**Normative data for the Rey Auditory Verbal Learning Test in the older French-Quebec population**

**Monica Lavoie1,2, Louis Bherer3,4,5, Sven Joubert5,6, Jean-François Gagnon7, Sophie Blanchet8, Isabelle Rouleau7,9, Joël Macoir1,2 & Carol Hudon2,10**

 1Département de réadaptation, Université Laval, Québec (QC), Canada

2Centre de recherche CERVO, Québec (QC), Canada

3Département de médecine, Université de Montréal, Montréal (QC), Canada

4Centre de recherche, Institut de cardiologie de Montréal, Montréal (QC), Canada

5Centre de recherche, Institut universitaire de gériatrie de Montréal, Montréal (QC), Canada

6Département de psychologie, Université de Montréal, Montréal (QC), Canada

7Département de psychologie, Université du Québec à Montréal, Montréal (QC), Canada

8Laboratoire Mémoire & Cognition (LMC), INSERM
UMR S894, Centre de Psychiatrie et Neurosciences (CPN), Institut de Psychologie, Université Paris Descartes, Sorbonne (Paris Cité), France

9Centre de recherche, CHUM, Montréal (QC), Canada

10École de psychologie, Université Laval, Québec (QC), Canada

**Corresponding author:**

Carol Hudon, Ph.D.

Centre de recherche CERVO

2601, de la Canardière (F-2400)

Québec (Québec) CANADA G1J 2G3

Email: carol.hudon@psy.ulaval.ca

**Introduction**

The Rey Auditory Verbal Learning Test (RAVLT; Rey, 1958) is an episodic memory test in which the participant is engaged in a word learning procedure. This test is used to assess verbal memory, new learning, susceptibility to interference, and recognition memory. Many variants of the RAVLT have been developed over the years (Lezak, Howieson, Loring, Hannay & Fischer, 2004; Mitrushina, Boone, Razani & D’Elia, 2005). The most common version contains 15 words (List A) that are read aloud for five consecutive trials. Each trial is followed by a free recall test. An interference list of 15 words (List B) is then presented once for a free recall test. Delayed recall of list A is tested immediately after list B recall and again after a 20-minute delay. Finally, recognition memory can be assessed either with a story in which the subject has to recognize words from list A or with a 50-word list in which the participant is asked to identify words from list A. The latter recognition procedure is more commonly used.

Over the years, many authors have studied the reliability and validity of the RAVLT. According to Van den Burg and Kingma (1999), internal reliability, that is, the consistency of results across items within a test, is high, with an alpha coefficient of about .90. Test-retest reliability is marginal-to-adequate over one-year intervals, with trial 5 and delayed recall trials being among the most reliable scores (Mitrushina & Satz, 1991b; Snow, Tierney, Zorzitto, Fisher & Reid, 1988; Uchiyama et al., 1995). Regarding the reliability of alternate forms of the RAVLT, the versions developed by Geffen, Butterworth, and Geffen (1994b) and by Majdan, Sziklas, and Jones-Gotman (1996) appear to produce comparable scores (Lemay, Bédard, Rouleau & Tremblay, 2004). Practice effects were also found since small, but significant, improvements have been reported on successive administrations of the same form of the RAVLT, separated by approximately one month to one year (Crawford, Stewart & Moore, 1989; Lezak, 1982; Uchiyama et al., 1995). With respect to convergent validity, the scores on the RAVLT correlate with other tests measuring learning and memory, such as the Logical Memory and Visual Reproduction subtests of the Wechsler Memory Scale-Revised (Johnstone, Vieth, Johnson & Shaw, 2000; Wechsler, 1987) and the California Verbal Learning Test (Crossen & Wiens, 1994; Delis, Kramer, Kaplan & Ober, 1987; Stallings, Boake & Sherer, 1995).

Numerous clinical studies have also been conducted with the RAVLT, which has proven to be sensitive to neurological impairment (Powell, Cripe & Dodrill, 1991), laterality of brain damage (e.g. Kilpatrick et al., 1997; Majdan et al., 1996; Malec, Ivnik & Hinkeldey, 1991), and memory deficits in various clinical populations, including those with specific language impairment (Records, Tomblin & Buckwalter, 1995), Alzheimer’s disease (e.g. Drolet et al., 2014; Mitrushina, Satz, Drebing & Van Gorp, 1994; Woodard, Dunlosky & Salthouse, 1999), Parkinson’s disease (Alegret et al., 2001), Huntington’s disease (Shimamura, Salmon, Squire & Butters, 1987), preclinical stage of Lewy body dementia (Marchand, Montplaisir, Postuma, Rahayel & Gagnon, 2017), and psychiatric disorders including depression and schizophrenia (e.g. Moritz, Heeren, Andresen & Krausz, 2001; Rosenberg, Ryan & Prifiteria, 1984; Torres, Flashman, O’Leary & Andreasen, 2001).

The effect of sociodemographic variables on RAVLT performance has also been widely studied in the literature. First, some studies reported the negative influence of age on the RAVLT, especially on the number of retrieved words in immediate and delayed free recall trials (Antonelli Incalzi, Capparella, Gemma, Marra & Carbonin, 1995; Dunlosky & Salthouse, 1996; Mitrushina et al., 1991; Vakil & Blachstein, 1997). Most authors found that forgetting increases with advancing age (Antonelli Incalzi et al., 1995; Dunlosky & Salthouse, 1996; Vakil & Blachstein, 1997) but Mitrushina et al. (1991) reported opposite results. Other variables of the RAVLT such as rates of learning, proactive interference (interference of previously learned material), serial recall (recall of the temporal order in which the words are presented) and recognition showed less change with age (Antonelli Incalzi et al., 1995; Mitrushina, Satz, Chervinsky & D’Elia, 1991; Vakil & Blachstein, 1997). The influence of the participants’ sex is less consistent across studies. While some authors found no impact of sex on performance (e.g. Mitrushina et al., 2005; Ponton et al., 1996; Savage & Gouvier, 1992), others found an advantage for females on the recall trials but not on the recognition trial (e.g. Bleecker, Bolla-Wilson, Agnew & Meyers, 1988; Lannoo & Vingerhoets, 1997; Miatton, Wolters, Lannoo & Vingerhoets, 2004; Vakil & Blachstein, 1994). As for intelligence quotient (IQ) and education, recall performance tended to be better with higher IQ (Bolla-Wilson & Bleecker, 1986; Query & Megran, 1983; Wiens, McMinn & Crossen, 1988) and some authors reported an increase in performance with higher education levels (e.g. Kurlyo, Temple, Elliott & Crawford, 2001; Lannoo & Vingerhoets, 1997; Miatton et al., 2004; Van der Elst, van Boxtel, van Breukelen & Jolles, 2005) but others did not (Mitrushina et al., 1991; Wiens et al., 1988). However, in a recent meta-analysis, Mitrushina et al. (2005) found no significant contribution of education to RAVLT scores. Finally, only a few authors studied the effect of culture on RAVLT performance. Kennepohl, Shore, Nabors and Hanks (2004) found that among African Americans, lower levels of acculturation were associated to significantly poorer RAVLT scores. In order to reduce cultural bias, a version of the RAVLT was developed by the World Health Organization and University of California Los Angeles (Maj et al., 1993; Ponton et al., 1996, 2000). In that version, the 15 test items pertain to five categories (body parts, animals, tools, household objects, and transportation vehicles) presumed to have ‘universal’ familiarity.

Rey developed the first normative data for the RAVLT in 1958, for Swiss people (Rey, 1958). However, these norms cannot be used in North America because the current administration differs from that used initially by Rey. Moreover, the English translation for some words differs from the original version (Wiens et al., 1988) and, due to educational and cultural differences, comparison of North Americans today with those in the samples collected by Rey is not valid (Wiens et al., 1988). Subsequently, many authors developed normative data for different populations. Schmidt (1996) provided metanorms for Americans aged 13 to 89 years by calculating a pooled mean and standard deviation. Most English normative data were developed for specific segments of the population, namely highly educated individuals (Bleecker et al.,1988; Mitrushina et al., 1991; Savage & Gouvier, 1992; Vakil & Blachstein, 1997), individuals with above-average IQ (Geffen, Moar, O’Hanlon, Clark & Geffen, 1990), young and middle-aged adults (Nielsen, Knudsen & Daugbjerg, 1989; Wiens et al., 1988), and males (Selnes et al., 1991; Uchiyama et al., 1995). Normative data are also available in several other languages such as Spanish (Ponton et al., 1996), Portuguese (Cavaco et al., 2015), Hebrew (Vakil & Blachstein, 1997), Dutch (Van der Elst et al., 2005), European French (Machet, 2010), and Canadian French (Sziklas & Jones-Gotman, 2008). However, for Canadian French, the study included only very young university students (mean age = 22 years old) and the results are therefore of limited use. Norms were also developed specifically for older adults. Based on the Mayo’s Older Americans Normative Studies (MOANS) data, Ivnik et al. (1992) provided age-adjusted norms for people aged 56 to 97 based on a sample of 530 cognitively healthy adults, mostly well-educated Caucasians. In 2002, Harris, Ivnik and Smith added data from 311 subjects, for a total of 836 participants aged 56 to 98 years old. In 2005, Steinberg, Bieliauskas, Smith, Ivnik and Malec reanalyzed those data in order to provide IQ-adjusted equivalents of the MOANS age-adjusted scores. Ferman et al. (2005) developed age- and education-adjusted normative data for older African Americans based on a sample of 306 participants aged 56 to 94 years old. Recently, normative data for older adults were also developed in Germany (Speer et al., 2014) and Greece (Messinis et al., 2016).

To our knowledge, no normative data have been developed specifically for Quebec-French individuals. For a test involving language such as the RAVLT, the use of language- and culturally-specific norms is crucial. Quebec-French differs from other languages, as well as from French from France and the rest of Canada. The differences concern not only articulation and prosody but also psycholinguistic features such as the frequency and familiarity of words, which are known to have a significant impact on lexical access (Desrochers & Bergeron, 2000), learning of verbal material (e.g. Tulving & Patkau, 1962) and word recognition (e.g. Connine, Mullennix, Shernoff & Yelen, 1990). Moreover, Arsenault-Lapierre et al. (2011) demonstrated that local norms are more sensitive to detecting a cognitive impairment.

Therefore, the objective of this study was to provide normative data for the RAVLT, taking into account the linguistic reality of the older French-speaking population of Quebec.

**Methods**

*Participants*

Anonymous data from healthy volunteers who had completed the RAVLT as part of other research studies were collected from researchers across the Province of Quebec (Canada). These volunteers were recruited via public advertisements or were relatives of patients participating in other research studies.

A total of 611 participants aged between 55 and 93 years old, whose mother tongue and usual language was French, were recruited for this study. Participants came from the Quebec City (6.71%) and Montreal (93.29%) regions. Medical and psychiatric history, based on self-report, was documented so that any participant with a history of neurological disease, psychiatric illness, head injury, or stroke was excluded from the study. Potential participants were also screened for cognitive impairment using standard tests of cognitive functioning, namely the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005), Mini-Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975), and Modified Mini-Mental State Examination (3MS; Teng & Chui, 1987). When no score from a cognitive screening instrument was available, participants were automatically excluded. For the MoCA, the normative data recently developed by Larouche et al. (2016) for Quebec-French people were used and participants scoring < -1.5 standard deviation from the norms were excluded. For the MMSE, participants scoring below the usual cut-off of 26 (Hébert et al., 2007) were also excluded from the study. For the 3MS, participants with a score < 78 were excluded, according to the cut-off score proposed by the Canadian Study of Health and Aging Working Group (1994) to ensure sensitivity. Participants were also screened for depression using the Geriatric Depression Scale (GDS; Yesavage et al., 1983), Beck Depression Inventory (BDI; Beck, Steer & Brown, 1996) or Center for Epidemiologic Studies Depression Scale Revised (CESD-R; Eaton, Muntaner, Smith, Tien & Ybarra, 2004). The cut-offs used were > 10 for the GDS and BDI and ≥ 16 for the CESD-R. Participants were excluded if no screening for depression score was available. Finally, participants were also excluded from the final sample if any data were missing for demographic variables or RAVLT scores.

The final sample consisted of 432 participants, including 152 men (35.2%) and 280 women (64.8%) aged between 55 and 93 years old (mean= 70.7, SD = 6.5). The sample had a mean education level of 14.6 years (SD = 3.3; range = 4 to 23). In comparison to current demographics for the Quebec population, highly educated individuals were overrepresented in our sample, with 79.6% of participants having 12 or more years of education (see Table 1; Institut de la statistique du Québec, 2006).

[INSERT TABLE 1 HERE]

*Materials and procedure*

The French version of the RAVLT was administered to all participants, beginning with *tambour* 'drum' (see Figure 1 for words included in Lists A and B; Rey, 1958; see Strauss, Sherman and Spreen, 2006, for the words in English). Administration of the RAVLT takes approximately 10 to 15 minutes (Strauss et al., 2006). First, participants have to recall a 15-word list (List A) across five consecutive trials. More specifically, the experimenter explains that s/he will read the list once and then, the participant will have to tell words s/he remembers. The experimenter also specifies that s/he will proceed in the same way up to 5 times to help the participant better memorize the words. Participants are instructed to listen to the words and, when the experimenter is done, to tell all the words they remember. They are informed that it is not necessary to recall the words in the order of their presentation. Before each new trial, the experimenter explains that s/he will read the same words and specifies that the participant have to say all the words s/he can recall, including the ones he already said on previous trials. There is a one-second delay between the words and the order is the same across all the trials. An interference list of 15 words (List B) is then presented once for a free recall test. The experimenter explains that s/he will read a new list of words and that the participant will have to recall the words from this list after. Immediately after the interference list, and again after a 20-minute retention delay, the experimenter asks the participant to recall the words from the first list, that is the one that was repeated five times. Finally, for the recognition task, the experimenter reads a list of 50 words (15 words of list A + 35 distractors) to the participants. S/he explains that this list contains all the words the participant learned, along with new words. The participant is asked to tell if each word belongs or not to the first list of words (list A).

[INSERT FIGURE 1 HERE]

*Statistical analyses*

Six variables of interest were selected for normalization: scores on trial 1, sum of trials 1 to 5, interference list B, immediate recall of list A, delayed recall of list A and recognition. To predict the scores on the first five variables according to sociodemographic data, a multiple regression analysis was performed using sex, age, and years of education as predictors. Sex was coded 0 for women and 1 for men. Interactions between predictors were also tested. To ensure the quality of data adjustment and improve the normality of the distribution, a casewise diagnostic was performed to identify the outliers for each variable of interest. Participants were excluded from the analysis when the standard residual value was above 3. For the recognition task, the normative data come from a subset of participants (n=393) for which the administration followed the procedure described above. Due to skewness of the scores, percentile ranks were used. Spearman correlations were performed between the recognition score and sex, age, and years of education, to determine which of these variables were associated with performance. Percentile ranks were then determined and stratified according to the demographic variables significantly correlated with the score.

**Results**

The mean scores (and range) for the selected variables are shown in Table 2, while descriptive data by age groups are presented in Table 3. For the first five variables of interest, the best predictive model included sex, age, and education and explained a significant amount of variance in the score (see Table 4). For all five variables, male sex, older age and lower education level were associated with a lower score on the test. No interaction between the predictors was found.

 Based on the results from these regression models, we provided the equations to calculate the expected score for a participant based on sex, age, and education level (Table 5). For each variable, the expected score is adjusted to take into account the sociodemographic characteristics of a given participant. To calculate the Z score, the following equation was used: (Actual score – Expected score) / Square root of the mean square residual.

 The score on the recognition task was significantly correlated with sex, *r*(393)= -0.19, *p*>.001, but not with age, *r*(393)=.04, *p*=.49, and years of education, *r*(393)=.008, *p*=.87. The scores matching percentiles 1, 2, 5, 10, 15, 25, 50, and 95, stratified by sex, are reported in Table 6.

[INSERT TABLES 2-6 HERE]

**Discussion**

The aim of this study was to establish the first normative data for the RAVLT that take into account the linguistic and cultural reality of the Quebec-French middle-aged and older population. The RAVLT is a test widely used by clinicians in the Province of Quebec so it is crucial that they have access to appropriate norms to determine how a patient’s performance compares to the expected performance of a healthy individual (i.e. without cognitive impairment) with similar sociodemographic characteristics. Verbal episodic memory is a key cognitive component as it can be one of the core features of various neurodegenerative diseases. Numerous clinical studies have revealed that the RAVLT is sensitive to memory deficits in various clinical populations such as mild cognitive impairment (Eliassen, Reinvang, Selnes, Fladby & Hessen, 2017), Alzheimer’s disease (e.g. Drolet et al., 2014; Mitrushina et al., 1994; Woodard, Dunlosky & Salthouse, 1999), Parkinson’s disease (Alegret et al., 2001), Huntington’s disease (Shimamura et al., 1987), and preclinical stage of Lewy body dementia (Marchand et al., 2017). Using a regression model, we developed equations to calculate Z scores for 5 variables of interest related to the RAVLT (scores on trial 1, sum of trials 1 to 5, interference list B, immediate recall of list A, and delayed recall of list A), allowing clinicians to easily interpret their patients’ performance. To illustrate this, consider a 70-year-old man with 8 years of education who obtained 5 on Trial 1. His expected score can be calculated with the following equation: 8.229-1.018 (1) -.049 (70) + .100 (8) = 4.581. The Z score is then calculated by subtracting the expected score from the actual score and dividing by the square root of the mean square residual: (5-4.581)/1.948 = 0.215. In this case, the participant’s performance would be considered clinically normal. To facilitate calculation of the Z score using the equations provided in Table 4, an MS Excel**®** document is available for clinicians in Supplementary Data or on demand by contacting the corresponding author. Moreover, for the recognition task, we provide percentile ranks stratified by sex.

Our regression analysis revealed that sex, age, and education had a significant influence on performance on the RAVLT for the variables associated with recall, while only sex was significantly associated with recognition. For all variables of interest, male sex was associated with a lower score, as was also found in previous studies (e.g. Bleecker et al., 1997; Miatton et al., 2004; Vakil & Blachstein, 1994). However, the influence of sex is somewhat inconsistent in the literature as some other studies found no effect of sex on performance on the RAVLT (e.g. Mitrushina et al., 2005; Ponton et al., 1996; Savage & Gouvier, 1992). Nevertheless, our results are in line with those reported in a recent study conducted with cognitively normal older people which showed a significantly greater advantage for women in tasks of verbal memory (Zhang, Zhou, Wang & Zhang, 2017). This female advantage in verbal learning has been demonstrated numerous times in the literature (e.g. Aartsen, Martin & Zimprich, 2004; Kramer, Delis & Daniel, 1988). Our results also revealed that older age was associated with poorer performance, which is consistent with the results of previous studies in which a negative influence of age was reported on the RAVLT, especially with respect to the number of words recalled in the immediate and delay trials (Antonelli Incalzi et al., 1995; Dunlosky & Salthouse, 1996; Mitrushina et al., 1991; Vakil & Blachstein, 1997). Finally, consistent with the results of the present study, most authors reported that higher education level was associated with better performance on the RAVLT (e.g. Kurlyo et al., 2001; Lannoo & Vingerhoets, 1997; Miatton et al., 2004; Van der Elst et al., 2005). However, in a recent meta-analysis, Mitrushina et al. (2005) found no significant contribution of education to RAVLT scores. In future studies, the reading level rather than the education level should be considered, in order to better predict premorbid functioning or intelligence, as suggested by some authors (e.g. Mokri et al., 2012; O’Bryant, Schrimsher & O’Jile, 2005). Indeed, different reasons may explain why an elderly person has not pursued education, particularly for elderly women. In our study, the education level was similar for men and women. However, the overrepresentation of highly educated participants is likely to have influenced the results.

 In the present study, a regression-based approach was used for most variables instead of typical normalization methods such as percentiles or standard Z scores derived from a mean and standard deviation, which is a significant strength. The present method gives a better estimate of the influence of sociodemographic characteristics on test performance and is thus more likely to yield an accurate judgment regarding the presence or absence of a memory impairment in an examinee. Moreover, these normative data were developed based on a relatively large cohort of participants (n=432), which is another strength.

However, there are also some limitations to take into account, the more important ones being the incidental sampling method, which led to overrepresentation of highly educated individuals in our sample. For individuals aged 65 years and older, the percentage of people with 12 years of education or more was twice as high in our sample compared to Quebec demographics (Institut de la statistique du Québec, 2006). Therefore, clinicians must interpret the calculated Z score carefully, especially for individuals with limited education. In future studies, a random sampling method would increase the representativeness of the sample. Moreover, an extensive screening was performed to ensure that the participants recruited in this normative study were physically, psychologically, and cognitively healthy. This procedure allowed controlling for confounding variables that could influence performance on the test. However, it also limited the representativeness of the current sample since medical and cognitive problems are common with increasing age.

In summary, this is the first study to provide normative data adjusted to the cultural and linguistic reality of Quebec middle-aged and older adults. These norms will allow more accurate detection of verbal episodic memory impairment in various clinical populations, which is also likely to improve early diagnosis of several neurocognitive disorders, a crucial step in ensuring appropriate medical care as early as possible in the course of a disease.

**Acknowledgements**

None

|  |
| --- |
| **Table 2**. Mean scores and range  |
| Variable Maximum possible score M (SD) Range |
| Trial 1 15 5.9 (2.1) 1-12 Trials 1-5 75 49.1 (10.1) 22-72Interference list 15 4.9 (1.8) 0-12 Immediate recall 15 10.4 (3.0) 1-15 Delayed recall 15 10.5 (3.2) 0-15Recognition 15 14.0 (1.5) 2-15  |

|  |
| --- |
| **Table 1**. Highest education level reached (% of the population) |
|  | Present sample Quebec demographics |
|  Education |
|  No HSD At least HSD No HSD At least HSDAge < 12 years ≥ 12 years < 12 years ≥ 12 years  |
| 55-64 17.2 82.8 24.6 75.4 |
| 65-74 20.9 79.1 42.0 58.0 |
| ≥75 21.0 79.0 54.7 45.3 |

*Note*: HSD = High school diploma

*Note*: M = Mean; SD = Standard deviation

**Table 3**. Medians and mean scores (SD) by age groups

|  |
| --- |
| Age 55-60 61-65 66-70 71-75 76-80 81-85 ≥86 y/o *n*=18 *n*=73 *n*=144 *n*=104 *n*=55 *n*=25 *n*=13  |
| Trial 1 Med=6 Med=7 Med=6 Med=6 Med=5 Med=5 Med=7 M=6.5 (2.4) M=6.4 (2.2) M=6.0 (2.1) M=5.7 (1.7) M=5.6 (2.2) M=4.9 (1.9) M=6.5 (2.5) |
| Trials 1-5 Med=53  Med=52 Med=49 Med=50.5 Med=47 Med=48 Med=51 M=54.2 (9.2) M=51.1 (9.3) M=49.7 (9.7) M=48.8 (9.4) M=45.3 (11.4) M=45.5 (10.5) M=49.5 (13.3) |
| Interference Med=5 Med=5 Med=5 Med=4.5 Med=4 Med=4 Med=4 list M=6.0 (2.0) M=5.2 (1.9) M=5.1 (1.7) M=4.7 (1.7) M=4.3 (1.7) M=4.1 (1.9) M=4.1 (1.2) |
| Immediate Med=12 Med=11 Med=11 Med=11 Med=10 Med=10 Med=11recall M=11.4 (2.5) M=10.6 (2.8) M=10.7 (2.9) M=10.4 (2.9) M=9.5 (3.4) M=10.0 (3.1) M=9.9 (3.6)  |
| Delayed Med=11.5 Med=11 Med=11 Med=12 Med=10 Med=10 Med=10recall M=11.4 (2.6) M=11.0 (2.7) M=10.6 (3.0) M=10.5 (3.2) M=9.6 (3.9) M=9.7 (3.3) M=9.8 (3.5)  |
|  |
| Age 55-60 61-65 66-70 71-75 76-80 81-85 ≥86 y/o *n*=11 *n*=57 *n*=133 *n*=99 *n*=55 *n*=25 *n*=13  |
| Recognition Med=14 Med=14 Med=14 Med=15 Med=14 Med=14 Med=15 M=13.8 (1.5) M=14.0 (1.9) M=13.9 (1.6) M=14.2 (1.3) M=13.9 (1.4) M=13.8 (1.7) M=14.1 (1.6) |

Med= Median; M= Mean (SD)

|  |
| --- |
| **Table 4**. Coefficients and model summary for each variable |
| Score *n* Coefficients: β (SD), *p* F, *p* R2 Adj. R2 |
| Trial 1 430 Sex: -1.018 (.198) *p*<.001 15.636 .099 .093 Age: -.049 (.014) *p*=.001  *p*<.001  Educ.: .100 (.029) *p*=.001 |
| Trials 1-5 432 Sex: -7.079 (.935) *p*<.001 30.518 .176 .170 Age: -.276 (.068) *p*<.001  *p*<.001 Educ.: .675 (.135) *p*<.001 |
| Interference list 429 Sex: -.698 (.169) *p*<.001 15.106 .096 .090 Age: -.058 (.012) *p*<.001  *p*<.001 Educ.: .068 (.024) *p*=.006 |
| Immediate recall 430 Sex: -1.987 (.277) *p*<.001 23.896 .144 .138 Age: -.047 (.020) *p*=.021  *p*<.001 Educ.: .188 (.040) *p*<.001 |
| Delayed recall 428 Sex: -2.314 (.283) *p*<.001 28.861 .170 .164 Age: -.064 (.021) *p*=.002  *p*<.001 Educ.: .171 (.041) *p*<.001 |

|  |
| --- |
| **Table 5**. Equations to calculate Z score according to sociodemographic variables |
| Trial 1 Z = (Actual score – (8.229-1.018 S -.049 A + .100 E))/1.948 |
| Trials 1-5 Z = (Actual score – (61.255-7.079 S -.276 A + .675 E))/9.2 |
| Interference list Z = (Actual score – (8.182-.698 S -.058 A + .068 E))/1.658 |
| Immediate recall Z = (Actual score – (11.753-1.987 S -.047 A + .188 E))/2.724 |
| Delayed recall Z = (Actual score – (13.403-2.314 S -.064 A + .171 E))/2.778 |

 *Note*: S = Sex (0 = women and 1 = men); A = Age in years; E = Education in years

**Figure 1**. Words in lists A and B (in French)

|  |
| --- |
| *List A List B* |
| Tambour Pupitre |
| Rideau Berger |
| Ceinture Moineau |
| Café Soulier |
| École Fourneau |
| Parent Montagne |
| Soleil Lunette |
| Jardin Éponge |
| Casquette Image |
| Paysan Bateau |
| Moustache Mouton |
| Dindon Fusil |
| Couleur Crayon |
| Maison Église |
| Rivière Poisson |

Source: Rey (1958; with permission from Presses universitaires de France)

**References**

Aartsen, M.J., Martin, M., & Zimprich, D. (2004). Gender differences in level and change in

cognitive functioning. Results from the Longitudinal Aging Study Amsterdam. Gerontology, 50(1), 35-38.

Alegret, M., Junque, C., Valleoriola, F., Vendrell, P., Pilleri, M., Rumia, J., & Tolosa, E. (2001).

Effects of bilateral subthalamic stimulation on cognitive function in Parkinson disease. *Archives of Neurology, 58*(8)*,* 1223–1227. doi: 10.1001/archneur.58.8.1223

Antonelli Incalzi, R., Capparella, O., Gemma, A., Marra, C., & Carbonin, P. U. (1995). Effects

of aging and Alzheimer’s disease on verbal memory. *Journal of Clinical and Experimental Neuropsychology, 17*(4),580–589. doi: 10.1080/01688639508405147

Arsenault-Lapierre, G., Whitehead, V., Belleville, S., Massoud, F., Bergman, H., & Chertkow, H.

(2011). Mild cognitive impairment subcategories depend on the source of norms. *Journal of Clinical and Experimental Neuropsychology, 33*(5), 596–603. doi:10.1080/13803395.2010.547459

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). Beck Depression Inventory-II: Manual. San

Antonio, TX: The Psychological Corporation.

Bleecker, M. L., Bolla-Wilson, K., Agnew, J., & Meyers, D. A. (1988). Age-related sex

differences in verbal memory. *Journal of Clinical Psychology, 44*(3),403–411. doi: 10.1002/1097-4679

Bolla*-*Wilson*,* K., & Bleecker, M. L. (1986). Influence of verbal intelligence, sex, age, and

education on the Rey Auditory Verbal Learning Test. *Developmental Neuropsychology, 2*(3),203–211. doi: 10.1080/87565648609540342

Canadian Study of Health and Aging Working Group. (1994). The Canadian Study of Health and Aging: study methods and prevalence of dementia. *Canadian Medical Association Journal, 150*(6), 899–913.

Cavaco, S., Goncalves, A., Pinto, C., Almeida, E., Gomes, F., Moreira, I., … Teixeira-Pinto, A.

(2015). Auditory Verbal Learning Test in a large nonclinical Portuguese population. *Applied Neuropsychology: Adult, 22*(5), 321–331. doi: 10.1080/23279095.2014.927767

Connine, C. M., Mullennix, J., Shernoff, E., & Yelen, J. (1990). Word familiarity in visual and

auditory word recognition. *Journal of Experimental Psychology: Learning, Memory and Cognition, 16*(6), 1084–1096. doi: 10.1037/0278-7393.16.6.1084

Crawford, J. R., Stewart, L. E., & Moore, J. W. (1989). Demonstration of savings on the AVLT

and development of a parallel form. *Journal of Clinical and Experimental Neuropsychology, 11*(6),975–981. doi: 10.1080/01688638908400950

Crossen, J. R., & Wiens, A. N. (1994). Comparison of the auditory-verbal learning test (AVLT)

and California Verbal Learning Test (CVLT) in a sample of normal subjects. *Journal of Clinical and Experimental Neuropsychology, 16*(2), 190–194. doi: 10.1080/01688639408402630

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (1987). *California Verbal Learning Test.*

San Antonio, TX: The Psychological Corporation.

Desrochers, A., & Bergeron, M. (2000). Norms of subjective frequency of use and imagery for a

sample of 1916 French nouns. *Canadian Journal of Experimental Psychology, 54*(4), 274.

Drolet, V., Vallet, G. T., Imbeault, H., Lecomte, S., Limoges, F., Joubert, S., & Rouleau, I.

(2014). Comparison of the performance between healthy older adults and persons with Alzheimer’s disease on the Rey auditory verbal learning test and the Test de rappel libre/rappel indicé 16 items. *Gériatrie et psychologie neuropsychiatrie du vieillissement, 12*(2), 218–226. doi: 10.1684/pnv.2014.0469

Dunlosky, J., & Salthouse, T. A. (1996). A decomposition of age-related differences in multitrial

free recall. *Aging, Neuropsychology, and Cognition, 3*(1)*,* 2–14. doi: 10.1080/13825589608256608

Eaton, W. W., Muntaner, C., Smith, C., Tien, A., & Ybarra, M. (2004) Center for Epidemiologic Studies Depression Scale: Review and revision (CESD and CESD-R). In: Maruish, M. E., ed. The Use of Psychological Testing for Treatment Planning and Outcomes Assessment. 3rd ed. Mahwah, NJ: Lawrence Erlbaum; 2004:363-377.

Eliassen, C. F., Reinvang, I., Selnes, P., Fladby, T., & Hessen, E. (2017). Convergent results from

neuropsychology and neuroimaging in patients with mild cognitive impairment. *Dementia and Geriatric Cognitive Disorders, 43*(3-4), 144–154. doi: 10.1159/000455832

Ferman, T. J., Lucas, J. A., Ivnik, R. J., Smith, G. E., Willis, F. B., Petersen, R. C., & Graff-

Radford, N. R. (2005). Mayo’s Older African American Normative Studies: Auditory-Verbal Learning Test norms for African American elders. *The Clinical Neuropsycholo- gist, 19*(2)*,* 214–228. doi: 10.1080/13854040590945300

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-Mental State”: A practical

method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*, 189–198. doi:10.1016/0022-3956(75)90026-6

Geffen, G. M., Butterworth, P., & Geffen, L. B. (1994b). Test-retest reliability of a new form of

the Auditory Verbal Learning Test (AVLT). *Archives of Clinical Neuropsychology, 9*(4)*,* 303–316. doi: 10.1016/0887-6177(94)90018-3

Geffen, G., Moar, K. J., O’Hanlon, A. P., Clark, C. R., & Geffen, L. B. (1990). Performance

measures of 16- to 86-year-old males and females on the Auditory Verbal Learning Test. *The Clinical Neuropsychologist, 4*(1)*,* 45–63. doi:10.1080/13854049008401496

Harris, M. E., Ivnik, R. J., & Smith, G. E. (2002). Mayo’s Older Americans Normative Studies:

Expanded AVLT recognition trial norms for ages 57 to 98. *Journal of Clinical and Experimental Neuropsychology, 24*(2)*,* 214–220.

Hébert, M., Thibeault, R., Sacolax, N., Tandon, K., Germain, M., Bruneau, P., & Gravel, J. (2007). Utilité clinique de trois outils d’évaluation pour les personnes atteintes de démence. *Canadian Journal of Occupational Therapy*, *74*(2), 102–114.

Institut de la statistique du Québec. (2006). *Breakdown of the population 15 years and over by*

*level of schooling, gender and age group*. Québec, 2006. Retrieved from: http://www.stat.gouv.qc.ca/donstat/societe/education/etat\_scolarisation/scol\_pop\_15\_sex\_a\_qc.htm.

Ivnik, R. J., Malec, J. F., Tangalos, E. G., Petersen, R. C., Kokmen, E., & Kurland, L. T. (1992).

Mayo’s Older Americans Normative Studies: Updated AVLT norms for ages 56 to 97. *The Clinical Neuropsychologist, 6,* 83–104. doi:10.1080/13854049208401880

Johnstone, B., Vieth, A. Z., Johnson, J. C., & Shaw, J. A. (2000). Recall as a function of single

versus multiple trials: Implications for rehabilitation. *Rehabiliation Psychology, 45*(1)*,* 3–19. doi: 10.1037/0090-5550.45.1.3

Kennepohl, S., Shore, D., Nabors, N., & Hanks, R. (2004). African American acculturation and

neuropsychological test performance following traumatic brain injury. *Journal of the International Neuropsychological Society, 10*(4), 566–577. doi: 10.1017/S1355617704104128

Kilpatrick, C., Murrie, V., Cook, M., Andrewes, D., Desmond, P., & Hopper, J. (1997). Degree of

left hippocampal atrophy correlates with severity of neuropsychological deficits. *Seizure, 6*(3)*,* 213–218. doi: 10.1016/S1059-1311(97)80008-8

Kramer, J.H., Delis, D.C., Daniel, M.H. (1988). Sex differences in verbal learning. *Journal of*

*Clinical Psychology, 44*(6), 907-915. doi: 10.1002/1097-4679(198811)44:6<907::AID-JCLP2270440610>3.0.CO;2-8

Kurlyo, M., Temple, R. O., Elliott, T. R., & Crawford, D. (2001). Rey Auditory Verbal Learning

Test (AVLT) performance in individuals with recent-onset spinal cord injury. *Rehabilitation Psychology, 46*(3)*,* 247–261. doi: 10.1037/0090-5550.46.3.247

Lannoo, E., & Vingerhoets, G. (1997). Flemish normative data on common neuropsychological

test: Influence of age, education, and gender. *Psychologica Belgica, 37*(3)*,* 141–155.

Larouche, E., Tremblay, M. P., Potvin, O., Laforest, S., Bergeron, D., Laforce, R, … Hudon, C.

(2016). Normative data for the Montreal Cognitive Assessment in middle-aged and elderly Quebec-French people. *Archives of Clinical Neuropsychology. In print.*

Lemay, S., Bédard, M.A., Rouleau, I., & Tremblay, P.L. (2004). Practice effect and test-retest

reliability of attentional and executive tests in middle-aged to elderly subjects. *The Clinical Neuropsychologist, 18*(2), 284–302. doi: 10.1080/13854040490501718

Lezak, M. D. (1982). The test-retest stability of some tests commonly used in neuropsychological

assessment. Paper presented to the Fifth European Conference of the International Neuropsychological Society. Deauville, France.

Lezak, M. D., Howieson, D. B., Loring, D. W., Hannay, H. J., & Fischer, J. S. (2004).

*Neuropsychological assessment* (4th ed.). New York, NY: Oxford University Press.

Machet, A. (2010). *Réétalonnage du test des 15 mots de Rey auprès de la population adulte*.

(Mémoire de maitrise, Université Victor Segalen Bordeaux 2, France). Retrieved from: https://dumas.ccsd.cnrs.fr/dumas-01302537/document

Maj, M., D’Elia, L., Satz, P., Janssen, R., Zaudig, M., Uchiyama, C., Starace, F., Galderisi, S., &

Chervinsky, A. (1993). Evaluation of two new neuropsychological tests designed to minimize cultural bias in the assessment of HIV-1 seropositive persons: A WHO study. *Archives of Clinical Neuropsychology, 8*(2)*,* 123–135. doi:10.1016/0887-6177(93)90030-5

Majdan, A., Sziklas, V., & Jones-Gotman, M. (1996). Performance of healthy subjects and

patients with resection from the anterior temporal lobe on matched tests of verbal and visuoperceptual learning. *Journal of Clinical and Experimental Neuropsychology, 18*(3)*,* 416–430. doi: 10.1080/01688639608408998

Malec, J.F., Ivnik, R.J., & Hinkeldey, N.S. (1991). Visual Spatial Learning Test. *Psychological*

*Assessment: A Journal of Consulting and Clinical Psychology, 3*(1), 82-88. doi: 10.1037/1040-3590.3.1.82

Marchand, D. G., Montplaisir, J., Postuma, R. B., Rahayel, S., & Gagnon, J. F. (2017). Detecting

the cognitive prodrome of dementia with Lewy bodies: A prospective study of REM sleep behavior disorder. *Sleep, 40*(1). doi: 10.1093/sleep/zsw014.

Messinis, L., Nasios, G., Mougias, A., Politis, A., Zampakis, P., Tsiamaki, E, … &

Papathanasopoulos, P. (2016). Age and education adjusted normative data and discriminative validity for Rey’s Auditory Verbal Learning test in the elderly Greek population. *Journal of Clinical and Experimental Neuropsychology, 38*(1), 23–39. doi: 10.1080/13803395.2015.1085496

Miatton, M., Wolters, M., Lannoo, E., & Vingerhoets, G. (2004). Updated and extended

normative data of commonly used neuropsychological tests. *Psychologica Belgica, 44*(3)*,* 189–216.

Mitrushina, M., & Satz, P. (1991a). Changes in cognitive functioning associated with normal

aging. *Archives of Clinical Neuropsychology, 6*(1-2)*,* 49–60. doi: 10.1093/arclin/6.1-2.49

Mitrushina, M., & Satz, P. (1991b). Effect of repeated administration of a neuropsychological

battery in the elderly. *Journal of Clinical Psychology, 47*(6)*,* 790–801. doi: 10.1002/1097-4679(199111)47:6<790::AID-JCLP2270470610>3.0.CO;2-C

Mitrushina, M., Boone, K. B., Razani, J., & D’Elia, L. F. (2005). *Handbook of normative data*

*for neuropsychological assessment* (2nd ed.). New York, NY: Oxford University Press.

Mitrushina, M., Satz, P., Chervinsky, A., & D’Elia, L. (1991). Performance of four age groups of

normal elderly on the Rey Auditory-Verbal Learning Test. *Journal of Clinical Psychology, 47*(3)*,* 351–357. doi: 10.1002/1097-4679(199105)47:3<351::AID-JCLP2270470305>3.0.CO;2-S

Mitrushina, M., Satz, P., Drebing, C., & Van Gorp, W. (1994). The differential pattern of

memory deficit in normal aging and dementias of different etiology. *Journal of Clinical Psychology, 50*(2)*,* 246–252. doi: 10.1002/1097-4679(199403)50:2<246::AID-JCLP2270500216>3.0.CO;2-L

Mokri, H., Ávila-Funes, J. A., Le Goff, M., Ruiz-Arregui, L., Gutierrez Robledo, L. M., &

Amieva, H. (2012). Self-reported reading and writing skills in elderly who never attended school influence cognitive performances: Results from the coyoacan cohort study. *The Journal of Nutrition, Health & Aging, 16*(7), 621-624.doi:10.1007/s12603-012-0070-8

Moritz, S., Heeren, D., Andresen, B., & Krausz, M. (2001). An analysis of the specificity and the

syndromal correlates of verbal memory impairments in schizophrenia. *Psychiatry Research, 101*(1)*,* 23–31. doi: 10.1016/S0165-1781(00)00241-9

Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., ...

Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society, 53*, 695–699. doi:10.1111/j.1532-5415.2005.53221.x

Nielsen, H., Knudsen, L., & Daugbjerg, O. (1989). Normative data for eight neuropsychological

tests based on a Danish sample. *Scandinavian Journal of Psychology, 30*(1), 37-45. doi:

10.1111/j.1467-9450.1989.tb01066.x

O'Bryant, S. E., Schrimsher, G. W., & O'Jile, J. R. (2005). Discrepancies between self-reported

years of education and estimated reading level: Potential implications for neuropsychologists. *Applied Neuropsychology, 12*(1), 5-11. doi:10.1207/s15324826an1201\_2

Ponton, M. O., Gonzalez, J. J., Hernandez, I., Herrera, L., & Higareda, I. (2000). Factor analysis

of the Neuropsychological Screening Battery for Hispanics (NeSBHIS). *Applied Neuropsychology, 7*(1)*,* 32–39. doi: 10.1207/S15324826AN0701\_5

Ponton, M. O., Satz, P., Herrera, L., Ortiz, F., Urrutia, C. P., Young, R., D’Elia, L. F., Furst, C.

J., & Namerow, N. (1996). Normative data stratified by age and education for the Neuropsychological Screening Battery for Hispanics (NeSBHIS): Initial report. *Journal of the International Neuropsychological Society, 2*(2)*,* 96–104. doi: 10.1017/S1355617700000941

Powell, J. B., Cripe, L. I., & Dodrill, C. B. (1991). Assessment of brain impairment with the Rey

Auditory-Verbal Learning Test: A comparison with other neuropsychological measures. *Archives of Clinical Neuropsychology, 6*(4)*,* 241–249. doi: 10.1016/0887-6177(91)90001-P

Query, W. T., & Megran, J. (1983). Age-related norms for the AVLT in a male patient

population. *Journal of Clinical Psychology, 39*(1)*,* 136–138. doi: 10.1002/1097-4679(198301)39:1<136::AID-JCLP2270390125>3.0.CO;2-Q

Records, N. L., Tomblin, J. B., & Buckwalter, P. R. (1995). Auditory verbal learning and

memory in young adults with specific language impairment. *The Clinical Neuropsychologist, 9*(2)*,* 187–193. doi: 10.1080/13854049508401601

Rey, A. (1958). *L’examen clinique en psychologie.* Paris: Presse Universitaire de France.

Rosenberg, S. J., Ryan, J. J., & Prifiteria, A. (1984). Rey Auditory-Verbal Learning Test

performance of patients with and without memory impairment. *Journal of Clinical Psychology, 40*(3)*,* 785–787. doi: 10.1002/1097-4679(198405)40:3<785::AID-JCLP2270400325>3.0.CO;2-4

Savage, R. M., & Gouvier, W. D. (1992). Rey Auditory-Verbal Learning Test: The effects of age

and gender, and norms for delayed recall and story recognition trials. *Archives of Clinical Neuropsychology, 7*(5)*,* 407–414. doi: 10.1093/arclin/7.5.407

Schmidt, M. (1996). *Rey Auditory-Verbal Learning Test.* Los Angeles, CA: Western Psychological Services.

Selnes, O.A., Jacobson, I., Machado, A.M., Becker, J.T., Wesch, J., Miller, E.N., … McArthur,

B. (1991). Normative data for a brief neuropsychological screening battery. *Perceptual and Motor Skills*, 73(2), 539-550.

Shimamura, A. P., Salmon, D. P., Squire, L. R., & Butters, N. (1987). Memory dysfunction and

word priming in dementia and amnesia. *Behavioral Neuroscience, 101*(3)*,* 347–351. doi:

10.1037/0735-7044.101.3.347

Snow, W. G., Tierney, M. C., Zorzitto, M. L., Fisher, R. H., & Reid, D. W. (1988). One-year test-

retest reliability of selected neuropsychological tests in older adults. Paper presented to the International Neuropsychological Society, New Orleans. LA.

Speer, P., Wersching, H., Bruchmann, S., Bracht, D., Stehling, C., Thielsch, M., … Lohmann, H.

(2014). Age- and gender-adjusted normative data for the German version of Rey’s Auditory Verbal Learning Test from healthy subjects aged between 50 and 70 years. *Journal of Clinical and Experimental Neuropsychology, 36*(1), 32-42. doi: 10.1080/13803395.2013.863834

Stallings, G., Boake, C., & Sherer, M. (1995). Comparison of the California Verbal Learning

Test and the Rey Auditory-Verbal Learning Test in head-injured patients. *Journal of Clinical and Experimental Neuropsychology, 17*(5)*,* 706–712. doi: 10.1080/01688639508405160

Steinberg, B.A., Bieliauskas, L.A., Smith, G.E., Ivnik, R.J., & Malec, J.F. (2005). MAYO’s

Older Americans Normative Studies: Age- and IQ- adjusted norms for the Auditory Verbal Learning Test and Visual Spatial Learning Test. *The Clinical Neuropsychologist, 19*(3-4), 464-523. doi: 10.1080/13854040590945193

Strauss, E., Sherman, E., & Spreen, O. (2006). A compendium of neuropsychological tests:

Administration, norms, and commentary (Third edition). New York, NY: Oxford University Press.

Sziklas, V., & Jones-Gotman, M. (2008). RAVLT and nonverbal analog: French forms and

clinical findings. *Canadian Journal of Neurological Sciences, 35*(3), 323–330. doi:

10.1017/S0317167100008908

Teng, E.L., & Chui, H.C. (1987). The Modified Mini-Mental State (3 MS) examination. *Journal*

*of Clinical Psychiatry, 48*(8), 314–318.

Torres, I. J., Flashman, L. A., O’Leary, D. S., & Andreasen, N. C. (2001). Effects of retroactive

and proactive interference on word list recall in schizophrenia. *Journal of the International Neuropsychological Society, 7*(4)*,* 481–490. doi: 10.1017/S1355617701744049

Tulving, E., & Patkau, J.E. (1962). Concurrent effects of contextual constraint and word

frequency on immediate recall and learning of verbal material. *Canadian Journal of Psychology, 16*(2), 83–95. doi: 10.1037/h0083231

Uchiyama, C. L., D’Elia, L. F., Dellinger, A. M., Becker, J. T., Selnes, O. A., Wesch, J. E., …, & Miller, E. N. (1995). Alternate forms of the Auditory-Verbal Learning Test: Issues of test comparability, longitudinal reliability, and moderating demographic variables. *Archives of Clinical Neuropsychology, 10*(2)*,* 133–146. doi: 10.1016/0887-6177(94)E0034-M

Vakil, E., & Blachstein, H. (1994). A supplementary measure in the Rey AVLT for assessing

incidental learning of temporal order. *Journal of Clinical Psychology, 50*(2)*,* 241–245. doi: 10.1002/1097-4679(199403)50:2<240::AID-JCLP2270500215>3.0.CO;2-5

Vakil, E., & Blachstein, H. (1997). Rey AVLT: Developmental norms for adults and the

sensitivity of different memory measures to age. *The Clinical Neuropsychologist, 11*(4)*,* 356–369. doi: 10.1080/13854049708400464

Van den Burg, W., & Kingma, A. (1999). Performance of 225 Dutch school children on Rey’s

Auditory Verbal Learning Test: Parallel test-retest reliabilities with an interval of 3 months and normative data. *Archives of Clinical Neuropsychology, 14*(6)*,* 545–559. doi: 10.1016/S0887-6177(98)00042-0

Van der Elst, W., van Boxtel, P. J., van Breukelen, J. P., & Jolles, J. (2005). Rey’s Verbal

Learning Test: Normative data for 1855 healthy participants aged 24–81 years and the influence of age, sex, education, and mode of presentation. *Journal of the International Neuropsychological Society, 11*(3), 290–302. doi: 10.1017/S1355617705050344

Wechsler, D. (1987). Wechsler Memory Scale-Revised manual. San Antonio, TX: Psychological

Corporation.

Wiens, A. N., McMinn, M. R., & Crossen, J. R. (1988). Rey Auditory-Verbal Learning Test:

Development of norms for healthy young adults. *The Clinical Neuropsychologist, 2*(1)*,* 67–87. doi: 10.1080/13854048808520087

Woodard, J. L., Dunlosky, J., & Salthouse, T. A. (1999). Task decomposition analysis of

intertrial free recall performance on the Rey Auditory Verbal Learning Test in normal aging and Alzheimer’s disease. *Journal of Clinical and Experimental Neuropsychology, 21*(5)*,* 666–676. doi: 10.1076/jcen.21.5.666.872

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., & Leirer, V. O. (1982–

1983). Development and validation of a Geriatric Depression Screening Scale: A preliminary report. *Journal of Psychiatric Research, 17*, 37–49. doi:10.1016/0022-3956(82) 90033-4.

Zhang, J., Zhou, W, Wang, L., Harvard Aging Brain Study. (2017). Gender differences of

neuropsychological profiles in cognitively normal older people without amyloid pathology. *Comprehensive Psychiatry, 75*, 22-26. doi: 10.1016/j.comppsych.2017.02.008