

Shokoufeh Mousavi¹, Alireza Aghayousefi¹, Sayed Mohsen Zadehossein¹,
Esmail Honejani², Nooshin Mirjahanian³

Received: 31.01.2017
Accepted: 29.05.2017
Published: 29.09.2017

Episodic memory in students with cerebral palsy

Pamięć epizodyczna u uczniów z porażeniem mózgowym

¹ Department of Psychology, Payame Noor University, Tehran, Iran

² Master of Science in Psychology, Department of Education, Isfahan, Iran

³ Department of Psychology, Khomeshahr Branch, Islamic Azad University, Khomeshahr/Isfahan, Iran

Correspondence: Shokoufeh Mousavi, Department of Psychology, Payame Noor University, PO BOX 19395-3697, Tehran, Iran, tel.: +98-21-23320000, e-mail: researchpnu@yahoo.com

Abstract

Objective: Motor defects in children with cerebral palsy ultimately negatively affect all the aspects of their development. Memory is one of the most important of these aspects. The present study has been aimed at comparing the episodic memory among students who suffer from cerebral palsy and healthy students. **Material and methods:** The research method in this study was a comparative causal method. A total of 36 middle school and high school students have participated. The researchers first visited Taha School for children with physical and motor disabilities in Isfahan (Iran), and selected 18 of their students with cerebral palsy for the study (the total number of students with cerebral palsy in that academic year was 25, some of whom had severe disabilities and thus were not able to do the physical assignments of this study, hence they could not be selected). Then, considering the age, gender and socioeconomic condition of the group of students, a comparative group of healthy samples (18 persons) were matched with them. Verbal tasks and subject-performed tasks were applied to assess the students' episodic memory. The memory was evaluated with a free recall test. **Results:** The results of *t*-test and ANOVA showed a significant difference between cerebral palsy students and the healthy ones in memory tasks. Overall, the students with cerebral palsy have shown fair and poor performance in verbal and practical memory tests compared to the healthy students. **Conclusions:** Dysfunction deficits and speech disorders are factors reducing the cognitive abilities of children affected by cerebral palsy. The studied children do not have enough ability to explore the surrounding world, which reduces their overall cognitive capacity. In this respect, impaired memory is an important part of their deficient cognitive functioning overall.

Keywords: episodic memory, verbal memory, practical memory, cerebral palsy

Streszczenie

Cel pracy: Zaburzenia motoryczne u dzieci z porażeniem mózgowym wpływają niekorzystnie na wszystkie aspekty ich rozwoju, w tym także na pamięć. Niniejsza praca ma na celu porównanie pamięci epizodycznej w grupach uczniów z dziecięcym porażeniem mózgowym i uczniów zdrowych. **Materiał i metoda:** W pracy wykorzystano przyczynową metodę porównawczą. Badaniem objęto łącznie 36 uczniów w wieku gimnazjalnym i ponadgimnazjalnym. Autorzy przeprowadzili badania w szkole Taha w Isfahanie (Iran) dla uczniów z niepełnosprawnością fizyczną, kwalifikując 18 uczniów cierpiących na mózgowie porażenie dziecięce (całkowita liczba uczniów z mózgowym porażeniem dziecięcym uczęszczających do placówki w tym roku szkolnym wynosiła 25, jednakże niektórzy z nich dotknięci byli poważną niepełnosprawnością, uniemożliwiającą im wykonanie zadań ruchowych będących częścią badania, nie mogli więc w nim uczestniczyć). Następnie uwzględniając wiek, płeć oraz status socjoekonomiczny wyłonionej grupy uczniów, dopasowano do nich grupę porównawczą zdrowych uczniów (18 osób). W badaniu wykorzystano zadania werbalne oraz zadania motoryczne. Pamięć epizodyczną mierzono za pomocą zadań typu *free recall* (swobodnego przypominania). **Wyniki:** Wyniki testu *t*-Studenta oraz analizy ANOVA wskazują na istnienie statystycznie istotnej różnicy pomiędzy uczniami z porażeniem mózgowym a uczniami zdrowymi w zadaniach pamięciowych. Ogólnie rzecz biorąc, uczniowie z porażeniem mózgowym osiągnęli umiarkowane i słabe wyniki w zadaniach werbalnych i pamięciowych w porównaniu z uczniami zdrowymi. **Wnioski:** Dysfunkcje ruchowe oraz zaburzenia mowy są czynnikami ograniczającymi zdolności kognitywne dzieci dotkniętych porażeniem mózgowym. Badane dzieci nie mają wystarczającej możliwości poznawania otaczającego świata, co ogranicza ich ogólną zdolność poznawczą. Upośledzenie pamięci jest więc istotną częścią ogólnego deficytu funkcji poznawczej u dzieci z porażeniem mózgowym.

Słowa kluczowe: pamięć epizodyczna, pamięć werbalna, pamięć praktyczna, porażenie mózgowie

INTRODUCTION

Cerebral palsy is defined as a non-progressive disorder in a growing brain. It causes the occurrence of motor, conditional and neurological disabilities in the developing child (Rogers, 2005). It occurs at the early stages of brain formation and in early years of life, being in fact one of the most common disabilities in children, with its prevalence estimated at 1–3.2/1000 live births (Toopchizadeh et al., 2008).

There are various causes for cerebral palsy, including genetic, congenital, metabolic, and inflammatory factors as well as infection and hypoxia (Weierink et al., 2013). All children with cerebral palsy suffer from a form of brain lesion which usually involves motor pathways. Motor deficiency and muscle weakness is one of the main characteristics of cerebral palsy. There are numerous secondary disorders in this field, such as cognitive, sensory, mental–social defects, which differ depending on the type and intensity of the cortical involvement (Pellegrino, 2002).

To date, studies on children with cerebral palsy have mostly focused on their movement ability, yet there is a body of evidence that the symptoms of cerebral palsy extend beyond motor disorders (Rosenbaum et al., 2007). Movement disorders are mostly grouped together with cognitive and behavioural disabilities and sensory performance (Bottcher, 2010). The problem faced by children with cerebral palsy more than healthy ones is establishing social relationships with their peers (Whittingham et al., 2010).

Researches have shown that the motor defects of children with cerebral palsy ultimately negatively affect all the aspects of their development (Litosh, 2002). One of the most important of these aspects is memory.

The recent studies on memory show that at present no conceptual definition of memory as a general component is assumed by specialists, but each of its different types is considered as a separate notion. Generally, memory is learning information through encoding, accumulation and recovery. Encoding means putting information in memory, accumulation is keeping information in time, and recovery means retrieving the saved information (Santrock, 2001).

Memory has been divided into various types, such as long-term memory versus short-term memory, active memory, semantic memory, emotional memory, etc., with episodic memory considered as one of the types of long-term memory (Mousavi et al., 2017b; Movahed Abtahi, 2010).

Episodic memory is one's conscious memory of events as episodes of their lives, such as their 16th birthday party, falling off a bike, or what they had for breakfast today. Episodic memory is in fact a memory of remembering (Sousa, 2006). This type of personal memory is mixed with emotions and is detailed. The main feature in episodic memory is that it is associated with a specific moment in time, not with any time or the entire time, but with the time that one experiences themselves (Conway, 2008). Recent studies have shown that episodic memory is self-awareness as

a continuous existence in time and the possibility of a mental conscious experience (Mousavi et al., 2017a; Söderlund et al., 2008).

Peeters et al. (2009) carried out a study aimed at reviewing the development of reading skills in children with cerebral palsy and comparing them with healthy children. They showed that children with cerebral palsy with additional speaking disorders encounter more risks in fully developing this ability.

The study by Assis-Madeira et al. (2013) reviewed the ability to express events and occurrences as one of the skills vital for performing everyday activities and expressing personal experiences, which can be considered as a part of episodic memory. They showed children with cerebral palsy to perform worse than healthy children in this area.

Khayat-zadeh Mahany et al. (2011) investigated the problems that children with cerebral palsy face, and showed speaking difficulties to account for the highest rate of problems among these children. They also showed a significant relationship between the level of motor function and mental and speech problems, eating, seizures and the number of accompanying problems.

In Iran, many studies have been carried out in the field of cerebral palsy and the disorders it causes (Khayat-zadeh Mahany et al., 2011; Khodapanahandeh, 2004; Toopchizadeh et al., 2008), but there is scarce information about the difference between the episodic memory of healthy and ill children, and few studies have been conducted to investigate this issue. Thus, this study attempts to compare and investigate speech and performance memory of students with these disorders, and compare them with healthy children.

MATERIAL AND METHODS

The research method used in this study has been a comparative causal method. Thirty-six middle school and high school students have participated. The researchers first visited Taha School for children with physical and motor disabilities in Isfahan, and selected 18 of their students for the study (the number of all of the students with cerebral palsy in that academic year was 25, some of whom had severe disabilities and were not able to perform the physical assignments of the study, hence they could not be selected). Then, considering the age, gender and socioeconomic condition of the group of students, the comparative group of healthy samples (18 persons) were matched with them ($p > 0.60$).

Episodic memory test

In this study, the episodic memory test included 32 short imperative sentences selected based on the study by Mousavi and Karami Nouri (2009). Thirty-two sentences were divided into two 16-sentence lists, and each of them were used to test verbal and practical memory. In order to do the episodic memory tests, after presenting the instructions and some examples, the participant is asked to do some assignments, and after the list is finished, in order to create

Types of memory	Number	Mean	SD
Verbal memory			
Student with cerebral palsy	18	2.44	1.10
Normal students	18	3.66	1.05
Practical memory			
Student with cerebral palsy	18	6.11	1.11
Normal students	18	7.88	1.31

Tab. 1. Descriptive characteristics (mean and standard deviation) of performed tasks

a time distance between the stages of encoding and accumulation, a semantic memory test is performed. The reason for the creation of this distance was for the long-term learning memory to be formed for the testees.

In order for the students not to use practical strategies in speech encoding, the speech list was what presented to the participants first. In the speech-related assignment, some sentences are read to the testees and they must repeat and memorize them. After presenting a speech list and creating an approximately 30-minute distance (at that time the testees received the semantic memory test), the free accumulation test was performed, during which a white sheet is handed out to the participants, and they are asked to write down any number of sentences that they remember in their order of preference. Then, the second list of the sentences is given to them, and they must do the assignment with the tools also given to them, after hearing the sentences. After finishing the list and a 30-minute time interval (semantic memory tests), the testees again receive the test sheet associated with free accumulation.

Each test is taken by an individual, and it took about 150 minutes for each testee. It was attempted to provide a peaceful and quiet environment without traffic to the extent possible. For each time the testee remembered the original sentence, he or she was given a score of one point.

RESULTS

The mean and standard deviation (SD) of tasks in the two groups (cerebral palsy and healthy students) are shown in Tab. 1.

The results of *t*-test between the two groups are shown in Tabs. 2 and 3. According to the results, there was a significant difference between the groups of cerebral palsy and normal students, so that testees with cerebral palsy had

Index	<i>t</i>	<i>df</i>	Two-tailed significance
Verbal	-2.295	34.000	0.036

Tab. 2. Results of *t*-test between the two groups in the verbal task

Index	<i>t</i>	<i>df</i>	Two-tailed significance
Practical	-3.094	34.000	0.007

Tab. 3. Results of *t*-test between the two groups in the practical task

Sources	SS	Df	MS	F	Sig
Between group	6.126	1	6.125	-	-
Intergroup	18.611	34	1.163	5.266	0.036
Total	24.736	35	-	-	-

Tab. 4. Summary of ANOVA results for the scores of testees in verbal task

Sources	SS	Df	MS	F	Sig
Between group	14.222	1	14.222	-	-
Intergroup	23.778	34	1.486	9.570	0.000
Total	38.000	35	-	-	-

Tab. 5. Summary of ANOVA results for the scores of testees in practical task

a lower performance than normal students. ANOVA analysis was also performed where a significant difference was found. The summary of ANOVA results for both verbal and practical tasks are shown in Tabs. 4 and 5.

DISCUSSION AND CONCLUSION

The aim of the study was to investigate the differences between verbal memory and practical memory in students with cerebral palsy and healthy students. The results of this study listed in Tab. 1 show that average verbal memory in testees with cerebral palsy and healthy students was 2.44 and 3.66, respectively, hence the difference between the two groups was significant, as shown in Tab. 2 (sig = 0.036 and *t* = -2.295). The results also show that average practical memory in testees with cerebral palsy and healthy students was 6.11 and 7.88, respectively, which is a statistically significant difference between the two groups, as shown in Tab. 3. (sig = 0.007 and *t* = -3.094). Generally, the results show higher mean scores in both practical and verbal memory in healthy students.

The obtained results are consistent with the findings of Peeters et al. (2009), Assis-Madeira et al. (2013), and Khayatzadeh Mahany et al. (2011) concerning the presence of the deficiency of motor and cognitive functions in patients with cerebral palsy in comparison with healthy participants.

Motion is considered to be one of the most important needs in human natural development. Performing basic motor skills, such as crawling, walking and jumping is very satisfying for a child. However, children who lack these motor capabilities are deprived of such a blessing (Balouchy and Ghaeni, 2009). The presence of a disorder in various functions of the motor system of children with cerebral palsy causes reduction of the working capacities of their upper organs, and ultimately limits their environmental capabilities and social compliance (Spencer, 1999).

The evidence at hand shows that the disorders in the functional performance and cognitive function of these patients might create problems in their social participation and educational potentials (Bottcher et al., 2010). The functional performance includes various behaviours including control, planning for motion, initiating a behaviour, and response

inhibition (Collette et al., 2006). This disorder weakens the function of the person in the practical memory test in comparison with healthy people.

Pirila et al. (2007) believe that most children with cerebral palsy also suffer from speech disorders, a problem that might occur due to motor disorders.

Speech disorders are seen in more than 80% of the children with cerebral palsy (Odding et al., 2006). The prevalence of these disorders has a significant relationship with the type and intensity of motor involvement (Shevell et al., 2009). The delay in cognitive growth and an IQ lower than average is seen in 50% to 75% of these children. These disorders can vary from mild to severe (Odding et al., 2006). Also, 15% to 60% of these children also suffer from seizure and epilepsy, and when this disease is accompanied by epilepsy, it provides the substrate for cognitive defects (Khodapanahandeh, 2004). Therefore, the presence of cognitive disorders leads to the reduction of the function of the person with cerebral palsy in speech memory tests in comparison with healthy people. Overall, cerebral palsy as a disease that comes with motor defect and weakness can be concluded to create the substrate for the creation of a disorder of cognitive activities including memory. In other words, motor weakness in the child with this disease leads to not having the sufficient movement to explore and discover their surrounding world, and as time goes by, their cognitive capacity reduces. Memory, as an important part of the cognitive function, is harmed in this respect. The person with cerebral palsy, in comparison with a healthy person, is not able to repeat tasks while performing the assignments associated with verbal and practical memory, and then talk about them and repeat them. Therefore, the verbal and practical memory, and in total the episodic memory of that person are weaker than a healthy person's. Investigation of other types of memory in cerebral palsy patients and their comparison with healthy subjects have not been a part of this study. Thus, further research is recommended to study cerebral palsy patients regarding their long-term memory, semantic memory, active memory, emotional memory and other types of memory. Also, interventions in the field of improvement of memory in patients from this group are much needed, with their effects on different types of memory investigated.

Conflict of interest

The authors do not report any financial or personal links to other persons or organizations that might adversely affect the content of this publication and/or claim authorship rights thereto.

References

- Assis-Madeira EA, Carvalho SG, Blascovi-Assis SM: Functional performance of children with cerebral palsy from high and low socioeconomic status. *Rev Paul Pediatr* 2013; 31: 51–57.
- Balouchy R, Ghaeni S: [Physical fitness of the children infected with cerebral paralysis through a work-group of "therapists – children – parents"]. *Scientific Journal of Ilam University of Medical Sciences* 2009; 17: 16–23.
- Bottcher L: Children with spastic cerebral palsy, their cognitive functioning, and social participation: a review. *Child Neuropsychol* 2010; 16: 209–228.
- Bottcher L, Flachs EM, Uldall P: Attentional and executive impairments in children with spastic cerebral palsy. *Dev Med Child Neurol* 2010; 52: e42–e47.
- Collette F, Hogge M, Salmon E et al.: Exploration of the neural substrates of executive functioning by functional neuroimaging. *Neuroscience* 2006; 139: 209–221.
- Conway MA: Exploring episodic memory. In: Dere E, Easton A, Nadel L et al. (eds.): *Handbook of Episodic Memory*. Elsevier, Amsterdam, Oxford 2008: 19–29.
- Khayatzadeh Mahany M, Amirsalari S, Karimloo M: [Accompanying problems in children with cerebral palsy and their relationship to type and level of motor disability]. *Jundishapur Scientific Medical Journal* 2011; 10: 59–67.
- Khodapanahandeh F: [Epilepsy in children with cerebral palsy]. *Razi Journal of Medical Sciences* 2004; 11: 743–748.
- Litosh NL: *Адаптивная физическая культура. Психолого-педагогическая характеристика детей с нарушениями в развитии*. СпортАкадемПресс, Moscow 2002: 225–229.
- Mousavi SH, Karami Nouri R: [A comparison of semantic and episodic memory in deaf and hearing students]. *Advances in Cognitive Sciences* 2009; 10: 83–93.
- Mousavi S, Motamedi A, Honejani E et al.: Evaluation and comparison of episodic memory in elderly people: the effect of strategies education on memory reinforcement. *Clinical Social Work and Health Intervention* 2017a; 8: 59–66.
- Mousavi S, Zare H, Etemadifar M et al.: Memory rehabilitation for the working memory of patients with multiple sclerosis (MS). *J Clin Exp Neuropsychol* 2017b; 1–6. DOI: 10.1080/13803395.2017.1356269.
- Movahed Abtahi M: *Studies on acute effects of nicotine on spatial learning and memory in rats using a radial arm maze*. Clinical psychology master's thesis, Faculty of Education and Psychology, University of Isfahan, Iran 2010.
- Odding E, Roebroeck ME, Stam HJ: The epidemiology of cerebral palsy: incidence, impairments and risk factors. *Disabil Rehabil* 2006; 28: 183–191.
- Peeters M, Verhoeven L, de Moor J: Predictors of verbal working memory in children with cerebral palsy. *Res Dev Disabil* 2009; 30: 1502–1511.
- Pellegrino L: Cerebral palsy. In: Batshaw ML (ed.): *Children with Disabilities*. 5th ed., Paul H. Brookes, Baltimore 2002: 443–466.
- Pirila S, van der Meere J, Pentikainen T et al.: Language and motor speech skills in children with cerebral palsy. *J Commun Disord* 2007; 40: 116–128.
- Rogers S: Common conditions influencing children's participation. In: Case-Smith J (ed.): *Occupational Therapy for Children*. 5th ed., Mosby Co., Boston 2005: 176–180.
- Rosenbaum P, Paneth N, Leviton A et al.: A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol Suppl* 2007; 109: 8–14.
- Santrock JW: *Educational Psychology*. McGraw-Hill, Boston 2001.
- Shevell MI, Dagenais L, Hall N; REPACQ Consortium: Comorbidities in cerebral palsy and their relationship to neurologic subtype and GMFCS level. *Neurology* 2009; 72: 2090–2096.
- Söderlund H, Black SE, Miller BL et al.: Episodic memory and regional atrophy in frontotemporal lobar degeneration. *Neuropsychologia* 2008; 46: 127–136.
- Sousa DA: *How the Brain Learns*. Sage, 2006.
- Spencer JD: Reconstruction of dislocated hips in children with cerebral palsy. *BMJ* 1999; 318: 1021–1022.
- Toopchizadeh V, Barzegar MH, Hosseini SMJ: [Cerebral palsy in respect of etiology, type, associated disorders and motor development in Tabriz Children Medical Center]. *Medical Journal of Tabriz University of Medical Science* 2008; 30: 27–31.
- Weierink L, Vermeulen RJ, Boyd RN: Brain structure and executive functions in children with cerebral palsy: a systematic review. *Res Dev Disabil* 2013; 34: 1678–1688.
- Whittingham K, Fahey M, Rawicki B et al.: The relationship between motor abilities and early social development in a preschool cohort of children with cerebral palsy. *Res Dev Disabil* 2010; 31: 1346–1351.