting articles. We especially found it difficult during this part of the process to understand the boundaries of our research question and to define inclusion and exclusion criteria in ways that are clear-cut instead of subjective. We also found that the terminology and definitions currently in the literature surrounding SBIs are somewhat disorganized, and this made sifting through and organizing the studies more laborious.

To address these challenges, we found in person meetings helpful for talking through aspects of the project we were struggling with and moving our group toward next steps. Frequent group communication was very important to make sure everyone's expectations were being met, roles were clear and voices were heard. Finally, we found that having our project chair be the same person as our course mentor was helpful, in that it kept expectations clear, made feedback consistent, and minimized excess communication.

Through our research we discovered that this body of literature is currently facing a dilemma. On the one hand, individualization is a key feature of SBIs, and single-subject research design (SSRD) studies, which dominate this body of literature, are ideal for capturing the effects of this individualization. On the other hand, there is also a need for research with higher levels of evidence design, and larger, more homogenous samples in order to provide stronger evidence, greater generalizability and identify clear links between SBIs and specific populations. We

recommend that future research seeks to bring this balance into the literature, along with continuing SSRD research. However, SSRD research done in this area must be carried out with greater attention to rigor, and it may be useful to use the SSRD research scale developed by Logan, Hickman, Harris, and Heriza (2008) for guidance. Finally, if the goal of research is for it to in fact be translated into practice, then it is essential that the interventions studied be outlined in enough detail to be readily utilized by practitioners.

Overall we are very proud that we were able to accomplish a project of this scale and quality amidst the other demands of graduate school. We are especially excited that our movement program will be implemented school-wide. Our group dynamic worked well despite challenging moments when one or more of us was having a hard or busy week. We learned to collaborate and understand different learning and work styles of other group members in new ways. With this we also learned to appreciate the unique strengths and contributions each individual brought to the project. This allowed for self-reflection and application of the strengths and leadership styles we were concurrently discussing in our management class. The project has been quite an undertaking and the group process has been an integral part of the learning experience it has provided.

Recommendations for Future Projects

One recommendation we have for follow-on projects in this area of practice is to limit the research question to a specific SBI or to focus on a specific population. Our research question was very broad both in terms of intervention and population. As a result, our findings contained general information that covered many different SBIs, but within each SBI there was a limited number of studies available, and between the different SBIs there was wide variability in participant diagnoses and age. Thus, a future knowledge translation project with a more focused

question may be beneficial to the collaborator and site because the project would provide more in-depth and applicable information.

Based on the findings of the present study, the efficacy of the following SBIs with moderate evidence may have potential to be the focus of future projects:

1. Sensory equipment used to provide proprioceptive and vestibular input such as therapy swings.
2. Sensory-cognitive interventions such as sensory stories or the Alert Program®.
3. Fine motor hand tools.

A focus on fine motor hand tools may become more relevant in upcoming years following the popularity of fidget spinners and cubes. Although there was also moderate evidence for multi-sensory environments and sound absorbing walls, these interventions may be more difficult topics for the design of this particular project, because the variability in the use of equipment in multi-sensory environments makes them difficult to operationalize, and sound-absorbing wall installation has limited feasibility in school-based settings.

Another recommendation is to further research on SBIs currently used in practice that did not meet the inclusion criteria of the present study. One example would be the use of oral motor tools, which are sometimes used as part of a sensory diet in practice. Although evidence for such interventions was not found for this particular research question, this topic warrants further exploration due to the commonality of its use.

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