

## Sensory Processing Disorder in Autism Spectrum Disorder: What Speech Therapist Should Know

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### ABSTRACT

The aim of this article is to discuss various subtypes of sensory processing disorder and their implication in the lives of individuals with Autism Spectrum Disorder (ASD). Typically, in human beings, sensory receptors receive information from internal and external environment and then send it to the brain for determination of the appropriate behavioral or motor response. In some individuals however, the process is affected by a dysfunction of the sensory integration process. The condition is known as sensory processing disorder (SPD). It is a heterogeneous condition that negatively affects how one's brains perceives and responds to sensory information. Research estimates that around 90% of individuals living with ASD have SPD, while that of general population is estimated to be only 5-10%. Individuals with SPD tend to react to sensory stimuli in a negative way both socially and emotionally. SPD is not considered a disorder (*per se*) by psychiatrists and other mental health professionals. Some doctors consider it as a symptom of other disorders (ASD, Anxiety, Attention Deficit Disorder, and Hyperactivity). Unfortunately, not much is known about its cause or neurobiology. Further, majority of individuals with SPD have challenges with communication commonly leading to aggression and other challenging behaviors. Speech therapy is therefore paramount to help improve their socio-communication skills. Speech therapist need to understand nature and implications of SPD so that that can address it and as well help other collaborating members of the multidisciplinary team. It is important that the government, universities, non-governmental organizations and related stakeholders invest more time, funds and resources in research and creation of awareness about the condition.

**Key words:** Sensory processing Disorder (SPD), Autistic Spectrum Disorder (ASD), Sensory Information (SI), Sensory Integration Therapy, Multidisciplinary Team

### INTRODUCTION

#### Autism Spectrum Disorder

Autism Spectrum Disorder, as defined by American Psychological Association-APA, is a neurodevelopmental disorder associated with impairment in social communication and interaction and restricted repetitive patterns of behavior, activity or interest. Typically, individuals living with the condition exhibit deficiency in socio communication skills and indulge in repetitive behaviors while their interests compared to typically developing peers are restricted (Hodges et al., 2019). Kanner and Asperger are thought to be the fathers of the Disorder although there is contradicting literature on this. In 1943, Leo Kanner and Hans Asperger endorsed the word Autism to describe a syndrome in children with difficulty in social communication and social interaction. Much has changed on both diagnoses and description since then. Most recent one was the introduction of DSMV in 2013 (Wairungu & Ndiema 2021). It changed the name and diagnostic criteria of the condition. Social skills deficit and that of communication are hitherto not considered as separate entities. This is because every

communication in human nature is meant to be social. The term socio-communication skills was therefore introduced (Ndiema & Wairungu, 2021). Since then ASD is no longer a triad of disabilities but a dyad.

Diagnostic and statistical manual 5th edition -DSM-V, introduced the term *Spectrum* which was not there in DSM-IV (Hodges et al., 2019). The diagnostic criteria according to DSM-V, includes persistent deficiency in social-communication skills (inclusive of verbal and non-verbal communication) and social-emotional reciprocity. In addition, individuals with ASD exhibit repetitive patterns of behavior, interest or activity and have a challenges adapting to change in routines. In addition, research indicates that majority of them have challenges responding to sensory stimuli, a condition known as sensory processing disorder. To come up with the “umbrella” term *Autism Spectrum Disorder*, DSM-V consolidated disorders considered separately earlier. They include Autism, Asperger’s Syndrome, Childhood Disintegrative Disorder and Pervasive Developmental disorder (PDD-unspecified) (Ndiema & Wairungu, 2021). *Rett syndrome* is not included in the umbrella term but is now considered a neurological disorder by itself. A separate disorder known as *social pragmatic communication disorder* (SPCD) was introduced. It represents individuals with challenges in socio-communication skills but who exhibit no repetitive behaviors nor have restricted interests (Hodges, 2019). The hall mark features of ASD therefore remain a combination of socio-communication skill deficit and repetitive behaviors, restricted interest and activities.

Autism Spectrum Disorder is a lifelong condition normally diagnosed at age three. The onset of Autism Spectrum Disorder may occur in two ways. It could be either early or delayed (Chen et al., 2021). In the early one, individuals exhibit symptoms in the first year of their life (Muthoni & Wairungu, 2023). In the delayed one, individuals develop typically but start showing symptoms in their second and third years of age. Unfortunately, they also lose previously acquired communicative and/or motor skills (Chen et al., 2021).

Living with Autism Spectrum is a challenge to both the individual and the family. The condition significantly affects education and quality of life of the individual. It also drains the family financially and is a source of stress to the family. It is not a disease to be treated but a condition to be managed. Its management is expensive. Early intervention yields better results. Owing to social communication skill challenges, Speech and language therapy is extremely critical. Comorbidities might also call for need to involve other professionals like occupational therapists. This study is meant to be a resource for speech therapists among other collaborating partners. The main area of concern is sensory processing disorder and their implication in learners with ASD.

## Epidemiology

The prevalence of ASD has been on a rising trajectory in the last few decades. Many theories exist to explain this (Wairungu, 2020). For example, a school of thought associate the increase to the widening spectrum of Autism diagnoses, decrease in discrimination and promoting awareness and acknowledgement of the condition. In 2007, the United Nation General Assembly named 2<sup>nd</sup> April as World Autism Awareness Day, hence promoting worldwide awareness of ASD. World Health Organization (WHO), estimates that about 1 in 100 children live with ASD (WHO, 2023). The Centers of Disease Control and protection (CDC), in 2023, estimated 1 in 36 children in the U.S have ASD. The disability cuts across all races, ethnicity and economic classes. The condition is predominantly in male, with prevalence of male to female ration of 4:1 (Mang’ombe & Wairungu, 2021). Several theories have been explored to try and explain the heightened risk of ASD in male gender. Among them “The Female Protective effect theory”, girls need to inherit more genetic factors associated with autism than boys to show characteristics of Autism according to Tsai (1980). The theory states that females with ASD have more mutations-alteration of single base unit in DNA, required to

activate autism. On the same note, “The Extreme Male Brain Theory”, research by Simon Bohen-Cohen (1990s) supports that people who suffer from autism may have been exposed to high levels of testosterone hormone during intrauterine growth.

### Perceived Causes

There is no single cause associated with ASD. Literature support that both Genetic and environment factors may influence the risk of being born with ASD. The possible interaction between DNA and the environment indicates that ASD could be a polygenic disorder. With the highly increasing autism genetics research, scientists have established ASD to be a trait with high heritability. Those with twin or older sibling with autism have higher chances of developing ASD for example. A 2019 study from National Institutes of Health involving more than 2 million people across five countries approximated ASD’s heritability to be nearly 80%. On the same note, Syndromic ASD is commonly associated with genetic disorders including Chromosomal Abnormalities. Proportions indicate up to 5%, single-genes such as fragile X syndrome or Rett Syndrome up to 5%. For others, Copy Number Variants (CNVs) up to 11%.

Researchers have proposed several environmental factors that may have influence in developing ASD. Environment refers to an umbrella term, (as defined by researches), not only limited to just toxins in the environment (heavy metals, air pollution, and pesticide), but also prenatal environment and exposure, extreme preterm birth and low birth weight, old maternal age at the time of conception, infection during pregnancy, use of certain medication during pregnancy (valproic acid, serotonin reuptake inhibitors), and maternal autoimmune disorder. As noted earlier, no one knows what causes ASD but some etiological theories have been controversial. The Lancet for example published a now discredited article by Dr. Andrew Wakefield 1998 associating ASD to MMR vaccination, the article was retracted by *The Lancet* in 2010. In a research done in Kenya, ‘parents’ and Professionals’ perception on causes of ASD, (2014) mystical forces was regarded to be the cause of ASD, including witchcraft, evil spirits, curses and drug abuse. However, the responses were plainly informed by superstitions and cultural beliefs. Precisely, no one knows beyond reasonable doubt what exactly causes ASD (Nyakundi & Wairungu, 2021). This poses a big challenge on prevention strategies. One cannot prevent that whose cause he does not know.

### METHODOLOGY

This is an in-depth qualitative desktop research that assumed a descriptive research design. It was conducted by consulting and analyzing information from renowned relevant scientific and academic databases. The literature review was conducted analysing information from several reputable databases. These included PubMed, Google Scholar, Cochrane Library, EBSCO-host, Francis and Taylor, JSTOR, and Wiley. Only articles with information to do with both Autism Spectrum Disorder and Sensory Processing disorders were considered relevant. Others were discarded.

**Justification:** Sensory processing disorder is the inability of the brain to interpret and respond to sensory input. It significantly affects behavior and education of children whom no medical diagnosis has been done. In the recent past, the concept has become more popular but there is still much not known about it (Ptak et al., 2022). SPD affects quality of service provision (or therapy) due to disruptions and inability to pay attention. Treatment of SPD is mostly done by occupational therapists. Language and communication difficulty is one of the major challenges in children with SPD. It is therefore important to incorporate Speech Language Therapist (SLTs) in treatment. Interdisciplinary participation between OT and SLTs is critical in addressing SPD challenges. This explains the importance of SLTs being trained on nature and implications of Sensory Integration Therapy. Findings of this research is a great

reference point for speech therapists and other members of the collaborating multidisciplinary team.

**Limitations of the Research:** The limitations of this research include potential for publication bias. Some literature was also old and outdated. It was more based on DSMIV and not the recent edition DSMV. Further, some publications were not translated in English hence could not be used though they were clearly relevant based on information in the abstract written in English. Further, only literature that is in the internet was considered leaving a lot that could be in text books and other *hardcopy* format in physical libraries. Finally, some internet data sources required one to purchase the articles at exorbitant prices.

### **RELATED CLINICAL THEORY: SENSORY INTEGRATION THEORY**

This theory is credited to Dr Jean Ayres, an occupational therapist and a researcher working with group of children with sensory integration difficulties. She theorized that sensory systems interact almost automatically to make sense of our every occurrence. This requires subliminal integration of information from different sensory system (Ayres, 1958, 1961). Sensory integration selects, grades and adds all the individual sensory input into complete brain function (Ayers, 1971). Through her work, she developed a primary assumption that the brain function of children suffering from ASD was atypical and by understanding their underlying problem, will eventually aid in designing correct treatment approaches (Ayres, 1975).

### **Nature and Sub-Categories of Sensory Processing Disorder**

Individuals with ASD respond to sensory input atypically compared to general population. The condition known as sensory processing disorder cuts across multiple sensory modalities. Individuals for example may be fascinated with moving objects, be indifferent to pain, respond adversely to specific sounds or texture, excessively smell, and excessively touch objects or avoid being touched (Chung & Sons, 2020). For a long time, diagnoses criteria for ASD mainly focused on the cognitive and social communication impairments. More recently however, the criteria for diagnoses has included the feature of sensory processing disorder (Gonclaves & Monteiro, 2023). Unfortunately, not much is known about its cause or its *neuro biology* (Chung & Son 2020). Typically, our sensory receptors receive external stimuli from within or without our bodies (external or internal environment). The receptors then transform the captured stimuli into specific sensory information which is instantly wired to the brain for action. It is then appropriately processed leading to a determined behavioral or mortal action (Galiana-Simal et al., 2020).

Sensory processing/integration (SI) is the mechanism of how our brain recognizes and responds to sensory stimuli or sensation. Ayres (1972) defined SI as the neurobiological process that discriminates sensory information from the environment and one's own body and facilitates the right response within the environment. It may also be described as the ability to detect, modulate, interpret and respond to sensory stimuli (Passarello, et al., 2022). It starts developing in the prenatal stage when the *foetus* detects the movement of the expectant mother. After birth, the peak of its development is usually between the 3<sup>rd</sup> and 6<sup>th</sup> or 7<sup>th</sup> year of a child's life (Ptak et al., 2022). In situations that neurological sensory integration is altered, the result is a disorder known as sensory processing disorder/sensory integration dysfunction or sensory integration dysfunction disorder (Galiana-Simal et al., 2020). They all mean the same thing.

Although sensory hyper- and hyperresponsiveness are common in other disabilities, they are more frequent in ASD population. Like Autism spectrum Disorder, Sensory Processing Disorder is heterogeneous in nature. Jean Ayres compared it to a traffic jam in neurological path (Wairungu, 2020). There is limited agreement regarding the pattern of these sensory deficits in ASD.

SI can be divided into 4 stages (Del Moral Orro et al., 2013), *registration*: when the brain receives sensory stimulus from sensory organ; *sensory modulation*: the ability of the brain to regulate the intensity of stimulus; *sensory discrimination*: the ability of the brain to perceive certain qualities of stimuli and determine its importance; *response*: once the brain harmonizes the processed information it generates the right feedback that results in a particular motor response and behavior. Disruption of one or more of the SI stages can result in unsuitable mannerisms/behavior and/or motor response (Gallian-simal et al., 2017) defined as Sensory Processing Disorder also known as Sensory Integration Dysfunction or Sensory Dysfunction Disorder.

Sensory Processing Disorder is not officially listed as disorder in the Diagnostic and Statistical Manual on Mental Disorder-5<sup>th</sup> edition (DSM-5), however it is integrated under ASD, under sub criteria of restricted patterns of behavior interest or activity. Sensory processing difficulties have been a main clinical trait of ASD from the original descriptions as reported by Asperger and Kanner. Roberson and Baron-Cohen (2017), proposed that sensory manifestation are main characteristics of neurobiology of Autism Spectrum Disorder. Sensory Processing Disorder symptoms in ASD are evident in early period of development and are prognosis of its diagnosis in childhood. The extreme stress caused by specific sensory stimuli can lead to self-injury, meltdown and aggression in those not able to express their discomfort (Wairungu, 2020).

Due to heterogeneity nature of SPD, every individual is unique in the way they experience sensory stimuli and they have unique challenges. There are three main patterns of dysfunction in SPD, as proposed by Miller et al. (2007): Sensory Modulation Dysfunction (SMD), sensory Discrimination Dysfunction (SDD) and Sensory Based-Motor Disorder (SBMD). SMD has three subtypes: sensory over-responsiveness/over-stimulation (an individual responds too much for prolonged period of time, or responds to weak sensory stimuli with weak intensity that a typical individual may not be aware, sensory under-responsive (individuals respond too little or may seem to be unaware of stimulus, they need extremely strong stimulation), sensory craver (they are in quest for intensity), SDD (they have trouble differentiating between characteristics of sensory stimuli) and can be seen in all of the sensory systems. SBMD, has two subtypes, dyspraxia and postural disorder (individuals seem to have difficulty with movement, coordination and balance).

### **The Eight Sensory Modalities in Sensory Processing Disorder**

As noted earlier, Sensory Processing Disorder happens when there is a breakdown of one or more of the sensory modalities. Our sensory systems are responsible for controlling the degree, and intensity of response to sensory stimuli (Critz et al., 2015). Below the various sensory modalities are explained.

**Tactile System (sense of touch):** Refers to information we receive through our skin receptors. It includes pain, light touch, temperature and pressure. Tactile challenges are among the most evident sensory features reported by parent of children with ASD (Foss-Feig et al., 2012). Dysfunction in the system can be seen when an individual avoids or overreacts from being touched or refuses to wear certain types of clothing. Other individuals seek out deep pressure through tight hugs rather than light touch. Some insist on pants and long sleeves even in very hot weather, or very light clothing even in extreme cold weather. This can pose great danger.

**Auditory System:** The auditory system is responsible for hearing. Sensory failure may lead to individuals being extremely sensitive to noise. Many individuals diagnosed with ASD also have auditory sensitivities (Goncalves & Monteiro, 2023). Their ability to filter out auditory information is deficient leading to auditory sensitivities (Font-Alaminos et al., 2020). Some cover their ears in crowded places or make unnecessary noise to mask the noise in the

surroundings. Individuals tend to be sensitive to sounds that typical individual may seem not to notice.

**Visual System:** This system is responsible for seeing. It uses light to detect information through our eyes. Individuals with dysfunction may have increased sensitivity to bright light and reading high contrast material like black and white (Wairungu, 2020). Some seek visual stimulation by staring and get excited with shiny and moving objects (Chung & Son, 2020).

**Gustatory System:** Picky eating habits are quite dominant in individuals with Autism Spectrum Disorder (Avery et al., 2018). This is due to malfunction of gustatory system. It is responsible for taste (Wairungu, 2020). When functioning correctly, one is able to taste discriminate and identify sweet, salty, and sour sensations. When there is dysfunction, individuals have intensified response to taste or texture of food. Individuals have picky eating habits and have extreme food preferences. Others seek out intense sour, sweet, or salty flavors. They go overboard with seasoning. They tend to bite on objects such as pens for compensatory purpose (Avery et al., 2018).

**Olfactory System:** It is a modality responsible for processing smell (Wairungu, 2020). The olfactory system enables us to discriminate between odors as well as filtering out those we should ignore and enhance those we should pay attention to. Individuals with dysfunction exhibit strong reactions to smells that others may not notice and may refuse to try foods or be in the same room as others eating them based on their smell. Some develop Nausea from scented materials such as perfume or flowers. Others have strong need to smell out object such as soap, other people, and clothing.

**Vestibular Systems:** It refers to structures within the inner ear, the semi-circular canal, which detects movements and change of position of our head. It is the system that informs us where our head is in relation to the ground. It is the system that helps us stay upright against gravity, understand acceleration and movement in space. Majority of individuals with ASD have vestibular dysfunction (Mansour et al., 2021). Dysfunction may result in fear or seeking out activities requiring feet to leave the ground such as swings, slides, impulsive jumping or climbing. Some may prefer sedentary activities.

**Interoception Modality:** Interoception refers to sensations related to the physiological and physical state of the body, how one perceives their own body. It is thought to be impaired in ASD though results on this has been inconsistent (William et al., 2023). Interoception detects responses that helps in regulation, including hunger and thirst, heart rate, respiration as well as feeling of the need to urinate or have a bowel movement. Difficulties may lead to self-regulation problems.

**Proprioception:** Finally, the eighth modality is the proprioception modality, sense of muscle and joint movements. It senses the location, position, movement and orientation of the body muscles and joints. It is precisely the conscious awareness of body and limbs. Its distinct properties include sense of heaviness, passive motion sense, limb position sense and active motion sense (Coscia et al., 2020). Dysfunction lead to clumsiness and tendency to fall and bumping into people and object as they move. Difficulty going up the stairs and lack of awareness of body position in space (Porter, 2017).

## Prevalence

Established on analysis of epidemiological studies, SPD prevalence is estimated to be between 5-16% of children in general population. Research evidence has shown that as high as 90% of individuals with ASD have sensory processing challenges with most prevalent pattern of SPD being SMD sensory over responsiveness subtype (Schoen et al., 2009; Tavassoli et al., 2014; Tomchek et al., 2014; Little et al., 2018). Research done by Frontier Integrative Neuroscience (2021), where all types and subtypes of SPD were explored indicated the following proportions: sensory over-responsivity 60%, under-responsivity 51% and sensory

craving 42%. Sensory-based motor disorder was identified in 40% and 29% were identified with sensory discrimination disorder. It was also noted that most children have more than one sensory system involvement, and experience more than one SPD pattern.

### Assessment

Regrettably, as stated by Miller et al. (2007), there are limited number of diagnostic assessment tools available for assessment of sensory capacity of children, and not effective for measuring specificity and assessment of types or subtypes of SPD. What can be accounted for in regards to SPD is behavior profiles and performance difficulties.

Sensory Integration and Praxis Test (SIPT) (Ayres, 1989), the Sensory Processing Measure (SPM) (Parham et al., 2007) and the Sensory Profile (SP) (Jorquera-Cabrera et al., 2017) and SP2 its latest version (Dunn, 2014), are the frequently used assessment tools for children suffering SPD.

### Treatment

As proposed by Ayers (2008), qualified pediatrics occupational therapist (OT) with knowledge and expertise in sensory integration provide the relevant skills in SPD treatment. The most commonly used treatment for SPD by OT is Sensory Integration Therapy (SIT) whose purpose is to compose a child by prompting self-regulation and learning self-adaptation to stimuli. SIT is a clinic based treatment aimed at improving sensory processing challenges by providing amplified stimulus. It allows flexible response hence improving a child's ability to process sensory stimuli.

Language and communication difficulty is one of the major challenges in children with SPD and therefore it is important to incorporate Speech Language Therapist (SLTs) in intervention. Due to challenges in self-expression, individuals can result to aggressive behavior including self-injurious behavior (Wairungu, 2020). Interdisciplinary participation is therefore critical including that of behavior analysts.

### CONCLUSION

There is notably a large knowledge gap in regard to SPD among health care givers, professionals in education and general population. This is despite the high incidence of SDP among children of general population estimated to be 5-16%, with occurrence in as many as 90% of those of Autism Spectrum Disorder. This reality has contributed to incorrect diagnosis and consequently poor treatment and management of the condition in the affected individuals. Further, there is lack of cure-pharmacological treatment resulting to SIT to be the only available therapy for SPD. It is for psychiatrist, other mental health professionals, OT and SLTs to work together in collaboration and to create awareness of the disorder to improve the overall well-being of affected individuals and their family. Also, we call for more funding by the government to support affected families and alleviate their financial burden. Managing ASD and SPD is expensive. Further, universities, non-governmental organizations and related institutions should allocate more funding, resources and time on research to identify the key causes and best preventive strategies against the condition.

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