Evaluation of the Effects of Sensory Integration-Based Intervention by a Preschool Special Education Teacher

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Abstract: This study addresses the call for increased research on common public school practices and progress monitoring by public school teachers. An alternating treatment design was implemented by a preschool teacher to evaluate the effect of sensory-integration based activities compared with an attention control on the on-task behavior of three participants with disabilities. The preschool participants were observed during one-to-one teaching sessions and completing maintenance tasks in an independent workstation during the second half of a school year. The results revealed no differences in the estimated percentages of time on-task when either condition was used for all three participants. More time on task occurred when the participants were working in one-to-one activities. The design used in this study serves as a model that can be used by teachers and occupational therapists working in a public school.

The process of sensory integration is supported by a theoretical construct that describes the relationship between the neurobiology of an individual and the environment (Fisher & Murray, 1991). Theorizing about the interaction between the sensory and motor systems and the environment has been a focus of the field of occupational therapy (Mailloux & Smith-Roley, 2004; Wilbarger & Stackhouse, 2005). Current theories build upon the work of Dr. Jean Ayres who developed a theory of sensory integration and described intervention practice for individuals with disabilities (Ayres, 1972; Ayres & Tickle, 1980). Although theory development regarding the interaction between behavior of the individual, the sensory and motor systems, and environmental stimuli is ongoing (Anzalone & Williamson, 2000; Baranek, Parham, & Bodfish, 2005; Wilbarger & Stackhouse), occupational therapists are actively recommending practices to address atypical behavior by individuals identified with disabilities thought to be a result of problems with sensory integration processing (Mailloux & Smith-Roley).

Reviewers of research on practices based on sensory integration theory have concluded that there is either little or no evidence to support such practices when used for children with learning disabilities (Hoehn & Baumeister, 1994; Kaplan, Polatajko, Wilson, & Faris, 1993), language and learning disorders (Griffer, 1999), mental retardation (Arendt, MacLean, & Baumeister, 1988), and autism spectrum disorders (Goldstein, 2000; Rogers & Ozonoff, 2005). Although most reviewers identify methodological weaknesses in the design as one of the main reasons for their conclusions, there also is a lack of relationship between any changes in behavior with the proposed dysfunctional sensory or motor system (Baranek, 2002; Dawson & Watling, 2000). Many of these authors call for more research on the outcomes of this approach (Dawson & Watling; Griffer; Kaplan et al). In spite of this lack of evidence, sensory integration-based activities continue to be recommended by occupational therapists and used by educators in
public schools (Rogers & Ozonoff). Parents have reported (Smith & Antolovich, 2000) and authors have speculated (Kaplan et al.) that interventionists perceive that children improve as a result of sensory integration-based therapy or that positive changes in behavior are attributed to the sensory integration strategies.

Several strategies that are put together in order to modulate arousal, attention, affect and action for an individual can be referred to as a “sensory diet” (Anzalone & Williamson, 2000; Baranek, 2002). Some of the strategies included in a typical “sensory diet” may be enjoyable for both the student and the educator. Massaging with lotion is an example. Escalona and her colleagues found that children with autism who received massage from their parents at bedtime exhibited less stereotypic behavior and showed more on-task behavior during play at school compared with those children with autism read a Dr. Seuss story (Escalona, Field, Singer-Strunck, Cullen, & Hartshorn, 2001). The authors state that the underlying mechanism for enhancing attentiveness is not known but they speculate that massage therapy has been noted to enhance parasympathetic activity that is correlated with attentiveness.

Case-Smith and Bryan (1999) used a single-subject AB design to evaluate the effects of sensory integration based therapy on the engagement, play and social behaviors of preschool children with autism or pervasive developmental disorders. Although they found increases in play behavior and engagement for three of the five participants, baseline measures were obtained following the winter break, a time the authors describe as typically resulting in regression of skills. Information on the generalization of play behaviors was lacking.

Reilly, Nelson, and Bundy (1983) used an alternating treatment design to evaluate a 30-minute sensory integration-based intervention compared with a fine motor activity on the vocalizations of 18 children with autism. Contrary to predictions they found that the fine motor activity resulted in more vocalization by participants, however, there was a history of positive reinforcement for vocalizations during fine motor activities. Schilling and Schwartz (2004) used a withdrawal design to evaluate the use of therapy ball for children with autism spectrum disorders and found that children were more engaged when using the therapy ball than when using alternative forms of seating (chair, bench, carpet square on floor). These single-subject designs could be used by public school personnel to evaluate intervention outcomes if the proper controls are incorporated.

Educators and therapists who work in public schools are currently expected to use “evidence-based” practices (Odom et al., 2004). The importance of measuring outcomes and using data to guide treatment decisions has been emphasized by leaders in the field of occupational therapy (Anzalone & Williamson, 2000; Baranek et al., 2005; Ottenbacher, Tickle-Degnen, & Hasselkus, 2002). Betty Hasselkus, previous editor of the American Journal of Occupational Therapy, wrote that best evidence can be determined by quasi-experimental designs including single-subject designs (Ottenbacher et al.). The Council for Exceptional Children Task Force on Quality Indicators for Special Education Research also agrees that the use of single-subject designs with a set of criteria can be used to determine effectiveness of a practice (Odom et al.). In the following study, a single-subject alternating treatment design was used to evaluate the effects of sensory integration-based activities on the on-task behaviors of three students with developmental disabilities. This study was implemented by a preschool teacher with a credential in early childhood special education.

Method

Participants

Two boys with developmental delay (Jose and Marco) and one boy with autism (Dante) were participants in this study. Jose was a four-year old boy of Mexican decent who began early intervention services eight months prior to the study. He received an assessment from an occupational therapist that concluded he displayed some signs of “tactile defensiveness” and inconsistently reacted to teacher directions by screaming and crying especially when asked to work one-on-one in a structured setting. Jose was an active boy, who used three to
four word sentences at the time of the study. He showed signs of appropriate play skills (turn-taking, sharing, and eye contact with verbal reminders), however, the majority of the time he played along side his peers (parallel play) and did not seem to attend to any activity during play or recess for more than five to ten minutes.

Marco was a four-year eleven-month old boy of Mexican decent who began early intervention services at an early age. He transitioned into this preschool classroom at the age of three years. Some of the behaviors Marco exhibited in the classroom were: resistance to being touched by the staff, crying and screaming if anyone left the classroom, hitting his head when angry, frustrated, and/or sad, and closing his eyes or covering his eyes with his arm to avoid task demands. Marco’s occupational therapy assessment also concluded signs of “tactile defensiveness”. Unlike Jose, Marco had Individualized Educational Plan (IEP) goals and objectives written to address this issue. Marco also displayed oral motor difficulties, such as low tone around his mouth and drooling, and it was at the suggestion of the occupational therapist that oral swipes and oral massage be performed on Marco as part of his “sensory diet”.

In addition, Marco had difficulties in the areas of fine motor, self-help, and strength/coordination. Marco was nonverbal and demonstrated his liking of Jose by walking hand-in-hand with him, sitting next to him during table activities, and helping him with classroom chores such as pulling the wagon and cleaning up toys. Marco also approached two or three of the typical peers in his after school program and would follow their verbal and physical directions to play and/or sit with them. Marco spent the majority of his time engaged in parallel play and did not demonstrate age appropriate play skills.

Dante was a four-year old boy of African-American decent who transitioned from a less structured class one-and-a-half months prior to the beginning of this study because of his lack of progress and his display of challenging behaviors (hitting and pushing others). Dante’s occupational therapy assessment identified his greatest areas of need to increase his ability to: attend to tasks and people, complete transitions smoothly, and perform fine motor tasks. Dante displayed parallel play skills during free play, and at the time of the study showed limited age-appropriate play and/or social skills, except for greetings and saying “sorry” when he was told he had hurt someone. Dante enjoyed wrestling and movement activities.

Preschool Teacher

The classroom teacher, and first author of this research, held a B.A. in psychology and her teaching credential in Early Childhood Special Education. She was enrolled in an advanced degree program and this study fulfilled one of the requirements for the degree. She had worked as a classroom aide for a year and as a home program tutor for ten years. She was trained to use discrete trial teaching methods, structured TEACCH activities (Mesibov & Howley, 2003) including independent work stations, Pivotal Response Training, a child lead approach based on the principles of applied behavior analysis (Koegel, Koegel, & Carter, 1999), and sensory integration-based activities. The sensory activities were demonstrated by an occupational therapist who worked for the district. The teacher had arranged a class-wide data collection system prior to commencement of the study.

Observers

Two observers were trained for this study. The primary observer was the Special Education Technician (SET or aide) currently working in the classroom and the secondary observer was the second author and the university advisor for the teacher’s degree program.

Setting

This Special Education Early Childhood classroom is located on the campus of an urban elementary school in San Diego. Located in a low-income neighborhood, the majority of the school’s population is traditionally underrepresented and the majority of students are on free and reduced lunch programs. Students with Individualized Educational Plans who typically have a diagnosis of autism, mental retardation, and/or have sensory deficits and/or behavior problems are placed in spe-
cialized preschool classrooms in this district. Because of the unique needs of the students, the student to staff member ratio is approximately one or two students to one adult. School sessions for the preschool classrooms are three hours and forty-five minutes long with the morning session taking place from 9:00 am to 12:45 pm and the afternoon session taking place from 11:50 to 3:35 pm.

As the children arrive at school they are greeted at the bus and walked to the classroom where each student checks their schedule and proceeds to put their backpack away, go to the bathroom and participate in their individualized “sensory diets” (usually consisting of some or all of the following activities: brushing, joint compressions, oral swipes, and exercises, therapy ball activities, the hammock, and scooter board). Once each student is finished, the students begin their work rotations. These activities include but are not limited to: discrete trial teaching of pre-academic skills, structured teaching independent work stations for maintenance tasks, fine motor rotations (writing, cutting, puzzles, beads), structured play, circle time, art, and specialist services.

Two Special Education Technicians (SET’s) support these classrooms. Typically these SET’s are not trained by the district or by the special education department in the various techniques and strategies used in these classrooms. The SET in this classroom, however, was informally trained by the classroom teacher in discrete trial teaching, sensory integration-based occupational therapy, overseeing the structured teaching independent work stations, and was consistent with the classroom teacher in how to teach fine motor skills such as prewriting and cutting. The SET was also trained by the teacher on how to take data throughout all teaching strategies and activities.

**Materials and Measures**

For the sensory diets that all participants received, a surgical brush was used as well as a specialized brush designed for oral swipes for Marco who was given oral swipes after joint compressions. Vestibular equipment was also used and included: a hammock, swing, and scooter board. Proprioceptive input was given via joint compressions, a therapy ball, weighted vests, weighted pillows, and a blanket. The following materials were used during attention control activities: puzzles, puppets, interactive (music/lights) toys, bubbles, books, blocks, and play dough.

The dependent measures for this study were: attention to task and disruptive behaviors. Attention to task was selected because it was a reported benefit of sensory integration-based activities according to the occupational therapist and the classroom teacher. For the purposes of this study, attention to task was defined as the ability to demonstrate eye contact with the teacher and appropriate participation in an activity. Disruptive behaviors were defined as: screaming (S) or any vocalization above conversational noise level that demonstrated the participant’s rejection of a command and/or task and lead to their inability to attend to, and/or perform a task for more than two seconds; crying (C) or crying for more than two seconds that lead to the participants’ inability to attend to, and/or perform a task; turning away (T) or any physical movement which was demonstrated by the participant turning their body and/or head away from the task or averting their eye gaze from the task leading to a lack of attending to, and/or perform a task for more than two seconds; running away (R) or any physical attempt made by the participant to escape, avoid, and/or reject the task by removing their body from the immediate work environment; eyes closed (E) or an action made by the participant to escape, avoid, and/or reject the task by closing their eyes for a duration of more than two seconds; and other (O) or any other behavior not previously mentioned which demonstrated an attempt to escape, avoid, and/or reject the task for a duration of more than two seconds (playing with materials, staring without movement).

Recording sheets were created to score the occurrence of dependent variables. Dependent measures were scored using whole interval time sampling (5 minutes of each 15-minute activity) with 10 seconds observation and 5 seconds recording. If off task and disruptive behavior occurred, any part of the interval, the type of behavior was recorded by circling the letter coded for that behavior.
Design and Analysis

An alternating treatments design (Barlow & Hersen, 1984; Cooper, Heron, & Heward, 2007) was used to evaluate the effects of sensory integration-based occupational therapy and an attention control on activity engagement and disruptive behaviors. The two treatments or conditions of sensory integration activities and attention control activities were implemented for one to two weeks in a counterbalanced order within each single subject (Cooper et al.).

Procedure

Training of the observers took place prior to beginning the observations. The observers scored videotapes of the participants in various activities (the same activities that they would be observed in during the treatment phase) until the criterion of an inter-observer agreement rating with the classroom teacher of a minimum of 80% over three consecutive observations was obtained for each observer.

During intervention, participants were randomly assigned to a sensory integration or attention control schedule that alternated every one or two weeks. Sensory diets or attention control activities were implemented upon the participants’ arrival at school and lasted for about ten minutes. The observers were not in the classroom at the time of intervention to ensure that they were blind to the intervention or condition the participants had received. The SET took the non-participating students to the restroom and the second observer did not arrive on the school grounds until after the intervention had been provided.

The sensory integration intervention consisted of the participant being brushed via the Wilbarger deep pressure and proprioceptive technique (DPPT) – brushing each arm, back, and each leg using long, firm strokes for a count of ten per body part, given joint compressions – applying firm pressure to the shoulders, elbow, wrists, fingers, hips, knees, and ankles for a count of ten per joint, use of a therapy ball (rolled on front of entire body for a count of ten – except on face and on top stomach down, pushing and pulling legs for a count of ten) (Wilbarger & Wilbarger, 1991), and swung in the hammock (stretched out, stomach down). If Marco received the sensory integration intervention, his sensory diet would also include oral swipes after joint compressions and wheelbarrow walking for a distance of ten feet.

When participants received the attention control, they were exposed to a variety of interactive activities with a staff member (not related to the sensory integration activities in their “sensory diets”) for the same amount of time that they would have spent receiving their “sensory diets”. An example 10-minute period might include the participant choosing an interactive story to read then, completing a series of puzzles or turn-taking games with bubbles or a ball.

Dante and Marco also received additional sensory integrative-based occupational therapy for half-an-hour three and four times a month respectively with a trained occupational therapist who worked specially on occupational therapy goals (from the student’s IEP). Sessions were typically held every Friday at 9:00 am and 9:30 am, however, for the purposes of this study, occupational therapy services were rescheduled to occur after data had been collected during two targeted activities following intervention. Occupational therapy sessions were designed to develop fine motor skills, attending, and transitions for Dante, and fine motor skills, toileting, feeding, and dressing for Marco.

Observations were made during the two educational activities (independent workstations and one-on-one activity) that were scheduled directly following the intervention sessions. Independent workstations were modeled from the structured teaching approach from the TEACCH program (Mesibov & Howley, 2003) where students independently worked on a series of mastered tasks until they had completed all the tasks arranged for that session. Activities in a one-to one format with the classroom staff included pre-academic tasks taught with a discrete trial format, fine motor activities such as cutting and drawing and imitation of simple play sequences. Participants rotated through these activities for two 15-minute sessions following the initial sensory or attention activity. Each participant was recorded one child at a time for five-minute samples with the order of observation ran-
domly conducted. All observations were made within the 30-minute period following the intervention activity. During intervention, 43 observations were recorded for Jose, 40 for Marco, and 46 for Dante.

**Inter-Observer Agreement**

Two observers scored 63% of all observations including both conditions (sensory and attention) throughout the study. Interobserver agreement scores were calculated using the formula: the number of agreements divided by the number of agreements plus the number of disagreements divided by 100 (Sulzer-Azaroff & Mayer, 1991). The overall mean inter-rater agreement was 91% with a range from 69% to 100%. The lowest agreement score occurred during a day with a fire drill (day 6). The mean inter-rater agreement score for Jose was 93% (range = 69% to 100%), for Marco 92% (range = 70% to 100%), and for Dante 89% (range = 75% to 100%).

**Results**

The percentage of on-task behaviors during two separate activities (independent vs. one-on-one) and across two conditions (sensory vs. attention) for each of the three participants appear in Figure 1. The diamond represents the percentage of attention to task following the sensory integration-based condition and the square represents the percentage of on task behavior when the attention control was used.

The data indicated that there were no differences in the trend as a result of treatment intervention or by condition across all three participants (see Figure 1). The only differences observed were for the type of activity, with the participants maintaining a higher level of on task behavior when working in a one-on-one activity than when in an independent activity (see Figure 1 – lower graph). This difference could be a result of the skilled staff that were familiar with the participants and thus, were able to prevent off task behaviors during the one-to-one sessions.

Dante and Marco’s highest percentage of on task behavior during the independent work activity occurred under the sensory condition, however, this high percentage occurred only once for Dante (session 9) with the second highest session scored during the attention control condition (session 23). Marco scored both the highest and lowest percentages under the sensory condition during the independent work activity. Marco had greater variability of on task performance when the sensory condition was implemented. Jose and Marco were on-task between 80% and 100% of the one-to-one sessions regardless of condition except for two observations following the sensory intervention for Marco and one during each condition for Jose when lower percentages were scored (see Figure 1). Dante’s data was more variable during one-to-one activities in both conditions.

There was more variety in the type of off task behaviors scored during in the independent work stations compared with the one-to-one activities for all participants. “Turning away” was scored for each of the boys with estimated ranges of between 5 and 65% for Marco, 10 and 55% for Dante and 5 and 40% for Jose. Jose was scored as “crying” during two sessions (with 10% & 45%). “Running” from the station was observed for Dante for 5 to 10% during nine sessions and by Marco for 5% of two sessions. “Other” types of off task behaviors were recorded in thirteen (Jose) to twenty (Marco) of the observations and between 5 and 65% (Jose & Marco) of the session when the participants were in the independent work stations.

The highest category of off task behaviors scored during one-on-one sessions were for “turning away” for all participants with estimated percentages scored for Jose and Marco as between 5 and 25% and for Dante as between 5 and 50% of a session. Dante was also scored as “crying” for 5% of one session. “Other behaviors”, were recorded in low percentages during one-to-one sessions for all participants and following both conditions with the exception of Jose who scored between 0% and 15% in this category during five sessions.

**Discussion**

This study investigated the effects of therapist recommended sensory integration-based activities on the on-task behavior in preschool children with disabilities. Results indicated
Figure 1. The estimated percentage of time on task for the three participants during independent and one-to-one activities following the two conditions of sensory integration based activities (triangle) and attention control activities (square).

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. All three participants chosen for this study had been prescribed “sensory diets” by an occupa-
tion therapist for sensory defensiveness, and difficulty with attention, yet there was no obvious benefit to starting their day with a “sensory diet” compared with an attention control activity. Similar to results from the alternating treatments design used by Reilly and colleagues (1983), the sensory integration-based condition did not have a greater effect on targeted outcomes.

What seemed to make the most significant difference in the participants’ on task behaviors was the individualized attention they received in a one-on-one educational activity versus an independent activity setting. The high percentage of on task behavior for all participants during the one-to-one activities demonstrated the effectiveness of using sound teaching strategies along with motivating materials to maintain on task behavior.

This study was organized and implemented by a preschool teacher working in a public school with the assistance of her classroom aide. Collecting the data on the student’s behavior provided important information. The preschool teacher became aware that she had incorrectly attributed some positive changes in student behavior to the sensory integration-based activities, an occurrence speculated by Kaplan and colleagues (1993) to be common.

Review of the data by the occupational therapist and the Individualized Education Plan (IEP) team resulted in the decision to remove the “sensory diet” for Jose and to place him in a less restrictive environment for the following academic year. If data on the efficacy of the “sensory diet” had been collected on a consistent basis for Jose, perhaps the sensory activities would have been discontinued sooner.

Interobserver agreement was obtained, in part, by a professor who does not work in the public school. Arranging for scoring with the assigned occupational therapist would serve multiple purposes including assessing the outcomes of proposed intervention strategies and avoiding requiring teachers to spend valuable time implementing ineffective or no longer needed interventions. Baranek (2002) recommends that professionals provide sensory or motor treatments in shorter-term durations such as between 6 and 12 weeks, and that progress is well documented in a systematic manner. Public school personnel could facilitate this process by requiring ongoing progress monitoring by their occupational therapy staff.

Limitations to this study include the limited time frame in which data was collected. This study was conducted at the later half of the school year when participants were accustomed to the staff, routine, and classroom environment and the data may have looked different if the study was conducted at the beginning of the school year. Follow-up data for Jose once sensory-based occupational therapy sessions were discontinued would have yielded interesting information on the maintenance of his on-task behavior.

This study serves as a model for collecting outcome data on interventions used in a public school classroom. Teachers are urged to develop a data collection system and to document student progress. Clearly, it is also important for occupational therapists to become accountable for the strategies they recommend and to provide research indicating that those strategies are evidence-based. Classroom teachers are expected to know the purpose for implementing any strategy and be able to identify the intended outcome. Teachers using ongoing progress monitoring systems can make data-based decisions regarding modifications or discontinuation of interventions in a timely manner in order to provide maximum benefit for their students with disabilities.

References


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