Journal of the International Neuropsychological Society (1998), **4**, 363–379.

Neuropsychological comparisons of Spanish-speaking participants from the U.S.–Mexico border region *versus* Spain

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(Received April 30, 1997; Revised October 29, 1997; Accepted November 13, 1997)

Abstract

Two samples of participants from the U.S.–Mexico Borderland ($N = 185$) *versus* Spain ($N = 205$) were compared on 16 Spanish-language neuropsychological measures. In most measures the two samples obtained similar results. There were some significant main effects of place of birth and some significant interactions between education and place of birth. Differences between the samples diminished with increasing levels of education. Within the Borderland sample, percent of life span spent in the U.S. and bilingual status were correlated with performance in some tests. Increased percent of life span spent in the U.S. was negatively correlated with performance on a Spanish word-generation task, and positively correlated with performance on the Wisconsin Card Sorting Test. Bilingual Borderland participants performed significantly better than monolingual speakers in learning a list of words. We suggest that the most likely causes for the observed interaction effects are documented regional differences in early SES-related nutrition, medical care, quality of educational experiences, and general socioeconomic conditions. (*JINS*, 1998, *4*, 363–379.)

Keywords: Borderland, Spanish, Neuropsychology, Place of birth, Bilingualism

INTRODUCTION

During the past few years, neuropsychological research and test development have begun to address the needs of Spanish-speaking populations. Some examples of research efforts include normative and standardization studies with Mexican participants in Mexico City (Ostrosky-Solís et al., 1985), Colombian subjects in Bogota (Ardila et al., 1994), and monolingual Spanish speakers in Los Angeles (Pontón et al., 1996). Within the U.S., studies have addressed the verbal and nonverbal memory of normal Spanish-speaking bilinguals raised in the U.S. and Mexico (Harris et al., 1993, 1995), and cognitive functioning in Los Angeles and Miami Hispanics who have a dementing illness (Loewenstein et al., 1995; Taussig et al., 1992). However, comparisons between Spanish-speaking groups from different regions have not, as yet, emerged. Thus, it is not clear whether research findings and normative standards generated with one Spanish-speaking group can be generalized to others.

To help address this question, two studies were undertaken in order to (1) compare the neuropsychological functioning of normal adult Spanish speakers in Spain versus the Borderland region between Mexico and the U.S., and (2) explore the possible contributions of unique sociocultural factors on neuropsychological tests in U.S.–Mexico border region residents.

There are several reasons to suspect that there may be significant neuropsychological differences between Spanish-speaking populations in different geographic regions.

Socioeconomic Differences

The socioeconomic variations within and between the Spanish-speaking nations are extremely wide, and this is particularly true of Mexico and Spain. For example, in 1992, the estimated average wage in manufacturing industries was approximately \$1.96 U.S./hr in Mexico, and \$11.34 U.S./hr in Spain (Nacional Financiera, 1992; United Nations, 1994).

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https://doi.org/10.1017/S1355617798003634 Published online by Cambridge University Press

Educational Differences

Differences also exist in education. The percentage of the total population age 25 years and over who have completed less than 1 year of schooling is significantly higher in Mexico (18%) than in Spain (5%; Reddy, 1994). Only 59 to 70% of Mexicans who start school actually complete primary school, and only 16% of the students who enter the education system eventually complete 12 years of education (*preparatoria*; Puglisi, 1995; United Nations Childrens' Fund, 1994). Conversely, 94% of children in Spain finish primary school (United Nations Childrens' Fund, 1994). Similarly, the illiteracy rate among 15-year-old and older individuals is estimated to be considerably higher in Mexico (12.7%) than in Spain (4.6%; Reddy, 1994). The school dropout rates in Mexico are attributed to family economic factors: both in rural and urban Mexico, parents need children to contribute to family income (Lorey, 1995).

The *nature* of one's educational experiences might also influence subsequent performances on cognitive tests (Neisser et al., 1996). The functions and structures of institutions as well as teachers' expectations and teaching methods are shaped by the larger socioeconomic and cultural context in which they are embedded (e.g., Albaladejo et al., 1994; Langdon, 1992; Reys & Reys, 1995). Although such experiences are likely to vary significantly both within and between geographic areas, some generalizations are possible and have been documented in the literature (e.g., Albaladejo et al., 1994). The Mexican education process appears to resemble the Spanish system. In both Mexico and Spain, the educational systems put considerable emphasis on rote learning of historical and scientific information (Langdon, 1992). Students typically go to class to listen to the teacher, and classroom participation is not emphasized. In the U.S., there is greater emphasis on classroom participation, problem solving, and social studies.

Available evidence suggests that low quality of education and dropout rates in both urban and rural schools are serious problems in the Mexican education system (see Lorey, 1995; Palafox et al., 1994). The majority of Mexican immigrants to the U.S. come from rural areas of Mexico (Lorey, 1995), where the quality and infrastructure of basic education is weakest (Lorey, 1995; Palafox et al., 1994).

Health Differences

Important gaps between Spain and Mexico are evident in terms of resources devoted to health services (promotion, prevention, and rehabilitation), with Spain greatly outperforming Mexico in (1) overall amount of money spent on health care (U.S. $21.19 *vs.* U.S. $0.99 per person per year, respectively; Reddy, 1994); (2) availability of human resources (e.g., 1 physician per 257 *vs.* 885 persons, respectively; Famighetti, 1995); and (3) service infrastructure (e.g., 1 hospital bed per 234 persons in Spain *vs.* 1 hospital bed per 1,367 persons in Mexico; Famighetti, 1995, pp. 800–801 and 820–821).

Illiteracy and poor socioeconomic and public health infrastructure also are factors often associated with malnutrition (Cravioto & Arrieta, 1982). In Mexico, where malnutrition has been considered to be the leading health problem (Instituto Nacional de la Nutrición, 1985/1990), protein-calorie deficiencies and anemias account for approximately 13 and 5%, respectively, of the registered deaths within the population (World Health Organization, 1993). This is in contrast with the situation in Spain where the rates of deaths attributed to these same factors are 0.2 and 2.1%, respectively (World Health Organization, 1993).

Culture and Acculturation

There has been substantial activity over the past three decades in the area of cross-cultural research. However, the term "culture" has a number of meanings, and may be comprised of more than one variable. *The New Lexicon Webster's Dictionary* (Cayne, 1988) offers the following distinct definitions: (1) the training and development of the mind; (2) the refinement of taste and manners acquired by such training; (3) the social and religious structures and intellectual and religious manifestations etc., that characterize a society. Hence, there appear to be two broad definitions of culture. The first one incorporates the notions of training, education, and improvement. This definition would include familiarity with testing procedures in general and test taking attitudes, and is likely to be confounded in the general "education" factor used in neuropsychology. The second definition refers to culture as a set of customs; social, intellectual, and religious. Culture as a set of customs that characterize a society can and frequently does coexist with those changes that can be brought about by exposure to various forms of intellectual endeavor such as those encouraged by Western-style schooling. Thus, a professional from Asia may have obtained the highest possible level of medical education in a Western medical college, becoming thoroughly familiar with Western-style testing procedures. Yet the religion she practices, the foods she eats, and the family traditions she follows may be similar to those of her less educationally privileged parents. Her ability to successfully perform on tests of cognitive ability is likely to be highly affected by her formal education. Yet, provided that the tests used are free of material to which she is unlikely to have been exposed either through personal or educational experience, her religion, the food she eats, or the social customs she follows should have no significant relevance to cognitive test performance. We argue that while customs are a crucial aspect of research in clinical and social psychology, sociology, and some branches of anthropology, they only play a role in cognitive testing if we chose to load the material used for testing with information that is familiar to a certain group and not to others.

We think that in constructing neuropsychological instruments, it is possible to exclude material that may bias the tests along dimensions of social, religious, culinary, or other customs that may be specific to a distinct group of people.

https://doi.org/10.1017/S1355617798003634 Published online by Cambridge University Press

By excluding such material it may be possible to study populations that are similar along some dimensions (e.g., language) and different along others (e.g., geography, economic status, education), without adding the confound of customs. However, it is not possible to control for those aspects of the term "culture" that are confounded with formal, Western-style schooling.

The term acculturation describes the degree to which a person identifies with a culture's customs, social practices, beliefs, and language (Arnold et al., 1994). Effects of acculturation on neuropsychological performance have been investigated in Hispanics within the U.S. For example, Arnold et al. (1994) assigned participants to different acculturation groups based on a unidimensional continuum and found a significant effect for acculturation on several neuropsychological measures.

We find the concept of acculturation quite elusive, and we think it is unlikely to be unidimensional. For example, the issue of bilingualism as an acculturation variable is complex. On one hand, as people spend more time in a host country they are more likely to become bilingual. This, however, assumes the maintenance of the language of origin. In fact, Hispanics within the U.S. frequently do not maintain bilingual status and tend to lose proficiency in their language of origin to a significant degree (Artiola i Fortuny & Mullaney, 1997; López, 1978). Therefore, if individuals have become assimilated to mainstream culture, it is possible that they no longer possesses native-like knowledge of Spanish and, to a lesser extent, aspects of their culture of origin. However, others may function equally in both cultures because they have painstakingly maintained contact with and practice of their culture of origin while acquiring a new one. In this research, we investigated two aspects of "contact with a country other than one's own" that could be easily quantified:

1. *Residence and education in the U.S.*: Amount of time spent in a country other than one's own is easily quantified. It is also arguably a measure of assimilation to the new culture. While the effects of foreign residence on the language of origin are tangible and subjectively identifiable (slower access to lexicon of origin, interference with language of environment, misuse of syntax) the potential effects of foreign residence on other aspects of cognition (i.e., problem solving, mental flexibility) are not as readily identified.

2. *Bilingualism*: While early work (19th Century to the 1960s) in the area of bilingualism supported the negative view that bilingualism is detrimental to cognition, more recent work suggests that bilinguals have superior general creative thinking skills when compared to monolinguals and individuals who possess very different levels of competence in the languages they speak (Baker, 1993; Peal & Lambert, 1962). There are reports suggesting that in some aspects of language functioning, such as speed of lexical access, bilinguals may be at a disadvantage compared to monolinguals (Ransdell & Fischler, 1987, 1989). This may be secondary to frequency of using a foreign language and code switching (Fernández & Nielsen, 1986). Research generally indicates that fluent bilinguals have better metalinguistic abilities than monolinguals (Bialystock, 1991; Galambos & Hakuta, 1988). We hypothesized that bilingualism within the sample tested in North America would be associated with better neuropsychological performance in general.

The present studies were conducted within the framework of a normative research program with two populations from two geographically distinct areas: metropolitan Madrid, Spain, and the Borderland of the U.S. and Mexico. The goal of our first study was to determine whether performances on selected neuropsychological tests are comparable in these two linguistically similar but geographically and socioeconomically distinct populations. Our second study addressed the Borderland sample only. We explored factors that are unique to that sample with regard to place of education, residence, and bilingualism, and which may help explain anticipated place of birth differences.

METHODS

Research Participants

The samples for the present study were selected from normal community volunteers residing in the metropolitan area of Madrid, Spain ($N = 218$), and the U.S.–Mexico Borderland area ($N = 200$), which included Tucson, Arizona, and Nogales and Agua Prieta, Sonora, Mexico. The normative sample includes individuals between the ages of 15 and 76 years, with zero to 20 or more years of formal education. The present study excluded all individuals below the age of 18 because many of the participants below that age had not yet completed their education. Henceforth, we will refer to these study samples as *Spanish* and *Borderland*, respectively.

A substantial number of our Borderland participants are immigrants to the U.S. who have resided in the United States for various periods of time. Participants in our Borderland sample include the following:

1. Mexicans who live within Mexico, in close proximity to the border with the U.S. (*fronterizos*). Tens of thousands of *fronterizos* hold jobs on the U.S side (Martínez, 1995). These individuals experience varying degrees of exposure to U.S culture through work, family ties, tourism, and consumption of U.S products such as television and music.

2. Mexican-Americans who live in the U.S. and for whom length of residence and number of years of education in Mexico vary. Individuals who have lived longer in the U.S. generally are more assimilated to the mainstream culture than are more recent immigrants (Martínez, 1995). However, this assimilation also depends on variables associated with personal and societal circumstances.

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In general, the Spanish sample can be considered strictly an urban population, while the Borderland sample is composed of suburban and smaller city dwellers. None of our participants resided in strictly rural areas.

Participant recruitment specified paid participation, and was achieved through social groups, flyers, and word of mouth. All of the participants included in the research were asked to read and sign an informed consent form. Illiterate participants were read the consent form. When necessary the content of the form was explained in detail, until it became clear to the test administrator that the participant understood. All participants were carefully screened *via* structured interview, and excluded if they met any of the following criteria:

A. History of past significant neurological history (e.g., cerebrovascular accident, epilepsy, past head trauma with loss of consciousness greater than 30 min, neoplastic disease, and significant exposure to neurotoxic agents).

B. Use of psychoactive medication suggesting ongoing neurologic or active psychiatric illness. However, medication for other medical conditions was not an automatic exclusionary factor.

C. Chronic medical conditions such as diabetes, hypertension, etc., only when cognitive problems were reported.

D. Complaints of current cognitive or emotional difficulty suggesting disorders with potential neurobehavioral effects.

E. Substance abuse if the participant reported significant related problems, including history of family–legal–employment difficulties, or admission to a treatment center.

F. A reported history of difficulty with the acquisition of reading, writing, or arithmetic skills requiring special remedial services where available. Seven participants with fewer than 5 years of education reported problems learning how to read and write. On further questioning, they said they had problems because they had not gone to school long enough. None of them remembered having any more trouble reading and writing than their schoolmates. We did not feel justified to exclude them from the study.

In addition, to be included in this study potential participants had to claim Spanish as their first language *and* demonstrate native fluency in Spanish. These latter criteria were assessed by the following methods:

1. Oral administration of a 15-item questionnaire that included items regarding the participant's contact with Spanish *versus* English on a daily basis (e.g., "At home, when you speak with your relatives, you speak in (a) Spanish only; (b) mostly Spanish and a little English; (c) in both languages equally; (d) mostly in English with a little in Spanish; (e) all in English"). Participants were excluded if they *favored* the use of English in more than 3 out of the 15 activities of daily living addressed through the questionnaire.

2. Assessment of oral fluency in Spanish by an educated native speaker of Spanish (at least 16 years of education in a Spanish-speaking country) during initial interview. Participants who produced syntactic errors or showed significant English interference on fluent speech were excluded.

It was important to exclude individuals whose Spanish did not meet the criteria for native fluency, as it was our intent to avoid the possibility of biasing the group comparisons through the use of participants who may identify themselves as Hispanics but who are not proficient Spanish speakers (Artiola i Fortuny & Mullaney, 1997). For those individuals who demonstrated Spanish fluency and reported additional English fluency, English competence was established through two different methods: (1) assessment of oral fluency in English by the examiner during initial interview; and (2) *a posteriori*, through the participant's results in a test of English fluency (Controlled Oral Word Association Test; Benton & Hamsher, 1989).

Participants who produced syntactic errors *or* showed significant Spanish interference on fluent speech *or* generated fewer than 29 words in the COWAT were assigned the label *monolingual Spanish speaker*. The cutoff point of 29 words was selected because it is approximately 1 standard deviation below the mean obtained by an elderly English-speaking sample with fewer that 12 years of education (Spreen & Strauss, 1991), and therefore we thought this cutoff point would allow inclusion of individuals of any age generating "normal" results relative to monolingual English speakers. Thus, bilingualism is defined here as the ability to alternately use two languages according to the criteria specified.

Our Borderland sample is subject to the possible effects of a number of factors that could globally be described as acculturation. We focused on measurable variables that can be teased away from the acculturation concept. We identified three relatively easy to measure variables that may impact on neuropsychological performance: bilingualism, percentage of education obtained in the U.S. (ED–US), and percentage of life span spent in the U.S. (RES–US). The extent to which the variables ED–US and RES–US yield similar effects is not known.

Test Development

The tests selected for this study have been adapted from standard English versions that are widely recognized as valuable neuropsychological assessment tools as described in a number of sources (e.g., Heaton et al., 1991; Lezak, 1995; Spreen & Strauss, 1991). They were selected to be used as a relatively short battery with emphasis on attention, learning and memory, and executive functioning. Administration of both verbal and nonverbal tests in the present study

https://doi.org/10.1017/S1355617798003634 Published online by Cambridge University Press

was conducted according to instructions adapted from the original English language instructions described in their respective manuals. Clarifications were added to the original English language instructions when they were deemed necessary for appropriate conveyance of the meaning of instructions, as determined through initial pilot studies with samples of native Spanish speaking volunteers from different countries. Test measures used in this study are listed in Table 1.

Nonverbal tests

Item content of nonverbal tests was not changed from the English versions (other than translations of instructions). The following nonverbal tests were used:

1. *Figure Memory Test*: The Figure Memory Test is a 21-item test of nonverbal memory that has separate components of learning efficiency (based on one to five learning trials), delayed retention (based on a 1-hr delayed recall trial), and recognition (based on a 36-item yes–no format). The Figure Memory Test is described by Heaton et al. (1991). The only procedural aspect of the original Figure Memory Test that was altered was the delayed recall trial: The Heaton et al. (1991) Delayed Memory component is based on a 4-hr delayed recall trial; ours is based on a 1-hr delayed recall trial. The Recognition component of the Figure Memory Test is identical to the procedure developed by R.K. Heaton and D. Delis (personal communication, November 1993). For the current study we present results for the following: *Learning Score* (defined as the score obtained in the last learning trial divided by the number of learning trials administered), *Savings Score* (defined as the percentage of information remembered at the last learning trial that is recalled after a 1-hr delay), and *Discriminability* (defined as 1 minus the coefficient obtained from dividing the sum of delayed recognition format false positives and misses by 36, multiplied by 100).
2. *Visual Span Test*: The Visual Span Test is structurally and procedurally identical to the Spatial Span Test described in the WAIS–RNI, and uses the WAIS–RNI Spatial Span Board (Kaplan et al., 1991). The test provides a visual analog to Digit Span in which participants repeat increasingly longer tapping sequences in forward and backward order presented by the examiner on the Spatial Span Board. We present results (total number of correctly recalled sequenced) for the separate scores on Visual Span Forward and Visual Span Backward.
3. *Wisconsin Card Sorting Test (WCST)*: Both the manual (Heaton et al., 1993) and Psychological Assessment Resources' computer versions of the test were used. We have demonstrated that for a normal Spanish-speaking population these two versions of the test produce essentially equivalent results (Artiola & Heaton, 1996). Here we present results for two of the WCST measures: Perseverative Responses (WCST–PR) and Number of Categories Completed (WCST–Ca).

Table 1. List of test measures and independent variables

Test	Measures
Figure Memory	Learning score Savings score Discriminability
Story Memory	Learning score Savings score Discriminability
Oral Fluency	Total of *P*, *M*, and *R*
Digit Span	Forward Backward
Visual Span	Forward Backward
Wisconsin Card Sorting Test	Perseverative Responses Total Categories
Spanish Verbal Learning Test	List A Trials 1–5 Recall List A Short Delay Free Recall List A Discrimination
Independent variables	Age, education, sex Years of education in the U.S. (ED–US) Years of residence in the U.S. (RES–US) Bilingualism

Verbal tests

The item content of the two verbal memory tests (i.e., Spanish Verbal Learning Test, and Story Memory Test) was developed entirely in Spanish (i.e., not translated) through pilot studies with native Spanish speakers from different countries.

It was our intent to develop tests devoid of information specific to one or another Spanish-speaking country. In order to assess the sociocultural and linguistic adequacy of item content (for the verbal tests) and instructions (all tests), the initial versions of the tests were administered to a small pilot sample of 18 native Spanish-speaking volunteers from different countries (Cuba, Colombia, Honduras, Guatemala, Mexico, Spain, U.S.A.) who had no history of neurological or psychiatric illness, and who were not included in the present study. Additionally, the tests were administered to 10 Spanish-speaking individuals who had a history of significant head trauma. All participants and patients answered questions regarding the degree of comprehensibility of the verbal tests, and the degree to which the test wording was consistent with their own sociocultural and linguistic experience. Further information on consistency of item response was obtained, without test administration, from an additional group of 20 native Spanish speakers residing in Barcelona, Spain, and three Mexican cities (Mexico City, Guadalajara, and Hermosillo). Participants tested and/or consulted in this pilot phase were men and women age 19 to 73 years with zero to 20 years of formal education in fields

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unrelated to psychology, sociology, or linguistics. The results obtained in the pilot study were used to make minor modifications on instructions and on item content.

The reader will note that while all participants were administered the same tests, we did accept regional variations as correct in responses to verbal tests (Story Memory and Oral Fluency). Acceptable regional variations are specified in the scoring criteria. We expect these scoring criteria to be expanded if and when the tests are used in other Spanish-speaking areas. The absence of interpretative problems (noted or reported) in the participants seen in the pilot study suggested that our goal of developing verbal tests that can be used with these two Spanish-speaking populations from different regions was met. Verbal tests were as follows:

1. *Story Memory Test*[1]: This is a 29-item verbal memory test that yields separate indices of learning efficiency (based on one to five learning trials), delayed retention or forgetting (based on a 1-hr delayed recall trial), and recognition (presented after the 1-hr free recall assessment, and based on a 36-item yes–no format). The test was modeled after the English-language Story Memory Test adapted by Heaton et al. (1991), but differs from it in terms of item content and one procedural aspect: the Heaton et al. (1991) version has memory assessment after a 4-hr delay. We present results for the following scores: Learning Score (defined as the score obtained in the last learning trial divided by the number of learning trials administered), Savings (defined as the percentage of information remembered at the last learning trial recalled after a 1-hr delay), and Discriminability (defined as 1 minus the coefficient obtained from dividing the sum of false positives and misses by 36, multiplied by 100).

2. *Spanish Verbal Learning Test (SVLT)*[2]: The basic format of the SVLT was modeled after the California Verbal Learning Test (Delis et al., 1987), and is procedurally identical. Briefly, the test consists of two lists (A and B), each containing 16 words. The words in each list belong to four semantic categories, with four words per category. Lists A and B share two semantic categories. In order to select the word list, 45 Spanish speakers from 10 different Spanish-speaking countries were asked to generate words belonging to a variety of semantic categories. Categories that showed few regional commonalities were discarded. The six categories selected for lists A and B were deemed appropriate for our purposes in that they shared words that possess the same meaning in the various Spanish-speaking regions sampled. The two most frequent exemplars of each category were rejected. We purposely rejected only two prototypical exemplars in order to make the lists relatively easy and understandable even to individuals with very low educational levels. In so doing we took the risk of making the lists too easy for individuals with higher levels of education. Short and long (20-min delay), free and cued recall measures were also recorded. Recognition memory was tested through auditory presentation of a list containing the 16 target items of List A, and 28 distractor items in a yes–no recognition paradigm. We present SVLT results for the following scores: total score on List A Trials 1–5, List A Short-Term Free Recall, and List A Discriminability.

3. *Digit Span Test*: The Digit Span test was adapted from the Digit Span subtest of the Wechsler Adult Intelligence Scale–Revised (WAIS–R; Wechsler, 1981), and thus has the same two task components: Forward Digit Span (which requires the participant to repeat orally digit sequences of increasing length in the same order in which they are presented), and Backward Digit Span (which requires the participant to repeat digit sequences of increasing length in reversed order). We kept the identical digit sequences used in the WAIS–R, but we added two two-digit sequences at the beginning of the test. We present results for the separate scores on Forward Digit Span and Backward Digit Span.

4. *Spanish Letter Fluency Test*: This test was adapted from, and thus is structurally and procedurally identical to, the Controlled Oral Word Association Test (COWAT) designed by Benton and Hamsher (1989) for the assessment of letter fluency in the English speaking adult. Like the COWAT, the SOFT consists of three 1-min oral-fluency trials. The participant is required to generate as many words as possible beginning with a given letter, with the level of verbal associative difficulty in the test increasing progressively across the three trials.

Spanish orthography, though popularly reputed to be phonemic, is, in fact, conventionalized (Green, 1990). The letter–sound correspondence is skewed. Pronunciation of the written language is relatively simple once the rules have been mastered. However, transcribing from speech is a different matter (Green, 1990). This mainly is due to the preservation of etymological (word of origin) spellings that are not always compatible with phonemic principles. For example, *h* is always mute: *huevo* (egg) = /webo/; *b* and *v* correspond to one phoneme; *c* and *g* have two different pronunciations depending of the vowel that follows: *cinco* (five) = /θinko/ (most regions of Spain) or /sinko/ (Latin America); *gigante* (giant) = /xigante/ (Green, 1990). Since we were particularly interested in creating a test that would emphasize oral language, and we wished to avoid errors based on poor knowledge of orthography, we eliminated all phonemes that do not possess a one-to-one grapheme correspondence. Additionally, we eliminated all letters possessing allophones in any or all of the regional variations of Spanish. The use of the letters *f*, *a*, and *s* traditionally utilized in English-language fluency tests was rejected as inappropriate for Spanish speakers. After we eliminated all the letters we considered to be possible sources of bias, we followed Benton and Hamsher's (1989), and Rey and Benton's (1991)

[1] Appendix A

[2] Appendix A

approach. The associative value of these letters was determined by estimating the relative frequency of words beginning with each letter in six dictionaries of the Spanish language published between the years 1824 and 1986. Results from this procedure allowed us to select the letters *p*, *m*, and *r* for our test. We report results for the sum of total number of words generated during the three 1-min trials.

The interview and all test administration were conducted entirely in Spanish. The examiners were native speakers of Spanish with Ph.D., M.A., or B.A. degrees in psychology in Spain, Mexico, or the U.S., and all had extensive supervised experience in neuropsychological test administration with Spanish speakers (Madrid site) and with English- and Spanish-speaking normal and clinical populations (U.S. and Mexico sites). All U.S.–Mexico examiners had received formal education in both English and Spanish and possessed native-like competence in both languages in all dimensions (comprehension, speaking, reading, writing).

Although each complete test battery was scored by the examiner who administered the tests, the scoring of the batteries was checked independently by a second, senior examiner. All participants were rated as having put forth adequate effort in the testing. All participants completed the entire seven-test battery. Table 2 shows a list of test measures and their abbreviations.

RESULTS

Study I

The sample consisted of 390 participants; 252 female and 118 male, age 18 to 76 years, with zero to 20 years of formal education. Sixty-eight participants were bilingual (English–Spanish). Nineteen participants (9 from the Borderland, 10 Spaniards) were left-handed. Table 2 presents these and other relevant demographic characteristics according to place of birth (POB). The Borderland sample consisted of 50 people living and tested in Tucson, Arizona, 132 participants living and tested in the border towns of Nogales and Agua Prieta, within Mexico, and three Mexican-born participants living and tested in Spain. The two groups of participants tested in North America did not differ in age [Tucson site: $M = 39.4$ years; Mexican sites: $M = 43.2$ years); $t(96) = -1.8$, $p = .08$.] However, the Tucson group was better educated [11.2 years *vs.* 9.0 years; $t(91) = 2.5$, $p = .01$]. Preliminary analyses showed that, when education was covaried, there were no differences between the two groups in any of the measures, except fluency in Spanish (participants tested in Mexico had a clear advantage). Ten participants were born and raised in the U.S. and were of similar age ($M = 38.4$ years) as Mexican-born participants ($M = 42.3$ years); $t(9) = .8$, $p = .44$]. They were significantly better educated than their Mexican-born counterparts (15.1 years *vs.* 9.3 years; $t(13) = -5.9$, $p < .0001$). Preliminary analyses showed that the U.S.-born participants differed from their Mexican-born counterparts only in fluency (Mexican-born participants had a clear advantage even after controlling for age and education.)

The Spanish sample consisted of 186 people living and tested in Spain, and 19 participants born and raised in Spain, but temporarily or permanently residing in the Tucson area. Preliminary analyses showed that these participants did not differ from participants born and residing in Spain in age [Tucson-tested: $M = 40.6$ years; Spain-tested: $M = 35.8$ years; $t(24) = 1.2$, $p = .22$]. However, the small group of Spaniards tested in Tucson had more years of schooling ($M = 16.7$ years) than their Spain tested counterparts [$M = 12.7$ years; $t(25) = 4.8$, $p = .0001$]. Preliminary analyses indicated that when age and education were covaried, these two groups did not differ in any of the measures except fluency: the Spain-tested group had a clear advantage.

In order to address the fact that a small number of Spaniards were tested in Tucson, and a small number of Mexicans were tested in Spain, we conducted exploratory analyses. These indicated that, in spite of great overlap, POB was a better predictor of neuropsychological performance than testing site. Hence only POB was considered in further analyses.

Study II

For the above-described Borderland sample of 185 participants, we considered the possible effects of residence in the U.S. (RES–US) and years of education in the U.S. (ED–US). These variables were highly correlated ($r = .70$). Preliminary analysis showed that RES–US had slightly better power than ED–US in predicting neuropsychological performance. Therefore, RES–US alone was used in prediction models. Bilingualism, a dichotomous variable as described in the Methods section of this article, was also significantly correlated with RES–US (Pearson $r = .60$), However, it made a very unique contribution in predicting some results, and hence it was not eliminated from further consideration. These variables are presented as percentages of total life span and percentage of total education, respectively and, for most analyses, they were considered as continuous variables.

Statistical Analyses

Study I

Analyses of variance (ANOVAs) were performed to study POB effects on performance on each measure. The residuals from these measures were all normally distributed, as required by the ANOVA procedure, with the exception of Figure Memory Savings, Story Memory Savings, and WCST–Categories. The distributions of these measures were all characterized by natural dichotomies—that is, a majority of the participants obtained the maximum score, with the rest of the participants trailing off at various distances from the maximum. These measures were transformed into

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Table 2. Demographic characteristics of samples

Characteristic	Borderland (N = 185)	Spain (N = 205)	Chi-square
Age	M = 42.2 (13.5)	M = 36.3 (16.1)	43.5, df = 4, $p > .0001$
	N (%)	N (%)	
18 to 30 years	37 (20%)	103 (50%)	
30 to 44 years	73 (36%)	42 (20%)	
45 to 54 years	39 (21%)	27 (14%)	
55 to 64 years	26 (14%)	19 (9%)	
65 and over	10 (5%)	14 (7%)	
Education	M = 9.6 (6.1)	M = 12.7 (4.4)	43.5, df = 6, $p > .0001$
	N (%)	N (%)	
0–2 years	26 (14%)	4 (2%)	
3–5 years	28 (15%)	8 (4%)	
6–8 years	24 (13%)	31 (15%)	
9–11 years	19 (10%)	27 (14%)	
12 years	28 (15%)	25 (12%)	
13–15 years	27 (16%)	49 (25%)	
16 and over	33 (18%)	61 (30%)	
Sex			15.3, df = 1, $p > .0001$
	N (%)	N (%)	
Female	138 (75%)	114 (56%)	
Male	47 (25%)	91 (44%)	
Handedness			0.0, df = 1, n.s.
	N (%)	N (%)	
Right	167 (95%)	195 (95%)	
Left	9 (5%)	10 (5%)	
Bilingualism			9.8, df = 1, $p > .002$
	N (%)	N (%)	
Yes	44 (24%)	24 (12%)	
No	141 (76%)	181 (88%)	
RES–US			
	N (%)		
0 years	112 (60%)	–	
0–25 years	38 (21%)	–	
>25 years	35 (19%)	–	

dichotomies based on whether or not the participant achieved the maximum score. The dichotomized versions of these measures were analyzed with logistic regression.

Study II

Hierarchical regressions were performed by forcing the demographic variables in as a group and then using a forward selection method for bilingualism and RES–US.

In order to minimize the risk of a type-I error, alpha was set to .01 for both studies.

RESULTS

Study I: Comparisons between the Borderland and Spanish samples

Table 3 shows the age and education corrected means and standard deviations obtained by the Borderland *versus* Spanish samples on 16 neuropsychological measures.

ANOVAs to test the effects of the POB relation with neuropsychological performance showed the expected effects of age and education on a number of measures (Table 3).

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Table 3. Age- and education-adjusted results by Borderland *versus* Spanish participants

Measure	Borderland $N = 185$ M (SD)	Spain $N = 205$ M (SD)	Effects of education F	Effects of age F	Effects of POB F	Effects of Education × POB F	Effects of Age × POB F
Spanish Verbal Learning Test							
List A Trials 1 to 5	53.5 (9.3)	59.4 (9.2)	43.7***	51.3***	.1	.06	4.2
List A Short Delay Free Recall	11.1 (2.7)	12.7 (2.6)	38.2***	41.2***	2.5	2.3	.7
List A Discriminability	91.6 (7.1)	93.6 (7.1)	35.5***	46.5***	2.9	14.6**	2.5
Story Memory							
Learning score	9.7 (4.7)	11.5 (4.7)	72.3***	32.2***	1.0	.1	.0
Savings score	87.0 (15.9)	84.8 (15.9)	6.3*	10.2**	1.3	.1	.4
Discriminability	87.2 (9.4)	89.7 (9.4)	21.1***	5.9	6.5*	17.8***	.2
Figure Memory							
Learning score	8.7 (4.5)	12.3 (4.4)	63.8***	62.0***	11.6***	1.2	2.6
Savings score	94.6 (10.0)	93.2 (10.1)	3.6	3.8	1.5	1.0	.2
Discriminability	79.0 (10.0)	84.9 (9.9)	85.9***	44.9***	8.5**	9.7**	0.0
Digit Span							
Forward	7.6 (2.0)	8.9 (2.0)	50.9***	11.7**	3.8	.0	.5
Backward	4.9 (2.1)	6.6 (2.0)	57.1***	14.5***	4.3	.6	.0
Visual Span							
Forward	6.9 (1.9)	7.7 (1.9)	42.0***	15.0***	1.9	2.1	.3
Backward	5.8 (1.9)	7.0 (1.9)	88.3***	43.3***	4.5	.9	.2
Oral Fluency	39.0 (11.8)	44.7 (11.8)	122.3***	1.8	2.2	.6	.0
Wisconsin Card Sorting Test							
Perseverative Responses	33.6 (19.2)	21.8 (19.1)	61.8***	24.4***	5.4*	3.1	.0
Categories	3.4 (1.6)	4.6 (1.6)	41.8***	15.0***	3.9	1.4	.0

Note. Required alpha = .01; *$p < .01$, **$p < .001$, ***$p < .0001$.

After accounting for the effects of age and education, there were no significant main POB differences or significant interactions between the Borderland and Spanish groups on 11 of the 16 measures. There were significant main effects for POB on two test results: the Figure Memory Test–Learning score and the WCST–Perseverative Response measure. In both of these measures, the Spanish participants did better than their Borderland counterparts. Significant interactions of Education × POB were found for the three discriminability measures (Story Memory, Figure Memory, and SVLT.) In two of these measures, the POB effect was also significant (Story Memory and Figure Memory).

In order to illustrate these various relations through the education continuum, scatterplots with regression lines for each sample are shown in Figures 1 through 4.

Figure 1 illustrates the relation between education and Forward Visual Span in the two groups, after statistically removing the effects of age. As is evident from Figure 1, there is neither a significant main effect of POB (signified by the close proximity of the lines) nor an appreciable interaction (signified by the fact that the lines are nearly parallel). Compare Figure 2, which shows both a significant main effect for POB, education, and their interaction. Figure 3 shows a significant interaction of Education × POB, but no main effect for POB. Figure 4 shows a significant POB effect. In this case, while the interaction did not quite meet our required alpha level, the figure suggests the same general pattern as shown in Figure 3.

As is illustrated in Figures 2 and 3, the relation between test performance and education was different in the two groups. In the Borderland group, and relative to the Spanish sample, lower levels of education are associated with much lower test performance than higher levels of education. This results in a regression line with an appreciably lower intercept and steeper slope.

Study II: Investigation of the contribution of additional independent variables on test results for the borderland sample

We examined correlations among the independent variables considered as possible predictors of performance that are specific to the Borderland participants.

Table 4 shows that either RES–US or bilingualism contribute significantly in predicting performance on 3 out of 13 test measures (the three dichotomous measures could not be included in this analysis), after the other demographic variables are controlled. These predictors were never both significant in the same model.

RES–US alone made a significant negative contribution to the variance of the oral fluency measure, and this was independent of bilingualism which made no significant con-

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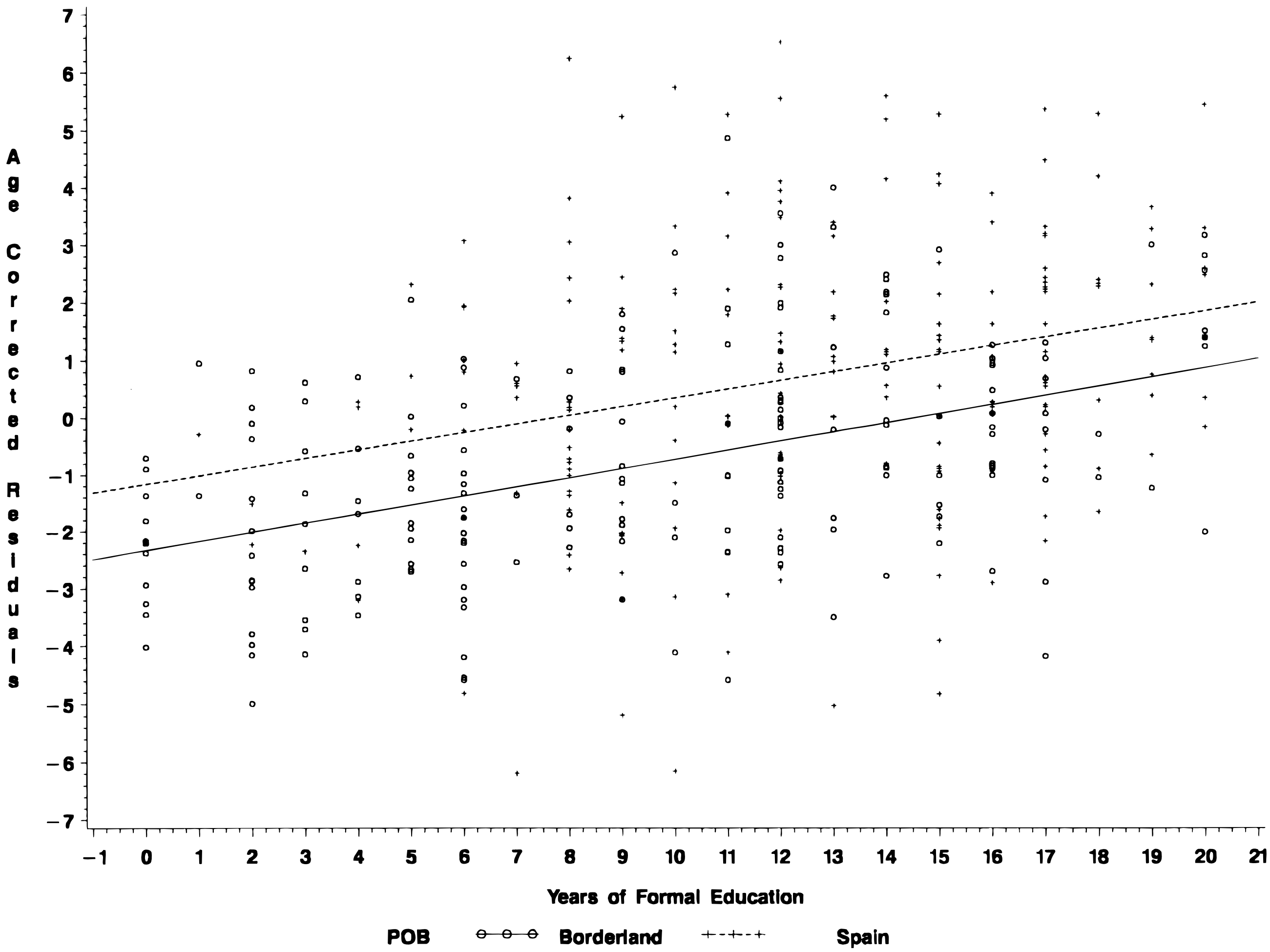

Fig. 1. Relations between age-corrected Forward Digit Span performances for samples from the Borderland and Spain.

tribution (Table 4). The effect becomes quite compelling when only individuals with 8 or more years of education are included in the analysis. Under those circumstances, the effect of the standard demographics becomes negligible ($R^2 = .04$) , while RES–US alone contributes an impressive proportion of the variance ($R^2 = .21$, $p > .0001$).

For the WCST, RES–US made a significant contribution in the Perseverative Responses measure. Increasing the percentage of life span spent in the U.S. was correlated with significantly better performance in the Perseverative Responses measure of the WCST. Repeating the analyses excluding participants with fewer than 8 years of education also resulted in a relative diminution of the effect of standard demographics ($R^2 = .07$, n.s.) and a relative increase of the effect of RES–US ($R^2 = .11$, $p > .01$.) Participants who have spent more than 25% of their life span in the U.S. produced virtually the same number of perseverative responses as Spanish participants with 16 years or more of formal education. Incidentally, these participants, on average achieved results similar to those obtained by mainstream English-speaking samples of similar demographic characteristics (Heaton et al., 1993).

Table 4 shows that bilingualism significantly contributed to the variance of the SVLT List A Trials 1–5. For this measure, bilingualism alone seems to be important, while RES–US is of no significance.

DISCUSSION

Two salient points emerged from the present studies. First, our data indicate that while the Spanish and Borderland samples obtained similar results in the majority of the measures used, there were some important differences for some of the measures used. Second, for the Borderland sample, percent of life span spent in the U.S. and bilingualism had significant and apparently independent effects on the performance of a small number of tests. We will address these findings separately.

Study I

The two population samples appear to be more similar overall than they are different. Indeed, participants from Spain and the Borderland obtained similar results in the majority

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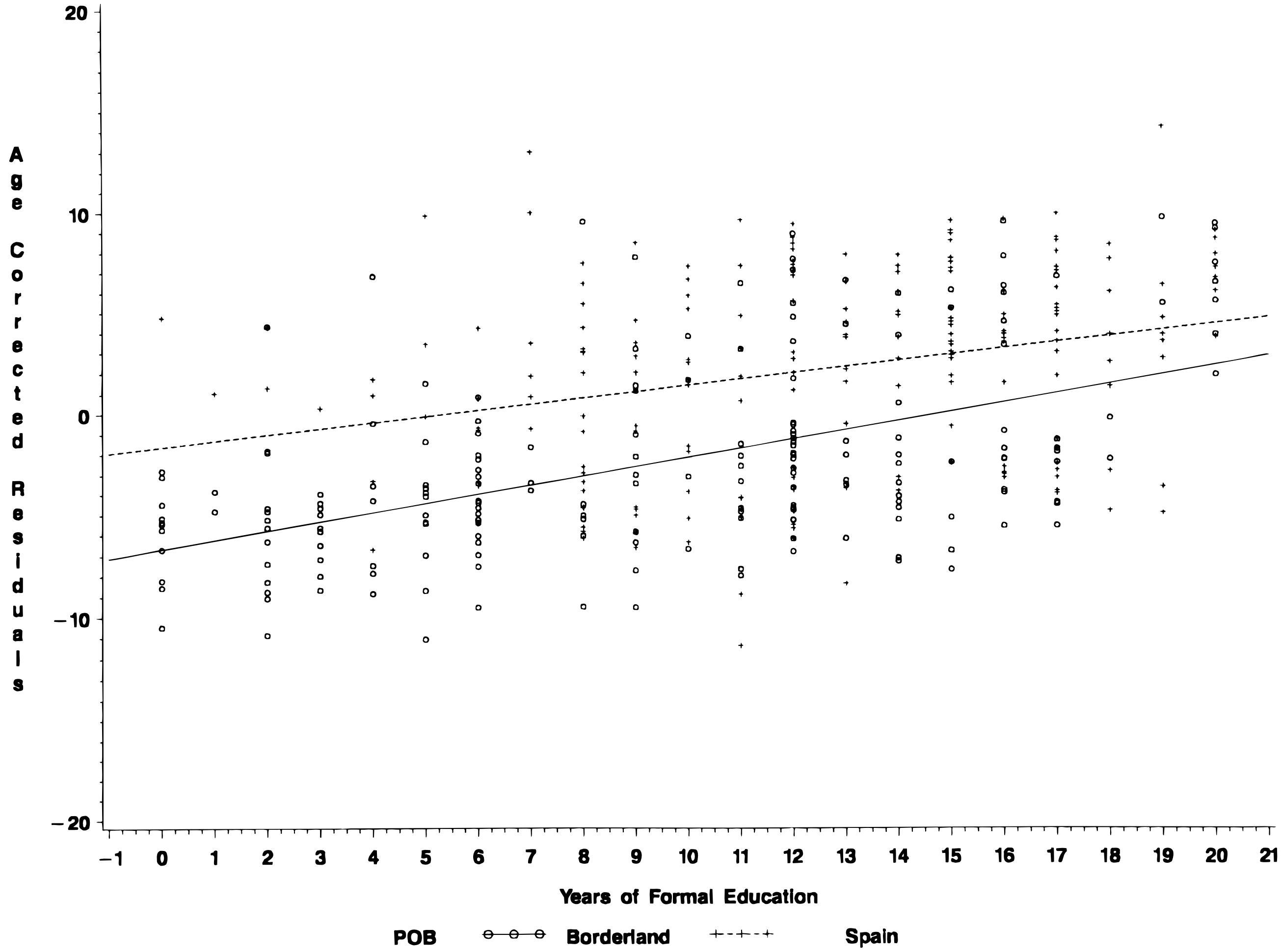

Fig. 2. Relations between age-corrected Figure Learning performances for samples from the Borderland and Spain.

(11) of the measures used. We think that this is important as it may mean that at least for some neuropsychological measures the tests may be "transportable" from one to another Spanish-speaking area.

We now focus on the differences found between the two samples: There were only two significant POB effects and three significant POB × Education interactions affecting a total of five of the measures used. In all cases, the differences were in favor of the Spanish sample. The differences were particularly and unexpectedly strong in the Figure Memory Test–Learning score. The overall difference between the two samples in the Learning score approximates 1 standard deviation. This is likely to be clinically meaningful, and deserves further exploration in future studies. Other POB differences are less impressive, and appear to diminish (or disappear) at the upper end of the education continuum. Of interest is the fact that no differences were found between the two samples in either the Learning Score of the Story Learning Test or the SVLT (List A, Trials 1–5), the most linguistically complex of all the tests used, suggesting that the test is appropriate for use with both Mexicans and Spaniards.

The POB × Education interactions observed take the shape of wider differences between the samples at the low end of the education continuum studied here (0–20+ years), which diminish with increasing levels of education. This is a recurring theme for the measures used, even though the interactions frequently fail to meet out required alpha level (e.g., Figure 4).

Some of the differences encountered (e.g., WCST) are thought to be a function of defined independent variables (RES–US; bilingualism), and will be discussed further below. For some measures, it appears that other factors may be causing the observed POB effect. We think that there may be two possible general factors at play: (1) linguistic–cultural, and (2) health-and-education-related. These will be discussed separately, bearing in mind that the various possible health and education factors are unlikely to exist in isolation and may have a common socioeconomic root.

Linguistic and Cultural Factors

We entertained the possibility that the differences between the two groups may have been due to bias in our testing

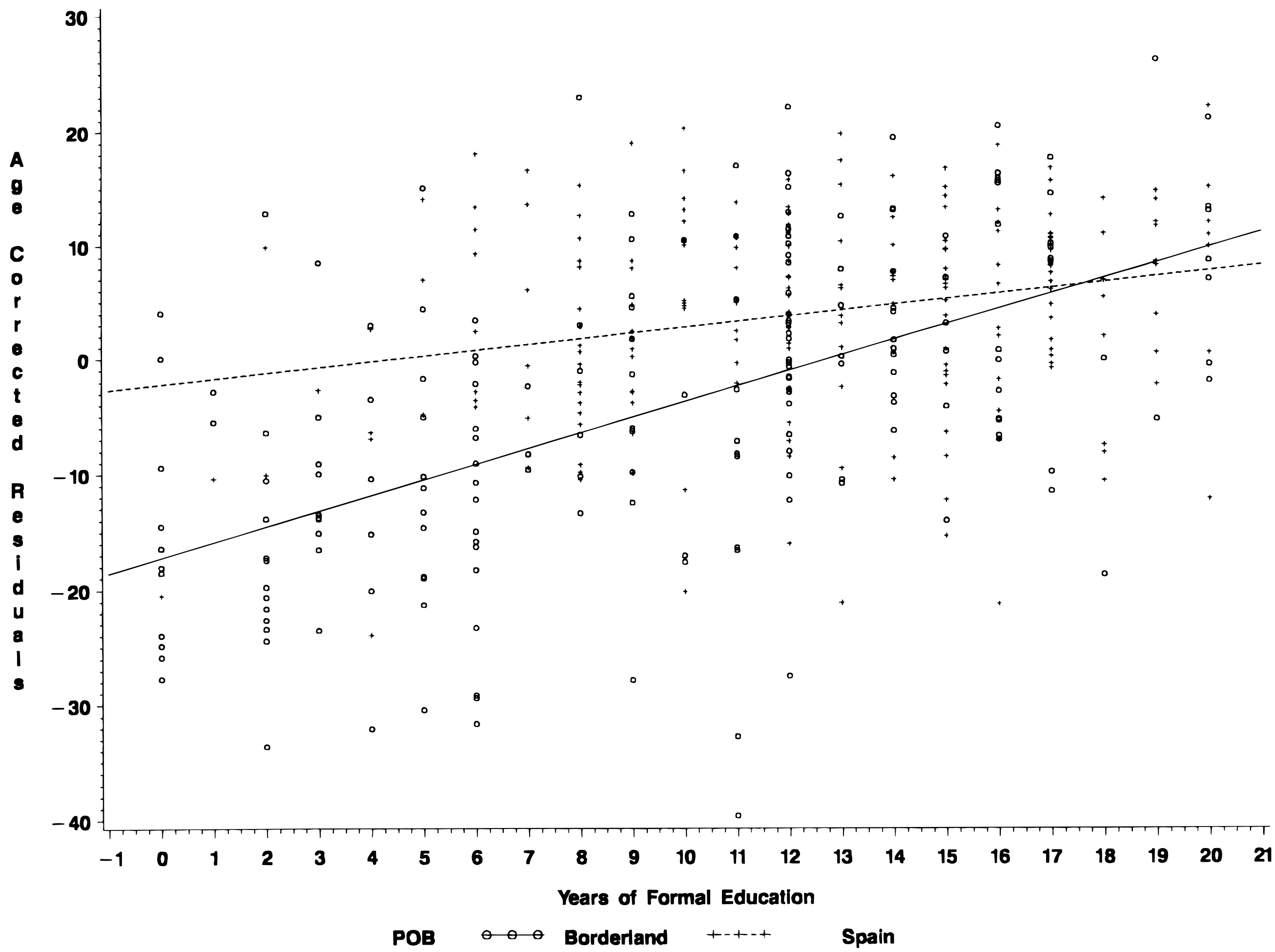

Fig. 3. Relations between age-corrected Figure Memory–Discriminability performances for samples from the Borderland and Spain.

material. Sources of error such as item bias (inadequate equivalence of test items) can affect the adequacy of instruments and must be considered (Van de Vijver & Hambleton, 1996). While it is impossible to exclude any influence of such factors categorically, we suggest that linguistic factors are unlikely to be at the root of the observed POB differences. This assertion is made on the following bases: First, we made specific efforts (described above) to avoid item content that was specific to one of our geographic groups. Second, group differences are most marked in nonverbal tasks, and nonexistent in tests with high degrees of linguistic complexity (i.e., Story Memory). A third reason for discounting linguistic differences is that our participants gave no indication that understanding the instructions or the test items posed a problem at any time.

We are unable to exclude the possibility that construct bias (nonequivalence of constructs across cultural groups) and method bias (e.g., differences in social desirability or familiarity with response formats) may have played a role at the lower end of the education continuum. However, we believe that these aspects of the examination are confounded with other, potentially more powerful factors in the backgrounds of poorly educated Borderland residents. Given the economic and educational realities of Mexico, it is likely that individuals who obtained their education in that country have been less exposed than their Spanish counterparts to the type of educational experiences that would make them succeed at tests of cognitive ability. Such tests, after all, were constructed originally with the aim of testing individuals educated in a Western industrialized society.

Why did Borderland participants with high levels of the education continuum seem to approach those of their Spanish counterparts also at the high end of the education continuum? We propose that the educational experiences of these higher SES Borderland residents may have been closer to those of their Spanish counterparts than was the case for lower education (and lower SES) residents in these two geographic areas. Unfortunately, we do not possess sufficient details on the qualitative difference between the Spanish and the Mexican educational systems to allow further elaboration. However, this may suggest that what we commonly refer to as cultural differences may be more parsimoniously

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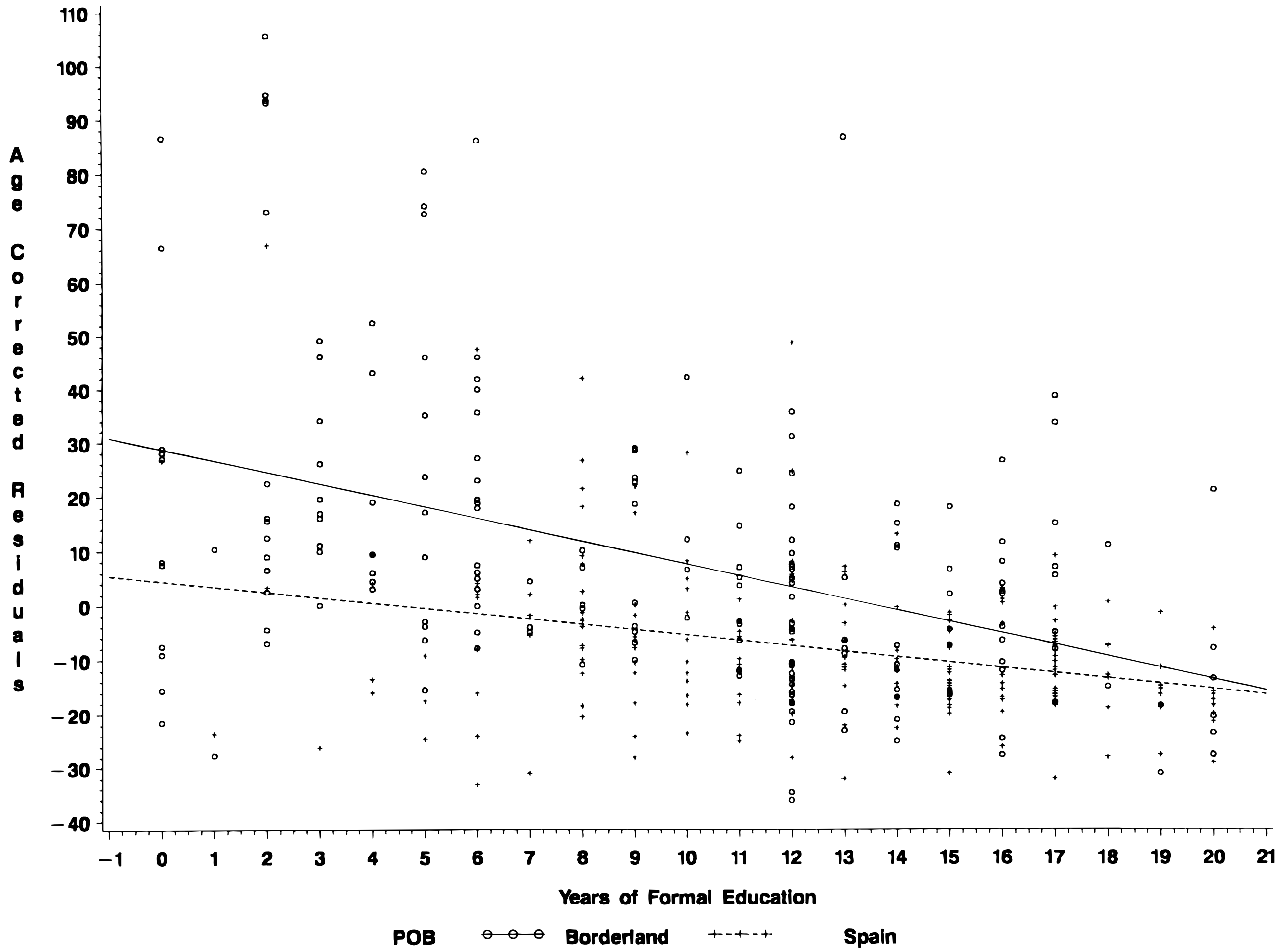

Fig. 4. Relations between age-corrected WCST–Perseverative Responses performances for samples from the Borderland and Spain.

described as differences in standard of living, regardless of one's country of origin.

Whatever the contribution of linguistic or cultural factors may be, it seems probable that, if levels of nutrition, medical care, and quality of education received by Borderland participants were comparable to those in the so-called First World, the Borderland group would not differ from Spaniards any more than mainstream English-speaking North Americans differ from say, English or Australians. There may be some tangible differences in the social customs between these latter societies with similar levels of industrialization and access to education, but we think that these are unlikely to be reflected on neuropsychological tests, which tend to use relatively simple linguistic and visual material for the purpose of measuring cognitive ability.

Medical–Health and Socioeconomic Factors

The large socioeconomic differences between Mexico and Spain render adequate nutrition, medical care, and high quality education (by Western standards) accessible to large proportions of the Spanish population and only to a relatively small percentage of the Mexican population. As noted in the Introduction, there are significant differences between Spain and Mexico in rates of morbidity and mortality that are related to medical care infrastructure.

Rural *versus* urban quality of life may contribute to the overall effect. Although none of our participants were currently residing in rural areas, most Mexican immigrants to the U.S. come from rural areas where both nutrition and quality of education are very poor. The Madrid sample was entirely urban, while participants in the Borderland sample were suburban and small-city dwellers. Therefore, the POB grouping variable in our study confounded continent with degree of urbanization, especially in terms of childhood living environment.

The negative impact of poverty—which often is associated with poor nutrition, poor access to medical care, and limited access to education—on future cognitive development has been documented by a number of authors (Bar-Din, 1990; Cravioto & Arrieta, 1982; Neisser, 1996). Early childhood development in the context of poor medical and

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Table 4. R-squares of Borderland participants' ($N = 185$) neuropsychological performance on standard demographics (age, education, sex), RES-US, and bilingualism

Measure	Standard demographics R^2	RES–US Increment R^2	ED–US Increment R^2	Bilingualism Increment R^2
Spanish Verbal Learning Test				
List A Trials 1 to 5	.33***			.03*
List A Short Delay Free Recall	.28***			
List A Discriminability	.29***			
Story Memory				
Learning score	.33***			
Discriminability	.13***			
Figure Memory				
Learning score	.36***			
Discriminability	.38***			
Digit Span				
Forward	.26***			
Backward	.33***			
Visual Span				
Forward	.30***			
Backward	.36***			
Oral Fluency	.34***		.07*	
Wisconsin Card Sorting Test				
Perseverative Responses	.23***	.03*		

Note 1. These regressions were performed by forcing the demographic variables in as a group and then using a forward selection method for bilingualism and RES–US.
The p values listed under the latter two terms are for the increment in R^2 attributable to the additional term. Entries under the RES–US, ED–US and bilingualism columns occur only if these terms were selected for inclusion in the model by the forward selection procedure.
Note 2. Required alpha = .01; $*p < .01$, $** \; p < .001$, $*** \; p < .0001$.

nutritional care may affect the adult individual's cognitive functioning in subtle but measurable ways.

The possibility that there are important differences in consumption of alcohol and use of other substances that may have had an impact on the present results cannot be excluded. We did not include in our sample participants who reported work, social, or family problems relating to substance use. However, we do not possess specific information regarding different patterns of consumption in the two geographical areas considered. We think that use of alcohol and other substances is included under the rubric of medical and nutritional differences that we cannot define adequately in more detail at this time.

The authors think that the socioeconomic differences between the two countries (and associated nutritional, medical, and quality of education factors), at least in the less privileged strata of society, are much more likely to be at the root of the few significant disparities between the two samples than the frequently invoked cultural differences. Our data also suggest that higher education–higher socioeconomic status may be instrumental in equalizing the performance of the two samples in neuropsychological tests.

Future studies should further elaborate the components of the POB factor. We suggest that, where possible, information regarding income, parental income–socioeconomic status during the participant's early years, and urban *versus* rural status of participant during formative years should be gathered. Additionally, information regarding the quality of early education received by participants may be of importance. This type of information, however, is more likely to emerge from cross-cultural research in education than from neuropsychological research.

The issue of race and its possible effects on neuropsychological functioning is hotly debated (Fraser, 1994; Gould, 1981; Herrnstein & Murray, 1994), and deserves some comments in the present context. Given Spain's population composition (i.e., Mediterranean and Nordic descent; Dostert, 1989; Reddy, 1994; Skabelund & Sims, 1990), it is reasonable to assert that our Spanish sample is essentially White. However, Spanish speakers from the Americas, although united by a common language and similar customs, represent a collection of nationalities and cultural groups of diverse ethnic–racial composition. In the majority of Latin American countries, approximately 40 to 95% of the total population are *Mestizo* (hybrid of European and Native American). In the case of Mexico, 60% of the total population is *Mestizo*, 30% Native American, and 10% White. As Culebras (1995) has pointed out, there is no genetic or biomedical commonality to Hispanics. In view of the complexity of the hybridization process in Hispanic popula-

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tions, we believe that the concept of race would not be a meaningful one within the present investigation. Although group differences in racial–ethnic composition may have influenced the neuropsychological results in this investigation, race–ethnicity was not studied as an independent variable because of its complex, multifactorial nature and the consequent difficulty in making reliable and valid participant classifications. In addition, as with the more readily measured variables such as place of birth and duration of residency and education in the U.S., socioeconomic and other (e.g., nutritional, health care, and cultural) confounds would preclude any straightforward interpretation of their neuropsychological correlates.

Whatever the ultimate nature of the POB factor, our results indicate that, for the set of measures used in this study, separate norms are appropriate for the two Spanish-speaking populations studied for a small number of the instruments used.

Our second salient finding concerns the indication that, for the Borderland sample, some social and linguistic variables play an important role in some of the measures. Increasing the percentage of life span spent in the U.S. is significantly associated with performance on two of our tests. Incidentally, percentage of education received in the U.S correlated highly with percentage of life span spent in the U.S in this study, but these variables cannot be assumed to be identical.

Word fluency correlates negatively with length of residence in the U.S., and this occurs regardless of bilingual status. This is not surprising. Success in word generation tasks depends significantly on rapid lexical accessibility. This is thought to be sensitive to the effects of language practice. Many Spanish speakers who reside in the U.S. simply do not have the opportunity to practice their own language frequently enough and hence become "rusty." Constant exposure to a different vehicle of expression leads to inefficiency in using the first vehicle. Groping for words in the language of origin is a common (and irritating) experience for those who live as linguistic expatriates. Indeed, language, like physical fitness, must be maintained. To give an example of the robustness of this effect, in the fluency task, participants from the Borderland who had never resided in the U.S. (regardless of bilingual status) performed as well as Spaniards. This effect, however, does not appear to be present in tests of verbal learning. When individuals are administered word generation tasks in their native language, but are residing in a different linguistic environment, we propose that a normative correction system should be in place to compensate for the effects of lack of current or recent exposure to the primary language.

On the other hand, living in the U.S. appears to be positively correlated with WCST performance. This is a test of abstraction and mental flexibility. It seems possible that this may be due to one or a combination of factors. First of all, the WCST measures abilities that are emphasized more in U.S. schools than in Mexican schools. As was mentioned in the Introduction, Mexican schools emphasize rote memorization and focus less on problem solving than do U.S. schools. Increased familiarity with problem-solving tests gained by living and being educated in the U.S. may render immigrants more able to successfully complete them. Anecdotally, tasks of abstraction and problem-solving have become increasingly used in Western European school systems and may account for the relative competence of the Spanish sample on the WCST. We propose that in the U.S. context, when testing Mexican immigrants who have spent relatively little time in the U.S., a different set of norms should be used for the WCST.

Our results indicate that, within the Borderland sample, bilingualism was positively associated with neuropsychological performance on one measure of the SVLT. Bilingualism appears to offer an advantage in our study, in keeping with the opinions of the majority of pediatric researchers that there are positive links between bilingualism and cognitive functioning (Baker, 1993), and with the opinions of social scientists who hypothesize that the verbal ability underlying proficiency in one language can be generalized to another language (Cummins, 1984). It may be that the use of two languages does increase cognitive elaboration, including the ability to adopt better learning strategies.

Both bilingualism and percentage of life span spent in the U.S. can, of course, be considered measures of acculturation. The present study shows that they can have positive or negative effects on neuropsychological performance and that this is dependent on cognitive domain. Hence, the heterogeneity of the commonly used acculturation scales may not allow for the identification of specific aspects of the sociocultural life of the immigrant that best predict performance in neuropsychological measures.

Conclusions

In samples of neurologically intact individuals from separate geographic regions the relationship between education and performance on a minority of neuropsychological measures can differ despite a common language and culture. Some of the possible reasons for these differences were identified (percentage of life span spent in the U.S., bilingualism), while others could not be separated from the independent variable, place of birth. This was particularly evident for a measure of visual memory.

We think that this research highlights a distinction that must be made between test development and the application of normative data. It is relatively easy to develop tests for use across populations that share a language, simply by capitalizing on the vast area of linguistic overlap. While we are encouraged by the relatively few differences we detected, when it comes to use of normative data we cannot assume that one set of norms can automatically be applied to separate peoples just because they share a language. For different tests and different cultures, norms must be collected, although the present results suggest that this may not be necessary for every measure. Also, there is some evidence from the present research that education can be a

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great equalizer, meaning that at higher levels of education, we may be able to apply the same set of norms to different cultural groups. However, this cannot be assumed; it must first be empirically established.

ACKNOWLEDGMENTS

The authors are indebted to Carmen Valiente Ots, Ph.D., for project management, and Beatriz López Luengo and Eva M. Muñiz Giner for technical support at the Spanish site, Lydia Prieto Meza for participant recruitment and technical support at the Mexican sites, Jesús Reyes of El Pueblo Neighborhood Center, Tucson for facilitating participant recruitment in the Tucson site, and Rossana Pierson and Dr. Héctor Ahumada for assisting in participant recruitment and generously providing office space in Nogales, Sonora. The authors also thank Helene A. Mullaney, M.A., for helpful editorial comments, and Roy Pardee III, M.A., J.D., for statistical consultation.

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Appendix A

Aprendizaje de Palabras (Spanish Verbal Learning Test)

Lista A	Lista B
1. abuelo	1. piano
2. jirafa	2. elefante
3. pierna	3. camisa
4. cama	4. cabeza
5. hipopótamo	5. leopardo
6. sofá	6. violín
7. ojo	7. pie
8. madre	8. falda
9. sillón	9. dedo
10. cebra	10. oso
11. tío	11. vestido
12. mano	12. trompeta
13. armario	13. rinoceronte
14. pantera	14. abrigo
15. primo	15. oreja
16. nariz	16. tambor

Aprendizaje de Prosa (Story Memory Test)

Pedro / Fuentes / de 45 años de edad / y de profesión minero / perdió su salario / en un juego de cartas./ Esto le dejó (lo dejó) sin dinero/ para el pago mensual / de la casa /. Su jefe / le permitió trabajar / horas extras,/ y su madre / le prestó el resto / haciéndole prometer / que no apostaría nunca más./ No obstante, al día siguiente / fue a las carreras de / caballos / con su primo Manuel / donde le robaron/ la mitad del dinero / que le habían prestado./ Por ello tuvo que vender / su televisor/ y conseguir / un segundo empleo / como taxista./ Así cumplió / con sus obligaciones económicas / puntualmente./

https://doi.org/10.1017/S1355617798003634 Published online by Cambridge University Press