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# The Rey Auditory Verbal Learning Test: Normative Data Developed for the Venezuelan Population

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**Abstract**

The Rey Auditory Verbal Learning Test (RAVLT) is a neuropsychological tool widely used to assess functions such as attention, memory, and learning ability in the auditory-verbal domain. Norms for the test have been developed in many different languages and they show different relationships with demographic variables. The main objective of this research was to develop specific norms for the Venezuelan population, with particular focus on the influences of age, education, gender, and socioeconomic status. A Spanish version of the test was administered to a quota sample of 629 healthy adults. Pearson's correlation analysis ($p < .001$) showed a significant association between RAVLT performance and age ($r = -.401$), education ($r = .386$), and socioeconomic status ($r = -.196$), but not between RAVLT performance and gender ($r = -.054$). Due to the strength of the correlations, only age and education were considered in the development of final norms.

*Keywords:* Norms; RAVLT; Learning; Memory; Demographics

## Introduction

The Rey Auditory Verbal Learning Test (RAVLT) is a neuropsychological tool used to assess cognitive functions such as: attention and concentration in terms of span under overloaded conditions (Lezak, Howieson, Bigler, & Tranel, 2012) and memory (Lezak *et al.*, 2012; Magalhães & Hamdan, 2010; Malloy-Diniz, Lasmar, de Gazinelli, Fuentes, & Salgado, 2007; Perea, González-Tablas, & Ladera, 1996; Spreen & Strauss, 1998). Attention and short-term memory are required for the entire test, but are specifically evaluated by trials I and VI. Verbal learning and memory are assessed by the learning curve, the total acquisition or total learning (ΣI–V) and trials V (final acquisition level), VII (delayed recall), and VIII (recognition).

Schoenberg and colleagues (2006) provide a good summary of the purposes of RAVLT, to "codify, consolidate, store and retrieve verbal information" (p. 2). In general, this test has been used to evaluate various aspects of memory and is an effective tool to identify and diagnose impairments in this function in different groups of patients (Lezak *et al.*, 2012; Malloy-Diniz *et al.*, 2007; Spreen & Strauss, 1998). Further, Callahan and Johnstone (1994) support the ability of this test to also assess global cognitive function in addition to verbal learning and memory. There are some additional summary measures that could be useful, for example, the index V–VII provides information related to resistance to retroactive interference, and the index I–VI measures resistance to proactive interference (Spreen & Strauss, 1998).

The kind of errors made is a source of valuable information about the type of faults affecting the processes of attention, memory, and learning in the subjects evaluated. Such is the case of repeated words or double recalls (R), which are taken as an index of perseveration (inappropriate use of environmental feedback), inattention and difficulties with spontaneous recall. Intrusions (words that are not part of the list [Int]) can be considered a sign of false memory and confabulation, while the repetitions of these intrusions (IR) are also suggestive of difficulties in monitoring. Subjective doubts during the evocation of words (questioned words [Q]) are an indicator of insecurity, and if these are repeated words (RQ), it indicates additional difficulties with recent


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memory and monitoring. Interference A (words of list A present in trial VI) and B (words of list B present on trial VII) are measures of proactive and retroactive intrusions, respectively.

The RAVLT is short and easy to administer, used extensively, and its efficiency has been proven on many occasions (Malloy-Diniz *et al*., 2007; Schmidt, 2004). Furthermore, it has shown superiority in terms of diagnostic value. According to Loring and colleagues (2008), the RAVLT was the only predictor of localization (left or right) of temporal lobe seizure onset, in comparison with other tools such as the California Verbal Learning Test, Boston Naming Test, and the Multilingual Aphasia Examination Visual Naming subtest. Similar results were found by Ferreira, Campagna, Colmenarez, and Suarez (2008), who conclude that the RAVLT was the only test able to predict the evolution from Mild Cognitive Disorder to Alzheimer's Type Dementia from a wide selection of neuropsychological tests, such as Clock Drawing Test, Folstein's Mini Mental Status Examination, Trail Making Test, Controlled Oral Association Test, Bender Visual Motor Gestalt Test, Wechsler Adult Intelligence Scale Revised Edition, Wisconsin Card Sorting Test, Weschler's Memory Scale Revised Edition, and Benton Temporal Orientation Test. Furthermore, Balthazar, Yasuda, Cendes, and Damasceno (2010) used the RAVLT to study the neurological substrate of the mnesic functions. Using the different trials of the test, they found that learning and delayed recall are more related to the operation of medial prefrontal cortex and hippocampus, while recognition is more related to the functioning of the thalamus and caudate nucleus, particularly in the left hemisphere.

From its creation by Andre Rey in 1958 (Spreen & Strauss, 1998), many psychometric studies, including development of norms, have arisen in various countries. The use of different versions of the test and implementation of diverse methodologies has built an unsystematic wealth of information about the properties of this test. In an attempt to catalog these studies, Schmidt (2004) produced a clinical and scientific relevant manual, where he presents the methodological details of diverse normative studies on the RAVLT, highlighting that one of the limitations of this instrument is the reduced comparability of norms due to methodological differences in the studies. Nonetheless, it is important to bear in mind that in general, healthy persons remember around five more words from trial I to trial V and forget one to two words from trial V to trial VII (Spreen & Strauss, 1998).

A very important area of research that has been carried out with the RAVLT is related to the impact that demographic variables have on the performance of this instrument. Age has been one of the most relevant variables studied in this regard. Consistently, studies show a significant negative correlation between age (in adults) and performance in the RAVLT (Ladera, Perea, & Morales, 2002; Magalhães & Hamdan, 2010; Malloy-Diniz *et al*., 2007; Messinis, Tsakona, Malefaki, & Papathanasopoulos, 2007; Perea *et al*., 1996; Perea and Ladera, 1995; Rickertand, 2000; Sánchez & López, 1997; Schmidt, 2004; Schoenberg *et al*., 2006; Van Der Elst, van Boxtel, van Breukelen, & Jolles, 2005). More specifically, it seems that the Total Learning score is the most sensitive in the RAVLT when studying age differences in performance (Vakil, Greenstein, & Blachstein, 2010).

Educational level has been found to positively correlate with performance on the RAVLT (Magalhães & Hamdan, 2010; Messinis *et al*., 2007; Perea *et al*., 1996; Rickertand, 2000; Van Der Elst *et al*., 2005). An interesting finding is provided by Teruya, Ortiz, and Minett (2009), who explained that years of schooling were strongly and positively correlated with all the subcomponents of the RAVLT, with the exception of learning (trials I–V). However, Schmidt (2004) argued that the correlation between RAVLT and educational level varies from low to moderate and considered it inconsistent; therefore, the author adds that it is' not imperative to include it in the normative comparisons, raising the question of whether this variable is relevant for stratification in specific contexts or not.

According to Schoenberg and colleagues (2006) and Schmidt (2004), there are conflicting findings about gender differences in performance of the RAVLT. In recent years, new evidence show that women tend to perform better than on the RAVLT (Malloy-Diniz *et al*., 2007; Messinis *et al*., 2007; Otero, Rodríguez, & Andrade, 2009; Salgado *et al*., 2011; Vakil *et al*., 2010; Van der Elst *et al*., 2005). In general, evidence suggest that women, young adults, and individuals with high education are those who perform better on this test.

The importance of developing population-specific normative tables for the use and interpretation of RAVLT has been considered by several authors. Messinis and colleagues (2007) developed normative tables for the Greek population, and Van Der Elst and colleagues (2005) provided them for the Dutch population. Both established stratifications using age, gender, and education level, as their investigations determined that these are the variables that significantly affect performance on the RAVLT. Australian norms for young adults (18–34 years old) were developed using gender and level of education as the stratification variables, since age was not significant in this group (Carstairs, Shores, & Myors, 2012).

The available norms for this test reveal a general agreement regarding the stratification criteria of age and education, but population-specific significance for the delimitation of ranges in these variables as well as for specific items or indexes of the test. The present study investigated that which demographic variables are significantly associated with the performance on the RAVLT for the Venezuelan population and provides normative data according to these variables that determine the results.

## Methods

### *Participants*

Standardization of the RAVLT was part of a larger project to create norms for the Venezuelan population of the capital area on different neuropsychological tests. Most of the participants completed the entire battery of tests. A quota sampling was used (Neuman, 2000). Initially, we designed seven groups of 100 persons divided by 10 in 10 years of age (from 20–29 to 70–79), giving a total of 600 subjects. Additional participants were evaluated in all the groups of ages which we decided to include giving a total of 629 individuals. The descriptive characteristics of the sample are presented in Table 1. Those groups were stratified based on the official 2001 census, according to the following variables of the population: Gender (both men and women), level of education (from 0 [illiterates] to >16 years of education), and socioeconomic status (from the highest = I to the lowest = V), classified by using the Médez-Castellano and Méndez (1994) method. The exclusion criteria included history of psychiatric, metabolic, immunologic, and neurological illness, symptoms of memory loss or other cognitive complaint, illegal substance use and abuse and legal substance abuse, use of psychotropic medication. Special attention was given to exclude individuals with any memory problems that could be associated with early dementia or Mild Cognitive Impairment.

### *Procedure*

The standardization project included several instruments organized in two sections. The first part included the subject's information sheet and informed consent, structured neuropsychological interview (for personal information about demographic characteristics, health history, and current pharmacological treatment) and the Médez-Castellano and Méndez (1994) method, a well-known Venezuelan measure for social stratification (socioeconomic level). This method considers the following variables: Occupation of the head of the household, level of education of the mother, main source of income of the family, and type of housing. Each variable is scored and the total score is classified in a scale from I to V, being I the lowest socioeconomic level (Méndez-Castellano and Méndez, 1994).

The purpose of this first part was to select a sample according to the inclusion and exclusion criteria. If the volunteers did not meet the exclusion criteria and fitted in the sampling needed, based on the demographic variables, they were invited to participate in the study. If the participant agreed to sign the informed consent, the second part of the assessment took place, and included the following tests: Benton's Temporal Orientation Test, RAVLT, Controlled Oral Word Association Test, Set Test, Trail Making Test, Clock Drawing Test, Attention Test, and Mini-Mental Status Examination. The duration of this assessment was 30–40 min and it was performed in various settings, with appropriate conditions for the testing in terms of privacy, ventilation, illumination, and furniture (smooth table and two comfortable chairs). There was an initial training for the proper administration of the tests by the same instructor. All the evaluators were psychologists or students of psychology in their final year of training.

**Table 1.** Descriptive statistics of the demographic characteristics of the sample

| Variable | *N* (mean, *SD*) | Percentage |
|---|---|---|
| Category | | |
| Age | 629 (49.98, 16.96) | |
| 20–49 | 295 | 46.9 |
| 50–64 | 177 | 28.2 |
| 65–79 | 157 | 24.9 |
| Education | 629 (8.71, 5.03) | |
| 0–3 | 116 | 18.4 |
| 4–12 | 364 | 57.9 |
| ≥13 | 149 | 23.7 |
| Gender | 629 | |
| Feminine | 325 | 51.7 |
| Masculine | 304 | 48.3 |
| SES | 629 | |
| II | 34 | 5.4 |
| III | 98 | 15.58 |
| IV | 352 | 55.96 |
| V | 145 | 23.05 |

A Spanish version of the RAVLT was developed for this norming (Appendix 1), taken from the English version (Lezak, 1995), with some changes in the original words translated, because it was necessary to maintain bisyllabic words, as it was a characteristic of the original version, which always attempting to maintain the same concept as the original word belonged. This was done for list A. For list B and for the recognition trial, we translated or adapted 15 common nouns similar to the original ones in the English version.

The procedure of administration was as follows: List A was orally presented five times for immediate recall after each presentation (trials I, II, III, IV, and V), then the list B was presented for recall (trial VI). In trial VII, the participants had to recall list A without a previous presentation, and in trial VIII, the recognition list was read out loud to the subjects and they had to identify all the words pertaining to list A.

## Results

The analysis of the results for the RAVLT initially included the use of parametric statistics such as the Pearson correlation coefficient, multiple regression, and analyses of variance (ANOVAs). After identifying the relevant categories of analysis, descriptive statistics were used, such as frequency distributions, measures of central tendency and variability in order to better define the demographic variables, and ranges to use for the norms. Statistical analysis of the data evaluated each trial, errors, and indices as separate elements of the RAVLT. This procedure allowed for the exclusion of extreme scores by test component and not by subject. For this reason, the sample size varies for each of the components. The variable used for the correlation and regression analyses was the total learning which refers to the sum of trials I, II, III, IV, and V (Σ I–V). The first step in the analysis was to determine the effect of sociodemographic variables (age, education, socioeconomic level, and gender) on this score.

Table 2 shows the Pearson correlation analysis. It is noted that the age had the strongest negative correlation ($r = -.401$), suggesting that the older the person is the lower Σ I–V and vice versa. Years of schooling correlated positively with Σ I–V ($r = .386$), this suggests that the higher the educational level, the better the performance on this indicator. The correlation between socioeconomic level (SES) and Σ I–V was negative and very weak ($r = -.196$). This relationship is superficial, but suggests that a lower SES tends to lower performance in the indicator Σ I–V. Between gender and the variable Σ I–V score, a non-significant correlation was found ($r = .054$), suggesting that gender and total learning operate independently.

A multiple regression (forward stepwise regression) illustrated how much of the variance in performance on Total Learning score (Σ I–V) was contributed by each demographic variable (Table 3). Thus, using the criterion Σ I–V and the sociodemographic characteristics (age, socioeconomic status, gender, and years of schooling) as predictors, it is shown in Table 2 that age and education best predict the score Σ I–V. Age explains 16% of the variance of Σ I–V, while years of schooling contribute to this

**Table 2.** Correlations between total learning (RAVLT I–V) and the sociodemographic variables (age, level of education, socio-economic status, and gender)

| | RAVLT Σ I–V | Age | Years of schooling | Socioeconomic level | Gender |
|---|---|---|---|---|---|
| RAVLT Σ I–V | | | | | |
| Pearson's correlation | 1 | | | | |
| Sig. (two-tailed) | | | | | |
| *N* | 616 | | | | |
| Age | | | | | |
| Pearson's correlation | −.401 (**) | 1 | | | |
| Sig. (two-tailed) | 0 | | | | |
| *N* | 616 | 629 | | | |
| Years of schooling | | | | | |
| Pearson's correlation | .386 (**) | −.150 (**) | 1 | | |
| Sig. (two-tailed) | 0 | 0 | . | | |
| *N* | 616 | 629 | 629 | | |
| Socioeconomic level | | | | | |
| Pearson's correlation | −.196 (**) | −.035 | −.397 (**) | 1 | |
| Sig. (two-tailed) | 0 | .378 | 0 | . | |
| *N* | 616 | 629 | 629 | 629 | |
| Gender | | | | | |
| Pearson's correlation | −.054 | .031 | .041 | .054 | 1 |
| Sig. (two-tailed) | .182 | .444 | .307 | .177 | |
| *N* | 616 | 2629 | 629 | 629 | 629 |

*Note*: RAVLT=Rey Auditory Verbal Learning Test
**Correlation is significant at the .01 level (two-tailed).

**Table 3.** Multiple regression: summary of the model (RAVLT I–V)

| Model | $R$ | $R^2$ | Adjusted $R^2$ | Std error of the estimate | Change statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $R^2$ change | $F$ change | df1 | df2 | Sig. F change |
| 1 | .401(a) | .161 | .16 | 8.875 | .161 | 117.929 | 1 | 614 | 0 |
| 2 | .522(b) | .272 | .27 | 8.273 | .111 | 93.665 | 1 | 613 | 0 |
| 3 | .528(c) | .275 | .275 | 8.244 | .006 | 5.23 | 1 | 612 | .023 |
| a | Predictors: (Constant), Age | | | | | | | | |
| b | Predictors: (Constant), Age, Years of Schooling | | | | | | | | |
| c | Predictors: (Constant), Age, Years of Schooling, Socioeconomic Level | | | | | | | | |

**Table 4.** ANOVA with Bonferroni adjustment for the age variable and ΣI–V

| Age | | Mean difference (I – J) | Std error | Sig. | 95% confidence interval | |
|---|---|---|---|---|---|---|
| (I) | (J) | | | | Lower bound | Upper bound |
| 20–49 | 50–64 | 3,807 (*) | 0.849 | 0 | 1.77 | 5.84 |
| | 65–79 | 9,801 (*) | 0.884 | 0 | 7.68 | 11.92 |
| 50–64 | 20–49 | −3,807 (*) | 0.849 | 0 | −5.84 | −1.77 |
| | 65–79 | 5,995 (*) | 0.978 | 0 | 3.65 | 8.34 |
| 65–79 | 20–49 | −9,801 (*) | 0.884 | 0 | −11.92 | −7.68 |
| | 50–64 | −5,995 (*) | 0.978 | 0 | −8.34 | −3.65 |

*The mean difference is significant at the .05 level.

**Table 5.** ANOVA with Bonferroni adjustment for the years of schooling variable and ΣI–V

| Years of schooling | | Mean difference (I – J) | Std error | Sig. | 95% confidence interval | |
|---|---|---|---|---|---|---|
| (I) | (J) | | | | Lower bound | Upper bound |
| 0–3 | 4–12 | −8,818 (*) | 0.998 | 0 | −11.21 | −6.42 |
| | 13 or more | −13,134 (*) | 1.154 | 0 | −15.9 | −10.36 |
| 4–12 | 0–3 | 8,818 (*) | 0.998 | 0 | 6.42 | 11.21 |
| | 13 or more | −4,316 (*) | 0.865 | 0 | −6.39 | −2.24 |
| 13 or more | 0–3 | 13,134 (*) | 1.154 | 0 | 10.36 | 15.9 |
| | 4–12 | 4,316 (*) | 0.865 | 0 | 2.24 | 6.39 |

*The mean difference is significant at the .05 level.

explanation by 11% more. In the variance, socioeconomic level has a very low contribution to the total variance (0.5%) and gender was excluded from the model due to its non-significant correlations with the total score (Σ I–V).

Age was the first variable compared by ANOVA (Table 4). After several comparisons using multiple age brackets, three age categories that differ significantly from each other were possible. These categories were: 20–49, 50–64, and 65–79 years; as shown in Table 4. Following a similar process of analysis, the second variable studied was years of schooling. Multiple ANOVAs were used, firstly using educational stages as categories of subdivision, then establishing categories using intervals of 3 years of education and then 5 years of education. ANOVAs of those entailed the establishment of the categories illustrated in Table 5. Three groups were divided as follows: 0–3 years of schooling (including the illiterate), 4–12 years of study, and 13 or more years of schooling. These groups differed significantly in terms of their performance on Σ I–V.

After establishing the sociodemographic variables that affect total learning on the RAVLT (Σ I–V), the most appropriate ranges to divide the two demographic variables that were significant was determined through ANOVA with the Bonferroni correction. This was done with the purpose of letting the ANOVA to determine the ranges in which to divide the demographic variables instead of doing it arbitrarily ourselves, as we had seen that some of the tables usually provided are divided by age in groups of 10 but without significant statistical differences between the groups (Spreen & Strauss, 1998). This procedure allowed the construction of the descriptive Tables 6–8 presented below. Tables 4–6 include descriptive statistics of the following RAVLT results: Trials (I, II, III, IV, V, VI, VII, and VIII), errors (repeated words or double recalls [R], Intrusions [Int], repetition of intrusions [IR], questioned words [Q], repeated words that are questioned [RQ], interference type A [A], interference type B [B], errors in recognition [ER]), and total learning (Σ I–V). As a result of the ANOVA, three age groups were created for the normative tables

**Table 6.** Descriptive statistics for individuals between 20 and 49 years old

| Age 20–49 | | Trials | | | | | Errors | | | | | | | | Total learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Years of schooling | | I | V | VI | VII | VIII | R | Int | IR | Q | RQ | A | B | RE | Σ I–V |
| 0–3 | *N* | 26 | 26 | 26 | 25 | 26 | 24 | 25 | 26 | 25 | 26 | 24 | 26 | 24 | 26 |
| | Mean | 4.6 | 9.1 | 3.7 | 7.6 | 12.4 | 4.5 | 1.4 | 0.7 | 0.6 | 1.0 | 0.2 | 0 | 0.5 | 37.3 |
| | *SD* | 1.4 | 2.7 | 1.7 | 2.7 | 2.4 | 4.2 | 1.8 | 1.2 | 0.9 | 1.3 | 0.4 | 0.2 | 0.7 | 10.2 |
| | Minimum | 2 | 4 | 1 | 3 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| | Maximum | 8 | 15 | 9 | 13 | 15 | 16 | 7 | 4 | 3 | 5 | 2 | 1 | 4 | 55 |
| 4–12 | *N* | 190 | 190 | 193 | 193 | 192 | 191 | 190 | 182 | 192 | 192 | 186 | 184 | 187 | 190 |
| | Mean | 5.3 | 11 | 4.9 | 9.29 | 13.8 | 5.6 | 1.54 | 1.2 | 0.49 | 0.9 | 0.1 | 0.02 | 0.3 | 42.29 |
| | *SD* | 1.7 | 2.1 | 1.8 | 2.43 | 1.46 | 3.7 | 1.27 | 1.8 | 0.78 | 1.3 | 0.3 | 0.15 | 0.62 | 8.67 |
| | Minimum | 2 | 5 | 1 | 3 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| | Maximum | 11 | 15 | 11 | 15 | 15 | 16 | 6 | 8 | 3 | 7 | 1 | 1 | 4 | 64 |
| ≥13 | *N* | 71 | 71 | 76 | 76 | 74 | 74 | 76 | 71 | 75 | 75 | 74 | 75 | 75 | 71 |
| | Mean | 6.06 | 11 | 5.7 | 9.7 | 14.1 | 5.53 | 1.34 | 0.6 | 0.56 | 0.8 | 0 | 0 | 0.25 | 46.94 |
| | *SD* | 1.9 | 1.9 | 1.6 | 2.39 | 1.34 | 4.53 | 1.39 | 1.2 | 0.83 | 1.1 | 0.4 | 0 | 0.47 | 8.17 |
| | Minimum | 2 | 7 | 3 | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| | Maximum | 12 | 15 | 10 | 14 | 15 | 19 | 6 | 4 | 3 | 4 | 1 | 0 | 2 | 64 |

**Table 7.** Descriptive statistics for individuals between 50 and 64 years old

| Age 50–64 | | Trials | | | | | Errors | | | | | | | | Total learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Years of schooling | | I | V | VI | VII | VIII | R | Int | IR | Q | RQ | A | B | RE | Σ I–V |
| 0–3 | *N* | 40 | 40 | 40 | 40 | 39 | 40 | 39 | 38 | 35 | 39 | 39 | 37 | 38 | 40 |
| | Mean | 3.9 | 7.9 | 3.2 | 6.58 | 11.5 | 4.48 | 1.77 | 1.5 | 0.33 | 0.6 | 0.5 | 0.03 | 1.03 | 31.75 |
| | *SD* | 1.37 | 2.1 | 1.3 | 2.32 | 2.44 | 3.93 | 2.01 | 2.1 | 0.79 | 0.9 | 0.6 | 0.16 | 1.13 | 7.27 |
| | Minimum | 1 | 3 | 1 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |
| | Maximum | 7 | 12 | 8 | 13 | 15 | 16 | 7 | 7 | 3 | 4 | 2 | 1 | 4 | 49 |
| 4–12 | *N* | 92 | 92 | 92 | 93 | 93 | 93 | 93 | 91 | 91 | 90 | 88 | 89 | 93 | 92 |
| | Mean | 5.05 | 10 | 4.4 | 7.87 | 13.1 | 5.2 | 2.1 | 1 | 0.66 | 0.8 | 0.2 | 0.01 | 0.59 | 40.1 |
| | *SD* | 1.6 | 2.1 | 1.6 | 2.47 | 1.71 | 3.92 | 1.55 | 1.5 | 0.93 | 1.1 | 0.4 | 0.11 | 0.94 | 8.20 |
| | Minimum | 2 | 6 | 1 | 3 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| | Maximum | 9 | 15 | 9 | 13 | 15 | 16 | 6 | 6 | 4 | 4 | 1 | 1 | 4 | 58 |
| ≥13 | *N* | 43 | 43 | 44 | 44 | 43 | 44 | 44 | 43 | 44 | 42 | 43 | 44 | 44 | 43 |
| | Mean | 5.33 | 11 | 5 | 8.61 | 13.7 | 5.23 | 1.5 | 0.7 | 0.52 | 0.7 | 0.2 | 0 | 0.27 | 44.14 |
| | *SD* | 1.49 | 1.8 | 2 | 2.27 | 1.51 | 4.39 | 1.37 | 1.2 | 1.07 | 0.9 | 0.4 | 0 | 0.5 | 6.7 |
| | Minimum | 3 | 7 | 2 | 3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| | Maximum | 9 | 14 | 9 | 14 | 15 | 18 | 6 | 4 | 4 | 3 | 1 | 0 | 2 | 61 |

**Table 8.** Descriptive statistics for individuals between 65 and 79 years old

| Age 65–79 | | Trials | | | | | Errors | | | | | | | | Total learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Years of schooling | | I | V | VI | VII | VIII | R | Int | IR | Q | RQ | A | B | ER | Σ I–V |
| 0–3 | *N* | 48 | 48 | 50 | 50 | 50 | 49 | 50 | 50 | 45 | 50 | 48 | 45 | 46 | 48 |
| | Mean | 3.9 | 7.4 | 3 | 5.32 | 10.6 | 2.14 | 1.48 | 1 | 0.36 | 0.5 | 0.4 | 0.04 | 1.02 | 29.33 |
| | *SD* | 1.7 | 1.9 | 1.3 | 2.72 | 2.82 | 2.12 | 1.27 | 1.5 | 0.71 | 0.9 | 0.6 | 0.21 | 1.09 | 7.74 |
| | Minimum | 0 | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| | Maximum | 7 | 12 | 7 | 13 | 15 | 8 | 4 | 7 | 3 | 4 | 2 | 1 | 4 | 52 |
| 4–12 | *N* | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 75 | 73 | 74 | 65 | 68 | 75 | 77 |
| | Mean | 4.38 | 8.5 | 4.1 | 6.56 | 12.2 | 4.06 | 1.51 | 1 | 0.56 | 0.6 | 0.1 | 0 | 0.59 | 33.99 |
| | *SD* | 1.33 | 2.3 | 1.3 | 2.32 | 2.37 | 3.78 | 1.3 | 1.3 | 0.91 | 1 | 0.3 | 0 | 0.84 | 8.162 |
| | Minimum | 2 | 3 | 1 | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| | Maximum | 9 | 13 | 6 | 12 | 15 | 17 | 6 | 5 | 4 | 4 | 1 | 0 | 3 | 52 |
| ≥13 | *N* | 29 | 29 | 29 | 29 | 28 | 29 | 29 | 29 | 29 | 28 | 23 | 25 | 28 | 29 |
| | Mean | 4.45 | 9.7 | 4.3 | 7.21 | 13.6 | 3.59 | 1.21 | 0.5 | 0.48 | 0.7 | 0.1 | 0 | 0.54 | 37.45 |
| | *SD* | 1.55 | 2.1 | 2.3 | 2.82 | 1.79 | 2.92 | 1.08 | 0.9 | 0.91 | 1.2 | 0.3 | 0 | 0.79 | 8.201 |
| | Minimum | 2 | 5 | 0 | 3 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| | Maximum | 8 | 14 | 11 | 14 | 15 | 14 | 3 | 3 | 4 | 4 | 1 | 0 | 3 | 61 |

(20–49, 50–64, and 65–79) and three ranges of years of schooling (0–3, 4–12, and 13 or more), regarding the correct scores; error scores were not divided into the same age or schooling groups by the ANOVA.

## Discussion

The aim of this study was to develop norms of the RAVLT for the Venezuelan population, including the exploration of the effects of sociodemographic variables, such as age, gender, socioeconomic level, and years of education on performance.

Many norms have been developed for different populations (Schmidt, 2004). Our results can be understood only in the frame of the administration used in this study, similar to the ones used by the following studies cited by Schmidt (2004): Bernard (1991), Bigler and colleagues (1989), Davidoff and colleagues (1990), Powel and colleagues (1991), Ryan and Geisser (1986), and Ryan and colleagues (1982). This procedure consists of administering trials I–V, trial VI (using list B), trial VII (free recall), using a presentation of one word per second. The word recognition list (trial VIII) is presented immediately after trial VII. No delayed recall task is implemented. In this sense, our norms can only be used in the frame of this specific administration.

In agreement with previous findings (Fichman *et al*., 2010; Ladera *et al*., 2002; Magalhaes and Hamdan, 2010; Malloy-Diniz *et al*., 2007; Messinis *et al*., 2007; Perea *et al*., 1996; Perea and Ladera, 1995; Rickertand, 2000; Sánchez & López, 1997; Schmidt, 2004; Schoenberg *et al*., 2006; Vakil *et al*., 2010; Van Der Elst *et al*., 2005), age is the main factor that has an impact on the total learning of the RAVLT. As expected, younger people performed better on this component (Σ I–V) than older people, and irrespective of level of education, the Total Learning mean for the younger group is consistently better than for the older group.

The second variable to have a significant influence on the component (Σ I–V) of the RAVLT was education. The positive correlation between years of schooling and Total Learning is congruent with previous researches (Cardoso, Zazo, & Minett, 2009; Fichman *et al*., 2010; Magalhães & Hamdan, 2010; Messinis *et al*., 2007; Perea *et al*., 1996; Rickertand, 2000; Schmidt, 2004; Van Der Elst *et al*., 2005). In fact, it was the second factor to explain the total variance of Total Learning. Also, in contrast to Teruya and colleagues (2009), the effect of education is evident in every age category and explained second highest amount of variance of the total learning score (Σ I–V).

The combination of age and level of education show a pattern of performance that reveals that the best scores are achieved by younger individuals with high levels of education. It could be argued that education might play a role as a protective factor against the impact of aging on learning. Some research has indicated that the ability to recall newly obtained information reduces with age. However, it seems that higher education levels improve the ability to store information (Spreen & Strauss, 1998; Van der Elst *et al*., 2005). This finding of the effect of age and schooling on learning applies to the rest of the cognitive functions that the test measures, as can be seeing in Tables 4 and 5 where it is shown that trials I, II, III, IV, V, VI, VII, and VIII also improve with increased years of education and lower age. There is a greater difference in scores between the first two groups of educational level, than between the second and the third levels of education. This could suggest that education plays a bigger role on semantic learning and memory in the early stages of schooling. Furthermore, this impact could be extended to immediate recall, as Teruya and colleagues (2009) hypothesized that people with higher levels of education present better results in trial I as a consequence of a better use of their articulatory rehearsal process (Baddeley, Gathercole, & Papagno, 1998).

Persons with more years of schooling show better performance on the RAVLT. It is interesting to note that the division of this variable ranged between low (or none) schooling, but there were no further divisions between middle and high schooling. This could reflect an underlying relationship between schooling as an indication of intellectual level with learning abilities or semantic memory.

Socioeconomic level has not been a variable studied in previous normative research for this test, so we have no reference on this subject with which to compare our results. In this study, socioeconomic level was taken into account since the sample had to be representative of the population and there are large differences in Venezuelan society between the high and the lower levels, in matters such as food intake, access to information, health, environmental stimulation, academic and other cultural characteristics. Thus, we thought socioeconomic level should be proportionally covered in our sample. In the analysis, however, the correlation between socioeconomic status and test scores was negative and very weak ($r = -.196$). The Graffar Mendez-Castellano method consist of in five socioeconomic levels, being I the highest and V the lowest. In this regard, it appears that this is a factor that does not necessarily need to be considered when obtaining norms, even in populations with very extreme SEL levels, although it is still useful to consider this demographic information.

Finally, the effects of gender on the Total Learning of the RAVLT were not significant ($r = -.054$); thus, this finding supports Fichman and colleagues (2010) and not those of Vakil and colleagues (2010). For the Venezuelan population, as in Brazil, gender and Total Learning performance seem to operate independently. For this reason, gender was not included in the construction of the normative tables for our population and it remains a contradictory finding across reports on this area.

Our results differ from those obtained by Pontón and colleagues (1996) in a sample with 300 Spanish-speaking individuals using the Spanish version developed by the World Health Organization. They found education to be the most important variable affecting the results. Age was divided in four groups (16–29, 30–39, 40–49, and 50–79) in that study. They also separated men and women; however, their performance is not significantly different, as they concluded. The education variable was divided into two groups: >10 years of education and <10 years of education, so comparisons with our results cannot be, but it i's interesting to see how demographic variables are affecting in same and yet different ways. Nonetheless, stretching some characteristics of the sample, if we compare our group with theirs, there is an obvious big difference between Spanish speakers in California and our population, in the capacity of learning as measured by this test; as well as fewer differences between the subjects (more homogeneous capacities in persons with the same demographic variables). This can be seen more clearly in the results of younger people: from 30 to 39 years of age and >10 years of schooling, the mean is 13.8 ($SD = 1.4$) and from 40 to 49 years the mean is 13.3 ($SD = 2.1$), while our mean for the group of subjects between 20 and 49 years, with >13 years of education is 11 ($SD = 1.9$).

This result highlights the need to develop norms for the population in which the tests are being administered and the risk involved when comparing patients to foreign norms, specially if the interpretation has diagnostic value, as it has been (Tombaugh, Kozak, & Rees, 1999).

Although our main findings are consistent with the international literature, the generalization of our results has a few limitations. First, the norms were developed from residents of the Metropolitan Area of Caracas; thus, the norms are not necessarily appropriate for the rest of the country. Although our findings are consistent with the international literature and our sample was large enough to be representative, the impacts of these characteristics that are geographically bound have always been a methodological concern in the development and use of tools in cross-cultural research and comparisons between across countries should not be made unless there is empiric evidence to support them (Byrne *et al*., 2009). With this consideration in mind, studies in other urban and rural areas are recommended, since there are large inequalities among the regions in terms of access to services, quality of education, and also differences in cultural practices and socioeconomic characteristics.

Furthermore, our norms cannot be compared with those that have established the age and years of education ranges a priori, such as some of the ones presented by Schmidt (2004), for example: Bleecker, Bolla-Wilson, Agnew, and Meyers (1988), Geffen, Moar, O'Hanlon, Clark and Geffen (1990), Uchiyama and colleagues (1995), just to name a few. Our analyses, in keeping with that of Magalhães and Hamdan (2010), employed a post hoc study which explores the presence of statistically significant differences between the ranges used for the final norms.

There could be some bias effects in the results of the study, for example, the use of self-reports to account for state of health which might have permitted some unhealthy subjects to participate. In fact, some people with controlled high blood pressure were part of the sample. Objective measures of general state of health or confirmations of health history were not possible; thus, it is recommended in the future to use alternative measures of health, specially of conditions that have a potential influence on cognition. Also, the research did not control for personal variables that are known to have an effect on test performance, such as motivation, fatigue, and previous exposure to the tools. Furthermore, this test was used in combination with a battery of tests; thus, it is possible that these results are interfered by the instruments administered before and, finally, the bias due to evaluator's effects on the administration and on the relation with the subjects of the study. However, the sample size is large and this should mitigate against minor variations in this regards.

Furthermore, one might consider that the results from such a small number of subgroups may have a negative effect in some cases. For example, when considering individuals at the extremes of the variable (such as 20 and 49 years of age). However, it is important to remember the relevance of the qualitative analysis of the tests scores when giving a conclusion about a patient's cognitive function.

We consider that the main value of this research is that it provides Venezuelan neuropsychologists with a more precise clinical tool that will allow more accurate assessment of functions such as attention, short-term memory, and learning in patients of differing ages and level of education.

Future research should aim to compare our sample with Venezuelan clinical groups with specific pathologies; this would allow for the identification of cutoff points, which could increase the value of the RAVLT as a diagnostic tool.

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## Conflict of Interest

None declared.

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## Appendix 1: RAVLT's Protocol

TEST DE APRENDIZAJE AUDIOVERBAL DE REY

**Lista A:** nube, lápiz, bote, lentes, tambor, café, luna, casa, color, río, hoja, nariz, tiza, piano, chivo.

**Lista B:** niño, campo, grama, colegio, piso, sombrero, carro, campana, padres, radio, gota, brazo, cinta, aro, carta.

**Lista de reconocimiento:** Luz, flor, sal, carpeta, café, libro, hoja, gorro, ojo, cielo, paño, nariz, camión, iglesia, galleta, mango, pupitre, tiza, lago, luna, acera, frío, tapón, piano, borrador, color, lápiz, toalla, chivo, colina, sol, lámpara, retrato, suelo, tambor, cocina, río, cochino, labrador, tapiz, bote, afiche, casa, puerta, nube, edificio, cabra, morado, lentes, cumbre.