

Multisensory Issues in Students with Autism
A Meta-Synthesis

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Submitted in partial fulfillment of the requirements for the Master of Education in Special
Education degree at the University of Alaska Southeast

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ABSTRACT

For students with autism sensory processing issues are not an uncommon experience. There are three types of sensory processing categories. They are sensory under responsiveness, sensory over-responsiveness and sensory seeking. These sensory processing difficulties may affect social communication, impact daily life skills, include self-injurious behaviors, and create or add to anxiety already being felt by autistic students. These categories are not mutually exclusive and some students may experience all of these problems while others may only struggle with one or two. There is no one answer for students with autism but it is a collection of effects that form the student's identity for their entire life. This meta-synthesis of the literature on sensory issues for students with autism explores the ups and downs of students struggling with sensory issues in hope to make navigating them easier.

1. Introduction

1.1. Background

Think of a color spectrum how it ranges from red to orange, yellow, green, blue, indigo and finally to violet. The term spectrum is the entire range of which a phenomenon can range. Autism too is a spectrum. Autism ranges from low functioning individuals to high functioning individuals; from individuals that may have lots of sensory issues to individuals with very little sensory issues. Just as the names of the colors change over time so do the names and conditions on the autism spectrum. The word autism is heard now more than ever before; but is there really an epidemic or are we just more aware of our surroundings?

Donvan and Zucker (2016) they mention that the U.S Center for Disease control and Prevention report in November 2015 stated there is:

A new estimate of the prevalence of autism in children ages 3 to 17. The figure, 1 in 45 is the highest ever announced by the CDC, up from 1 in 50 in 2007. (no page number).

There are many reasons that autism seems to be on the rise according to Gernsbacher, Dawson and Goldsmith (2005). These reasons include autism is a fairly new reporting category under IDEA, broadening of the diagnostic criteria for a diagnosis of autism and increased media attention for autism by people with autism as well as celebrities and parents. Prior to the 1991-1992 school year autism was not a reporting category under IDEA (individuals with disabilities act) for students with disabilities served in schools. People who have autistic

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behaviors or tendencies have been around for years, but it was not reported until the early 1990s in the United States. It was first acknowledged in the study by Leo Kanner in 1943. There is no evidence that turning the autism diagnosis into a spectrum has caused an epidemic or mass increase of cases reported. The final reason is that majority of people are learning about autism because of increased media awareness (pp. 55-58). Donvan and Zucker (2016) also remind readers that the reporting and diagnosing criteria are not the same in all fifty states. Also the CDC 1 in 45 estimates does not count actual children. They rely on interviews with parents who were asked if a child in the family has been diagnosed with autism or another disability (no page numbers).

Wolff (2004) states that there have been individuals with autistic tendencies dating back to 1747 with the case of a man named Hugh Blair of Borgue. Blair had echolalia, abnormal language including when asked a question he would reply with the question and the answer (a language we now call echolalia), odd motor mannerisms like collecting feathers and sticks. He insisted that things stay in the same place and would only sit in a certain seat at church. He also had severe mental retardation. When he became an adult he was affectionate but he was inconsiderate when it came to a conversation he would say the wrong thing at the wrong time. He also would visit people at odd hours. His brother went to court to annul his marriage stating that he was not of the mental capacity to marry (p.202).

According to Toth and King (2008) autism is not a new spectrum. There are many historical accounts of people with symptoms of autism it just hadn't been named yet. One of the most famous cases was a boy named Victor who was found wandering in the woods naked in 1798. He had been seen several years earlier, but eluded his community. He was detained

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around age eleven or twelve and educated by a French doctor named Jean Itard. Over time he was taught to match letters, distinguish emotions and write simple sentences. He never mastered the ability to speak in coherent sentences. During that time period the term autism did not exist (p.958). Wolff (2004) maintains that psychologists today would say Victor was autistic (p.203).

Donvan and Zucker (2016) continued to establish data that autism is not a new diagnosis in America. They wrote of cases in early America 1846 where “idiots” (the term of the time) were unable to follow oral directions and would repeat what they were told. These people were considered intellectually incapacitated by their friends and neighbors had other interesting talents. Some were able to compute numbers in their heads. Others were able to sing songs from memory after only hearing it once (no page numbers).

In 1936, Dr. G.E.Ssucharewa published a story about six boys age ten to thirteen with symptoms similar to Asperger’s (Tasi and Ghaziuddin,2013 p.322) Other students described as having autistic symptoms by Kanner in 1943. These students had low intelligence and language skills. Hans Asperger described autistic psychopathy in 1944. Many of these students had above- average intelligence and language capacities, but social and affective communication difficulties (Toth and King, 2008, p.958).

Tsai and Ghaziudinn (2013) reference a 1943 study by Leo Kanner describing symptoms of eleven physically normal boys that included aloofness (indifference to others/things), speech delays, non-communicative use of speech and inability to develop relationships with people. He also noticed patterns in play and *splinter skills* (ability to do something but not necessarily in sequential order or generalize it to other environments). Kanner believed only two criteria were diagnostically relevant; they were autistic aloneness (or difficulty to connect with others) and

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obsessive insistence on sameness (needing a set routine and repetitive behaviors). It is important to note that Kanner believed that all symptoms were there at birth or in infancy (pp321-322).

Kanner stated late in his career “I never discovered autism, it was there before.” (Donovan and Zucker, 2016). One of Kanner’s famous cases was in his 1943 study a boy named Donald.

Donald had *echolalia* as a child. Echolalia is the tendency for someone to repeat words and phrases. It is one of the stereotypical behaviors associated with an autism diagnosis. At the time of the article Donald was an 82-year-old adult that could engage in conversational speech.

Another example of autistic behaviors came from another case worked on by Samuel Gridley Howe. He said the subject could tell you all the letters and make the words say the sounds but when he was done reading he didn’t have a clue what he read (Donvan and Zucker 2016, no page number).

At nearly the same time Hans Asperger was studying autistic psychopathy which he believed was a personality disorder. Asperger’s study participants gained speech around the same time as their peers, but often used pronouns incorrectly. Their speech was inconsistent, repetitive at times and centered around preferred topics. The students ignored others and their environment, played repetitively and had limited interests. They became upset with objects, parents, teachers, and peers and could become verbally and physically abusive to themselves and others. Some of the students seem to gain pleasure from their disruptive actions which others had no apparent consequence or knowledge anything had occurred. Asperger did not think the condition was discovered in infancy. He also believed the students had excellent logical abstract thinking. Over time he changed his diagnosis to reflect only high functioning intelligence

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students. Originally his work had said all intelligence could be affected including the developmentally disabled (Tsai and Ghaziuddin 2013, p.322).

Parent organizations have helped to gain more research for autism. Parents have sponsored policy changes that have made a huge impact in the autistic community. They started in the 1960's and now span worldwide. Parent groups provide information for policy makers, schools, other parents as well as establishing public and residential day schools for autistic students. In the 1970s and 1980s arrangements were made for adults with autism which lead to the closing of many hospitals for the mentally disabled. Prior to these parent organizations putting a spotlight on treatment and education for autistic people those who experienced autism were institutionalized. Famous people like Temple Grandin, Liane Willey, and Luke Jackson who have autism have also helped spread awareness with bibliographies and advice books (Wolff, pp.205-206). "Increasing awareness of autism has led to many innovative interventions and wider access to good care and education." (Wolff, p206).

Today the DSM-5 is one of the main ways we diagnose autism:

The American Psychiatric Association's Diagnostic and Statistical Manual, Fifth Edition (DSM-5) provides standardized criteria to help diagnose ASD.

Diagnostic Criteria for 299.00 Autism Spectrum Disorder

Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive; see text):

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Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.

1. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
2. Deficits in developing, maintaining, and understand relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior.

Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypes, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).

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3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
4. Hyper- or hypo reactivity to sensory input or unusual interest in sensory aspects of the environment (e.g. apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior.

Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).

Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

Note: Individuals with a well-established DSM-IV diagnosis of autistic disorder, Asperger's disorder, or pervasive developmental disorder not otherwise specified should

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be given the diagnosis of autism spectrum disorder. Individuals who have marked deficits in social communication, but whose symptoms do not otherwise meet criteria for autism spectrum disorder, should be evaluated for social (pragmatic) communication disorder.

(American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric Association; 2013)

According to the DSM-5 an umbrella over the autism spectrum disorder would help improve the diagnosis without limiting criteria or increasing the number of children diagnosed. The DSM-IV held that children could be diagnosed with autistic disorder, Asperger's disorder, childhood disintegrative disorder or pervasive developmental disorder not otherwise specified (PPD-NOS). Some of the difficulties experienced by individuals with autism include communication difficulties, such as a lack of a filter in conversation. Difficulties in social situations, making friends, misreading nonverbal interactions, and social cues, dependency on routines and set schedules, resistance to change (in schedule, environment, staffing) or hyper focus on items (lights, seams, flapping). It is important to remember that autism is a spectrum ranging from mild to severe difficulties. Difficulties must start in early childhood even if not recognized until the child becomes unable to cope in social situation years later (Autism Spectrum Disorder DSM-5).

Autism has so many subsets and varieties that a parent just receiving a diagnosis doesn't really know what they are getting into. Even in families with multiple children with autism sometimes they can get a spectrum of symptoms. There is a famous quote: "If you have met one student with autism you have met one student with autism." No one really knows who said it first but it is quoted in multiple authors' books.

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Part of those symptoms include varying degrees of sensory modulation described by Kern Garver, Carmody, Andrews, Mehta and Trivedi (2008):

sensory modulation is the ability to regulate the degree, intensity and nature of sensory stimulation and the capacity to process sensory information in such a way that an individual generates responses that are appropriately graded in relation to incoming sensations. Sensory modulation is an innate, neurological function; however, in some cases, this function does not develop as it should.” (p.85)

Individuals with autism experience sensory modulation differently (Kern et al, 2008, p.86). This is known as having sensory difficulties or sensory processing issues.

The definition of sensory processing by Baker (2008) is:

Sensory processing refers to the way that sensory information e.g. visual, auditory, vestibular or proprioceptive stimuli is managed in the cerebral cortex and brainstem for the purpose of enabling adaptive responses to the environment and engagement in meaningful daily life activities (p 867).

This is how we process the world around us and make sense of things we are seeing, hearing, feeling, smelling or touching.

1.2. Author's beliefs and experiences

Life does not always happen the way you intend it too. I do not know why my mother was meant to have three children and two of them landed on the autism spectrum. What I do know is that made for an interesting childhood. I was the oldest, so by the age of ten I knew more about an IEP and inclusion than most first year teachers. My brothers are eighteen and thirty now. Michael, the older of the two was listed as developmentally and mentally impaired until he was

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in fourth grade and then he was changed to autistic. To this day he still does not know he has autism and believes he is normal and everyone has twenty-four-hour support. He also is still convinced that Santa has a key to the front door, because the first time we moved we didn't have a Chimney and someone had to convince him Santa would still bring presents. Now with the NORAD Santa tracking program he believes that Santa exists and no one can prove him wrong.

Parker was diagnosed with autism at around age five. He was adding and subtracting in his head instead of showing his work (a huge stressor for his teachers his whole life). This has been a constant struggle for him because he does not understand why he needs to show his work if he can do the work in his head. He hates to write and complains that his hand hurts. He had OT services through Medicaid until he was about fourteen when he was exited for failure to progress. When Parker was twelve he discovered Michael's language skills were lower than his. Parker would intentionally tell Michael that it was raining cats and dogs. Michael would argue he didn't see cats in the sky. This would prompt world war three in my house with Parker taunting Michael and then laughing. It made for interesting dinners. Another favorite for Parker is when the news came on. Michael's comprehension was limited so he would only catch a few words of a broadcast and make the rest up. No one could convince him he was wrong. Michael is still convinced today that Obama was a terrorist that he was Ossama Bin Laden. I think after Bin Laden was finally killed we were able to convince him they were two different people. I have seen many aspects of growing up with autism from early intervention preschool up through adult assisted living support.

The one thing my brothers and I share is a problem with our sensory processing. For me the problem is mild, lights hurt my eyes, and sounds are upsetting if they get too loud. Trust me

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according to everyone else what I think is loud is like a normal sound. Clothes can't be itchy at all and I hate tags. Pants have to be tight but not too tight that I can't breathe, but not so loose that my legs stick together. Shoes well those are a disaster. If I could live in flip flops I would because shoes no matter how wide pinch my feet and make me uncomfortable. I also have trouble focusing my attention. I either over focus and nothing can disturb me, hours go by and I'm still writing a paper, reading a book or playing a video game. I haven't gotten up to eat or anything. Another problem is I'm easily distracted by shiny things; I call it sparkle brain. Anything that catches my eye distracts me when I'm supposed to be taking a test, listening to a lecture or otherwise doing school. My body just feels like I need to get up and run around the room. My mom knew this could be a sign of ADD or ADHD, but instead of medication we decided I would self-medicate with caffeine. I would have a MT. Dew for breakfast and sometimes for lunch to get me through the school day. It doesn't keep me awake at night it just calms me down enough to focus. I'm really good at faking social situations, when I want to but really I just want to stay home. Crowds make me feel annoyed every little thing sets me off, her voice is squeaky, the music is loud etc. I stopped making excuses for not going to gatherings long ago. I have frequent headaches that land me in the emergency room. I have no short term memory; I was tested for gifted four times as a child, but each time I didn't make it in because of the short-term memory test. I also had to go to speech as a child because I was too loud and had nodules on my vocal cords. When I failed to make progress they exited me from the program. Could I be on the spectrum probably, but it's not enough to get me services, support or severely impact my life. Plus, girls on the spectrum manifest differently than boys.

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For my brothers' sensory issues manifest differently. My brother that is thirty does not regulate that he should be too hot. He does not feel the heat when others do. He wears sweatshirts and long pants when it is 100 degrees and we have to remind him to take off layers or wear a t-shirt. This brother is very low energy. He would be happy just sitting around doing nothing all day long.

My other brother is eighteen and has issues with shoes, tags, jeans (too scratchy) and he is very busy; when he gets agitated he will bite his arm or shoe to try to relieve stress and anxiety. Now that he is older he can verbalize that he is upset because of traffic or the plan being changed, but as a child he would just start biting something and it took a bit of deciphering to know what was going on. As a kid he would run away and hide when he was embarrassed for getting into trouble. I can remember he must have been in the second grade and he was crawling around the floor of his classroom while the teacher was instructing and being observed. Parker was picking up staples with a magnet while she tried to ask comprehension questions about the story. He didn't seem to be paying attention at all and his teacher was so embarrassed. Then she asked a question to the class and he shouted out the right answer. He's on a high dose of ADHD medicine to keep him kind of calm and help him focus. When he is not medicated he has as he calls itchy blood that makes him run around the room and unfocused.

The choice to research sensory issues and autism didn't just come from my family. Some of my students have sensory seeking behaviors; they chew on their arms, bounce their bodies off walls, balls and people, bang their heads and other self-injurious behaviors. While others of my students are very low energy and just daze into space yet others run from one activity to another or even out of the classroom. The reason that I feel these are sensory seeking behaviors is one

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the occupational therapist has told me they are and two because they seem to receive some relief of anxiety when they participate in them. Due to the fact that I have many students if not all of my students experiencing some sort of sensory issue I decided it was the most logical topic for me.

The research questions I would like to answer is number one how do I help my students to regulate their bodies to benefit them? Are there effective strategies? I'm not so much worried about my students being quiet and calm and in their seats, but when my brother describes the uncomfortable itchy feeling and is in tears because he is not medicated and can't cope that's something I don't want my students to feel. I want them to learn to be in control of their bodies so they aren't upset and injuring themselves.

The second question I have is; What impacts sensory issues?

The final question is what impact does sensory processing have on social skills?

1.3. Purpose of this meta-synthesis

This meta-synthesis which focused on students with multisensory issues and autism had two main purposes and one underlying purpose. Number one was to identify that students with autism do have a variety of multisensory issues. These issues are described by multiple authors in journal articles. The second purpose was to find strategies that helped these students in school. The underlying purpose of conducting this meta-synthesis was to identify common themes that emerged from the journal articles and to connect them to my current experiences as a self-contained teacher with many students that have autism and sensory issues.

2. Methods

2.1. Selection criteria

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The 40 journal articles and one book included in this meta-synthesis met the following selection criteria.

1. The articles included students with autism.
2. The articles included students with sensory issues.
3. The articles were published in peer-reviewed journals.
4. The articles were published between the years of 1997-2016.

2.2. Search procedures

In the summer of 2016, I conducted methodical searches of the EBSCOhost (a) Education Resources Information Center (ERIC, EBSCOhost) database. The subject of the database was education. I then searched for autism and multisensory issues. I used the following

search term combinations to conduct Boolean searches of the database:

1. (“sensory processing disorder”) AND (“autism”).
2. (“psychology”) AND (“autism”).
3. (“sensory processing issues”) AND (“autism”).
4. (“multisensory issues”) AND (“autism”).
5. (“history of autism”)

The database searches led to 40 articles that met my selection criteria and a book (Baker et al, 2008; Baranek, G. 1999; Boyd et al, 2009; Brandwein,et al, 2015; Chen et al, 2009; Cheung, & Sie, 2009; De le Marche et al, 2012; Donovan, & Zucker, 2016; Duerden et al, 2012; Dunn et al, 2002; Foss-Feig et al, 2012; Fuentes et al, 2011; Gabriels et al, 2008; Germani et al, 2014; Gernsbacher et al, 2005; Gomot et al, 2008; Gotts et al, 2012; Grandin & Panek, 2013; Hinton et al, 2010; Hinton et al, 2007; Iarocci

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& McDonald, 2006; Kern et al, 2008; Lane et al, 2011; Lane et al, 2010; Leonard et al, 2010; Mazurek et al, 2013; Morrison, 2007; O'Neill & Jones, 1997; O'Riordan & Filippo, 2006; Paton et al, 2012; Robertson & Simmons 2013; Schaaf et al, 2015; ; Siaperas et al, 2012; Stevenson et al, 2014; Tavassoli et al, 2016; Toth,& King, 2008; Tsai, & Ghaziuddin, 2014; Tseng et al, 2011; Watson et al, 2011; Wigham, et al, 2015; and Wolff, 2004).

2.2.1 Database searches

I developed a coding form to categorize the information presented in each of the 40 articles and one book. This coding form was based on: (a) publication type; (b) research design; (c) participants; (d) data sources; and (e) findings of the studies.

2.2.2 Ancestral searches

I conducted database searches to locate articles for this meta-synthesis. I also included one book by an author with autism.

2.3. Coding procedures

I used a coding table to categorize the information presented in each of the 40 articles and one book. This coding table was based on: (a) publication type; (b) research design; (c) participants; (d) data sources; and (e) findings of the studies

2.3.1. Publication type

I assessed and sorted each article based on the publication type (example: research study, descriptive article, guide, opinion piece/position paper, annotated bibliography, review of the literature). Research studies use systematic methods to obtain and/or study quantitative and/or qualitative data. Descriptive articles label experiences and phenomena, but do not

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employ systematic methods to obtain and analyze information. Guides endorse specific strategies and/or explain how practitioners might apply certain programs, policies, or curricula.

Opinion pieces'/position papers describe an author's opinion about a topic; these articles may support or campaign for particular educational objectives, political views, policy positions, or philosophical ideas. Annotated bibliographies include a list of articles on a given topic with a brief summary of each piece of work. Reviews of the literature summarize and yield the vital themes of previously published works on a topic (Table 1).

2.3.2. Research design

I categorized each study by research design (example: quantitative research, qualitative research, mixed methods research). Quantitative researchers collect and study mathematical data. Mixed methods research uses both quantitative (example: with numbers) and qualitative (without numbers) research methods within a single study (Table 2).

Qualitative researchers use language (words instead of numbers) to describe experiences and tell subject's stories.

2.3.3. Participants, data sources, and findings

I included the participants in each of the studies (children and students with autism). I also included students with (multisensory issues or disorders and autism).

I identified the data sources that were studied for each study (e.g., interviews, observations, focus groups, surveys, standardized tests). Lastly, I summarized the findings of each study (Table 2).

2.4. Data analysis

I used a modified version of the Stevick-Colaizzi-Keen method previously employed by

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Duke and Ward (2009) to analyze the 40 articles and one book contained within this meta-synthesis. I first identified significant declarations within each article. For the purpose of this meta-synthesis, I defined significant statements as statements that addressed issues related to: (a) students with autism (b) students with multisensory issues (c) strategies to help students with autism (d) strategies to relax students with autism (e) strategies to reduce anxiety in students with autism. I then attempted to develop a list of non-repetitive, non-overlapping (verbatim) significant statements with (paraphrased) conveyed meanings. These (paraphrased) expressed meanings represented my understanding of each significant statement. There were very few themes that were different between the articles. To conclude, I grouped the significances from all 28 articles remaining into main ideas (or evolving themes). These themes represented the core of the entire body of literature (Table 3).

3. Results

3.1. Publication type

I found 40 articles and one book that met my selection standards. The publication type of each article is identified in Table 1. Of the 40 articles and one book 25 (61%) of the articles were quantitative research design: Baker et al, 2008; Boyd et al, 2009; Brandwein, et al, 2015; Chen et al, 2009; Cheung, & Sie, 2009; Duerden et al, 2012; Fuentes et al, 2011; Gabriels et al, 2008; Germani et al, 2014; Gomot et al, 2008; Gotts et al, 2012; Hinton et al, 2010; Hinton et al, 2007; Kern et al, 2008; Lane et al, 2010; Mazurek et al, 2013; O’Riordan & Filippo, 2006; Paton et al, 2012; Robertson & Simmons 2013; Schaaf et al, 2015; Siaperas et al, 2012; Stevenson et al, 2014; Tavassoli et al, 2016; Tseng et al, 2011; and Wigham, et al, 2015. Two (.05%) of the 41 total works were qualitative research: Iarocci & McDonald, 2006 and Wigham,

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et al, 2015. Three (.07%) of the articles were mixed methods research: Baranek, G. 1999; De le Marche et al, 2012 and Lane et al, 2011. Two (.05%) of the articles were literature reviews: Morrison, 2007; and Tsai, & Ghaziuddin, 2014. Two of the articles/books were opinion pieces: Donovan, & Zucker, 2016; and Gernsbacher et al, 2005. Finally, seven (17%) of the articles were descriptive: Dunn et al, 2002; Foss-Feig et al, 2012; Grandin & Panek, 2013; Leonard et al, 2010; O'Neill & Jones, 1997; Tsai, & Ghaziuddin, 2014; and Wolff, 2004.

Table 1

Author(s) & Year of Publication	Publication Type
Baker, A.E.Z., Lane, A., Angley, M.T., & Young, R.L (2008)	Quantitative
Baranek, G. (1999).	Mixed
Boyd, B.A., McBee M., Holtzclaw, T., Baranek, G.T. & Bodfish, J.W. (2009).	Quantitative

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Brandwein, A.B., Foxe, J.J., Butler, J.S., Frey, Hans-Peter., Bates, J.C., Shulman, L.H. & Molholm, S. (2015)	Quantitative
Chen, Yu-Han., Rodgers, J. & McConachie, H. (2009).	Quantitative
Cheung, P., & Sie, A.M.H (2009)	Quantitative
De le Marche, W. & Steyaert, J., Noens, I. (2012).	Mixed
Donvan, J. Zucker, C. (2016)	Opinion
Duerden, E.G., Oatley, H.K., Mak-Fan, K.M., McGrath, P.A., Taylor, M.J., Szatmari, P. & Roberts, S.W. (2012).	Quantitative
Dunn, W., Saiter, J., & Rinner, L. (2002).	Descriptive
Foss-Feig, J.H, Heacock, J.L.& Cascio, C.J. (2012).	Descriptive
Fuentes, C.T., Mostofsky, S.H.& Bastian, A.J., (2011).	Quantitative
Gabriels, R.L., Agnew, J.A., Miller, L.J., Gralla, J., Pan, Z., Goldson, E. Ledbetter, J.C., Dinkins, J.P. & Hooks, E. (2008)	Quantitative
Germani, T., Zwaigenbaum, L., Bryson, S., Brian, J., Smith, I., Roberts, W., Szatmari, P., Roncadin, C., Sacrey, L.A.R., Garon, N., & Vaillancourt, T. (2014)	Quantitative
Gernsbacher, M.A. Dawson, M. & Goldsmith, H.H. (2005)	Opinion
Gomot, M., Belmonte, M.K., Bullmore, E.T., Bernard, F.A. & Baron-Cohen, S. (2008).	Quantitative
Gotts, S.J., Simmons, W.K., Millbury, L.A., Wallace, G.L. Cox, R.W. & Martin, A. (2012).	Quantitative
Grandin, T. & Panek, R. (2013)	Opinion/ Descriptive
Hinton, C.L., Harper, J.D., Kueker, R.H., Lang, A.R., Abbacchi, A.M., Todorove, A. & LaVesser, P.D. (2010)	Quantitative
Hinton, C., Graver, K. & LaVesser. (2007).	Quantitative
Iarocci, G. & McDonald, J. (2006).	Qualitative
Kern, J.K., Garver, C.R., Carmody, T., Andrews, A.A., Mehta, J.A. & Trivedi, M.H. (2008).	Quantitative
Lane, A.E., Dennis, S.J. & Geraghy, M.E. (2011).	Mixed
Lane.A.E, Young, R.L., Baker.A.E.Z. & Angley, M.T. (2010).	Quantitative
Leonard.H, Dixon.G, Whitehouse, A.J.O., Bourke, J., Albert, K., Nassar, N., Bower, C. & Glasson, E.J. (2010).	Descriptive
Mazurek, M.O., Vasa, R.A., Kalb, L.G., Kanne, S.M., Rosenberg, D., Keefer, A., Murray, D.S., Freedman, B. & Lowery, L.A. (2013)	Quantitative
Morrison, E.E. (2007).	Literature Review
O'Neill, M. & Jones, R.S.P. (1997).	Opinion/Descriptive
O'Riordan, M. & Filippo, P., (2006).	Quantitative
Paton, B., Hohwy, J. & Enticott, P.G. (2012).	Quantitative
Robertson, A.E. & Simmons, D.R. (2013).	Quantitative
Schaaf, R.C., Benevides, T.W., Leiby, B.E., & Sendeck, J.A. (2015).	Quantitative

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Siaperas, P., Ring, H.A., McAllister, C.J., Henderson, S., Barnett, A., Watson, P. & Holland, A.J. (2012).	Quantitative
Stevenson, R.A., Siemann, J.K., Woynaroski, T.G., Schneider, B.C., Eberly, H.E., Camarata, S.M & Wallace, M.T. (2014)	Quantitative
Tavassoli, T., Bellesheim, K., Siper, P.M., Wang, A.T., Halpern, D., Gorenstein, M., Grodberg, D., Kolevzon, A & Buxbaum, J.D. (2016)	Quantitative
Toth, K. & King, B.H. (2008).	Descriptive
Tsai, L.Y. & Ghaziuddin, M. (2014).	Literature Review
Tseng, M-H., Fu, C-P., Cermak, S.A., Lu, L. & Shieh, J-Y. (2011).	Quantitative
Watson, L.R., Pattern, E., Baranek, G.T., Poe, M., Boyd, B.A., Freuler, A. & Lorenzi, J. (2011).	Qualitative
Wigham, S., Rodgers, J., South, M., McConachie, H. & Freeston, M. (2015).	Quantitative
Wolff, S. (2004).	Descriptive

3.2. Research design, participants, data sources, and findings of the studies

As I earlier noted, I found 40 articles and one book that met my selection standards. I then narrowed down the list to 28 articles that met selection standards and had a sample to test. Baker et al, 2008; Baranek, G. 1999; Boyd et al, 2009; Brandwein, et al, 2015; Chen et al, 2009; Cheung, & Sie, 2009; De le Marche et al, 2012; Duerden et al, 2012; Fuentes et al, 2011; Gabriels et al, 2008; Germani et al, 2014; Gomot et al, 2008; Gotts et al, 2012; Hinton et al, 2007; Kern et al, 2008; Lane et al, 2011; Lane et al, 2010; Mazurek et al, 2013; O’Riordan & Filippo, 2006; Paton et al, 2012; Robertson & Simmons 2013; Schaaf et al, 2015; Siaperas et al, 2012; Stevenson et al, 2014; Tavassoli et al, 2016; Tseng et al, 2011; Watson et al, 2011; and Wigham, et al, 2015. The research design, participants, data sources, and findings of each of these studies are identified in Table 2.

Table 2

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Authors	Research Design	Participants	Data sources	Findings
Baker et al., 2008	Quantitative	22 Students with autism spectrum disorder. 18 males 4 females	Short sensory profile, Vineland Adaptive Behavior Scales: Interview addition, Developmental Behavior Checklist-Parent	The purpose of the study was to (1) describe the sensory processing patterns of children who have autism spectrum disorder and (2) explore the relationship between those patterns and emotional, social and behavioral responses in the group. 83% of those studied showed some degree of sensory processing dysfunction. Most participants show under responsiveness and sensory seeking. Auditory filtering is also an area of concern. High frequency of inattention and distractibility. Students with auditory filtering issues may appear to be distracted and inattentive.
Baranek, 1999	Mixed	32 children 3 categories, autism 11, developmental disabilities 10 and typical 11	Videotape review of first 2 years of life	Study confirmed that sensory-motor functioning and social communication are potentially early identifiers of autism in infants. Children with autism show delays in responding to their names being called and other attention-getting strategies.
Boyd et al, 2009	Quantitative	61 children with autism 31 autism, 22 Asperger's, 5 PPD NOS, 3 ASD unspecified 64 typical children	Repetitive Behavior Scale- Revised Sensory Questionnaire Behavior Rating Inventory of Executive Functioning	The purpose of the study was to examine the relationship between sensory features and repetitive behaviors in high functioning school-age children with autism and if executive defects are correlated with both

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				<p>classes of behaviors and if there were variables to predict the presence of repetitive behaviors in high functioning autism. The high functioning autism group had more restrictive behaviors for example hand flapping, lining up toys perfectly, and resistance to the change of plans, sensory processing issues, and issues with executive functioning. There was mixed evidence on the relationship between executive dysfunction and repetitive behaviors. * All of these subtypes now fall under autism in the DSM-5 except typical children.</p>
Brandwein et al., 2015	Quantitative	52 children with autism spectrum disorder between the ages of 6-17. 7 females	Audiovisual Simple Reaction Time Test, ERP Analysis and Measures	<p>The purpose was to investigate the clinical significance of EEG indices of auditory and visual sensory processing integration in students with autism. Can they predict the severity of symptoms in autism?</p> <p>Significant relationship between neural indices of early auditory and visual processing and the severity of autism. EEG reaction time did not predict visual/auditory sensitivities.</p>
Chen et al. 2009	Quantitative	29 students including 26 males and 3 females Ages 8-16. IQ must be above 70.	Social Communication Questionnaire, WISC, The short sensory profile,	<p>Wanted to find out if children with autism and sensory processing abnormalities will show a greater degree or restricted and repetitive behaviors.</p>

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			The embedded figures test. Childhood Routines Inventory	Also if students have a great repetitive behavior and sensory symptom would it show a detail focuses cognitive style. Sensory processing did not have an effect on performances on the cognitive tests. Restrictive and repetitive behaviors did effect the speed in which students finished the completed the embedded figures test. This suggests relationships with tactile, visual and auditory hyper responsiveness in autism rather than hypo responsiveness.
Cheung, & Sie 2009	Quantitative	Total 2026 students in two groups. 1840 without disabilities. 186 with ADHD or Autism. Ages 2-12. (72 with Autism, 114 ADHD)	Sensory profile	Purpose was to compare children with autism and ADHD and without disabilities (such as down syndrome) to examine whether there were differences in sensory processing. Sensory processing has major impact on daily functioning. Students with ADHD or ASD experienced more sensory processing difficulties than typical peers. Students with ASD are likely to experience sensory processing issues over their childhood whereas students with ADHD are more likely to experiences sensory processing in auditory processing as well as other sensory areas over time.

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De le Marche et al., 2012	Mixed	80 students with ASD, 56 students that were siblings of ASD and 33 typical 169 total.	Adolescent and Adult Sensory Profile, Developmental, Dimensional and Diagnostic Interview, Social Responsiveness Scale	Main goals of the study were to assess sensory processing in adolescents with autism and in their non-autistic siblings. Adolescents with ASD have a low neurological threshold and actively try to defend themselves against overstimulation. Sensation seekers have high neurological thresholds and look for extra stimulation. Low neurological threshold is consistent with hyper arousal. Results indicate that atypical sensory processing is a characteristic of genetic risk to ASD. Which is increased in siblings of those with ASD. Non-affected siblings of children with ASD show less sensory seeking behaviors than the general population.
Duerden et al. 2012	Quantitative	250 total 212 boys and 38 girls; 21 months to 19.3 years' old	ADOS- Autism Diagnostic Observation Schedule- Generic and Autism Diagnostic Interview, Cognitive and Adaptive Ability and Receptive and Expressive Language, Repetitive Behavior Assessment, Self-Injury Assessment	Purpose to assess the incidence of self-injurious behaviors with students with autism into new categories of atypical sensory processing, impaired cognitive ability, abnormal fundamental communication, abnormal social functioning, age, the need for sameness, and compulsive or ritualistic behavior. 241 students said they had self-injurious behavior in the last three months. Children with lower IQ were more likely

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				to commit self-injurious behaviors. Resistance to change was a contributing factor to self-injurious behaviors. Self-injury may serve to offset anxiety associated with resistance to change or sameness.
Fuentes, et al 2011	Quantitative	24 right handed students. 12 with ASD (1 female) 12 typical (1 female). Students between 12-16 years' old	Proprioceptive Tasks (KINARM robotic arm), Passive Elbow Angle Matching Task, Passive Fingertip Matching Task, Active Elbow Angle Matching Task, Control Trials (individuals could see their arm), EMG Recordings	Wanted to establish whether there were proprioceptive (body movement) differences in the autism group on a peripheral level (outer part of the body) or in how the information is neutrally represented (in the nervous system and brain) and integrated with efficient information. The Autism group demonstrated sensory and motor impairments, but on the proprioceptive (body position) tasks showed no impairments.
Gabriels, et al. 2008	Quantitative	70 students with ASD, 58 males, 12 females. Ages 3-19.7 years' old	Sensory Profile for Caregiver, RBS-Repetitive Behavior Scale,	Wanted to know if there was a relationship between repetitive behaviors and sensory response. Wanted to make sure if there was a difference it wasn't due to items overlapping in the rating scales. Third was to establish if there was a phenotypic subtype of autism was suggested with high rates of repetitive behaviors and abnormal sensory responses. Subgroup within the autistic community may be unresponsive to pain sensation and cause self-injury by engaging in

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				repetitive behaviors such as head banging or biting themselves.
Germani et al. 2014	Quantitative	91 participants, 24 months to 36 months	Infant Toddler Sensory Profile, Diagnostic appointment, Mullen Scales of Early Learning, Autism Diagnostic Observation Schedule, Autism Diagnostic Interview revised,	Wanted to compare 24-month Infant Toddler Sensory Profile scores to 36-month score and compared them to high risk infants diagnosed with autism, high risk not diagnosed with autism and low risk infants with no family history of autism. Atypical sensory processing in high risk infants may be due to poor emotional regulation and atypical behavioral responses as part of a trajectory towards and autism diagnosis.
Gomot et al. 2008	Quantitative	24 total participants. 12 males 12 typical 10-15 years old 3 Asperger's (now high functioning autism) and 9 with high functioning autism *No child was on medication for 2 months prior.	fMRI, Adolescent Autism Spectrum Questionnaire	Assess brain activation patterns that correlate quantitatively with number of autistic traits. To investigate novelty detection in children with autism when attention is actively oriented towards the changing events. The study used an fMRI to characterize brain regions involving the detection of new target sounds in children with autism. Hyper-selectivity can be both good and bad. On the good side it allows students to be very accurate in fields of math, science and computers. On the bad side it can interfere with adaptation and change. The over focused attention can be

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				counterproductive during social interactions, and may have students develop narrow interests in activities.
Gotts et al. 2012	Quantitative	29 typical participants (28 males one female) between 12 and 23. 21 high functioning autistic children (29 males, 2 females). Between the ages of 12 and 23.	MRI data, ADOS,	Wanted to if see differences in functional connectivity should be concentrated preferentially among social brain areas and the severity of autism social symptoms should be predicted preferentially by connectivity levels among the social brain waves. 13 seed regions of interest, all which showed lower connectedness in autism spectrum disorders group relative to the typically developing group. All 12 seed regions are part of what's called the social brain.
Hinton et al. 2007.	Quantitative	36 high functioning autistic children, 26 typical children all between the ages of six and ten. All have an IQ 70+.	Social Responsiveness Scale, Sensory profile	Wanted to examine the relationship between social competence and sensory processing in children with high functioning autism. Moderate to strong relationship between child's typical sensory responsiveness and social impairment for typically developing children and children with high functioning autism. These atypical responses to multisensory, touch, and oral sensory/smell stimuli were identified as possible predictors of social severity. Social severity relates to the social anxiety experienced by those with

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				autism, ranging from a little anxiety to a lot of anxiety and not wanting to involve with people at all.
Kern et al. 2008	Quantitative	103 autistic individuals age 3-43. 103 typical ages 3-42. Gender and age matched to autistic group.	Sensory profile and CARS (childhood autism rating scale)	Wanted to examine sensory modulation based on the four modulation sections of the sensory profile. Autism group different from control group on all four ratings in the sensory profile, suggesting that those with autism engage in the behaviors more frequently than the control group. The gap between the groups is lessened as the autism group gets older.
Lane et al., 2011	Mixed	54 children with autism and their caregivers ages 3.9-9.4.	Short Sensory Profile,	Wanted to investigate the existence of sensory subtypes in children with autism. Study revealed mixed results in the association of sensory processing in children with autism. The study found that children with autism experience three sensory subtypes (sensory-based inattentive seeking (these are students with mild sensory perception problems,) sensory modulation with movement sensitivity, and sensory modulation with taste/smell sensitivity. Findings support the continued use of sensory interventions in the remediation for communication and behavioral difficulties.

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Lane et al, 2010	Quantitative	30 children with autistic disorder, or pervasive developmental disorder not otherwise specified 7, and their caregivers. Note two of the autistic children also had fragile X syndrome.	Short sensory profile, Physiologic measures (tests on the body), Vineland Adaptive Behavioral Scale,	Wanted to describe the patterns of sensory processing difficulties in those with autism and to examine the relationship between sensory processing patterns in the group and adaptive behavior; (These are behaviors that are used to adjust to certain situations for instance independence in everyday tasks, these are usually taught with a task analysis method in maladaptive students breaking down each step to the tiniest pieces). Study confirms subtypes of sensory processing dysfunction. Definite difference between typical students and autistic students in the area of under responsiveness/ seeks sensation and auditory filter domains. The auditory filtering domain describes things that are generally over responsive reactions such as is distracted or has trouble functioning if there is a lot of noise around, and can't work with background noise. Suggests sensory over responsivity and under responsivity may actually both be happening in the same child with autism.
Mazurek et al., 2013	Quantitative	2973 children and adolescents enrolled in autism treatment	Autism Treatment Network Battery, Short Sensory Profile, Child Behavior checklist, GI	Wanted to know if increased anxiety in students with autism had to do with sensory over

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		network. Aged 2-17 years.	symptom inventory for Autism treatment network, Stanford Binet Scales of Intelligence-5 th edition Abbreviated Battery IQ, Mullen Scales of Early Learning	responsivity and if students with autism and gastrointestinal issues had increased anxiety, additionally if children with GI problems will show greater difficulty with anxiety when it comes to over responsiveness and finally if sensory over responsiveness will independently contribute to the prediction of GI problems. Of the total number of children in the sample size 24.7% had at least one chronic GI symptom. Strong association between sensory over-responsivity and anxiety.
O'Riordan & Filippo 2006	Quantitative	12 high functioning autism, 12 typical mean for both groups around 8 years of age. Last experiment 13 autistic 13 typical mean age 10 years.	Experiment 1: Hearing test using headphones asked students to press button when two tones were same frequency, Experiment two: Four different types of sandpaper, feel if sandpapers felt the same or different. Experiment 3: Close eyes and tell when the pen was touching their arm. Then used string	Wanted to assess if auditory and tactile discrimination ability in autism and normal development, if enhanced discrimination is a feature of autism then children with autism should perform well on all three experiments. Enhanced ability of individuals with autism to discriminate between stimuli extends from the visual to the auditory, but not to the tactile modality. Children with autism were not able to identify the tones as the same until later in the sequence than the control group.
Paton et al. 2012	Quantitative	17 individuals (3 females) with high functioning	Rubber Hand experiment: questionnaires about	Wanted to know if the rubber hand would reveal proprioceptive and

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		autism, 17 control group (5 females)	each experiment variation	sensorimotor differences between students with autism and the control group. Significantly less such general drift was seen the autism group. Complex multisensory integration such as seen in the rubber hand illusion is a huge area to study for understanding the sensory processing differences in autism.
Robertson & Simmons 2013	Quantitative	212 (142 females, 70 males from 16-66 years	Survey Monkey, Glasgow Sensory Questionnaire, Autism Quotient,	Wanted to prove that those with high autism quotient scores who have an 80% chance of having autism would have high frequencies of sensory difficulties but low and medium AQ scores would have lower sensory scores. *Note: A higher total sensory score is usually experiencing both hyper and hypo sensitivity to sensory stimuli more frequently. Those with high levels of autistic traits experience more sensory disturbances. Positive correlation between the number of autistic traits and frequency of atypical responses to sensory stimuli. There was no age effect found in the sample.
Schaaf et al. 2015	Quantitative	59 children with ASD, 29 typical <i>*Enrolled more with ASD to make sure they had a representative sample.</i>	30 min Sensory Challenge Protocol (SCP) child had to sit (in padded chair mounted to a platform) quietly in a semi- dark room for 3 min (called	Wanted to study the autonomic nervous system activity during sensory stimulation of autistic children. Children with ASD displayed signs of

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		<i>Ages 6-9</i>	it a space ride) while hooked up to machines to monitor heart rate, Child Symptom Inventory,	behavioral dysregulation and avoidance during the SCP. Behaviors included hands over ears, rubbing at skin after being touched, covering their eyes or looking elsewhere. The ASD participants did not experience a physiological response and they showed difficulty regulating their behavioral responses during the SCP. The characteristics of autism that include rigid behaviors and limited social interaction and engagement may be related to the decreased autonomic and behavioral flexibility.
Siaperas et al. 2012	Quantitative	50 male children aged 7-14 years of age with autism. Typical peer group of 50 boys.	Movement Assessment Battery for Children-2, Sensory Integration Praxis Test	Wanted to investigate the relationship between sensorimotor performance and age and sensorimotor impairments in the autism group. Significant impairments across the sensorimotor functions investigated. May lead to difficulty in motor planning for those with autism such as planning simple actions because of sensory impairments, such as keeping balance. Those with ASD experience significant impairments with movement performance, and sensory processing.
Stevenson et al 2014	Quantitative	31(26 males, 5 female) children with ASD and 31 (13 males, 18	Diagnostic Interview, Wechsler Abbreviated Scale of Intelligence second edition, Autism	Wanted to study multisensory integration in students with autism. Sought to examine the

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		<p>females) Typically developing peers. Groups were matched on chronological age and performance IQ.</p>	<p>Diagnostic Observation Schedule, Visual Stimuli Experiment,</p>	<p>susceptibility to the SIFI (sound induced flash illusion which is the visual illustration that is caused by a non-visual cue like a beep or two beeps. For example, the light flashes one time but two beeps are played so the brain records this as two flashes of light) in a larger cohort of cognitively-able children with autism. Weak central coherence proposes that children with autism have difficulty integrating discrete information into combined, holistic perceptions and experiences.</p>
<p>Tavassoli et al 2016</p>	<p>Quantitative</p>	<p>35 (28 males) students with ASD and 27 (12 males) typical peers. Ages 4-16. IQ 80-132.</p>	<p>Sensory Processing Scale Assessment, Autism Spectrum Quotient, Short Sensory Profile,</p>	<p>Wanted to use SPS (Sensory Processing Scale Assessment) to capture hyper and hypo reactivity to sensory stimuli and sensation seeking behaviors across multiple modalities for children with autism. Also to examine the reliability of the SPS in an autistic sample and examine the convergent validity of the SPS relative to the SSP and determine which SPS items were most helpful in order to simplify the use of it. 65% of those with ASD displayed sensory issues, 4% of typical sensory issues. 33% of ASD visual seeking 15% auditory hyper-reactivity 33% tactile hyper-reactivity.</p>

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Tseng et al 2011	Quantitative	112 children total. 67 with autism 45 typical. 4-7years old. *Said preschool but went until age 7.	Childhood behavior checklist translated into Chinese, Sensory Profile- Chinese version	Wanted to investigate the rate of co-occurring sensory processing dysfunction in preschool children with autism who manifested emotional and behavioral problems. Also to examine the relationship between sensory processing dysfunction and emotional and behavioral problems in preschool children with autism and typically developing children. Children with autism demonstrated a higher rate of emotional problems, a lesser rate of behavioral problems, as well as sensory processing dysfunction. Sensory processing predictor of avoiding was likely children who internalized problem behaviors in both children with autism and typical peers. Those with the sensory processing problem of sensitivity was a predictor of externalizing problem behaviors in children with autism whereas in typical children sensation seeking was the predictor of externalizing problems in the typically developing group.
Watson et al, 2011	Qualitative	72 students with autism mean age 4.4 years, 44 other development disabilities mean age 4.0 years	The Visual Reception Scale for the Mullen Scales of Early Learning, Brief IQ of Leiter International Performance Scale Revised, ADOS Modules 1,2, and 3.	To examine the patterns of sensory responsiveness as factors that may account for variability in social-communication symptoms of autism and variability in language, social and communication

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		*monetary incentive \$25-75 as well as toy for child or block.	Mullen Scales of Early Learning, Receptive Language and Expressive Language, Preschool Language Scale Auditory Comprehension and Expressive Communication, Vineland Adaptive Behavior Scale-Survey Edition, Sensory Experiences Questionnaire, The Sensory Profile, Sensory Processing Assessment for Young Children, The Tactile Defensiveness and Discrimination Test-Revised,	skill development in children with autism or other developmental disabilities. Hypo responsiveness is positively associated with social communication symptom severity among both groups. Hyper responsiveness is not significantly associated with social communication severity. There was a positive association for sensory seeking. Hypo responsiveness is negatively associated with language skills and social adaptiveness in both groups. Sensory seeking was also negatively associated with language skills in both groups. Abnormal sensory processing may play an important role in the development of autism and other developmental disabilities as well as in the rate of learning language, social and communication skills.
Wigham et al, 2015	Quantitative	53 children with ASD (47 boys and 6 girls). 8-16 years old. IQ of 70 or above.	Social Responsiveness Scale- parent version, Full Scale IQ- Wechsler Abbreviated Scale of Intelligence, Short Sensory Profile, Spence Children's Anxiety Scale, Intolerance of Uncertainty Scale-Parent Version, Repetitive Behavior Questionnaire	Wanted to examine the relationships between sensory processing abnormalities and repetitive behaviors while analyzing the part that intolerance of uncertainty and anxiety may play in students with autism. Direct path from sensory under responsiveness to repetitive motor behaviors and insistence on

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				sameness. There was a significant indirect effect from sensory under responsiveness to both types of repetitive behavior both insistence on sameness and repetitive motor. The most important path was from intolerance of uncertainty and anxiety to insistence on sameness.
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3.2.1. Research design

As stated previously, I located 28 articles that further met my selection criteria. Of those 28 articles 24 (86%) of them were quantitative research: (Baker et al, 2008; Boyd et al, 2009; Brandwein, et al, 2015; Chen et al, 2009; Cheung, & Sie, 2009; Duerden et al, 2012; Fuentes et al, 2011; Gabriels et al, 2008; Germani et al, 2014; Gomot et al, 2008; Gotts et al, 2012; Hinton et al, 2007; Kern et al, 2008; Lane et al, 2010; Mazurek et al, 2013; O’Riordan & Filippo, 2006; Paton et al, 2012; Robertson & Simmons 2013; Schaaf et al, 2015; Siaperas et al, 2012; Stevenson et al, 2014; Tavassoli et al, 2016; Tseng et al, 2011 and Wigham, et al, 2015). One (3%) of the articles were qualitative research: Watson et al, 2011. The rest of the three articles that remained (11%) were mixed methods: (Baranek, G. 1999; De le Marche et al, 2012; and Lane et al, 2011.)

3.2.2. Participants and data sources

Many of the participants 25 (89%) came from research or intervention centers. Baker et al, 2008; Baranek, 1999; Boyd et al, 2009; Brandwein, et al, 2015; Chen et al, 2009; De le Marche et al, 2012; Duerden et al, 2012; Fuentes et al, 2011; Gabriels et al, 2008; Germani et al, 2014; Gomot et al, 2008; Gotts et al, 2012; Hinton et al, 2007; Kern et al, 2008; Lane et al, 2011; Lane

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et al, 2010; Mazurek et al, 2013; Paton et al, 2012; Robertson & Simmons 2013; ; Siaperas et al, 2012; Stevenson et al, 2014; Tavassoli et al, 2016; Tseng et al, 2011; Watson et al, 2011; and Wigham, et al, 2015. Only three (10%) of the participants came from schools. Cheung, & Sie, 2009; O’Riordan & Filippo, 2006; Schaaf et al, 2015. Of the 28 articles that I included 21 (75%) of them used questionnaires to get their research. Baker et al, 2008; Boyd et al, 2009; Chen et al, 2009; Cheung, & Sie, 2009; Duerden et al, 2012; Gabriels et al, 2008; Germani et al, 2014; Hinton et al, 2007; Kern et al, 2008; Lane et al, 2011; Lane et al, 2010; Mazurek et al, 2013; Paton et al, 2012; Robertson & Simmons 2013; Schaaf et al, 2015; Tavassoli et al, 2016; Tseng et al, 2011; Watson et al, 2011; and Wigham, et al, 2015. Eight (28%) of the articles used experiments to prove their research. Brandwein, et al, 2015; Fuentes et al, 2011; Gomot et al, 2008; Gotts et al, 2012; O’Riordan & Filippo, 2006; Paton et al, 2012; Schaaf et al, 2015 and Stevenson et al, 2014. Of the 28 articles ten (36%) of them used a form of testing whether it be academic, IQ, CARS, Vineland etc. Baker et al, 2008; Baranek, G. 1999; Brandwein, et al, 2015; Duerden et al, 2012; Germani et al, 2014; Kern et al, 2008; Lane et al, 2010; Mazurek et al, 2013; Siaperas et al, 2012; and Watson et al, 2011. Two articles used some form of an interview with the subjects in addition to questionnaires or experiments. De le Marche et al., 2012 and Mazurek et al, 2013. Only one article chose to do a video analysis from home videos of children under two Baranek.1999. Only one article used surveys on sites like survey monkey to achieve results they then compared to the questionnaires: Robertson & Simmons 2013.

3.2.3. Findings of the studies

The findings of the 28 research studies included in this meta-synthesis can be summarized as follows.

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1. Many students with autism have multisensory issues with auditory and visual difficulties. These sensory issues can be broken up into three major groups, hyper responsive, hypo responsive and sensory seeking. Students experiencing visual or auditory difficulties may appear to be inattentive to class or distracted.
2. There is no one cause for autism, nor is there one intervention that will fix the issues of every autistic child. Weighted vests may work for one child but not another. Noise reducing headphones may help some students but not others.
3. Many students with autism exhibit social difficulties due to their processing issues. For example, a student who is suffering from too much light in the classroom may develop behaviors such as covering their eyes. This is not helpful in a social situation where people want you to look at them. Additionally, students experiencing sensory difficulties may have a lack of a social filter. That means they say the first thing that pops into their head. This thought is often not on topic and inhibits those with autism from making and keeping friends due to their random remarks. The over focused attention may also inhibit social situations with students developing a very narrow amount of interests and activities making friends and keeping them difficult.
4. Students with autism struggle to complete daily living tasks. Those students who experienced hyper sensitivity have both good and bad sides to it. The good thing about hyper sensitivity is that it can help those with autism attend to as task these students are often very good at math, science and computers. On the bad side of the equation hyper sensitivity can interfere with how students adapt and change in their world. For example,

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students benefit from a set schedule when the schedule changes students may melt down getting upset that it is not the normal order for the day.

5. The final issue that students have is that when they have sensory processing issues students tend to have a lot of anxiety. This anxiety can lead to skin picking, avoidance of activities that places students in socially uncomfortable situations and more.
6. Finally, the last implication for students with sensory processing issues is self-injurious behavior. This includes head banging, digging at skin, biting oneself, and other injurious behaviors. This may be linked to the amount of anxiety students are struggling with, lack of language and social anxiety.

3.3. Emergent themes

Five themes emerged from my analysis of the 40 articles and one book included in this meta synthesis. These emergent themes, or theme clusters, include: (a) sensory processing dysfunction types, (b) social communication issues, (c) impact on daily living, (d) self-injurious behaviors and (e) anxiety from sensory processing issues. These five theme clusters and their formulated meanings are shown in Table 3.

Table 3

Theme Clusters	Formulated meanings
<p>Sensory processing dysfunction</p> <ul style="list-style-type: none"> ● Under responsiveness/ hypo responsive ● Over responsiveness/ hyper responsive ● Sensory seeking 	<ul style="list-style-type: none"> ● Most students in research showed signs of sensory processing disorders or issues. ● There are three sensory subtypes; sensory based inattentive seeking, sensory modulation with movement sensitivity and sensory modulation with taste/smell sensitivity. ● The findings show that students suffered from visual and auditory issues. The symptoms of the auditory and visual stimulation may make students appear to be distracted or inattentive. ● The group of students referred to as high functioning autism have more restrictive behaviors, sensory processing issues and issues with executive functioning (attention control, working memory, problem solving, cognitive flexibility (ability to switch between two different concepts or ideas and to think about multiple things simultaneously). ● Executive function skills are really important to the classroom setting and to life. ● There is a relationship between neural indices (neural index or having to do with the neurological system of the body and the

	<p>way things travel in the brain) of early auditory and visual processing.</p> <ul style="list-style-type: none">● For Students identified as having autism, sensory processing issues did not have an effect on their performance on cognitive tasks.● Autistic students are likely to experience sensory processing difficulties throughout childhood.● Our students with high functioning autism have a low neurological threshold (this means that the amount of stimuli required for a neuron to respond. If the nervous system responds quickly to the sensory stimuli we say it is a low neurological threshold. If it responds slowly to the sensory stimuli we say it is a high neurological threshold.)● Students with a low neurological threshold will try to keep themselves from being overstimulated. Some examples are using a weighted blanket or vest, using a Thera putty or playdoh, a fidget or another calming activity. This is consistent with hyper arousal (reduced pain tolerance, anxiety, insomnia, exaggerated responses and fatigue.● Sensation seekers have high neurological thresholds and look for extra stimulation. Examples may be a hooki stool that allows them to move, flicking something back and forth in front of their eyes and wiggle seats.● Studies have linked a genetic link from autism to atypical sensory processing.● Non-affected siblings of children with autism showed less sensory seeking behaviors that typical non-affected peers. However, siblings of students with autism do experience sensory processing difficulties.
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	<ul style="list-style-type: none"> ● There is a positive correlation between the number of autistic traits a person has and frequency of atypical responses to sensory stimuli.
<p>Social Communication difficulties</p>	<ul style="list-style-type: none"> ● Students with autism are at a disadvantage when it comes to dealing with social situations because they become uncomfortable with people they are unfamiliar with. ● Students with autism suffer from over focused attention that can be counterproductive (to stop someone from achieving goals) during social interactions. It may also have students develop a narrow interest in activities. For example, a student may only want to talk about a certain book or video game not understanding it is of no interest to their audience. ● There is a moderate to strong correlation between a child's typical sensory responsiveness and social impairment for typically developing children and children with high functioning autism. These atypical responses to multisensory, touch and oral sensory smell stimuli were identified as possible predictors of social severity. In other words, the more sensory issues the student has the harder it is for them to be socially acceptable. ● Children with autism show delays in responding to their names being called and other attention getting strategies. This effects both daily living and social skills. ● The characteristics of autism that include ridged behaviors (inability to change schedules, inflexibility) and limited social interactions and engagement may be related to autonomic (internal stimuli, spontaneous) and behavioral flexibility.

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	<ul style="list-style-type: none"> ● Hypo responsiveness is positively associated with social communication symptom severity among both groups typically developing children and autistic children. ● Hyper responsiveness is not significantly associated with social communication severity. ● Hypo responsiveness is negatively associated with language skills, and social adaptiveness in both the typical and autistic children. ● Sensory seeking was also negatively associated with language skills in both groups. ● High risk infants (an infant with a greater than average chance of having health issues due to conditions that may interfere with the birth process, also may be considered low socio economic status, poor care while pregnant or immediately after birth) with poor sensory processing skills may be due to poor emotional regulation and may later be diagnosed as having autism.
<p>Impact on daily living</p>	<ul style="list-style-type: none"> ● Auditory filtering (inability to process what was said because of a break down between the ears and the brain) Students with auditory filtering issues may appear to be distracted or not paying attention. This condition is sometimes called a central auditory processing disorder or auditory processing disorder. ● Children with autism show delays in responding to their names being called and other attention getting strategies. This effects both daily living and social skills. ● The high functioning autism group had more restrictive behaviors, sensory processing issues and issues with executive functioning. This means a change in a

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	<p>daily schedule can mess up the student's entire day. For example: The bus was late and the student falls apart, becomes irrational that she will have to walk to school and miss breakfast. When the bus arrives she is able to get on board and it's like nothing ever happened.</p> <ul style="list-style-type: none"> ● Students with autism and students with ADHD (attention deficit hyperactive disorder) experience more sensory processing difficulties than their typical peers. ● Students with autism are more likely to experience sensory processing difficulties over their childhood whereas students with ADHD are more likely to experience sensory processing in auditory as other sensory areas over time. This does not mean that a student with autism will one day wake up and have no more sensory issues. Additionally, there are students with both autism and ADHD that may experience sensory difficulties across all periods of life.
<p>Self-injurious behaviors</p>	<ul style="list-style-type: none"> ● Many of the students' survey said they had self-injurious behaviors in the last three months. ● Children with lower IQ were more likely to commit self-injurious behaviors than typical peers. ● Those children who were most resistant to change were likely to engage in self injurious behaviors. ● Anxiety may be a contributing factor to self-injurious behaviors as injurious behaviors may offset those feelings from resistance or change or insistence on sameness. ● There is a group within the autistic group that may be unresponsive to pain sensation

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	and cause themselves self-injury by engaging in repetitive behaviors such as head banging, biting themselves, picking their skin and hitting their hands repeatedly on walls and desks.
Anxiety	<ul style="list-style-type: none"> ● Self-injury may be a reaction from the anxiety due to having a schedule change or wanting things to be kept the same. ● Behaviors due to anxiety may include holding hands over ears to avoid or filter out noises, rubbing at skin after being touched, covering eyes to block out light or to look away from situations. ● The most important path was from intolerance of uncertainty (worry that an event may happen that can cause stress and that the event is unavoidable) and anxiety to insistence on sameness. ● Strong association between sensory over responsiveness and anxiety. Many of these students also have gastrointestinal issues.

4. Discussion

In this section I have summarized the emergent themes from my analysis of the 40 articles and one book included in this meta-synthesis. These emergent themes were then connected to my own practices as a special education teacher.

4.1. Sensory processing dysfunction types and symptoms

According to the research, there are three main types of sensory processing dysfunction. They are under responsiveness, over responsiveness and sensory seeking. Those children who are under responsive may move very little, not respond to their name being called seem to be in their own little world. Those that are over responsive are very sensitive to input, things smell too

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much, lights are too bright, their clothes are too itchy. Those that are sensory seeking may crave loud noises, deep pressure, they may rock, twirl or bounce off things. Research also alludes to subgroups of these three main groups. They include sensory based inattentive seeking, sensory modulation with movement sensitivity and sensory modulation with taste/smell sensitivity.

These groups all effect how an autistic person looks at and views the world. For instance, going into a grocery store may effect multiple autistic people in different ways. The smells may be overwhelming for one while the lights are completely upsetting to another and yet another may just find the amount of people and the fact that they have to do so much walking frustrating.

Visual and auditory issues also are a part of sensory issues. One auditory issue I have experienced in my room a lot is called Central Auditory Processing Disorder students who experience this cannot understand what they are hearing not because they don't know the words being spoken, but because something is hindering the meaning as it reaches the brain. This does not mean the student is not listening even though they may appear distracted or inattentive.

Research mentions that there are lot of accommodations that can be done in the classroom before the students walk in. In my practice, the daily schedule on the board as well as schedules on individual students' desks to help them understand what is coming next. The lights can be dimmed. In my classroom there are not three sets of lights on only one, which is bright enough to see, but not so bright that students need to cover their eyes. Research shows mixed reviews of Hokki stools, weighted blankets and vests, color coded cubbies, and sensory break items needing to be available. In my experience, during some more difficult parts of the day it may be helpful for students to listen to music they find relaxing or smell a lotion or chap stick. I

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have learned that the most important thing is to keep trying new things if you haven't found something that works yet.

4.2. Social Communication Difficulties

Research shows that for students with autism there is such an uphill battle for them when it comes to social communication. For one the pragmatic skills (the rules for social communication) in students with autism are fairly low. This may mean students who have autism say inappropriate things without thinking such as: "Do you smell hotdogs?" to the principal when they are explaining a safety drill and asks if there are any questions. They may not continue a conversation once they have said their part they change topics or walk away. I have seen sometimes students with autism may get stuck on a topic and only want to talk about that, not realizing the communication partner has little interest or wants to talk about something else. Research shows students with autism may not respond when their name is called which then leaves them out of social communication unless someone makes the effort to get them involved. I have noticed many of my students struggle as they get older to keep and maintain friends because of the narrow interests they have. Research references some students with autism have limited or no communication skills this makes simple things like asking for food difficult and may cause frustration or outbursts.

Research reflects that for teachers with autistic children it is very important that social skills lessons are a part of the curriculum. Students need to learn to look for facial clues that someone may be upset with them. Students also need practice communicating and taking turns with various communication partners. In my school when students are upset and not wanting to talk teachers need to understand that is ok and talking at a later time is appropriate while the

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student tries to work through the feelings they are having. Our department head and psychologists help teachers learn there are many books and curriculums to help students with autism to learn to communicate. Research supports that teachers need to make social communication a priority over reading writing and math, because it's the one thing students will need the most as an adult. As an adult a student with autism may not need to know algebra, but they need to know how to talk and get along with various types of people that don't have the same interests as them.

4.3. Impact on daily living

According to the research, students with autism have impacts on their daily living. One example is students with auditory processing issues. These students may not hear their name being called which may put them in danger. Crossing the street, they may not look both ways.

In addition, these students may have issues with executive functioning skills, which are the skills that enable people to plan, organize and carry out task completion. According to numerous sources executive functioning skills are important. While the list of executive skills is from research the examples are things that have happened in my family or classroom.

The first problem that may happen with a child that has an executive functioning issues is impulse control. That means I see it I want it I'm going to do it without any regard for the consequences. That's the child that climbs up the counter to get the cookies off the fridge, no fear of falling, just wants cookies no matter that mom said no.

The second executive functioning skill is emotional control. This is the kid that becomes irrational when something goes out of schedule or not the way they expected. The bus is late and

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suddenly the student is screaming they have no way to school and if they don't get to school then they can't have breakfast, then they will have to walk and they will be late for morning meeting.

The third executive skill is to be flexible. These kids dread fire drills they are constantly worried about one messing up their day. They cannot adjust to a change in schedule.

Another executive skill is working memory. They can't remember the directions to the assignment even though you just finished explaining it.

Next is self-monitoring. These students think they did great on the math test and are shocked when it comes back as not an A. They really struggle with negative feedback which may also cause a poor impulse control situation.

The next part is planning and prioritizing. These kids struggle to set goals and complete things in order. They don't know if it's more important to study for the spelling test tomorrow or work on the science project due a month from now.

A follow up on that is task initiation. These kids don't know how to buckle down and get started. They don't know where to begin or how to start so they sit there and do nothing.

The final skill is organization. This is the desk with papers hanging out, they can't find their homework, pencil or sometimes even backpack. Someone stole their pencil because they can't find it.

Research shares that it is very important for parents and teachers to teach explicitly these executive functioning skills. Especially how to cope with impulsivity, flexibility and emotional control. Without these skills it will be nearly impossible for students to survive middle and high school without major behavior issues. In my experience, students with autism are going to need more than one lesson on how not to be impulsive and they are going to need it in many different

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mediums. For example, one day you might watch a video and talk about it the next we might write about it then might review the video again and then sing or listen to a song. One way I have learned to help students with organization is to teach them to set up their binders' color coded, homework is one tab red for instance, science is green so that everything has a place. I Research and my experience supports that teachers may need to remind students everyday where things go. A student that just crams everything in their desk is not going to be successful when they are older because it's hard to find things just shoved places. Teachers also need to remember these skills are not learned overnight they take time, patience and lots of practice.

4.4. Self-injurious behavior

Many students surveyed in the research said they had episodes of self-injurious behavior in the last few months. This behavior can be mild such as picking at skin or it can be severe such as the child banging their head on hard items. There is a range between as well from biting oneself, hitting oneself in the head, and smacking one's cheeks. Students with lower IQ's are more likely to engage in self-injurious behaviors, but high IQ students may do it as well according to multiple sources. In my experience as well as well supported by research, students with limited communication skills may engage in these behaviors to express frustration. One of the biggest factors in self-injurious behavior according to the reading is resistance to change. Students who are extremely rigid and like their set schedule everything planned out so there is no uncertainty are most likely to use self-injurious behaviors. Some of these children may do it for the input they get from hitting their head and others may do it because they do not feel pain many times teachers will not be able to determine the cause of the self-injurious behaviors in students with limited communication according to the examination of articles. Yet others may do

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it because it's the only thing they can control. The schedule changed and they can't fix that, but they can hit their head.

In my experience, for teachers with autistic students' self-injurious behavior is probably the scariest thing you will deal with. The first time a student hits their head and you don't know why you may freeze and not know what to do. For students who frequently engage in the behavior I have learned it is sometimes helpful to keep a pillow nearby. If you have a head banger you get very used to pushing a pillow between them and the desk. The articles I read had no solutions for head banging or any self-injurious behaviors. This is what I've learned through my dealings, nothing is scientifically proven it is what worked for one student. The student would bang his head when it was time to do work, transition to another activity or room if it was non-preferred (not his favorite), also if he was denied use of the computer. During work time he would kick students and teachers who came close. He was also pushing the backs of his shoes down and walking on them. At multiple points in the year he would run down the hallway and try to steal teachers' laptops. (I fixed that by putting him in slippers, he would run, lose the shoe and stop to pick it up allowing staff to catch him. This also stopped the kicking). The student had no verbal skills but used an iPad to communicate. When the student was going to be transitioned to a new activity he was given a timer, the staff would say you have two minutes. At the one-minute mark the announcement one more minute was made. When the timer went off staff would take students compression vest to him and say, "time to clean up." My student on a good day would put on the vest and begin cleaning up. Then student would walk a lap around the room on the way to his desk. Staff learned more than one lap met he was looking for somewhere to bang his head. There were pillows stashed at various points in the room, one went

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to lunch and recess with staff as well as all specials. The team may never know the exact reason the student needed to hit his head, but we could just do our best to make him safe and help him calm down. Some days all he needed was a pillow, others it was music or a walk. I have learned to try everything and if something doesn't work try something else and ask someone for help.

4.5. Anxiety

Research supports that for many students with autism anxiety is both a major part of their life as well as a huge obstacle in their way of success. Anxiety can lead to self-injurious behaviors such as picking skin, pinching oneself, biting oneself (both nails and arms), and even head banging. The most common reasons for anxiety in autistic students that we know of are insistence on sameness (this is my schedule always and it can't change) and intolerance of uncertainty (this student is constantly worrying that things will happen that they can't control). School drills, substitute teachers and changes in schedule make these students very upset.

In my experience, teachers with students with anxiety, whether with autism or without we need to remember to take deep breaths. When a student sees you taking deep breaths and remaining calm it will help them to calm down too. Students at the elementary level call this belly breathing. Another thing that may help is offering students that you see struggling a break to go to the safe place (area where only one student can be with a pillow, fidgets and a variety of calming books. Students with autism have a lot of anxiety from all sorts of sources and we may not notice even half of them. When students see you modeling how to handle your anxiety correctly and talking it out what you are doing that is a great thing for them to watch them see.

5. Conclusion

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The findings of this meta-synthesis highlight the complications of issues influencing students with multisensory issues and autism. Students battle all sorts of sensory issues including social communication, impacts on their daily lives, self-injurious behaviors and anxiety. There is not one answer that is going to help every student with autism because they are all unique different people. This is super frustrating when you are a teacher because there's not a button to push to fix it. We do know that based on the research students with autism benefit from modeling and repetition. These things need to be used to help ease anxiety and learn missing executive function skills. The research did not show me what I wanted to see. I was hoping for an answer something I had missed for my autistic students. What it did remind me is that all autistic students are different. What works for one will not work for another.

Another thing that the research does show is that there needs to be more research in the area of autism and interventions for handling sensory issues. The research focused on what sensory difficulties there were, but not on interventions to fix them. That is frustrating for not only special education teachers, but parents as well. Most of the intervention techniques are things I have experimented with my own students.

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