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WORKING MEMORY IN THE ELDERLY PEOPLE

Memory loss is one of the most common complaints among older adults, therefore, a lot has been said in the literature about the age-related memory problems. Working memory system is usually the first to suffer impairment, thus, it has been receiving a great deal of researchers attention.

In the research seventy two people have been tested. The subjects were divided into two groups: experimental and control one. The experimental group includes 37 people, who are more than 65 years of age. The control group consists of 35 people, ranged from 40 to 55 years. The methods used in the research are those designed for testing working memory, i.e. the Digit Span test from the WAIS-R(PL) and Trail Making Test (TMT).

Both the structural and processual parameters of working memory differentiated the elderly from younger patients. The results show the intergroup differences in the capacity of working memory and the switching ability. Yet another example of a problem typical of the elderly is a slowdown in the thinking process. Finally the results prove the view saying that there is a link between memory problems developing with age and frontal lobe dysfunctions.

Keywords: working memory, aging, frontal lobe

INTRODUCTION

As a result of a systematic growth of the elderly population in recent years there has been a significant development of geriatric neuropsychology. This phenomenon seems to be very meaningful as Polish population is aging at fast rate.

Memory deterioration is considered to be an important feature of aging process. A lot has been said in the literature on memory problems, however, not only amnesic defects are the source of the problem but also executive dysfunctions (Jodzio, 2008a). It is believed that aging causes decline in working memory capacity, which results in deterioration of the normal cognitive functioning (Engle, Sędek, Hecker & McIntosh, 2006). Generally speaking, working memory is a peculiar mediator between aging and cognitive

deterioration. In Jodzio's opinion (2011), it is working memory that links the cognition aspects together which fail the most in the process of ageing and they are: executive functions and attention.

According to Susułowska (1989) memory problems in the elderly become apparent particularly when the task requires divided attention or mental reorganization of the material.

It is believed that, older people have weaker processing of information, which hinders reorganizing objects in the memory. Central executive (CE) plays a key role in working memory. CE controls the processing and decides what working memory should pay attention to. Many researchers link central executive to frontal lobe, – or, more precisely – to prefrontal cortex (cf. Baddeley, 1986; Shallice, 1982; Szatkowska,

2005). Interestingly, frontal lobe dysfunctions and resulting processes appear in the course of aging. It is linked to the popular view from the 80s (cf. La Rue, 1992) – the frontal lobes (the youngest structures: phylogenies and ontogenesis) age the fastest (the frontal aging hypothesis).

In conclusion, with age, we can observe not only decline in information storage but also in information processing and retrieval capacity. Attention control is becoming weaker with age, which results in misallocation of processing resources. Therefore, forgetting in the elderly occurs when the task requires divided attention and reorganization of the material.

The purpose of the study was to evaluate the functioning of working memory mechanisms in the elderly and determine the dynamics of changes in the structural and processual aspects of working memory.

METHODS

Participants

The research involves 72 people who are divided into two groups: experimental (E) and control one (K). The control group consists of 35 people, while the experimental group includes 37 people. The age of the participants in the control group range from 40 to 55 years.

Inclusion criteria of the experimental group included the following: age 65 years, the proper social functioning and the lack of the symptoms of dementia. The participants freely moved in the house and outside. They lived without the help of others. These people were active, engaged in social activities, most of them were members of Senior Clubs. Some respondents took care of grandchildren. All the participants had no problems with doing daily chores.

All the participants filled Mini Mental State Examination (Stańczak, 2010). The result (after age and education correction) maintained within normal limits, i.e. between 28–30 points.

In all the individuals head trauma with loss of consciousness, chronic somatic and neurological disease, mental disorders were excluded.

The average age in the experimental group was 71.67 (SD = 5.64), in the control group: 48.35 (SD = 3.39). There were no significant differences in education years ($p = 0.38$) and sex ($\chi^2_{(1)} = 0,017$; $p = 0.83$) within the two groups.

Measures

The study has been preceded clinical interview, which has facilitated to communication with the subjects and gathering of demographic data and information on psychosocial functioning.

To examine structural parameters of working memory Forward Digit Span Task from The Wechsler Adult Intelligence Scale WAIS-R(PL) has been used (Brzeziński, Gaul, Hornowska, Machowski & Zakrzewska, 1996). Forward Digit Span Task is used to measure working-memory's number storage capacity.

To examine processual parameters of working memory Backward Digit Span Task from The Wechsler Adult Intelligence Scale WAIS-R(PL) and Trail Making Test, TMT from The Halstead-Reitan Battery have been used (Kądziaława, 1990).

Backward Digit Span Task is used to measure processing of information, thereby ability to perform mental operations. It is often used to evaluate the performance of the central executive (cf. Ostrosky-Solis & Lozano, 2006). Trail Making Test is used to measure processual aspects of working memory. It gives reliable measurement of executive control (Arbuthnott & Frank, 2000).

ANALYSIS OF RESULTS

The first step of the analysis was to determine structural aspects of working memory in the elderly. The elderly reiterated significantly fewer digits than the younger people ($t = 2.36$;

$p < 0.05$). This shows shorter capacity of working memory and memory storage (cf. tab. 1).

What is more, the processual aspects of working memory differentiated the elderly from younger people. Differences occurred in the efficiency of making mental operations, fluent switching, searching and concentration, which may indicate an impairment of central executive (which provides cognitive flexibility). The results of the analyzes are presented in table 1.

It is important to note that older people performed all the tasks significantly longer than the younger.

Tabela 1. Mean results in working memory task in study groups (standard deviation in bracket)

Test	Group		t-statistic
	Experimental	Control	
Digit Span			
FORWARD	5.89 (1.62)	7.08 (2.08)	2.32*
BACKWARD	4.11 (1.67)	5.58 (1.45)	3.41***
Trail Making Test			
PART A	65.52 (19.34)	47.65 (14.59)	-3.78***
PART B	164.56 (67.94)	118.96 (39.96)	-2.96**

SD – standard deviation

$p^* < 0.05$, $**p < 0.01$, $***p < 0.001$

The evaluation of error types in Forward Digit Span Task was the source of information on memory strategy in the elderly. We have calculated the average number of all the errors. We have distinguished three types of position errors: errors at the beginning of the series (so-called recency mistakes), errors at the end of the series (so-called serial position mistake) and errors in the middle of the series. Since there were no errors at the beginning of the series, we decided to eliminate them from further analysis. There were differences within recency mistakes ($F_{(1,70)} = 4.63$; $p < 0.05$). Results showed that

older people make errors significantly more often at the end of the series.

The next step was to analyze the types of errors in each of the groups. Repeated measures analysis of variance was performed. The types of errors were independent variables: errors in the middle of the series and errors at the beginning of the series. Dependent variable belonged to the two groups: experimental or control. Figure 1 presents the results.

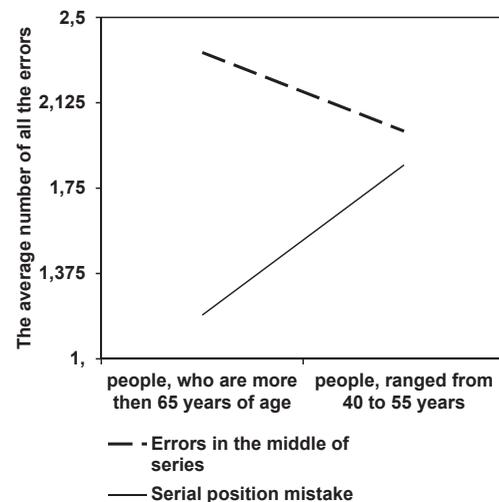


Fig. 1. The main effect of the task and interaction of error types with the group

It was found that the main effect of the task: both the elderly and the younger made more errors in the middle of the series ($F_{(1,70)} = 7.44$; $p < 0.05$). Group interaction and the tasks ($F_{(1,70)} = 4.39$; $p < 0.05$) were the second effect. It means that the number of errors at the end of the series increases with age.

DISCUSSION AND CONCLUSIONS

The study was designed to evaluate the structural and processual memory parameters in the elderly. The results provide data to support the notion of appearing dysfunction with age

working memory, which organizes, integrates and directs human cognitive activity.

Elderly gained significantly worse in tasks examining the structural aspects of memory. Well, they remained much less material in memory. These results indicate the limited memory capacity and reduced operational in the autumn of life. Older people also reached weaker results in all the tasks investigating the process-parameter memory. Most problems have made them tasks requiring divided attention, swift reorganization of the material and fluent switching between different aspects of solving problem. The data obtained suggest that older people have more trouble with sequential processing of information, and so the ability to perform transactions undergoes mental deterioration with age. These results may indicate a combination of age deterioration of the functioning of the central execution system and hence reduced cognitive flexibility. The data obtained correspond with the results of meta-analyzes carried out by the Bopp and Verhaeghen (2005), according to which the differences between the elderly and younger occurred in all the tasks measuring working memory, and the simple tasks relating to the structural parameters of the WM showed smaller effect of age than the task focusing the processual parameters. However, these results are contrary to previous studies carried out by Babcock and Salthouse (1990), which in turn showed little effect of age on the structural aspect of WM.

A characteristic deficit of people senior-aged a slowdown in thinking, especially when serial, and therefore more controlled than the automatic processing of information. It is worth quoting a passage now classic monograph Bromley (1969, pp. 203–204), in which it stresses that “older people need more time to switch from one setting to another. Time metastasis may be proportional to the difficulty of the task. The delay is longer, mistakes may be more common if older man can not rely on external signals (...)”.

A major problem in the autumn of life is also the choice of optimal strategy for remembering.

It has been observed that older people have committed more errors at the end of the line than younger. The tendency to confuse the recent numbers may be due to inhibition of pro-active, older people are beginning to quietly repeat the material immediately after hearing the first digit, resulting in a stop paying attention to the next digit. This phenomenon is typical of the syndrome selectively short-term verbal memory deficit (Warrington & Shallice, 1969). This observation is particularly interesting because the person with the criterion group compared to the comparative group reiterated significantly fewer digits, which may indicate that the strategy adopted by memorization proved to be ineffective.

Pattern of results shows that elderly patients compared with younger, clearly worse perform tasks involving working memory functions. At the same time it shows that the elderly are primarily problems of extraction of material from memory, thus significantly worse in tasks that require rapid access to the stored knowledge. The results clearly correspond to the data quoted by Jodzio (2008b). In the autumn of life there are problems solving complex tasks that require high level of set-shifting. Considerable difficulties older people make tasks involving concentration and quick switching between various aspects of the situation. Elderly perform several complex tasks that require a lot of concentration were given different results. Such disparities results are almost never observed in the group of younger people. In the case of simple tasks and automatic disproportion is not appeared also in the group of older people. The results quoted studies indicate emerging age weakening control process. Associated with age control weakness revealed, among others, in tasks that require switching between tasks and update the contents of WM. Jodzio (2008a) describes the study Oberauer, which uses diagrams Brinley. These studies revealed a longer reaction time in older people when switching between tasks, which is characteristic for the low-capacity memory, in

addition elderly patients exhibited difficulty in remembering strings mixed so those composed of various stimuli. Brzezicka-Rotkiewicz and Sędek (2005) also used Brinley diagram in their study. Research has shown that older people are slower than younger ones. The specific angles shown a similar rate slowing, suggesting that facilitate the task results in the enhancement of the relative amount of time needed to complete a task at the level marked by younger people.

Many researchers have postulated that working memory plays a key role in explaining the deterioration with age cognitive function (cf. Brzezicka-Rotkiewicz & Sędek, 2005; Salthouse, 1991). It is worth noting that most researchers central executive system associated with a frontal lobes. At the same structures particularly active during troubleshooting tasks involving working memory are around the dorsolateral prefrontal cortex, so this area that are involved in the coordination and allocation of attentional resources (Crottaz-Herbertte, Anagnoson & Menon, 2004). Generally speaking, the aging process disrupts the frontal lobes, which are the biological substrate of memory. Equally often the main memory connects to the cingulate cortex, which is involved in controlling attention and inhibition process (Brzezicka-Rotkiewicz & Sędek, 2005). Impaired control processes indicates a while as a common problem in the elderly.

Despite the passage of more than three decades, the concept of WM invariably raises interest in the scientific community. The issue of working memory and its share in the process of cognitive aging remains unresolved, speaking the necessity of making further research within this issue, especially with regard to the parameters working memory. In addition, it would be an extension of research on the assessment of general intelligence, lack of control of this factor hinders the interpretation of the results. Balancing groups in intelligence would enable the full reasoning.

Undoubtedly contemporary research progress has increased the ability to effectively impacts in

the course of cognitive impairment. Not every problem of cognitive nature should be seen as a sign of disease. Mental deficiencies for the most part a manifestation associated with age (normal) cognition (Treder & Jodzio, 2013). Early intervention can improve the quality of life of patients and their ability to normal functioning.

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FUNKCJONOWANIE PAMIĘCI OPERACYJNEJ W JESIENI ŻYCIA

ABSTRAKT

W literaturze przedmiotu poświęcono wiele miejsca problemom pamięciowym osób w wieku podeszłym, gdyż pogarszanie pamięci uważa się za jedną z nadrzędnych trudności w jesieni życia. Najczęstszemu upośledzeniu podlega system pamięci operacyjnej, stąd budzi on niezmiernie zainteresowanie badaczy.

W badaniach wzięły udział 72 osoby, które utworzyły dwie grupy: kryterialną i porównawczą. Grupę kryterialną stanowiło 37 osób, które przekroczyły 65 rok życia. Grupę porównawczą utworzyło 35 dorosłych w przedziale wiekowym 40–55 lat. Pamięć operacyjną zbadano za pomocą Testu Łączenia Punktów oraz podtestu Powtarzania Cyfr.

Zarówno parametry procesualne, jak i strukturalne pamięci operacyjnej różnicowały osoby w wieku podeszłym od osób młodszych. Uzyskane wyniki wskazują na międzygrupowe różnice w zakresie pojemności pamięci operacyjnej oraz zdolności przełączania. Innym charakterystycznym deficytem osób w wieku senioralnym jest spowolnienie tempa myślenia. Uzyskane rezultaty uzasadniają pogląd mówiący o związku skojarzonych z wiekiem problemów pamięciowych z dysfunkcją płatów czołowych mózgu.

Słowa kluczowe: pamięć operacyjna, starzenie się, płaty czołowe