The Adaptation of Neuropsychological Test Adaptation: A Pilot Study for Memory Subtest

Lucia Trisni Widhianingtanti, Augustina Sulastri, Endang Widyorini, Margaretha Sih Setija Utami, Haryo Goeritno, Monika Windriya Satyajati.

Faculty of Psychology, Unika Soegijapranata

Abstract

Current studies of neuropsychology have been widely developed in various countries. neuropsychological assessment requires valid and reliable neuropsychological testing tools. Meanwhile, in Indonesia, neuropsychological assessment has not been widely available nor adapted. This study is a part of a longitudinal study to adapt neuropsychological tests into Indonesian norms, particularly in Memory domains, namely Digit Span Forward (DSF), Digit Span Backward (DSB) and Digit Span Sequence (DSS); symbol range, Visual Reproduction; Auditory Verbal Learning. The subjects of this pilot study were 219 (two hundred and nineteen) healthy adults with age range from of 18 to 64 years. Subjects were selected randomly with some initial criteria for detecting the presence or absence of cognitive dysfunction. This research uses quantitative descriptive analysis model, to determine the difficulty level of each test items, and the results are shown using percentage of difficulty level of each item based on memory ability of respondents.

Keywords:

Test adaptation, neuropsychology, test norms

Introduction

As a part of neuroscience studies, neurospcyhology had develepoed into a special field in the study of psychology. This includes on how psychology could explain between what happens in the brain and what people do. Perception, emotion, motivation, beliefs, and many other topics in psychology could be explained using neuropsychology. Thus, research conducted in this field is developed rapidly in these recent years.

To get a deeper understanding about one's neuropsychological condition, first, a psychologist should conduct a battery of assessment. A comprehensive assessment could help psychologist and other mental health professionals to identify the problems in patients, which could help professionals to conduct intervention, such as medical intervention, rehabilitation therapy, or psychotherapy. Unfortunately, in Indonesia, the numbers of neuropsychological assessment or neuropsychological test is still limited. Thus, this research aims to create an adaption of existing neuropsychological tests to be used in Indonesian norms. Hambleton, Merendan, and Spielberger (2005) stated that test adaptation is a series of activity which include: measuring the same construct and interpreting it into a different language and culture; choosing the translator; deciding which utilities would be used to prepare the test in second language; adapting the test; and also checking the equity of the two versions of the tests.

In this research, we adapt four neuropsychological test batteries which measure memory. The first set of tests Digit Spans, which includes Digit Span Forward (DSF), Digit Span Backward (DSB), Digit Span Sequence (DSS). Clients are asked to memorize a series of numbers in these test in three modes, which are forward, backward, and sequence. The second test is Symbol Span, in which clients are asked to memorize symbol. The third test is Visual Reproductin, which

asked clients to memorize an image and reproduce it. The last is Auditory Verbal Learning (AVL). This AVL test measure client's ability to memorize two series of words repeatedly.

Memory

Feldman (2012) defined memory as a cognitive function which include the brain. The process of memory includes coding, storing, and retrieving old information which was stored in the brain. Most scientists view memory as a relation between our own experience and past history. The stimuli that once were experienced by someone had left a perception on the brain. That perception were then stored in the mind, and could be retrieved again when we met the same kind of stimuli. Thus, memory includes the process of learning, retention, and remembering. The same definition of memory was also explained by Slamet (2010) and Chaplin (2011). The two references stated that past experience is one important part before someone could interpret the stimuli they are facing now.

Theories Related to Memory

Disuse Theory

This theory stated that memory will slowly be erased after certain periods of time unless it trained repeatedly, just like we trained our body and muscles. Memory will also slowly fade from the mind if someone felt that the information is not important, regardless of the time.

Interference Theory

This theory defined memory as candle or canvas. Knowledge is "painted" in canvas and it is memorized in the brain. But after some period of time, there canvas will be "re-painted" again when we get new knowledge. This process called interference. It is more difficult for us to memorized knowledge that is interfered with the same kind of new knowledge.

Information Processing

This memory describe how memory processed. At first, new knowledge are stored in sensory storage, then it is being processed in short-term memory (STM). In STM, there are two options. The first one is that the memory in the STM is erased after some period of time. The second option is that the memory in STM moved into long-term memory (LTM). In this part, memory will be stored for long period of time. It could be stored for months and even years.

Neuropsychological measurement

There are several ways of measuring neuropsychology as below:

Technical Neuroimaging

Computerized Axial Tomography (CAT) using X-rays compiled by a computer

Magnetic Resonance Imaging (MRI) uses non-harmful radio frequencies and the interaction with the brain, which then measured by the computer to create brain images.

Positron Emitted Tomography (PET) uses a radioactive solution which is injected to study the metabolic activity of the brain

Electroencephalography (EEG) records the electrical activity of the brain ("brain waves") of cables attached to the surface of the scalp

Psychological Tests

Test Battery: Reitan-Halstead

Other battery approaches : WAIS (Wechsler Adult Intelligence Scale) assessment of cognitive function; LNNB 1 (Luria Nebraska Neuropsychological Battery **)** and LNNB 2

In this article, Memory is chosen the variable. Thus, the neuropsychological test consisting from 4 subtests were being translated then tested to subjects. The tests has free license and was used in various countries. We tested whether the construct of the aitems would suit Indonesian norms.

Research Subjects

The research subjects consisted of 219 people with various backgrounds. The percentage of female subjects were 61.64% (n=135), and male subjects were 38.36% (n=84). The subjects came from various age groups, from adolescent age group (16-19 years) to the elderly group (over 60 years). The highest percentage of subjects is in the age group 20-24 years (38.36%, n=84), 16-19 years (15.98%, n=35), and 25-29 years

(9.59%, n=21). The least age group is in the range of 45-49 years (3.20%, n=7).

Subjects had various educational background. Most of them has finished High School (56.16%, n-123) and Higher Education Degree (30,79%, n=67). Other groups of subjects had finished Elementary or Middle School (11,87%, n=26) and a few portion of subjects had finished Post-Graduate Degree (1,37%, n=3). Most subjects were students (49,3%, n=108), and other subject had various job background as seen in Table 1.

Table 1. Subjects' Job Background

Work	Frequency	Percentage
Labor	5	2.3
Honorary-worker	5	2.3
College students	108	49.3
Students	7	3.2
Civil Servants	5	2.3
Professionals	2	.9
Private Company Employee	30	13.7
Police/Army	4	1.8
Entrepreneurs	16	7.3
Others	37	16.9
Total	**219**	**100.0**

Data Collection Process

Research Process

The study was conducted in April 2017. Data collection involved 11 research assistants as enumerators to test 19-20 people. Research assistants had educational background in psychology, had adequate mastery of psychological testing instruments, and have sufficient knowledge and interest in biopsychology/neuropsychology. The data were collected in 2 weeks. The data submitted by assistants were then processed by the researchers.

Test Procedure

The test consists of 4 subtests, namely as follows:

Number Span (Digit Span)

This subtest has 3 parts, which are Digit Span Forward (DSF), Digit Span Backward (DSB), and Digit Span Sequence (DSS). In DSF, testee were asked to repeat a series of number mentioned by the tester. In DSB, testee were asked to repeat the number backwards. In DSS, testee had to sequence the numbers first, then repeat it.

Symbol Span

This test is divided into two parts. Each consists of 2-9 series of symbols that shown in form card and mentioned orally. In the first part, tester looked at symbol cards which contains 5-15 series of symbols. Each symbol is aligned with an alphabet. Testee had to memorize the symbols then mention the alphabets. In the second part, testee had to memorize and mention the alphabets backward.

Visual Reproduction

This test is divided into two parts. The testee memorize to visual 2-dimension image, then re-draw it in a piece of paper.

Auditory Verbal Learning

In this test, 2 series of words were given to testee. Each consists of 15 words. The tester read aloud the words in the first list. Testee then memorize and mention it. This procedure is repeated for 5 times. Then, another series given, and tester has to memorize it.

RESULTS

Based on the results of the analysis of the tool test *Memory and Learning* which consist 4 subtest based on function memory can be reported as follows:

Digit Span (Number Range)

Digit Span or range of numbers measure auditory memory short term, *immediate recall* attention and worry. Test this divided to be three part:

a) *Digit Span Forward* (DSF)

DSF consists of 8 questions about the range of numbers in the form of 2 numbers down 9 number that mentioned orally. On part DSF tester mention the row number and then subject asked to repeat mentioning it in order that correct. Each question consists of from two time experiments A and B, second trial tried on each subject. If subject or testee made one mistake, the trial continue to the next circuit. Stop after failed second inner trial one circuit.

The results of an analysis of DSF questions can be reported in table 1 below:

Table 1. Digit Span – Forward

No.	Tested Numbers	Testee Amounts Correct Answer	%
1.	1A	218	99.54
	1B	219	100
2.	2A	218	99.54
	2B	217	99.09
3.	3A	213	97.26
	3B	212	96.8
4	4A	192	87.67
	4B	176	80.37
5.	5A	115	52,51
	5B	106	48.4
6.	6A	45	20,55
	6B	49	22.37
7.	7A	15	6.85
	7B	18	8,22
8	8A	2	0.91
	8B	4	1.83

In table 1, it can be seen that questions number 1 through 4 indicate that the numbers that are easy to remember by testee. From 219 testees, 176 (80.37%) up to 219 (100%) testee were able to remember the range number which consists of a range of 2 numbers up to 5 numbers in the correct order. The 5 and 6 series has moderate difficulty level. Only 48.4% - 52.51% testee were able to recall the sequence of numbers in these series in sequence and correctly. While the range no. 6 to 8 which consists of a range of 7 numbers up to 9 numbers is the most difficult to remember by testee that is indicated by 0.91% - 20.55% testee that were able to remember correctly.

b) *Digit Backward Span* (DSB)

DSB comprises 8 range of numbers that each comprised of 2 until 9 range of numbers mentioned by the tester. The tester calls a row number and testee were requested to mentioned the number in reverse. DSB Each range of numbers in DSB consisted of two trial, Trial A and Trial B. The B part is the second trial that were given only if testee failed the first trial. If testee failed at both trial, then DSB has to be stopped.

The results of the analysis of DSB questions isreported in table 2. In table 2 it can be seen that the questions number 1 through 3 (3A) indicate that the question were easy to remember by testee. From 219 testee, 162 (73.97%) up to 219 (100%) testee were able to remember the range of numbers well, which consists of a range of 2 numbers up to 4 numbers in a correct sequence. Range no. 3 (3B) and 4 (4A) consisting of a range of 4 - 5 numbers is a range of numbers with a moderate difficulty level that is indicated by 41.55% - 54.79% testee who were able to recall the sequence of numbers in sequence and correctly. While the range is no. 4 (4B) up to 8 which consists of a range of 5 numbers up to 9 digits is a range of numbers that is difficult to remember by testee that is indicated by 0% - 34.7% testee who are able to remember correctly in sequence and correctly.

Table 2. Digit Span – Backward

No.	Tested Numbers	Testee Amounts Correct Answer	%
1.	1A	219	100
	1B	219	100
2.	2A	198	90.41
	2B	202	92,24
3.	3A	162	73.97
	3B	120	54.79
4	4A	91	41,55
	4B	76	34.7
5.	5A	44	20.09
	5B	37	16.89
6.	6A	6	2.74
	6B	11	5.02
7.	7A	3	1.37
	7B	3	1.37
8	8A	0	0
	8B	1	0

c) Digit Span Sequence (DSS)

DSS comprises about a range of numbers from 2 digits to 9 digits 9 number that mentioned orally. The tester mentioned a series of number, and testee were asked to repeat the numbers in different order. Testee had to reorder the numbers from the smallest to the biggest one.

The results of this test is reported in table 3. It shows that questions number 1 through 3 indicated as easy. From 219 testees, 159 (72.6%) up to 219 (100%) testee were able to remember the numbers correctly. The moderate difficulty of repeating numbers in sequence were seen in question no 4 to 5. This was indicated by 52.97% and 54.79% of testee who were able to recall the sequence of numbers correctly. Item no. 5 to 8 which consists of a range of 6 numbers up to 9 digits is a range of numbers that is difficult to remember by testee. This was indicated by only 1.83% - 34.7% of the testees who are able to remember correctly in sequence and correctly.

Table 3. Digit Span – Sequencing

No.	Tested Numbers	Testee Amounts Correct Answer	%
1.	1A	219	100
	1B	216	98.63
2.	2A	210	95.89
	2B	193	88.13
3.	3A	172	78.54
	3B	159	72,6
4	4A	116	52.97
	4B	120	54.79
5.	5A	76	34.7
	5B	50	22.83
6.	6A	16	7.31
	6B	30	13,7
7.	7A	7	3.2
	7B	7	3.2
8	8A	8	3.65
	8B	4	1.83

Symbol Span (Symbol Range)

Symbol span is a visual working memory test to assess one's functioning to memorize symbols. This test consists of two parts. Each part contains of eight series of symbols. Testee are asked to memorize the symbols in 5-15 seconds, then mention it orally.

Symbol Span Forward (SSF)

The first symbol span subtest is symbol span forward (SSF). In this subtest, testee are asked to memorize the number in the same order with the series given. 219 testee joined this test. Question number 1 and 2 in this test are indiviated as easy because 71.69% (n=157) to 95.89% (n=210) had done the test correctly. Item number 3 had moderate difficulty since 43.38% to 51.6% testee succeeded to do the test correctly. Question number 4 to 8 are categorized as dificcult since no more than 24.2* testee succeeded to answer correctly.

Table 4. Symbol Span – Forward

No.	Tested Numbers	Testee Amounts Correct Answer	%
1.	1A	209	95.43
	1B	210	95.89
2	2A	181	82.65
	2B	157	71.69
3.	3A	113	51.6
	3B	95	43.38
4	4A	37	16.89
	4B	53	24.2
5.	5A	31	14.16
	5B	38	17,35
6.	6A	13	5.94
	6B	14	6.39
7.	7A	9	4,11
	7B	10	4.57
8	8A	8	3.65
	8B	6	2.74

b) *Symbol Backward Span (SSB)*

In table 5, it can be seen that SSB questions number 1 and 2 indicated as easy since 201 (91.78%) testees

were able to remember the range of symbols correctly in sequence. Question no. 3 (3A) which consists of a range of 4 symbols is an item with a moderate difficulty level that is indicated by 47.03% testee which is able to recall the sequence of symbols in sequence and correctly. While the item is no. 3 (3B) up to 8 which consists of a range of 4 symbols up to 9 symbols is a range of symbols that is difficult to remember by testee that is indicated by only 6.39% - 36.07% testee succeded to remember correctly in sequence and correctly.

Table 5. Symbol Span – Backward

No	Tested Numbers	Testee Amounts Correct Answer	%
1.	1A	198	90.41
	1B	201	91.78
2.	2A	155	70.78
	2B	140	63.93
3.	3A	103	47.03
	3B	79	36.07
4	4A	65	29.68
	4B	60	27.4
5.	5A	44	20.09
	5B	44	20.09
6.	6A	19	8.68
	6B	31	14.16
7.	7A	20	9,13
	7B	19	8.68
8	8A	15	6.85
	8B	14	6.39

Visual Reproduction

Visual Reproduction function to visual measure memory and constructional ability on individual. This is a drawing test in which subject has to redraw a pattern that once was memorized.

Results of analysis of *Visual Reproduction* can be reported in table 6 as follows: From the Card 1, it could be seen that 49.77% (n=109) were succeeded to answer correctly. This concludes that Card 1 is regarded as easy. Meanwhile, Card 2 and Card 3 are categorized as difficult, since less than 13,24% testee could anwer correctly.

Table 6. Visual Reproduction

No.	Benchmark Value	Number of Testee Answers	%
1	0	2	0.91
	1	13	5.94
	2	95	43.38
	3	109	49,77
2	0	0	0.00
	1	2	0.91
	2	11	5.02
	3	67	30.59
	4	110	50.23
	5	29	13,24
3	0	5	2.28
	1	6	2.74
	2	9	4,11
	3	20	9,13
	4	16	7.31
	5	35	15.98
	6	48	21.92
	7	80	36.53

Auditory Verbal Learning

Auditory Verbal Learning is a subtest that measured memory span, memory disturbances, memory recognition, and the ability to learn new things. This test has two series of vocabulary that needs to be memorized by testee. Series A is given verbally by tester, and testee had to repeat 15 words in this series. This procedure is repeated for 5 times, then testee are given the Series B. After memorizing and repeating 15 words in Series B. Testee are asked to repeat the words in Series A. After 20 minutes break, testee are asked to repeat series A once more, and also find the words in a paper that showed a lot of words.

Results of analysis of *auditory* questions *Verb l Learning* can be reported in tables 7 to 15 as follows:

Table 7. Auditory Verbal Learning - A1

No. Test	List of Words	Testee Amounts Correct Answer	%
1	PIPE	205	93.61
2	WALL	185	84.47
3	HOUR	125	57.08
4	SUGAR	84	38.36
5	STUDENT	102	46,58
6	MOTHER	123	56.16
7	STAR	39	17,81
8	PHOTO	21	9.59
9	BAG	64	29,22
10	PADI	81	36.99
11	MOUTH	78	35.62
12	CHICKEN	121	55.25
13	SOUND	102	46,58
14	ROOF	112	51.14
15	LAKE	156	71.23

From table 7 of *Auditory Verbal Learning* - A1, it can be seen that the words pipe, wall and lake are words that are easy to remember by testee, which are sequentially indicated by the number of testees who correctly answered as many as 205 (93.61%) testee for pipes. , 185 (84.47%) testee for the wall, and 156 (71.23%) testee for the lake; on the contrary words that are difficult to remember when sorted from the hardest to difficult ones are photos (9.59%), stars (17.81%), bags (29.22%), mouths (35.62%), rice (36.99%), and sugar (38.36%). While hours (57.08%), mothers (56.16%), chickens (55.25%), roofs (51.14%), students (46.58%), and sound (46.58%) were words that are quite a bit still quite difficult to remember by testee.

Table 8. *Auditory Verbal Learning* - A2

No. Test	List of Words	Testee Amounts Correct Answer	%
1	PIPE	197	89.95
2	WALL	197	89.95
3	HOUR	165	75,34
4	SUGAR	135	61.64
5	STUDENT	166	75.8
6	MOTHER	172	78.54
7	STAR	96	43.84
8	PHOTO	61	27.85
9	BAG	106	48.4
10	PADI	111	50,68
11	MOUTH	148	67.58
12	CHICKEN	154	70.32
13	SOUND	167	76.26
14	ROOF	156	71.23
15	LAKE	197	89.95

In table 8 *Auditory Verbal Learning* - A2 which is a repetition of the *Auditory Verbal Learning* - A1, shows that more words were easy to remember, which are pipes (89.95%), walls (89.95%), lakes (89.95%), mothers (78.54%), sounds (76.26%), students (75.50%), hours (75.34%), roof (71.23%), chicken (70.32%), mouth (67.58%), and sugar (61.64%).The words that are moderately difficult to be memorized are rice (50.68%), bags (48.40%), and stars (43.84%). The most difficult word to remember by testee was photos (27.85%).

Table 9 *Auditory Verbal Learning* - A3 is the result of two times repetition after A1 and A2. More easily remembered words were shown but the word 'photo' was still considered to be the most difficult to remember. This indicated by 55.71% (n=122) correct answer.

Table 9. Auditory Verbal Learning - A3

No.Test	List of Words	Testee Amounts Correct Answer	%
1	PIPE	198	90.41
2	WALL	205	93.61
3	HOUR	181	82.65
4	SUGAR	158	72.15
5	STUDENT	186	84.93
6	MOTHER	191	87.21
7	STAR	153	69.86
8	PHOTO	122	55.71
9	BAG	151	68.95
10	PADI	146	66.67
11	MOUTH	157	71.69
12	CHICKEN	164	74.89
13	SOUND	185	84.47
14	ROOF	175	79.91
15	LAKE	210	95.89

Table 10 shows the result of A4 series. Most of the words were considered as easy. More than 73.06% testee could remember the words correctly. Similarly, table 11 shows the result of A5 series. More than 75.34% testee could memorized all the 15 words correctly.

Table 10. Auditory Verbal Learning - A4

No.	List of Words	Testee Amounts Correct Answer	%
1	PIPE	211	95.35
2	WALL	212	96.8
3	HOUR	178	81.28
4	SUGAR	181	82.65
5	STUDENT	193	88.13
6	MOTHER	192	87.67
7	STAR	172	78.54
8	PHOTO	142	64.84
9	BAG	171	78.08
10	PADI	160	73.06
11	MOUTH	161	73.52
12	CHICKEN	169	77,17
13	SOUND	201	91.78
14	ROOF	189	86.3
15	LAKE	207	94.52

Table 11. Auditory Verbal Learning - A5

No.Test	List of Words	Testee Amounts Correct Answer	%
1	PIPE	215	98.17
2	WALL	212	96.8
3	HOUR	198	90.41
4	SUGAR	188	85.84
5	STUDENT	202	92,24
6	MOTHER	200	91.32
7	STAR	185	84.47
8	PHOTO	165	75,34
9	BAG	179	81.74
10	PADI	165	75,34
11	MOUTH	170	77.63
12	CHICKEN	176	80.37
13	SOUND	207	94.52
14	ROOF	183	83,56
15	LAKE	213	97.26

Table 12. Auditory Verbal Learning - B1

No.Test	List of Words	Testee Amounts Correct Answer	%
1	CHAIR	177	80.82
2	SECURITY	188	85.84
3	CAGE	76	34.7
4	SLIPPERS	92	42.01
5	REFRIGERATOR	54	24.66

6	MOUNTAIN	64	29,22	6	MOTHER	199	90.87
7	BOTTLE	40	18.26	7	STAR	167	76.26
8	SOAP	39	17,81	8	PHOTO	149	68.04
9	CLOUD	59	26.94	9	BAG	159	72,6
10	SHIP	37	16.89	10	PADI	133	60.73
11	SHEEP	52	23.74	11	MOUTH	147	67.12
12	BOMB	164	74.89	12	CHICKEN	162	73.97
13	PAPER	132	60.27	13	SOUND	167	76.26
14	HALL	169	77,17	14	ROOF	162	73.97
15	SHRIMP	150	68.49	15	LAKE	195	89.04

Table 13. Auditory Verbal Learning - A6

No.	List of Words	Testee Amounts Correct Answer	%
1	PIPE	196	89.5
2	WALL	197	89.95
3	HOUR	182	83.11
4	SUGAR	189	86.3
5	STUDENT	188	85.84
6	MOTHER	201	91.78
7	STAR	168	76.71
8	PHOTO	162	73.97
9	BAG	161	73.52
10	PADI	136	62.1
11	MOUTH	143	65.3
12	CHICKEN	164	74.89
13	SOUND	168	76.71
14	ROOF	154	70.32
15	LAKE	185	84.47

Table 14. Auditory Verbal Learning - A7

No.	List of Words	Testee Amounts Correct Answer	%
1	PIPE	200	91.32
2	WALL	202	92,24
3	HOUR	181	82.65
4	SUGAR	175	79.91
5	STUDENT	184	84.02

Table 15. Auditory Verbal Learning - Recognition

No.Test	List of Words	Testee Amounts Correct Answer	%
1	PIPE	217	99.09
2	WALL	215	98.17
3	HOUR	217	99.09
4	SUGAR	218	99.54
5	STUDENT	215	98.17
6	MOTHER	214	97.72
7	STAR	204	93.15
8	PHOTO	205	93.61
9	BAG	213	97.26
10	PADI	203	92.69
11	MOUTH	209	95.43
12	CHICKEN	210	95.89
13	SOUND	199	90.87
14	ROOF	208	94,98
15	LAKE	210	95.89
16	CHAIR	184	84.02
17	SECURITY	207	94.52
18	CAGE	147	67.12
19	SLIPPERS	149	68.04
20	REFRIGERATOR	129	58,9
21	MOUNTAIN	130	59.36
22	BOTTLE	88	40,18
23	SOAP	105	47.95
24	CLOUD	133	51.6
25	SHIP	90	41.1
26	SHEEP	119	54.34

27	BOMB	191	87.21
28	PAPER	111	50.68
29	HALL	144	65.75
30	SHRIMP	110	50.23

CONCLUSION

This study is a pilot study to test the adaptation of a neuropsychological test, spesifically the memory domain. All the adapted tests were translated to Bahasa Indonesia and administered to 219 participants. Results showed the percentage of correct answers for each items. The percentage showed no major variances between the original tests. The sequence of the items that were translated showed no major differences with the items in the original versions.

These item were administered in the same order with the real ones starting from the easiest item to most difficult item in each subtest. No major changes in the percentage result showed that this pilot study needs to be continued. The items are considered qualified for the real adaptation process, which would include a bigger number of participants from a wider areas in Indonesia.

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