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FLEMISH NORMATIVE DATA ON COMMON NEUROPSYCHOLOGICAL TESTS: INFLUENCE OF AGE, EDUCATION, AND GENDER

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Normative data on a large, neurologically intact, nonpsychiatric sample of 200 adult Flemish subjects (male=106, female=94) are presented according to age, education, and gender. The neuropsychological test battery included the Bourdon Wiersma Dot Cancellation, the Paced Auditory Serial Addition Test (PASAT), the Stroop Color-Word Test (SCWT), the Trail Making Test (TMT), the Rey or Taylor Complex Figure Test, version A or B of the Auditory Verbal Learning Test (AVLT), version F or G of the Benton Visual Retention Test (BVRT), and the Controlled Oral Word Association Test (COWAT). Stepwise linear regression analyses reveal a significant effect of education on all measures except Dot Cancellation and an interference score of the SCWT. Age contributed significantly to performance on memory tests and timed tests. Gender only accounted for a proportion of the variance in the copy score of the Taylor Complex Figure, the delayed recall score of the Rey Complex Figure, and the results of the AVLT. The two alternate versions of the AVLT are interchangeable. The Rey and Taylor Complex Figures are not of equivalent difficulty and differentially influenced by demographic factors, as well as versions F and G of the BVRT.

Despite the widespread use of neuropsychological tests in clinical practice and research protocols in Flanders, minimal information is available regarding test performance of healthy Flemish individuals and the influence of demographic factors on performance. The purpose of the present study is to provide normative data and data regarding the relative contributions of age, education and gender on neuropsychological test performance of healthy Flemish subjects.

Method

Subjects

Two-hundred normal healthy adults (male=106, female=94), were recruited for voluntary participation in a Flemish normative study for neuropsychological tests. They were informed about the research project through personal contact with one of the authors or psychology students participating in a graduate training program in neuropsychological assessment. The subjects were required

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to be in good health, to have no history of cardiovascular, neurological, or psychiatric disease, and to be taking no psychoactive medication. They were screened for these requirements through a standardized interview at the start of the session.

Age ranged between 18 and 74 years with a mean of 42.2 years (SD=15.3). Years of education includes primary, secondary, high school and university, and ranged from 7 to 19 years with a mean of 13.0 years (SD=2.8). The majority were right handed (n=178). There were no significant gender differences in age and education (Table 1). There was a high negative correlation between age and education (r=-.486, p<.001) reflecting the increase in educational level in the Flemish population over the past 50 years.

Table 1
Demographic Data According to Gender: M (SD)

	Males	Females	df	Significance
n	106	94		
Age	40.9 (16.8)	43.7 (13.3)	195.4	.177
Education	13.1 (3.0)	12.8 (2.5)	197.3	.371

Procedure

All subjects were assessed individually by one of the authors or by students participating in a graduate training program on neuropsychological assessment. The students recorded their sessions on audiotapes that were later reviewed by one of the authors to ensure a correct administration procedure. All test protocols were rated by the first author.

The neuropsychological test battery included 9 psychometric tests who were selected on the basis of their frequent use in our neuropsychological laboratory, as well in clinical as in research context. A brief description of each test is provided below:

Complex Figure Test (CFT). This test is used to assess visuospatial constructional ability and visual memory (Lezak, 1995). Factor analysis suggests that the CFT loads on a visuospatial perceptual/memory factor (Berry, Allen & Schmitt, 1991). The CFT was developed by Rey (1941) and elaborated by Osterrieth (1944) (for an English translation of both articles see Corwin & Bylsma, 1993). An alternate version of the Rey-Osterrieth figure is the Taylor figure (Taylor, 1979). The procedure involves having the subject copy the complex figure and then, without prior warning, reproduce it from memory.

Subjects received randomly one of the two alternate figures (Rey or Taylor). Two recall trials are provided: an immediate recall following the copying of the figure, and a delayed recall after approximately 30-45 minutes. Experimental variation in the delay period from 15 to 60 minutes, does not have significant effects on recall (Berry & Carpenter, 1992). Three measures of performance can be derived: a copy score, which reflects the accuracy of the original copy and is a measure of visual-constructional ability; an immediate recall score; and a delayed recall score, which assesses the amount of information retained over time. Scoring criteria for the Complex Figure are strictly applied for both the correctness of the details and their placement (Duley, Welkins, Hamby, Hopkins, Burwell & Barry, 1993; Spreen & Strauss, 1991). Copy and memory trials are scored in the same manner. The highest possible score is 36. Although the copy administration of the Rey and Taylor figures in young healthy adults are of equivalent difficulty, recall of the Rey Figure is harder than recall of the Taylor Figure (Berry et al., 1991; Duley et al., 1993; Strauss & Spreen, 1990). Because of this difference, normative data for both figures will be given separately.

Auditory Verbal Learning Test (AVLT). This test measures immediate verbal memory span, verbal learning, short-term and long-term memory, and allows for a comparison between retrieval efficiency and learning (Lezak, 1995). The original version was developed by André Rey (1964). The current version consists of a fixed list of 15 nouns (List A) read aloud for five consecutive trials (Trials A1 to A5), each trial followed by a free-recall test. After trial A5, an interference list of 15 words (List B) is presented, followed by a free-recall of that list (Trial B1). Immediately following this, recall of the first list is tested without further presentation of those words (Trial A6). After a delay period (20-40 minutes), the subject is again required to recall words from the first list (Trial A7). Finally, recognition of the List A words is tested in a list of 50 words containing all items from lists A and B and 20 words phonetically or semantically similar to those in lists A and B (Trial A8). The addition of a recognition trial permits the identification of people with retrieval problems, who will perform substantially better on the recognition trial than on the free-recall trial. The score for each trial is the number of words correctly recalled. We administered randomly one of two alternate forms (version A or B). A number of performance measures can be derived: the scores on trials A1 to A5; a sum score over the 5 trials; the scores on trials B, A6, A7 and A8 (number of true and false positive responses); and measures of proactive interference (poor list B performance after learning of list A by the substraction of trial B from trial A1), and retroactive interference (words lost from trial 5 to trial 6). In a factor analytic study the AVLT was found to have a verbal learning and memory loading (Ryan, Rosenberg, & Miltenberg, 1984). The AVLT has

proven useful in delineating memory system deficits in a variety of disorders, and to be sensitive to lateralized (i.e. left hemispheric) and frontal brain damage (Lezak, 1995).

Benton Visual Retention Test (BVRT). This test is often used to assess visual memory and visual perception. The test has two possible administration procedures, a drawing and a recognition administration, each containing a few alternate forms, respectively C, D, and E for drawing, and F and G for recognition (Spreen & Strauss, 1991). We administrated randomly one of the two alternate recognition forms, each consisting of 15 stimulus cards, on which one to three geometric figures are printed. Each of the cards is exposed for 5 seconds (Instruction N). Immediately after each exposure, the subject is shown a corresponding multiple-choice card with four similar stimuli, and he or she must choose the one that is identical to the stimulus card (Benton, 1961). The maximum score is 15. The test has shown to be sensitive to the presence of brain damage, but does not distinguish between hemispheric side of the lesion. This is probably due to the fact that many of the designs can be conceptualized verbally (for an overview, see Lezak, 1995; Spreen & Strauss, 1991). The recognition form involves visual attention and short-term retention capacity rather than visual memory.

Bourdon-Wiersma Dot Cancellation Test. This concentration test is a self-paced cancellation task measuring the ability to sustain and focus visual attention (Van Zomeren & Brouwer, 1994). Cancellation tasks require selectivity at fast speed on a repetitive motor response task (Lezak, 1995). In this task the subject is presented a 21 x 29.5 cm sized white sheet of paper with 25 rows of 25 patterns. Each pattern consists of 3, 4 or 5 randomly arranged dots. The subject is instructed to cross out all 4-dot patterns as quickly and accurately as he or she can to completion (each row contains 8 target patterns). The performance is scored for omissions, errors, average row time, and average row deviation time. Lowered scores on cancellation tasks have been reported to reflect the general response slowing and inattentiveness of diffuse brain damage (Lezak, 1995). Specific patterns of performance for patients with epilepsy and dementia have been described (De Zeeuw, 1981).

Paced Auditory Serial Addition Test (PASAT). Devised by Gronwall (1974), this test is a serial-addition task used to assess the rate of information processing and sustained attention (Spreen & Strauss, 1991). It also requires division of attention between subtasks (Van Zomeren & Brouwer, 1994). A prerecorded tape delivers a random series of 61 digits from 1 through 9. The subject is instructed to add pairs of digits so that each is added to the one immediately preceding it: The second is added to the first, the third to the second, the fourth

to the third, and so on. The subject is thus required to perform several subtasks at the same time, e.g. comprehending the auditory input, responding verbally, inhibiting encoding of one's own response while attending to a next stimulus in the series, and performing at an externally determined pace. The digits are presented at four rates of speed, each differing by 0.4 seconds and ranging from one every 1.2 seconds to one every 2.4 seconds. In the Dutch PASAT version used here, only one (low) presentation rate was assessed (2.4 seconds). The number of correct responses is recorded. The maximum score per trial is 60. The PASAT appears as a very sensitive test of deficits in information processing ability after mild brain injury (Gronwall & Wrightson, 1981; Ponsford & Kinsella, 1992). For normal subjects, the PASAT can be quite a demanding and frustrating task (Lezak, 1995; Spreen & Strauss, 1991).

Wechsler Digit Span Test. The digit span test used in the Wechsler intelligence (Wechsler, 1981) and memory scales (Wechsler, 1987) is commonly used for measuring span of immediate verbal recall. It comprises two different tasks, Digits Forward and Digits Backward. On Digits Forward the subject is read random number sequences of increasing length, and after each sequence the subject is asked to repeat it from memory. On Digits Backward the subject is read similar number sequences, and after each sequence the subject is asked to repeat it backwards. Both tests are similar in that they involve auditory attention and short-term retention capacity (Lezak, 1995). However combining the raw scores of both tests means a loss of information because they both involve different mental activities and are both differentially affected by brain damage (Banken, 1985; Kaplan, Fein, Morris & Delis, 1991). Digits Forward measures the efficiency of attention (i.e., freedom from distractibility) rather than memory (Kaufman, McLean & Reynolds, 1991). Digits Backwards involves mental double-tracking because both memory and reversing operations must proceed simultaneously. It therefore relies more heavily on memory than Digits Forward (Lezak, 1995). Because two trials are given at each span length and one point is scored for each correct trial, information about the length of span is confounded with information about the reliability of span performance (Lezak, 1995). For neuropsychological purposes, information on the length of span (forward as well as backward) is more useful (Kaplan et al., 1991).

Stroop Color-Word Test (SCWT). This well-known test measures selective attention (Van Zomeren & Brouwer, 1987) and concentration effectiveness (Lezak, 1995). Originally developed by Stroop (1935), many versions of this test have been described (MacLeod, 1991). We used a Dutch version (Hammes, 1971) consisting of three parts, with each part being presented on a white 21 & 29.5 cm card containing ten rows of ten items. The first part examines the speed at which the names of 100 randomized color names (blue, green, red and

yellow) printed in black, are read. The second part examines the speed at which 100 randomized colored rectangles are named. The third part again involves 100 color names each printed in some color other than the color it names, but the subject is instructed to name the colors in which the words are written and to ignore the color names. Apart form the separate completion times (in seconds) of parts I, II and III, an interference score is obtained by subtracting the time needed for part II from that of part III. This score reflects the interference of the automatic reading response with the response required by the task. In addition to the standard SCWT-protocol we also administered an experimental modification of this task that has been shown to improve the differentiation between patients with mild head injury and matched controls (Bohnen, Jolles & Twijnstra, 1992). These authors made a fourth part that was similar to part III except for the fact that 20 randomly selected items (colored color names) were placed in a small rectangle. The instructions given to the subject for this modified subtask (part IV) were the same as those for part III, except for the rectangularly lined items. For these items the subject was requested to read the printed word. Compared to part III, this fourth condition introduces additional interference as flexibility is required for the naming and reading of the items depending on a specific visual cue. A second measure of interference is derived by substraction of the time needed for part II from that of part IV. The SCWT is found to be sensitive to the effects of head injury (Bohnen et al., 1992; Ponsford & Kinsella, 1992; Stuss et al., 1985), and dementia (Fisher, Freed & Corkin, 1990; Koss, Ober, Delis & Friedland, 1984). The interference effect also seems greater for patients with left frontal lobe damage than for other patient or control groups (Spreen & Strauss, 1991).

Trail Making Test (TMT). This test, originally part of the U.S. Army Test Battery, was added by Reitan to the Halstead Battery. It is widely used to assess visual conceptual and visuomotor tracking (Lezak, 1995), speed for visual search, attention, mental flexibility, and motor function (Spreen & Strauss, 1991). The test requires the connection, by making pencil lines, between 26 encircled numbers randomly arranged on a page in proper order (Part A) and of 26 encircled numbers and letters in alternating order (Part B). Scoring is expressed in terms of the time (in seconds) required for Part A and Part B of the test. Part B is clearly the more sensitive part of the TMT. It is very sensitive to brain damage, including closed head injury, alcoholism, mild hypoxemia, chronic obstructive pulmonary disease, etc. For an overview see Lezak (1995) and Spreen & Strauss (1991).

Controlled Oral Word Association Test (COWAT). This test examines the oral production of words beginning with a designated letter or of a given semantic category within a limited amount of time (Spreen & Strauss, 1991).

For the category fluency the subject is asked to name as much words of a given semantic category (animals, professions) in one minute. For the letter fluency, the subject is asked to name as much words beginning with a designated letter of the alphabet in one minute, excluding names of people or places. For the Dutch version of this test, we used the letters N, A, and K because they were reported previously in a preliminary Flemish normative study on this test (Ghys, 1985). The letter fluency task has proven to be a sensitive indicator of brain dysfunction (Lezak, 1995), with bilateral frontal lesions showing the most severe impairment (Benton, 1968). The category fluency task is most extensively studied in the context of dementia. For an overview, see Lezak (1995) and Spreen & Strauss (1991). A positron emission tomography (PET)-scan study (Parks et al., 1988) with normal volunteers indicated that word fluency activates bilateral temporal and frontal lobes.

Statistics

Significant differences between subgroup demographics (age, education), and performance on one of the two alternate forms of the CFT, AVLT and BVRT were examined using independent samples t-tests. Gender differences were examined using chi-square analyses.

Stepwise linear regression analyses were used to determine the relative contributions of age, education and gender on the neuropsychological measures. A p value of .05 or less was used as the criterion for inclusion in the regression model.

Because of the great number of possible measures which can be derived from the administered tests, only the more important variables were selected: the copy score, the immediate and delayed recall score of the Complex Figure of Rey and Taylor; trial A1, the sum score from trial A1 to A5, the delayed recall score and the hit rate on the recognition form of the AVLT; the number correct on versions F and G of the BVRT; the average row time and the number of omissions on the Bourdon test; the number correct on the PASAT; the forward and backward span length on the Digit Span Test; the completion times of parts A and B of the TMT; the interference scores between parts II and III (III-II) and between parts II and IV (IV-II) of the SCWT; and the number of animals, the number of professions, and the sum score over trials N, A and K of the COWAT.

Results

Independent samples t-tests revealed no significant differences in age and education between subjects who received either the Rey CFT and version A of the AVLT, or the Taylor CFT and version B of the AVLT. However subjects

who received version G of the BVRT were significantly older and were significantly less educated than subjects who received version F. There was no difference in gender, nor for the CFT, the AVLT, or the BVRT. The immediate and delayed recall showed significantly higher scores for the Taylor figure. There was no difference between the copy scores. The two alternate versions of the AVLT revealed no significant differences in obtained scores. When both versions of the BVRT were compared, t-tests revealed significantly higher scores for version G, unless the fact that these subjects were older and less educated (Table 2).

Table 2

Demographic Data and Average Scores of Subjects Receiving Either One of the Two Alternate Forms of the CFT, AVLT and BVRT: M (SD)

	Version A[a]	Version B[b]	df	Coefficient/*t*-value
CFT				
n	136	64		
Male/Female	76/60	30/34	1	1.42
Age	41.7 (15.4)	43.3 (15.1)	198	-.68
Education	13.1 (2.9)	12.8 (2.6)	198	.61
copy	33.8 (3.2)	33.9 (1.9)	198	-.31
immediate recall	24.8 (6.8)	26.9 (4.9)	194	-2.43*
delayed recall	24.2 (6.0)	26.3 (6.1)	198	-2.23*
AVLT				
n	136	64		
Male/Female	77/59	29/35	1	2.23
Age	41.3 (15.4)	44.1 (15.1)	198	-1.18
Education	13.1 (2.9)	12.8 (2.6)	198	.67
A1	7.9 (2.4)	7.6 (1.8)	198	.93
Sum A1-A5	56.2 (10.1)	53.9 (8.3)	148.1	1.70
A7	11.3 (3.1)	10.7 (2.9)	196	1.29
A8 hit rate	14.0 (1.2)	14.0 (1.2)	197	-.24
BVRT				
n	53	53		
Male/Female	30/23	24/29	1	1.36
Age	32.7 (12.8)	41.8 (15.2)	104	-3.34**
Education	13.9 (2.6)	12.8 (2.6)	104	2.12*
number correct	13.3 (1.5)	14.0 (1.1)	95.1	-2.90**

[a] Version A: Rey CFT, AVLT A, BVRT F / [b] Version B: Taylor CFT, AVLT B, BVRT G

* $p<.05$ / ** $p<.01$

Table 3 lists the results of the Stepwise linear regression analyses. Age contributed significantly to the performance on the Rey and Taylor memory trials, with older people performing worse than younger people. The recall of the Rey figure was also influenced by education, favoring subjects with a higher educational level. Gender accounted for a significant proportion of the variance in the copy score of the Taylor CFT, with women performing better than men. The delayed recall score of the Rey figure was also influenced by gender, but here men outperformed women.

Because t-tests revealed no significant differences between both versions of the AVLT, both versions were analyzed together as one dependent measure in the regression model. The regression analyses revealed a significant contribution of all three factors to performance on the AVLT, except for one measure, the hit rate on recognition (trial A8). which was only influenced by age. Older subjects, men and subjects with a lower educational level, performed worse than younger subjects, women and subjects with a higher educational level.

Age was the only factor which accounted for a significant proportion of the variance in the measures of the Bourdon-Wiersma Dot Cancellation Test, with older subjects performing slower and making more omissions.

Education was the single factor that contributed significantly to the performance on the Digits Forward and Digits Backward, on the PASAT, on the results of the COWAT, and on version G of the BVRT. In any case, subjects with a higher educational level performed better than subjects who were less educated. Version F of the BVRT was not influenced by any of the factors.

The III-II interference score of the SCWT was only influenced by age, with older subjects having the greatest interference scores. Age and education accounted significantly for the variance in the IV-II interference score, and parts A and B of the TMT, with older subjects and subjects with a lower educational level performing worse.

The normative data (means and standard deviations) of the test results can be found in the appendix (Tables A1 to A4). Only those demographic variables for which the regression analyses revealed a significant influence on performance, were used to stratify the normative sample:

For the Bourdon test and the Taylor CFT, subjects were subdivided into three age groups: ≤30 years (n=68), 31-50 years (n=64), and >50 years (n=68).

For the PASAT, the Digit Span Test, the COWAT and the BVRT, subjects were classified into four educational level groups: primary school completed (n=51), secondary school completed (n=52), high school completed (n=55), and university completed (n=42).

For the SCWT, the TMT and the Rey CFT, a combination of age (≤30yrs; 31-50yrs; >50yrs) and education (primary school; secundary school; high school; university) would provide a total of 12 different normative samples.

Table 3

Results of the Stepwise Linear Regression Analyses

Test	Derived measure	Variable(s)	B	SE B	T	R^2
CFT Rey	copy	none				
	immediate recall	education	.941	.152	6.181***	.226
		age	-.109	.032	-3.406*	.289
	delayed recall	education	1.071	.151	7.096***	.273
		age	-.099	.032	-3.086*	.322
		gender	-1.847	.850	-2.173*	.345
CFT Taylor	copy	gender	1.540	.441	3.490***	.164
		age	-.034	.014	-2.398*	.236
	immediate recall	age	-.163	.036	-4.503***	.249
	delayed recall	age	-.201	.045	-4.481***	.245
AVLT	A1	age	-.066	.009	-7.348***	.214
		gender	.811	.272	2.985**	.248
		education	.160	.054	2.961**	.280
	Sum A1-A5	age	-.302	.039	-7.693***	.230
		education	.908	.235	3.862***	.284
		gender	4.310	1.124	3.833***	.334
	A7	age	-.089	.013	-7.007***	.200
		gender	1.403	.380	3.694***	.253
		education	.263	.074	3.536**	.298
	A8 hit rate	age	-.024	.006	-4.334***	.087
BVRT F	number correct	none				
BVRT G	number correct	education	.183	.055	3.320**	.178
Bourdon	average row time	age	.037	.010	3.706***	.066
	omissions	age	.233	.053	4.416***	.091
PASAT	number correct	education	1.715	.363	4.730***	.178
Digit Span	Forward span	education	.106	.043	2.441*	.054
	Backward span	education	.192	.039	4.931***	.189
SCWT	III-II	age	.487	.077	6.310***	.170
	IV-II	age	.651	.090	7.256***	.216
		education	-1.762	.553	-3.184**	.255
TMT	part A	age	.354	.054	6.587***	.180
		education	-1.075	.328	-3.281**	.223
	part B	education	-6.624	.702	-9.436***	.315
		age	.535	.140	-6.829***	.363
COWAT	animals	education	.517	.148	3.489***	.058
	professions	education	.528	.131	4.025***	.083
	Sum N-A-K	education	1.985	.301	6.602***	.193

* $p<.05$ / ** $p<.01$ / *** $p<.001$

Because of the small number of subjects over 50 years of age with a university degree (n=5), and of subjects under 30 years of age who did not complete secundary school (n=3), we decided to use only 6 samples with a different subdivision into two education groups for each age group. Subjects under 50 years of age were subdivided into a group who completed primary and/or secondary school (≤30yrs: n=17; 31-50yrs: n=37) and a group who completed high school or university (≤30yrs: n=51; 31-50yrs: n=27). Subjects over 50 years of age were subdivided into a group who completed primary school (n=32) and a group who completed secondary and/or high school or university (n=36).

A combination of age, education and gender would provide too many subgroups each containing only a small number of subjects. Because the three factors contribute significantly to all measures of the AVLT except one, we decided to provide normative data of 8 subgroups (Table A4): males (n=106) and females (n=94), age ≤45yrs (n=91) and age >45yrs (n=109), primary/ secondary school completed (n=103) and high school/university completed (n=97).

In the tables with the normative data, sample sizes will not always be maximal because of missing data.

Conclusions

Educational level accounted for a substantial proportion of the variance in performance on all neuropsychological tests favoring subjects with a higher educational level, except for the Bourdon-Wiersma Dot Cancellation Test, the III-II interference score of the SCWT, and the Taylor CFT, which were not influenced by education.

Age contributed to both verbal (AVLT) and visual (CFT) memory tests, indicating that memory performance is decreasing with age. Age also contributed to performance on those tests in which the subject was instructed to perform as fast as he or she could (Bourdon, SCWT and TMT). Increased age appears to result in a general slowing of performance.

Only a few test performances were significantly contributed by gender. On the copy trial of the Taylor CFT and the measures of the AVLT, women were performing better than men. On delayed recall of the Rey figure, men scored higher than women.

As opposed to both versions of the AVLT, the two alternate versions of the CFT and BVRT are not interchangeable. They are not of equivalent difficulty and are influenced differentially by demographic factors. A profound description and discussion on the findings with the CFT can be found elsewhere (Vingerhoets & Lannoo).

The results of this normative study demonstrate that interpretations and conclusions regarding performance on neuropsychological tests should take into account the relative contributions of factors such as age, educational level and gender.

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Appendix

Table A1
Normative Data by Age for Bourdon Wiersma Dot Cancellation Test and Taylor Complex Figure Test: M (SD)

	≤30yrs	31-50yrs	>50yrs
Bourdon Test	*n*=67	*n*=63	*n*=67
average row time	12.28 (1.58)	12.69 (2.43)	13.62 (2.31)
average row deviation time	1.26 (.46)	1.29 (.50)	1.27 (.50)
omissions	7 (7)	13 (12)	14 (14)
errors	0 (0)	1 (2)	0 (1)
Taylor Complex Figure	*n*=19	*n*=18	*n*=27
copy	34 (1)	34 (2)	33 (2)
immediate recall	30 (3)	27 (4)	25 (5)
delayed recall	30 (3)	25 (6)	24 (7)

Table A2
Normative Data by Education for BVRT, PASAT, Digit Span and COWAT: n M (SD)

	Primary School	Secondary School	High School	University
BVRT (version F)	*8* 13 (2)	*13* 13 (2)	*16* 14 (1)	*16* 13 (2)
BVRT (version G)	*12* 13 (1)	*15* 14 (1)	*19* 14 (1)	*7* 14 (1)
PASAT	*20* 36 (12)	*27* 46 (10)	*35* 46 (10)	*23* 50 (6)
Digit Span Forward	*20* 6 (1)	*28* 6 (1)	*35* 6 (1)	*23* 6 (1)
Digit Span Backward	*20* 4 (1)	*28* 5 (1)	*35* 5 (1)	*23* 6 (1)
COWAT animals	*51* 22 (6)	*52* 26 (7)	*55* 25 (6)	*42* 26 (5)
COWAT professions	*47* 17 (5)	*44* 19 (6)	*53* 20 (5)	*38* 21 (5)
COWAT N	*47* 10 (4)	*46* 14 (5)	*53* 14 (5)	*38* 14 (4)
COWAT A	*47* 10 (4)	*46* 13 (5)	*53* 13 (4)	*38* 15 (6)
COWAT K	*47* 13 (4)	*46* 17 (5)	53 18 (5)	*38* 19 (4)
COWAT N+A+K	*47* 33 (9)	*46* 44 (13)	*53* 46 (12)	*38* 47 (12)

Table A3
Normative Data by Age and Education for SCWT, TMT and Rey CFT: M (SD)

Age	≤30yrs	≤30yrs	31-50yrs	31-50yrs	>50yrs	>50yrs
Education	≤12yrs	>12yrs	≤12yrs	>12yrs	<12yrs	≥12jrs
SCWT	*n*=16	*n*=51	*n*=36	*n*=27	*n*=31	*n*=36
part II	53 (8)	52 (12)	57 (11)	54 (10)	30 (9)	55 (7)
part III	79 (14)	78 (13)	91 (18)	88 (23)	108 (22)	94 (20)
part IV	88 (18)	90 (14)	110 (23)	99 (22)	129 (29)	110 (21)
III-II	27 (13)	26 (13)	34 (17)	34 (17)	48 (22)	39 (17)
IV-II	36 (17)	38 (12)	52 (20)	46 (16)	69 (28)	54 (18)
TMT	*n*=17	*n*=51	*n*=37	*n*=27	*n*=31	*n*=36
part A	34 (13)	27 (6)	38 (10)	33 (15)	45 (11)	39 (14)
part B	71 (15)	60 (16)	88 (25)	73 (28)	120 (47)	76 (21)
Rey CFT	*n*=11	*n*=38	*n*=28	*n*=18	*n*=21	*n*=20
copy	34 (2)	34 (5)	34 (1)	35 (1)	33 (3)	34 (2)
immediate recall	27 (3)	29 (4)	23 (6)	25 (7)	19 (5)	25 (4)
delayed recall	25 (4)	29 (4)	22 (6)	26 (6)	18 (4)	24 (5)

Education <12yrs: Primary School / Education ≥12yrs: Secondary, High School or University
Education ≤12yrs: Primary or Secondary School / Education >12yrs: High School or University

Table A4
Normative Data by Age, Education, and Gender for the AVLT: M (SD)

Gender	Male	Male	Male	Male	Female	Female	Female	Female
Age	≤45yrs	≤45yrs	>45yrs	>45yrs	≤45yrs	≤45yrs	>45yrs	>45yrs
Educ.	≤12yrs	>12yrs	≤12yrs	>12yrs	≤12yrs	>12yrs	≤12yrs	>12yrs
n	17	40	33	16	12	22	41	19
A1	8 (2)	9 (2)	6 (2)	7 (2)	10 (2)	9 (2)	7 (2)	9 (1)
A2	11 (2)	12 (2)	8 (2)	10 (1)	13 (2)	11 (2)	10 (2)	11 (2)
A3	12 (3)	13 (2)	9 (2)	11 (1)	13 (2)	12 (2)	11 (3)	13 (2)
A4	13 (2)	13 (2)	11 (2)	12 (2)	14 (2)	13 (2)	12 (2)	13 (2)
A5	14 (2)	14 (1)	11 (2)	12 (2)	14 (1)	13 (2)	13 (2)	14 (2)
Sum	57 (10)	60 (8)	45 (8)	52 (6)	63 (7)	59 (7)	54 (8)	59 (8)
B	7 (2)	8 (2)	6 (2)	7 (2)	8 (2)	7 (3)	7 (2)	8 (2)
A6	12 (2)	13 (2)	9 (2)	9 (3)	13 (2)	12 (3)	11 (2)	12 (4)
A7	12 (3)	13 (2)	8 (3)	9 (3)	13 (2)	12 (2)	11 (3)	13 (2)
A8+	14 (1)	15 (1)	13 (1)	13 (1)	15 (0)	14 (1)	14 (1)	14 (1)
A8-	1 (2)	0 (1)	3 (1)	2 (2)	1 (1)	0 (1)	1 (2)	1 (1)

Education ≤12yrs: Primary or Secondary School / Education >12yrs: High School or University
A8+: hit rate / A8-: false positives

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