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Sensory Integration Dysfunction in Children with Learning Difficulties

Efektywność terapii integracji sensorycznej u dzieci z trudnościami w uczeniu się

SUMMARY

In the article, conclusions from different research projects carried out by scientists over several decades are presented. They concern the co-occurrence of different sensory dysfunctions, including even genetic ones, as well as learning difficulties. The efficiency of therapeutic measures taken within sensory integration therapy has also been described.

Keywords: review of research on reasons for learning difficulties; sensory dysfunction; sensory integration; sensory integration therapy

INTRODUCTION

First reports of studies concerning sensory integration dysfunction in children with learning difficulties (dyslexia) emerged in the late 1960s when Anna J. Ayres, PhD, psychologist, special educational needs professional and occupational therapist, published research outcomes indicating that sensory integration dysfunction affects postural responses, muscle tone, motor planning, speech development, behavior, emotions, and cognitive function. She then formed the first sensory processing theory which was then, based on follow-up studies, refined in the following years. In 1967,

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in an article titled "Types of Perceptual Motor Deficits in Children with Learning Difficulties", which was included in a collaborative publication *Readings in Learning Disability*, she published outcomes of a study carried out on a group of children who had been diagnosed with learning disabilities. On their basis, she isolated and specifically described behaviors common among those children. They included tactile defensiveness, bilateral motor coordination deficits, apraxia and dysfunctional perception of three-dimensional space. She noticed that all these indicators only appeared in children with learning difficulties who exhibited impairments in the sensory integration domain. Ayres concluded that perceptuomotor problems are related to disturbed integration of input coming from more than one sensory organ. In all children studied, she noticed disturbances in the function of at least two senses. Most of Ayres' publications regarding sensory integration were published in the early 1970s.

In her book *Sensory Integration and Learning Disorders*, published in 1972, Ayres presented Southern Californian tests of sensory integration. She pointed out the usefulness of sensory integration tests in diagnosing the causes of learning disorders, and in the case of such problems being exhibited by a child, the use of suitable therapeutic measures was proposed. Through an analysis of the results of her own research and references to other authors' research studies, she concluded that, in children exhibiting learning difficulties, problems with the following can be observed: muscle tone, balance responses, eye movements, bilateral motor coordination, reflex integration, co-contraction, crossing the midline, movement planning, body schema (Ayres 1972). From 1974 until 1976, Ayres was providing sensory integration therapy to two groups of children with learning problems. Based on the obtained results, she assumed that sensory integration therapy produces desired outcomes, especially in regard to children with disruptions of vestibular-proprioceptive input processing (Ayres 1976).

That fact that there is a number of relationships between behavioral problems and the manifestation of retained reflexes (ATNR, STNR, TLR) in children with learning difficulties (dyslexia) was also observed by Arlene Finocchiaro (1974). She observed differences in the severity of behavioral disturbances and their manifestation between children with learning difficulties who exhibited retained reflexes and children who did not retain those. She also noted that the asymmetrical tonic neck reflex is more exacerbated among children with dyslexia (Przyrowski 2004).

In the research conducted in the 1980s, which aimed at identifying vestibular system disturbances in children with learning disorders, it was concluded that impaired vestibular processing affects a child's inappropriate function in the motor domain. There were suggested measures to enable quick diagnosis and to tailor individual therapy to a given child's needs before they even start school.

Herbert Petri and Mortimer Mishkin (1994) pointed out the disrupted coordination of eye and head movements in children with learning difficulties. They observed significant differences in eye and head movement coordination mechanisms in children with learning difficulties and those who did not have such problems. Petri and

Mishkin (1994) highlighted the fact that those differences might be related to abnormal vestibular system function, which is involved in the coordination of eye and head movements, which, in turn, is especially important for reading. On the other hand, Barbara Knieckerbocker (1980) described ways of executing the diagnostic process and sensory integration therapy among children with learning difficulties.

Rachel Mayberry and Hayley Gilligan (1985) studied eye movements in children with mental retardation, cerebral palsy and learning disorders. The following aspects of movements were studied: movement fluidity, crossing the midline, binocular eye movement and the independence of eye movements from head movements. All groups of children that were the focus of the study scored lower than children from the control group. A correlation between postural responses and eye movements was also observed. However, no clear correlations between post-rotatory nystagmus and following eye movements were observed.

Sharon A. Cermak, Elizabeth A. Ward and Lorraine M. Ward (1986) noted that children with learning difficulties differ from their peers without learning problems in terms of the ability to cross the midline. The authors explained the difficulties of crossing the midline with poor hemispheral coordination in children with reading difficulties. Moya Kinnealey, Barbara Oliver and Patricia Wilbarger (1995) worked on studies on children with learning difficulties with regard to the choice of activities during sensory integration therapy. Based on the outcomes of those studies, she pinpointed which vestibular-system-stimulating activities are most often preferred by children with learning difficulties and how this affects the progress of therapy.

In the late 1980s, Barbara Fisher and Alexander Wilson (1987) observed significant differences in the development of balance responses (which are often associated with sensory integration dysfunction) between a group of children with learning difficulties and a group of normally functioning pupils. They also observed that there were some differences in scores from samples formed to examine balance in a group of boys with learning difficulties. It was assumed that there are two groups of boys with balance disturbances and learning disorders. One in which there were balance disturbances related to a sensory system dysfunction and another one with individuals exhibiting balance disturbances without clear signs of a sensory system dysfunction.

Valerie O'Brien, Sharon Cermak and Elizabeth Murray (1988) published the results of a study of children with learning difficulties and sensory integration dysfunction manifested in the form of dyspraxia. They assumed that the severity of sensory integration dysfunction (dyspraxia) correlated with the severity of dysfunction in the domain of visual perception and visual-motor coordination.

Anita Bundy (1991) presented outcomes of research studies conducted with the use of the Southern California Praxis Tests. They detailed not only the disorders but also the approaches used in sensory integration therapy. In their book, they published the results of studies on children with autism, mental retardation, hyperactivity as well as learning difficulties, among others, and they also characterized

the therapeutic strategies used in these children, which help to overcome sensory integration dysfunction.

In 1995, Erna Blanche, Tina Botticelli and Mary Hallway presented the results of many years of observation and personal experience in providing therapy for children with autism, fragile X syndrome, Down syndrome and learning difficulties (dyslexia). They pointed out the possibility of combining the NDT (neurodevelopmental treatment) approach and sensory integration therapy in helping children with cerebral palsy.

Carol Kranowitz (2012) described the symptoms of sensory integration dysfunction that occur in children with learning difficulties. He also indicated the most effective ways of overcoming them and emphasized the significant relationship between intramodal and intermodal dysfunction of integration of the vestibular, proprioceptive and tactile systems in some learning disorders.

The first article on sensory integration therapy in Poland appeared in 1993 in the specialty periodical "Wspólna Troska" dedicated to therapists working with children with damage of the central nervous system. In that article, Aleksandra Kałużna (2004) presented sensory integration therapy. In 1995, Zbigniew Przyrowski outlined sensory integration dysfunction in children with learning difficulties (dyslexia), while also drawing educators' and psychologists' attention to the sensory integration theory's role in the therapy of children with this problem. The objective of that article, which was dedicated to specialists in the field of therapy of children with dyslexia, was to create awareness of the need and the option to utilize sensory integration therapy to overcome learning difficulties.

In 1998, Violet F. Maas presented the sensory integration theory more broadly for the first time in Poland. The author described different types of sensory integration disorders, particularly emphasizing their occurrence in children with learning difficulties. In 1998, Przyrowski, presented the sensory integration disorders, which one can observe in children with cerebral palsy, based on a literature review and his own experience. The author also presented a type of sensory integration dysfunction that also occurs most commonly in children with dyslexia, i.e. postural dysfunction and dyspraxia.

In 2001, Przyrowski described the process of diagnosing sensory integration disorders with the help of clinical observation samples created by Ayres, and published a Questionnaire for Assessment of Sensorimotor Child Development, Prone Extension Test, Assessment Scale for the Measurement of Asymmetrical Tonic Neck Reflex (*Skala do Mierzenia Asymetrycznego Tonicznego Odruchu Szyjnego*). In the early years of the 21st century, a number of Polish-language publications came out, indicating a relationship between sensory integration dysfunction in children with dyslexia, however, the main foundations for our knowledge of sensory integration disorder had been laid by the above authors through their expanding on Ayres' theory.

It is obvious that the presented review of research studies is not exhaustive. Despite that, on their basis, it can be assumed that the following can be present in children with learning difficulties and sensory integration problems:

- disturbances in the development of postural responses, including balance, defense responses, background postural responses, co-contraction,
- disturbances in muscle tone regulation, most commonly in the form of hypotonia,
- abnormal development of eye movements, including the vestibulo-oculo-motor reflex,
- reduced post-rotatory nystagmus,
- impairments in crossing the midline,
- abnormal distribution of muscle tone,
- abnormal function of the shoulder and hip girdles,
- abnormal dissociation between the shoulder and hip girdles,
- impairments in the development of bilateral motor coordination and differentiation of right and left,
- abnormal development of movement coordination and visual-motor coordination.

Those impairments are related to the processing and integration processes, mainly those of vestibular and proprioceptive input, and, to some extent, tactile as well.

RESEARCH ON THE IMPACT OF SENSORY INTEGRATION THERAPY AFFECTING SENSORY INTEGRATION DISORDERS IN THE CONTEXT OF LEARNING DIFFICULTIES

In the publication by Jacek Szmalec (2019), which contains detailed research criteria and a description of the adopted research method, the author investigated sensory integration therapy conducted for 9 months in children showing disorders in this sphere in terms of their cognitive competences, which are one of the indicators illustrating learning difficulties.

The study was conducted on children who were qualified to either the experimental group (50 children) or the control group (healthy children – 50 children) according to the following criteria:

- age: between 5–6 years old,
- gender: the same number of girls and boys in every studied groups,
- family situation: all examined children grew up in full families,
- place of residence: the families of children lived in towns of up to 40,000 residents,
- housing conditions,
- attending kindergarten,
- his or her in the intellectual norm according to the diagnosis of the Psychological and Pedagogical Counseling Center.

The experimental group included children whose guardians or parents observed abnormalities in the child's development, which they signaled to specialists: doctors, psychologists, teachers from two to four years before coming to a sensory integration therapist. The type of developmental disorders in terms of abnormalities regarding postural tension, balance, dissociation and location of the visual stimulus along with sensory integration processes were assessed during a diagnostic session, individual for each child. The Southern California Sensory Integration Tests, clinical observation sheet and school readiness scales were used to assess the condition of children with the disorder before and after treatment. The tests were conducted by certified sensory integration therapists.

The obtained results showed a significant improvement in the motor functioning of children with sensory integration disorders in terms of all motor parameters, and bringing their results closer to the results of children from the control group, i.e. healthy children.

The author investigated whether sensory integration therapy, contributing to improving the overall functioning of the child by improving its motor functions, constitutes the basis for achieving school readiness, which would mean that participation in sensory integration therapy of 5–6-year-old children in the intellectual norm positively affects their cognitive competences. Children in the study group received an average of 17.3 points before therapy (±2.5; median equal 18), and after treatment their results increased (average 30.3 ±2.3; median 30). The increase was statistically significant, which was confirmed by the Wilcoxon test at the level of $p < 0.001$. The control group also recorded higher results after 9 months (Wilcoxon test, $p < 0.001$) – the average result increased from 30.4 (±1.9; median 30) to 35.7 (±0.6; median 36). In addition, comparison of the Mann–Whitney *U* test results obtained in both groups allows the determination of the significance of differences in both the initial and final results – in both cases $p < 0.001$ was obtained. In the examined group before the treatment all results were in the "medium" category, whereas after the therapy – in the "high" category. The statistical significance of this change was confirmed by a character test ($p < 0.001$).

The situation in the control group did not change – twice all the results were classified as high. When comparing the results of the study group and the initial control group, Fisher's test showed statistical significance at $p < 0.001$ (Szmalec 2019).

SENSORY INTEGRATION THERAPY

According to the Regulation of the Minister of National Education of 17 November 2010 concerning the guidelines for providing and arranging psychological and educational support in state kindergartens, schools and other institutions (Journal of Laws 2010, No. 228, item 1487), educational facilities are obligated to "identify

the individual pupil's needs and the type and extent of support needed. This is only possible through the collaborative work of multidisciplinary teams for psychological and educational support present in every school" (Wiśniewska 2012). It is more and more common for such teams to include an occupational therapist who largely uses sensory integration therapy in their practice.

Sensory integration therapy incorporates a range of activities and games which the child should perform and so it is therefore named "scientific play". Sensory integration therapy is a form of goal-oriented play. In such a therapy, the child does not learn particular skills but rather aims to improve intersystem integration in the central nervous system. The therapist stimulates the child's senses and helps to improve their fine and gross motor function as well as visual-motor coordination.

The objective of sensory integration therapy is therefore to improve the integration of the senses, and "to provide and control sensory input in such a way that the child spontaneously forms the adaptive responses that integrate these sensations" (Ayres 1981). The therapist restricts, eliminates or inhibits the input in the case of sensory hypersensitivity, but also provides strong input in the case of hyposensitivity. At the same time, they observe and analyze the child's behavior, constantly choosing and modifying the activities so that they can accommodate the child's needs and abilities as well as their mood (Przyrowski 2012). The activities should be neither too easy nor too difficult for the child. They ought to be derived from the developmental sphere that is closest to the child since activities close to the child's limit improve central nervous system organization and have a modificatory influence on the child's behaviors within the motor and emotional domains. They also improve cognitive and language function, as well as impact the effectiveness of learning. Therefore, there is no repetitive activity scheme in sensory integration therapy. For therapy purposes, specific equipment and devices are utilized, which are to encourage the child to engage in the activity while simultaneously providing appropriate sensory input. "Through play, that is enjoyable and interesting to the child, integration of sensory input occurs in the central nervous system, which allows better organization of action" (Wiśniewska 2006). While utilizing this method, the therapist improves gross motor skills, fine motor skills, balance, bilateral motor coordination, praxis. For this purpose, the following hanging equipment is put into use: teeter-totters, swings, hammocks and trampolines, dry pools, skateboards, slides, balance boards, tunnels as well as fine objects for manual play. The therapy is tailored to the individual needs and abilities of the child. During therapy sessions, the therapist makes observations of the child's behavior as well as performs various tests. The atmosphere during sessions facilitates the mobilization of its participants. As the child succeeds, their self-esteem increases and they willingly partake in those sessions. The experience gained in the area of self-control and behavior is transferred to other situations. The change is noticed by parents and teachers. Not only does the child's functioning in the environment change, but also their image.

CONCLUSIONS

From scientific research on the occurrence of various sensory integration disorders and dysfunctions with the co-occurrence of learning difficulties, in the broad sense of the term, it can be concluded that individuals with learning difficulties usually have some sensory dysfunction, and the causes of their problems can even be genetically-based. In order to eliminate or decrease the negative impact of sensory integration dysfunction on the effectiveness of learning, maximum sensory integration should be achieved through the means of measures taken as a part of sensory integration therapy, which should be tailored individually to every patient.

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STRESZCZENIE

W artykule przedstawiono wnioski z projektów badawczych przeprowadzonych w ciągu kilku dekad. Dotyczą one współwystępowania różnych dysfunkcji sensorycznych (w tym genetycznych) oraz trudności w uczeniu się. Opisano pomiary efektywności podjętych działań terapeutycznych z zakresu terapii integracji sensorycznej.

Słowa kluczowe: przegląd badań na temat przyczyn trudności w uczeniu się; dysfunkcje sensoryczne; integracja sensoryczna; terapia integracji sensorycznej