

**A Model for Classroom-Based Intervention for Children With
Sensory Processing Differences**

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Abstract

This study examines the impact of a general education, classroom-based sensory program for students exhibiting sensory processing differences in the school environment. Students were divided by age and degree of sensory needs between control and experimental groups. Teachers of experimental groups implemented the BrainWorks sensory program class wide. In spite of the top-down nature of the training for teachers, which generated a skeptical and/or resistant teacher population in both groups, results demonstrated a positive impact, although the degree of magnitude differed across classrooms and age groups. Of equal significance is difference in teacher implementation structures, which provides input for future training approaches. The degree of change in classroom performance of students in the experimental group suggests that training for teachers with students who have sensory differences is effective, and students can benefit from a classroom-based sensory program to improve classroom performance. This study is significant because it goes beyond the therapeutic environment and evaluates actual classroom-level/educational setting impact, with concrete implications for effective classroom interventions. Future research in this area could expand to evaluate actual academic gains as measured by standardized academic scores, furthering the data in this study, which evaluated performance on standardized sensory and behavioral measures.

A Model for Classroom-Based Intervention for Children With Sensory Processing Differences

Sensory processing disorder (SPD) is a condition that impairs an individual's ability to organize input from sensory sources and react according to that input (Alibrandi et al., 2014; Murray et al., 2009). SPD can take the form of Sensory Modulation Disorder, which is associated with under- or overresponsiveness to sensory input such as touch, movement, or other sensations; Sensory-Based Motor Disorder, involving difficulty organizing and sequencing tasks related to physical movement; or Sensory Discrimination Disorder, which limits the ability to distinguish among visual, movement, auditory, tactile, and other sensory input (Alibrandi et al., 2014; Murray, Baker, Murray-Slutsky, & Paris, 2009). SPD often coincides with autism spectrum, attention deficit, behavior, anxiety, or attachment disorders (Sensory Processing Institute for Research and Learning, 2006). Although SPD is not included in the *DSM-V*, these sensory integration issues create challenges in academic and daily living settings and can be treated through regular therapies and sensory integration programs (Sensory Processing Disorder Foundation, 2014).

Studies on the impact of clinically based therapy, the use of sensory strategies, and movement breaks provide a rationale for developing the capacity for teachers to provide a classroom-based intervention for students with SPD. This study investigates the impact of a program that involves training teachers on the implementation of sensory strategies and movement breaks as reflected in student gains in sensory processing and behavioral measures. While particular to an individual school, the impact of these measures in a short-term program reinforces other studies reflecting similar benefits (e.g., Worthen, 2010). Researchers hope that this study can contribute to increasing work in this area, so that students impacted by sensory processing challenges can improve their academic focus, learning, and behaviors to support their growth and achievement of their potential as students and community members.

Research Review

According to the Sensory Processing Institute for Research and Learning (2006), between 5 and 13% of students enter school with sensory processing disorder. This disorder can involve behaviors that directly impact classroom performance socially and academically. Aspy and Grossman (2007) note that behaviors resulting from SPD impede social and cognitive function on many levels, which in turn impairs classroom performance and learning. Children with SPD often suffer inconsistent attention and arousal, behaviors involving movement or self-stimulation, impairments in communicative responses, and difficulties with daily routines or social interactions (Pfeiffer, Koenig, Kinnealey, Sheppard, & Henderson, 2011; Schoen, Miller, & Sullivan, 2015; Worthen, 2010).

Sensory-seeking behaviors may involve jostling, pushing, misusing materials, inappropriate movement or touching, and other behaviors perceived as disruptive. Sensory avoiders may have difficulty with noise, lines, and various activities in the classroom or school setting. Sensory dysregulation can lead to attentional difficulties, distractibility, difficulty processing multistep directions, and challenges with managing transitions. Sensory dysregulation can interfere enormously with academic performance, learning, and social participation, limiting the prospects for successful school experiences (Alibrandi et al., 2014; Aspy & Grossman, 2007; Reebye & Stalker, 2008; Sensory Processing Institute for Research and Learning, 2006).

SPD Interventions in Therapeutic Settings

Historically, as Aspy and Grossman (2007) note, there is a great deal more practice in the field of therapy for SPD than there is research. Of the research that exists, there is much more related to clinical than classroom impact. Some of this research demonstrates the effectiveness of sensory integration therapies and sensory strategies.

The Sensory Processing Disorder Foundation (2014) shows the impact of an intensive short-term intervention conducted in a clinical setting with parental support. Over the course of 30 sessions, 98 children

demonstrated gains well above the expected level. A study by Pfeiffer et al. (2011) showed gains in social responsiveness and self-regulation through a sensory processing program for a group of 6- to 12-year-olds receiving 18 therapeutic sessions over a 6-week period in a summer program. A study by Miller, Coll, and Schoen (2007) found significant results in attentional and internalizing functions as the result of a 10-week intervention with 24 children with various disabilities and sensory processing challenges with the average age of 6.

SPD Interventions in School-Based Settings

Most of this research has been undertaken without direct linkages to classroom performance. A few studies, however, have looked directly at teacher use of sensory integration methods to improve academic performance, and there is a growing realization that the classroom is the most natural setting to evaluate the impact of sensory interventions (Worthen, 2010). In 2001, Keller examined the impact of using sensory integration strategies to improve handwriting. Her approach combined gross motor activities as a warm-up, fine motor warm-up activities, followed by direct instruction in letter writing, guided practice, semi-independent, teacher-guided practice, and then independent practice. Her findings, conducted in a single setting, found that student learning objectives were met. Additionally, student awareness of using sensory strategies to self-regulate also developed.

A study of the impact of providing sensory input during work at desks found that participation and on-task activity improved significantly (Schilling & Schwartz, 2004, cited in Aspy & Grossman, 2007). In a school-based study, Parham, Ecker, Miller Kuhaneck, Henry, & Glennon (2007) found that a long-term intervention had the greatest impact on the academic functioning of children 6 to 8 years old, notably in the area of math. The impact of the intervention diminished as children grew older.

In a review of recent research on the impact of sensory interventions on classroom behavior, Worthen (2010) found that there was a positive impact in numerous research studies focused on preschool- through elementary-aged students, both those with and without developmental differences or disabilities. Among key findings was that the use of auditory input such as calming music to enhance work efficiency, alternative seating devices and postures for improving attention, tactile stimulation and pressure to reduce off-task behaviors, and other interventions produced positive outcomes for groups of students in the studies reviewed. As a result, Worthen recommends that school-based occupational therapists (OTs) develop programs with sensory strategies for use in general education classrooms to improve behavior and attention and promote academic achievement.

Several studies have examined the effectiveness of teaching self-regulation strategies to students and have noted positive results. A study of preschool children found that self-regulation serves to mediate classroom skills and that curricula that incorporate teaching strategies for self-regulation can have a positive impact on student behavioral and social and academic performance (Raver et al., 2011). Shanker (2013) describes interventions to promote self-regulation that are critical to higher order and metacognitive thinking in the classroom. Another study on the classroom impact of self-regulation found that when students are dysregulated, their attention shifts to a search for a return to regulation, withholding attention from the learning task (Boekaerts & Corno, 2005, p. 204). Often the use of coping mechanisms can be *bottom up* (used to cope with challenging external stimuli) rather than *top down* (an attempt to prepare for learning). Boekaerts and Corno further point out that all students face stressors, but students with sensory differences face chronic internal and external stressors that undermine the path to learning goals. Teaching coping mechanisms is essential for ongoing social and academic self-regulation because when students have access and the will to use regulation strategies, they can maintain a focus on goals (p. 206). Direct teaching of the use of strategies—an inherent part of this study's intervention—can be an important step for students' progress toward their own approach to self-regulation.

In addition to direct sensory processing interventions, there is an emerging body of research on the value of movement breaks for all students in school, not merely those with SPD (e.g., Jensen, 2000; Mulrine, Prater, & Jenkins, 2008; Swinth, 2015). Movement provides stimulus to the brain, increases levels of neurotransmitters

that improve mood and focus, allows for processing time, and provides a break from learning that in turn allows students to refocus. Effective movement breaks can include those that vary posture and access to material during learning as well as breaks for stretching, walking, and other exercise (Jensen, 2000). Many researchers believe that movement is essential to optimize learning and achievement and can support attentional gains and behavioral improvement (e.g., Mulrine et al., 2008). Incorporation of movement is an important aspect of this study's intervention.

Teacher Knowledge

In spite of the emerging body of research about the benefits of sensory strategies and movement breaks in the classroom, provision of school-based services for sensory processing is still largely dependent on districts or even school-based OTs, who have discretion over the type of OT services provided (Morris, 2007). Moreover, some research has shown that teachers have little understanding of sensory processing disorder or the implementation of sensory strategies. Alibrandi et al. (2014) report that while 87% of Head Start staff claimed familiarity of SPD, only 17% could provide an accurate definition. Similarly, 53% reported knowledge of sensory diets, but only 10% could define them. When sensory processing disorder is misunderstood, teachers may misinterpret sensory-seeking or sensory-avoiding behaviors as problematic behaviors the child can control and attempt to eliminate them (Aspy & Grossman, 2007; Murray et al., 2009). In such cases, where the underlying state of dysregulation remains unaddressed, students may seek alternative behaviors, and learning and social integration are undermined. Even among those with an understanding of sensory processing needs of children, misunderstanding of areas of difficulty may result because sensory input is ongoing and cumulative (Aspy & Grossman, 2007).

If educational approaches are to succeed for students with SPD, teacher instruction about movement breaks and the use of sensory strategies to enhance sensory modulation will be necessary to enable these children to attend and maintain focus on instruction in their educational environment (Aspy & Grossman, 2007; Murray et al., 2009). Recognizing the importance of meeting sensory needs as a precondition for effective instruction, Aspy and Grossman include the sensory domain in their comprehensive model for instructional programming. Thus, consideration of this domain is critical, both in terms of managing the environment and developing proactive sensory interventions so that a child can maintain regulation. Finally, Murray et al. note that just providing sensory input is not enough. Students need to learn strategies to meet their own needs, maintain a state of regulation, and develop alternative behaviors.

Context of This Study

Given the emerging research on the classroom impact of movement breaks, sensory strategies, student instruction in self-regulation and the need for greater teacher information to effectively implement such interventions, this study examined the efficacy of a classroom-based program (hereafter called the "BrainWorks program") for children with sensory processing challenges. Based on a short OT-provided training program for teachers and subsequent teacher implementation of interventions for students with sensory challenges, the study examined sensory and behavioral improvements in classroom settings. These research questions guided the study:

- **Research Question 1.** How does a classroom-based sensory modulation program impact sensory and behavioral measures for children with sensory processing differences, based on pre- and postevaluations with the *Sensory Processing Measure (SPM)* and the *Behavioral Assessment System for Children (BASC-2)*; Miller Kuhaneck, Ecker, Parham, Henry, & Glennon, 2010; Parham et al., 2007; Reynolds & Kamphaus, 2004)?
- **Research Question 2.** What factors in teacher implementation impact the results? What other aspects of program implementation may impact outcomes?

This paper focuses on Research Question 1.

Method

Setting

This study took place in a rural district that includes 48.7% economically disadvantaged students in the elementary-middle school grades, the focus of this study (XXX ISD, 2013).^{*} The combined elementary and middle school has a total of 261 students, with good attendance rates, parent involvement, and standardized achievement rates across demographic groups. Overall achievement rates for the No Child Left Behind Act (2002) reporting purposes meet the state's benchmarks for proficiency. In terms of third-grade reading scores, for example, the district scores were 4% higher than statewide levels in 2010–2011. Among Hispanic students, scores lagged by 7%, with subgroup data unavailable for other ethnic groups or students in special education. Results were similar in math, and throughout other grade levels reported (fourth through sixth). Sixth-grade reporting for special education students indicated a large lead in this district over statewide numbers. Overall, the district is meeting benchmarks for Adequate Yearly Progress as defined by the state (XXX ISD, 2012). Also according to this reporting, in 2010–2011, 94.9% of teachers held a bachelor's degree and 5.1% held a master's degree. The previous year, the numbers were 82.7% and 17.3% respectively, likely reflecting either teacher turnover or statistical corrections.

Participants

Students were selected from classes where teachers attended training and subsequently implemented the BrainWorks program (the experimental group) and classes where teachers did not implement interventions (the control group). Researchers selected one teacher from each grade to be in the experimental group, based on balancing the number of students in the control and experimental groups. The only exception was fifth grade, in which no students qualified for the study. Students were divided into control and experimental groups for equivalent numbers within the groupings of prekindergarten (PK) through second grade and third through sixth grades. Groups were also fairly balanced based on severity of sensory differences as measured by the SPM and the BASC-2. Overall, there were 24 students in the control group and 22 in the experimental group. Teachers in both groups identified students with symptoms of sensory modulation disorder, based on information provided during staff training sessions.

As noted, these students were divided into control and experimental groups, with divisions occurring to deliberately balance the groups based on age and scores on the SPM and BASC-2 (Table 1).

^{*} According to APA Guidelines, while retrievability of data sources is essential, the ethics of participant confidentiality outweigh this principle. Given the small size of the district, with only one elementary, middle, and high school, district names have been redacted, both in text and in citations. Original documents remain in hard copy with researchers. *Source*. <http://blog.apastyle.org/apastyle/2013/08/lets-talk-about-research-participants.html>

Table 1

Group Distributions Based on Preintervention Scores

Grade	Control			Experimental		
	<i>N</i>	SPM	BASC-2	<i>N</i>	SPM	BASC-2
PK-2	11	61.70	53.07	14	66.23	56.47
3-6	13	58.71	53.02	8	56.13	50.71

Note. PK = Prekindergarten.

Training and Implementation

Teachers with students in the experimental group participated in the initial training and received on-going instruction and support from a licensed occupational therapist (referred to henceforth as the OT researcher) over the course of 10 weeks. This included all teachers from second through sixth grades because students move among teachers starting in second grade, and teachers would therefore implement interventions for those students in the experimental group when they were in their classrooms. For students in second through sixth grades, the homeroom teacher completed the assessments for the students included in this study.

The intervention was designed and implemented by the OT researcher, using the BrainWorks program. After her on-site training, she maintained at least weekly contact with teachers for support as they implemented the sensory program. There was also a paraprofessional in the school's motor skills lab (discussed later) who served as an on-site research assistant for the study. She checked in with participating teachers and relayed information to the OT researcher.

Teacher training began in August with an in-service conducted by the on-site research assistant. This session focused on the signs and symptoms of sensory processing disorder and provided teachers with a basic checklist to identify children who might have SPD. The assistant also outlined the study design. At the conclusion of that training session, all teachers were asked to complete an online survey to gather information about teachers' experience levels, their current level of understanding of sensory processing disorder, and their previous use of sensory strategies in the classroom. All teachers completed the survey before students began attending school.

In the initial teacher training session, each teacher was asked to observe their students and identify two to four students with signs and symptoms of sensory processing disorder. Parent consent-to-evaluate forms were sent home with those children. Consent was received for 50 out of 60 of the identified students. For these students, teachers completed the SPM or SPM-P (used for students aged 5 and younger in prekindergarten classrooms) and BASC-2 assessment forms in September after having had the children in their classes for five weeks. The on-site research assistant provided teachers with verbal and written instructions and guidelines from the OT researcher for completing the assessments. The OT researcher scored the assessments. Four students were eliminated from the study because of scoring within the typical range on both assessments, leaving the total number of students involved in the study at 46.

After assessments were completed and assignments were made to experimental and control groups, the OT researcher conducted two, one-hour training sessions after school in late September. All teachers were required to attend the first session; only experimental group teachers were required to attend the second session.

The first session explained the purpose of the study then covered sensory modulation and the benefits of movement breaks. The BrainWorks program was introduced including the use of the BrainWorks tachometer, which students use to monitor their need for sensory strategies, and the BrainWorks folder with activity cards, which are used for selecting appropriate strategies to enhance self-regulation.

The second training session titled "Sensory Diets in the Classroom" covered a variety of calming, alerting, and just-right activities that could be used in the classroom setting. A variety of sensory modifications and adaptations that could be helpful to students in the experimental group were discussed. An outline of the components of the intervention program was presented. Additionally, the OT researcher met individually or in small groups with teachers in the experimental group for approximately 20 minutes to review the assessment results of each of their students and to make individualized recommendations for each of them. The BrainWorks program for students in the experimental group included the following:

1. **Brain breaks every 15–20 minutes for students in PK through Grade 2, every 30–40 minutes for Grades 3–4, and every 50 minutes for Grades 5–6.** Brain breaks were defined as short opportunities (30–90 seconds) to move the whole body. Teachers were provided with BrainWorks activity cards to guide appropriate activity selection. The recommended activities were primarily proprioceptive in nature such as isometric exercises, deep pressure to the head, and wall push-ups.

The OT researcher suggested that all Brain Breaks be followed by two belly breaths (deep breathing that causes the abdomen to expand outwardly).

2. **Sensory breaks twice per day for students in all grades.** Sensory breaks of at least 10 minutes were defined as longer opportunities for movement and sensory input. Teachers were given options for sensory breaks through the use of BrainWorks activity cards representing activities such as yoga, classroom exercises, and movement songs as well as access to GoNoodle.com, a website providing video-guided movement breaks.
3. **Classroom instruction in the identification of sensory needs through BrainWorks tools.** Instruction options included the book titled *Arnie and His School Tools* for younger students, teacher instruction, a short video explanation prepared and presented by the OT researcher, and direct class instruction from the OT researcher via Skype. Teachers were asked to use the BrainWorks analogy and tachometer frequently throughout the duration of the study.
4. **The use of sensory equipment provided by the OT researcher on an as-needed basis.** Equipment included FootFidget® Footrests, Kore Wobble Stools, noise-reduction headphones, fidget toys, weighted lap pads, and therapy balls for seating.
5. **Modifications and adaptations per OT researcher.** Recommendations included such things as dimming the lights, playing modulating music, and preferential seating.

Recommendations by the OT researcher for individualized sensory strategies or the use of sensory equipment were based on the OT researcher's professional interpretation of the assessment tools as well as the use of *The Sensory Processing Measure—Preschool Quick Tips* (Henry, 2014), a tool that assists clinicians in the selection of appropriate intervention strategies based on the results of the SPM.

After training, teachers spent 10 weeks implementing the program as outlined previously and remained in contact via email and phone calls with the OT researcher. The on-site research assistant stopped by the classrooms assigned to the experimental group regularly to observe and assure follow-through of program components. Apparent lack of follow-through was reported to the OT researcher and the principal. The principal communicated with the teachers regularly as well and let the OT researcher know of potential issues with teacher follow-through. At the end of 10 weeks, teachers completed the SPM or SPM-P and BASC-2 assessment scales for each student and another online teacher survey.

Data Collection and Analysis

Data collection was purposeful and thorough to examine various facets of the study and to elucidate variables that might impact both research results and the conduct of future studies in this area. As a validity strategy (discussed later), data in each category were triangulated so that greater insight and interpretive validity could be applied through transparency and reporting.

To respond to Research Question 1, the impact of the intervention on student classroom functioning, the primary data sources were the scores on pre- and post-SPM or SPM-P and BASC-2 assessments for students in the control and experimental groups. Teacher feedback on the impact of the intervention was a secondary source.

Prior to the training, and at the conclusion of the 10-week intervention, teachers in both the control and experimental groups completed the SPM (or SPM-P) and BASC-2 for each identified student to evaluate the impact of the interventions on the sensory and behavioral areas identified in each measure. These scores were compared to determine the level of change in individual behaviors, processing, and other factors measured as well as to determine the overall level of performance changes by student as well as grouped by teacher.

At the conclusion of the study, teachers completed a survey on their experiences implementing the intervention. The results were reviewed overall, to determine the impact of the training, as well as individually, to look for differences in implementation that could impact student results. Questions focused on teacher learning, implementation of movement breaks, implementation of sensory breaks, use of self-regulation and choice tools, and overall perception of the impact of the intervention on students' classroom behaviors. Student

scores were used as a framework for examining areas of teacher implementation. This relied on starting with student scores at the high and low end of the ranges and then examining teacher reporting on implementation: first, through the overall perspective reported in their final survey, and then through the data in their implementation reports. These data were also compared to the OT researcher's notes and correspondence during implementation.

Validity Measures and Checks

This study relies on several forms of validity. First, for triangulation purposes, we sought to examine data points from multiple perspectives. These are summarized in Table 2. Next, to avoid simple conclusions, we examined our results for discrepant data, both in terms of student performance and teacher implementation, or other mitigating factors identified in field notes and/or teacher correspondence. As a further validity strategy, we examined the notion of participant reflexivity. This is particularly important when examining teacher implementation notes and teacher surveys. In terms of the experimental effect and the validity of results corresponding with student growth, students from both the control and experimental groups were measured in late September and after 10 weeks of the study. While there would have been acculturation effects, those would present equally in both groups, allowing for examination of differences based on the independent variable of the BrainWorks program's effect.

Table 2

Summary of Data Analysis Triangulation Methods

Data source	Triangulation
Baseline BASC-2 and SPM scores	<p>Examination of field notes from training</p> <p>Purposeful sampling and assignment to control and experimental groups</p>
Post-implementation BASC and SPM scores	<p>Comparison with datasheets for details on interventions by various teachers to look for patterns</p> <p>Examination and disclosure of mitigating factors in implementation</p>
Teacher implementation reports	<p>Comparison with teacher surveys</p> <p>Comparison with student results</p> <p>Search for discrepant data</p>
Teacher surveys on their experiences implementing the measures	<p>Triangulation with implementation notes</p> <p>Triangulation with student outcome scores</p> <p>Search for discrepant data</p>

It is worth noting two cases that might have impacted evaluation of data. Both cases weakened the results in terms of noting change. First, one student was transferred from an experimental to a control classroom during the study. Both the transfer and the fact that a teacher in the control group completed his evaluation may have rendered his gains less significant. Second, one student in the control group was having difficulties in class, and consequently received additional supports. His results may have shown greater improvements overall, thus making the experimental groups' results appear relatively less impactful.

Results

Because students in this study had sensory issues that had previously been unaddressed, it is perhaps unsurprising that interventions demonstrated improved classroom functioning. However, within results, there was variation both among scales of sensory function and between age subscales. In addition, the approach of individual teachers in the way that they implemented interventions also produced different results. Because recent guidelines about presenting data on differences between control and experimental groups might not be easily understood using commonly used statistics such as *p*-scores (U.S. Department of Education, 2012), data are presented using deltas of average T-scores for each scale).

Control vs. Experimental Groups

Analysis of pre- and postscores from both the SPM and the BASC-2 showed significant improvement. The total change for the experimental group based on the SPM is reflected by T-score of 3.71 (5.95%) improvement. Based on the BASC-2, the experimental group's total T-score was a 6.1 (11.9%) improvement. The control group on the other hand reflected no interventions beyond preexisting work based on IEP goals to the extent that it was being implemented. Total progress is represented by a 0.33-point gain on the SPM (2.5%) and 13.05 (1.27%) on the BASC-2, with positive results only in visual processing and planning categories on the SPM. (Full SPM results are presented in Table 3 and Figure 1. Table 4 and Figure 2 reflect the impact of interventions as measured by the BASC-2.

Table 3

Comparison of Group SPM Results

Scales	Control		Experimental	
	Ave. T-score	Delta (%)	Ave. T-score	Delta (%)
SOC	-1.52	-1.65	7.62	11.8
VIS	4.00	8.20	5.05	7.74
HEA	-0.33	1.10	4.62	7.47
TOU	-1.19	-1.34	1.67	2.98
BOD	-1.81	-1.31	2.05	3.43
BAL	-0.62	1.89	3.10	5.13
PLA	0.38	1.18	4.76	7.26
Total	0.33	2.50	3.71	5.95

Note. SOC = Social Participation; VIS = Visual Processing; HEA = Auditory Processing; TOU = Tactile Processing/Touch; BOD = Body Awareness; BAL = Balance and Motion; PLA = Planning and Ideas.

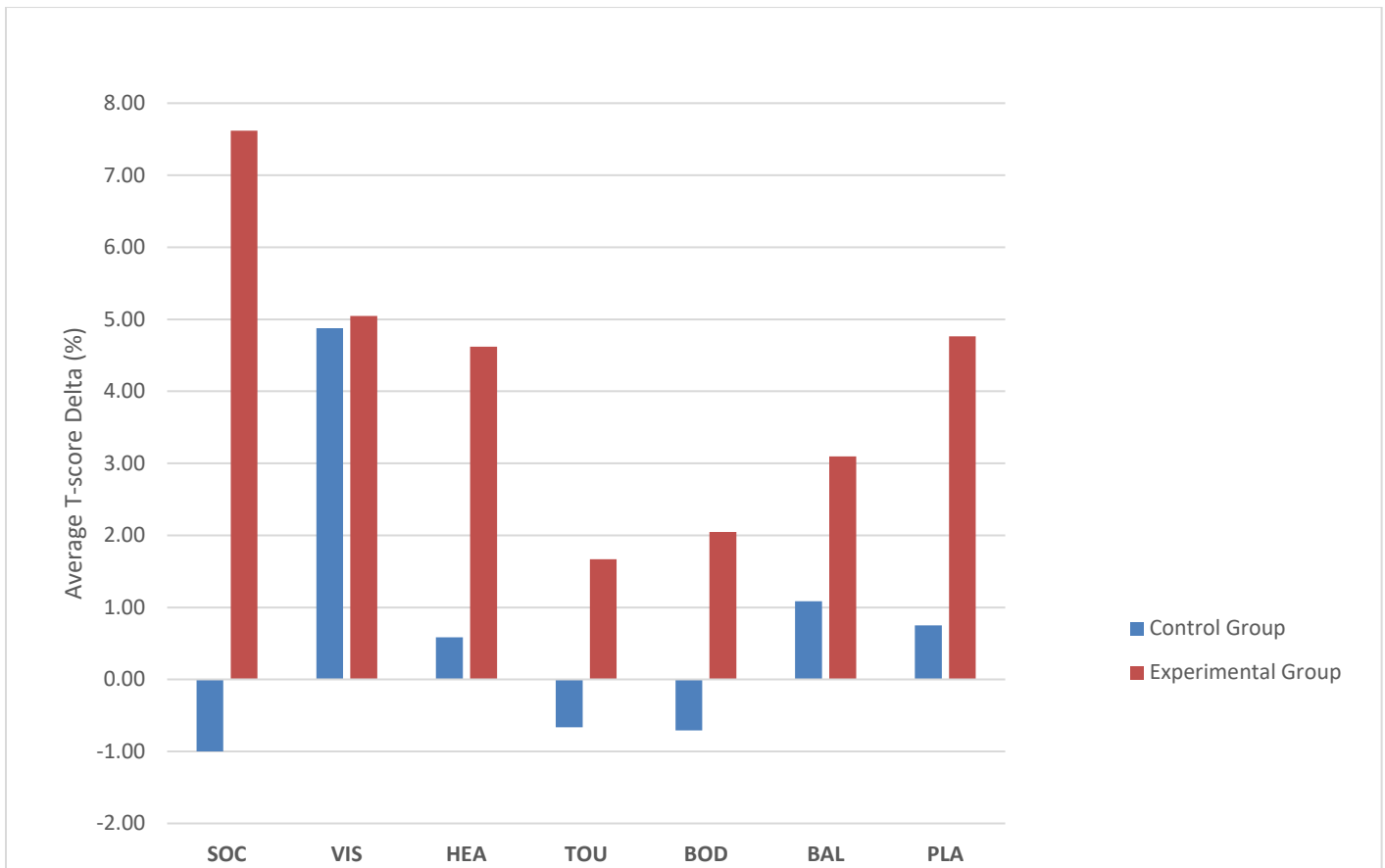


Figure 1. Comparison of control vs. experimental group SPM results. SOC = Social Participation; VIS = Visual Processing; HEA = auditory Processing; TOU = Tactile Processing/Touch; BOD = Body Awareness; BAL = Balance and Motion; PLA = Planning and Ideas.

Table 4

Comparison of Group BASC-2 Results

Scale	Control		Experimental	
	Ave. T-score	Delta (%)	Ave. T-score	Delta (%)
Hyperactivity	2.24	3.70	7.10	10.8
Aggression	-2.52	-4.93	3.52	6.5
Conduct Problems	-1.83	-3.50	4.50	7.7
Externalizing Problems	-0.67	-1.20	5.48	9.2
Anxiety	3.05	5.86	4.00	7.7
Depression	1.00	1.84	5.00	8.7
Somatization	0.71	1.36	2.86	5.6
Internalizing Problems	1.95	3.64	5.10	9.3
Attention Problems	2.62	4.01	7.38	11.1
Learning Problems	2.17	3.16	5.00	7.6
School Problems	2.61	3.84	6.31	9.3
Atypicality	0.81	1.26	10.00	14.1
Withdrawal	0.71	1.16	6.38	10.4
Behavioral Symptoms Index	1.05	1.69	8.29	12.6
Adaptability	-1.05	-2.35	10.14	24.6
Social Skills	0.43	1.04	8.52	22.3
Leadership	1.11	2.87	4.50	11.5
Study Skills	-0.44	-1.16	3.75	10.0
Functional Communication	-0.33	-0.94	6.57	17.4
Adaptive Skills	-0.05	-0.13	8.43	22.6
Total	13.05	1.27	6.10	11.9

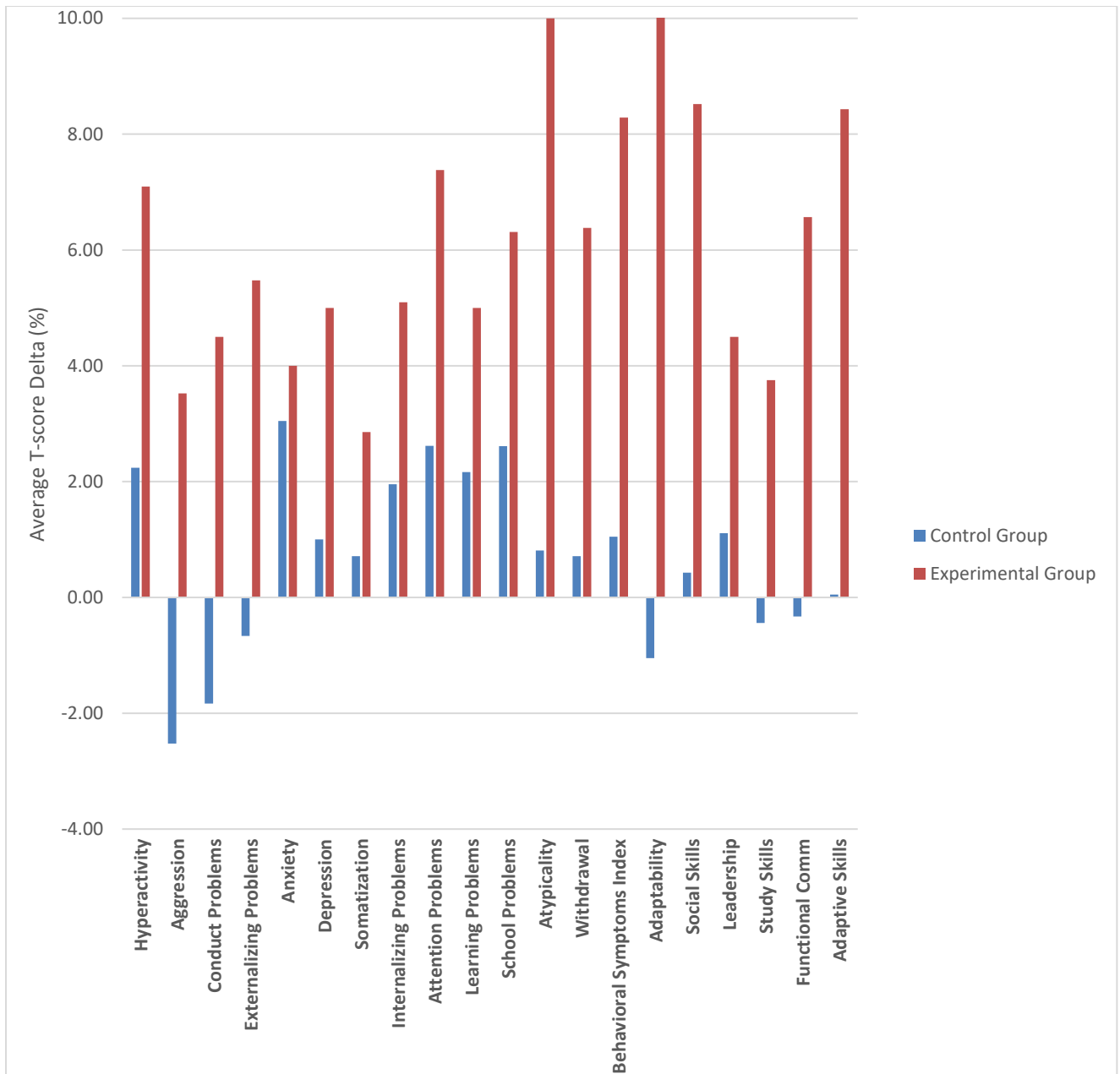


Figure 2. BASC-2: Comparison of control vs. experimental group.

Based on SPM results, the most dramatic improvement was in the Social Participation scale. Further detail from the BASC-2 scales pinpoints Adaptability and Adaptive Skills, Social Skills and Functional Communication, and Atypicality as areas of improvement typically felt to be contributors to Social Participation. The skills reflected in the Social Participation scale on the SPM include working well with others, handling frustration appropriately, and maintaining eye contact and appropriate personal space. While these are difficult skills for a clinician to address in a traditional therapeutic setting, the classroom environment is ideal as long as sensory modulation is being addressed to promote success in these skills. Similarly, based on the SPM, the experimental group demonstrated improvements in planning by measuring such skills as organization of materials, problem solving, and sequencing of tasks. Scales of the BASC-2 reflecting areas critical to those skills may include Attention Problems and Hyperactivity, Learning Problems, and Study Skills. These prosocial and academic behaviors have a direct impact on classroom participation and represent significant opportunities for academic gains and successful functioning in mainstream classrooms.

On the Visual Processing scale of the SPM, students in both groups demonstrated improvements. This is interesting because it suggests that students exposed to classroom practices may become accustomed to and adjust for visual processing demands. Similar gains on this scale could also be a result of the school's Motor Lab, based on the *Ready Bodies, Learning Minds* program, which strives to enhance learning readiness through specific movement activities to develop the reflexive and sensory systems. In the school where this study took place, PK and kindergarten classes attended Motor Lab daily; first graders attended every other day.

Gains in Auditory Processing, a frequent challenge for students with sensory issues, were also notable in the experimental group.

As discussed previously under the section on student cases and validity, these results may be slightly understated because of the student changes in the experimental and control groups.

Discussion

While not generalizable, this study provides evidence in the context of one school district of the impact of a classroom-based sensory program for teachers and students. The classroom improvement gains demonstrate the importance of including this type of approach so that students are able to better focus on their developmental and academic learning. Previous studies in clinical settings have shown similar improvements, however, incorporating sensory strategies for students' self-regulation in a school setting is relatively new.

It is evident that further research in this area is needed. Given the importance of student outcomes, progress toward IEP and academic goals, and overall well-being within an educational environment, expanding the use of sensory processing training and use of systematic approaches can benefit students and teachers alike. Most important, this type of training supports teachers' efforts to develop effective strategies to support their students as they achieve their potential. Moreover, by targeting student awareness, such student-centered tools provide them with the awareness of how to improve their own self-regulation. Thus, as they progress through the school system, the habits of self-regulation will become instilled, enabling students to take control of their own performance and improve their academic outcomes. This will benefit not only the students, but teachers and schools, as student academic progress contributes to the overall success rate and outcomes of schools.

References

- Alibrandi, N., Beacock, L., Church, C., Des Moines, S., Goodrich, K., Harris, L., . . . Vrtovnik, L. (2014). *Perceptions and awareness of sensory processing disorder among head start personnel* (Masters Thesis). Available from ProQuest Dissertations and Theses database (UMI No.1558942).
- Aspy, R. & Grossman, B. (2007). *The ziggurat model: A framework for designing comprehensive interventions for individuals with high-functioning autism and Asperger syndrome*. Shawnee Mission, KS: AAPC.
- Boekaerts, M., & Corno, L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology: An International Review*, 54(2), 199–231.
- Henry, D. A. (2014). *The Sensory Processing Measure–Preschool (SPM-P): Manual*. Los Angeles, CA: Western Psychological Services.
- Jensen, E. (2000). Moving with the brain in mind. *Educational Leadership*, 58(3), 34–37.
- Keller, M. (2001). Handwriting club: Using sensory integration strategies to improve handwriting. *Intervention in School and Clinic*, 37(1), 9–12. doi:10.1177/105345120103700102
- Miller, L. J., Coll, J. R., & Schoen, S. A. (2007). A randomized controlled pilot study of the effectiveness of occupational therapy for children with sensory modulation disorder. *American Journal of Occupational Therapy*, 61, 228–238. doi:10.5014/ajot.61.2.228
- Miller Kuhaneck, H., Ecker, C., Parham, L. D., Henry, D. A., & Glennon, T. J. (2010). *Sensory processing measure–Preschool (SPM-P)*. Los Angeles, CA: Western Psychological Services.
- Morris, M. (2007). SPD services in school . . . How to get what you need. *The SPD Companion*, 12. Retrieved February 19, 2016, from http://www.sensory-processing-disorder.com/The_SPD_Companion-SPD-Services-In-Schools.html
- Mulrine, C. F., Prater, M., & Jenkins, A. (2008). The active classroom: Supporting students with attention deficit hyperactivity disorder through exercise. *Teaching Exceptional Children*, 40(5), 16–22. doi:10.1177/004005990804000502
- Murray, M., Baker, P., Murray-Slutsky, C., & Paris, B. (2009). Strategies for supporting the sensory-based learner. *Preventing School Failure*, 53(4), 245–251. doi:10.3200/PSFL.53.4
- No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. (2002).
- Oden, A. (2017). *Ready bodies, learning minds: cultivation the complete mind*. (3rd ed.). Spring, TX: Author. Available from <http://www.readybodies.com/shop/rblm-cultivating-complete-child/>
- Parham, L. D., Ecker, D., Miller Kuhaneck, H., Henry, D. A., & Glennon, T. J. (2007). *Sensory processing measure (SPM): Manual*. Los Angeles, CA: Western Psychological Services.
- Pfeiffer, B. A., Koenig, K., Kinnealey, M., Sheppard, M., & Henderson, L. (2011). Research Scholars Initiative—Effectiveness of sensory integration interventions in children with autism spectrum disorders: A pilot study. *American Journal of Occupational Therapy*, 65, 76–85. doi: 10.5014/ajot.2011.09205
- Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP’s impact on low-income preschoolers’ preacademic skills: Self-regulation as a mediating mechanism. *Child Development*, 82(1), 362–378. doi:10.1111/j.1467-8624.2010.01561.x
- Reebye, P., & Stalker, A. (2008). *Understanding regulation disorders of sensory processing in children: Management series for parents and professionals*. London, United Kingdom: Jessica Kingsley.

- Reynolds, C. R., & Kamphaus, R. W. (2004). *Behavior assessment system for children: BASC-2*. Circle Pines, MN: American Guidance Service.
- Schoen, S. A., Miller, L. J., & Sullivan, J. (2015) A pilot study of integrated listening systems for children with sensory processing problems. *Journal of Occupational Therapy, Schools, & Early Intervention*, 8(3), 256–276. doi:10.1080/19411243.2015.1055418
- Sensory Processing Disorder Foundation. (2014). The effectiveness of intensive, short-term intervention for sensory processing disorder: A retrospective pretest post-test study. Retrieved from <http://www.spdfoundation.net/files/1814/2490/0905/SPDF-ABAS-BASC-Results.pdf>
- Sensory Processing Institute for Research and Learning. (2006). Educator fact sheet: Signs and Symptoms of sensory processing disorder. Retrieved from http://www.thespiralfoundation.org/pdfs/ed_factsheet.pdf
- Shanker, S. (2013). *Calm, alert, and learning: Classroom strategies for self-regulation*. Ontario, Canada: Pearson.
- Swinth, Y. (2015). Do children get enough movement in school? *Journal of Occupational Therapy, Schools, & Early Intervention*, 8(3),193–195. doi:10.1080/19411243.2015 .1095552
- U.S. Department of Education, National Center for Special Education Research, Institute of Education Sciences. (2012). Translating the statistical representation of the effects of education interventions into more readily interpretable forms. (NCSEER Publication No. 2013-3000). Retrieved from <http://ies.ed.gov/ncser/pubs/20133000/pdf/20133000.pdf>
- Veenendall, J. (2008). *Arnie and his school tools: Simple sensory solutions that build success*. Shawnee Mission, KS: Autism Asperger Publishing.
- Worthen, E. (2010). Sensory-based interventions in the general education classroom: A critical appraisal of the topic. *Journal of Occupational Therapy, Schools, & Early Intervention*, 3(1), 76–94. doi:10.1080/19411241003684217
- XXX ISD. (2012). NCLB report card for elementary campus. State: XXX Independent School District. Retrieved February 18, 2014 (URL redacted for confidentiality).
- XXX ISD. (2013). XXX district improvement plan 2013–2014. State: XXX Independent School District. Retrieved February 18, 2014 (URL redacted for confidentiality).