# Autism - The Sensory Piece

Marta Weis

Lynchburg College

# Autism – The Sensory Piece

Imagine what it might feel like to bring your child to the doctor because there is something not quite right. He does not cuddle or look towards my voice but he is a good boy that rarely cries or makes a fuss. He does not seem to notice when there is a loud noise or respond the way other children do. The parent wants to know but fears what the diagnosis might be. The scenario of parents visiting a doctor describing patterns of unusual behaviors could be the beginning of a lifetime of challenges.

Frequently there is national media coverage about the increased numbers of individuals diagnosed with Autism Spectrum Disorder (ASD) and the dilemma of how to provide educational programs for these unique individuals. Within the umbrella term of ASD, there are individuals that sit in the corner rocking back and forth flapping their hands in front of their faces while emitting repetitive guttural moans, as well as, gifted individuals that exhibit robot like actions and overwhelming anxiety about common everyday events. What are the common characteristics diagnostic elements needed for the diagnosis of ASD? What is causing the increasing cased of ASD? What causes the distinctive behaviors and could there be contributing sensory processing factors?

Concerned parents describe unusual over-responsive or under-responsive behaviors when they first seek medical opinions about why their children act the way they do. They could mention a child that will stiffen up when being held, cry when they bathe or change them and yet rarely cry any other time (Baranek, Parham, & Bodfish, 2005). Some parents might worry that their child does not respond to their voice but will

seem to be interested to the noise of a fan. The diagnosis of autism depends on observable behaviors that are first referenced by over or under responses to stimuli in the natural environment that does not match typically developing children. Not all individuals with unusual responses to environmental stimuli are diagnosed with autism; however, many of the behavioral red flags are described as sensory-based discrepancies.

The first part of this paper will describe diagnostic characteristics of and the prevalence rates for autism. The second will outline sensory processing terminology and descriptions. The third part of this paper will describe research studies focusing on what if any links there are between ASD and sensory processing problems. The last part of this paper will discuss implications for educators and why understanding how sensory processing difficulties influence the behaviors of individuals with ASD.

## ASD Diagnostic Conditions

Autism Spectrum Disorders (ASD) is the umbrella term used by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) for five Pervasive Developmental Disorders (PDDs) (Brown & Percy, 2007). Individuals with ASD are from all ethnic, racial, and socioeconomic groups and are four to five times more likely to be males (CDC).

The diagnostic criteria for autism has evolved since Leo Kanner first described individuals with fundamental behaviors so uniquely distinctive they did not belong in another category (Ben-Sasson, 2009). The diagnosis of autism involves impairments in

three general areas of behavior. The individual would lack the interest in seeking attention of others or have skills to engage and then respond to social interaction or social reciprocity. The individual would have impairments in verbal and non-verbal communication. They could be slow learning to talk or echo word phrases without communication intent or not understanding how to use words for communication. The individual would engage in repetitive, ritualistic, or obsessive interests in items or activities.

This triad of behavior abnormalities occurs and is pervasive in all environments. The diagnostic criteria for autism require qualitative impairments in social and communication as well as repetitive or restrictive behavior patterns observed in individuals before the age of three. The diagnosis requires displaying a total of six or more atypical behaviors with specific numbers from social, communication, and repetitive. At least two would be from the social patterns and one each from communication and REPATIVE areas. The diagnosis also requires that the behaviors not be because of Rett's Disorder and Childhood Disintegrative Disorder or other disorders are not factors. The diagnostic procedure could include administering the Autism Diagnostic Observation Schedule (ADOS), which is a partially structured observation of social, and communication patterns and other testing procedures (Ben-Sasson, Hen, Fluss, Cermak, Engel-Yeger, 2008).

The Center for Disease Control (CDC) and National Institutes of Health (NIH) have noted the increased incidents of ASD and research teams are studying the upward

trend. Gurney, Fritz, Ness, Sievers, Newschaffer, and Shapiro (2003) tacked documented cases of ASD from 1982 through 2002 in Minnesota and found that the number of documented cases in the state virtually stayed the same from 1982 to 1992, with three per 10,000 and spiked to 52 per 10,000 in 2001-2002 and this upward trend is expected to continue. Currently the CDC web site posts the incidence rate averaged at 1 in 110 in the United States (Centers for Disease Control and Prevention, 2011).

Gurney et al. (2003) considered the hypothesis that individual's with ASD were always present but were included in the statistics of other diagnosis but did not find the corresponding drop in other categories. The authors in this study theorized that single year rates in stable populations should stay the same and looked at the ASD rates in second graders in 1992 to compare to second graders in second grade in 1996 and found the higher rates. Their pattern shows the rate increasing for each successive birth group. Gurney et al. concluded that the fluctuating procedures and requirements for labeling disabilities have changed over time. They also cite federal and state policies and laws designed for improved identification and data reporting as contributing factors in the increased cases of ASD. The authors pointed out that though diagnostic procedures, policies, and reporting all contributed to the increased ASD incidence in this study the factors may not account for the increase and that further studies were needed.

## Sensory Processing Characteristics

Sensory processing refers to the neurologically based task of interpreting environmental information and synthesizing the information into a usable form of the

information (Sweet, 2010). Individuals are continuously bombarded with information from the environment that affects the way we act or react to stimulus from smells, tastes, sight, sounds, and touch though the way individuals react to each event is dependent on their processing thresholds. Sensory processing involves noticing the stimulus, integrating the information, planning the response, and then consciously reacting or not reacting to the event (Dunn, 2007). One example would be if someone hears a bird chirp, thinks that there must be a bird in the area, and then orients their head in the direction of the noise. Another example would be if someone that does not like dogs, hears the bark or growl of a dog, thinks that they must stay away, and then breaks out in a sweat. Individuals with high neurological thresholds are slower in activating the cell's response to the stimulus and an individual with a low neurological threshold activate the cell's response very quickly; however, thresholds are on a continuum and can vary over stimulus and time (Reynolds & Lane, 2007).

Though everyone reacts to stimuli differently, every individual utilizes a self-regulation strategy when faced with sensory stimuli. Dunn (2007) concluded there were:

> four patterns of self-regulation behaviors associated with sensory thresholds. The four patterns that resulted are (a) sensory seeking, which represents high thresholds and active self-regulation strategy; (b) sensation avoiding, which includes the low threshold and active self-regulation strategy; (c) sensory sensitivity, which includes low thresholds and a passive self-regulation strategy;

and (d) low registration, which represents a high threshold and a passive self-regulation strategy ( p. 85).

Examples of the sensory processing types include the tactile sensation-seeking individuals that actively look for sensory sensations and might touch themselves or objects in their environment. The second example includes the auditory sensation-seeking individuals that will make noise themselves or thrive in noisy situations. The third example is the sensory avoiding individual that will have difficulties in a crowded room with noisy people and might avoid that situation. The fourth example is the sensory sensitivity individual that appears not to notice most stimuli although their behavior could be because they notice everything so as a self-protective measure they shutdown (Dunn, 2007). The body's sensory processing includes more than just the processing of input from the five senses. The body's vestibular sense help regulate, movement, balance, and coordination. The body's proprioceptive sense helps with the tactile and vestibular process to help with body awareness. Interpreting all of the neurological information from the senses involves praxis or motor planning to execute the reaction (Dunn, 2007).

The umbrella term, sensory modulation dysfunction (SMD), is currently being used to include both over- and under-responsivity, along with fluctuating or overlapping responsivity (Reynolds & Lane, 2008). Vulnerable individuals often have compromised neurological systems and have noticeable difficulties self-regulating their behavioral responses towards stimulus. Studies of individuals with various disabilities have noted

significantly different sensory processing patterns and linked some patterns to specific disabilities (Dunn, 2007).

## ASD and the Sensory Connection

Sensory abnormalities were part of the diagnostic criteria for autism in DSM-3rd Edition but were dropped in the later definitions most likely due to the difficulties with the subjective nature of behavioral descriptions (O'Brien, Tsermentseli, Cummins, Happe', Heaton, and Spencer, 2009). Sensory abnormalities are not currently part of the diagnostic criteria included in DSM-IV however; researchers are using standardized sensory profiles to substantiate the anecdotal accounts.

Provost, Crowe, Acree, Osbourn, and McClain (2009) compared the behaviors of preschool children with and without ASD using the Sensory Profile Caregiver Questionnaire (SP). The study included 25 children between the ages of 3 and 5 with a clinical diagnosis of autism and 25 typically developing children of matched ages.

The SP consists of 125 caregiver questions based of a five-point scale. There are questions in three areas, Sensory Processing, Modulation, and Behavioral and Emotional Responses. These areas are divided into 14 sections that reflect the children's reactions towards specific types of sensory input, their modulation of input and their behavioral and emotional reaction. The SP items are further categorized by nine analyzing factors that indicate relevant information on the child's responsivity towards environmental stimuli. The information is then analyzed to indicate a sensory quadrant score suggesting

behavioral patterns. The quadrants are Low Registration, Sensory Seeking, Sensory Sensitivity, and Sensory Avoiding.

Provost et al. (2009) showed significant differences between the sensory responses of the children with ASD when compared to their age, gender, and ethnically matched pair in all sections, all quadrants, and most of the factors (Provost et al., 2009). In all sections, the children with ASD fell into the Definite Difference classification indicating sensory processing, modulation, behavioral and emotional difficulties. The sections with the highest reported differences were Behavioral Outcomes of Sensory Processing (74%), Modulation of Sensory Input Affecting Emotional Responses (72%), and Touch Processing (64%) Vestibular Processing (60%), Multisensory Processing (60%), Oral Sensory Processing (56%), Auditory Processing (48%), and Modulation Related to Body Position and Movement. This study concluded that there were significant processing differences in young children with ASD when compared to a matched group of typically developing children, which collaborates previous studies (Provost et al., 2009).

The study by Provost et al. (2009) established a pattern of sensory processing differences but the question remains how do the differences manifest in the observable behaviors? Lane, Young, Baker and Angley (2010) conducted a study of 54 children with ASD looking for specific patterns of sensory processing with regards towards adaptive behavior. The participants' caregivers completed the Short Sensory Profile, the groups mean age was 97 months, and 47 were males. The author's goals were to look

describe the SP patterns and to look at the relationship between the patterns and the participants adaptive behaviors then compared the information to other studies.

Lane et al. (2010) did find specific patterns of SP in groups of children with ASD and the study revealed definite characteristics. They found that the children had definite differences in the Under-responsiveness/Seeks Sensation and the Auditory Filtering domains and the cluster analysis indicated three distinct subtypes of children with ASD (Lane et al., 2010). The Cluster 1 group had mild observable difficulties in the Under-responsiveness/Seeks Sensation that had appeared like inattentiveness, distractibility, over-focusing on details, and impulsivity. The Cluster 2 group had movement and modulation sensory difficulties across all domains with scores more than one standard deviation from the norms and appeared to have poor grasp, low muscle tone, and tires easily. The Cluster 3 group had sensory modulation difficulties with smell/taste but not the movement related area. They reported a significant foretelling correlation between AP abnormalities and maladaptive behaviors with the difference in the maladaptive behavior described by the SP purpose by over 50%. This finding correlates with Ahearn, Clark, and MacDonald's (2007) study that looked at the function and treatment of vocal stereotypy in children with ASD in that some individuals make grunt or yell just to provide the sensory in-put of noise or vibrating vocal chords and not as a form of communication and because of this, many modifying treatments are difficult.

In another recent study, Ben-Sasson, Cermak, Orsmond, Tager-Flusberg, Kadlec, and Carter (2008) examined the sensory cluster differences in 170 toddlers with a mean

age of 28 months and a clinical diagnosis of autism. The authors theorized that studying the sensory patterns of sensory behaviors in early development of children with autism is important because they studies establish the beneficial link to sensory integration based interventions in early intervention programs. Using the parent rating of the Infant and Toddler Sensory Profile (ITSP), the toddlers were rated with the under-responsivity, over-responsivity, and seeking scales and their emotional behaviors were rated with the Infant and Toddler Social Emotional Assessment (ITSEA). The ITSP determined the three basic sensory modulation characteristics are under-responsivity, which describes a lack of, or slow response to stimuli, over-responsivity that describes quick excessive reactions to stimuli, and the seeking that describes an intense prolonged interest in sensory experiences.

Ben-Sasson et al. (2008) noted that the Interdisciplinary Council on Developmental and Learning Disabilities (ICDL), though not yet validated, uses a different model by establishing a dimensional link to the sensory modulation. The ICDL links under-responsiveness with self-absorption, over-responsiveness with stubbornness or being fearful, and seeking with an over-active state. Additionally, the toddlers were rated with the Autism Diagnostic Interview-Revised (ADI-R) which focuses on the three areas of Communication, Social Interaction, and Restrictive, Repetitive, and Stereotyped Behaviors. Another diagnostic measurement was the Autism Diagnostic Observation Schedule-Generic (ADOS-G) which is considered the gold standard of autism diagnosis. The study compared the sensory profiles with the findings of the two autism

measurements, as well as, The Mullen Scales of Early Learning (MSEL). The group's affective symptoms showed a 61% depression/withdrawal rate across clusters, a 30% negative emotionality rate, a 14% separation distress rate, and a 18% inhibition to novelty rate with 5% showing anxiety rates in the top 10th percentile of the ITSEA cutoffs. Ben-Sasson et al. stated, "differences in the severity of ASD symptoms may have partially contributed to the higher presentation of anxiety in the high frequency verses low frequency cluster" (p. 821).

Ben-Sasson et al. (2008) concluded (1) rates of extreme sensory over-responsivity

> behaviors differentiated clusters more than under-responsivity, (2) children in clusters with high under- and over-responsivity evidenced more negative emotions, anxiety, and depressive symptoms than children with lower under- and over-responsivity, and (3) sensory and affective differences between clusters were not due to ASD severity (p. 822).

The authors summarized the implications for this study highlighted the need for sensory assessments as part of the initial diagnostic process for young children suspected of having ASD because sensory anomalies impact the ways children engage and learn. They suggested that individuals with over-responsiveness, mixed, or high frequency clusters may benefit from a sensory-based intervention and concluded with the need to

further study the effects of early intervention programs that include a sensory component (Ben-Sasson et al.'s, 2008).

Many young children with ASD enter general early intervention programs without a specific label, often because of the medical professions wait and see attitude. They know something is wrong but are reluctant to attach a label. This delay in identification has been shortened with the increased knowledge of ASD within the medical community and the expanding research on the benefits of early intervention programs. Are there noticeable sensory processing differences between children with ASD and other disabilities in these programs serving children with mixed disabilities?

O'Brien et al. (2009) compared 34 children with ASD, 22 children with learn difficulties, and 32 children with typical development using an adapted version of the Short Sensory Profile (SSP). This study found that there was higher level of sensory impairments with the two clinical groups when compared to the typically developing controlled group and the group with ASD showed the highest level of impairments in the areas of auditory hypersensitivity and visual stimulus seeking behaviors.

This study pointed out that the SSP did not distinguish between separate responses towards modalities in terms of hyper-sensitivities and that the distinct findings of children with ASD in the area of auditory hyper-sensitivity could be an important indicator in differentiating between typically developing children and children with ASD in the primary school age group. The authors also suggested that more research is needed to distinguish if there is a relationship between visual processing and stimulus-seeking

behaviors. They noted that it is not clear why children with ASD engage in some repetitive actions. Do some individuals hand-flap in front of their eyes because they have a hypo or hyperactive need for visual stimulus (O'Brien et al., 2009).

Wiggins, Robins, Bakeman, and Adamson (2009) looked for sensory processing differences in 34 children with developmental delays (DD) and ASD at their first initial clinical assessment using ADOS, SSP, and The Battelle Developmental Inventory. Wiggins et al. concluded, "the children with ASD displayed more abnormal responses to sensory input than children with DD, especially in the areas of tactile sensitivity, auditory filtering, and taste/smell sensitivity" (p. 1090). The authors noted an interesting relationship linking the SSP and the ADOS behavior and stereotyped interest scores but not the communication and social scores, which replicated other studies. This correlation between dysfunctional areas point towards a co-occurrence of sensory dysfunction and behaviors with stereotyped interests while other researchers believe that reduced sensory processing is the center feature of ASD that are observed as behaviors and stereotyped interests with communication and social impairments (Wiggins et al., 2009).

The research has established the likelihood of pre-school children with ASD having difficulties with sensory processing but do the difficulties continue. Ben-Sasson, et al.'s (2008) study assembled a meta-analysis of 14 studies that looked at sensory function of children with ASD. They found noteworthy differences in the presence/frequency of sensory processing anomalies of the children with ASD when compared to the control groups. Ben-Sasson et al. stated, "differences between ASD's

and typical groups were greatest for under-responsivity, followed by over-responsivity, and seeking" (p. 8). Ben-Sasson et al. (2008) further mentioned that the inconsistency of the findings were reduced when each study's participant groups were matched by the severity of the autistic symptoms, age, and kind of the control groups included. They cited problems with studies moderating factors that lead to inconsistent results although they found that the sensory differences were highest in the 6-9 year old. The authors concluded that this meta-analysis just highlighted the need for sensory studies of adolescents and adults for comparison.

Minshew and Hobson (2008) conducted a study that focused on the sensory function in higher functioning adolescents and adults with ASD. Minshew and Hobson (2008) hypothesized that because the individuals with ASD were verbal the results of the study was more accurate because the information was not dependant second hand interpretation of behaviors. They conducted a study of 60 individuals with high functioning ASD with a mean age of 17 years and well matched control group o 61 individuals with a mean age of 19 years and an age range between 8 and 54. Both groups had full-scale IQ scores of 90 or above.

All the individuals with autism had a clinical diagnosis of ASD. They agreed to participate in the study and the data was collected over a four-year period. The control group comprised of neurotypical community volunteers that were also matched by socioeconomic levels. The individuals with ASD and their parents independently completed a Sensory Sensitivity Questionnaire that comprised of thirteen yes and no

questions in four domains of probable sensory modulation areas for individuals with ASD. The areas were low and high temperatures, low and high pain tolerance, tactile, and overall sensory sensitivities that covered light, sounds, odors and tastes, and crowded places. The participants also completed the Luria-Nebraska Neuropsychological Battery Tactile Functions to assess tactile sensations and the Reitan-Klove (RK) Sensory Perceptual Examination to assess tactile perceptual deficits (Minshew & Hobson, 2008).

Minshew and Hobson (2008) stated that of the individuals with ASD completing the self-reports, 32% had sensitivity issues, were from all age groups, and IQ levels. Thirty percent of individuals with ASD showed evidence linked to impairments of complex sensory processing in the cortex. The study also indicated that the data did not support the idea that individuals with ASD are super-sensitive to sensory stimuli but theorized because of the documented pattern of higher cortical impairments but not elementary processing that it might be because of a processing lag time in evaluating stimuli (Minshew & Hobson, 2008). They also speculated that maybe they just did not ask the right kind of questions and suggested further studies using more sensitive neuropsychological testing is needed(Minshew & Hobson, 2008).

## Discussion

This paper has reviewed studies involving sensory processing with individuals with ASD. Though they all indicated links between ASD and abnormal sensory processing behaviors, however, Baranek, Parham, and Bodfish (2005) mention a need for more studies designed to investigate first the incident of motor and sensory characteristics

in autism and then how these characteristics influence the core deficit areas of communication and social interactions. For example, why do children on the spectrum lack the interest in their mother's face or other people and fixate on the things around them. If the children do not show an interest in people, how will they learn new skills and communicate their needs? Infants and toddlers with ASD have a great disadvantage because they appear to lack the prolonged interest in the information their caregivers have to share and humans are dependent on learning skills through mimicking others. Researchers continue to hypothesize what factors contribute to the dysfunction of reciprocal social exchanges and question the possibility that abnormal neurological processing of sensory stimuli are one of the contributing factors. Although future research could answer these questions, there are implications of the association between ASD and sensory processing difficulties for the special education teacher.

## Conclusion

There is overwhelming evidence that the increase in the children diagnosed with ASD will continue because of this it is likely that special education teachers will be writing individual education plans (IEP) for students with ASD. Additionally, there is growing evidence that Sensory Processing Dysfunctions are associated with many individuals with ASD; therefore, the IEP goals and accommodations will need to address the individual's sensory processing difficulties. The implications for special education teachers would be that by understanding how sensory processing difficulties manifest in behavior patterns they can be better teachers for their students with ASD. The teacher's

ability to identify these unusual reactions to environmental stimuli would help plan appropriate intervention strategies based on the individual's sensory strengths and weaknesses in motor planning and modulation areas. Teaching simple strategies the individual could use to modify and cope with their unusual reactions to stimuli would be a behavior management technique for the classroom, as well as, a pattern for a life-skill the individual could use in their future. The interventions would target skill building, teaching compensatory strategies, and providing the opportunities to generalize the skills with the goals of enhancing the individual's ability to enjoy and engage in a meaningful life in their community and social activities.

References

Ahearn, W. H., Clark, K. M., MacDonald, R. P., & Chung, B. I. (2007). Helping children with sensory processing disorders: The role of occupational therapy. *Journal of Applied Behavior Analysis*, 40, 263-275.

Baranek, G. T. (2005). Sensory and motor features in autism: Assessment and intervention. In P. R. Volkmar, (Ed.), *Handbook of autism and pervasive developmental disorders Volume II: Assessment, interventions and policy* (pp. 3rd ed., pp. 831– 857). Hoboken, NJ : John Wiley & Sons.

Ben-Sasson, A., Cermak, S. A., Orsmond, G. I., Tager-Flusberg, H., Kadlec, M. B., & Carter, A. S. (2008). Sensory clusters of toddlers with autism spectrum disorders: Differences in affective symptoms. Journal of Child Psychology & Psychiatry, 49, 817-825. doi:10.1111/j.1469-7610.2008.01899.x

Ben-Sasson, A., Hen, L., Fluss, R., Cermak, S., Engel-Yeger, B., & Gal, E. (2009). A meta-analysis of sensory modulation symptoms in individuals with autism spectrum disorders. Journal of Autism & Developmental Disorders, 39, 1-11.

Gurney, J. G., Fritz, M. S., Ness, K. K., Sievers, P., Newschaffer, C. J., & Shapiro, E. G. (2003). Analysis of prevalence trends of autism spectrum disorder in minnesota. Archives of Pediatrics Adolescent Medicine, 157, 622-627. doi:10.1001/archpedi.157.7.622

Lane, A. E., Young, R. L., Baker, A., & Angley, M. T. (2010). Sensory processing subtypes in autism: Association with adaptive behavior. Journal of Autism & Developmental Disorders, 40, 112-122. doi:10.1007/s10803-009-0840-2

Minshew, N. J., & Hobson, J. A. (2008). Sensory sensitivities and performance on sensory perceptual tasks in high-functioning individuals with autism. Journal of Autism & Developmental Disorders, 38, 1485-1498.

O'Brien, J., Tsermentseli, S., Cummins, O., Happé, F., Heaton, P., & Spencer, J. (2009). Discriminating children with autism from children with learning difficulties with an adaptation of the short sensory profile. Early Child Development & Care, 179, 383-394. doi:10.1080/03004430701567926

Provost, B., Crowe, T. K., Acree, K., Osbourn, P. L., & McClain, C. (2009). Sensory behaviors of preschool children with and without autism spectrum disorders. New Zealand Journal of Occupational Therapy, 56, 9-17.

Reynolds, S., & Lane, S. J. (2008). Diagnostic validity of sensory over-responsivity: A review of the literature and case reports. Journal of Autism & Developmental Disorders, 38, 516-529.

Wiggins, L. D., Robins, D. L., Bakeman, R., & Adamson, L. B. (2009). Breif report: Sensory abnormalities as distinguishing symptoms of autism spectrum disorders in young children. Journal of Autism & Developmental Disorders, 39, 1087-1091. doi:10.1007/s10803-009-0711-x