ОЦЕНКА И СРАВНЕНИЕ МЕТОДОВ ОЦЕНКИ СЕНСОРНОЙ ИНТЕГРАЦИИ У ДЕТЕЙ С РАССТРОЙСТВАМИ АУТИСТИЧЕСКОГО СПЕКТРА И ЛЕГКОЙ УМСТВЕННОЙ ОТСТАЛОСТЬЮ

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Ощущение необходимо для восприятия и понимания человеком окружающей среды, поддерживая сложные когнитивные функции. В этом исследовании изучается сенсорная интеграция (СИ) у детей с расстройством аутистического спектра (РАС) и легкими умственными отсталостью (УО) в возрасте от 6 до 12 лет. Мы сравниваем три метода оценки: тесты сенсорной интеграции и праксиса (SIPT), сенсорный профиль и измерение сенсорной обработки 2-го издания (SPM-2). Была оценена эффективность каждого метода в выявлении проблем сенсорной обработки. Результаты показали, что дети с РАС демонстрируют значительные трудности в слуховой, вестибулярной и тактильной обработке по сравнению с группой УО. Хотя SIPT считается золотым стандартом, его сложность может ограничивать эффективность для детей с РАС. Сенсорный профиль стал наиболее полным инструментом для оценки зрительного восприятия и моделей сенсорной обработки, подчеркивая необходимость индивидуальных вмешательств. Результаты подчеркивают важность раннего скрининга и индивидуализированных инструментов оценки для содействия адаптивному развитию и решения проблем сенсорной интеграции в клинической практике.

Ключевые слова: методы оценки, Сенсорная интеграция (СИ), расстройство аутистического спектра (РАС), умственная отсталость (УО), тесты сенсорной интеграции и праксиса (SIPT), сенсорный профиль, показатель сенсорной обработки (SPM-2).

Финансирование: финансовых грантов или других источников поддержки исследований для данного исследования нет

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EVALUATION AND COMPARISON OF METHODS FOR ASSESSING SENSORY INTEGRATION IN CHILDREN WITH AUTISM SPECTRUM DISORDERS AND MILD INTELLECTUAL DISABILITY

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Sensation is essential for human perception and understanding of the environment, underpinning complex cognitive functions. This study examines sensory integration (SI) in children with Autism Spectrum Disorder (ASD) and mild intellectual disabilities (ID) aged 6-12. We compare three assessment methods: the Sensory Integration and Praxis Tests (SIPT), Sensory Profile, and Sensory Processing Measure 2nd Edition (SPM-2). Each method's efficacy in identifying sensory processing challenges was evaluated. Results indicated that children with ASD exhibited significant difficulties in auditory, vestibular, and touch processing compared to the ID group. Although the SIPT is considered a gold standard, its complexity may limit effectiveness for children with ASD. The Sensory Profile emerged as the most comprehensive tool for assessing visual perception and sensory processing patterns, emphasizing the need for tailored interventions. The findings highlight the importance of early screening and individualized assessment tools in promoting adaptive development and addressing sensory integration challenges in clinical practice.

Keywords: Sensory Integration (SI), Autism Spectrum Disorder (ASD), Intellectual Disability (ID), Assessment Methods, Sensory Integration and Praxis Tests (SIPT), Sensory Profile, Sensory Processing Measure (SPM-2).

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Sensation is the fundamental process by which humans perceive their environment, involving the reflection of individual object properties that engage the senses. This process lays the groundwork for more complex cognitive functions like memory, thinking, and imagination. The clarity of our understanding of the world relies on the development of sensory processes, which not only help us perceive external signals but also connect us to our surroundings, making them essential for knowledge acquisition and mental development [1].

Sensory systems include: visual; auditory; tactile; proprioceptive; olfactory; taste; vestibular. They provide the brain with the necessary information [2]. Sensory systems, including those for pain, temperature, and internal bodily sensations, can sometimes be isolated. All sensory systems share key characteristics: they exhibit high sensitivity to specific stimuli, assessed through the absolute threshold of sensation (the minimum stimulus strength that elicits a sensation), the differential threshold of sensation (the smallest change in stimulus strength perceived as a change in intensity), and the intensity of sensations (the subjective severity of a sensation, influenced by both the stimulus intensity and the sensory system's functional state) [3].

Sensory systems exhibit several key properties:

1. Inertia: Sensations persist even after the stimulus is removed, leading to a slow onset and offset of sensations.
2. Adaptation: Sensory sensitivity adjusts based on stimulus intensity; prolonged exposure decreases absolute sensitivity but increases differential sensitivity.
3. Filtering: Only a portion of sensory information is processed, helping to identify significant signals amid sensory noise.
4. Trainability: Sensitivity and adaptation speed can improve through sensory activity.
5. Interaction: Sensory systems work together rather than in isolation.
6. Modulation: Sensory systems can regulate responses to stimuli, balancing excitation and inhibition to adapt to environmental changes.

Dysfunction in these systems can cause hypersensitivity, where neutral stimuli feel intense or painful, or hyposensitivity, where stimuli go unnoticed. Issues with adaptation and filtering can impair attention, making it difficult to focus on important stimuli. Understanding sensory integration can enhance learning and behavior, highlighting the brain's role beyond just driving physical and mental activities [4].

Sensory Integration

Development begins with constant sensory stimulation from the body and environment. The brain processes and organizes this information, prioritizing important signals and filtering out non-essential ones. This unconscious process, known as sensory integration, enables effective ordering of sensations [5] . Ayres defined sensory integration as the neurological process that organizes sensations from both the body and the environment, allowing for effective interaction with surroundings. This dynamic interaction reflects a child's relationship with their physical and social environment and is a natural part of typical sensorimotor development. Sensory integration enhances a child's ability to engage in meaningful and purposeful activities [6].

The literature extensively discusses how vulnerabilities in sensory integration (SI) can negatively impact children's participation in daily activities and routines, such as sleep, feeding, toileting, learning, play, and social interactions [7 – 11].

Assessment of Sensory Integration in Childhood

Timely recognition and intervention for developmental disorders are crucial for children's well-being and that of their families. This responsibility falls to health and education professionals. The American Academy of Pediatrics (AAP) notes significant progress in early screening, assessment, and intervention for children with developmental and behavioral disorders [12]. Assessment tools used in Early Childhood Intervention (ECI) should be tailored to the diverse families served. They must promote active involvement from both professionals and families to create a shared understanding of the child [13]. Assessment practices for young children focus on the principles of authentic assessment [14].

Authentic assessment evaluates children's functional abilities in their natural environments, like home and community, reflecting the experiences of the child and family. It relies on the observations and insights of familiar, informed caregivers [15,16].

L. A. Wenger identified two methods for mastering sensory standards: perceptual and intellectual. The perceptual method is key in sensory education for young children, helping them identify and distinguish object properties. Through physical engagement, children learn to recognize and classify items like dolls and spoons. This process is supported by examination, which organizes perception for practical use, and comparison, which enhances sensory experience through practice. Effectiveness increases when children use appropriate sensory standards, with methods tailored to their abilities and the objects involved [17].

METHODS

In a study investigating visual perception differences between autistic children and those with intellectual disabilities aged 6 to 12, we assessed sensory integration using three methods. We compared the results based on the disorders in each group to enhance testing efficiency. The methods included the Sensory Integration and Praxis Tests (SIPT), The Sensory Profile , and the Sensory Processing Measure 2nd Edition (SPM-2) [18].

The Sensory Integration and Praxis Test (SIPT), developed by Ayres in 1989, consists of 17 tests to assess sensory integration difficulties, evaluating sensory perception, discrimination, reactivity, and their effects on praxis and daily life. Suitable for individuals aged 4 and up, it can be used throughout the lifespan. The SIPT identifies

sensory challenges often linked to conditions like autism, ADHD, and dyspraxia but does not assess olfaction, taste, or auditory functions. In a study in Yekaterinburg, not all 17 subscales could be completed due to unavailability and high costs of the test, along with some being too difficult for autistic children. As a result, 7 feasible subscales were selected for the study.

The Sensory Profile assesses a child's sensory processing abilities and their impact on daily life, specifically for children aged five to ten. The questionnaire features 125 items organized into three main sections: Sensory Processing, Modulation, and Behavioral and Emotional Responses. Sensory Processing includes six categories: Auditory, Visual, Vestibular, Touch, Multisensory, and Oral. Modulation consists of five areas related to endurance, body position, movement, and how sensory and visual inputs affect emotional responses and activity levels [19].

The Sensory Processing Measure 2nd Edition (SPM-2), developed by American experts, assesses sensory integration by focusing on a child's daily actions. It serves as a rapid screening tool for sensory integration disorders and involves a parent questionnaire with about 80 questions, resulting in a sensory profile that highlights hypersensitive areas. The SPM-2 evaluates sensory integration across five domains (visual, auditory, tactile, gustatory/olfactory, and vestibular) and three age groups (10 to 30 months, 2 to 5 years, and 5 to 12 years) using an ordinal scale (Never; Rarely; Often; Always). Future research will focus on the 5 to 12-year age group.

RESULTS

The analysis of the Sensory Profile shows key differences in sensory processing between children with Autism Spectrum Disorder (ASD) and those with mild Intellectual Disability (ID). Using the Mann-Whitney test for small sample sizes, researchers compared performance across subscales. In Visual Processing, 100 % of the ASD group scored at the Typical Performance level, compared to 75 % of the ID group. However, 71 % of the ASD group scored at the Probable Difference level for Visual Input Affecting, indicating more difficulties in processing visual input. In the Fine Motor/Perceptual factor, 71 % of the ASD group showed a Definite Difference, while half of the ID group scored at the Typical level, suggesting significant challenges for children with ASD. Overall, no significant differences ($p > 0.05$) were found in several subscales, indicating similarities in overall performance, but the differing performance percentages underscore the importance of individual assessments.

Significant differences were found in several areas:

- Auditory Processing ($p = 0.0320$)
- Vestibular Processing ($p = 0.0246$)
- Touch Processing ($p = 0.0006$)
- Visual Input Affecting ($p = 0.0075$)

The ID group generally performed normally, while the ASD group showed weaknesses, particularly in auditory and tactile processing. The ASD group faced greater challenges with sensory registration and visual input, affecting their environmental engagement. In contrast, the ID group scored higher in low registration, indicating better distraction management. The ID group also tended to seek more sensory input, while the ASD group was less likely to withdraw from overwhelming stimuli, potentially impacting their activity engagement [18].

Raw scores from the SPM-2 are converted into normalized T-scores for standardized comparisons across different scales. T-scores categorize children's sensory processing abilities as follows: 40-59 (Typical functioning), 60-69 (Mild to moderate issues), and 70-80 (Significant problems). Results showed P-values greater than 0.05, indicating no significant differences between the ASD and ID groups, suggesting that any observed score differences were minimal. While both groups exhibited overlapping sensory processing challenges, individual assessments highlighted specific concerns, especially in auditory, visual, and vestibular processing. However, due to the small sample size, these findings should be interpreted cautiously, with larger studies needed for more definitive insights [18].

For the analysis of subtests for ASD and ID groups, only seven manageable subtests were chosen due to difficulties in administering the full test to autistic children: Standing and Walking Balance (SWB), Design Copying (DC), Postural Praxis (PPr), Bilateral Motor Coordination (BMC), Praxis on Verbal Command (PrVC), Oral Praxis (OPr), and Graphesthesia (GRA). Scores were converted to standard Z scores with interpretations ranging from severe dysfunction (-3.0 to -2.5) to advanced functioning (+2.0 to +3.0). The performance of the ASD group did not fall below that of the ID group, and both groups showed similar capabilities in most areas. This suggests that the SIPT test may not have been effective due to its complexity and the challenges faced by children with sensory processing disorders [18].

Comparison of three sensory integration measurement methods Sensory Profile, SPM2, SIPT

After analyzing the performance of children in the two experimental groups for sensory integration tests, we can evaluate the advantages and disadvantages of the three tests in two contexts: general comparison and research-specific comparison. A review of studies conducted in various locations and with different test groups summarizes the pros and cons of these tests as follows (Table 1).

Considering the advantages and disadvantages of the three tests, and focusing on visual perception comparisons between the two groups, the following points emerge:

- The SIPT test's difficulties limited accurate measurement of visual perception; one directly related subtest could not be performed due to equipment needs, although the design copy test (DC) partially addressed this.

- The SPM primarily investigates a child's sensitivities to visual stimuli rather than the visual perception process itself, with no significant differences found between the two groups.

- The sensory profile test assesses both visual processing and input, providing useful insights into a child's visual perception.

Table 1. A review of studies conducted in various locations and with different test groups.

METHOD	AGES	Completed by	Negative points	Positive points
SIPT	from 4 through 8 years, 11 months.	Examiner	1- Access and use of SIPT due to the high cost of the equipment package 2- Lack of translation of tools and the right to use SIPT outside the United States 3- It is time consuming to test. generally, takes 2½ h 4-Lack of access to standardized data for populations outside the United States. 5- Too much difficulty in taking the test for ASD children. (The child must be able to attend for long periods of time and follow the verbal directions, as a result, it may not be an appropriate testing instrument for all children on the autism spectrum.)	This comprehensive, standardized assessment tool is considered the gold standard tool for evaluating sensory integration and praxis (motor planning) functions.
SPM2 (Child form)	5–12 years	Caregivers or Parents	1- A lack of normative data for participant groups outside of the United States 2- Methodological limitations 3- A lack of investigation into some important psychometric properties, particularly responsiveness	1- It is cheap 2- Don't need equipment and materials 3-Their ability to be implemented by non-professionals 4- The short duration of the tests. 15-20 minutes
Sensory profile	Birth to 14 years and 11 months	Caregivers or Parents	1- Perhaps, it is possible to pay attention to defects in hypothesis testing, cross-cultural validity and structural validity in this aim [20].	1- It is cheap 2- Don't need equipment and materials 3-Their ability to be implemented by non-professionals 4- The short duration of the tests. 10 - 15 minutes 5- Investigating all aspects of the sensory processing of children, especially children with ASD

Considering the advantages and disadvantages of the three tests, and focusing on visual perception comparisons between the two groups, the following points emerge:

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DISCUSSION

The SIPT is considered the «gold standard» for evaluating sensory integration functions, including sensory discrimination, praxis, and postural control. However, it does not specifically address family, context, or routines. The test consists of 17 subtests assessing four interconnected areas: visual form and space perception, tactile discrimination, praxis, and vestibular/proprioceptive processing. It is typically administered by an occupational therapist with advanced training in ASI [21]. Overall, SIPT findings indicate that while both groups displayed varying sensory processing abilities, the ASD group did not perform worse than the ID group. The complexity of the tests may have limited their effectiveness for children with ASD, highlighting the need for more tailored assessment tools for this population [18].

The SPM items provide insights into reactivity and discrimination vulnerabilities in sensory systems, as well as information on praxis and postural control. It links sensory integration to the child's everyday performance but is structured and scored based on sensory systems and sensorimotor skills. Proper interpretation requires an understanding of SI Theory and its impact on the child's daily activities [22]. The analysis of the Sensory Profile reveals significant differences in sensory processing patterns between children with ASD and those with mild intellectual disability. These results emphasize the need for tailored interventions that consider the unique sensory profiles of each group to enhance their engagement in everyday activities [18]. Therefore, it can be said that considering the purpose of the study, the best test in the comprehensive examination of children's sensory processes is the sensory profile test, which the general studies conducted on this test also confirm this claim.

CONCLUSION

Understanding the link between sensory integration (SI) and a child's participation, development, and behavior is essential for clinicians. Early screening for SI and participation issues, along with referrals for assessments and personalized interventions, can effectively address developmental challenges. Currently, pediatricians often use tools focused on developmental milestones, which may overlook sensory issues. Existing SI assessment tools assess sensory processing but do not evaluate the impact on participation in home and community settings. New assessment tools are needed to align with modern early intervention strategies that emphasize routines and family involvement. While more tools for measuring SI functions have emerged, most require detailed analysis by specialized occupational therapists, and none are designed as screening tests for pediatricians.

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