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THE SENSORY PROCESSING AND INTEGRATION IN ASD: IMPACT ON EDUCATIONAL OUTCOMES

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Abstract

Autism spectrum disorders (ASDs) depict a large class of conditions that manifest in a variety of displays and particularities. The number and type of symptoms can differ drastically from one person to another and array from mild to severe. Symptoms fall into a range of categories; dysfunctions in perceptual and sensory processing are present with impact in communication, in neurological functioning outcomes and in various functional behavior limitations (Pfeiffer et al., 2005). In school settings and in everyday life the sensory processing and integration of the stimuli may impact the acquisition of new information and sometime, in particular situation the educational process itself.
Sensory information and atypical behavioral responses are common to people with this diagnostic, with over 96% of children with ASD having hyper or hyposensitivity in several areas. Particular processing of sensory stimuli can cause aggressive and self-harming behavior, especially for those who are non-verbal and cannot communicate their difficulties in an adequate and functional manner. Among the most affected senses are the proximal senses, such as taste, smell, and touch, but new studies report that disruption of auditory and visual processing pathways is becoming more common (Marco, E J et al, 2011). Due to these particular hypersensitivities daily activities are disturbed. This is a factor that limits the participation of these individuals in certain events and activities, and in school itself. Most preschoolers had difficulty with sensory processing, which was associated with behavioral changes such as irritability, lethargy, or hyperactivity.
In this research we evaluated the sensory processing difficulties layered by age and interaction plans: tactile, vestibular, proprioception, auditory, olfactive, taste and visual. The participants (N= 43) report data for themself (N=9), for babies(N=5), for kindergarten age (N=15) and for school age (N=14). Preliminary data indicate for tactile sensory processing the M= 1.9, for auditory sensory processing the M= 2.49, for vestibular sensory processing the M= 2.1, for proprioception sensory processing the M= 1.72, for visual sensory processing the M= 2.07, for taste sensory processing the M= 1.74, for olfactive sensory processing the M= 1.97. The most reported disturbance on sensory processing was on the auditory, vestibular and visual part. The affected sensory processing area interferes with the educational process that is based mainly on auditory, visual and vestibular. These preliminary results are in concordance with others reports from literature and could explain the hypersensitivity for auditory and visual stimulus and the odd behaviors displayed by ASD persons, like tiptoes walking. Further research and analysis will be developed in order to tailor these aspects of sensory processing in ADS, with impact on education and everyday living.

Keywords: *Sensory processing, autism spectrum disorder, sensory integration, educational challenges, hyper and hyposensitivity*.

1. Introduction

Autism Spectrum Disorder is a neurodevelopmental disorder characterized by social, communication and behavioral impairments. ASD can be diagnosed at any age, but early signs appear in the first two years of the child's life. Autism is known as the 'spectrum' because there is a wide variety in the type and severity of symptoms that these people experience.

According to the American Psychiatric Association's Guide to Diagnosing Mental Disorders (DSM V, 2013), people with ASD present:

- Difficulties in communicating and interacting with others
- Repetitive behaviors and a narrow range of interests
- Symptoms that affect the patient's ability to work, work and other aspects of his life
- Excessive response to sensory stimuli

Based on epidemiological studies conducted in recent years, the prevalence of people with ASD seems to increase globally. There are several possible explanations for this increase, the main ones being increased awareness, better and more accurate diagnostic tools, as well as improved reporting.

Data published by the WHO in 2017, estimates that worldwide 1 in 160 children has one of the disorders of the autism spectrum (WHO, 2017). This estimate is an average figure, as the prevalence of these diseases is still unknown in underdeveloped countries. Recent studies in the EU suggest that autism affects around 1% of Europeans, representing over five million people (Elsabbagh et al., 2012). A 2005 report by the European Commission on the ASD underlined the difficulty of getting data due to poor common health information and the difficulty to access health surveys (Montserrat, 2005).

The difficulty in obtaining prevalence data is that there is no medical test to determine in an absolute way whether a person has autism or not. The diagnostic is done mainly on clinical observation and psychometric tests. But based on the new CDC data, published in the USA, an increased number in the ASD is seen (CDC, 2022; NIMH, n.d.) This is highly relevant due to the impact on medical and educational systems.

Autism spectrum disorders (ASDs) depict a large class of conditions that manifest in a variety of displays and particularities. The number and type of symptoms can differ drastically from one person to another and array from mild to severe. Symptoms fall into a range of categories; dysfunctions in perceptual and sensory processing are present with impact in communication, in neurological functioning outcomes and in various functional behavior limitations (Pfeiffer et al., 2005). In school settings and in everyday life the sensory processing and integration of the Sensory information and atypical behavioral responses are common to people in this spectrum, with over 96% of children with ASD having hyper or hyposensitivity in several areas. Particular processing of sensory stimuli can cause aggressive and self-harming behavior to those who cannot communicate their difficulties. Among the most affected senses are the proximal senses, such as taste, smell, and touch, but new studies report that disruption of auditory and visual processing pathways is becoming more common (Marco et al., 2011).

Sensory processing problems in children with autism can be described as a combination of defensiveness and apparent insensitivity. These people may be hypersensitive to some sounds, but they may appear deaf to others, or they may become attached to certain stimuli and ignore others, for example, they may focus on an accessory while not being aware of the person who wears it. Research on this subject suggests that individuals with autism process information differently from typical children, but this improves over time(Kern et al., 2006)

Due to these particular hypersensitivities, daily activities are impaired and atypical sensory integration is a factor that limits the participation of these individuals in certain events and activities and it definitely impacts on school setting and academic achievements. Studies found that most preschoolers had difficulty with sensory processing, which was associated with behavioral changes such as irritability, lethargy, or hyperactivity (Kern et al., 2007).

Several theories have been formulated to explain this phenomenon, but they all have one thing in common, that these abnormalities are not related to the severity of autism and the variability of intellectual capacity. Some authors argue that sensory changes originate in inappropriate integration and fragmentation, and another theory is based on differences in adult neuronal plasticity, which can cause an atypical connection between the anterior and posterior regions of the brain. Another suggestion is based on the current theory of autism which has identified an imbalance of arousal and neuronal inhibition that could be the cause of this condition. Genetic studies have identified abnormalities in areas of the genome associated with synaptic development, myelination, and transmission. Also, imbalances between neurotransmitters such as glutamate and GABA, which contribute to synaptic instability. Inhibitions may manifest as a low response in cortical activation patterns, and inconsistent neural processing may be the cause of both secondary and underlying symptoms. Atypical neural responses in the sensory and motor cortex may explain why most people with ASD have low sensory sensitivities, clumsiness, and even balance disorders. (Behrmann & Minshew, 2015). In terms of secondary symptoms, unsafe neural networks have an increased susceptibility to epileptic seizures, which is one of the most common comorbidities in autism. This also impacts everyday activities and educational outcomes.

Excessive response to sensory stimuli has recently been added to the DSM-5 diagnostic criteria, so it is not yet sufficiently studied. Criteria for this symptom include adverse reactions to stimuli, such as noisy environments, uncomfortable clothing or touch, signs that do not elicit these responses in typical

individuals. Electroencephalography studies have shown deficits in sensitive areas, selective attention to sensory input, suggesting that people with ASD may become easily overwhelmed by irrelevant and multiple stimuli, but this condition is extremely heterogeneous, with symptoms appearing only in some people.

The variety of sensory characteristics reported in children with autism are described as different response patterns, these being: decreased reaction, hyperreactivity, atypical sensory interests, repetitive behaviors and increased perception. Such a sensitive heterogeneity of this disorder is a challenge both for understanding the pathogenesis and for planning the therapeutic and educational intervention (Behrmann & Minshew, 2015; Bodison et al., 2008).

2. Design and methods

This study implies an exploratory and observatory design. The sensory integration deficit was evaluated using a form that approach specific integration based on the age and each sensory domain: tactile sensory processing, auditory sensory processing, visual sensory processing, taste sensory processing, olfactive sensory processing. The questionnaire was developed based on others presented in the literature for adults such as Sensory Processing Disorder Symptoms Test for Adults (Behrmann & Minshew, 2015) or for children. The form was set and the design was created using Google form. The form has 7 different sections with conditional set-go to specific section based on the answer they chose. The form collects the approval of the participant to take part in the study and comply with the GDPR Data Protection. Demographic data such as age, level of education, socio-economic status was collected through responses. The participants fill the form for themself, for their babies, for toddlers, and for school age children as they chose. For each category the question was similar in difficulty or the target information they provide in connection with sensory processing and integration. Example of such question are: “I am very sensitive with the stimuli around me, I don’t like to be touch”; ‘I am sensitive to light”, “I collide with different object and I have bruises”, “I can’t focus during work time/ school time, etc”, “I avoid some foods because of the texture. I would rather go hungry than eat a mushy banana”, When I’m in a car with other people, I’m always asking, “Can we turn down the radio volume?” etc. For each age category the affirmation was adapted such as “your baby is sensitive with the stimuli around he”, “your child doesn’t like to be touched” etc.

The invitation to participate in the study was sent individually to parents of children with ADS, but also distributed to different subject mailing lists and posted on different social media platform.

The data for this study were exported from the Google form in an Excel format and analyzed with the Excel Analysis ToolPak.

3. Objective and results

In this research we evaluated the sensory processing difficulties layered by age and interaction plans: tactile, vestibular, proprioception, auditory, olfactive, taste and visual. The sensory integration disturbance is particularly important in connection with work and education because this process is based on the integration of all senses in order to display a proper outcome and to have a functional status.

3.1. Results

The demographic data indicates that 13.6% of the participants live in the rural area and 86.4% comes from the urban area. For socio-economic status 36.4% have a high status and 63,6% a mean status. No participant reported poor socio-economic status. For health and medical out-come 22.7% have a formal diagnosis and 77.3% have no diagnosis. For the addressability 40% fill the form for themselves, 41,8% for their school-age children, 13.6% for toddlers and 4.6% for babies. For gender self-reported data on adult/adolescent age the results indicate that 16.7% were male and 83.3% female and for education 11.1% are during high school and 88.9% at high education.

In this research we evaluated the sensory processing difficulties layered by age and interaction plans: tactile, vestibular, proprioception, auditory, olfactive, taste and visual. The participants (N= 43) report data for themself (N=9), for babies(N=5), for kindergarten age /toddlers (N=15) and for school age (N=14). Preliminary data indicate for tactile sensory processing the M= 1.9, for auditory sensory processing the M= 2.49, for vestibular sensory processing the M= 2.1, for proprioception sensory processing the M= 1.72, for visual sensory processing the M= 2.07, for taste sensory processing the M= 1.74, for olfactive sensory processing the M= 1.97. The most reported disturbance on sensory processing was on the auditory, vestibular and visual part. The affected sensory processing area interferes with the educational process that is based mainly on auditory, visual and vestibular.

For the adults and the adolescents the question with the highest score for the tactile sensory “I collide with different object and I have bruises” - M= 3.05 and the integration sensory ” I often feel tired

and start my day slowly" – M = 3.05.Visual and sound sensory record high mean in the question "I am sensitive to sounds or visual stimuli" – M= 2.77. The mean for adult and adolescent checklist was M=2.36. The results for sensory processing for this group are: The tactile sensory processing M= 1.78, for auditory sensory processing the M= 2.27, for vestibular sensory processing the M= 1.94, for proprioception sensory processing the M= 1.53, for visual sensory processing the M= 1.93, for taste sensory processing the M= 1.93, for olfactive sensory processing the M= 1.06. A list with the data collected for each age group are display in table nr. 1.

Table 1. The mean for sensory processing based on the age group stratification and sensory domain.

Sensory processing type	*Overall score*	*Adults and adolescent*	*Babies*	*Toddlers/Preschool age group*	*School age group*
Tactile	M= 1.9	M= 1.78	M= 2.55	M= 1.6	M= 1.7
Auditory	M= 2.49	M= 2.27	M= 3.42	M= 1.7	M= 2.6
Vestibular	M= 2.1	M= 1.94	M= 3.83	M= 1.71	M= 1.3
Proprioception/ Kinesthesia	M= 1.72	M= 1.53	M= 2.8	M= 1.35	M= 1.2
Visual	M= 2.07	M= 1.93	M= 2.2	M= 2.32	M= 1.9
Olfactive	M= 1.74	M= 1.93	M= 1.16	M= 2	M= 1.83
Taste	M=1.97	M= 1.06	M= 2.5	M= 1.9	M= 2.42

3. Discussion

These preliminary results are in concordance with others reports from literature and could explain the hypersensitivity for auditory and visual stimulus, for kinesthesia and the odd behaviors displayed by ASD persons, like tiptoes walking, self-harm or specific stimulation.

The results indicate that the most sensitive sensory processing areas are the auditory, vestibular and visual. This is in concordance with others results reported in literature which underline that disruption of auditory and visual processing pathways is becoming more common (Marco et al., 2011) and proximal senses, such as taste, smell, and touch are not as affected as it was previously thought.

The design and result of this study does not cover a direct correlation with academic performance but poor visual, vestibular, proprioceptive and auditory sensory processing definitely impact the educational outcome. This idea is discussed by Bodison et al, 2008. The authors *"the school readiness skills that are influenced by sensory integration include ability to sustain attention to task; follow directions, visual tracking, and visual praxis skill, use postural control".*

4. Conclusions

Sensory processing is an important and significant topic in relation to ASD. This study underlines the areas of sensory processing that are more sensitive. Teachers and therapists can use the results of this study to develop the students' intervention educational plan and to select the best strategies for each student. Because each student is different, it is important to identify as soon as possible the most sensitive sensory processing areas and to include this information in therapy and everyday life. Further research and analysis should be developed in order to tailor these aspects of sensory processing in ADS, with impact on education and everyday living.

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