5-22-2017

The Effects of Sensory Diet Exercises on the Classroom Behavior of a Student with Autism

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A research paper submitted to the College of Education
of the University of Mary Washington

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May 2017

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05/22/17

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April 28, 2017

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Introduction

The EDCI 590 project that I conducted was a single-subject study of the effect of sensory diet exercises on the classroom behavior of a student with autism spectrum disorder (ASD). According to Kuypers (2011), a *sensory diet* is a structured, individualized set of activities used to help organize a student's sensory system to improve self-regulation (p. 108). Yack, Aquilla, and Sutton (2002) define *self-regulation* as the nervous system's ability to attain, maintain, and change levels of arousal or alertness according to situations or activities (p. 28). According to Hannaford (1995), learning does not happen in the brain alone, but through the whole body (p.13). Our bodies take in information from our senses and deliver the knowledge to our brains. However, students with ASD have difficulty absorbing the information from the environment due to their sensory processing difficulties.

Students with ASD commonly have difficulty maintaining normal levels of arousal. They may react in a hypersensitive or hyposensitive way to stimuli in their environment (Sansoti,Powell-Smith, & Cowan (2010, p. 21). Hyposensitive is the lack or under-sensitive reaction to stimuli. For example, a student with a hyposensitive reaction to sound may not respond when his name is being called (Sansoti, et al., 2010, p. 21). The other extreme, hypersensitivity, is the oversensitive reaction to stimuli. An example of this would be a student being "overly startled by sudden noises" Sansoti, et al., 2010 p. 21). These adverse reactions to stimuli indicate *sensory processing disorder* (SPD). As defined by Kranowitz (2005) SPD is the inability to use sensory information to function in daily life (p. 9). SPD can cause a student to lose focus, be unable to complete academic tasks, have a high level of frustration, or act impulsively in the classroom (Yack et al., 2002, p. 28). SPD can also be known as a difficulty with sensory integration or dysfunction in sensory integration. SPD is common in students with

disabilities, particularly ASD (Sansoti, et al., 2010, p. 2). Their sensory needs can be addressed through occupational therapy, but can also be met in the classroom through movement and sensory breaks. A sensory break is a quick movement opportunity that allows a student to receive sensory input (Kuypers, 2011). The sensory diet helps the students with autism regulate their bodies to accept the sensory information without feeling overwhelmed (hypersensitive) or lethargic (hyposensitive) (Hannaford, 1995).

The American Psychiatric Association (APA, 2013) lists specific learning difficulties associated with ASD as literacy and numeracy (p.59). Sansoti, et al. (2010) echo the APA statement of literacy difficulties, primarily with reading comprehension. They believe that students with ASD struggle with reading comprehension, especially in pragmatic language (p. 87). They define pragmatic language as "applying context to answer questions" (p. 87). Students with ASD struggle with taking the information they have read and applying it to correctly answer comprehension questions.

The goal of this project is to investigate how sensory diet exercises impact the classroom behavior of a student with autism. As a teacher of students with ASD, I decided to conduct a single-subject study by implementing these exercises in my classroom. On the following pages, I present a review of current literature pertaining to characteristics of students with ASD, academic challenges for students with autism, and therapies and exercises to address their sensory needs. Next, I list my research questions and describe the methodology I used to conduct my single-subject study. The results of the study are presented, followed by analysis and discussion of the implications for classroom practice and future research.

Literature Review

Characteristics of Students with Autism

According to the American Psychiatric Association (APA, 2013), autism is defined as a disorder in which a child demonstrates deficits in social communication and development, employs a range of repetitive behaviors, and has restricted interests. Autism is currently recognized as autism spectrum disorder (ASD), and has been classified this way since the 1970s (Sansoti et al., 2010). Autism can present itself in varying degrees of severity, which is why it is identified as a spectrum disorder. A person on the lower end of the spectrum is usually non-verbal, has an intellectual disability, and has noticeable repetitive behaviors such as hand flapping or rocking. A person on the higher end of the spectrum, or a person with high functioning autism, has normal language ability, low average to above average cognitive ability, odd social manners, and unique special interests (Sansoti et al., 2010, p.12). The term *high functioning autism* first appeared in the *Diagnostic and Statistical Manual of Mental Disorders* in 1994 (Sansoti et al., 2010, p. 12). A comorbidity also exists with people with ASD. The APA (2013) states that comorbidity is when the symptoms of one disorder may occur with other disorders (p. 5). According to the APA (2013), 70% of people identified with ASD may have one additional comorbid mental disorder and 40% may have two or more comorbid mental disorders (p. 58). For example, individuals with ASD may also have specific learning disabilities. The most commonly noticed learning difficulties that are comorbid with ASD are in the areas of literacy and numeracy (APA, 2013, p. 59). Some additional medical conditions could also occur, such as epilepsy, sleep problems, constipation, avoidant/restrictive food intake, or extreme narrow food preferences (p. 59).

A common characteristic of ASD is the lack of executive functioning skills. The part of the brain that controls executive functioning is the frontal lobe. As explained by Branstetter

(2014), executive functioning skills are used to regulate thinking, feeling, and behavior to reach a pre-determined goal (p. 14). She adds that executive functioning skills are used to perform cognitive processes, such as working memory, motor skills, attention, visualizing, verbalizing thoughts, and task completion. Dennison and Dennison (2010) state the three levels of learning or "memory processing" as sensory memory (input from sensory feedback), short-term, or working memory (memory that is temporarily stored) and long-term memory (stored for minutes to a lifetime) (p. 3). Working memory is the ability to hold information in one's short term memory, while performing another task. An example given by Silverman and Weinfeld (2007) is remembering a telephone number while looking for a pen to write it down (p. 60). There are four main ways that executive functioning affects an individual's attention to tasks: initiating, sustaining, inhibiting, and shifting (Denckla, 1994, as cited in Silverman & Weinfeld, 2007, p. 111). Many children with ASD live in the moment and are unable to form a plan and organize the steps to act.

Scientists believe that students with ASD experience accelerated brain growth between the ages of two to four years old (Redcay & Courchesne, 2005). This rapid growth causes poor neural connections in the brain, particularly in the frontal lobe (Courchesne & Pierce, 2005). Neurotypical brains automatically prune these faulty connections, but autistic brains do not. The lack of automatic pruning causes stimuli overload in the autistic brain. The child with ASD becomes overwhelmed in his environment because the brain is burdened by the information it receives from its senses. The student is unable to filter information that is unnecessary, as a neurotypical child would. This overload of stimuli causes an emotional meltdown. When this meltdown occurs, it results in sensory defensiveness where the student is unable to regulate their senses and may appear to be in crisis.

Academic Challenges of Students with Autism

Because students with ASD are inattentive and easily distracted by their environment, they require numerous redirections to focus on the educational task. Per Sansoti, et al. (2010) many students with autism cannot concentrate on the required task because they only want to talk about a preferred topic of interest. They also note that students with autism become overwhelmed when academic tasks become more abstract (Sansoti, et al., 2010).

Students on the autism spectrum struggle with interpreting a problem, integrating knowledge and generalizing information, which are all necessary skills in dealing with abstract ideas. Per Silverman and Weinfeld (2007) students with ASD have difficulty generalizing, especially when emotional nuances or multiple meanings are being considered (p. 101). Students with ASD understand concrete concepts. However, they will have difficulty understanding how the concepts fit into the bigger picture unless the goal of the instruction is explained explicitly (Silverman & Weinfeld, 2007). Sansoti, et al. (2010) add that students with ASD exhibit limited problem solving skills, especially in middle and high school levels where the more abstract concepts are employed, such as word problems, advanced comprehension, and geometry (p. 8). They also ascertain that this increase in abstract concepts causes students with ASD to feel frustrated because they are not able to perform the higher-level thinking skills. This frustration will eventually lead to an emotional outburst (Sansoti, et al., 2010, p. 8).

Students with ASD also have difficulty completing tasks in a timely manner due to the lack of executive functioning skills, such as task initiation, performance monitoring, and time management. Task initiation motivates the student to begin and recognize the supplies he needs to begin his work (e.g. pencil, calculator, notebook, etc.). A student with ASD has difficulty

organizing this information and may get stuck before he begins. Silverman and Weinfeld (2007) suggest using a visual support to help a student with ASD complete assignments.

Sansoti, et al. (2010) also describe challenges that students on the autism spectrum have with reading comprehension. They state that the struggle stems from a student's difficulty with pragmatic language, or applying context from the passage to answer questions (Sansoti, et al. 2010, p. 87). They explain that students with ASD continue their thought process (usually aloud) even after they have answered the question. They refer to this as topic drift (Sansoti, et al., 2010, p.87). Sansoti et al. (2010) connect topic drift with the inability to integrate and synthesize information because the student is unable to stop thinking about a preferred topic (p. 87).

Another challenge for students with ASD is the physical process of eye movement in reading. Per Dennison and Dennison (2010) one eye must lead and the other must blend to read (p.90). They refer to this as tracking. Hannaford (1995) explains that the difficulty in learning to read for students with special needs is attributed to weakened eye muscles. She explains that the stress of learning to read causes a visual reflex to danger that causes the eyes to move peripherally. This allows them to take in as much of the environment as possible (p. 106). Per Hannaford (1995), the eye muscles need to be retrained before students can read without eye strain.

Sensory Needs, Exercises, and Therapies

The sensory needs of students with ASD can be addressed with exercises involving three main sensory systems: tactile, vestibular, and proprioceptive. The first of these relates to the sense of touch. The tactile system receives information through receptor cells in the skin. The cells provide information about temperature, pain, and help develop body awareness and motor planning (Yack, et al., 2002). Many activities depend on the tactile system, such as brushing hair,

dressing, brushing teeth and toileting (p. 42). The tactile system also tells the body when it is in danger, and triggers the body to react. This reaction is called the "fright, flight, or fight response" (Yack, et al., 2002, p.42). The fright, flight, or fight response may overwhelm a student with ASD causing anxiety to build and the need to escape an area. The tactile system can also cause a hypersensitive reaction in students with SPD. For example, a student may become extremely distracted by the scratchy feeling of his clothing, causing him to lose focus in the classroom.

The second sensory system addressed by a sensory diet is the vestibular system. The vestibular system provides the body with information about movement, gravity, and changing head position (Yack, et al., 2002, p. 45). This system helps us determine not only if the body is moving, but the speed and direction of the movement. Most importantly, the vestibular system helps the body balance incoming sensory information and assists with maintaining appropriate levels of arousal, which is the key to self-regulation (Yack, et al., 2002). The vestibular system is strongly associated with the auditory system because both systems respond to vibrations. The receptors for the vestibular system are located in the ears. Fluid moves in the ears and displaces hair cells that detect changes in gravity (Yack et al., 2002). The vestibular system also has a close connection to the visual system. Eye movements are developed through the help of the vestibular system, to include tracking and focusing and to help stabilize the eyes when the body is in motion (Yack et al., 2002). Finally, the vestibular system tells the muscles when it is time to work. It helps the body regulate posture and movement, in such activities as walking and balance.

The third sensory system addressed by a sensory diet is the proprioceptive system. This system gives the body information about body position, the relationship of the body parts to each

other and the relationship of the body to other people and objects (Yack et al., 2002). Receptors for the proprioceptive system are in the muscles, tendons, joints and connective tissues (Yack, et al., 2002, p. 48). The proprioceptive system and vestibular system work together to help the body move.

A successful sensory diet must be designed to fit an individual's sensory requirements. This process begins with a sensory history and profile provided by the parents (Yack, et al., (2002). The profile asks the parents to rate their child's reaction to sensory items in specific situations. An example of a sensory profile question provided by Yack, et al. (2002) asks, "Does your child appear fearful of playground equipment or carnival rides?" (p. 55). The questions are then categorized by the following sensory systems: vestibular, tactile, proprioceptive, visual, auditory, and olfactory (smell)/gustatory (taste). These questionnaires help the occupational therapist determine the level of SPD the child has in a natural environment. An occupational therapist then evaluates the child's motor skills, through activities such as throwing a ball, walking a straight line, tracing shapes, or drawing a picture of themselves. These activities evaluate the child's level of developmental skills and determine the child's strengths and weaknesses. The survey and motor tests help the therapist determine the most beneficial therapeutic approach, including sensory diet exercises.

There are two main therapies that address the sensory needs of students with ASD. One therapy that has been found to improve sensory responses is sensory integration therapy (SIT). SIT is a clinic-based therapy that uses play and sensory enhanced interventions (Case-Smith, Weaver, & Fristad, 2014). The goal in SIT is to increase a student's ability to integrate sensory information to prolong attention spans, learn social skills, and increase motor planning (Case-Smith et al., 2014, p. 3). The occupational therapist individualizes the child's program and

targets specific sensory goals. For example, if a student is exhibiting tactile defensiveness by not being able to sit with his class during circle time, the occupational therapist can incorporate calming activities into his session and sensory diet. At the end of each session, the occupational therapist then teaches the parent, or teacher if the therapy is administered in the school environment, how to balance the child's activities. The therapist recommends a combination of active and quiet activities that the child can work on at home. Per Case-Smith, et al. (2014), SIT is very successful because it instills a motivation to learn and builds self-esteem in the child (Case-Smith et al., 2014, p. 12).

A second therapy used to address a student's sensory needs is the sensory based intervention (SBI). SBI is a structured therapy that focuses on using strategies for specific behaviors. The strategies are built into the child's daily routine and administered by the child's parents or care takers (Case-Smith et al., 2014). The SBI strategies are provided in the child's school or home, not in a clinical atmosphere. Some examples of SBI strategies are the use of a weighted blanket or pressure vest, or sitting on a ball. These strategies provide the sensory input of deep pressure, which can calm an anxious child. SBI is only used when a child is in a hypo or hyper state of arousal (Case-Smith et al., 2014). Case-Smith et al. (2014) state that if effective, an immediate behavior change is noticed when using SBI (p. 12). They explain that the behavior change occurs because the specific strategy was designed to meet that sensory need (p. 12).

Therapies for addressing the sensory needs of students with ASD include a variety of sensory diet exercises. Willbarger and Willbarger first introduced the concept of a sensory diet during the 1990s (as cited in Kranowitz, 2005, p. 229). A daily sensory diet, like a healthy nutritional diet, provides a balance of sensory exercises to address emotional and physical requirements of an individual. One of the main goals of a sensory diet is to meet the sensory

needs of the nervous system, and prevent sensory defensiveness, which will affect positive social interactions (Yack et al., 2002). Some examples of sensory defensive behaviors include "silliness, noise making, aimless running, or pacing" (Yack, et al., 2002, p. 73) which may develop into repetitive stereotypic behaviors such as self-abuse, and self-stimulatory behaviors.

According to Kranowitz (2005), there are three types of exercises in a sensory diet that each address different sensory needs: alerting, calming, and organizing. An alerting activity helps the hyposensitive child by awakening his sensory system. Examples of an alerting activity include eating crunchy snacks, jumping on a trampoline or bouncing on a therapy ball (Kranowitz, 2005, p. 229). Calming activities help the hypersensitive child by decreasing sensory stimulation. These activities can include pushing against walls, sucking on hard candy, rocking or swinging slowly, and cuddling (Kranowitz, 2005, p. 230). Organizing activities usually follow calming or alerting activities. They help the child to regulate his sensory responses when he is not in the hyposensitive or hypersensitive stage. Organizing activities may include chewing gum, pushing or pulling heavy loads, hanging by the hands from a pull up bar, or getting into an upside-down position (Kranowitz, 2005, p. 229).

Per Yack, et al. (2002), a sensory diet consists of two categories of exercises, the "main course", and the "sensory snacks" (pp. 72-73). The main course activities provide a long-lasting impact on the nervous system. They are activities that provide movement, deep touch pressure, and heavy work. Per Heller (2002), heavy work exercises increase body awareness and help individuals feel grounded. Examples of heavy work exercises are pushing a book cart, lifting a stack of text books, wearing a weighted vest, pushing against a wall with your hands or feet, or rolling on the floor (Heller, 2002, p. 172). Heavy work exercises calm by using large muscle groups and allowing the body to feel where it aligns in the atmosphere (Heller, 2002). When the

individual is hyposensitive, the heavy work exercises energize the body by accelerating the heart rate and increasing adrenaline (Heller, 2002). The effects of these exercises last about two hours and should be repeated throughout the day, as necessary (Heller, 2002).

The sensory snacks are exercises that have a lesser impact on the nervous system. These activities usually involve oral, auditory, visual, or smell systems (Yack, et al., 2002, p. 73). Oral motor activities may include licking stamps, blowing a whistle, blowing bubbles, drinking through a straw or chewing gum (Kranowitz, 2005, pp. 232-233). Auditory activities include listening to calming music, stories, poems, or imitating rhythms played on a drum. Activities that address the visual system may be using playdough, drawing letters in various substances (shaving cream, sand, pudding, etc.), drawing mazes, completing dot to dot puzzles, or cutting activities (Kranowitz, 2005, p. 237).

Based on this review of literature, students with ASD differ from typically developing children in several ways, and encounter many challenges throughout the school day due to their sensory processing disorders. The literature describes therapies and numerous sensory diet exercises to address the sensory needs of these students, both at home and in the classroom. However, there has been little research on the effectiveness of sensory diet exercises in improving specific classroom behaviors of students with ASD. Therefore, the research question for this research project was: How does an intervention of sensory diet exercises impact the classroom behavior of a student with ASD?

Methodology

I conducted a single-subject research study on the effects of sensory diet exercises on the classroom behavior of a student with autism. The participant in my single-subject research study was a student in my self-contained special education classroom. He is a middle school child who is eleven years of age and has been diagnosed with autism spectrum disorder. I will refer to him with the pseudonym Rob. Because of his sensory needs and executive functioning difficulties, one of his most persistent classroom challenges is responding promptly and appropriately to common classroom requests. This is a functional skill that is listed on the daily goal sheet for the entire class. During this study, Rob received the intervention of sensory diet exercises along with the other students in the self-contained class.

As outlined by Horner, Carr, Halle, McGee, Odom & Wolery (2005), a single-subject research study compares an observable relationship between a dependent and independent variable. The independent variable in my research project was the intervention of sensory diet exercises which Dennison and Dennison (2010) call "The Lengthening Activities." According to Dennison and Dennison (2010), these exercises are designed to allow the student to focus and take initiative which are the main skills needed for meeting the classroom goal of responding promptly and appropriately to common classroom requests. My dependent variable in my project was the student's behavioral goal, to be measured by the number of seconds recorded between a request to begin a classroom task and compliance. The study followed an ABAB format with no intervention during the baseline A Phases, and with the intervention of sensory diet exercises during the B Phases.

During the first A phase, I collected baseline data to determine the number of seconds it took the student to comply with any of 11 classroom tasks during the 30-minute language arts block. The 11 tasks, which students are very familiar with, are:

- retrieve supplies (pencil, notebook, textbook, or worksheet)
- open a word document
- write a journal entry
- complete a worksheet
- complete a series of short answer or multiple choice questions
- complete a graphic organizer
- read a short story or reading passage
- illustrate
- put supplies away
- place completed work on the clipboard
- write name on the assignment

These are not only common classroom requests, but are also ones that take approximately the same amount of time to perform. The daily language arts lesson was designed so that at least four of these classroom tasks were requested during the 30-minute time frame. When a task was requested of the student, a teaching assistant began the stopwatch on his iPhone. Once the student complied with the task, the timer was stopped and the time was recorded on the Student Data Form (see Appendix). The first set of baseline data was collected over the course of five school days.

After the baseline data was collected, I taught four of the sensory diet exercises recommended by Dennison and Dennison (2010). The class stood at the front of the classroom. I demonstrated how to perform the first exercise and the class executed it. After the first exercise was performed correctly, I proceeded to the second exercise. I continued the process until all four exercises were executed. The class practiced the intervention exercises for three days before

Phase B data was collected. This allowed the students to become familiar with the exercises and execute each one without complication.

The four sensory diet exercises used in this study were lengthening activities recommended by Dennison and Dennison (2010). Each exercise took approximately one minute to complete. The first, entitled "The Owl" lengthens the neck and shoulder muscles, which releases tension. The students grasp the top of one shoulder with their opposite hand and squeeze the muscles firmly. Next, they turn their head to look over that shoulder, exhaling fully with a "hooo" sound. They draw both shoulders back and exhale for a count of three. Inhaling, they turn their head toward the opposite shoulder and exhale. The students inhale and turn their head forward. They drop their head and exhale, tucking their chin. After tucking their chin, they repeat the previous steps squeezing the opposite shoulder (Dennison & Dennison, 2010, p. 74).

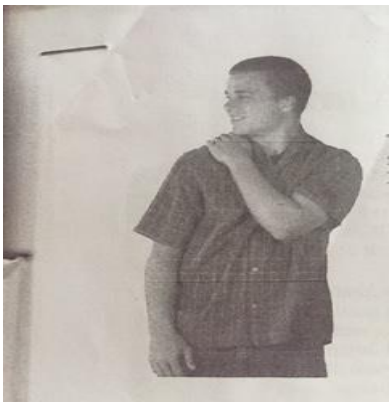

Figure 1 Sensory diet exercise "The Owl". From "Lengthening Exercises," by P.E. Dennison and G.E. Dennison, 2010, *Brain Gym: Teacher's Edition,* p.74. Copyright 2010 by Hearts at Play.

The second exercise in the lengthening activities is "Arm Activation." This exercise lengthens the muscles of the upper chest and shoulders. The students stand with their feet shoulder-width apart. They raise one arm above their head and wrap the other arm behind their head to hold the raised arm near their ear. The students exhale gently through closed lips for

three counts. After the three counts, the students switch arms and repeat the previous steps (Dennison & Dennison, 2010, p. 76).

Figure 2. Sensory diet exercise "Arm Activation." From "Lengthening Exercises", by P.E. Dennison and G.E. Dennison, 2010, *Brain Gym: Teacher's Edition,* p.76. Copyright 2010 by Hearts at Play.

The third exercise is the "Calf Pump," which is used to realign the weight-bearing muscles of the legs. The students stand and extend one leg forward, bending it at the knee. The knee should line up with the center of that foot. While they exhale, they press the heel of their back leg gently to the ground. As they release the stretch, they lift their back heel and inhale. They repeat this stretch three times and alternate legs (Dennison & Dennison, 2010, p. 82).

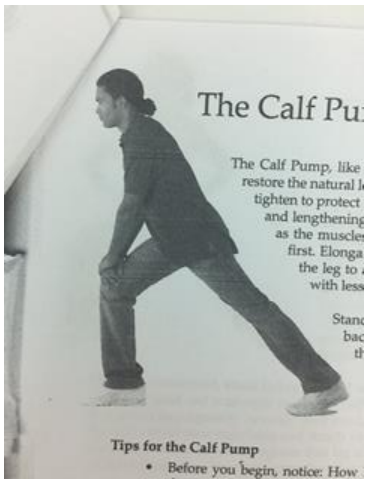

Figure 3. Sensory diet exercise "The Calf Pump." From "Lengthening Exercises", by P.E. Dennison and G.E. Dennison, 2010, *Brain Gym: Teacher's Edition,* p.82. Copyright 2010 by Hearts at Play.

The fourth lengthening exercise is "The Grounder." It is used to increase the student's flexibility, balance, and whole-body coordination. The students face forward with their feet spread apart and their hands on their hips. The students turn their right foot and head to the right, while the left foot remains pointed forward. The students bend their right knee slightly and slowly exhale. Their knee should not extend past the middle of their right foot. As the students straighten, they inhale and return to the starting positon. The students repeat the movements with the other leg forward. The students complete each exercise three times (Dennison & Dennison, 2010, p. 84).

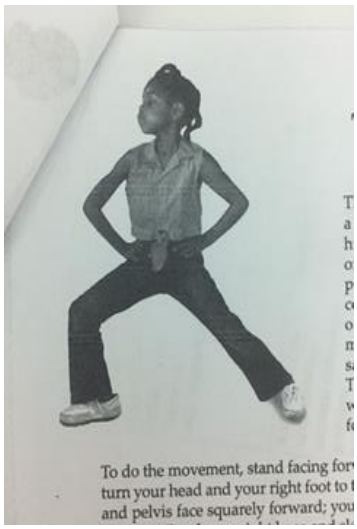

Figure 4. Sensory diet exercise "The Grounder". From "Lengthening Exercises", by P.E. Dennison and G.E. Dennison, 2010, *Brain Gym: Teacher's Edition,* p.84. Copyright 2010 by Hearts at Play.

During the first intervention phase of data collection (Phase B), the sensory diet exercises were performed prior to the start of the 30-minute language arts block daily. The class completed the exercises in the same order each time. The students transitioned back to their desks directly after the intervention exercises were completed. I started the language arts lesson that incorporated at least 4 of the 10 classroom tasks, exactly as for Phase A, and data was collected in the same manner over the course of five school days.

The second set of Phase A baseline data was collected in the same manner over five days without any sensory diet exercises. Then the second set of Phase B intervention data was collected, again in the same manner, but with implementation of the intervention. The purpose for removing and re-introducing the intervention was to create a control. The experimental control occurs when an experiment documents three demonstrations of experimental effects at three different points in the experiment: the first intervention phase, the withdrawal (second baseline) phase, and the second intervention phase (Horner, et al., 2005).

In addition to collecting data on the Student Data Form, I also kept a daily teacher-research log to record informal observations and reflections on the child's reactions to the intervention and any other contextual circumstances that might have influenced the results of my study, such as snow days or student illnesses. An analysis of the data was completed to determine if the sensory diet intervention did in fact decrease the time the subject took to begin work on the tasks compared to the baseline data during phases without the intervention.

Analysis and Discussion

In following with expectations based on the literature (Dennison & Dennison, 2010; Kranowitz, 2005), the results of this study indicated that there was a possible, but inconclusive relationship between the use of sensory exercises and times for task compliance (see Table 1). During the first baseline A phase, before teaching students the lengthening exercises, there were a total of 28 classroom task requests, and Rob's average time of compliance was 6.91 seconds. During the first experimental B phase, when the exercises were performed before each class period, there were a total of 25 task requests, and his average time of compliance was 7.39 seconds. During the second baseline A phase, when the exercises were removed, there were a total of 21 task requests, and his average time compliance was 9.48 seconds. During the second experimental B phase, when the exercises were reinstated before each class period, there were a total of 26 task requests, and Rob's average time of compliance was 4.28 seconds. In short, although Rob's compliance times improved during the last phase of the study, there were many irregularities that made comparisons across phases difficult.

Table 1

	Total number of task requests	Number of non-compliance to requests	Number of completed requests	Average times of completed requests
1st Baseline (A)	28	2	26	6.91 seconds
1st Intervention (B)	25	2	22	7.39 seconds
2nd Baseline (A)	21	4	17	9.48 seconds
2nd Intervention (B)	26	2	24	4.28 seconds

Throughout the single-subject study, numerous outside influences skewed the results of the intervention. These influences included student illness, difficulty transitioning back to school on Mondays, and unfavorable tasks. Based on data from the teacher-researcher journal, there are several possible reasons for the lack of correlation between the use of sensory exercises and times for task compliance in this study. Data was collected on school days that Rob was present. During baseline A phase (Figure 5) Rob was present for five school days. He was absent on the second day of Phase A (March 6). The first day of Phase A, (March 3) occurred on a Friday. I began collecting data on a Friday because I was scheduled to attend a meeting on Monday, March 6. The meeting was scheduled during the language arts block, causing a conflict. The intervening weekend appeared to have caused Rob to forget how to complete the exercises and further instruction was necessary. The following Tuesday (March 7) the data showed the longest response time of Phase A, an average of 12.63 seconds (Figure 5). A writing assignment was assigned on the third day of Phase A (March 8). Rob did not comply with this assignment, causing an unacceptable classroom behavior. Thus, only four days of data were usable for the first baseline phase A.

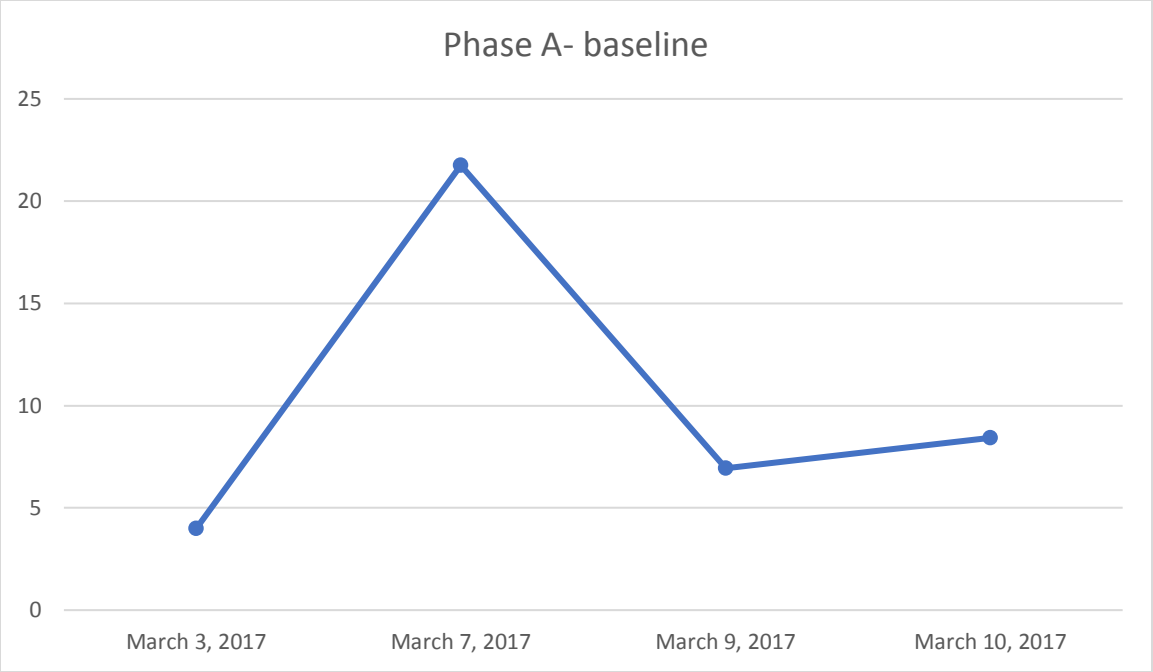

Figure 5

Between the first baseline A phase and the first experimental B phase of the study, there were two days during which data were not collected (March 11 and March 12) because they were a Saturday and Sunday. The students practiced the intervention (sensory diet exercises) on March 13th, March 16th, and March 17th. There was a snow day on March 14th and I was absent March 15th.

The first intervention B phase began on March 20th. Rob seemed very lethargic. He showed signs of an illness (low energy, easily distracted, and frequently complained of a headache). As the week progressed, Rob showed more signs that he was not feeling well (low grade fever, complained that his shoulders hurt, and reported a sore throat). After speaking with his mother, I learned that his brother had tested positive for strep earlier in the week. Even though Rob was not feeling well, he responded to the intervention and complied with classroom tasks in less than 10 seconds on three out of the five days (Figure 6). However, the first day of

the intervention Monday, March 20th the data had to be removed due to Rob's non-compliance. There were only four days of usable data during this phase.

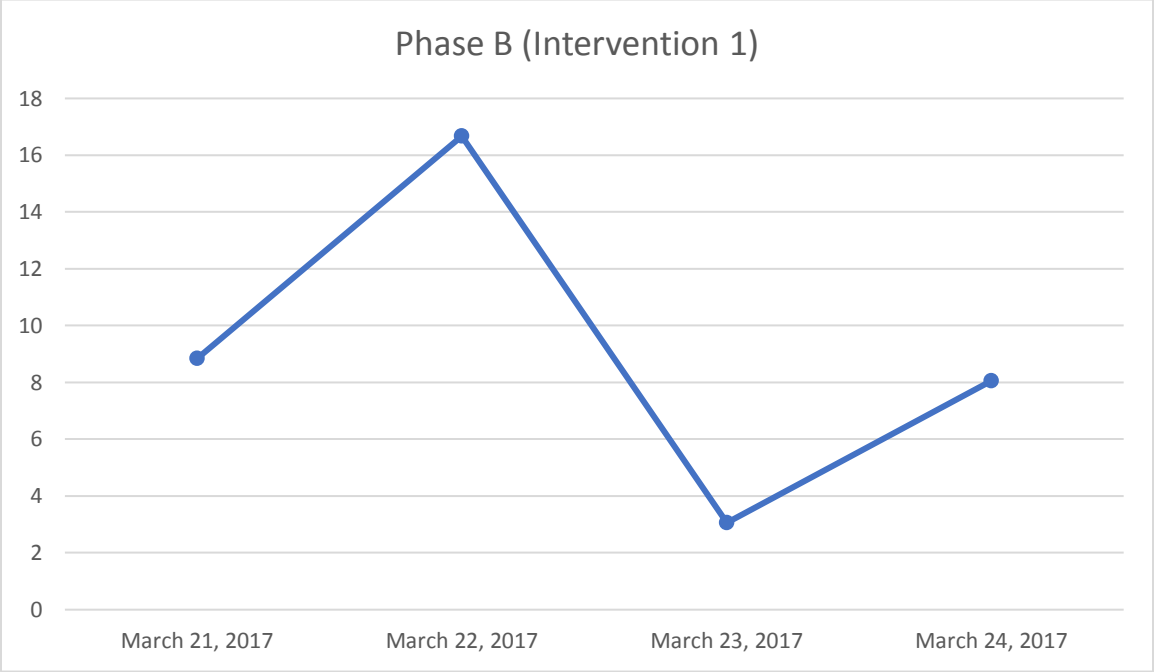

Figure 6

The second phase A (removal of the intervention) began on Monday, March 27. The student was present during all five days. There was a gap of 3 days between the fourth and fifth days of second A phase, due to a scheduled teacher work day (March 31) and a weekend (Aril 1-2). Based on his history, Rob struggles with transitions and usually is not motivated to complete his school assignments on Mondays. Rob struggled on the first day of the second A phase not only because the exercises were withdrawn for this phase of the study, but also because it was a Monday and he was asked to complete a writing assignment. He required many prompts to begin his assignment (average 27.5 seconds). Rob started the task, but was not able to complete it. The third day of the second A phase was Rob's best response time (4.01 seconds) of the second phase A. This phase had the most instances of non-compliance times of 30 seconds or more (4). In

addition to the non-compliance during a writing assignment, Rob did not comply with the task of retrieving supplies at the start of class (1), and putting away supplies (2). Rob struggles with organizational skills, especially his supplies.

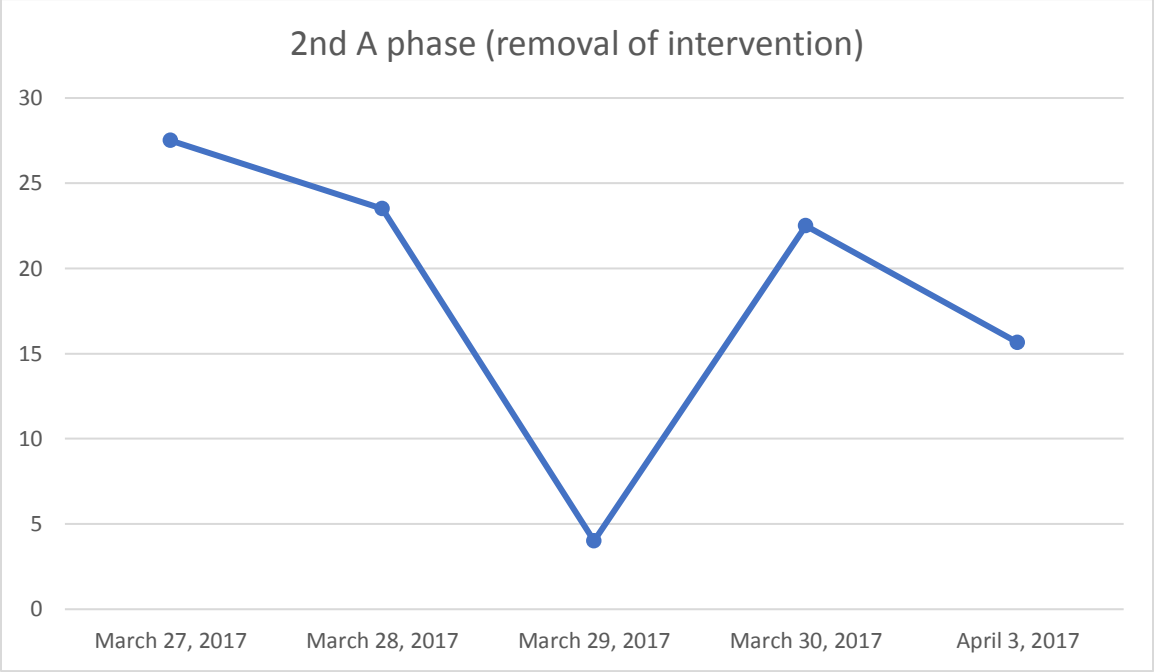

Figure 7

The final phase of the single-subject study, the second experimental phase B (intervention re-introduced) showed the best response times overall. There was a long weekend during this phase between the first and second days of data collection (April 7, April 8, April 9). Rob began his classroom assignments, on average, in less than five seconds on three out of five days (Figure8). There was an increased response time on Monday (April 10). Rob consistently demonstrated longer response times on Mondays throughout the study. The data on the final day of the study was not usable because Rob was unable to stay in the classroom due to behavior issues. After speaking with his mother, I learned that Rob had night terrors and was unable to

sleep the previous night. Rob complied with classroom assignments the other four days. He was even willing to complete a writing assignment, which he refused to complete earlier in the study.

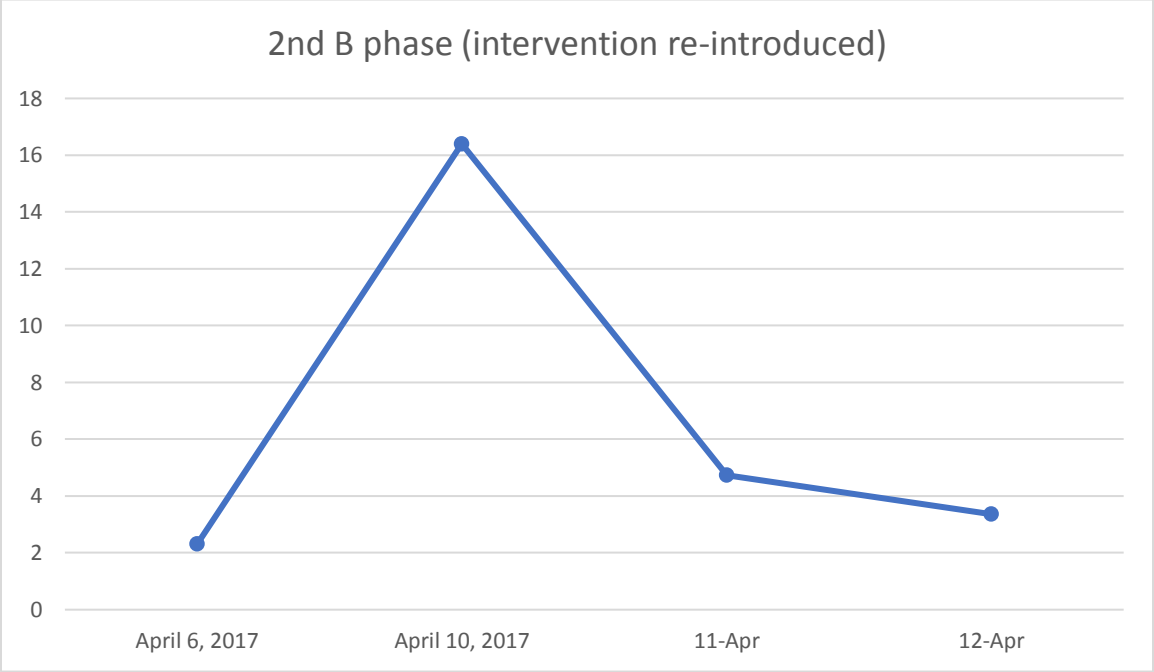

Figure 8

Unfavorable classroom tasks to Rob (writing tasks), required the need for numerous adult prompts. The data was also analyzed comparing reading and writing tasks throughout all phases of the study (Table 2). During the first baseline phase A Rob was given a total of three reading tasks and completed all of them. He was also given a total of three writing tasks during the initial phase A. He was non-compliant on one writing task. During the first phase B Rob was given a total of two reading tasks and had zero non-compliance episodes. He was also given a total of two writing tasks and had one non-compliance episode. During the second phase A Rob was assigned a total of 2 reading tasks and had zero non-compliance episodes, and two writing tasks with one non-compliance episode. During the final experimental phase B Rob was given a total

of two reading tasks with zero non-compliance and a total of four writing tasks with one non-compliance episode. When Rob refused to complete classroom tasks, or demonstrated non-compliance, the data was removed.

Table 2

	Total number of reading task requests	Number of non-compliance to reading task requests	Total number of writing task requests	Number of non-compliance to writing task requests
1st Baseline (A)	3	0	3	1
1st Intervention (B)	2	0	2	1
2nd Baseline (A)	2	0	2	1
2nd Intervention (B)	2	0	4	1

Conclusion

Overall, based on the collected data and analysis, the results of the intervention were inconclusive. When the intervention of sensory exercises was introduced in the first experimental phase B, Rob's average response time increased from 6.91 seconds in first baseline phase A to 7.39 seconds in experimental phase B . The increase in response time did not correspond with the expected results. According to Kuypers (2011) the sensory diet exercises should have enabled Rob to regulate his body and attend to the task quicker than the previous phase. Dennison and Dennison (2010) recommended the lengthening exercises to help a student focus and take initiative, which is why I chose these exercises to help Rob respond promptly to classroom tasks. When the intervention was removed in the second phase A, there was an increase in the average response time (9.48 seconds), which was the longest average response time of any phase in the

study. There was also a dramatic decrease in the average response time (4.28 seconds) when the intervention was introduced in the final phase, experimental phase B. This phase demonstrated the shortest average response time in the entire study, which corresponded with the hypothesis. Therefore, the overall results of the intervention were inconclusive.

In reflection, the single-subject study could have been modified in various ways. The data could have been collected over consecutive school days. This would eliminate the pauses that occurred within each phase. A second modification would be controlling the favorable and non-favorable tasks. Rob's response time and non-compliance was affected by this variable. His response time was shorter for reading tasks which were favorable. Writing tasks, which were unfavorable resulted in non-compliance or longer response times.

Future research would be necessary to study the effects of sensory diet exercises in other areas of a student's life. Some areas may include social interaction, compliance in the home setting or other school environments. Also, further research could determine the effect of sensory diet exercises performed by students with ASD who have differing cognitive and physical abilities, as well as a wider age range of students.

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Appendix

Procedural Documents

This appendix contains originals of all the documents used in identifying participants and gathering data for this research project which was conducted at a suburban Virginia private elementary/middle school, March 3, 2017 to April 13, 2017. These include, in order of appearance:

Each item is an accurate reproduction of the document developed and used to collect data for this research project. The Parent Consent Form and the Data Collection Form were created by the researcher based on the review of literature.

Parent Consent Form – Single-Subject Research

Dear Parents,

My name is Anne Glencer and I am your child's sixth grade teacher and a graduate student in the University of Mary Washington's College of Education. To successfully complete my graduate degree, I am conducting a research project in my classroom during February and March, 2017.The purpose of this letter is to request your permission to let your child participate in my research study. Participation is entirely voluntary. If you agree, I will also ask your child for his or her agreement to participate. Please read further to learn about what the study entails.

My research focuses on the effects that sensory diet exercises have on the classroom behavior. I am particularly interested to learn how providing sensory integration, through a sensory diet, can affect classroom behavior, especially in the area of regulation. The project involves having children in the class do specific motor exercises that enhance sensory diet and then, when academic activities are assigned, timing how long it takes your child to begin the task. For purposes of comparison, there will be some days when the exercises are not done to see if the amount of time to begin a task changes. During the study, I will use a data collection form to record how many seconds it takes your student to begin his tasks after given instructions. I will also keep a teacher observation log to list occurrences that may impact the data.

Students whose parents allow them to participate in the study will be doing the same work as required for all students in the class. However, for the purposes of my research I will use data only from a student who has parental consent to participate in the study. There are no extra benefits to any students for participating in the study, and no penalties for any students who do not participate in the study. Whether your child participates in this research or not, the decision will have no effect either positive or negative on the student's grades on any assignment.

All data collection will be kept confidential. I will not reveal any confidential information about your child to anyone else, unless required by law to do so. In any reports I make about this research, all participants will be given pseudonyms and I will not report any identifying information about individual students or their school.

The benefit of this research is to provide educators with deeper understanding of how students react to a sensory diet intervention. Children in the class may benefit directly by doing sensory diet exercises recommended for improving classroom behavior.

The risks to students participating in the study are minimal. Since all students in the class will be doing the same activities, the risks of participation are the same as the normal risks of being in school. However, timing students will be a new experience that could cause some anxiety and I will minimize the risk by asking a teacher assistant to discreetly time your student and record the data. If I notice a student having unusual anxiety, I will stop the timing procedure and resume on a different day.
If you give permission for your child to participate in this study, and later change your mind, you have the right to withdraw him/her from the study without penalty at any time.

If you agree to allow your child to participate in this study, please sign the form below and return it to me by _____(date). If you have any questions before returning the form, or at any time throughout the duration of the study, please do not hesitate to contact me by email at anninmark@yahoo.com. The research described above has been approved by the University of Mary Washington IRB which is a committee responsible for ensuring that research is being conducted safely and that risks to participants are minimized. For information about the review of this research, contact the IRB chair, Dr. Jo Tyler, at jtyler@umw.edu.

Thank you for taking the time to review this letter.

Sincerely,

Anne Glencer

* *

Form to be completed by Parent or Guardian

All of my questions and concerns about the research described above have been addressed.

I choose, voluntarily, to allow my child to participate in this research project.

I certify that I am at least 18 years of age.

_____

print first and last name of child

_____

print name of parent/guardian

_____ _____

signature of parent/guardian date

Form to be completed by Researcher

I confirm that the parent/guardian named above has been given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability.

A copy of this Informed Consent Form has been provided to the parent or guardian.

Anne Glencer_____

print name of researcher

_____ _____

signature of researcher date

Student Data Form for Single Child Study

Anne Glencer- Spring 2017

Date	Classroom Task Requested*	Total time in seconds to begin task after instructions were given.	Average time (total time/number of activities)
	1. 5. 2. 6. 3. 7. 4. 8.	1. 5. 2. 6. 3. 7. 4. 8.	
	1. 5. 2. 6. 3. 7. 4. 8.	1. 5. 2. 6. 3. 7. 4. 8.	
	1. 5. 2. 6. 3. 7. 4. 8.	1. 5. 2. 6. 3. 7. 4. 8.	
	1. 5. 2. 6. 3. 7. 4. 8.	1. 5. 2. 6. 3. 7. 4. 8.	
	1. 5. 2. 6. 3. 7. 4. 8.	1. 5. 2. 6. 3. 7. 4. 8.	

***Legend of Classroom Tasks:**

A-retrieve supplies (pencil, notebook, textbook, or worksheet)

B- open a word document

C-write a journal entry

D-complete a worksheet

E-complete a series of short answer or multiple choice questions

F-complete a graphic organizer

G-read a short story or reading passage

H-illustrate

I-put supplies away

J-place completed work on the clipboard

K- write name on assignment