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Chapter 8

NEUROPSYCHOLOGICAL ASSESSMENT IN SPANISH SPEAKING POPULATION

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ABSTRACT

Health care professionals are now faced with a growing number of patients from different ethnic groups, and from different socio-economical backgrounds. In the field of neuropsychology there is an increasing need of reliable and culturally fair assessment measures. Spanish is the official language in more than 20 countries and the second most spoken language in the world. The purpose of this article was to describe two tests developed and standardized for Spanish-speaking population and to review the main findings with a variety of clinical and experimental populations. The Brief Neuropsychological Test Battery NEUROPSI briefly assesses a wide spectrum of cognitive functions, including orientation, attention, memory, language, visuoperceptual abilities, and executive functions; normative data were collected from 1614 monolingual Spanish-speaking individuals, ages 16 to 85 years. Four age groups were used: (1) 16 to 30 years, (2) 31 to 50 years, (3) 51 to 65 years, and (4) 66 to 85 years. Data also are analyzed and presented within 4 different educational levels that were represented in this sample: (1) illiterates (zero years of school); (2) 1 to 4 years of school; (3) 5 to 9 years of school; and (4) 10 or more years of formal education. The NEUROPSI Attention and Memory was designed to assess orientation, attention and concentration, executive functions, working memory and immediate and delayed verbal and visual memory. Normative data were obtained from a sample of 950 monolingual Spanish Speaking subjects, aged 6 to 85 years. Educational level ranged from 0 to 22 years of education. These instruments may help fill the need for brief, reliable and objective evaluation of a broad range of cognitive functions in Spanish-speaking people.

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INTRODUCTION

Spanish is the official language in more than 20 countries and the second most spoken language in the world (330 million speakers). When tests developed in other countries are used within Latin America, they are frequently just translated and the norms of other populations are used. This procedure undoubtedly invalidates the results. Furthermore, neuropsychological tests are translated to Spanish literally, with little consideration of cultural relevance. For example, using backward word spelling for the evaluation of attention (such as in the Mini-Mental State Examination; Folstein et al., 1975), naming the fingers to evaluate language or word finding difficulty (as found in the Alzheimer's Disease Assessment Scale; Rosen et al., 1984), or asking for the seasons of the year to assess orientation, as included in several geriatric scales, may be inappropriate in certain countries and some cultural contexts. In many countries, instead of four seasons there are only a rainy and a dry season. In tropical areas, there may be two rainy and two dry seasons. The seasonal changes around the year may be so mild and unnoticed, that the concept of "season" is irrelevant and nonsense. In many world areas the names of the fingers are rarely used, even by highly educated neurologically intact people. The use of visual stimuli that are of high frequency for one culture but infrequent or nonexistent for another (i.e. drawing of a pretzel) is also inappropriate. Since the simple translation, use of inappropriate visual stimuli and use of norms of a foreign instrument does not take into account this kind of cultural differences, errors in diagnosis can be predicted unless items are correctly adapted or developed to assess the new population and new normative data are obtained.

It has also been proposed that in neuropsychological testing, schooling is a more significant variable than age (Ostrosky-Solís et al., 1998). This effect of education has been reported not only for Spanish speaking populations but for English speaking as well; for example, the Mini Mental State Examination Score is affected more by level of education than by age across whites, Hispanics and Afro-American English speaking subjects (Launer et al., 1993, Murden, McRae, Kaner, and Bucknam, 1991). Moreover, the effects of education extend to both verbal and non verbal neuropsychological measures (Rosselli and Ardila, 2003).

Cognitive assessment, of both healthy and pathological populations, requires the use of objective and reliable neuropsychological instruments designed and adapted to appropriately evaluate the populations we are interested in. Moreover, appropriate normative data must be developed in order to establish an accurate clinical picture about the nature of the impairments (Bauer, Tobias, and Valenstein, 1993; Mayes, 1986; Squire and Shimamura, 1996). Therefore, it is important to have neuropsychological tests that are developed and standardized for Spanish-speaking populations. It is not only important to have data collected in Spanish-speaking populations, but also, given the influence that educational factors have on cognitive performance (Ardila, Ostrosky-Solis, Rosselli and Gomez, 2000; Ardila, Rosselli and Ostrosky, 1992; Castro-Caldas, Reis and Guerreiro, 1997; Heaton, Grant and Matthews, 1986; Ostrosky-Solís, Ardila, and Rosselli, 1999; Ostrosky-Solís, Ardila, Rosselli, López and Mendoza, 1998; Ostrosky-Solís, Arellano and Pérez, 2004; Ostrosky, Canseco,

Quintanar, Navarro and Ardila, 1985; Ostrosky, et al., 1986, 2003b), norms for neuropsychological tests should represent persons with different educational levels including illiterates.

Given the current limitations in the neuropsychological assessment of Spanish speakers, two tests were developed and standardized with this population. The purposes of the present article are: 1) to describe and review findings obtained from the Brief Neuropsychological Test Battery NEUROPSI (Ostrosky-Solís et al., 1997) with Spanish-speaking adults; and 2) to describe and review findings obtained from the NEUROPSI Attention and Memory with Spanish-speaking children and adults (Ostrosky-Solís et al., 2003).

BRIEF NEUROPSYCHOLOGICAL TEST BATTERY IN SPANISH: NEUROPSI

Different comprehensive evaluation instruments have been developed to assess cognitive dysfunctions in the neuropsychology domain. Some of these instruments represent extensive neuropsychological test batteries, such as the Halstead–Reitan Neuropsychological Battery (Reitan and Wolfson, 1993), the Luria–Nebraska Neuropsychological Battery (Golden, 1980), and the Scheme of Neuropsychological Assessment (Ardila and Ostrosky, 1991; Ardila et al., 1981). Such comprehensive batteries have two significant limitations: (1) their administration and scoring require many hours making them impractical for use in many clinical settings; and (2) administration and scoring require rather specialized training.

To overcome these difficulties, short mental status questionnaires (e.g., the Mini-Mental Status Exam; Folstein et al., 1975), and behavioral scales (e.g., Blessed Dementia Scale; Blessed et al., 1968) have been developed. They are easy to administer, score, and interpret. These instruments, however, are not completely satisfactory. Some limitations of these short questionnaires are (1) false negatives are high, and they are not sensitive to mild brain impairments (Bertolucci et al., 1994; Dick et al., 1984; Nelson et al., 1986; Schwamm et al., 1987); and (2) they may point to general cognitive impairments, but they are not specific enough. As a potential solution to these difficulties, some short instruments have been proposed such as the instrument of the Consortium to Establish a Registry for Alzheimer's Disease (CERAD; Morris et al., 1989), or the Brief Neuropsychological Cognitive Examination (BNCE; Tonkonogy, 1997).

The NEUROPSI was developed taking into account principles and procedures developed in cognitive neuroscience. Therefore, measures of specific cognitive domains that can be differentially impaired following brain damage are included. This battery has standardized procedures for both administration and scoring. It includes items that are relevant for Spanish speaking individuals, and can be applied to illiterate or subjects from low educational groups. It includes language and picture tests that have high, medium, and low frequency of occurrence in the Spanish language (Aveleyra et al., 1996). Normative data were collected from 1614 monolingual Spanish-speaking individuals, ages 16 to 85 years. Four age groups were used: (1) 16 to 30 years, (2) 31 to 50 years, (3) 51 to 65 years, and (4) 66 to 85 years. Data also are analyzed and presented within 4 different educational levels that were represented in this sample: (1) illiterates (zero years of school); (2) 1 to 4 years of school; (3) 5 to 9 years of school; and (4) 10 or more years of formal education.

The domains covered include Orientation, Attention, Concentration, Language, Memory, Visuo-Motor, Executive Function, Reading, Writing, and Calculation, each having its own subtests. Each area includes assessment of different aspects of that particular cognitive domain. Thus, memory assessment includes immediate and delayed recall of verbal and visual–nonverbal functioning. Retrieval is assessed by independent recall and by different types of cuing (semantic clustering or recognition). Language evaluation includes the assessment of several important parameters such as naming, repetition, comprehension, and fluency. Assessment of attention includes level of alertness, span or efficiency of vigilance–concentration, and selective attention. Executive function includes both problem solving (abstraction and categorization) and several motor programming tasks. Potentially, therefore, the NEUROPSI provides data regarding distinct clinical neuroanatomic syndromes.

Interpretation of NEUROPSI results is twofold: (1) quantitative, in that each item is scored, and can be further compared with normal performance in the general population; and (2) qualitative; different types of errors can be distinguished and specifically analyzed. For example, in addition to an overall memory performance score, the battery provides several memory parameters including rate of decay, primacy and recency effects, rate of acquisition across learning trials, intrusion and perseveration rates, semantic *versus* serial-order clustering and signal detection parameters (discriminability and response bias) of recognition performance.

This battery has been used in a number of research with different types of Spanish speaking populations. One of the first studies was carried out with patients with primary systemic hypertension (Ostrosky-Solís, Mendoza and Ardila, 2001). This condition represents a risk factor for cerebrovascular disease. It has been hypothesized that the chronic hypertension may eventually result in small subcortical infarcts associated with some cognitive impairments. One hundred fourteen patients with primary systemic hypertension (PSH) and 114 matched subjects were selected. PSH patients were further divided in four groups depending upon the hypertension severity. In addition to the medical and laboratory exams, a neuropsychological evaluation was administered. The NEUROPSI neuropsychological test battery was used. An association between level of hypertension and cognitive impairment was observed. Most significant differences were observed in the following domains: reading, executive functioning, constructional abilities and memory recall. No differences were observed in orientation, memory-recognition and language. It was concluded that some neuropsychological functions appeared impaired even in the PSH group with the least risk factors, thus cognitive evaluation may be important in cases of PSH not only to determine early subtle cognitive changes, but also for follow-up purposes, and to assess the efficacy of different therapeutic procedures.

The NEUROPSI has also been used to establish sensitivity and specificity indexes in a group of schizophrenic patients and with a sample of demented and mild cognitive impairment patients.

Cognitive impairment is a prominent feature of schizophrenia that correlates with functional outcome. In the clinical practice and research, there is a need to count on brief, reliable and standardized instruments to evaluate the cognitive profile in psychiatric, geriatric and neurological patients. There are only a few standardized and validated instruments with the Hispanic population, so the adaptation and validation of instruments become a high relevance issue, is a brief neuropsychological battery evaluating a wide spectrum of cognitive functions and standardized with Spanish speaking population according to age and

educational level. The purpose of the present study was to determine the sensitivity and specificity of The Brief Neuropsychological Test in Spanish (NEUROPSI) for its clinical use in patients with schizophrenia, as well as in distinct subtypes of schizophrenic patients positive, negative and mixed. A total sample of 60 subjects (30 patients with schizophrenia and 30 matched controls) were assessed. Using the NEUROPSI total score we found 87.5% sensitivity and 92.8% specificity. A discriminant analysis using the 25 subtest scores of the NEUROPSI accurately classified 83.3% of the sample. None of the control subjects was classified as patient. Classification by subtype showed 80% of patients with negative symptoms, 90% of patients with positive symptoms and 70% of patients with mixed symptoms. The results showed that the instrument contributes to an accurate diagnosis of cognitive dysfunction in schizophrenic patients and it could help in management as well as development of more specific pharmacological treatment for each schizophrenic subtype (Picasso and Ostrosky-Solís, 2004)

Regarding dementia, a group of 314 Spanish-speaking elders were classified in 55 participants with mild to moderate dementia, 74 participants with mild cognitive impairment (MCI), and 185 control participants, according to clinical evaluation. Sensitivity, specificity and detection characteristics of frequently cognitive and functional tests were calculated in comparison with the clinical evaluation: Minimental State Examination, Brief Neuropsychological Test Battery (NEUROPSI), Short Blessed Test, Pfeffer Functional Activities Questionnaire and Blessed Dementia Scale. Influence of education on sensitivity and specificity values varied along the tests. For all the cognitive and functional measures, a great number of MCI participants who fulfilled Mayo's clinical criteria (Petersen et al., 1999) were misclassified as controls and a few were misclassified as demented. Level of education plays a very important role in both cognitive and functional assessment. The cognitive tests that are commonly used to screen demented patients may fail to detect MCI particularly in high-functioning individuals as well as those who are well educated (Mejia, Gutierrez, Villa and Ostrosky-Solis, 2004).

The NEUROPSI has also been used to assess the impact of variables such as education and culture in the cognitive profile of adults. Although culture and education are factors that significantly affect cognitive performance, it is often difficult to distinguish between the effects of education and the effects of culture, since the educational level influences the sociocultural status of an individual. Therefore, although it is common to attribute the differences between the performance in neuropsychological tests to both the level of education and culture, frequently the effects of the two variables are confounded. In this study (Ostrosky-Solis, Ramirez, Lozano, Picasso and Velez, 2004) we analysed the influence of education and of culture on the neuropsychological profile of indigenous and a nonindigenous population. We studied a total sample of 44 individuals divided into 4 groups: (1) 7 illiterate indigenous subjects; (2) 7 control subjects with no education; (3) 15 indigenous subjects with 1–4 years of education; and (4) 15 control individuals with 1–4 years of education. Subjects were paired by age and educational level. The indigenous population was Maya, who live in the state of Yucatan in the Mexican Republic. The NEUROPSI (Ostrosky-Solís, Ardila, and Rosselli, 1997, 1999) was individually administered. Results showed differential effects for both variables. Indigenous subjects showed higher scores in visuospatial tasks, and their level of education had significant effects on working and verbal memory. No significant differences were found in other cognitive processes (orientation, comprehension, and some executive functions). Our data showed that culture dictates what it is important for survival

and that education could be considered as a type of subculture that facilitates the development of certain skills instead of others. However, the influences of both variables on cognitive skills are different, which should be considered when assessing subjects of different cultures. The interpretation of neuropsychological tests, leading to accurate assessment of cognitive dysfunction, is dependent on both education and cultural skills.

On the other hand, the ability to read and write is important for an individual's success and survival in the contemporary world, therefore understanding the variables associated with illiteracy represents a significant task not only in developing, but also industrialized countries. It is therefore proposed that the neuropsychological profile is related to the learning to read ability. A sample of 497 adults who were learning to read and primary school programs were selected in four different Mexican states. The participants were divided into groups (normal, moderately abnormal, severely abnormal) according to their neuropsychological profile obtained from the total score of the NEUROPSI test battery. Lower scores in the abnormal groups were observed especially in motor, memory and conceptual subtests. In the memory subtests, a significantly increased frequency of intrusions was observed. Lower neuropsychological test performance was additionally associated with deficits in phonological processing. Increased left-handedness was observed in participants with abnormal scores and among those spending a longer time at school. It was concluded that even though illiteracy may be associated with a diversity of factors, two major variables can be distinguished: socioeconomic factors and learning disabilities. It was further concluded that phonological processing could be regarded as a predictor to the learning to read ability and that having the neuropsychological profile could help in avoiding individual frustration while spending many years trying to learn how to read and write before adequate diagnosis is made (Ostrosky-Solís, Ardila, Lozano, Ramírez, Picasso, González-Cantú and Lira-Hereford, 2004).

NEUROPSI ATTENTION AND MEMORY

Appropriate performance and personal adjustment in daily life requires both attention and memory; which, in turn, are indispensable preconditions for suitable functioning of other cognitive domains (Lezak, 1995). The evaluation of these processes is essential in neuropsychological assessment because impairments of these functions are some of the most common symptoms observed following brain damage in children, adolescents and adults (Larrabee and Crook, 1996; Lezak, 1995; Ruff, Light and Quayhagen, 1989; Squire and Shimamura, 1996).

Evidence of multiple attentional and memory systems is provided by experimental, neuropsychological, psychopharmacological and developmental dissociations between performances in a variety of situations. Classification of attention and memory has proved to be heuristically useful for describing specific problems (Tulving, 1987; Van Zomeren and Brouwer, 1994). Components of attention and memory are often related to each other and to other cognitive abilities as well, such as executive functions; yet the specifications and relationships among these components are not consistent, nor fully understood.

Development of attention and memory subfunctions involves a complex pattern of change, with some aspects exhibiting significant change and others exhibiting remarkable stability across the life span (Klenberg, Korkman and Lahti-Nuuttila, 2001; Plude, et al.,

1994). The scarcity of developmental studies which include a wide age range, as well as a wide spectrum of attentional and mnemonic subfunctions, restricts the comprehension of development as a continuous and complex process. Therefore, the NEUROPSI Attention and Memory was developed to measure these components across the life span, thus providing objective data for both clinical and experimental assessment.

This test was standardized with a sample of 950 non paid volunteers (Ostrosky-Solís et al., 2003). Sample age ranged from 6 to 85 years, and, in the adult sample (16 to 85 years), educational level ranged from 0 to 22 years of education. The normative sample was gropupes into nine age groups (6 to 7 years, 8 to 9 years, 10 to 11 years, 12 to 13 years, 14 to 15 years, 16 to 30 years, 31 to 55 years, 56 to 64 years and 65 to 85 years); and three educational levels: (zero to 3 years of education, 4 to 9 years of education and 10 to 22 years of formal education). For a detailed description of the sample characteristics, please refer to Ostrosky-Solís et al. (2003)

The NEUROPSI Attention And Memory (Ostrosky-Solis et al., 2003) cover the following domains: orientation, attention and concentration, executive functions, working memory, immediate verbal memory, delayed verbal memory, immediate visual memory and delayed visual memory, each having its own subtests. Each area includes assessment of different aspects of that particular cognitive domain. Thus, assessment of attention includes level of alertness, span or efficiency of vigilance–concentration, and selective attention. Executive function assessment comprises concept formation, flexibility, inhibition and several motor programming tasks. Memory assessment includes immediate and delayed recall of auditory-verbal and visual–nonverbal functioning. Word list learning includes three learning trials of 12 words. Each of the 12 items belonged to one of three high frequency semantic categories in Spanish language (animals, fruits or body parts). Delayed recall includes free and semantic cued recall, as well as a recognition trial, which includes a 24 words list, that does not contain high frequency words within each category.

It is important to point out that items were not simply translated but adapted according to frequency and relevance for Spanish-speaking individuals, for example the battery included language and picture tests that were previously standardized according to high, medium, and low frequency of occurrence in the Spanish language (Aveleyra et al.,1996). Phonological verbal fluency was evaluated using letter *P*. This letter was selected based on the ratio of words in the Spanish language starting with this letter, relative to the total number of words in a Spanish dictionary. According to this analysis, there is a good proportion of high frequency words beginning with this letter in Spanish.

Interpretation of NEUROPSI Attention and Memory follows the same reasoning of the NEUROPSI test Battery. A quantitative approach is obtained from the total score, and qualitative data from each subtest is also available. The subtests included are described in the appendix. In total, 30 different scores are obtained. The Stroop subtest (Stroop, 1935) was not used with adults having fewer than 4 years of education. In children aged 6 to 7 years and in adults having fewer than 4 years of education, the Rey-Osterreith figure (Osterreith, 1944) was replaced by the semicomplex figure (Ostrosky-Solís et al., 1999). Since data of these populations were missing for Stroop and Rey-Osterreith Complex Figure, both tests were excluded of the factor analysis, but descriptive information is presented for the remaining age and education groups.

In order to identify the developmental sequences of attention and memory, a study was carried out with normative data derived from the neuropsychological battery NEUROPSI

Attention and Memory. A sample of 521 Spanish-speaking individuals, aged 6 to 85 years, participated in this study. Nine age groups were evaluated: 1) 6-7, 2) 8-9, 3) 10-11, 4) 12-13, 5) 14-15, 6) 16-30, 7) 31-55, 8) 56-64 and 9) 65-85 years. In the adult sample, data were also analyzed within 3 different educational levels: 1) 0-3, 2) 4-9, and 3) 10 or more years of education. Data from subtests measuring orientation, attention and concentration, executive functions, working memory, immediate and delayed verbal memory, immediate and delayed visual memory were included. The developmental staging and clustering of attention and memory subfunctions suggested that although these subfunctions are related, their developmental sequences are separated from one another. The effect of education was uneven: while in some factors it proved to be particularly sensitive, in some others it was unnoticed. The consideration of both the developmental sequence, as well as differential effects of education, can improve the sensitivity and specificity of neuropsychological measures, allowing early diagnosis of cognitive dysfunction and implementation of adequate rehabilitation programs (Gómez and Ostrosky-Solis, In Press)

The NEUROPSI Attention and Memory has also been used to evaluate the effects of hormone therapy (HT). Recent reports suggest that HT with estrogen may have a protective effect on the ageing brain and cognitive function. However, clinical evidence regarding the cognitive effects after 6 months of HT in 30 early postmenopausal women, who were divided into three groups as follows: group 1, Therapy conjugated equine estrogen (ET) CEE 0.625 mg/day (n=10); group II, Estrogen-progestine Therapy (EPT), CEE 0.625 mg/day plus chlormadinone 1mg/day (n=10); and group III, the control group, who did not receive treatment (n=10). The three groups were matched by age and years of education. Exclusion criteria were: central nervous system diseases, severe cardiac disease, and clinical history of cancer and depression. Subjects were tested using a comprehensive battery for the evaluation of attention memory and executive functions, which was standardized and validated in Spanish speaking subjects. The rate of cognitive change was defined by the difference between the measurements at the sixth month minus the baseline score. Mean group differences were assessed with MANOVA, followed by one-way ANOVA considering statistical significance when $p<.05$; the alpha significance level.05 was corrected using the Bonferroni procedure. The EPT group showed higher scores than the control group and ET group in the Total Attention Score and in the copy of the Rey-Osterreith Complex figure. The ET group showed significantly higher scores than the control group and the EPT group in the subtest of spatial backward span and in the immediate face codificaction. The short-term positive effects observed with the HT in this sample could be related to the stimulation of brain receptors and/or neurotrophic factors that are still present at this age (Aveleyra, Carranza-Lira, Ulloa and Ostrosky-Solís, 2005).

CONCLUSION

In Latin America and in Spanish-speaking countries there is a need for brief, reliable, and norm-based neuropsychological instruments to assess cognitive abilities of geriatric, neurological, and general medical populations. Standardized neuropsychological instruments in Spanish are still few. Notably, Spanish is the first language for about 10% of the world population. Interestingly, the United States represents the fifth-largest Spanish speaking country in the world (Mexico, Spain, Colombia, Argentina, and the U.S.) with over

20,000,000 Spanish speakers. The tests reviewed were developed to help fill this need of the Spanish-speaking world, and eventually, it might be adapted to other languages. However, it has to be emphasized that current results were obtained in Mexico. There is, as a consequence, a limitation in generalizability of results to other populations. Furthermore, sensitivity at higher educational level has to be taken with caution, considering the ceiling effect observed in participants with over 10 years of education.

From a clinical point of view, attention and memory impairments represent the most common symptoms observed following brain damage in children, adolescents and adults (Anderson, Northam, Hendy and Wrennall, 2001; Larrabee and Crook, 1996; Lezak, 1995; Ruff, Light and Quayhagen, 1989; Squire and Shimamura, 1996). In order to provide an adequate assessment, differential diagnosis and treatment of these populations, normative developmental data is required. Even more, educative training depends on the knowledge we have about the differential capabilities along the life-span. Assessment of cognitive functions in healthy populations is essential to understand the disabilities reported after brain damage, as well as to plan effective rehabilitation programs.

In summary, the NEUROPSI and the NEUROPSI Attention and Memory may help fill the need for brief, reliable and objective evaluation of a broad range of cognitive functions in Spanish-speaking people. It is the only available Spanish instrument that provides norms across a broad range of ages and educational levels including illiterates, primary school, high school, and professional level.

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APPENDIX. DESCRIPTION OF THE BRIEF NEUROPSYCHOLOGICAL TEST BATTERY IN SPANISH: NEUROPSI

I. ORIENTATION. *Time* (day, month, and year), *Place* (city and specific place), and *Person* (age or, when were you born). Maximum score 6 points.

II. ATTENTION AND CONCENTRATION (maximum score 27).

Digits Backwards. Up to six digits. Maximum score 6 points. *Visual Detection.* On a sheet that includes 16 different figures, each one repeated 16 times, the respondents are requested to cross out those figures identical to the one presented as a model. The 16 matching figures are equally distributed at the right and at the left visual fields. The test is suspended after 1 min. Two scores are obtained: number of correct responses (maximum score 16), and number of errors. *Serial 3 Substraction* from 20 to 5; maximum score 5.

III. ENCODING (maximum score 18). *Verbal Memory.* Six common nouns corresponding to three different semantic categories (animals, fruits, and body parts), are presented three times. After each presentation, the participant repeats those words that he or she remembers. The score is the average number of words repeated in the three trials (maximum score 6). In addition, intrusions, perseverations, recency and primacy effects are noted. *Copy of a Semicomplex_Figure.* A figure similar to the Rey–Osterrieth Complex Figure, but much simpler, is presented to the participant. The participants are instructed to copy the best they can. A specified scoring system is used, with a maximum score of 12 points.

IV. LANGUAGE (maximum score 26): *Naming.* Eight different line drawing figures are presented to be named. They correspond to animals, musical instruments, body parts and objects. The names used are different from those names included in the Verbal Memory section. If the participant presents visual difficulties, an alternative procedure is used: The patient is required to name body parts and small objects placed in the hand. Maximum score 8. *Repetition.* The participant is asked to repeat one monosyllabic word, one three-syllable word, one phrase with three words, and one seven-word sentence. Successful repetition in each one is scored 1. Maximum score 4. **Comprehension.** On a sheet of paper two circles (small and large) and two squares (small and large) are drawn. Six commands, similar to those used in the Token Test are given to the participant. The easiest one is, "Point to the small square," and the hardest one is "In addition to the circles, point to the small square." Maximum score 6. *Verbal Fluency: Semantic Verbal Fluency (animals).* Two scoring systems are used: the total number of correct words; and an abbreviated 4-point scale. In the latter, 1 point is given to zero to 5 words; 2 points to 6 to 8 words; 3 points to 9 to 14 words; and 4 points to 15 or more words in 1 min. Intrusions and perseverations are noted. For the current analyses, only the first scoring system was used. *Phonological Verbal Fluency* (words beginning with the letter 'F '). Two scoring systems are used: the total number of correct words, and an abbreviated 4-point scale. One point is given to zero to 3 words; 2 points to 4 to 6 words; 3 points to 7 to 9 words; and 4 points to 10 or more words in 1 min. Intrusions and perseverations are noted. For the current analyses, only the first scoring system was used.

V. READING. Participants are asked to read aloud a short paragraph (109 words). Next, three questions about the paragraph are orally presented. The correct answer to each question is scored 1. Maximum score 3. Paralexias are noted.

VI. WRITING. This involves writing a six-word sentence to dictation, and copying a different six-word sentence. Maximum score 2. Paragraphias are noted.

VII. CONCEPTUAL FUNCTIONS (maximum score 5 10). *Similarities.* Three pairs of words (e.g., orange–pear) are presented and participants are asked to report the similarity. An example is provided. Each one is scored as zero (physical similarity: *both are round*), 1

(functional similarity: *both can be eaten*), or 2 (the answer corresponds to the supraordinate word: *fruits*). Maximum score 6. *Calculation Abilities.* Three simple arithmetic problems are presented. Maximum score 3. *Sequences.* The participant is asked to continue a sequence of figures drawn on a paper: one circle, one cross, two circles, two crosses, three circles ("What figure follows?"). Maximum score 1.

VIII. MOTOR FUNCTIONS (maximum score 8). *Changing the Position of the Hand.* Participants are asked to repeat three positions with the hand (right and left). The task is demonstrated by the examiner up to three times. A maximum score of 2 is used for each hand. Maximum score 4. *Alternating Hand Movements.* To alternate the position of the hands (right hand closed, left hand open, and to switch). Maximum score 2. *Opposite Reactions*. If the examiner shows a finger, the respondent must show a fist; if the examiner shows a fist, the subject must show a finger. Maximum score 2.

IX. RECALL (maximum score 30). *Recall of Verbal Information.* Recall of the six words presented in verbal memory. (1) *Spontaneous Recall*. Maximum recall 6. (2) *Cued Recall*. Recall by categories (*animals*, *fruits*, and *body parts*). Maximum score 6. (3) *Recognition*. The examiner reads 14 different words, and the participant must tell which ones were previously presented. Maximum score 6. *Recall of the Semicomplex Figure.* Maximum score 12.

APPENDIX. DESCRIPTION OF THE NEUROPSI ATTENTION AND MEMORY

I. ORIENTATION. General information regarding subject's orientation in time, place and person. (Maximum score = 7 points).

II. ATTENTION AND CONCENTRATION:

Auditory/verbal*: Digit forward span.* It consists of pairs of random number sequences that the examiner reads aloud, at the rate of one per second, the subject's task was to repeat each sequence exactly as it was given. (Maximum score = 9 points).

Digit Detection. This vigilance test examines the ability to sustain and focus attention. It involves the sequential presentation of digits over a period of time with instructions for the patient to tap only when the target item 5 was preceded by the item 2. (Maximum score = 10 points).

Mental Control. Requires the subject to count from 1 to 40 by 3´s within a time limit. (Maximum score = 3 points).

Visual/nonverbal: *Spatial forward span.* A board with blocks attached in an irregular arrangement. In the spatial forward span test, each time the examiner taps the blocks in a prearranged sequence, the patient must attempt to copy this tapping pattern exactly as it was given. (Maximum score = 9 points).

Visual Search. This test requires visual selectivity at fast speed on a repetitive motor response task. It consists of rows of figures randomly interspersed with a designated target figure. The subjects were requested to cross out those figures equal to the one presented as a model. Two scores were obtained: total number of correct responses (maximum score = 24), and number of intrusions.

III. MEMORY

Working Memory.

Auditory/verbal: *Digit backward span.* Pairs of random number sequences that the examiner reads aloud, at the rate of one per second, and the subject's task was to repeat each sequence in an exactly reversed order. (Maximum score = 8).

Visual/nonverbal: *Spatial backward span.* Board with blocks. Each time the examiner taps the blocks in a prearranged sequence, the patient must attempt to copy the tapping pattern in an exactly reversed order. (Maximum score = 9).

Immediate and 20 minutes delayed recall.

Auditory/verbal: *Word List.* (Three learning trials of 12 words.) Immediate trials consisted of three presentations with recall of a 12-word list. Each of the 12 items belonged to one of three semantic categories (animals, fruits or body parts). After each presentation, the subject repeated those words that he/she remembered. The total score was the average number of words repeated in the three trials (maximum score = 12). The delayed presentation provided one first free recall on the long term (20 min) (maximum score = 12). The second long term recall trial utilized the item categories as cues, asking the subject for items in each of the three categories (maximum score = 12). A recognition trial, in which the examiner asked the subject to identify as many words as possible from the list, when shown a list of 24 words containing all the items from the list, as well as words that were semantically associated or phonemically similar, was also provided (maximum score = 12 points). In addition, intrusions, perseverations and false positive errors scores were noted.

Verbal Paired Associates. Twelve word pairs, four that were not readily associated (i. e., coche-payaso), four forming phonetic associations (i. e., camión-melón) and four forming semantic associations (i. e., fruta-uva). The list was read three times, with a memory trial following each reading. The words were randomized in each of the three learning trials to prevent positional learning. The total score was the average number of words repeated in the three trials (maximum score = 12). It was provided a 20 min. delayed recall (maximum score = 12). In addition, intrusions, perseverations and errors were noted.

Logical Memory I and II. Prose learning that allows to score thematic recall and factual knowledge. The examiner reads two stories, stopping after each reading for an immediate free recall. Each story contains 16 story units and five thematic units. A delayed recall trial after 20 minutes was also given.

Visual/Nonverbal: *Rey-Osterreith Complex Figure / Semicomplex Figure.* In the copy administration subjects were shown a nonsense figure which they must copy. A delayed recall was also provided in which subjects were asked to recall what they had drawn on the administration trial. (Maximum scores = 32 in Rey-Osterreith Complex Figure, 12 in Semicomplex figure).

Faces. On the immediate trial subjects were shown two photographs with their respective names. After seeing each of them for five seconds, subjects were asked to repeat the names (maximum score = 4 points). On the delayed recall subjects were asked to remember the names of the persons (maximum score = 8 points) and to identify the previously shown persons among a set of four photographs (maximum score = 2 points). In addition, false positive errors were noted.

IV. EXECUTIVE FUNCTIONS

Category Formation Test. Five visually presented sets, each one containing four figures of common objects. Each set was organized on the basis of different principles. On each set trial the subjects were asked to form as many categories as they could. (Maximum score = 25).

Verbal Fluency. Measures the quantity of words produced within a time limit of one minute and consists of a semantic as well as a phonological trial. On the semantic trial subjects were required to generate items in a category (animals), whereas on the phonological trial subjects were required to generate words according to an initial letter ("P"). Total number of correct words, intrusions, perseverations, clusters and switchings were noted in both tests.

Design Fluency. The subject was instructed to draw different patterns by connecting the dots in each five-dot matrix using four lines. Subjects were given three minutes to perform this test. Total number of correct designs, intrusions and perseverations were noted.

Motor Functions.

Conjugate eye movement. **A pencil was shown to the subject** and he/she has to follow it with his eyes to the left and then to the right. (Maximum score = 4 points).

Conflicting commands. The instruction was: "Tap once, when I tap twice; tap twice when I tap once". (Maximum score = 2 points).

Go/No-Go. The instruction was: "Tap twice, when I tap once, but when I tap twice, don't tap at all". (Maximum score = 2 points).

Luria's Hand sequences. The examiner with his right hand made a fist, then extended his fingers, holding his hand horizontally and finally turned his hand by 90^0 with the extended fingers still pointing forward. After seeing this sequence of movements, subjects with their

right hand must repeat it exactly as it was given. In a second trial the examiner repeated the sequence in an exactly reversed order with his left hand and subjects must repeat it with their left hand, exactly as it was given. (Maximum score = 4).

Alternating pattern. Copy of a drawing without lifting the hand from the paper. The test required alternating between peaks and blocks. (Maximum score = 8).

Stroop Test. Subjects were required to read, as fast as they could, a set of color words printed in black ink. On the second trial, subjects were required to call out, as fast as they could, the color names of colored ovals. On the third trial subjects were asked to call out, as fast as they could, printed color names when the print ink was in a different color than the name of the colored word. In the three trials, the total number of correct answers and the time employed to perform each trial were noted (maximum score = 36).