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Age effect on Verbal Auditory and Visual Memory Performance in Indonesian Elderly

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Abstract

A longer life expectancy is not always accompanied by good quality of life, including proper brain functions and controlling cognition. Neuropsychological instruments are widely used to monitor cognitive performance, including memory tests. Many older people complain about their memory, and patients with different forms of dementia have severe memory problems. This study aims to investigate the effect of age on verbal, auditory, and visual memory performance in the Indonesian elderly. A total of 178 healthy participants (age 50-80, two groups were used:50-59 and 60-80) completed the Indonesia-adapted Rey-Auditory Verbal Learning (RAVLT) and Figural Reproduction (F.R.) tests as a part of INTB (Indonesia Neuropsychological Tests Battery). Significant negative effects of age on RAVLT were found on recall of a word list (trial 1-7; $p<.005$). In contrast, learning over trials and recognition memory was not affected. An age-dependent decline in memory and speed was also found for cards 2 and 3 of the F.R. test. A subsequent analysis of covariance controlling for putative education effects revealed that education did significantly affect both memory tests but that the impaired recall of the RAVLT remained. The sensitivity of both tests for ageing and education makes both tests suited for objectively assessing different aspects of memory for Indonesians. The results also show that normative data for Indonesians need to be adapted for age and education, as is internationally done.

Keywords: Verbal auditory memory, visual memory, elderly, Rey Auditory Verbal Learning, figural reproduction, Indonesia Neuropsychological Tests Battery

Introduction

A longer life expectancy is not always accompanied by good quality of life, proper brain functions, and those controlling cognition. It is a fact that entering the elderly stage is not always beautiful. It is a challenge that needs to be faced by the people of Indonesia.

Ageing, a natural process characterized by a progressive risk of wear and tear, disease, and death, is accompanied by a reduced memory, among others, for complex geometric pictures (Marques 2012) and auditory presented words in a verbal learning and memory task (Diniz et al. 2008), These results and the substantial international literature about cognitive decline accompanying ageing shows that elderly indeed have difficulties in memorizing events and facts, including those of their personal life. Close to us, researchers found the phenomenon of "pikun" in the elderly in several nursing homes in Semarang, Central Java Region. Pikun is a phenomenon of forgetting activities or moments that have been experienced, and it regards both recent and more past events. The elderly who are "pikun" can even forget and no longer recognize their husband or wife and their children. This phenomenon of forgetting can also make an older person forget that he has eaten and think his friends stole his food in the room, which can provoke fights among the elderly. Reality like the above demonstrates the relevance of monitoring brain functions, including cognitive performance. It allows

striving for a proper diagnosis for the type and nature of mainly early stages of "pikun", to inform the relatives about the changes that are occurring in the brain of their beloved ones, and to provide better care and treatment so that the life of the elderly can become less problematic.

The activity to monitor brain performance has been widely carried out in foreign countries, and neuropsychological instruments are often used to monitor cognitive performance. Next, for example, in the Netherlands, memory clinics were established more than 25 years ago. The fertile growth regarding their services can also be seen in the number of clinics which in 1998 amounted to 12, while in 2016, the number increased to a total of 91, and more than 24000 patients have been served. These memory clinics use various multidisciplinary cognitive screening methods, including neuropsychological assessment for functional analysis of what the brain can do. Memory Clinics are currently accepted as routine care facilities for people with cognitive problems and various cognitive impairment and dementia types in many Western countries (Gruters et al., 2019).

It needs to be acknowledged that Indonesia does not currently have this extensive health service. Nevertheless, the move towards the use of neuropsychological instruments has become visible. One of these initiatives is taken by the Indonesian Neuropsychology Consortium. They initiated the collection of data from ten neuropsychological tests adapted for Indonesia, covering the main cognitive domains of learning and memory, attention, language, and executive functions. Together, this battery of tests was called Indonesian Neuropsychological Test Battery (INTB). Here we investigate the data on two learning and memory tests: the RAVLT, an auditory verbal memory test, and a visuospatial memory F.R. (Figural Reproduction) test, in Indonesian older people and investigate the age effect on these two tests. It is expected that the elderly will do less well compared to the less elderly. If this is the case, this will contribute to validating both tests as memory tests for Indonesians.

Method

This study was part of the INTB project and focused on the elderly category aged from 50 to 80 years old. The number of elderly was 178 participants (M = 58.44; SD = 7.02), and we separated those data into two groups. Young elderly were those aged between 50-59 years, and people above 60 as older elderly. These two groups were created based on Indonesian government regulation in the Ministry of Health, which stated that the Elderly is a person age 60. A questionnaire obtained demographic facts and health status. The data collection was done on four Indonesian islands in urbanized areas of Java (Jakarta, Semarang, Surabaya), Bali (Denpasar), South Sulawesi (Makassar), and East Kalimantan (Samarinda). Participant education levels varied from elementary school to doctoral. The mean years of education were 12.21 (SD 3.73).

All participants completed the RAVLT and F.R. Test as part of INTB. In Rey's test, people are listening to and are asked to recall a list of fifteen words, which was repeated five times (trials 1 to 5). The latter allowed getting an indication of learning over trials. Next, a second-word list was presented, and subjects were asked to recall this list as well, and this was immediately followed by a recall of the first list (trial 6). The final recall (trial 7) occurred 20 minutes later. In the meantime, subjects performed other tasks. Trial 8 was a recognition task. It occurred immediately after trial 7. The participant is then read a list of fifty words and asked to indicate whether each word was presented before (list 1 or 2) the recognition test. For more details, see Rey (1964).

The F.R. Test measures the ability to memorize and reproduce visual-spatial stimuli. This test consists of three cards with geometrical figures increasing in complexity (Marques, 2012). Each image was shown to participants for 5-10 secs, then immediately removed from view. Then participants need to memorize and draw the image as close as possible. The scoring ranges between 0 - 3 for card 1, 0 - 5 for card 2, 0 - 3 for card 3A, and 0 - 4 for card 3B. Also, the time to finish each subtask was measured. We conducted

Student's T-Test analysis to measure the age effect on RAVLT and F.R. test. In addition, the mean and standard deviation of each subtest was calculated.

Results

Student's T-Tests for independent groups showed significant age-effects on RAVLT for all recall trials of word list A (trial 1-6; all p's <.005) and trial 7 (the delayed trial) as well (p<.05), where younger outperformed the elderly group. No significant age effects were detected for other variables of the RAVLT, such as learning over trials 1 to 5, on the recall of list B, and recognition. The results are presented in Table 1.

Table 1. Mean, Standard Deviation, t-value, df, and p-value for age effect on RAVLT

RAVLT Variables		Mean	SD	t	df	p
Trial 1				2.87	176	.005
	50 - 59	5.52	2.08			
	60 - 80	4.56	2.14			
Trial 2				3.50	176	.001
	50 - 59	7.88	2.92			
	60 - 80	6.68	2.29			
Trial 3				2.98	176	.003
	50 - 59	9.12	2.25			
	60 - 80	8.02	2.45			
Trial 4				2.83	176	.005
	50 - 59	9.80	2.41			
	60 - 80	8.66	2.75			
Trial 5				3.14	176	.002
	50 - 59	10.65	2.32			
	60 - 80	9.39	2.89			
Trial 6				3.49	176	.001
	50 - 59	8.88	2.66			
	60 - 80	7.31	3.18			
Trial 7				3.59	176	.000
	50 - 59	8.93	2.71			
	60 - 80	7.25	3.35			
List B				1.35	176	.178
	50 - 59	5.30	1.78			
	60 - 80	4.90	2.06			
Recognition				1.68	176	.095
	50 - 59	19.03	5.20			
	60 - 80	17.46	7.02			
RAVLT LOT				0.68	176	.500
	50 - 59	15.37	8.17			
	60 - 80	14.51	7.57			

Only the reproduction of picture 1 of the F.R. Test did not show an age effect t(176) = 1.49; p=.139, while the two other pictures showed the younger achieved higher scores and spent less time completing the task (p<.05). Also the total time showed an age-dependent effect with more time necessary for the elderly group, for more details see Table 2.

Table 2. Mean, Standard Deviation, t-value, df, and p-value for age effect on F.R. Test.

F.R. Variables		Mean	SD	t	df	p
Score Card 1				1.49	176	.139
	50 - 59	2.27	0.86			
	60 - 80	2.07	0.83			
Score Card 2				2.02	176	.045
	50 - 59	3.60	1.20			
	60 - 80	3.20	1.27			
Score Card 3A				2.16	176	.032
	50 - 59	1.71	1.23			
	60 - 80	1.29	1.26			
Score Card 3B				2.56	176	.011
	50 - 59	2.66	1.44			
	60 - 80	2.07	1.51			
Time Card 1				- 2.76	176	.006
	50 - 59	16.73	11.17			
	60 - 80	22.16	14.50			
Time Card 2				-3.30	176	.001
	50 - 59	21.09	10.84			
	60 - 80	29.84	24.53			
Time Card 3A				-2.75	176	.007
	50 - 59	16.92	9.71			
	60 - 80	22.72	18.48			
Time Card 3B				-2.13	176	.034
	50 - 59	18.86	10.67			
	60 - 80	22.92	14.23			
Total Score				2.87	176	.005
	50 - 59	10.24	3.49			
	60 - 80	8.63	3.65			
Total Time				-3.65	176	.000
	50 - 59	73.60	32.11			
	60 - 80	97.64	55.56			

Discussion

The most apparent findings were that the performances of the younger were better than those of, the older elders in two different memory tests. A decline in brain functions may cause this performance difference. The latter may have various reasons, such as the normal ageing process or the beginning of not yet diagnosed physical diseases affecting brain functions, such as cardiovascular diseases, extended functions, and diabetes. Physical changes in the

elderly also can cause a decrease in the basal metabolic rate and cognitive abilities (Mahan & Raymond 2017). Moreover, physical frailty in the elderly is associated with decreased cognitive function and an increased risk of dementia (Ruan et al., 2015). Whatever the reason is, both tests are sensitive to ageing effects.

All recall trials (A1 to A7) of the RAVLT showed an age-dependent decrease. It is striking that this difference was already present in trial 1 and did not become more significant over trials. This might imply that what was measured in trial 1 and reduced in the elderly group was crucial for the performance difference in the subsequent recall trials. Therefore it was not surprising that not all aspects of memory declined (Glisky, 2007). There was no effect on the recall of list B between young elderly and older elderly subjects, as well as on the recognition trial. The age effect on recall and the lack of age effect on recognition may show that the encoding and consolidation process seems not to be hampered by ageing, but that older people may have more problems in the retrieval of the encoded information; the fact this issue was already present in trial 1, suggest that the reduced capacity to remember the only once heard words, and in particular their reduced memory buffer or their retrieval might be a reason for the reduced recall. The lack of differences in the recognition task, retrieval is easier considering that clear cues are given in the form of that the words to be remembered are given, although intermixed with distractor words, also suggests that the retrieval of just encoded information could be the reason for the age-dependent memory decline.

Another interesting finding was that there was no difference in the learning process between the young and older elderly. It shows that the ability to learn new things, in this case, verbal information is less vulnerable to the ageing process than recalling things from memory. This finding is in agreement with what others found: the rate of learning shows fewer changes with age than free recall (Incalzi et al., 1995; Mitrushina et al., 1991; Vakil & Blachstein, 1997).

Not only was verbal recall hampered in the older group, but also the recall of visually presented geometrical stimuli in the F.R. Test. Most theories on memory acknowledge that visual and verbal stimuli are processed and stored differently, and in neuropsychological assessment, both verbal and visual memory tests are administered. Here we show that verbal and visual presented stimuli are less well recalled in the older group and that the elder group needs more time to complete the reproduction of the figure on paper with a pencil. The lack of age effects in the first card of the F.R. Test might be due to the simplicity of the figure. Card 2 and 3 are indeed more complex and need more time to complete than card 1. Considering that the test measured visuospatial short-term memory, it can be inferred that, similar to trial A1 of the RAVLT, both verbal and visual short-term memory is vulnerable to the ageing effect. However, a caveat in assessment is that most cognitive tests are sensitive to education effects (Glisky et al., 2007). Younger people are expected to enjoy a more comprehensive education than the elderly. This prompted us to investigate whether the age-dependent effects in both tests persisted when years of education were controlled for, as can be done with an analysis of covariance with age as a between-subjects factor and education as a covariate. In agreement with what was commonly reported in the international literature, education effects were found for most of the recall trials of the RAVLT and all F.R. Test scores. The analyses of covariance also showed that some of the recall variables lost their significant age effect. In contrast, other variables (the recall scores of Trial A2, A5, A6, and A7) kept their sensitivity for age. For the F.R. Test, only the total time to complete the three figures kept its age-dependency. Therefore it seems that the recall of verbally presented material is affected by age and education. In contrast, the performance of the F.R. Test seems more affected by education than by age.

Based on our findings, there were other performances between each group in two different memory tests, as expected that young elderly

outperformed auditory-verbal and visuospatial memory. This was our contribution to validating both tests as memory tests for Indonesians.

Conclusions

This study found rather significant age effects on two different memory tests, one covering different aspects of verbal learning and memory, the other on short-term visuospatial memory in the elderly population. The auditory memory tests showed that ageing between 50-80 did affect the recall tasks, while learning and recognition were not affected. The age-dependent effects of the scores of the visual-spatial memory task were contaminated by years of education. The results also show that it is imperative that the normative data of both tests need to be adapted for age as well as education effects. In that case, a larger group of subjects is necessary than currently available. Until then, some reluctance in using these tests for diagnosing the type of cognitive decline is appropriate for another usage, such as establishing within-subject changes across the life span. The tests are well suited.

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