

UPDATED AND EXTENDED FLEMISH NORMATIVE DATA OF COMMONLY USED NEUROPSYCHOLOGICAL TESTS

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We present the results of healthy Flemish adults on commonly used neuropsychological tests: Rey Auditory Verbal Learning Test (AVLT, form A and form B), Coetsier Story Recall Test (CSRT), Rey Visual Design Learning Test (VDLT), Rey and Taylor Complex Figure Test (CFT), Benton Visual Retention Test (BVRT, form F and G), Bourdon-Wiersma dot cancellation Test (BW), Trail Making Test (TMT), Stroop Colour Word Test (SCWT), and the Controlled Oral Word Association Test (COWAT). Regression analyses reveal a significant effect of age and educational level on almost each test variable. Gender accounted for a proportion of the variance in the copy score of the Rey CFT and in the AVLT (form A). The alternative versions of the Rey AVLT, the Rey and Taylor CFT and the BVRT (form F and G) differ significantly. Normative data, stratified for age, educational level and gender when necessary, are included in an appendix.

In clinical practice we are often confronted with the lack of normative data on commonly used neuropsychological tests. Samples of healthy controls are either too small or the available normative data are simply outdated. Adequate normative neuropsychological data are usually only available for an English speaking population. Although most neuropsychological tests are translated from an original English version, normative data of the translated version remain lacking. To face up to this shortage and to enhance the quality of the neuropsychological assessment of native Flemish speaking patients, we decided to study a large group of healthy volunteers. Flemish normative data have been published before (Lannoo & Vingerhoets, 1997), yet in this article the purpose is to present normative data on a larger group of healthy people. When possible, we divided the group into smaller age ranges to provide more specified norms. We also provide normative data of two memory tasks that were not included in the previous study.

Method

Subjects

A total of 373 healthy adults (200 males and 173 females) volunteered to participate 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 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 standardised interview at the start of the session. The age ranges from 20 to 86 years, with a mean of 45.46 years ($SD=16.7$), the volunteers have a mean level of 13.17 years of education (minimum 5 - maximum 23 years, $SD=3.0$). Eighty-six percent is right-handed, 7.5% is left-handed, and 3.2% is ambidexter. When looking at the demographic variables, we find a difference in both age and education level between men and women, the latter being slightly older and less educated (Table 1). We created subgroups based on age and educational level. For age we chose the following division: ≤ 30 , $30 \leq 50$, >50 , or when the number of data was sufficiently large enough in each subgroup, we chose smaller age ranges: $20 \leq 29$, $30 \leq 39$, $40 \leq 49$, $50 \leq 59$, $60 \leq 69$, $70+$. When making a division based on education, we used less or equal to and more than 12 years of education as a crucial point in which over 12 years of education implies an engagement in studies after the age of 18 (bachelor or master degree). An age by gender by education overview is provided in Table 2.

Table 1. *Demographic Variables of the Total Group and According to Gender*

	Total group	men	women	df	p-value
n	373	200	173	1	.162
age: M (SD)	45.5 (16.7)	43.8 (17.2)	47.4 (16.1)	371	.04
educ: M (SD)	13.2 (3.0)	13.6 (3.2)	12.7 (2.8)	371	.005

Procedure

Each volunteer was tested individually by one of the authors or by one of the students participating in a training program on neuropsychological assessment. A similar order of test administration was used by each of the examiners.

Because the study was conducted at the University Ghent, one can expect the population under study to be biased towards an East-Flanders population.

However, given that the city of Ghent and its surroundings is fairly typical for the Flemish habitation and environmental planning, and given the limited extent of the Flemish territory, we expect interregional differences to be minimal and thus our group to be representative for the Flemish speaking part of the Belgian population.

The testing was recorded on tape and checked by the first author on accuracy of the instructions given, motivation of the volunteer and correct timing (especially regarding the delayed recall in the memory tasks). In addition, one of the authors also checked the accuracy of the scoring of the test protocols for each volunteer.

The neuropsychological battery included the following tests that were selected on the basis of their frequent use in our neuropsychological laboratory, as well as in both clinical and research context: Rey Auditory Verbal Learning Test (AVLT), Rey Visual Design Learning Test (VDLT), Rey and Taylor Complex Figure Test (CFT), Coetsier Story Recall Test (CSRT; Logisch Verbaal Geheugentest van Coetsier), Benton Visual Retention Test (BVRT), Bourdon-Wiersma Dot Cancellation Test (BW), Stroop Colour Word Test (SCWT), Trail Making Test (TMT) and the Controlled Oral Word Association Test (COWAT). A detailed description of most tests was given before (Lannoo & Vingerhoets, 1997). In this article we add a description of the Rey Visual Design Learning Test (VDLT) and the Coetsier Story Recall Test (CSRT).

Because of the variability in existing AVLT-versions, we add in Appendix 2 the versions used in this study (form A - form B). In Appendix 3 the story of the CSRT and scoring form can be found. Further, in Appendix 4 we provide a possible determination of severity of a deviant performance, as used in our laboratory. Maybe this could lead to an overall consensus on defining a patient's cognitive performance.

Rey Visual Design Learning Test (VDLT)

The purpose of this test is to assess non-verbal learning and memory. It assesses immediate memory span, new learning and recognition memory. The test was developed by Rey (1964) and instructions were translated into English by Graves and Sarazin (1985) in the University of Victoria Laboratory. The test consists of 15 simple geometric forms, each presented on separate stimulus cards at a rate of two seconds per card. When all cards are presented, the subject must draw all the designs that he or she can recall on a sheet of paper with 15 empty squares, equal to the amount of designs shown. This procedure is repeated five times. There is some disagreement about whether or not the patient is given a time limit to respond. According

to Rey (1968) the patient should receive one minute to respond to each trial, Spreen and Strauss (1991) recommend 90 seconds while Lezak (1995) doubts that any time limit is necessary. In our study the volunteers did not get a time limit either. They had to perform a delayed recall and a recognition task after 30 to 45 minutes. Rey (1968) and Spreen and Strauss (1991) present the patient with the recognition test immediately after the learning trials. In the recognition task the subject is shown 30 figures. The patient is asked to identify those 15 figures that were presented on the cards previously shown.

Coetsier Story Recall Test (CSRT)

In this test the patients are confronted with a story they have to reproduce. A short story of about 150 words is read out loud by the examiner. The patient is asked to listen carefully and try to memorise as much as possible from the story. Subsequently there are two recall moments: one immediately after the story is told, one delayed recall after 30 to 45 minutes. The patient has to write down the story or the parts he or she can recall. In scoring the memorised reproductions, there are three possible categories: very important features ($n = 12$) (number of the features mentioned is multiplied by five), important features ($n = 9$) (number of these features mentioned is multiplied by three), details ($n = 22$) (number of details mentioned is multiplied by one). The final score is the sum of these three multiplications, with a maximum score of 109. The quantity of words and ideas in story recall tests takes a patient out of the class of tests that measure supraspan rote memory of simple words. It provides a measure of the amount of information that is retained when more is presented than most people can remember on one hearing and thus offers a memory performance that has more ecological validity than list learning.

Statistics

The most important variables of each administered test were selected to be included: the copy score, immediate and delayed recall score of the Rey and Taylor Complex Figure Test; trial A 1, the sum of scores from trial A 1 to A 5, the delayed recall score and the hit rate on the recognition form of the AVLT (form A and form B) and VDLT; the immediate and delayed recall score of the Coetsier Story Recall Test (CSRT); the number correct recognitions on form F and G of the BVRT; the average row time and the number of omissions on the Bourdon test; the completion time of parts A and B of the

TMT; completion time of cards II and III of the SCWT and the interference score between parts II and III; the number of animals and professions, and the sum score over trials N, A, K of the COWAT. The different age and educational groups were checked for normality on each variable (test result) through a one-sample Kolmogorov-Smirnov test. When normality was not obtained or where data showed a large range in performances, we added percentile ranks. Independent samples t-tests were used to examine differences between subgroup demographics (age and education). Gender differences were examined using chi-square analyses. Differences in performance on the alternative forms of the CFT (Rey and Taylor), AVLT (form A and B) and BVRT (form F and G) were explored with univariate analyses. To further determine the relative contributions of age, education and gender on the different neuropsychological measures, stepwise linear regression analyses were performed. A *p* value of .05 or less was used as the criterion for inclusion in the regression model.

We performed a multivariate analysis with the age groups ≤ 30 , $30 \leq 50$, > 50 , as fixed factors and as dependent variables we chose the total sum and the delayed recall of the AVLT and VDLT and CFT immediate and delayed recall, average row time of the BW, SCWT cards II and III as well as the interference score, TMT parts A and B. We chose a polynomial contrast to elucidate the shape of change in the selected parameters when age increases.

Results

Through one-sample Kolmogorov-Smirnov tests we checked for normality of the distribution in the different groups for the different variables. Only the following variables did not obtain normality and were further quantified through percentile ranks: number of hits and false positives in the recognition task of the AVLT (form A and B) and VDLT, number correct hits in the BVRT (form F and G), BW average deviation of row time and number of false positives; and this in each age group. Also, TMT parts A and B and SCWT cards II and III and the interference score appeared not distributed

Table 2. *Distribution Male/Female over the Different Age and Education Groups*

Age	≤ 30	≤ 30	$30 \leq 50$	$30 \leq 50$	> 50	> 50
Educ	≤ 12	> 12	≤ 12	> 12	≤ 12	> 12
<i>Male</i>						
N	26	50	27	29	33	39
%	59.1%	65.8%	50.9%	40.3%	40.7%	67.2%
<i>Female</i>						
N	18	26	26	43	48	19
%	40.9%	34.2%	49.1%	59.7%	59.3%	32.8%

Age	20 ≤ 29	20 ≤ 29	30 ≤ 39	30 ≤ 39	40 ≤ 49	40 ≤ 49	50 ≤ 59	50 ≤ 59	60 ≤ 69	60 ≤ 69	70+	70+
Educ	≤ 12	> 12	≤ 12	> 12	≤ 12	> 12	≤ 12	> 12	≤ 12	> 12	≤ 12	> 12
Male												
N	20	48	3	12	20	19	14	26	11	11	12	4
%	69.0%	66.7%	42.9%	54.5%	50.0%	39.6%	40.0%	54.2%	39.3%	84.6%	46.2%	80.0%
Female												
N	9	24	4	10	20	29	21	22	17	2	14	1
%	31.0%	33.3%	57.1%	45.5%	50.0%	60.4%	60.0%	45.8%	60.7%	15.4%	53.8%	20.0%

normally, but only for the groups with an educational level higher than 12 years and between the ages of 20 and 29.

Independent samples t-tests revealed a significant difference in mean age ($p = .04$) and mean years of education ($p = .005$) between men and women. The women in our group are older and have had fewer years of education (Table 1). There is a significant difference in age between the groups of people who performed the different versions of the CFT, the AVLTL and the Benton. The group, who performed the Taylor version of the CFT, form B of the AVLTL and form G of the BVRTL, was significantly older. For this reason the variable age was included as a covariate in the univariate analyses. Both groups did not differ in terms of gender or educational level. The results of the univariate analyses are presented in Table 3.

Table 3. Differences in Performances on Alternative Versions of the AVLTL, CFT and BVRTL, with Age as Covariate: *M* (*SD*)

	form A (n=233)	form B (n= 151)	p-value
AVLTL			
initial recall (A 1)	7.8 (2.3)	7.4 (2.0)	.336
total recall (A 1 - A 5)	56.2 (9.6)	52.7 (8.7)	.006**
delayed recall (A 7)	11.5 (3.0)	10.5 (3.0)	.022*
CFT			
	Rey figure (n=224)	Taylor figure (n= 152)	
copy	34.0 (1.9)	33.9 (1.9)	.674
immediate recall	23.8 (6.5)	25.1 (6.7)	.000***
delayed recall	22.9 (6.9)	23.8 (7.6)	.002**
BVRTL			
	form F (n= 151)	form G (n= 139)	
correct recognition	12.9 (1.8)	13.6 (1.5)	.000***

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

A significant difference was found between the two forms of the AVLTL. Apparently form B is more difficult to memorise, since the total sum of A 1 - A 5 ($p = .006$) and the delayed recall ($p = .022$) was lower for this version. Univariate analyses also showed significant differences between the CFT Rey and Taylor, for both the immediate ($p = .000$) and delayed recall ($p = .002$). People had higher performances on the Taylor version of the CFT in both the immediate and delayed recall. A third significant difference ($p =$

.000) was found between forms F and G of the BVRT, the G-form being easier (higher portion of correct answers).

Table 4 lists the results of the stepwise linear regression analyses. Because we found significant differences between the alternative versions of the CFT, AVL T and the BVRT, these versions were investigated separately in the stepwise regression analyses.

For the Rey CFT we found a significant effect of age and years of education on all three measures (copy, immediate and delayed recall). Older people and people with a lower educational level make worse copies and have lower scores on the recall conditions. Besides age and educational level, also gender influenced the copy score, the women making better copies than men. The copy score on the Taylor CFT was not influenced by any of the demographic variables (gender, age, and education). Recall performances are influenced by age and years of education. Older people and people with less years of education have lower recall performances.

Gender, as well as age and educational level influenced every selected measure on form A of the AVL T (learning, recall, recognition). Younger people, women, and people with a higher educational level have higher scores after the initial presentation of the material (A 1), a higher total sum score (trial A 1 - A 5), higher retrieval scores (A 7), and a higher score on the recognition trial (A 8 hit rate). In form B of the AVL T, age is the most important influencing factor. Performance after the first presentation (A 1) is influenced by age and level of education (higher education equals higher A 1 score), all the other included measures are only affected by age. Older people have lower scores on learning, recall, and recognition. Another memory task influenced by age is the CSRT: higher age means lower recall scores.

Also influenced by both age and educational level is the F-form of the BVRT. Younger people and people with a higher educational level are better performers on this visual recognition task. The G-form is only affected by age, with the elderly performing worse.

The VDL T scores are influenced by age and years of education: lower educational level and higher age equals lower scores on A 1 (score after the first presentation), lower total sum scores (A 1 - A 5), lower retrieval score (A 6) and worse recognition performances (lower hit rate).

In the BW, mean reaction time and the number of omissions is influenced by age, the number of omissions is also influenced by years of education. Older people have a slower mean reaction time and more omissions. Higher educated people have fewer omissions.

The performances on the TMT and cards II and III of the SCWT are influenced by age and years of education. Elderly and less educated people perform these tests slower. The interference score of the SCWT (III - II) is only age dependent.

Table 4. Results of the Stepwise Regression Analyses

test	measure	Variable (s)	B	SE B	t	R2	
CFT Rey	copy	age	-.027	.008	-3.547***	.090	
		education	.101	.044	2.294 *	.108	
		gender	.488	.245	1.993 *	.124	
	immediate recall	age	-.138	.023	-5.909***	.231	
		education	.599	.134	4.479***	.295	
	delayed recall	age	-.175	.024	-7.425***	.298	
education		.582	.135	4.308***	.353		
CFT Taylor	copy	none					
	immediate recall	age	-.173	.030	-5.815***	.234	
		education	.384	.171	2.244*	.259	
	delayed recall	age	-.215	.033	-6.518***	.274	
		education	.445	.189	2.353*	.300	
	AVLT form A	A 1	age	-.049	.009	-5.746***	.195
education			.147	.048	3.049**	.223	
gender			.705	.269	2.615**	.246	
Sum A 1 - A5		age	-.238	.034	-7.114***	.262	
		education	.784	.190	4.133***	.305	
		gender	4.354	1.056	4.123***	.355	
A7		age	-.061	.011	-5.461***	.182	
		gender	1.511	.350	4.311***	.235	
		education	.236	.063	3.742***	.281	
A 8 hit rate		age	-.032	.006	-5.355***	.171	
		education	.0864	.034	2.540*	.192	
		gender	.422	.190	2.228*	.209	
AVLT form B		A 1	age	-.032	.010	-3.141**	.106
			education	.124	.057	2.179*	.134
		Sum A 1 - A 5	age	-.204	.041	-5.027***	.148
	A 7	age	-.083	.014	-6.138***	.206	
	A 8 hit rate	age	-.018	.007	-2.487*	.041	
BVRT form F	number correct	age	-.041	.008	-5.430***	.235	
		education	.109	.046	2.390*	.263	
BVRT form G	number correct	age	-.039	.007	-4.36***	.190	
VDLT	A 1	age	-.040	.009	-4.591***	.218	
		education	.162	.050	3.255**	.265	
	Sum A 1 - A 5	age	-.481	.050	-9.684***	.475	
		education	.758	.282	2.687**	.497	
	A 6	age	-.116	.013	-9.032***	.442	
		education	.181	.073	2.483*	.462	
	A 7 hit rate	age	.198	.053	3.752***	.426	
		education	-.0344	.009	-3.706***	.494	
CSRT	immediate recall	age	-.423	.093	-4.556***	.181	
	delayed recall	age	-.461	.088	-5.238***	.475	
BW	average row time omissions	age	.082	.008	9.664***	.198	
		age	.181	.032	5.623***	.115	
		education	-.433	.185	-2.341*	.127	
TMT	A	age	.560	.055	10.258***	.532	
		education	-1.052	.315	-3.335**	.551	
	B	age	1.069	.107	9.969***	.537	
		education	-3.924	.606	-6.470***	.601	
SCWT	II	age	.307	.039	7.969***	.194	
		education	-.534	.221	-2.417**	.207	
	III	age	.974	.084	11.561***	.565	
		education	-1.025	.482	-2.125**	.572	
	III- II	age	.699	.061	11.404***	.258	
COWAT	animals	education	.567	.107	5.300***	.120	
		age	-.074	.019	-4.001***	.156	
	professions Sum N A K	education	.611	.090	6.820***	.114	
		education	1.445	.219	6.589***	.154	
		age	-.101	.038	-2.675**	.170	

*p < .05. ** p < .01. *** p < .001

In the COWAT, the category animals and the total sum of categories N, A, K are age and education dependent. The category professions is influenced by the educational level only. Older people and less educated ones can retrieve fewer words in the mentioned categories.

The multivariate analysis revealed a linear trend in all included dependent variables ($p < 0.001$). However for the average row time of the BW, the interference score of the SCWT and the TMT parts A and B also show a quadratic trend ($p < .05$). Results are shown in Figure 1.

The normative data (means and standard deviations) of the test results can be found in Appendix 1. Only those demographic variables for which the regression analyses revealed a significant influence on performance were used to stratify the normative sample. We provide separate norms for all alternative test versions: CFT (Rey and Taylor), AVLT (form A - form B), BVRT (form F - form G). For the AVLT, VDLT, CFT, LVG, BVRT and CSRT we divided the age groups in ≤ 30 , $30 \leq 50$, > 50 . Where gender was an influencing factor, we provided separate norms for men and women, and in case of the educational level we chose to make a distinction between ≤ 12 years

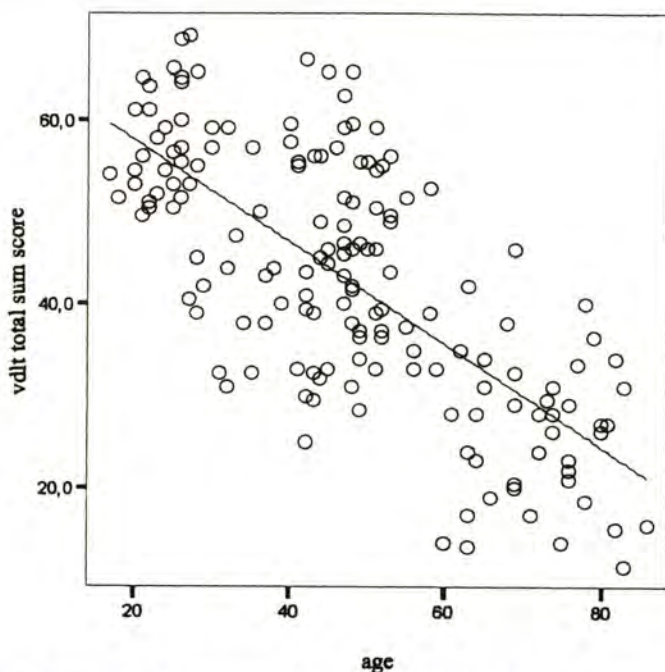


Figure 1A. Scatterplot showing a linear trend of VDLT total sum score with increasing age

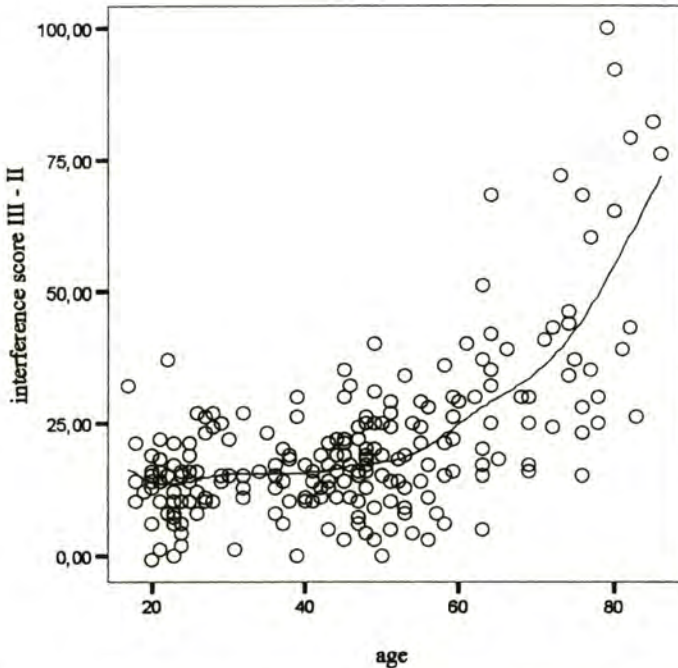


Figure 1B. Scatterplot showing a quadratic trend of SCWT-interference score with increasing age

of education (completion of secondary school until age 18), and > 12 years of education, which equals further education after age 18 (bachelor or masters). For the BW, TMT, SCWT, COWAT the group was large enough to be divided into smaller age categories: $20 \leq 9$, $30 \leq 39$, $40 \leq 49$, $50 \leq 59$, $60 \leq 69$, > 70 . When the group did not show a normal distribution or where data showed a large range in performances, we added percentile ranks in the normative tables. Because of the high specificity in the normative data, inevitably some groups became rather small. The authors would like to add the explicit warning to be cautious when interpreting data of small cells. They should be seen as a rough estimate, not as normative data.

Conclusion

In this article we present normative data of commonly used neuropsychological tests. We studied a large group of healthy adult volunteers in a broad

range of age groups and of different educational levels. Because the quality of an assessment depends on the quality of the instruments used, the Flemish Forum on Assessment decided to investigate how satisfying diagnostic instruments are according to the users in the Flemish speaking part of Belgium. A survey took place to make an inventory of the instruments frequently used and it contained an evaluation of the manual, the instruments, the instructions, norms, language and scoring of the instruments. Masters in Psychology completed the larger part of the surveys. The reported instruments were divided into 9 domains, including the domain attention and memory. Three of the tests we included in our study (CFT, AVLT and SCWT) are in the top 5 of most frequently used tests in Flanders when assessing attention and memory (Spruyt, 2003). Concerning normative data 50% of the professionals rate the existing data as not satisfying for the CFT. For the AVLT and SCWT a small majority of the clinicians indicates obvious problems, reflecting the necessity for updated normative data in a Flemish speaking population.

In this extended study we found that the alternative versions of CFT, AVLT (as opposed to the results in the original study by Lannoo & Vingerhoets, 1997), and BVRT are not interchangeable. Furthermore, the alternative versions are differently influenced by demographic variables. For example, in form A of the AVLT, gender has a significant impact on the performances, but this is not the case for form B.

As opposed to the study performed by Lannoo and Vingerhoets (1997) who found no differences between forms A and B of the AVLT, our study revealed that form B of the AVLT is more difficult to memorise. Over the five trials people learned more words in form A, and had a higher recall score. This difference in both learning and recall between forms A and B could be due to the frequency and familiarity of the words employed: curtain, house, and school (used in form A) sound more familiar than shepherd, sheep, and sponge (used in form B) and can probably be more easily retained. It is also possible that the 15 words of form A lend themselves more to making more elaborate associations (four to five words grouped), while most words in form B can only be combined in a two by two paired-associate form. Therefore, in form A one remembered word can trigger three to four others, while in form B it only triggers one other word, resulting in a lower total sum score over the five trials and a lower overall recall score. Separate normative data for both forms are provided in Appendix 1, but still users should keep the differences in both forms in mind.

The non-interchangeability of the Rey and Taylor CFT has yet again been proven by this study. We find no differences between performances on the copy score, but for the immediate and delayed recall, participants perform better on the Taylor CFT. Vingerhoets, Lannoo, and Wolters (1998) sum-

marised various studies that established equal results. In line with their conclusions, we again like to highlight the important research and clinical implications this difference in both versions has: "In pre-post test research settings the order of administration should be randomised. For diagnostic purposes the memory performance on the Taylor Figure should be evaluated against normative data that are specific for this figure, and its memory scores should never be compared against normative data for the Rey-Osterrieth Figure."

In the BVRT the results indicate that form F and G are not of equal level of difficulty. Participants in our study performed better on the G-form. This was also the case in the original study by Lannoo and Vingerhoets (1997). Although form G appears to be more difficult because it contains more items that are rated as complex, Benton (1961) pointed out that form G is actually not more difficult than form F because one should not look at the complexity of the presented figure itself but at the similarity of the alternatives offered in multiple-choice recognition. As a result Benton claims that both forms are equivalent. Other investigators that studied normative data on the BVRT do not report differences between form F and form G. So a reasonable explanation for these conflicting results is not obvious but should be investigated further.

Looking at the influence of demographic variables on the performances, we found that as age increases, performances on attention and memory tests decrease. This finding is in agreement with most existing research on the relationship between age and cognitive functioning. In agreement with Salthouse, Fristoe, and Rhee (1996) we observed a linear trend in the memory tasks indicating a gradual decline in memory performances over the different age groups. Spreen and Strauss (1991) reported normative data on the VDLT for adults (aged 20-84) and found that in the recall trials, the performances decline with age. Other authors also found memory decline with increasing age (Albert, 2002; Katz, 2001; Lannoo & Vingerhoets, 1997; Small, Stern, Tang, & Mayeux, 1999; Vanderaspoilden & Morais, 2001).

In time-related tests (BW, TMT, SCWT) we see a general slowing in the elderly. Our results display a quadratic trend in the performances on time-related tests reflecting a very subtle decline until about the age of 60 after which the decline is much steeper. Selnes, Jacobson, Machado, and Becker (1991) studied normative data on the TMT and they found similar results, psychomotor speed showing age effects. West (1999) points out that the slowing on the SCWT might be due to the fact that older adults experience more lapses of intention than younger people, and lapses tend to be of longer duration in older than in younger adults. Lapses of intention are most apt to occur when the focus of attention is directed away from the intended goals. These data force clinicians to use separate norms for the different age groups in order to evaluate their test results adequately.

A second demographic variable under study was educational level. Mean years of education explained quite a proportion of the variance in performances on most tests, in favour of the higher educated people. In the previous study by Lannoo and Vingerhoets (1997) education was also of influence on various tests: BVRT (form G), TMT, COWAT, recall of the CFT (Rey). These results again highlight the importance of separate normative data for people of different educational levels. More importantly, it points out that in neuropsychological assessment, asking the patient for his or her schooling is not an option, but a must.

Gender, the third demographic variable, influenced the verbal memory task (AVLT form A), women having a higher total sum score, reflecting the general belief that there is a female advantage in working with verbal material (Vingerhoets, 2000). Gender was also of influence on the visuoconstructive part of the CFT (copy score of the Rey CFT), the women making better copies than men. Similar results were found for the Taylor-figure in the study of Lannoo and Vingerhoets (1997) and Vingerhoets, Lannoo, and Wolters (1998). These results are in contrast with the finding by Maccoby and Jacklin (1974) who concluded that sex differences exist in visuospatial abilities favouring men. We can not think of a plausible explanation for these contradictory findings. Further investigation can hopefully clarify these results.

In conclusion, our updated and extended normative study points out to professionals who work with the mentioned test material that they should be aware of the impact of age and educational level on the test performances, and they should keep in mind that alternative versions are not always as equivalent as we would like them to be.

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APPENDIX 1

Table 1. Male Performances on AVLT (form A) and CFT (Rey): M (SD)

AUDITORY VERBAL LEARNING TEST (AVLT version 1)						
gender	MALE					
educ age	≤ 12 j			> 12 j		
	≤ 30	30 ≤ 50	> 50	≤ 30	30 ≤ 50	> 50
N	16	11	23	37	16	16
A 1	8.7 (2.0)	6.7 (1.6)	5.7 (1.8)	9.0 (2.4)	7.8 (2.0)	6.6 (2.0)
A 2	11.7 (2.2)	7.6 (2.4)	8.2 (2.0)	12.3 (1.9)	11.0 (1.8)	9.4 (1.5)
A 3	13.2 (1.2)	8.6 (3.3)	9.3 (2.5)	12.9 (1.7)	12.4 (1.1)	10.5 (1.8)
A 4	13.2 (2.0)	10.8 (2.6)	10.6 (2.3)	13.6 (1.4)	12.9 (1.8)	11.6 (2.2)
A 5	13.9 (1.6)	11.7 (2.4)	11.2 (1.9)	13.7 (1.4)	13.2 (1.4)	12.4 (1.9)
Sum	60.7 (7.5)	45.5 (9.6)	44.9 (8.5)	61.5 (7.4)	56.9 (5.9)	50.4 (8.2)
B	6.3 (2.2)	6.4 (1.9)	4.9 (1.9)	7.5 (2.2)	6.9 (1.4)	6.3 (2.2)
A 6	12.5 (2.2)	9.6 (3.1)	8.6 (2.6)	12.6 (2.0)	12.4 (1.9)	9.6 (3.1)
A 7	12.7 (2.0)	8.6 (4.2)	8.0 (3.0)	12.5 (2.1)	12.8 (2.2)	9.2 (2.9)
A 8+	14.4 (1.0)	13.1 (1.1)	12.6 (2.6)	14.5 (0.7)	14.3 (1.0)	13.4 (1.4)
A 8-	0.6 (1.5)	3.3 (2.9)	2.4 (2.4)	0.41 (0.9)	0.6 3 (1.4)	1.5 (1.5)
Percentile ranks A 8+						
10	12.00	11.30	8.00	13.00	11.60	11.40
20	14.00	12.00	12.00	14.00	13.20	12.40
30	14.00	12.90	12.00	14.00	14.00	13.00
40	14.80	13.00	13.00	15.00	14.00	13.00
50	15.00	13.00	14.00	15.00	15.00	13.00
60	15.00	13.00	14.00	15.00	15.00	14.00
70	15.00	14.00	14.00	15.00	15.00	14.90
80	15.00	14.00	15.00	15.00	15.00	15.00
90	15.00	14.70	15.00	15.00	15.00	15.00
Percentile ranks A 8-						
10	3.20	7.00	6.00	2.00	3.40	4.00
20	1.00	7.00	4.00	1.00	1.00	3.00
30	0.90	6.10	4.00	0.00	0.00	2.90
40	0.00	3.00	2.00	0.00	0.00	1.20
50	0.00	2.50	2.00	0.00	0.00	1.00
60	0.00	2.00	1.00	0.00	0.00	1.00
70	0.00	1.80	0.50	0.00	0.00	0.10
80	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00

For not normally distributed variables, percentile ranks are added in *italic*

COMPLEX FIGURE TEST REY (CFT Rey)

gender	MALE					
educ age	≤ 12 j			> 12 j		
	≤ 30	30 ≤ 50	> 50	≤ 30	30 ≤ 50	> 50
N	16	12	23	37	18	18
copy	33.9 (2.1)	34.2 (1.8)	32.7 (2.6)	34.6 (1.3)	34.6 (1.3)	33.2 (2.8)
N	25	30	48	54	44	21
IR	24.0 (6.4)	23.0 (6.0)	19.0 (6.2)	28.4 (3.5)	24.5 (6.3)	22.8 (6.7)
DR	23.2 (6.1)	21.5 (5.9)	17.5 (6.3)	28.6 (3.7)	24.2 (5.9)	20.1 (7.1)

IR = immediate recall, DR= delayed recall

For not normally distributed variables, percentile ranks are added in *italic*

Table 2. Female Performances on AVLT (form A) and CFT (Rey): M (SD)

AUDITORY VERBAL LEARNING TEST (AVLT version 1)						
FEMALE						
gender						
educ	<i>≤ 12 j</i>			<i>> 12 j</i>		
age	<i>≤ 30</i>	<i>30 ≤ 50</i>	<i>> 50</i>	<i>≤ 30</i>	<i>30 ≤ 50</i>	<i>> 50 (51-76)</i>
N	8	20	22	19	26	7
A 1	85 (2.8)	7.2 (1.5)	7.3 (2.1)	9.3 (2.1)	8.4 (1.9)	8.6 (1.6)
A 2	11.6 (2.2)	10.4 (2.1)	9.8 (2.5)	12.3 (1.7)	11.1 (2.2)	11.6 (1.1)
A 3	12.7 (2.1)	11.6 (2.1)	11.6 (2.5)	13.7 (1.2)	12.7 (1.6)	12.9 (1.1)
A 4	13.0 (2.0)	12.4 (1.9)	12.4 (2.2)	14.1 (1.1)	13.2 (1.6)	14.3 (0.7)
A 5	12.7 (2.3)	12.6 (1.9)	12.8 (2.2)	14.2 (1.1)	13.7 (1.7)	13.7 (1.2)
Sum	58.6 (10.3)	54.3 (8.0)	54.0 (9.6)	63.5 (5.6)	59.1 (7.5)	61.0 (4.8)
B	8.6 (1.7)	6.1 (2.0)	6.3 (2.3)	7.7 (3.2)	7.5 (2.4)	7.1 (2.2)
A 6	12.5 (1.9)	10.5 (2.9)	11.1 (3.1)	13.4 (1.9)	11.3 (3.4)	13.6 (1.4)
A 7	13.4 (1.5)	11.0 (2.9)	11.5 (2.9)	13.3 (1.8)	12.0 (2.1)	13.7 (1.1)
A 8 +	<i>14.7 (0.7)</i>	<i>13.8 (1.2)</i>	<i>13.5 (2.4)</i>	<i>14.7 (0.7)</i>	<i>14.0 (1.2)</i>	<i>14.9 (0.4)</i>
A 8 -	<i>0.4 (0.7)</i>	<i>1.1 (1.7)</i>	<i>1.0 (1.3)</i>	<i>0.2 (0.5)</i>	<i>0.7 (1.5)</i>	<i>0.0 (0.0)</i>
Percentile ranks A 8+						
10	<i>13.00</i>	<i>13.00</i>	<i>9.90</i>	<i>13.00</i>	<i>12.00</i>	<i>14.00</i>
20	<i>14.60</i>	<i>13.00</i>	<i>13.00</i>	<i>14.00</i>	<i>13.00</i>	<i>14.60</i>
30	<i>15.00</i>	<i>14.00</i>	<i>13.00</i>	<i>15.00</i>	<i>13.70</i>	<i>15.00</i>
40	<i>15.00</i>	<i>14.00</i>	<i>14.00</i>	<i>15.00</i>	<i>14.00</i>	<i>15.00</i>
50	<i>15.00</i>	<i>14.00</i>	<i>14.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>
60	<i>15.00</i>	<i>15.00</i>	<i>14.80</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>
70	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>
80	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>
90	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>	<i>15.00</i>
Percentile ranks A 8-						
10	2.00	3.00	3.40	1.00	3.40	0.00
20	1.20	2.00	1.00	0.00	1.00	0.00
30	0.30	1.00	1.00	0.00	0.00	0.00
40	0.00	1.00	1.00	0.00	0.00	0.00
50	0.00	1.00	1.00	0.00	0.00	0.00
60	0.00	0.00	1.00	0.00	0.00	0.00
70	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00

For not normally distributed variables, percentile ranks are added in *italic*

!! Warning: because of the small number of volunteers in some cells (in bold) these data can not be seen as normative

COMPLEX FIGURE TEST REY (CFT Rey)

FEMALE						
gender						
educ	<i>≤ 12 j</i>			<i>> 12 j</i>		
age	<i>≤ 30</i>	<i>30 ≤ 50</i>	<i>> 50</i>	<i>≤ 30</i>	<i>30 ≤ 50</i>	<i>> 50 (51-76)</i>
N	8	19	25	18	26	8
copy	34.9 (1.0)	34.3 (1.1)	33.1 (2.1)	34.7 (1.7)	34.7 (1.2)	33.6 (2.3)
N	25	30	48	54	44	21
IR	24.0 (6.4)	23.0 (6.0)	19.0 (6.2)	28.4 (3.5)	24.5 (6.3)	22.8 (6.7)
DR	23.2 (6.1)	21.5 (5.9)	17.5 (6.3)	28.6 (3.7)	24.2 (5.9)	20.1 (7.1)

IR = immediate recall, DR = delayed recall

For not normally distributed variables, percentile ranks are added in *italic*

!! Warning: because of the small number of volunteers in some cells (in bold) these data can not be seen as normative

Table 3. Male and Female Performances on AVLT (form B), Benton form F, CFT Taylor, VDLT: M (SD)

AUDITORY VERBAL LEARNING TEST (AVLT version 2)						
gender educ age	MALE AND FEMALE					
	≤ 30	≤ 12 j 30 ≤ 50	> 50	≤ 30	> 12 j 30 ≤ 50	> 50
N	14	16	36	17	24	36
A 1	7.7 (1.9)	8.0 (2.4)	6.2 (1.7)	8.6 (1.8)	7.5 (1.5)	7.6 (2.0)
N	31	40	72	31	40	72
A 2	10.9 (2.0)	10.1 (2.6)	9.1 (2.3)	10.9 (2.0)	10.1 (2.6)	9.1 (2.3)
A 3	11.6 (2.0)	12.0 (2.2)	10.5 (2.2)	11.6 (2.0)	12.0 (2.2)	10.5 (2.2)
A 4	12.5 (2.0)	12.3 (1.9)	11.3 (1.7)	12.5 (2.0)	12.3 (1.9)	11.3 (1.7)
A 5	13.2 (2.1)	12.9 (1.9)	11.8 (2.1)	13.2 (2.1)	12.9 (1.9)	11.8 (2.1)
Sum	56.3 (8.1)	55.3 (8.5)	49.6 (8.2)	56.3 (8.1)	55.3 (8.5)	49.6 (8.2)
B	7.1 (2.3)	7.4 (1.8)	6.1 (2.1)	7.1 (2.3)	7.4 (1.8)	6.1 (2.1)
A 6	12.0 (2.7)	11.1 (2.7)	9.5 (2.7)	12.0 (2.7)	11.1 (2.7)	9.5 (2.7)
A 7	12.1 (2.8)	11.3 (2.7)	9.3 (2.9)	12.1 (2.8)	11.3 (2.7)	9.3 (2.9)
A 8 +	14.5 (1.0)	13.6 (1.8)	13.8 (1.5)	14.5 (1.0)	13.6 (1.8)	13.8 (1.5)
A 8 -	0.4 (0.7)	1.1 (1.7)	1.0 (1.3)	0.2 (0.5)	0.7 (1.5)	0.0 (0.0)
<i>Percentile ranks A 8+</i>						
10	13.00	9.40	11.90	12.00	11.50	11.70
20	14.00	13.00	13.00	14.00	13.00	12.40
30	14.50	14.00	13.70	15.00	13.00	13.10
40	15.00	14.00	14.00	15.00	14.00	14.00
50	15.00	14.50	14.00	15.00	14.00	14.00
60	15.00	15.00	15.00	15.00	14.00	15.00
70	15.00	15.00	15.00	15.00	15.00	15.00
80	15.00	15.00	15.00	15.00	15.00	15.00
90	15.00	15.00	15.00	15.00	15.00	15.00
<i>Percentile ranks A 8 -</i>						
10	4.00	1.90	7.10	1.00	2.00	6.30
20	2.00	1.00	6.00	0.40	2.00	3.20
30	1.50	0.00	3.30	0.00	1.00	2.00
40	1.00	0.00	2.40	0.00	0.00	1.00
50	0.00	0.00	2.00	0.00	0.00	0.50
60	0.00	0.00	1.00	0.00	0.00	0.00
70	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00
For not normally distributed variables, percentile ranks are added in <i>italic</i>						
BENTON VISUAL RETENTION TEST (BVRT form F)						
gender educ age	MALE AND FEMALE					
	≤ 30	≤ 12 j 30 ≤ 50	> 50	≤ 30	> 12 j 30 ≤ 50	> 50
N	22	21	22	42	30	14
correct	13.2 (1.3)	13.1 (1.5)	11.2 (2.3)	13.9 (1.2)	13.1 (1.3)	12.4 (2.1)
<i>Percentile ranks Benton form F</i>						
10	11.30	11.00	7.00	12.30	12.00	9.00
20	12.00	12.00	9.00	13.00	12.00	11.00
30	12.00	12.00	9.90	14.00	12.00	11.00
40	13.00	12.00	11.00	14.00	13.00	12.00
50	13.50	13.00	12.00	14.00	13.00	12.50
60	14.00	14.00	12.00	14.00	13.00	13.00
70	14.00	14.00	13.00	15.00	14.00	14.00
80	14.00	15.00	13.00	15.00	14.00	15.00
90	15.00	15.00	14.00	15.00	15.00	15.00
For not normally distributed variables, percentile ranks are added in <i>italic</i>						

COMPLEX FIGURE TEST (CFT Taylor)

gender	MALE AND FEMALE					
	$\leq 12j$			$> 12j$		
educ	≤ 30	$30 \leq 50$	> 50	≤ 30	$30 \leq 50$	> 50
age	≤ 30	$30 \leq 50$	> 50	≤ 30	$30 \leq 50$	> 50
N	17	19	37	17	26	36
copy	33.8 (2.2)	35.0 (1.3)	33.4 (1.6)	33.7 (2.1)	34.1 (2.1)	33.9 (2.0)
IR	28.6 (6.9)	26.2 (5.1)	20.5 (7.1)	28.9 (4.2)	26.5 (4.7)	25.0 (6.7)
DR	28.2 (6.4)	24.7 (5.9)	18.4 (8.6)	28.6 (4.9)	25.4 (5.5)	23.7 (7.2)

IR = immediate recall, DR = delayed recall

VISUAL DESIGN LEARNING TEST (VDLT)

gender	MALE AND FEMALE					
	$\leq 12j$			$> 12j$		
educ	≤ 30	$30 \leq 50$	> 50	≤ 30	$30 \leq 50$	> 50
age	≤ 30	$30 \leq 50$	> 50	≤ 30	$30 \leq 50$	> 50
N	9	25	42	28	38	27
A 1	5.7 (1.7)	5.5 (2.2)	3.7 (1.7)	7.0 (2.2)	5.7 (1.6)	5.2 (2.0)
A 2	8.4 (1.3)	7.8 (2.3)	5.1 (2.1)	10.7 (1.7)	8.2 (2.4)	7.1 (3.0)
A 3	10.7 (1.7)	9.2 (2.5)	5.8 (2.5)	12.5 (1.6)	9.6 (2.6)	8.2 (3.3)
A 4	12.2 (1.4)	10.2 (2.6)	6.3 (2.6)	13.2 (1.7)	10.8 (2.3)	9.5 (3.5)
A 5	13.4 (1.1)	11.4 (2.2)	7.5 (3.0)	13.8 (1.4)	11.5 (2.5)	10.3 (3.4)
Sum	51.4 (5.7)	44.0 (10.6)	28.3 (9.7)	57.2 (7.3)	45.8 (10.3)	40.4 (14.9)
A 6	12.7 (1.9)	10.0 (2.8)	6.8 (3.0)	13.6 (1.4)	10.6 (2.9)	9.7 (3.3)
A 7+	14.0 (1.0)	13.0 (3.2)	11.7 (2.2)	13.6 (1.4)	13.6 (1.4)	13.4 (1.5)
A 7-	0.22 (0.4)	1.4 (1.6)	3.0 (2.2)	0.5 (1.1)	1.5 (1.9)	1.7 (1.6)

Percentile ranks A 7+

10	12.00	9.80	8.30	13.70	11.90	11.00
20	13.00	12.00	10.00	14.00	12.00	12.00
30	14.00	12.80	11.00	15.00	13.00	13.00
40	14.00	14.00	12.00	15.00	13.60	13.20
50	14.00	14.00	12.00	15.00	14.00	14.00
60	14.00	14.00	12.80	15.00	14.00	14.00
70	15.00	15.00	13.00	15.00	15.00	14.00
80	15.00	15.00	13.00	15.00	15.00	15.00
90	15.00	15.00	14.00	15.00	15.00	15.00

Percentile ranks A 7-

10	1.00	4.40	6.00	2.20	4.00	4.20
20	1.00	3.00	5.40	1.00	3.00	3.40
30	0.00	2.00	4.00	0.30	2.00	2.00
40	0.00	1.00	3.00	0.00	1.00	1.00
50	0.00	1.00	3.00	0.00	1.00	1.00
60	0.00	1.00	2.00	0.00	0.00	1.00
70	0.00	0.00	1.90	0.00	0.00	1.00
80	0.00	0.00	1.00	0.00	0.00	0.00
90	0.00	0.00	0.30	0.00	0.00	0.00

For not normally distributed variables, percentile ranks are added in *italic*

!! Warning: because of the small number of volunteers in some cells (in bold) these data can not be seen as normative

Table 4. Male and Female Performances on, Benton form G and Coetsier Story Recall Test: M (SD)

BENTON VISUAL RETENTION TEST (BVRT form G)

gender	MALE AND FEMALE		
	≤ 30	30 ≤ 50	> 50
age			
N	35	38	66
correct	14.3 (0.7)	14.1 (0.9)	13.0 (1.9)
<i>Percentile ranks Benton, form G</i>			
10	13.00	13.00	10.00
20	14.00	13.00	11.00
30	14.00	14.00	12.00
40	14.00	14.00	13.00
50	14.00	14.00	13.00
60	14.60	15.00	14.00
70	15.00	15.00	14.00
80	15.00	15.00	15.00
90	15.00	15.00	15.00

For not normally distributed variables, percentile ranks are added in *italic*

COETSIER STORY RECALL TEST (CSRT)

gender	MALE AND FEMALE		
	≤ 30	30 ≤ 50	> 50
age			
N	15	27	54
IR	67.8 (13.0)	50.7 (19.3)	45.5 (18.7)
DR	63.0 (15.7)	49.6 (17.6)	40.7 (17.8)
<i>Percentile ranks CSRT immediate recall</i>			
10	51.80	17.80	23.00
20	57.40	32.60	27.00
30	59.00	40.40	33.00
40	63.40	51.20	38.00
50	66.00	54.00	42.00
60	68.20	58.20	48.00
70	70.00	61.80	57.50
80	83.60	65.80	61.00
90	90.80	77.80	70.00
<i>Percentile ranks CSRT delayed recall</i>			
10	42.00	21.60	18.50
20	48.20	27.00	26.00
30	53.80	42.40	29.50
40	58.00	49.20	33.00
50	61.00	52.00	37.00
60	65.00	53.60	44.00
70	69.00	61.00	48.50
80	79.40	66.60	56.00
90	89.20	72.00	67.50

IR = immediate recall, DR = delayed recall

For not normally distributed variables, percentile ranks are added in *italic*

Table 5. Male and Female Performances on TMT, COWAT, SCWT: M (SD)

TRAIL MAKING TEST (TMT)						
gender	MALE AND FEMALE					
educ	≤ 12 j					
age	20 ≤ 29	30 ≤ 39	40 ≤ 49	50 ≤ 59	60 ≤ 69	70+
N	31	7	40	33	26	16
A	30.5 (9.1)	30.0 (5.7)	37.6 (12.0)	41.8 (10.4)	46.4 (16.1)	62.4 (17.0)
B	71.1 (24.6)	77.7 (25.4)	91.7 (38.2)	100.1 (43.3)	112.3 (49.8)	158.8 (50.2)
<i>Percentile ranks TMT A</i>						
10	44.60	38.00	55.60	58.00	78.40	121.10
20	40.00	36.80	47.00	53.00	68.60	87.20
30	34.00	34.80	43.40	47.00	54.30	72.70
40	31.20	32.00	38.20	45.00	51.00	67.40
50	31.00	28.00	36.00	43.00	45.50	64.00
60	27.80	27.20	34.00	42.00	41.20	60.00
70	26.20	25.80	29.30	38.00	35.00	58.10
80	21.40	24.20	26.40	31.00	31.80	52.80
90	19.20	23.00	25.00	27.00	28.90	42.80
<i>Percentile ranks TMT B</i>						
10	105.60	123.00	122.50	173.60	179.00	253.10
20	87.80	106.20	108.60	131.60	152.20	191.20
30	80.00	90.20	96.10	109.00	144.30	177.70
40	74.20	80.40	89.20	101.20	114.40	170.20
50	65.00	70.00	84.00	85.00	103.50	153.00
60	60.60	70.00	83.40	80.00	83.60	142.60
70	56.00	59.20	71.30	73.20	75.50	117.20
80	51.60	51.60	67.00	64.80	69.40	110.40
90	43.80	51.00	56.60	57.00	61.70	100.70
educ	> 12 j					
age	20 ≤ 29	30 ≤ 39	40 ≤ 49	50 ≤ 59	60 ≤ 69	70+
N	70	21	47	48	12	4
A	29.1 (9.5)	32.7 (14.9)	32.1 (10.1)	40.3 (12.2)	45.0 (17.0)	66.0 (22.5)
B	60.7 (15.9)	69.5 (19.3)	67.7 (21.0)	79.6 (22.9)	115.5 (48.8)	167.5 (45.8)
<i>Percentile ranks TMT A</i>						
10	39.00	50.20	47.00	57.00	69.00	97.00
20	34.00	40.60	41.20	53.00	66.60	92.60
30	30.00	35.20	39.00	44.60	64.60	79.40
40	29.00	33.40	36.40	40.00	55.20	72.20
50	27.00	29.50	30.00	37.50	44.00	68.00
60	26.00	26.20	27.60	34.00	36.40	57.80
70	24.00	24.80	24.70	32.70	31.00	50.40
80	22.00	22.00	22.80	31.00	29.40	48.60
90	20.00	17.30	19.90	27.70	25.20	48.00
<i>Percentile ranks TMT B</i>						
10	81.90	102.80	93.40	113.50	211.80	216.00
20	74.40	88.20	82.80	95.60	162.00	216.00
30	65.70	79.00	74.20	90.60	139.10	206.50
40	61.00	75.20	67.80	81.20	100.00	197.00
50	58.50	67.00	65.00	73.00	98.00	165.00
60	56.00	62.40	60.40	68.60	94.40	133.00
70	51.30	56.00	56.00	65.70	88.30	128.50
80	47.00	50.60	52.00	60.80	76.00	124.00
90	42.10	45.00	44.60	56.40	65.60	124.00

For not normally distributed variables, percentile ranks are added in *italic*

!! Warning: because of the small number of volunteers in some cells (in bold) these data can not be seen as normative

CONTROLLED ORAL WORD ASSOCIATION TEST (COWAT)

gender	MALE AND FEMALE					
educ	≤ 12 j					
age	20 ≤ 29	30 ≤ 39	40 ≤ 49	50 ≤ 59	60 ≤ 69	70+
N	31	7	40	35	28	25
Animals	24.2 (6.9)	22.3 (3.5)	22.6 (5.6)	22.3 (6.1)	22.5 (7.6)	17.3 (4.3)
N	100	28	82	78	35	30
prof	19.7 (5.7)	19.1 (5.5)	19.1 (5.4)	19.2 (4.9)	16.1 (4.3)	14.2 (4.3)
N	31	7	38	33	24	25
N	10.7 (5.0)	10.9 (3.2)	10.4 (4.4)	10.9 (4.0)	9.4 (3.7)	7.4 (3.3)
A	12.6 (3.6)	9.7 (4.6)	11.1 (4.3)	10.4 (3.9)	9.7 (3.0)	8.5 (3.8)
K	15.4 (4.3)	13.6 (5.0)	16.0 (4.6)	12.4 (4.3)	12.4 (4.9)	10.6 (3.3)
educ	> 12 j					
age	20 ≤ 29	30 ≤ 39	40 ≤ 49	50 ≤ 59	60 ≤ 69	70+
N	70	21	45	47	11	5
Animals	26.4 (5.5)	24.9 (6.9)	28.6 (5.4)	24.4 (4.3)	22.4 (5.6)	19.0 (4.3)
N	100	29	82	78	35	30
prof	19.7 (5.7)	19.9 (5.5)	19.1 (5.4)	19.2 (4.9)	16.1 (4.3)	14.2 (4.3)
N	70	21	45	46	11	5
N	13.1 (4.3)	11.5 (4.4)	14.0 (4.5)	13.2 (4.7)	12.0 (4.1)	12.2 (6.3)
A	13.8 (4.8)	12.2 (4.1)	14.3 (5.2)	12.5 (4.9)	11.7 (4.6)	12.0 (2.5)
K	18.0 (4.7)	15.4 (4.0)	18.6 (5.7)	17.2 (4.8)	15.3 (5.0)	15.2 (5.2)

Warning: because of the small number of volunteers in some cells (in bold) these data can not be seen as normative

STROOP COLOUR WORD TEST (SCWT)

gender	MALE AND FEMALE					
educ	≤ 12 j					
age	20≤29	30≤39	40≤49	50≤59	60≤69	70+
N	30	6	39	34	27	25
I	53.8 (10.7)	55.5 (5.3)	57.7 (12.8)	58.9 (7.3)	62.1 (11.6)	78.6 (20.6)
II	84.4 (18.0)	83.3 (11.7)	91.2 (17.5)	97.6 (21.8)	114.8 (29.9)	155.6 (40.5)
N	99	28	87	82	40	30
II- II	28.8 (12.6)	36.0 (16.3)	30.9 (13.4)	38.8 (18.8)	51.2 (24.0)	82.0 (36.7)

Percentile ranks SCWT card II

10	72.20	63.00	75.00	68.00	76.00	112.40
20	62.80	62.20	69.00	67.00	70.80	100.40
30	60.00	60.40	63.00	65.00	67.00	87.60
40	58.00	56.20	59.00	60.00	61.00	81.20
50	52.00	54.00	55.00	58.00	58.00	72.00
60	48.80	52.60	53.00	56.00	57.20	65.20
70	46.30	51.20	51.00	54.50	56.00	64.00
80	44.00	50.40	47.00	51.00	54.20	60.40
90	39.40	50.00	43.00	49.00	47.80	57.60

Percentile ranks SCWT card III

10	104.90	102.00	117.00	130.00	173.40	220.28
20	102.40	97.20	107.00	111.00	137.60	198.00
30	95.00	89.30	100.00	106.00	125.80	180.60
40	88.00	84.40	98.00	102.00	119.20	166.60
50	82.50	82.00	90.00	99.50	102.00	145.00
60	75.80	80.00	81.00	94.00	98.00	130.20
70	73.60	76.50	79.00	80.50	92.80	125.00
80	68.20	71.20	76.00	78.00	89.80	123.00
90	59.80	68.00	72.00	72.00	86.00	109.80

Percentile ranks SCWT interference score III- II

10	24.30	26.60	26.40	29.30	46.50	86.00
20	19.00	23.00	22.00	26.60	39.00	75.20
30	16.00	19.80	19.30	24.00	33.50	65.60
40	15.00	17.40	17.00	21.00	30.00	45.20
50	14.00	15.00	16.50	17.50	30.00	43.00
60	10.80	14.60	14.60	14.80	29.00	37.80
70	10.00	13.00	13.00	13.10	22.50	33.20
80	8.00	9.60	10.00	8.40	17.00	26.40
90	5.40	3.00	6.90	4.70	15.50	23.60

educ

> 12 j

age	20≤29	30≤39	40≤49	50≤59	60≤69	70+
N	69	22	48	48	13	5
II	51.6 (9.1)	58.5 (10.5)	52.6 (10.9)	57.1 (8.7)	65.1 (13.9)	83.4 (15.1)
III	79.6 (15.6)	96.7 (18.5)	81.8 (18.8)	96.1 (20.4)	112.8 (28.8)	190.4 (67.8)
N	99	28	87	82	40	30
III- II	28.8 (12.6)	36.0 (16.3)	30.9 (13.4)	38.8 (18.8)	51.2 (24.0)	82.0 (36.7)

Percentile ranks SCWT card II

10	60.00	76.60	69.10	69.10	90.80	108.00
20	57.00	68.40	63.00	63.00	77.60	103.80
30	53.00	66.10	56.00	62.00	73.40	91.20
40	51.00	59.60	54.00	59.40	63.40	82.60
50	50.00	56.00	51.50	57.00	60.00	76.00
60	49.00	54.20	50.00	55.00	60.00	76.00
70	47.00	52.00	47.00	52.70	59.20	74.80
80	45.00	49.00	44.80	50.80	52.80	71.20
90	43.00	45.00	41.90	48.00	49.00	70.00

Percentile ranks SCWT card III

10	97.00	128.40	109.20	125.10	163.80	256.00
20	90.00	109.40	98.20	114.00	143.60	254.40
30	85.00	106.00	87.30	105.60	129.00	249.60
40	80.00	99.60	84.00	103.00	110.60	233.20
50	77.00	94.50	81.00	97.00	100.00	211.00
60	75.00	88.00	77.40	91.60	99.20	157.00
70	71.00	83.00	71.70	83.70	95.60	120.00
80	67.00	81.20	65.80	77.00	93.20	117.00
90	64.00	74.20	59.90	67.90	77.40	116.00

Percentile ranks SCWT interference score III- II

10	24.30	26.60	26.40	29.30	46.50	86.00
20	19.00	23.00	22.00	26.60	39.00	75.20
30	16.00	19.80	19.30	24.00	33.50	65.60
40	15.00	17.40	17.00	21.00	30.00	45.20
50	14.00	15.00	16.50	17.50	30.00	43.00
60	10.80	14.60	14.60	14.80	29.00	37.80
70	10.00	13.00	13.00	13.10	22.50	33.20
80	8.00	9.60	10.00	8.40	17.00	26.40
90	5.40	3.00	6.90	4.70	15.50	23.60

For not normally distributed variables, percentile ranks are added in *italic*

!! Warning: because of the small number of volunteers in some cells (in bold) these data can not be seen as normative

Table 6. Male and Female Performances on the BW: M (SD)

BOURDON WIERSMA DOT CANCELLATION TEST (BW)

gender	MALE AND FEMALE					
age	20 ≤ 29	30 ≤ 39	40 ≤ 49	50 ≤ 59	60 ≤ 69	70+
N	99	29	87	81	41	31
ART	12.8 (1.9)	13.0 (2.4)	13.2 (2.5)	13.8 (2.2)	15.3 (3.1)	18.9 (5.2)
AD	1.3 (0.6)	1.3 (0.4)	1.2 (0.5)	1.4 (0.7)	1.6 (0.6)	2.2 (0.9)
false	0.2 (0.4)	0.2 (0.6)	0.7 (2.7)	0.3 (1.2)	0.3 (0.7)	0.9 (2.0)
<i>Percentile ranks ART</i>						
10	15.33	17.20	16.00	16.08	18.32	28.64
20	14.11	15.40	15.14	15.40	16.97	21.06
30	13.84	13.84	14.01	14.80	16.45	19.88
40	13.00	13.60	13.20	14.40	15.46	19.10
50	12.60	12.40	12.60	13.65	15.20	18.20
60	12.11	12.18	12.15	13.02	14.58	17.39
70	11.50	11.90	11.69	12.60	14.04	16.15
80	11.00	11.20	11.46	12.06	13.08	15.06
90	10.60	10.56	10.73	11.03	11.27	13.08
<i>Percentile ranks AD</i>						
10	1.86	1.80	1.82	2.00	2.55	3.50
20	1.62	1.60	1.55	1.58	2.16	2.92
30	1.44	1.50	1.39	1.44	2.00	2.44
40	1.32	1.32	1.30	1.32	1.65	2.29
50	1.22	1.29	1.20	1.25	1.44	1.90
60	1.16	1.21	1.08	1.13	1.31	1.79
70	1.02	1.00	0.97	1.04	1.25	1.66
80	0.94	0.92	0.88	1.00	1.12	1.44
90	0.80	0.89	0.70	0.80	0.97	1.08
<i>Percentile ranks false</i>						
10	1.00	1.00	1.00	1.00	1.00	2.80
20	0.00	0.00	0.00	0.00	1.00	1.00
30	0.00	0.00	0.00	0.00	0.00	1.00
40	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00	0.00	0.00
70	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	0.00	0.00	0.00	0.00	0.00
educ	≤ 12 j					
age	20 ≤ 29	30 ≤ 39	40 ≤ 49	50 ≤ 59	60 ≤ 69	70+
N	30	7	39	35	28	26
omissions	5.6 (4.5)	5.7 (4.5)	12.4 (9.7)	15.8 (14.8)	12.5 (8.9)	20.6 (15.3)
<i>Percentile ranks omissions</i>						
10	12.90	15.00	24.00	40.20	26.30	48.10
20	9.80	10.20	20.00	26.60	21.40	32.20
30	7.70	6.20	16.00	18.00	18.30	25.00
40	5.00	4.80	12.00	13.60	15.40	20.40
50	4.50	4.00	10.00	10.00	9.00	14.50
60	4.00	4.00	8.00	8.00	7.00	12.00
70	2.60	4.00	7.00	6.80	6.00	11.00
80	1.00	2.80	3.00	5.00	4.60	9.40
90	1.00	1.00	2.00	1.00	2.00	6.10
educ	> 12 j					
age	20 ≤ 29	30 ≤ 39	40 ≤ 49	50 ≤ 59	60 ≤ 69	70+
N	70	22	48	46	13	5
omissions	6.5 (6.6)	9.2 (9.3)	10.5 (11.3)	10.8 (9.9)	13.5 (8.1)	10.8 (4.8)
<i>Percentile ranks omissions</i>						
10	16.60	25.80	22.50	23.30	27.80	17.00
20	9.80	18.20	15.20	17.80	19.20	16.20
30	7.00	12.40	11.30	13.90	17.60	13.80
40	6.00	9.60	8.40	11.00	14.80	12.20
50	5.00	5.50	7.00	8.00	14.00	11.00
60	3.00	4.20	5.00	6.00	10.80	9.80
70	3.00	2.00	3.70	5.00	7.40	8.00
80	2.00	1.60	3.00	3.00	5.60	5.00
90	0.10	0.00	2.00	1.40	4.00	4.00

ART = average row time, AD = average deviation of row time
 For not normally distributed variables, percentile ranks are added in *italic*

APPENDIX 2

AUDITORY VERBAL LEARNING TEST (AVLT) VLAAMSE VERSIE – VORM A										
A	A1	A2	A3	A4	A5	B	B1	A6	A7	A
trommel						boek				trommel
gordijn						trein				gordijn
riem						bloem				riem
koffie						tapijt				koffie
school						strand				school
ouders						harp				ouders
zon						zout				zon
hof						vinger				hof
pet						appel				pet
boer						schouw				boer
zetel						knop				zetel
kalkoen						schaduw				kalkoen
kleur						sleutel				kleur
huis						ratel				huis
rivier						goud				rivier
Intrusies										
Totalen						Som				

Herkenning: A8 (a: lijst a; b: lijst b; sa/sb: semantisch verwant lijst a/b; fa/fb: fonetisch verwant lijst a/b)

riem (a)	boek (b)	stroom (sa)	ratel (b)	bloem (b)
thee (sa)	gordijn (a)	trein (b)	muis (fa)	zilver (sb)
zon (a)	hoed (sa)	pet (a)	ouders (a)	strand (b)
klas (sa)	kleur (a)	lof (fa)	koek (fb)	roos (sb)
vinger (b)	schouw (b)	ketel (fa)	zetel (a)	goud (b)
boer (a)	harp (b)	appel (b)	schrift (sb)	peer (sb)
peper (sb)	kip (sa)	schaduw (b)	sleutel (b)	brand (fb)
hof (a)	tapijt (b)	huis (a)	rivier (a)	koffie (a)
konijn (fa)	kalkoen (a)	ton (fa)	fout (fb)	blauw (fb)
knop (b)	takel (fb)	zout (b)	trommel (a)	school (a)

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**AUDITORY VERBAL LEARNING TEST (AVLT)
VLAAMSE VERSIE – VORM B**

A	A1	A2	A3	A4	A5	B	B1	A6	A7	A
lessenaar						hamer				lessenaar
herder						schip				herder
mus						plant				mus
schoen						zee				schoen
kachel						vloer				kachel
berg						mosterd				berg
spons						viool				spons
bril						teen				bril
schaap						banaan				schaap
beeld						venster				beeld
geweer						rits				geweer
potlood						figuur				potlood
kerk						baard				kerk
vis						spade				vis
fiets						stof				fiets
Intrusies										
Totalen						Som				

Berkenning : A8 (a : lijst a ; b : lijst b ; sa/sb: semantisch verwant lijst a/b ; fa/fb : fonetisch verwant lijst a/b)

schaap (a)	vloer (b)	bureau (sa)	banaan (b)	schip (b)
stoof (sa)	bril (a)	spade (b)	verder (fa)	spijker (sb)
geweer (a)	lens (sa)	fiets (a)	vis (a)	baard (b)
heuvel (sa)	kachel (a)	meneer (fa)	snor (fb)	boot (sb)
teen (b)	hamer (b)	kus (fa)	mus (a)	viool (b)
spons (a)	plant (b)	zee (b)	kade (sb)	schop (sb)
azijn (sb)	merel (sa)	stof (b)	venster (b)	kamer (fb)
kerk (a)	figuur (b)	herder (a)	lessenaar (a)	potlood (a)
schaal (fa)	berg (a)	berk (fa)	slof (fb)	vloed (fb)
rits (b)	riool (fb)	mosterd (b)	beeld (a)	schoen (a)

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APPENDIX 3

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Logisch verbaal geheugen (Coetsier Story Recall Test)

Toen gisteren / om vier uur in de namiddag / een rode personenauto / met een snelheid van 50 kilometer per uur / op de hoofdbaan voorbijkwam, // werd hij zijdelings aangerezen / door een zware vrachtauto, // die met ongeveer dezelfde snelheid / uit een smalle zijstraat kwam // en zonder remmen / noch uitkijken / de hoofdbaan overstak. //

De chauffeur van de beschadigde personenauto / vroeg onmiddellijk getuigen, // en twee politiemannen, / die telefonisch verwittigd werden / kwamen spoedig / per motorfiets / ter plaatse. //

Terwijl de ene politiemann / het drukke verkeer regelde, // kon de andere / ongestoord / de plaats van het ongeval met krijt uittekenen // en nadien alle gegevens in zijn nota-boekje neerschrijven, / om later verslag uit te brengen over deze botsing. //

Niettegenstaande de politie nadien / in de vrachtwagen / veel gesmokkelde sigaren ontdekte, // werd de bestuurder niet om die reden opgeleid; // ook niet / omdat hij onvoorzichtig was / bij het kruisen van de hoofdbaan; // doch wel / omdat hij dronken/ het ongeval veroorzaakte. ///

LVG: SCOREFORMULIER

Nr	inhoud	juiste weergave						wijzingen		toevoegingen	
		onmiddellijk			bewaring			onmiddellijk	bewaring	onmiddellijk	bewaring
		I	II	III	I	II	III				
1	aanr./bots/ongeval *										
2	auto hfdb aangereden dr auto zijstr		x	x			x	x			
3	personenauto (op de hoofdbaan)	x			x	x			x		
4	vrachtauto (op zijstraat)	x			x	x			x		
5	zonder remmen	x			x	x			x		
6	zonder uitkijken	x			x	x			x		
7	auto(pers./aanger/hfdb.) 50 (km/u)	x			x	x			x		
8	auto (vracht-/aanr./zijstr.) zelfde snelh	x			x	x			x		
9	gisteren	x	x				x	x			
10	om vier uur	x	x				x	x			
11	in de namiddag	x	x				x	x			
12	rode (personenauto/hfdb./aanger.)	x	x				x	x			
13	zware (vrachtwagen/zijstr./aanrijd.)	x	x				x	x			
14	ongeveer (dezelfde snelheid)	x	x				x	x			
15	smalle (zijstraat)	x	x				x	x			
16	zijdelings (aangereden)	x	x				x	x			
17	(de hoofdbaan) overstak	x	x				x	x			
18	chauff (persauto/hfdb/aang.) vroeg get.		x	x					x	x	
19	politie kwam (ter plaatse)		x	x					x	x	
20	(2) politiemannen/agenten/enz.	x			x	x			x	x	
21	telefonisch verwittigd	x			x	x			x		
22	per motorfiets	x			x	x					
23	beschd (persauto/hfdb/aanger.)	x	x				x	x			
24	(vroeg) onmiddellijk (getuigen)	x	x				x	x			
25	(kwamen) spoedig	x	x				x	x			
26	een politie (man, enz.) regelde verkeer		x	x					x	x	
27	de andere tekende de plaats af		x	x					x	x	
28	(de andere) schreef geg neer/op		x	x					x	x	
29	om verslag uit te brengen		x	x					x	x	
30	drukke	x	x				x	x			
31	ongestoord	x	x				x	x			
32	van het ongeval	x	x				x	x			
33	met krijt	x	x				x	x			
34	in zijn notaboekje	x	x				x	x			
35	later	x	x				x	x			
36	best. (vw./aanrijd./zijstr.) opgel		x	x					x	x	
37	niet wegens smokkelwaar		x	x					x	x	
38	niet wegens onvoorzichtigheid		x	x					x	x	
39	(wel) omdat hij dronken (ong.veroorz.)		x	x					x	x	
40	politie/men/enz. /ontdekte/vond...	x	x				x	x			
41	nadien	x	x				x	x			
42	veel	x	x				x	x			
43	(gesmokkelde) sigaren	x	x				x	x			

* de uitdrukkingen die impliciet mogen blijken, zonder uitdrukkelijk weergegeven te zijn, staan tss haakjes, voorbeelden van synoniemen staan tussen streepjes

X5 X3 X1 X5 X3 X1 Aantekeningen:

APPENDIX 4*Determination of severity of a deviant performance*

In our laboratory for neuropsychology a test performance (P) is considered normal if it falls within one standard deviation of the mean score of the appropriate norm group ($P \leq M \pm 1SD$). If the performance falls below -1SD but above -2SD from the mean score of the appropriate norm group, the performance is considered to indicate a mild impairment on the designated measure ($M-1SD > P \geq M-2SD$). If the performance falls below -2 SD from the mean of the appropriate norm group but above -3 SD, the performance is considered to reflect a moderate impairment on the designated measure ($M-2SD > P \geq M-3SD$). If the performance falls below -3 SD from the mean of the appropriate norm group, the performance is considered to indicate a severe impairment on the designated measure ($M-3SD > P$).

However, we would like to point out that this method of interpreting a cognitive performance can only be fairly applied on the normative data given in this article when the performances within an age group do not differ greatly and/or the data are normally distributed. Large standard deviations are due to a great variability in performances within a certain age group. Therefore when groups are small and standard deviations large, the mentioned method of interpretation should be used cautiously. More in particular we suggest that the method of interpretation outlined above can be used for the following tests: AVLT (form A and form B), CFT (Rey and Taylor), VDLT, BW and the COWAT.

When determining the severity of a deviant performance on the other tests, we advise to consult the percentile ranks rather than using the standard deviation-method. For variables or subgroups in which the data are not normally distributed percentile ranks are provided in Tables 1 through 6 of Appendix 1. In these cases the percentile might prove a better indicator than $M (sd)$ to evaluate a subject's performance.