The influence of acculturation on the Wisconsin Card Sorting Test by Mexican Americans

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Abstract

This study examined the speculation that the Wisconsin Card Sorting Test (WCST) might be a relatively culture-free neuropsychological test. The relationship between level of acculturation and performance on the Spanish version of the WCST was investigated, using a sample of Mexican American adults (N=52). When the sample was divided into two groups based on level of acculturation as measured by the Acculturation Rating Scale for Mexican Americans—2nd Edition, within-group contrasts demonstrated that higher levels of acculturation significantly improved performance on the WCST. The performance of this sample was compared to select Spanish norms, finding no clinically significant differences. Contrasts with English norms for the WCST yielded significant differences on a majority of the WCST measures, demonstrating that the English norms are inappropriate for use with this population. This study concludes that the WCST is not a culture-free neuropsychological test.

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Keywords: Acculturation; Mexican Americans; Hispanics; Latinos/Latinas; Wisconsin Card Sorting Test; Normalization (test)

Rosselli and Ardila (1993) speculated that the Wisconsin Card Sorting Test (WCST; Grant & Berg, 1948) might be a relatively culture-free neuropsychological instrument following a study of the performance of Spanish speaking children in Colombia. This speculation is of concern not only because of the widespread use of the WCST among neuropsychologists
for assessing executive functions but also because of the growing Hispanic population in the United States.

Two extensive surveys of test use by practicing neuropsychologists found the WCST to be one of the most widely used instruments to assess executive functions (Butler, Retzlaff, & Vanderploeg, 1991; Rabin, Barr, & Burton, 2005). During the period of time between these two landmark surveys, the Hispanic population of the United States increased 57.9% from 22.4 million in 1990 to 35.3 million in 2000 (U.S. Census Bureau, 2001). Mexican Americans accounted for 58.5% of all Hispanics in the United States during the 2000 census, making them the largest Hispanic group in the United States. We chose to test the speculation that the WCST might be a relatively culture-free neuropsychological instrument with a sample of 20- to 29-year-old Mexican Americans by examining the relationship between levels of acculturation and WCST performance.

The theoretical construct of acculturation describes the changes that take place when persons from different cultures come into continuous contact with one another (Redfield, Linton, & Herskovits, 1936). These changes have been conceptualized bidimensionally, comprehending an individual’s relationships to both the culture of origin and the culture of interaction (Marín & Gamba, 1996). The extent and pace of individual change are influenced by the contexts prior to as well as during immigration and subsequent settlement periods (Cabassa, 2003). Dana (1993) asserts that this process of acculturation is a fundamental moderator variable that must be considered to produce a culturally valid interpretation of assessment data. A recent review of the neuropsychological research literature, however, found that the level of acculturation was rarely if ever reported (O’Bryant, O’Jile, & McCaffrey, 2004).

Several important studies have investigated the performance of Hispanic subjects on the WCST. Using Spanish instructions with a college educated sample, Artiola i Fortuny and Heaton (1996) administered the WCST in both the standard and computerized formats and found that performance by subjects from Spain was similar to that of English speaking North American subjects, regardless of form of administration. Artiola i Fortuny, Heaton, and Hermosillo (1998) found significant differences between Spanish speaking subjects from Spain and the U.S.–Mexico border region. Differences between the two groups diminished with increasing levels of education.

The primary purpose of this study was to investigate the relationship between different levels of acculturation and WCST performance by Mexican Americans. A secondary purpose was to compare the performance of the sample with norms for Spanish speakers from the border region of the U.S. and Mexico (Artiola i Fortuny, Hermosillo, Heaton, & Pardee, 1999) and with the English norms contained in the manual (Heaton, Chelune, Talley, Kay, & Curtiss, 1993). Three hypotheses were investigated.

First, we hypothesized that when the sample was divided into two subgroups based on level of acculturation, performance on the WCST by the more acculturated subgroup would be significantly better than performance by the less acculturated subgroup. Second, there would not be a significant difference between performance by the sample as a whole and the U.S.–Mexico border region norms for Spanish speakers. Third, there would be a significant difference in performance on the WCST between the Mexican American sample and the English norms.
1. Method

1.1. Power analysis

A power analysis was completed to estimate the number of subjects needed to provide an 80% probability of detecting an effect size of .75 standard deviations at \(\alpha = 0.01\) in the total number of perseverative responses on the WCST. This effect size was previously demonstrated between the English norms (Heaton et al., 1993) and the norms for Spanish speakers developed by Artiola i Fortuny et al. (1999). A minimum of 19 participants in the sample group was estimated to be needed to detect a significant difference in the means of this variable when compared with the English norms (\(n = 67\)).

1.2. Instruments

1.2.1. Acculturation Rating Scales for Mexican Americans—2nd Edition (ARSMA-II)

The ARSMA-II (Cuéllar, Arnold, & Maldonado, 1995) was developed specifically for Mexican Americans and is the most widely researched of the acculturation scales (Gamst et al., 2002). This multidimensional orthogonal scale contains two subscales with good internal consistency, the Anglo Orientation Subscale (AOS; coefficient alpha = .83) and the Mexican Orientation Subscale (MOS; coefficient alpha = .88). The AOS and MOS are combined to produce a rating describing the degree of acculturation. This combined score is then interpreted as one of four different categories of acculturation, listed here from least to most acculturated: Very Mexican Oriented; Mexican Oriented to Approximately Balanced Bicultural; Slightly Anglo Oriented Bicultural; and Very Assimilated, Anglicized.

The ARSMA-II was used to ascertain each subject’s level of acculturation. Due to sample size limitations, this study divided the sample into two subgroups using a cut-off score. Those classified as Very Mexican Oriented by the ARSMA-II with a cut-off score less than \(-1.33\) formed the less acculturated subgroup (\(n = 41\)). Those scoring above the cut-off score in the other three ARSMA-II categories of acculturation were grouped together into the more acculturated subgroup (\(n = 11\)).

1.2.2. WCST

The standard 128-response card set of the WCST (Heaton et al., 1993) was used in all administrations. Spanish instructions translated by L. Artiola i Fortuny and D. Hermosillo (personal communication, March 27, 2001) were presented. The WCST has been widely used in clinical and research applications to measure executive functions and has demonstrated moderate to good reliability (Generalizability coefficient, \(M = .57\)).

1.2.3. Standard Progressive Matrices (SPM)

The SPM was administered with the plan for the results to be used as an intellectual screener. The Mexican norms were in press at the time of the testing of subjects. Therefore, we chose not to screen the sample beyond the rigorous intake interview, which had been used in previous studies (Artiola i Fortuny et al., 1998).
Table 1
Demographic characteristics of the Northwest sample and acculturation subgroups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Northwest sample (N=52)</th>
<th>Less acculturated (n=41)</th>
<th>More acculturated (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>23.13 ± 2.80</td>
<td>23.20 ± 2.87</td>
<td>22.91 ± 2.63</td>
</tr>
<tr>
<td>Total years education</td>
<td>9.41 ± 3.10</td>
<td>8.98 ± 3.17</td>
<td>11.04 ± 2.30</td>
</tr>
<tr>
<td>Mexican education</td>
<td>8.64 ± 3.40</td>
<td>8.76 ± 3.03</td>
<td>8.23 ± 4.40</td>
</tr>
<tr>
<td>U.S. education</td>
<td>0.77 ± 2.31</td>
<td>0.22 ± 0.66</td>
<td>2.81 ± 4.44</td>
</tr>
<tr>
<td>Percent education in U.S.</td>
<td>6.71 ± 19.04</td>
<td>2.08 ± 5.87</td>
<td>23.99 ± 35.98</td>
</tr>
<tr>
<td>Percent lifespan in U.S.</td>
<td>14.28 ± 17.60</td>
<td>10.95 ± 10.79</td>
<td>26.67 ± 29.99</td>
</tr>
<tr>
<td>Annual income (U.S.$)</td>
<td>11851 ± 8650</td>
<td>11299 ± 8882</td>
<td>13,907 ± 7797</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>44 (85%)</td>
<td>37 (90)</td>
<td>7 (64)</td>
</tr>
<tr>
<td>Female</td>
<td>8 (15%)</td>
<td>4 (10)</td>
<td>4 (36)</td>
</tr>
</tbody>
</table>

* Acculturation subgroups differed significantly on years of U.S. education and percent education in U.S. (Kolmogorov-Smirnov Z=1.783; P= .003, two-tailed); and sex (Pearson χ²(1) = 4.717; P= .030, two-tailed).

1.3. Participants

A convenience sample of 44 male and 8 female Spanish speakers of Mexican heritage, ages 20–29 years (M = 23.13, S.D. = 2.80) was recruited in the Northwest region of the United States. The sample consisted of volunteers from a Latino cultural center, migrant worker camps, and a Spanish speaking Catholic congregation. All subjects except one were born in Mexico. The sample was predominantly male (85%) due to the majority of subjects being recruited from a day labor program for men at the Latino cultural center. Table 1 describes the demographic characteristics of the sample and the acculturation subgroups.

The levels of acculturation as measured by the ARSMA-II represented by the participants were largely lower levels of acculturation: Very Mexican Oriented (n=41, 79%); Mexican Oriented to Approximately Balanced Bicultural (n=10, 19%); and Slightly Anglo Oriented Bicultural (n=1, 2%). None of the participants scored at the Very Assimilated, Anglicized level of acculturation. The sample was grouped into the acculturation subgroups described previously using the cut-off score for the Very Mexican Oriented level of acculturation.

1.4. Procedure

Participants completed the intake interview and testing in the subject’s language of choice. Participants endorsing a history of learning disability, head injury with loss of consciousness, stroke, epilepsy, electroshock therapy, neurosurgery, exposure to toxic substances, cerebral disorders, psychiatric disorders, substance use problems, or hearing or vision disabilities were excluded from the sample.
The SPM was administered after completion of the intake interview, which was followed by the administration of a language preference questionnaire. The ARSMA-II was then orally presented with the choice of five responses enlarged and placed on a laminated sheet in front of the participant. Responses were recorded by the examiner, followed by the administration of the WCST.

2. Results

Fifty-four of 74 potential participants who volunteered qualified to complete the entire battery of tests after being interviewed. All but one subject chose to be interviewed and tested in Spanish. WCST administrations for two participants were judged invalid and were excluded from the analysis. Data from the remaining 52 participants were analyzed. Pearson product–moment correlations were performed to determine if a relationship existed between the acculturation subgroups and the scores obtained on the WCST by the Northwest sample (N = 52). A significant correlation was found between the acculturation subgroups and the Total Number of Trials measured on the WCST (r = −.348, P = .012).

2.1. Within-group contrasts of acculturation subgroups

The most notable difference between the acculturation subgroups was in the variable percentage of education received in the United States. The more acculturated subgroup did not vary significantly in total years of education with the less acculturated subgroup yet had a significantly larger percentage of education received in the United States (more acculturated: M = 24.0%; less acculturated: M = 2.1%). Lifespan lived in the United States was not significantly different between the two groups. The two subgroups also differed significantly on numbers of males and females, a variable previously shown to not influence WCST performance (Artiola i Fortuny et al., 1999; Heaton et al., 1993).

Table 2 summarizes the significant differences in WCST results obtained by each acculturation subgroup. A Mann–Whitney U test was performed to contrast the performance of the two subgroups and found significant differences on the Total Number of Trials (more acculturated: M = 104.4; less acculturated M = 119.7) and Non-Perseverative Errors (more acculturated: M = 16.1; less acculturated: M = 22.4) measures between the two subgroups.

After a priori contrasts were completed, we decided to do a post hoc contrast of the WCST performance of the acculturation subgroups by converting the raw scores into T scores to subject the raw scores to a process of demographic correction for total years of education. When the WCST raw scores of the two acculturation subgroups were transformed into T scores using the procedure described in Manual de Normas y Procedimientos para la Batería Neuropsicológica en Español (Artiola i Fortuny et al., 1999), a t test demonstrated no significant differences between the two groups.

2.2. Between-group contrasts of Northwest sample with the Spanish and English norms

Contrasts of demographically corrected WCST T scores of the Northwest sample (N = 52) with those of the Spanish norms (N = 390) demonstrated no clinically significant differences.
Table 2
Wisconsin Card Sorting Test raw score results of the Northwest sample and acculturation subgroups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Northwest sample (N = 52)</th>
<th>Less acculturated (n = 41)</th>
<th>More acculturated (n = 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S.D.</td>
<td>Mean</td>
</tr>
<tr>
<td>Categories Completed</td>
<td>3.94</td>
<td>1.92</td>
<td>3.83</td>
</tr>
<tr>
<td>Total Number of Trials</td>
<td>116.46</td>
<td>18.20</td>
<td>119.71</td>
</tr>
<tr>
<td>Total Correct</td>
<td>69.65</td>
<td>13.86</td>
<td>70.76</td>
</tr>
<tr>
<td>Total Number of Errors</td>
<td>46.81</td>
<td>23.56</td>
<td>48.95</td>
</tr>
<tr>
<td>Perseverative Responses</td>
<td>30.06</td>
<td>24.39</td>
<td>30.98</td>
</tr>
<tr>
<td>Non-Perseverative Errors</td>
<td>25.73</td>
<td>18.52</td>
<td>26.54</td>
</tr>
<tr>
<td>Percent Concept Response</td>
<td>21.08</td>
<td>13.41</td>
<td>22.41</td>
</tr>
<tr>
<td>Trials to First Category</td>
<td>23.44</td>
<td>27.54</td>
<td>23.22</td>
</tr>
<tr>
<td>Failure to Maintain Set</td>
<td>1.12</td>
<td>1.38</td>
<td>1.20</td>
</tr>
</tbody>
</table>

* Acculturation subgroups differed significantly on Total Number of Trials (Mann–Whitney U = 147.5, P = .039, two-tailed) and on Non-Perseverative Errors (Mann–Whitney U = 131.0, P = .034, two-tailed).

Table 3
Two-tailed t tests contrasting Wisconsin Card Sorting Test raw scores of the Northwest sample with the English norms

<table>
<thead>
<tr>
<th>WCST scores</th>
<th>Northwest sample (N = 52)</th>
<th>English norms (N = 67)</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>Categories Completed</td>
<td>−6.78**</td>
<td>3.94</td>
<td>1.92</td>
</tr>
<tr>
<td>Total Number of Trials</td>
<td>11.03**</td>
<td>116.46</td>
<td>18.20</td>
</tr>
<tr>
<td>Total Number of Errors</td>
<td>8.66**</td>
<td>46.81</td>
<td>23.56</td>
</tr>
<tr>
<td>Perseverative Responses</td>
<td>6.02**</td>
<td>30.06</td>
<td>24.39</td>
</tr>
<tr>
<td>Non-Perseverative Errors</td>
<td>6.54**</td>
<td>25.73</td>
<td>18.52</td>
</tr>
<tr>
<td>Percent Concept Response</td>
<td>−8.59**</td>
<td>50.37</td>
<td>22.35</td>
</tr>
<tr>
<td>Trials to First Category</td>
<td>3.08*</td>
<td>23.44</td>
<td>27.54</td>
</tr>
<tr>
<td>Failure to Maintain Set</td>
<td>3.11*</td>
<td>1.12</td>
<td>1.38</td>
</tr>
</tbody>
</table>

Note. df = 51 for all t tests. Effect size calculated using Cohen’s delta (1988).
* P < .01.
** P < .001.

Two-tailed t tests were completed to contrast the WCST performance of the Northwest sample with that of the English norms (Heaton et al., 1993). Results in Table 3 demonstrate the significant differences between the two groups and effect sizes greater than one standard deviation on nearly all of the WCST measures when the Northwest sample was contrasted with the English norms (n = 67).

3. Discussion

This study examined the speculation that the WCST might be a relatively culture-free neuropsychological test. The influence of acculturation on performance on the WCST was
investigated with a sample \((N=52)\) of 20-to 29-year-old Mexican Americans. Within-group contrasts were made between subgroups divided according to acculturation level as measured by the ARSMA-II. Contrasts of the WCST performance of this sample were made with the norms developed for Spanish speakers in the *Manual de Normas y Procedimientos para la Batería Neuropsicológica en Español* (Artiola i Fortuny et al., 1999) and with the English norms contained in the manual (Heaton et al., 1993).

3.1. First hypothesis

The first hypothesis was supported. The ARSMA-II divided the Northwest sample into meaningful subgroups based on level of acculturation that performed significantly differently. Significant within-group differences were demonstrated for Total Number Trials and Non-Perseverative Errors measures on the WCST. In each instance, the more acculturated subgroup performed better than the less acculturated subgroup. The significant differences demonstrated between the acculturation subgroups contradict the speculation that the WCST might be a relatively culture-free neuropsychological instrument.

The question arises whether these differences in WCST performance were due to the educational differences between the two subgroups. The acculturation subgroups had similar amounts of total education yet differed significantly on the percentage of this education received in the United States. The more acculturated subgroup had a mean of nearly three years of education in the United States compared to a mean of less than three months for the less acculturated subgroup. While it appears that country of education plays a significant part in the acculturation process, this is likely confounded with total years of education.

It is important to note, however, that when the raw scores of the acculturation subgroups were transformed into \(T\) scores using the procedure detailed in the *Manual de Normas y Procedimientos para la Batería Neuropsicológica en Español* (Artiola i Fortuny et al., 1999), no significant within-group differences remained. The process of demographic correction for total years of education contained in the Spanish norms removed enough of the influence of acculturation so that significant differences between the two subgroups no longer remained.

3.2. Second hypothesis

When the mean \(T\) scores of the combined Northwest sample \((N=52)\) were compared to those of the Spanish norms \((N=390)\), no clinically significant differences were demonstrated. The norms developed by Artiola i Fortuny et al. (1999) effectively accounted for the influence of significant cultural variables related to education causing differences in performance between the two groups. Though it remains to be demonstrated with a larger, randomized sample, the U.S.–Mexico border region norms contained in the Spanish norms appear to be appropriate for use with this growing population of Mexican Americans in the United States at lower levels of acculturation.

3.3. Third hypothesis

The third hypothesis that there would be a significant difference in performance on the WCST between the Mexican American sample and the English norms was clearly supported.
Contrasts between the performance of the sample with the English norms demonstrated convincingly significant differences ($P < .001$) on nearly all measures of the WCST between the two groups. This clearly refutes the speculation that the WCST might be a culture-free neuropsychological instrument. This finding empirically demonstrates that the English norms are not appropriate for use with this Spanish speaking population and shows the cultural bias in the WCST when the English norms are used to evaluate Mexican Americans at lower levels of acculturation. This study compellingly demonstrates that use of the English norms could produce false positive indications of executive functioning deficits in normal subjects. Clinicians assessing Mexican Americans with the WCST should be especially careful to seek convergence of data from multiple sources before making definitive diagnoses when using the U.S.–Mexico border region norms.

3.4. Limitations and directions for future research

This study provides evidence supporting the trend that more acculturated Mexican Americans perform better than less acculturated Mexican Americans on the WCST. The majority of the sample for this study, however, included participants who ranked at the two lowest levels of acculturation on the ARSMA-II. Validation of this trend would require further study with a variety of age groups and with subjects scoring at higher levels of acculturation on the ARSMA-II. The likely confound between years of education and place of education as they influence WCST performance also deserves further investigation.

This study empirically supports the use of the U.S.–Mexico border region norms for the WCST in the neuropsychological battery of tests developed by Artiola i Fortuny et al. (1999) with Spanish speaking populations. Future research is recommended to investigate the use of these norms with populations from other Spanish speaking countries and territories.

References


