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Research Article

SENSORY PROCESSES OF CHILDREN WITH AND WITHOUT AUTISM SPECTRUM DISORDER IN BOSNIA AND HERZEGOVINA

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A B S T R A C T

Incorporating the sensory processing deficit into the diagnostic criterion only recently, it suffices to say that this challenge in the treatment of children with ASD, as well as intellectual disabilities, has not received much attention.For this reason, the aim of this paper was to examine the sensory processes and to identify the sensory processes deficits of children with ASD in relation to children with intellectual disabilities and children of the typical population.Sensory processing of 105 subjects aged 3-8 was done using the Short Sensory Profile questionnaire.By children with ASD, a greater deficit of sensory processes was found in relation to children with intellectual disabilities and children of typical development.In the area of auditory perception, the highest statistically significant difference was found at $p < 0.05$: $F = 33.029$ with $p = 0.0001$.The difficulties of sensory integration and processing of children with ASD significantly affect the learning ability of these children and all related forms of work.The results support the incorporation of sensory behavior criteria into the ASD diagnosis process itself, and special attention should be paid to modulating the sensory stimulation of children with ASD on the one hand, and by including sensory integration as an important part of the overall education and rehabilitation treatment in our country.

INTRODUCTION

Autism is an early developmental disorder. Autism spectrum disorder (ASD) is developmental disorders defined by impairment in social communication and social interaction as well as repetitive and restricted behaviors and interests (American Psychiatric Association, 2013). For ASD, behavior change is characteristic in all areas of the central nervous system: motor, perceptual, intellectual, emotional and social (Bujas Petković and Frey Skrinjar, 2010).Autistic children mostly have bizarre behavior, obsolete development and deviant development, which distinguishes most clearly the autism from other states (Milačić Vidojević, 2008).

People with ASD do not reject social contacts deliberately, but are incapable of realizing them and do not understand the social situation (Bujas Petković and Frey Škrinjar, 2010).The reasons for the lack of understanding of social situations and the disorientation in them are complex and multifaceted.

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Poor communication skills, lack of understanding, lack of a symbolic game, lack of abstract thinking and enjoyment in someone else's situation are just some of the causes of social isolation of people with autism.

Children with ASD as babies did not react when parents took them in their arms, and when they grow up they do not want to have any contact with their environment (Dmitrovic, 2005).Signs of autism can be very variable and different, but the disorders of social relationships are the most prominent symptoms of autism (Begovac, Vidović and Barišić, 2009). The general weakness in the development of linguistic communication skills stems from a cognitive disorder of the process of symbolization and sequencing (Ribić, 1991).So children with autism exhibit more cries than speech, constant physical restlessness or persistent silence (Golubović, 2004).

The results of epidemiological studies have shown that between two thirds and three quarters of children with autism have some form of intellectual deficiency (Glumbić, 2009). The symptom usually appears until the third year of life is over and it is considered that there is no tendency towards inheritance (Dmitrovic, 2005), although some studies indicate a very strong genetic component.The etymology of the ASD is

not yet well known, although it is very likely that these are various causes that give a similar clinical picture with the dominant symptoms of disorders of verbal and non-verbal communication, social interactions and stereotypical behavior (Bujas Petković and Frey Škrinjar, 2010) .

Due to neurological sensitivity, limitations in understanding the world, communication difficulties and difficulty in personality formation, children with ASD are also susceptible to the development of emotional disorders and behavioral disorders.Specific difficulties can also be manifested by the appearance of aggression, auto aggression, destruction, isolation, hypersensitivity to everyday and unknown situations, then the appearance of hypersensitivity or insufficient sensitivity to sound, sight, touch, and in the absence of self-control or incapability of just calming and relaxing.Problems in behavior, such as excessive activity, explosiveness, mood changes, aggression and self-harm, did not change with regard to different IQ results (Mayes, Calhoun, Murray and Zahid, 2011).

For a long time, a person with autism was hiding under the diagnosis of intellectual disbailities (ID). However, studies have shown that ASD prevalence is increasing over time, and that the prevalence of people with ID is relatively constant (Blaxitl, Baskin and Spitzer, 2002). An increase in the prevalence of autism over the past decades has been largely recorded in people who have preserved intellectual abilities, which means that the prevalence of persons with typical autism remained almost the same (Croen, Grether, Hoogstrate andSelvin, 2002).

It is evident that in the world the number of children with ASD is constantly increasing and there are numerous discussions about why this diagnosis is becoming more and more frequent (Dizdarević, 2013). Today, it is generally assumed that the incidence of autism is 4-10 children per 10,000 newborns, while the author (Guldberg, 2010) states that the incidence of autistic syndromes is significantly higher: from 20-40 children per 10,000 births. Recent studies show the prevalence of one to two cases per 1000 people for autism, and about 6 per 1000 for ASD; with an average ASD of 4.3: 1 for the male population. The prevalence of ASD in the United States is currently estimated to affect 1 in 68 children (Christensen *et al*. 2016).

In Bosnia and Herzegovina there are no official data on the number of children with ASD or children with ID, and we cannot talk about prevalence. The number of registered people with ASD has increased dramatically since the 1980s, partly because of the improved diagnosis of ASD, so it is still speculated that the percentage of ASD has really risen (Glumbić, 2009). The state as an "institutional parent" often appears to be a neglected parent, because the people who make up the childcare system are not sufficiently strengthened and supported to act in the best interest of children (Ajduković-Radočaj, 2012).

Sensory processes of children with ASD

In order to successfully communicate and participate in interactions with others, we need a certain state of alertness, sustainable attention and emotional responses/reactions. Crucially important is the process of incorporating all sensory data into one whole, which is called sensory integration, i.e., networking of sensory stimuli that come from the body and from the environment in the central nervous system. The integration of all nerve impulses occurs in the crust of the cerebrum consisting of a global system and multiple individual, specific systems. We do not pay any attention to them in everyday life, usually we are not even aware of them, which means that we are well sensually integrated (Greenspan and Lewis, 2004).

Everything we do requires sensory integration and when it comes to sensory data, it refers to the information (stimulus) that comes in tactile (touch), vestibular (movement and balance), proprioceptive (muscles and joints), auditory (hearing), visual (eyesight) and oral-gustative (taste and smell) system (Mamić and Fulgosi Masnjak, 2010).

Sensory integration is a neurobiological activity that allows the reception and processing of sensory information that come to the brain from different senses.Sensory integration disorder is a condition where the brain does not process or does not organize the flow of sensory impulses in a way that provides the individual with good, precise information about himself and his world. When the brain does not handle the sensory input, it also effectively does not control behavior. Difficulties may arise due to inadequate, insufficient, or poor sensory processing of the stimulus, which is manifested by difficulties or dysfunction of sensory integration. Only when all the individual systems operate in harmony; then there is a qualitative integration at the global level; we are well-oriented in the environment in which we are, and we feel and express ourselves in the emotional sense of the environment and ourselves (Fisher, Murroy and Bundy, 1991).

Without good sensory integration, learning is difficult, and an individual often feels uncomfortable and cannot easily deal with common demands and stresses.Feelings can be thought of as "brain foods," they provide the energy and knowledge needed to control the body and mind. But without a well-organized process of sensory processing, the senses cannot be digested and cannot feed the brain (Ayres, 2009).

Since most children with sensory integration disorders have almost the same amount of neurons as children without difficulties, their problem is caused by relationships (sensory) that work incorrectly (Ayres, 2009). Children with ASD do not respond to certain sounds, they are sensitive to the taste of certain foods, and are more often painless than children of typical development and children with mixed disorders (Hoshino *et al*., 1982). Some children with autism are described as sensory insensitive or have a high threshold in response to stimuli (Watling, Deitz and White, 2001). They differ from other children based on their sensory experiences too. Based on a survey of studies that included anecdotal and clinical reports, the prevalence of sensory sensation among people with autism was estimated to be between 30 and 100% (Dawson and Watling, 2000). Unpleasant sensory experiences can further contribute to the appearance of some more inappropriate and undesirable forms of behavior of children with ASD (Davis and Dubie, 2004).

Children with autism may be hypersensitive to sounds, they may look like deaf; may become fixed to a particular stimulus, for example, autistic people can focus on the earrings but not notice the person who carries them, which is a consequence of the problem of sensory processing (Frith, 1992). The degree of sensory difficulties in different domains can affect the functioning of various activities of everyday life.

Children with higher levels of tactile hypersensitivity have shown notable visual stereotypes, echolal repetitions and abnormally focused attention (Baranek, 1999). Childern with ASD have four sensory subtypes: Mild, Sensitive-Distressed, Attenuated-Preoccupied and Extreme-Mixed were identified, where the Mild and Extreme-Mixed subtypes reflected quantitatively different sensory profiles, while the Sensitive-Distressed and Attenuated-Preoccupied subtypes reflected qualitatively different profiles (Ausderau *et al*, 2014).

Inclusion of Sensory Behavior Difficulties in Criteria for Diagnosis of ASD in DSM-V (Gibbs, Aldridge, Chandler, Witzlsperger and Smith, 2012) is the best evidence that these children have a clinically significant experience of sensory hypersensitivity not observed among peers from the general population. For this reason, the new DSM-V (American Psychiatric Association, 2013) sensory issues are one of the four restricted / repetitive behavioral features defined as "hyper or hypo reactivity to sensory input or unusual interest in sensory aspects of the environment".

Differences in sensory response

Sensory issues and problems are clearly not unique to autism, where individuals with intellectual impairments or attention deficit disorder (ADD) may also exhibit sensory over/under-responsiveness (Grapel, Cicchetti and Volkmar, 2015).

The patterns of the sensory process of children with ASD or other pervasive developmental disorders with the control group of the typical population revealed the essential differences in the profile of the sensory processes for children with ASD, which indicate that the dysfunction of the sensory processes is one of the characteristics of autism (Baranek 2006). Comparison of the sensory processes of children with autism and children of typical development showed that 95% of children with autism versus 5-16.8% of children of typical development show certain difficulties in sensory processes (Tomchek and Dunn, 2007; Ahn *et al*., 2004).

Significant differences between ASD-children and children of typical development exist with regard to the frequency of sensory deficits in terms of hypo or hyper-sensitivity (Ismael, Lawson and Hartwell, 2018).

Research suggests that children with ASD have an increased response to auditory stimulation and withdraw, and often have the need for increased proprioceptive and vestibular input through self-stimulating, repetitive behaviors such as rocking, spinning, or flapping their hands (Case-Smith and Bryan, 1999 Tomchek and Dunn, 2007).It is precisely the sensitivity to sound stimulus in childhood that is a powerful discriminator between children with and without autism (Dahlgren and Gillberg, 1989).

Tomchek and Dunn (2007) conducted a study examining the difference in sensory processing between children with autism and children of typical development aged between 3 and 6 years.The results obtained showed that 95% of children with autism showed a certain degree of sensory dysfunction. A study conducted on the basis of parenting reports related to sensory responses of their children included four groups of children: autism, fragile x syndrome, combined disturbances, a typical population of up to 2.5 years of age.Children with autism and children with fragile x symptoms showed differences in relation to the remaining two groups and that they develop late, they are tactile and auditory more sensitive (Rogers, Hepburn and Wehner, 2003).

Sensory processing problems of ASD are believed to be an underlying factor related to behavioral problems, and may also influence a child's functional performance in daily activities, such as eating, sleeping, and daily routines, including bath time and bedtime behaviors (Schaaf *et al*., 2011).

Also, sensory processing disorders are common to children with intellectual disabilities and contribute, as well as ASD, to undesirable behaviors and performing daily activities (Kiani and Miller, 2010), and difficulties have been found in all sensory areas (Engel-Yeger *et al* ., 2011). Children with Down syndrome have a 25% chance of experiencing differences in population normative values in their processing of sensory experiences (Bruni, Cameron, Dua, and Noy, 2010).Children with Down syndrome show the difficulties of visual-spatial, visual memory, and visual sequencing abilities (Visu-Perta, Benga, Tincas, and Miclea, 2007; Wuang, Wang, Huang, and Su, 2008).

Thus, parents of children with Williams Syndrome often recorded vestibular, auditory, gustatory and proprioceptive hypersensitivities, while visual and tactile processing was not frequently reported as problematic (Janes, Riby and Rodgers, 2014).

An insight into the earlier studies clearly shows the difficulties of the sensory response of children with ASD. Incorporating the sensory processing deficit into the diagnostic criterion only recently, it suffices to say that this challenge in the treatment of children with ASD, as well as intellectual disabilities, has not received much attention. For this reason, the aim of this paper is to examine the sensory processes and to identify the sensory processes deficits of children with autism spectrum disorders in relation to children with intellectual disabilities and children of the typical population.

MATERIAL AND METHODS

Participants

Considering that there is no early intervention system in Bosnia and Herzegovina nor institutions supporting children with ASD and intellectual disabilities, it was very difficult to reach a sample of children with developmental disabilities who have already been diagnosed. We used data from centers for support for children with developmental disabilities within the NGO sector, that is, associations of parents of children with ASD and intellectual disabilities from all over the country. The criterion for inclusion in the sample is that children were diagnosed courtesy of a neuro-pediatrician and that they met the criteria set in DSM-V (APA, 2013). The criterion for inclusion of children of typical development was that they were included in the preschool program and were not under suspicion of developmental difficulties or that they used drugs. Where it could be done, the groups were equalized to the age and gender.This criterion was hard to satisfy because of the larger number of boys with ASD. The total sample (105 participants) included 35 children in each group.

Instrumentation

In order to test the sensory processes, not only of children with ASD but also with other conditions, the most widespread measuring instrument is the Sensory Profile (Dunn, Little,

Dean, Robertson, and Evans, 2016), which allows understanding of the sensory processing patterns of children with ASD and the effect of these patterns on children's participation at home, at school, and in community (Dunn, 2014).

Sensory processing of all three groups of respondents was carried out using the Short Sensory Profile questionnaire (McIntosch, Miller and Shyu, 1999). The test examines the seven sensory areas through 38 particles: Tactile sensitivity (7 items), Taste / smell sensitivity (4 items), Movement sensitivity (3 items), Unpleasant /Seeks Sensation (7 items), Auditory Filtering (6 items), Low energy / Weak (6 items), Visual / Auditory Sensitivity (5 items).Each item uses a choice of five responses on the Likert scale: 1-always, 2-often, 3-occasional, 4-rare, 5-never. Administration of the Short Sensory Profile takes about 10 minutes.

Data collection

Data collection was carried out in 2017 in Bosnia and Herzegovina. Children aged 3 to 8 years were included in the sample by a proportional stratified sample method that contributes to the representativeness of the sample units, and reduces the time and cost of collection. The assessment was carried out by the method of observing children during therapeutic activities individually with each child.In order to respect the ethical principles of the research, during the examination, each respondent or his legal guardian was informed in detail about the purposes of the collected data, the individuals were examined only with the personal approval of the parent / guardian, the respondents were provided with an adequate level of anonymity in order to protect their privacy.

Data Analysis

Descriptive statistics were used. Item analysis was used to calculate the basic statistical parameters related to the sensory processing of all three samples. A single-factor variance analysis (ANOVA) was applied to determine differences in the sensor profile in relation to the type of difficulty and to all sensory processing areas. To test the difference between the three groups of respondents we used the Tukey HSD test.

RESULTS

The average descriptive data for all three groups of respondents achieved in all 7 SSPs: the number of respondents in the group (N), the mean, the standard deviation, the standard error, and the lower and upper limits of acceptance of the interval of the arithmetic mean of the total scores of the sensory processes are given in Table 1.

Table 1 Descriptive data in relation to the type of disability

Type of disability	Number of respondents	Arithmetic mean	Standard deviation	Standard error	95% acceptability of the interval of the arithmetic mean	
					Lower limit	Upper limit
ASD	35	127,20	25,461	4,304	118,45	135,95
ID	35	135,57	22,909	3,872	127,70	143,44
TP	35	171,40	16,772	2,835	165,64	177,16
Total	105	144,72	29,095	2,839	139,09	150,35

Legend: ASD- Autism spectrum disorder, ID- intellectual disabilities, TP- typical development

The greatest deficit of sensory processes of children with ASD was detected in relation to children with intellectual disabilities and children of typical development, which shows the value of arithmetic mean 127.20, while the value of arithmetic mean of children with intellectual disabilities is 135.57, and the value of children with typical development was 171.40.

Table 2 presents a single-factor analysis of variance showing the sums of the deviation squares of the results from their mean value, the number of degrees of freedom, the arithmetic mean of the square of the deviation, the F ratio and the significance value.

Based on the results obtained, there is a statistically significant difference between the respondents in relation to the type of difficulty at $p < 0.05$.Based on the obtained results, the statistical significance of the subjects at $p < 0.05$: $F = 39.795$ was $p = 0.0001$.

Table 3 shows a single-factor analysis of the areas surveyed by the questionnaire in relation to the type of disability of children.

The statistically significant difference was recorded in all seven areas at the level of $p < 0.05$. In the area of auditory perception, the highest statistically significant difference was found at $p < 0.05$: $F = 33.029$ with $p = 0.0001$. By analyzing the descriptive data for this area, it is notable that the arithmetic mean of auditory of a child with ASD is 18,09, the arithmetic mean of children with intellectual disabilities is 19,57, and the arithmetic mean of children of typical development is 26,49 which indicates that children with ASD have the biggest deficit in the area of auditory perception.

In the area of Unpleasant /Seeks Sensation, a statistically significant difference was found at the level of $p < 0.05$: $F = 28.068$ with $p = 0.0001$.By analyzing the descriptive data for this area, it is notable that the arithmetic mean of unpleasant sensations of children with ASD disorder is 21.60, the arithmetic mean of children with intellectual disabilities is 24.06, and the arithmetic mean of children of typical development is 30.43, which indicates that children with ASD have the largest deficit in the area of unpleasant sensations.

In the area of tactile perception, a statistically significant difference was found at $p < 0.05$: $F = 27.528$ with $p = 0.0001$.By analyzing descriptive data for this area, it is notable that the arithmetic mean of tactile perception of children with ASD is 22.91, the arithmetic mean of children with intellectual disabilities is 26.89, and the arithmetic mean of children of typical development is 31.69, which indicates that children with ASD have the greatest deficit in the area of tactile perception.

In the Low energy/Weak region, a statistically significant difference was observed at $p < 0.05$: $F = 19.430$ with $p = 0.0001$.

Table 2 Single-factor analysis of variance in relation to the type of difficulty

	Sum of the deviation square	Degree of freedom	The arithmetic mean of the square of the deviation	F	Significance
Between the groups	38586,419	2	19293,210		
Within the group	49450,571	102	484,810	**39,795**	0,0001
Total	88036,990	104			

Table 3 Single-factor analysis of variances in relation to the type of difficulty

		Sum of the deviation square	Degree of freedom	The arithmetic mean of the square of the deviation	F	Significance
Tactile sensitivity	Between the groups	1350,419	2	675,210		
	Within the group	2501,829	102	24,528	27,528	0,0001
	Total	3852,248	104			
Taste/smell sensitivity	Between the groups	345,848	2	172,924		
	Within the group	2296,114	102	22,511	7,682	0,001
	Total	2641,962	104			
Movement sensitivity	Between the groups	250,076	2	125,038		
	Within the group	1322,914	102	12,970	9,641	0,0001
	Total	1572,990	104			
Unpleasant /Seeks Sensation	Between the groups	1453,390	2	726,695		
	Within the group	2640,857	102	25,891	28,068	0,0001
	Total	4094,248	104			
Auditory Filtering	Between the groups	1406,705	2	703,352		
	Within the group	2172,057	102	21,295	33,029	0,0001
	Total	3578,762	104			
Low energy/Weak	Between the groups	1077,390	2	538,695		
	Within the group	2828,000	102	27,725	19,430	0,0001
	Total	3905,390	104			
Visual/Auditory Sensitivity	Between the groups	563,371	2	281,686		
	Within the group	1776,857	102	17,420	16,170	0,0001
	Total	2340,229	104			

Table 4 Results of post hoc analysis, Tukey HSD test

(I) class	(J) class	The difference between the arithmetic mean (I-J)	Standard error	Significance
ASD	ID	-8,371	5,263	0,254
	TP	-44,200*	5,263	0,000
ID	ASD	8,371	5,263	0,254
	TP	-35,829*	5,263	0,000
TP	ASD	44,200*	5,263	0,000
	ID	35,829*	5,263	0,000

Legend: ASD- Autism spectrum disorder, ID- intellectual disabilities, TP- typical development

By analyzing descriptive data for this area, it is noticeable that the arithmetic mean of Low energy / Weak of children with intellectual disabilities is 21.57, the arithmetic mean of children with ASD is 24.34, and the arithmetic mean of children of typical development is 29.31, which indicates that children with intellectual difficulties have the biggest deficit in the Low energy / Weak area.

In the area of visual / auditory perception, a statistically significant difference was found at the level of $p < 0.05$: $F = 16.170$ with $p = 0.0001$.By analyzing the descriptive data for this area, it is notable that the arithmetic mean of attitudes of children with ASD is 18,14, the arithmetic mean of children with intellectual disabilities is 19,74, and the arithmetical mean of children of typical development is 23,66 which indicates that children with ASD have the largest deficit in the area of visual / auditory perception.

In the area of movement perception, a statistically significant difference was found at $p < 0.05$: $F = 9.641$ with $p = 0.0001$. By analyzing the descriptive data for this area, it is notable that the arithmetic mean of the perception of the movement of children with ASD is 9.51, the arithmetic mean of children with intellectual disabilities is 9.66, and the arithmetic mean of children of typical development is 12.86 which indicates that children with ASD have the greatest deficit in the area of movement perception.

In the area of taste / smell senses, the smallest statistically significant difference was found at $p < 0.05$: $F = 7.682$ with $p = 0.001$.By analyzing the descriptive data for this area, it is notable that the arithmetic mean of children with ASD in this region is 12.60, the arithmetic mean of children with intellectual disabilities is 14.09, and the arithmetic mean of children of typical development is 16.97, which indicates that children with ASD have the biggest deficit in the area of taste / smell senses.

Single-factor analysis of variance ANOVA confirmed that the sub-examinees of the respondents differ statistically between themselves but did not give us an answer on which groups they are working on. To validate who makes that difference, we used one of the post hoc tests, the Tukey HSD test.

To confirm who makes this difference, we used a post hoc test, a Tukey HSD test. Statistical significance has been established between a group of children with ASD and children of typical development, as well as a group of children with intellectual disabilities and children of typical development. Children with ASD have the greatest deficit of sensory processes in relation to children with intellectual disabilities and children of typical

development, which coincided with the results of post hoc analysis applied to the whole Short Sensory Profile.

DISCUSSION

On the basis of the obtained results, as expected, the largest deficits in the sensory processes in all seven examined areas were shown by children with ASD, compared to children with intellectual disabilities and children of typical development. These results of the research are consistent with the results of the sensory processes of children with ASD from other countries. Early studies described a pattern of sensory modulation and mobility disorders that have an effect on all sensory systems in more than 70% of children with autism under 6 years of age (Ornitz *et al*, 1978). Although it was sometimes thought that only a small number of children with autism exhibited irregularities in perception (Ornitz *et al*., 1977), today it is known that children with autism have widespread problems with significantly more severe symptoms than those mentioned (Kientz and Dunn, 1997). Volkmar and colleagues (1986) did not find any answer to sound (81%), sensitivity to loud sounds (53%), visual overview of hands or fingers (62%). This suggests that children with autism have dysfunctional auditory, visual, tactile and oral treatment that is significantly different from the control group.

CONCLUSIONS

The results obtained in our study do not significantly differ from the previous results in the world.The difficulties of sensory integration and processing of children with ASD significantly affect the learning ability of these children and all related forms of work. The results support the incorporation of sensory behavior criteria into the ASD diagnosis process itself, and special attention should be paid to modulating the sensory stimulation of children with ASD on the one hand, and by including sensory integration as an important part of the overall education and rehabilitation treatment in our country, on the other. These results should encourage decision-makers to include sensory integration as part of a therapeutic workload in children's education programs and education of children with the aim of maximizing the potential of the child and enhancing learning opportunities by modulating sensory inputs.Here, many authors emphasize the difficulty of the inconsistency of the requirements that are placed to a child with ASD and its characteristics.In our practice, this is often the case, which requires special training of educators-rehabilitators during the first cycle of studies with content from the field of sensory integration not only in the field of ASD learning but also in the field of intellectual and other developmental difficulties such as ADHD, dyslexia, learning difficulties, etc.

Such research will help us identify specific sensory processes and typology of behavior of autism that will enable more targeted intervention approaches and hence improve the allocation of resources for this population. Stimulating sensory integration is one of such approaches, which allows the integrity of sensory and emotional experiences, which results in the stimulation of sensory integration more durable due to these stronger feelings that children experience.

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