Development of The Multicultural Neuropsychological Scale (MUNS): A New Tool for Neuropsychological Assessment of Culturally Diverse Populations

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ABSTRACT

Objectives: The purpose of this study is to describe the development of the Multi-cultural Neuropsychological Scale (MUNS). Methods: This is a short scale devised with universal stimuli which are easy to translate into different languages. It consists of 7 subtests evaluating five cognitive domains: attention, memory, executive functioning, constructional praxis and language and was applied to 72 adults of both sexes in an educational range between 1 and 20 years of education. Results: Age correlated with memory subtests (range= -0.28 to -0.32); and education was correlated with memory (range= 0.37 to 0.49), constructional praxis (0.44), language (0.59) and attention (0.25). There were no significant differences between males and females. Conclusions: The MUNS appears as a short, portable, and user-friendly tool to assess neuropsychological functioning in adults with low and high education. Future studies remain to be conducted in order to demonstrate its cross-cultural validity.

Keywords: cross-cultural-test-neuropsychology

1. INTRODUCTION

The neuropsychological assessment of culturally diverse individuals is a topic of growing concern. A globalized world, social conflicts and the quest for better economic opportunities have created a huge and constant migratory movement. According to the United Nations, in 2015 there were 244 million migrants in the world. The majority of them (43%) were born in Asia [1]. Most of the current neuropsychological tests are inappropriate to assess migrants who have been raised and educated in a culture different to where most of these tests have been developed, especially non-Western cultures [2]. Some of the classic tests like the Trail Making Test (TMT) include stimuli that are particular of some cultures like Latin alphabet letters. The Boston Naming Test includes pictures of a beaver or a pretzel, which are little known by many individuals living outside the United States of North America. Many of the current tests are timed, which is inappropriate for the assessment of low educated individuals [2, 3]. Low educated population (no more than lower secondary education) comprises one-third of migrants [4].
A common solution to mitigate these problems was to adapt the tests to the target culture [5, 6, 7]. Although this has been a satisfactory solution in some circumstances, adapting tests presents problems because of the vast amount of work necessary to adapt a basic battery as well as the significant financial cost necessary for this endeavor, which are not available in many countries [8]. Furthermore, how can a test be adapted and normed for a population of immigrants in a given country if that population is considerably small? Therefore, the development of cross-cultural tests (CCT) has offered a different approach [9]. These tests have been developed in such a way that they need little adaptation or no adaptation at all. They are developed using stimuli that are common to most of the cultures such as everyday objects (eggs, coffee, sun, moon, etc.) and few verbal items to avoid translation difficulties. The Rowland Universal Dementia Assessment (RUDAS) [10] is one of the most successful examples. This is a very brief test, developed for dementia screening that contains culture-fair items. RUDAS has demonstrated a high sensitivity across multicultural samples [11]. Another good example of a CCT is the Cross-Cultural Dementia Screening (CCD) [12]. This is a short test (20 minutes approximately) which does not require reading or writing skills and evaluates memory, mental speed and inhibition and divided attention. However, for the most part, these tests are aimed at dementia assessment and are appropriate for the elderly, but very little has been done as regards adults and children. Besides, length is one of the limitations of these tools: some are too short and others are too long.

The purpose of this study is to describe the development of the Multi-cultural Neuropsychological Scale (MUNS). The MUNS is a short scale devised with universal stimuli which are easy to translate into different languages. It is aimed at an adult population (>14 years old) and consists of 7 subtests evaluating five cognitive domains: attention, memory, executive functioning, constructional praxis and language.

2. METHODS

Procedures

As mentioned before the MUNS evaluates five cognitive domains: attention (2 subtests), memory (1 visual and 2 verbal subtests), executive functioning (1 subtest), constructional praxis (1 subtest) and language (1 subtest) (see Table 1). After the administration of several cases it was observed that the Footsteps & Honks (FH) subtest proved to be very difficult for low educated (LE) individuals and rather easy for high educated (HE) subjects, therefore it was discarded. However, the FH was administered to all the subjects in order to maintain a standard administration procedure. The subtests are described in Table 1. Most of the materials and instructions are included in a stimulus book. Only five additional answer sheets are needed for the Party (P), Visual Memory (VM, immediate and delayed) and the Points & Lines (PL) subtests.

<table>
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<th>Table 1: MUNS subtests description</th>
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| The version for LE comprises 10 words while for HE contains 14 words. All the words included in this list were taken from the Swadesh list, which is a lexicostatistical list that represents the Basic Core Vocabulary existing in any language [13]. They belong to two semantic categories (natural elements such as wind or cloud, and body parts). The examiner reads the list for three learning trials. A delayed free recall trial is given after 20 minutes. A recognition trial follows the free recall. One point is given for each correctly remembered word. Three scores are obtained: Immediate (learning trials 1-3), Delayed and Recognition (individuals are presented with a list containing the learning trials words and distractors. Subjects must recognize the words in the learning trials list).

2) The Character Information subtest (CI). In this verbal memory test a short paragraph with personal information about a fictitious character is read to the testee whose task is to remember this information. Words for the information were also taken from the Swadesh list. There is not an immediate trial but a delayed free recall trial after 15-20 minutes and a cued recall trial with questions about the information that the testee did not remember spontaneously. One point is given by each element correctly remembered. Two scores can be obtained: Spontaneous Recall and Cued Recall.

3) The Visual Memory subtest (VM). This subtest consists of a series of 4 pictures of universal elements (flower, leaf, hand, building, see Figure 1). The pictures are divided in several sections and some of them are filled. Subjects are shown the picture for 10 seconds and immediately after the picture is removed they are presented with the same picture but with all the sections in blank. The task of the subjects is to fill in the blanks as shown in the previous picture. There is an immediate and a delayed essay. To obtain the score incorrect answers are subtracted from the maximum score (72 for the immediate essay and 36 for the delayed).
4) The Arrows subtest (Arr). This is an attention subtest with two parts: in part I a series of pictures containing arrows pointing at different directions are shown every two seconds. The testee must count the arrows pointing to the right. In part II the subject has to count arrows pointing up and to the left. The LE subjects are asked to carry on a single account (adding both arrows), while HE individuals are asked to keep two separate accounts. One point per correct item is given.

5) The Footsteps and Honks subtest (FH). This is an attention subtest with two parts: in part I a sound recording of footsteps is presented. The task is to count the footsteps. In the second part the recording includes footsteps, honks and distracting sounds. The task is to count steps and honks in separate accounts. Incorrect answers are subtracted from the maximum score.

6) The Party subtest (P). In this executive functioning test the subject is given a sheet containing a map of a fictitious downtown. In the map there are marked spots indicating shops where the following items can be purchased: food, drink, silverware, table, chairs and dessert. There is more than one option where to buy these items and the price in number of coins (indicated beside each item) is different for each one. Subjects are asked to buy one item of each category trying not to exceed a 100 coins budget. In addition, the subjects have to indicate with a line in the map the route that they will take to buy all these items. They are asked to take the shortest possible route. The number of items purchased, the number of blocks traveled as well as the amount of money they saved are scored.

7) The Points and Lines subtest (PL). In this visuoconstructional praxis subtest subjects are shown four designs comprised of a set of points that are connected with lines. Their task is to copy the figure in a set of points that are adjacent to the design. The number of correctly connected lines is scored.

8) The Animals Fluency test (AF). In this case subjects are asked to produce as many animals as they can in a two minutes period time. The two minutes period was selected on the basis that names of animal differ in their length across languages. One point per item is given.

Four out of the seven subtests have two versions depending on the educational level of the testee: LE (up to 7 years of school), and HE (more than 7 years). The development of different versions for LE and HE individuals was based on the sound previous research showing that LE individuals have difficulty to solve some of the current tests [3, 14]. This usually produces a floor effect of their performance. The two versions differ in extension (verbal memory and executive functioning subtests) or in the cognitive load (attention test). Pilot trials were run in order to determine the extension and difficulty level for each version. For example, on the Word List (WL) subtest, subjects with LE are presented with a 10 words list, while the HE individuals are asked to remember 14 words. For the Character Information (CI) subtest, LE subjects are presented with a story containing 10 items of information about a fictional character, while the story for HE individuals contains 15 items. In the P test LE subjects are presented with fewer options of items to purchase: while HE subjects are given three options per item, LE individuals are given just two. Statistical analysis were performed with the Statistica software package.

Figure 1: Examples of items of the visual memory test

Sample
The MUNS was administered to 72 Argentinian adults of both sexes (65% female) and an educational range between 1 and 20 years of education ($\bar{x} = 9.1 \pm 4.1$), who gave their consent to participate. The MUNS was also administered to a subject who was illiterate, but he was not amenable to testing, therefore he was not included in the analyzed data. The age range was 15-87 ($\bar{x} = 34.54 \pm 19.3$). Several subjects from a rural area were included in the sample. Individuals were excluded from participation if they had any history of neurological disease, psychiatric diagnosis, diabetes, head trauma, stroke, heart attack, non-controlled high
blood pressure, coma, drug intake, alcoholism, sleep disorders, learning disabilities or chronic headaches.

3. RESULTS

Overall, subjects understood the instructions and were able to perform the tasks, even the elderly with very low education. On average, administration took between 30 and 40 minutes.

In order to equate the score ranges between educational groups all scores were transformed to percentages. For the Animal Fluency (AF) subtest a hypothetical maximum of 60 points was set in order to obtain the percentage. The subtests scores were added to compose the total score (TS). Different ANOVA analysis, in which the educational level (high-low) was the independent variable, showed that the mean scores for each subtest for which the activities were different according to the educational group were not significantly different across groups, except for the P test. To correct for this difference a slightly different scoring scale was used with the LE group. Differences on the P test were not significant after this correction. Therefore, each version of the test represented the same level of difficulty for each group. Mean and standard deviations for the entire group on each subtest were as follows: AF= 43.9 ± 14, WL-immediate (essays 1-3) = 58.8 ± 12, WL-delayed= 62.3 ± 19.7, CI 52.7 ± 18, VM immediate= 80.2 ± 9.8, VM delayed= 76.7 ± 11.5, Arrows (Arr)= 78.5 ± 14.8, PL= 96.3 ± 13.8, P= 79.3 ± 7.9, TS= 628.7 ± 71.1. The Shapiro–Wilk W-test for normality of the TS score was non-significant (p = 0.06), indicating that the distribution can be considered normal (15). However, the same normality test indicated that the WM-delayed, Arr, PL, and P subtests were negatively skewed.

Age and education were not significantly correlated. Age had a significant correlation with immediate (-0.32) and delayed VM (-0.32), the Recognition trial of the WL (-0.28), the Delayed trial of the WL (-0.27) and the TS (-0.24). Education was significantly correlated to the performance on the following subtests: AF (0.59), VM immediate (0.49), VM delayed (0.37), Arr (0.25), PL (0.44) and TS (0.52).

However, these correlations changed when low and high education groups were analyzed separately. In the LE group (n= 31) education correlated significantly with WL-immediate (0.39), WL – delayed (0.41), CI (0.45), VM immediate (0.44), Arr (0.52), PL (0.82), P (0.40) and the TS (0.78). In the HE group (n= 41) it correlated with AF (0.48), WL – immediate (0.32), VM immediate (0.34), VM delayed (0.38), Arr (0.46) and the TS (0.54).

An ANOVA confirmed that there were no significant differences in the performance between males and females, F(1, 70) = 0.11, p=0.75.

4. DISCUSSION & CONCLUSION

The MUNS uses stimuli that are common to many cultures in the world, for instance, a leaf, flower or hand for the VM subtest (see Figure 1) or the Swadesh list for the WL and CI subtests. Therefore, it might be an appropriate option for cross-cultural use. However, empirical data is necessary to support this hypothesis. The fact that individuals from rural areas with LE were able to follow the instructions without difficulties and cooperated during the process is a very positive outcome since this is usually a population to which it is difficult to administer many of the tests currently in use [3, 14].

The use of a different version of the same subtest for the assessment of different educational groups is particularly useful in environments where neuropsychology is not well developed and many of the clients are LE. As expected, education had a powerful influence on several subtests. However, the different correlations across the educational groups question about the expression of the different constructs across these groups. For example, when examining these data it seems that the influence of education on the constructional praxis is very powerful during the initial segment of the range, i.e. among LE individuals, and less important in HE subjects. However, verbal fluency (AF subtest) seems to have a more significant effect among HE subjects. These findings have been observed in other studies [14]. Ostrosky-Solís et al. [16] found very similar results. In their research there is a significant difference in the performance on semantic fluency between the LE groups (less than 5 years) and the HE groups (more than 4 years), but not between the LE groups. Likewise, the performance on the figure copy changes significantly among the LE groups and shows a very slight change among the HE groups.

The use of percentages as the score for each subtest represents a very practical feature since allows the use of a common scoring system for both educational groups despite the use of different stimuli. This characteristic allows a simple scoring procedure. Moreover, it allowed testing the influence of age and education in the entire sample, even when the raw scores where different for HE and LE individuals. In
addition, because the level of difficulty was similar in those subtests where different versions where administered (depending on the educational level of the individual), might allow in the future the use of a common cut-off score for both groups.

The normal distribution of the TS score is another positive outcome since it allows a better discrimination of the subjects who perform at both ends of the continuum. The negative skew of the PL was expected since most subjects perform at the upper level in this kind of tests. The WM-delayed, Arr, and P subtests seem to be not very demanding tests. Altogether these data suggest that the performance of a given subject on the MUNS should be analyzed by looking at the individual subtests scores and not only at the TS score.

Age influenced most of the memory scores. The influence of age on memory tests has been repeatedly reported in previous studies [17]. Interestingly, age did not significantly affect the performance on the executive functioning subtest. This is probably the result of the specific characteristics of this subtest which mainly measures planning skills. Another study in which a similar test was used (the Multiple Errands Test) did not yield any significant correlations between age and the test score [18].

Because of its features the MUNS should be especially useful in environments where neuropsychology services are limited and for screening purposes or the assessment of immigrant populations where neuropsychological assessment is well developed. Furthermore, given it uses universal stimuli and few verbal items it should be easy to translate and apply in different languages. The MUNS is a rather short scale that can provide information on five cognitive domains but with a heavy load on memory since this is one of the most vulnerable cognitive domains in many conditions affecting the brain [19, 20]. Despite its brevity it can provide more information than other cross-cultural screening tests such as the RUDAS or the CCD. Because of this the MUNS results in a longer scale that requires more training to administer it. However, these data were collected by students who, on average, underwent six hours of training.

Thus, clinicians who have to assess immigrant clients can have a short, easy to translate, portable and simple to administer test that can provide them with at least, minimal objective data on the cognitive performance of their clients. Nevertheless, because this is a preliminary report no information is provided in this article about norms, validity or reliability. Based on the classic format of some of the subtests (word list, information about a character, etcetera) and the normal distribution of its score, it might be predicted that their validity will be appropriate. However, empirical data is necessary to support this prediction. These studies are currently in progress and their results will be reported in future articles.

**REFERENCES**


**FUNDING**

This research was founded by grants of the Catholic University of Córdoba and the Science and Technical Secretary (SECYT).

**ACKNOWLEDGEMENTS**

We would like to thank the colleagues and students who participated in the data collection in different stages of this study. Among them I would like to highlight the contributions of Julián Rubbiolo and Camila Batistella. I would also like to thank Marc Norman Ph.D for his generous and thoughtful revision.

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**To Cite This Article:** Alberto Luis Fernández, Gabriel Jáuregui Arriondo, Maximiliano Folmer, Valentina Seita, Gabriel Ciariimboli, Candelaria Aimar. Development of The Multicultural Neuropsychological Scale (MUNS): A New Tool for Neuropsychological Assessment of Culturally Diverse Populations. *International Annals of Medicine, 2018;2(8).* https://doi.org/10.24087/IAM.2018.2.8.594


