5-2020

Sensory-Based Interventions Used in Schools for Students with Disabilities to Increase On-Task Behavior

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by

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A Starred Paper

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree of

Master of Science

in Special Education

May, 2020

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Chapter 1: Introduction

Children who display sensory processing deficits struggle with fulfilling grade-level requirements, and show attention, motor, cognitive, or social emotional skill deficits, which affects school performance (Spence, 2015). On-task behavior in school is a required component for student learning and success. The amount of off-task behaviors being displayed by students is increasing at a rapid rate and can impede learning essential knowledge. Off-task behaviors in classrooms appear as inattention to the task at hand and/or hyperactivity. These behaviors may emerge from sensory processing deficits. Approximately 5-10% of typically developing children in America have a sensory processing disorder that may adversely affect school performance (Spence, 2015).

Sensory processing disorder is due to disruptions with the brain's ability to take in sensory information (vestibular- orientation in space, proprioception- muscle-joint awareness, tactile- touch, visual- sight, auditory- sound, gustatory- taste and auditory- sound and olfactory- smell) from the environment and organize the information to make an adaptive response. Children with this disorder are more apt to display sensory seeking behaviors or sensory avoidance behaviors that can overall affect the way they perform in an environment, like a school setting. Sensory modulation is a pattern of sensory processing dysfunction that enables a student to focus on essential sensory stimulation while not responding to unimportant sensations. According to the article, "A systematic review of sensory processing interventions for children with autism spectrum disorders," current estimates indicate that more than 80% of children with autism spectrum disorders (ASD) exhibit co-occurring sensory processing problems (Ben-Sasson et al., 2009, as cited in Case-Smith, Weaver, & Fristad, 2014). Another article states that sensory

processing problems are more common in children with ADHD than in typically developing children (Ghanizadeh, 2011). These statistics show that it is common for people with a diagnosed disability to have sensory processing problems.

Sensory-based interventions use discrete sensory experiences or environmental modifications to facilitate the regulation of behaviors. The most common SBI's include tactile, proprioceptive, and vestibular stimulation. Examples of tactile stimulations include: brushing, massaging, and other forms of touch sensation. Examples of proprioceptive stimulation include compressions, lifting weights, push/ pull activities, and other interventions that include a sensation when muscles and joints are activated by movements and muscle contractions. Examples of vestibular simulations include: swinging, spinning, swimming, and performing other activities that involve the sense of movement.

Several sensory-based interventions are being implemented in schools to increase a student's ability to remain on-task. Sensory-based interventions (SBI) are a common rehabilitation approach to address behavioral problems caused by dysfunction in sensory processing. The purpose of this starred paper was to review the literature that evaluates the effectiveness of implementing sensory-based interventions into a student's day to increase on-task behavior.

Research Question

One research question guided this review of literature:

Does implementing sensory-based interventions increase on-task behavior for students with disabilities?

Focus of Paper

The review of literature in Chapter 2 includes 10 studies with participants who are identified as having Attention Deficit Hyperactivity Disorder (ADHD), Developmental Disabilities, and Autism Spectrum Disorder. Studies included are dated from 2001 to 2015 and includes preschool and elementary school students.

EBSCO and Google Scholar databases were used as a starting point for my literature review of peer-reviewed studies related to evaluating the use of sensory-based interventions for elementary students with disabilities. I used several keywords and combinations of keywords to locate appropriate studies: elementary, students, ADHD, Autism Spectrum Disorder, sensory-based interventions, on-task, attention problems, movement, physical activity, sensory integration.

Importance of Topic

As a special educator, I work closely with students who have Autism Spectrum Disorder, Developmental Disabilities, Emotional Behavioral Disorders and ADHD. Students under these disability categories often have a difficult time being engaged in a task and being able to access their ability to learn due to their inattentiveness, hyperactivity and display of off-task behaviors in several different ways. It is proposed that behavioral problems in children are linked to dysfunctions in sensory processing (Ayres, 1991, as cited in Yunus, Liu, Bisset, & Penkala, 2015). It was stated in "Sensory-Based Intervention for Children with Behavioral Problems: A Systematic Review" that, Sensory processing is necessary to receive, modulate, integrate and organize sensations received in the central nervous system to produce appropriate behavioral responses. The inability to intake sensory input and produce appropriate behavioral responses is

a critical piece to look at for students who are displaying inappropriate school behavior frequently that is affecting their education. The idea of implementing Sensory-Based Interventions into a student's day is becoming used more in the school systems. Adding time in the day where students can receive the appropriate sensory stimulation is being used frequently amongst schools to increase students' ability to be on-task and engaged in the classroom. Remaining on-task is crucial for student learning and success.

Definitions

Sensory Processing Disorder (SPD): a condition in which the brain has trouble receiving and responding to information that comes in through the senses (Case-Smith et al., 2014).

Sensory-Based Interventions (SBI): a common approach that uses experiences or environmental modifications to address behavioral problems in children (Case-Smith et al., 2014).

Sensory Modulation: the ability to regulate and organize reactions to sensory input (Case-Smith et al., 2014).

Sensory Input: the stimuli that is perceived by our senses like smell, sight, touch, taste, and hearing (Case-Smith et al., 2014).

Sensory Integration: a form of occupational therapy in which special exercises are used to strengthen the patient's sense of touch (tactile), sense of balance (vestibular), and a sense of where the body and its parts are in space (proprioceptive) (Case-Smith et al., 2014).

Chapter 2: Review of Literature

The purpose of this literature review was to examine the effects of sensory-based interventions on students on-task behavior in the educational setting. In this chapter, I review 10 studies that determine if the implementation of sensory-based interventions increase on-task behavior in students with disabilities. Studies are presented in ascending chronological order.

Literature Review

Bagatell, Mirigliani, Patterson, Reyes, and Test (2010) examined the effectiveness of therapy ball chairs on classroom participation in six boys with autism spectrum disorder (ASD). The participants attended a public school in a large urban school district. The six students were all enrolled in an intensive instructional program ages kindergarten through 1st grade specifically designed for children with ASD whole fell in the moderate to severe range of autism. The teaching staff consisted of one teacher and three instructional aides.

The program addressed the students' sensory, language, behavioral, and social needs. Services, including speech and language, and occupational therapy were embedded in the classroom environment daily. The occupational therapist worked in the classroom directly for 30 minutes a week. In-seat behavior and engagement were two behaviors identified as being the most difficult for the participants. Circle time was observed as being the most problematic time. Circle time lasts approximately 16 minutes and is a group activity that is designed to promote language, socialization, and early academic skills. Four of the six children were identified as having difficulty with in-seat behavior, and five of the six children were identified as having difficulty with engagement.

A single-subject design was used to examine the effects of using a therapy ball on in-seat behavior and engagement. An A-B-C design was used; A represented the baseline condition, B represented the intervention phase, and C represented a choice condition. Each participant was fitted and then provided a therapy ball and a ring stabilizer to keep the ball from rolling.

During the baseline phase (Phase A), circle time was done without any intervention. The children sat in chairs facing the teacher with the classroom assistants behind them to redirect them verbally and physically as necessary. Phase A lasted 5 days (1 school week). The intervention phase (Phase B) was then conducted over a 9-day (2 school weeks, with one holiday) span. The only change for Circle Time during this phase is the teacher, children, and classroom aides sat on therapy ball chairs. The participants were allowed to bounce and move on the balls as long as the staff considered the movement safe. During the choice phase (Phase C), the participants were given the choice of sitting on a regular seating device (chair) or on a therapy ball chair. Phase C lasted 5 days (1 school week).

Data collection was done daily for the entire 16 minutes of Circle Time over 4 weeks (19 days). Observations were done by two video cameras set up in the classroom. Data collection was done on in-seat behavior and engagement. In-seat behavior was defined as "any portion of the child's bottom in contact with the ball, the ball in contact with the floor, and a minimum of one foot in contact with the floor" (Schilling & Schwartz, 2004, as cited by Bagatell et al., 2010). Engagement was defined as "oriented towards appropriate classroom activity… or teacher and either interacting with materials, responding to the speaker or looking at the speaker" (Schilling & Schwartz, 2004, as cited in Bagatell et al., 2010). Bagatell et al. (2010) reviewed the DVDs and recorded behaviors. They established interrater agreement. Interrater agreement was

defined as being within 2 seconds in their timed observations. The number of seconds a child demonstrated the behaviors (out of seat and not engaged) was recorded. Interrater agreement for in-seat behavior ranged from 96% to 100%. Engagement ranged from 88% to 100%.

Table 1 represents the mean number of seconds each child was out of seat for each phase. The results indicated that each child had a unique response to the use of a therapy ball chair. It seemed to have a positive effect on Participant 1 because of the decrease in the amount of time out of his seat each day from Phase A to Phase B. Participant 2, 3, and 4 did not show consistency during the baseline phase and showed little variability during intervention. Participant 4 showed a steady decrease across phases, but during Phase C chose to sit on a chair and his out of seat behavior decreased slightly. Participant 5 had an increase in out of seat behavior during the intervention phase. Participant 6 was not present for enough days to collect accurate data.

Table 1

Duration of Time Out of Seat

MEAN SECONDS OF OUT OF SEAT			
	Baseline- Phase A	Intervention- Phase B	Choice- Phase C
Participant 1	88.2	22.8	25.5
Participant 2	26.8	5.3	11.7
Participant 3	29.4	21.3	45.6
Participant 4	105.8	77.6	64.0
Participant 5	7.6	37.1	36.2
Participant 6			

Table 2 represents the mean number of seconds each child was disengaged for each phase. The results for engagement were unique for each child. The mean seconds of disengagement were not given for the first three participants because the results were inconsistent due to other factors in the classroom. Overall, the use of the therapy ball did not positively affect engagement. The first three participants had consistently low amounts of disengagement and the results were consistent through the three phases for the children. Participant 4's level of non-engagement was consistently high during Phase A, fluctuated slightly in Phase B and was highest during Phase C. Participant 5 and 6's non-engagement level increase significantly during Phase B and the pattern continued in Phase C.

Table 2

Duration of Disengagement

MEAN SECONDS OF DISENGAGEMENT			
	Baseline- Phase A	Intervention- Phase B	Choice- Phase C
Participant 1			
Participant 2			
Participant 3			
Participant 4	300.0	299.0	475.0
Participant 5	187.3	410.3	397.0
Participant 6	327.0	517.6	399.4

The results of this study are mixed and do not affirm previous studies that suggest therapy balls have a substantial improvement in in-seat behavior and engagement. The results suggest that therapy ball chairs may be more appropriate for children who seek out vestibular-proprioceptive input. It was stated that this study makes the statement "therapists need to make

better determinations about who is an appropriate candidate for sensory processing interventions" stronger. The authors noted several limitations including there was a small number of children in a particular context, a stronger design would have been an alternating-treatment or multiple-baseline design, the length of the study could have been increased with longer phases and there were environmental variables that could not be controlled.

Bonggat and Hall (2010) examined the effects of sensory integration-based activities on the on-task behaviors of three students with developmental disabilities. The three participants were between ages 4 and 4 years 11-months-old diagnosed with developmental delay and autism. All the participants attended a special education early childhood classroom on the campus of an urban elementary school in San Diego.

Participant 1 is a 4-year old boy of Mexican descent identified with a developmental delay. An occupational therapist concluded he showed signs of "tactile defensiveness." He would have inconsistent reactions to teacher directions by screaming and crying. He was very active and showed signs of appropriate play but often he played alongside his peers and did not seem to attend to activity during play for more than 5-10 minutes.

Participant 2 is a 4-year, 11-month-old boy of Mexican descent identified with a developmental delay. It was noted that the participant was resistant to being touched by staff, crying and screaming if anyone left the classroom, and would close or cover his eyes to avoid task demands. An occupational therapist also concluded he showed signs of "tactile defensiveness" as well.

Participant 3 is a 4-year-old boy of African American descent identified with Autism Spectrum Disorder (ASD). His occupational therapy assessment indicated his greatest areas of

need is to increase his ability to: attend to tasks and people, complete transitions smoothly and perform fine motor tasks.

An alternating treatment design was used to evaluate the effects of sensory integration-based occupational therapy and attention control on activity engagement and disruptive behaviors. Materials used for attention control activities included puzzles, puppets, interactive toys, bubbles, black, and play dough. The sensory integration intervention consisted of the participant being brushed, given joint compressions, use of a therapy ball, pushing and pulling legs and swung in a hammock.

Participants were randomly assigned to a sensory integration or attention control schedule that alternated every 1 or 2 weeks lasting 10 minutes. Observations were made during two, 15-minute sessions of independent workstations and a one on one activity that took place during the 30 minutes directly following the intervention sessions. Dependent measures were scored using whole interval time-sampling (5 minutes of each 15-minute activity) with 10-second observation and 5 seconds recording. If off-task and disruptive behavior occurred during the interval, the type of behavior was recorded. The overall mean inter-rater agreement was 91% with a range from 69% to 100%.

The percentage of on-task behaviors during two separate activities and across two conditions (sensory vs. attention control) for each participant was calculated. The results indicate that there were no differences in data as a result of treatment intervention or by the condition used across all three participants. The only trend that sticks out is that participants maintained a higher percentage of on task behavior when working in a one on one activity. The independent work activity is when the participants had the lowest percentages of being on-task.

Participants 2 and 3 showed their highest percentage of on task during the independent work activity under the sensory condition; however, this only occurred one time for Participant 3. Participant 2 scored both the highest and lowest percentages of on task under the sensory condition.

Overall, the results indicated that sensory integration activities had no better effect on the participants' ability to remain on task and reduce the number of disruptive behaviors than attention control activities. The mentioned limitation of this study included the time frame in which data were collected. The experiment was done in the second half of the school year when the participants are familiar with staff and routines.

Kercood, Grskovic, Lee, and Emmert (2007) examined the effectiveness of fine motor physical activity with tactile stimulation of four students with attention problems. A single-subject alternating treatment design was conducted to have students solve math problems during two conditions to measure if tactile stimulation reduced excessive motor movement and increased task completion.

The four students were 9 years old and in fourth grade. The participants all attended general education classrooms in an elementary school. The students were nominated by their teachers as having hyperactivity and attention problems. Observations and rating scales on hyperactivity and attention were done by teachers and parents to finalize each student's participation in this study.

During baseline, the four participants were given worksheets containing math word problems at a third- to fourth-grade level that had been taught previously for a 20-minute session in a separate empty classroom and was instructed to complete as many problems as they could.

Intervention procedures were the same except the students were provided with an activity that gave tactile stimulation in the corner of their desk, that they could use while working.

The dependent variables measured included the number of math problems correct, the number of math problems attempted and percent of intervals of off-task behavior for each 20-minute session. The videotaped session was used for observers to use 10-second momentary time sampling for off-task behavior. Interobserver agreement was calculated to be 86-100%.

Table 3 represents the mean number of math story problems attempted, mean percent correct, and percent difference. For the number of problems correct, the results indicate that two of the four students performed better with the fine motor activity with tactile stimulation, answering 55% and 45% more problems correctly. The other two students performed similarly in both conditions. For the number of problems attempted, Participants 1 and 2 attempted more problems on average in the intervention condition. Participants 3 and 4 attempted more problems on average during baseline.

Table 3

Mean Number of Math Story Problems Attempted and Correct

	BASELINE		INTERVENTION	
	Attempted	Correct	Attempted	Correct
Participant 1	10.8	2.4	12.1	4.4
Participant 2	9.6	0.9	10.3	2.0
Participant 3	9.4	0.6	8.6	0.4
Participant 4	6.5	1.6	5.5	1.8

Table 4 represents the average amount of off-task behavior observed during intervals during baseline and intervention conditions. When looking at off-task behavior data, all four students engaged in more off-task behavior in baseline than in intervention. Data were not taken on the length or number of times the participants held the fine motor activity with tactile stimulation, but all participants were observed using the toy during intervention sessions.

Table 4

Average Amount Off-Task Behavior

	BASELINE	INTERVENTION
Participant 1	38%	21%
Participant 2	35%	14%
Participant 3	39%	21%
Participant 4	28%	21%

Results suggest that fine motor manipulation of a tactile stimulation object reduces excessive motor movement and increases task completion of students with attention problems. One limitation stated, is that students were asked to write their answers to the math problems and this could have countered the effects of tactile stimulation.

Koenig, Buckley-Reen, and Garg (2012) examined the effectiveness of the Get Ready to Learn (GRTL) classroom yoga program among children with Autism Spectrum Disorders (ASD) in decreasing maladaptive behaviors. It was hypothesized that students who participated in GRTL would show a decrease in interfering behaviors or students would show increased adaptive classroom behaviors such as time on task. This study includes 46 participants from ages 5-12 who have a diagnosis of ASD. Eight classes total with six children per class were recruited. In both intervention and control conditions, three classes were classified as self-

contained autistic support classrooms and one class of partial inclusion or integrated class where students spent time in regular education classrooms.

A pretest-posttest control group design was used to explore the effects of the GRTL program on challenging behaviors among children with ASD with 24 participants in the intervention group and 22 participants in the control group. Classes that were chosen used the Aberrant Behavior Checklist (ABC)-Community to assess challenging behaviors taken by parents and teachers pre and post-intervention. The ABC-Community has a high test-retest reliability (.96-.99). Baseline data were collected for the video observations before intervention, and data were then collected for the post-intervention. Video raters achieved 85% agreement.

The GRTL program was implemented with the intervention group every school day for a period of 16 weeks for 15-20 minutes. The control group participated in the standard morning activity. An analysis of variance was conducted to compare and determine the differences between groups on ABC-Community and video observations with effect sizes reported. No significant differences were found between the intervention and control groups ABC-Community ratings or video observations.

Students who participated in the program showed significant differences ($F [1,44] = 5.079$, $p=.029$) in total ABC-Community scores compared with the students in the control condition. The students in the control group did not show a reduction in maladaptive behaviors and instead scored higher or the same. Video observations were looked at and frequency counts of off-task behavior and teacher redirection during 4-minute segments were recorded for students in the self-contained classrooms ($n=6$). The number of off-task behaviors and the need for redirection dropped during the first structured activity for the intervention and control group. All

classrooms showed improvement in decreased off-task behaviors and redirections over the 16-week experiment.

A limitation includes that the raters were aware of the different conditions and this could have contributed to bias in scoring. Results indicate that the intervention group showed a reduction in behaviors that were identified as maladaptive and affecting the student's success in school.

Oriel, George, Peckus, and Semon (2011) examined the effectiveness of aerobic exercise before classroom activities on academic engagement and reduction of stereotypic behaviors in young children with Autism Spectrum Disorder (ASD). There is a total of seven males and two females (nine participants) in this study between 3-6 years old that are placed in early intervention autistic support classrooms. Seven of the children have a formal diagnosis of ASD, one a diagnosis of intellectual disability, and one a diagnosis of developmental delay.

A within-subjects crossover design with a treatment condition and a control condition was used to examine the effectiveness of aerobic activities on academic engagement and stereotypic behaviors. Two of four classes were assigned randomly to the treatment condition and the other two the control condition. The treatment condition included 15 minutes of running/jogging, followed by a classroom task. The control condition included doing the classroom task with no aerobic exercise before. Dependent variables measured were: stereotypic behaviors, the percentage of on-task behavior and the number of correct/incorrect responses to academic tasks. Interrater reliability was established by having more than one person observe a participant and reported to range from 70% to 100%.

Table 5 represents the mean percentages of control days versus treatment days for correct/incorrect responses and on-task time. When looking at correct/incorrect responses, seven of the nine participants improved in correctly responding during the exercise condition. These improvements were found to be statistically significant ($p < .05$). For on-task time no significant differences were found between the conditions. Even though statistical significance was not observed, visual analysis revealed that five of the nine participants improved on-task time during the exercise condition. Looking at stereotypic behaviors, no statistical significance was observed; however, four of the five participants demonstrated fewer stereotypic behaviors during the intervention phase.

Table 5

Mean Percentages of Control Days Versus Treatment Days

	CONTROL DAYS	TREATMENT DAYS
Correct/Incorrect Responses	71.49	82.57
On-Task Time	94.48	95.92

Limitations of this study include the short duration and the lack of measurement of exercise intensity during the exercise condition. Overall, the results of this study show that aerobic exercise may improve academic responding in young children with ASD.

Peck, Kehle, Bray, and Theodore (2005) examined the effectiveness of yoga for improving on-task behavior. Participants include 10 elementary school students with attention problems with an age range from 6-10 and across grade levels 1, 2 and 3. The participants were recruited by the school psychologist because their grade-level teachers had sought consultation services due to the students' attention problems.

A multiple baseline design was used to conduct this study across three grade levels with a follow-up phase that included 10 children. Students were grouped by grade level to make smaller groups to increase engagement during the yoga sessions. A baseline, intervention and follow-up phase were conducted. Participants engaged in "Yoga Fitness for Kids" during the intervention phase, which included deep breathing, physical postures (i.e., jumping up and down) and relaxation exercises for 30 minutes twice a week. The participants then returned to their classrooms to be observed during whole group lessons or individual seat work directly after the yoga intervention.

Students were observed for time on task in their classrooms by the school psychologist and/or interns using a structured Behavior Observation Form (BOF). A 10-minute observation was done using momentary time-sampling with 10-second intervals. Time on task was defined as the percentage of intervals observed where the students had eye contact with the teachers or the task they were assigned, and/or they performed the requested classroom task. The participants were observed two times per week across all phases. Interobserver agreement was calculated to be 91%.

The effect sizes were calculated for each grade level and served as an indicator of the role the yoga treatment played in increasing on-task behavior in the classroom. Effect sizes for the average for each grade level group ranged from 1.51 to 2.72, indicating a large effect. Effect sizes at follow-up decreased but ranged .77 to 1.95. Table 6 represents the average time on task for the participants in each grade level during the baseline, intervention and follow-up phase. The students that participated in the yoga intervention seem to increase their average time on task during intervention and then just slightly decrease during the follow-up phase.

Table 6

Average Time On-Task for Participants by Grade Level

GRADE LEVEL	BASELINE	INTERVENTION	FOLLOW-UP
3	68.92	84.58	80.77
2	60.94	81.31	72.75
1	65.48	85.28	75.56

Peer comparison data indicated that classmates' time on task remained essentially unchanged through the three phases of this study. However, the positive baseline trends, together with a large number of overlapping data points, suggest the interpretation of findings should be taken with caution. One limitation mentioned in this study is that even though the observation time stayed constant throughout this study, the students oftentimes were engaged in different types of tasks following the classroom routine during observations (e.g., whole-group activities, individual seatwork, etc.). The type of activity the student was doing at the time of observation could have skewed the observed data.

Reichow, Barton, Sewell, Good, and Wolery (2014) evaluated the effectiveness of wearing a weighted vest on engagement in kids with ASD and developmental disabilities. This study includes three participants that attend different classes within a university affiliated early childhood center. Each class had a total of 12 children with and without disabilities, one lead teacher, one teacher assistant and then the three participants had one-on-one assistance. Tommy was a 5-year-old male with a diagnosis of autism. Tommy struggled to stay engaged in routines and tasks and needs constant redirection to stay on-task. Bert was a 4-year-old male diagnosed with developmental delays. Sam was a 5-year-old boy diagnosed with ASD. Sam frequently showed lower levels of engagement and needed frequent redirection to remain on task. The

participants have all worn weighted vests previously to this study and have sensory needs determined by the occupational therapists at the childhood center.

An alternating treatment design was used to evaluate the effectiveness of wearing a weighted vest on the participants' engagement. Three conditions were observed during 10-minute observation sessions: baseline (no vest), weighted vest, and vest with no weight. Each participant wore 5% of his body weight in their weighted vest with the weight evenly distributed. The conditions were assigned randomly over five consecutive school days and each condition was observed twice over those 5 days. After beginning treatment with one participant, the authors determined that a pre-treatment baseline phase of no-vest condition would strengthen the design and then used that model with the other two participants.

The sessions of this study occurred during a highly engaging daily morning table-time activity in the participants' original classroom led by the teacher, while the assistants provided verbal and physical assistance. At the start of each session, the vest was placed on the participant immediately before the activity. Each session was videotaped, and data were collected during the first 10 minutes of the table-time activity. The observer of each session was completely blind to the status of the vest condition. Five categories of behavior were coded: (a) engagement, (b) non-engagement, (c) stereotypic behavior, (d) problem behavior. and (e) unable to see the child. Data were collected from the 10-minute video session using 10-second momentary time samples. Across participants, the mean interobserver agreement was greater than 90%.

For Tommy, three graphs displayed the percentage of intervals coded as engaged, problem behaviors, and stereotypic behaviors. The data from these graphs can be interpreted that

the weighted vest was not functionally related to engagement. It appears that Tommy's level of engagement decreased during all three conditions. For Bert and Sam, there were no differences in engagement, stereotypic behavior, or problem behavior between conditions.

The results of this study can be interpreted to conclude that weighted vests were not an effective intervention for increasing engagement for these participants during table time activities in inclusive classrooms. An important limitation noted in this study is that this study focuses on the relation of wearing a weighted vest and the immediate behavior displayed. It has been noted in previous research that a delayed effect of wearing a weighted vest can occur and that would not have been detected in this study.

Spence (2015) evaluated the effectiveness of implementing a sensory-based program on on-task behavior for students with attention difficulties. This study consisted of two teachers and 12 students. Participants are from an urban city, Dayton, Ohio, and attend the River's Edge Montessori school within the Dayton Public School district. The students' age ranges from 6.6 years old to 9.4 years old, five girls and seven boys, across three grade levels (first, second, third) were represented.

A 6-week sensory-based intervention program (S'cool Moves) was implemented to evaluate the effectiveness of sensory interventions on the increase of on-task behaviors. S'cool Moves is a program that teaches students sensory-based techniques and moves to, in theory, calm the body down and help participants stay engaged while in the classroom. Inclusion criteria for participants included: students that showed functional off-task class performance by completing 60% or less of class assignments for a 2-week period and students with special education

services had an IQ score of 70 or higher. This program will consist of a pre-implementation phase, a 6-week intervention implementation phase and a post-intervention/follow up.

The pre-implementation phase consisted of recruiting participants, obtaining consent, collaboration with teachers to designate a consistent schedule and train teachers on the sensory intervention program.

The intervention phase lasted 6 weeks. During the first week of the intervention phases, pre-test data collection was taken on student attention to task and engagement in classroom assignments and activities. The S'cool Moves program was used during the first through the sixth week of the implementation phase. The sensory and movement strategies were provided to students in small group sessions for 15 minutes a week on the first day of each week.

The post-intervention phase consisted of a follow-up session with both the teacher and the student participants individually where they heard a brief summary of the outcome, along with recommendations for future use if interested.

A descriptive analysis and comparison of the quantitative and qualitative data collected at the pre- and post-testing phases of the project will be conducted. Quantitative data consisted of the number of small group sessions attended, the frequency of student on-task and off-task behavior before and after sensory-based intervention and the number of assignments students completed prior to and at post-intervention. Momentary time sampling observation chart and weekly class assignment chart were the measurement tools used. The Occupational Therapist (OT) practitioner observed one student each session performing the sensory strategies learned in the small group sessions for 10 minutes one time per week during the implementation phase. Every 30 seconds, the practitioner recorded the student's behavior on or off-task. The students

marked the Daily Tracking Form every time the sensory-based intervention was performed in class throughout the week. The form was then collected at the end of every week. Qualitative data included the students and teachers' personal experiences with the program.

Outcomes from the Momentary Time Sampling Observations indicated that 100% of students improved their on-task behavior after the intervention. The pre- to post testing ranged from 15-55%; this is an indication that the intervention supported a positive change in on-task behavior. Outcomes from the measure of assignments completed show that seven students increased the number of completed assignments, three students completed the same amount of assignments, and two students decreased the number of completed assignments. One major limitation mentioned in this study is that the 6-week period may not have been enough time to allow sufficient time for the intervention to demonstrate significant improvement in students.

VandenBerg (2001) evaluated the effectiveness of wearing a weighted vest on children's on-task behavior in the classroom for students with attention deficit hyperactivity disorder. This study consisted of four participants receiving school-based occupational therapy services and had been diagnosed with ADHD. The children attended midwestern rural school district and ages ranged from 5 years, 9 months, to 6 years, 10 months. It was described by the occupational therapist that each child had a sensory modulation problem shown by excessive movement, picking at body parts such as nails, reaching or playing with objects excessively, unnecessarily getting in and out of seat, overreaction to extraneous stimuli and inability to complete an activity successfully.

A quasi-experimental, single system, AB design was used to evaluate the effectiveness of wearing a weighted vest on children's on-task behavior in the classroom. Two conditions were

observed during six, 15-minute observation sessions: baseline (no vest) and intervention (weighted vest). Each participant wore 5% of their body weight in their weighted vest with the weight evenly distributed. For each condition, the children were observed and timed in their regular classroom while engaged in classroom fine motor activities (coloring pictures, cutting shapes and gluing them to paper, stringing beads, etc.). Baseline and intervention data were collected over a span of six different days within a 15-day period during which on-task behavior was measured in seconds during a 15-minute activity. On-task behavior was defined as engagement in those processes that were necessary to complete the activity assigned by the teacher such as, reaching for required materials and visually focused on the activity. Interrater agreement was defined as the observers being within 10 seconds of one another in their timed observation of on-task behavior. Eleven nonparticipants were observed for practice, with the last six consecutive timings being within 10 seconds of each other by observers.

Results indicated that on-task behavior increased by 18% to 25% in all four students while wearing the weighted vest. Table 7 represents the mean amount of time that the student was on task during the baseline phase (no vest) and intervention phase (weighted vest).

Table 7

Mean Time Spent On-Task

STUDENT	BASELINE	INTERVENTION
1	54%	79%
2	63%	81%
3	64%	82%
4	64%	81%

The researchers concluded that using a weighted vest for children with attention difficulties to increase on-task behavior is effective. A significant increase in on-task behavior was demonstrated in all of the students during the intervention phase. Two limitations of this study were noted. The use of an ABA or alternating treatment design would strengthen the validity of results. Another limitation is the small sample size.

Watling and Dietz (2007) examined the effects of Ayre's Sensory Integration intervention on the behavior and task engagement of young children with autism spectrum disorder (ASD). The classic Ayre's sensory integration enhances nervous system processing of sensation and gives a person enhanced sensory experiences to allow for appropriate behavior responses. Participants for this study included four boys between ages 3 years, 0 months, and 4 years, 4 months, whom had been diagnosed with ASD.

A single-subject study used an ABAB design to compare the immediate effect of Ayre's sensory integration on the participant's undesired behaviors and task engagement. A familiarity phase was also included to allow participants to become familiar with the occupational therapist, environment and the study protocol. This study consisted of three phases: familiarization, baseline (A) and treatment (B). During baseline phases, the participants were one on one with an occupational therapist in a room set up as a free-play scenario, similar to preschool environments. Treatment phases consisted of having activities that were selected for the Ayre's sensory integration sessions based on sensory profiles, caregiver information and clinical observations (e.g., swings, rope ladder, trampoline, etc.). Each phase included three, 40-minute intervention sessions per week. Each session was then followed by a 10-minute tabletop activity where data were collected. Table-top activities were selected according to the child's

developmental level and child preferences and met the criteria of: (a) the activity match the cognitive and fine motor skills of the child, and (b) the activity encouraged focused attention and purposeful engagement (e.g., puzzles, stickers, blocks).

The study sessions were videotaped, and the 10-minute videos were divided into intervals for rating. Undesired behavior defined as behaviors that interfere with task engagement, was rated 10-second intervals. Engagement defined as, intentional, persistent, active, and focused interaction with the people and objects around, was rated in 3-second intervals. Interobserver agreement for undesired behavior was calculated using the point by point method and had a mean of 91%. Agreement for engagement was calculated using the same system and had a mean of 95%.

When looking at all the participants, there was an overlap in the number of intervals of undesired was observed in the baseline and treatment phases. Antoine participated in 32 sessions and his lowest rates on undesired behavior occurred on a greater percentage of days in the B phases (32%) than the A phases (10%). Billy participated in 31 sessions and his highest rates of undesired behavior occurred at the end of A1 and the beginning of B1. Charles participated in 33 sessions and showed very low levels of undesired behaviors throughout all phases. David participated in 34 sessions and displayed undesired behavior in all phases but had a greater percentage of days with low rates (64%) compared to A phases (33%). Conclusions cannot be drawn about the effect of Ayre's sensory integration on undesired behavior because there is such an overlap in scores across the baseline and treatment phases.

When looking at the data for engagement, all the participants scored relatively high, with scores that overlap in all phases of the study. Antoine's rates of engagement were higher in

phases A2 and B2 and all data points, except for one, reach 160 intervals engaged or above. Billy reached the top number of intervals (engaged for the 200 intervals) the first day and continued at high rates the rest of the study. Charles also had high rates of engagement throughout the study without much difference between phases. David showed his highest amounts of intervals engaged during the B2 phase. Overall, David demonstrated his highest rates (over 160 intervals) during the treatment phases.

Subjective data were taken during the study that suggested that new behaviors emerged during the treatment phases for each participant. Antoine showed increased vocalizations, eye contact, socialization, and improved transitions. Billy showed an increase tolerance for transitioning, engagement in activities and he was more responsive to given directions. Charles showed a decrease in protesting and withdrawal behaviors and an increase in flexibility during transitions. Lastly, David showed more initiation, increased social interactions and longer duration of engagement. More subjective reports were made from caregivers stating they saw a positive change in behavior in the home environment.

The results of this study indicate that short-term Ayre's sensory integration did not have a substantially different effect from that of a play scenario on undesired behaviors or engagement. There was no change in frequency of undesired behaviors immediately after Ayre's sensory integration, but it was reported that caregivers reported positive changes at home. This could suggest that the effect may be more evident after a latency period.

This study had strengths and limitations. Four primary strengths included, the study was carried out systematically, both interventions were carried out by the same occupational therapist, controlling the effect of the therapist-participant interaction, the raters for engagement

and undesired behavior were blind to which intervention condition preceded the data collection period and the study had high interrater agreement and high procedural reliability. The main limitation of this study was the restraints given because of the operational definition of engagement. It was possible that the definition cause for overestimation of engagement. The other limitations of this study were the small sample size, complications in rating engagement, short duration of the A2 phases, and the potential for bias in subjective observations recorded by study personnel and caregivers.

Summary

The 10 studies in this chapter evaluated whether sensory-based interventions increased on-task behavior in the educational setting for students with disabilities. Table 8 presents a summary of these findings, which are discussed in Chapter 3.

Table 8

Summary of Findings

AUTHORS	PARTICIPANTS	PROCEDURES	FINDINGS
Bagatell, Mirigliani, Patterson, Reyes, & Test (2010)	Six boys in kindergarten through 1st grade with a diagnosis of ASD.	A single-subject design was implemented: baseline, intervention and choice condition. Data was collected while observing behavior during circle time for 16 minutes across 4 weeks.	Results of this study are mixed. Results do not affirm previous studies that suggest therapy balls aid in increased engagement.
Bonggat & Hall (2010)	Three boys in preschool, two diagnosed with developmental disabilities and one diagnosed with autism.	An alternating treatments design was implemented where participants were randomly assigned to a sensory integration or attention control schedule that alternated every 1 or 2 weeks lasting 10 minutes. Students were then observed for two 15-minute sessions of independent workstations and a one on one activity that took place during the 30 minutes directly following the intervention sessions.	The results revealed no differences in the estimated percentages of time-on-task when either condition was used for all three participants.
Kercood, Grskovic, Lee, & Emmert (2007)	Study was conducted on eight 4th and 5th grade students with noted attention problems.	A single-subject alternating treatment design was conducted to have students solve math problems during two conditions to measure if tactile stimulation reduced excessive motor movement and increased task completion.	Results suggest that fine motor manipulation of a tactile stimulation object reduced excessive motor movement and increased task completion of students with attention problems.
Koenig, Buckley-Reen, & Garg (2012)	This study includes 46 participants from ages 5-12 who have a diagnosis of ASD.	Using an experimental pretest–posttest control group design, video observation was used to measure the effectiveness of the Get Ready to Learn (GRTL) classroom yoga program among children with ASD.	It was found that students who engaged in their standard morning routine and the intervention group showed a reduction in behaviors that were identified as maladaptive by teachers, including irritability, social withdrawal, hyperactivity.

AUTHORS	PARTICIPANTS	PROCEDURES	FINDINGS
Oriel, George, Peckus, & Semon (2011)	The study was on 24 students diagnosed with ASD ages 3 to 6 years old.	A within-subjects crossover design with a treatment condition and a control condition to examine the effectiveness of aerobic activities on academic engagement and stereotypic behaviors. Two of four classes were assigned randomly to the treatment condition and the other two the control condition and were then observed during a classroom task. The number of stereotypic behaviors and the percentage of on-task behavior responses were measured.	Results indicated that there were no significant differences were found for on-task behavior or stereotypic behaviors.
Peck, Kehle, Bray, & Theodore (2005)	Study was done on 10 elementary students ages 6 to 10 and in first through third grade.	A multiple baseline design: baseline, intervention and follow-up phase were conducted. Students engaged in intervention and were then observed in classroom for ten minutes following the intervention during whole group lessons or individual seatwork.	Comparison data indicated that classmates' time on task remained essentially unchanged throughout the three phases of the study.
Reichow, Barton, Sewell, Good, & Wolery (2014)	Three children, ages 4 and 5, two children with ASD and one with developmental delays.	A 10-s momentary time sample was used to observe the three conditions: no vest, vest with no weights, and a weighted vest.	Mixed-effects were observed in one child, and the others had a few problem or stereotypic behaviors.
Spence (2015)	The study was on 12 students from an urban community with noted attention difficulties.	A descriptive analysis and comparison of the quantitative and qualitative data collected at the pre and post-testing phases of the project were conducted.	Outcomes revealed 100% of the students increased their averaged on-task behavior, 58% of the students increased weekly assignments completed, and off-task behaviors related to sensory modulation dysfunction decreased.
Vandenburg (2001)	The study was conducted on four students 5 to 6 years old diagnosed with ADHD.	A quasi-experimental, single system, AB design was used. Two conditions were observed for six 15-minute observation sessions: baseline (no vest) and intervention (weighted vest).	On-task behavior increased by 18% to 25% in all four students while wearing the weighted vest.
Watling & Dietz (2007)	Four boys from 3 to 4 years of age diagnosed with Autism.	A single-subject study used an ABAB design to compare the immediate effect of Ayre's sensory integration on the participant's undesired behaviors and task engagement. Each phase included three 40-minute intervention sessions per week. Each session was then followed by a 10-min tabletop activity where data were collected.	No clear patterns of change were determined in task engagement.

Chapter 3: Conclusions and Recommendations

Children with disabilities have a number of sensory impairments that affect their ability to stay on-task in the classroom. Implementing sensory-based interventions into a student's school day has been viewed as one way to increase on-task behaviors in students with disabilities. The purpose of this starred paper was to evaluate if implementing sensory-based interventions increased on-task behavior in students with disabilities. Chapter 1 provided historical and theoretical information on this topic, and Chapter 2 presented a review of 10 studies that were conducted to examine the effects of sensory-based interventions, on-task behavior. In this chapter, I discuss the findings of these studies, present recommendations for future research, and discuss implications for current practice.

Conclusion

The majority of studies in Chapter 2 found no conclusive evidence that implementing sensory-based interventions has a positive effect on on-task behavior. Specifically, six studies reported no effect in implementing sensory-based interventions (Bagatell et al., 2010; Bonggat & Hall, 2010; Oriel et al., 2011; Peck et al., 2005; Reichow et al., 2014; Watling & Dietz, 2007). Four studies showed that implementing sensory-based strategies resulted in an increase of on-task behavior (Koenig et al., 2012; Kercood et al., 2007; Spence, 2015; Vandenburg, 2001). Kercood et al. also found that sensory interventions helped reduce excessive motor movement in the students. Spence and Kercood et al. both noted an increase in task completion as well.

One study involved alternate seating, such as sitting on therapy balls (Bagatell et al., 2010). The results of this study are mixed and do not affirm previous studies that suggest

therapy balls have a substantial improvement in in-seat behavior and engagement. Two studies included wearing a weighted vest (Reichow et al., 2014; Vandenburg, 2001). The results from these studies are opposite. Reichow et al. found that weighted vests were not an effective intervention but, Vandenburg found that using a weighted vest for children with attention difficulties to increase on-task behavior is effective. Three studies involved sensory-based interventions that involved movement or the body such as aerobics or yoga (Koenig et al., 2012; Oriel et al., 2011; Peck et al., 2005). In two of the three studies, there was no definitive evidence that on-task behavior was improved, but it was stated that by observation and subjective evidence there was, in fact, an increase. Four studies involved sensory integration techniques such as brushing, swinging, compressions, trampoline, tactile stimulation and etc. (Bonggat et al., 2010; Kercood et al., 2007; Spence, 2015; Watling et al., 2007). Two of these four studies showed improvements and one of the others, Watling et al. suggested that there was subjective evidence of improvement over time.

Recommendations for Future Research

The use of sensory-based interventions needs to be defined clearly and evaluated thoroughly for each participant. There needs to be more information found on how to figure out the correct type of sensory stimulation each individual needs, what interventions can be put into place and what are the long-term effects of those interventions.

Future research needs to be conducted to establish recommended practices for how to use sensory-based interventions. Specifically, research needs to be conducted to determine what sensory-based interventions should be implemented for each individual because there are sensory profiles and observations that take place, but every person is so individualized these tools do not

always give an accurate depiction of what will work best for each person. Interventions that were trialed in the studies seemed to have inconsistent results across participants. Further examination as to why some interventions were effective or non-effective could be useful in pinpointing which interventions are successful with different sensory needs. Sensory-based interventions do appear to increase on-task behavior in some children, but it did not work for all of the students. What are the student characteristics associated with effectiveness?

Future studies should dive deeper into long term effects of consistent sensory interventions. A few different studies stated that a latency period could be important when looking at results. How long does it take for interventions to show effectiveness?

In my experience, it seems that sensory-based interventions embedded into my students' day are necessary to help them regulate their bodies. It seems that it takes months and many trials of interventions until I understand what works best for each student and what they need. It would be beneficial and efficient to keep researching how to figure out what sensory needs a student has, specific interventions that can give them what they need and what effects the interventions will have on them.

Limitations

Although study limitations were identified in Chapter 2, it is important to address one major overall study limitation. Specifically, the time frame of each study was too short to see the true effects of the sensory intervention trialed. Future studies must be willing to have longer intervention periods that stay consistent with frequent data collection.

Implications for Current Practice

Educational teams and people working with children need to be aware of sensory needs that students have that can cause sensory seeking or sensory avoidance behaviors that can overall affect the way they perform in each environment. In order to be successful in school, a student needs to remain engaged and on task which can be hindered by Sensory Processing Disorder. Teams need to understand what strategies to implement for students that are showing a need and how to implement sensory-based interventions. There are so many different types of sensory tools around schools but, often times we are unsure what exactly is going to benefit the child and have to try several different things before finding something that works.

As a special education teacher, who works primarily with ASD, I am shocked at the results from the studies I examined. I can see my students have sensory needs but am often given the same three tools to try with every student of mine (weighted vest, compressions, and brushing), despite the fact they all have very different needs. What I have found is that there is no definite research out there of a systematic way to implement sensory-based interventions for specific needs.

Summary

With the legal and ethical responsibility to implement evidence-based practices, teachers and service providers have a responsibility to use interventions that are supported by research. Overall, using sensory-based interventions is not effective in increasing on-task behavior in students with disabilities in the studies I reviewed. Although research shows sensory interventions are not effective in increasing on-task behaviors, we need to keep in mind that all children are different. Different interventions should be trialed for each student and some

students may benefit from sensory interventions embedded in their school day. Teachers and educational team members need to be sure to find and document interventions that work for children and understand the behavior they are trying to modify and collect data on the results.

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