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Normative Performance on the CLOX Task in a Multi-Ethnic Bilingual Cohort: A Project FRONTIER Study

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Abstract

The CLOX test is a neuropsychological measure intended to aid in the assessment and detection of dementia in elderly populations. Few studies have provided normative data for this measure, with even less research available regarding the impact of socio-demographic factors on test scores. This study presents normative data for the CLOX in a sample of English- and Spanish-speaking Hispanic and non-Hispanic Whites. The total sample included 445 cognitively healthy older adults seen as part of an ongoing study of rural cognitive aging, Project FRONTIER. Unlike previous studies, criteria for "normality" (i.e., unimpaired) for CLOX1 and CLOX2 were based not merely on global impairment, but also on domain-specific impairment of executive functioning on the EXIT25 and/or Trail Making Test B (Trails B), or visuospatial/constructional impairment on the Line Orientation and Figure Copy subtests of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), respectively. Hierarchical regression analyses revealed that

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CLOX1 scores require adjustment by Age across ethnicities, while Education and Gender are necessary stratification markers for CLOX1 performance only in non-Hispanic Whites. None of the demographic variables were valid predictors of CLOX2 performance, negating the need for such adjustments. In addition to being the first study to provide separate normative data for CLOX performance in Hispanic and non-Hispanic White samples, the current study offers a novel approach to defining "normal" by cognitive domain. We also highlight the need to directly examine the impact of socio-demographic factors before applying normative corrections based on factors that have negligible impact on test scores.

Keywords

Executive functioning; visuospatial skills; norms; geriatrics; cognition

Introduction

Clock drawing tests (CDTs) are commonly used in the neuropsychological assessment of cognitive functioning and dementias (Shulman, 2000). In particular, CDTs have been found to be valid measures of executive control functioning (ECF), the cognitive function responsible for integrating isolated and basic mental activities into unified, complex, and goal-directed cognitive activities (Royall et al., 2003; Libon, Swenson, Barnoski, & Sands, 1993). The CDT has been found to be a useful tool in discriminating between cognitively healthy older adults from those meeting diagnostic criteria for dementia (Sunderland, Hill, & Mellow, 1989; Tuokko, Hadjistavropulous, Miller, & Beattie, 1992).

A number of studies have provided support for the notion that CDTs are valid and reliable measures of cognitive functioning, demonstrating, for instance, high correlations with other traditional neuropsychological tests of visuospatial processing and global cognition (e.g., MMSE, CAMCOG) (Heinik, Solomesh, & Berkman, 2004; Manos & Wu, 1994; Mendez, Ala, & Underwood, 1992; Shulman, Gold, & Cohen, 1993; Sunderland, Hill, & Mellow, 1989). Additionally, errors noted on CDTs have been found to follow a consistent path along with longitudinally observed cognitive impairments associated with dementias, providing further support for the notion that CDTs can be validly used in the assessment of dementias (Kirk and Kertesz, 1991; Tuokko, Hadjistavropulous, Miller, & Beattie, 1992).

A wide variety of CDTs have been developed, each relying on differing systems of quantitative or qualitative error scoring (Freedman et al., 1994; Libon, Malamut, Swenson, Sands, & Cloud, 1996); Mendez, Ala, & Underwood, 1992; Royal, Cordez, & Polk, 1998). The Executive Clock Drawing Test (CLOX) relies on a quantitative scoring system, while being further divided into two sub-areas of assessment of executive functioning (CLOX1) and visuospatial/ visuoconstructive abilities (CLOX2). The CLOX has been shown to be a valid and reliable measure of executive functioning and visuoconstructional abilities, correlating strongly with other measures of global cognition (MMSE scores) and executive functioning (the Executive Interview 25-item Examination) (EXIT25; Royall, Cordes, & Polk, 1998). The brief and bi-dimensional nature of the CLOX, as well as its convergent validity with other neuropsychological measures, have been offered as advantages over other measures (Royall, Chiodo, & Polk, 1999). However, there remains a need for additional normative data, which is particularly timely given the increasing diversity of the U.S. elderly population (U.S. Census, 2004).

One of the fastest growing minority groups in the U.S. are Hispanics (U.S. Census of Population, 2000). A limited number of studies have examined the psychometric properties or normative performance on neuropsychological tests in the Hispanic population, an important avenue of investigation given that Mexican American older adults exhibit increased cognitive dysfunction on various measures including the CLOX (Royall, Espino, Polk, Palmer, & Markides, 2004), MMSE (Heller et al., 2006), Halsteid-Reitan (Arnold, Montgomery, Castaneda, & Longoria, 1994), Wechsler Memory Scale-Revised (Demsky, Mittenberg, Quintar, Katell, & Golden, 1998), and Wisconsin Card Sorting Test (Coffey, Marmol, Schock, & Adams, 2005), as well as have lower levels of educational achievement (e.g., U.S. Census, 2008; Harris & Llorente, 2005). The generally poorer test performance reported for Hispanics may reflect group differences on various socioeconomic markers, which in turn further speaks to the importance of providing further validation and normative data for various neuropsychological instruments in this particular ethnic group.

Despite the clear gaps in knowledge noted in this area of research, studies have already established that the CLOX is generally less sensitive to issues of ethnocultural disparity, including linguistic or education inequalities, compared to other measures (La Rue et al., 1999). Additionally, reports indicate that the CLOX is a valid measure of ECF in elderly Hispanics (Royall et al., 2004), including in its Spanish translated version (Royall et al., 2003). While the CLOX appears to be a valid assessment tool in elderly samples of Hispanics, no research has to our knowledge provided normative data for CLOX performance in this ethnic group. As pointed at in a study by Royall et al. (2003), obtaining normative data for diverse groups is essential, as relying on non-matching reference norms based on contrasting ages or ethnicities makes it more likely that interpretative errors will be committed. This study attempted to fill in the gaps in knowledge in this domain, providing normative data for the CLOX in a sample of Hispanic and non-Hispanic White older adults. The current study also advances on prior normative work by utilization of domain-specific criteria for inclusion into the reference group. The majority of prior normative studies have utilized screeners of global cognition (e.g. MMSE) or self-report for inclusion without formal assessment of domain-specific integrity. In the current study, inclusion into the normative reference group was based on “normal” performance on independent tests of executive functioning and visuospatial skills.

Materials and Methods

Data was analyzed from a sample of 445 English- and Spanish-speaking Hispanic and non-Hispanic Whites recruited as part of Project FRONTIER, an ongoing epidemiological study of health among rural-dwelling individuals. A self-report questionnaire was used to assess ethnicity as well as linguistic fluency and proficiency. Approximately half of the Hispanic sample reported being of Mexican origin and described having greater mastery of Spanish than English, such that all tests were administered in Spanish for this group. All other participants reported adequate mastery of English and were tested in this language. The protocol includes a standardized medical examination, clinical labs, neuropsychological testing, as well as interviews with participants and informants. Inclusion criteria are (1) age 40 and above and (2) residing in one of the counties part of Project FRONTIER, including Cochran County and Parmer County, both located on the Texas – New Mexico border. Participant recruitment is conducted by community recruiters through brochures/flyers, presentations and events, as well as in-person and/or door-to-door solicitation. All participants signed written informed consent and completed extensive questionnaires and tests that included demographic, health, behavior, functional and cognitive assessments including MMSE, Clinical Dementia Rating (CDR) scale, CLOX, Trails B, Line Orientation and Figure Copy subtests of the RBANS, among other neuropsychological measures. Years of education was used as an indicator of educational attainment and was based on participant self-report. Project FRONTIER is conducted under an Institutional Review Board approved protocol.

In order to have a well-defined "normal" sample, participants were excluded if they exhibited global cognitive impairments defined as an MMSE score <1.5 *SD* below the sample mean (scores <24) and/or a global CDR greater than zero (a score of zero representing no dementia), with CDR scores ranging from 0 to 15. Additionally domain-specific (i.e. executive functioning and visuospatial functioning) cut-scores were implemented. Individuals exhibiting executive functioning deficits defined as scores >15 on the EXIT25 and/or >1.5 SD above the sample mean on Trails B were excluded from the CLOX1 normative sample. Trails B standardized scores were based on raw scores, and the established cutoff corresponded to a raw score >223. Participants scoring < 1.5 SD below the sample mean on the Line Orientation (total scores <10) and Figure copy (total scores <9) subtests of the RBANS were excluded from the CLOX2 normative sample due to impaired visuospatial/constructional abilities. The 1.5 *SD* cut-score was chosen to be consistent with guidelines utilized for syndromes of cognitive impairment such as Mild Cognitive Impairment (MCI) (Albert et al., 2001; Petersen et al., 1999).

Measures

Global cognitive functioning was measured using the MMSE (Folstein, Folstein, & McHugh, 1975), with scores ranging on a scale from 0 to 30 and higher scores describing better cognitive functioning. The MMSE has been found to be a valid and reliable indicator of global cognitive impairment in multi-ethnic bilingual samples of older adults (Espino, Lichtenstein, Palmer, & Hazuda, 2001).

The CDR global score was used to evaluate functional level (Morris, 1997). Scores are obtained using a semi-structured interview of participants, with cognitive functioning rated across six different areas of functioning: memory, orientation, judgment and problem solving, community affairs, home and hobbies, and personal care. The CDR been shown to have adequate psychometric properties (Morris, 1997).

The CLOX (Royall et al., 1998) is a clock drawing task divided into CLOX1, a measure of ECF requiring subjects to draw the face of a clock with hands pointing at 1:45, with no further instruction; and CLOX2, a measure of visuospatial/ visuoconstructive abilities requiring subjects to copy the face of a clock. CLOX performance data are extracted from a quantitative scoring system including ratings for various sub-areas of performance, with total scores ranging from 0 to15. The CLOX has been found to have good interrater reliability and internal validity in English- and Spanish-speaking Hispanics and non-Hispanic Whites, as well as adequate sensitivity to various levels of executive functioning (Royall, Mulroy, Chiodo, & Polk, 1999; Royall et al., 2003).

The EXIT25 is a bedside measure of executive control (Royall, Mahurin, & Gray, 1992). EXIT25 has been found to be highly correlated with other measures of executive control, with high internal validity (α=.85) and high interrater reliability (r=.91) (Stockholm, Vogel, Gade, Waldemar, 2005). EXIT25 consists of 25 items ranging from 0 to 50, with higher scores suggesting greater deficits of executive control. A cut-score of 15 out of 50 is typically used to discriminate between non-demented control subjects from both cortically and non-cortically demented ones in elderly populations. This test has also been shown to be more sensitive than MMSE at identifying the presence of milder levels of cognitive impairments (Stockholm et al., 2005).

Trails B is a measure of cognitive flexibility that requires visual scanning abilities, flexible switching between the components of the task, and the capacity to work under time pressure. Reitan’s scoring strategy was used to administer and score this test (Reitan & Wolfson, 1995), including requiring participants to self-correct under time pressure. Raw scores represent total time to completion in seconds.

The RBANS (Randolph, 1998) is a brief, individually administered screening test battery composed of 12 subtests measuring visuospatial/constructional abilities, attention, language, immediate and delayed memory, further generating five Index scores and a Total Scale score. The Figure Copy and Line Orientation subtests are used as tests of visuospatial/constructional abilities. All subtests were administered and scored as defined in the manual (mean of 100 and standard deviation of 15; subtest scores: mean of 10 and standard deviation of 3), with the exception of the Figure Copy and Figure Recall, more thoroughly described in Duff et al. (2007).

Procedures

The normative sample was composed of cognitively healthy participants as determined by consensus by a panel composed of a clinical neuropsychologist and medical doctors who reviewed available objective test data and subjective and/or a collateral source. These were used as indicators of any previous diagnosis, cognitive or functional impairments (e.g., difficulty performing tasks of daily living such as driving). Exclusion criteria for the normative references are described above. The current study used the Predictive and Analytical Software, version 18, and significance was set at $p \leq .05$.

Statistical Analyses

Linear regression models were created to determine the relation between demographic factors and CLOX1 and CLOX2 scores. This was done to determine if and how the sample should be stratified based on these factors.

Results

Table 1 and 2 present the characteristics of the CLOX1 and CLOX2 samples across ethnicities. In the total sample of 445 individuals, the mean age of participants was 61.9, with a mean of 10.9 years of education. The complete sample included 43% of Hispanics and 57% of non-Hispanic Whites, with a total of 68.7% of women. A total of 156 participants were excluded based on global exclusion criteria.

As reported in Table 1, 167 participants (37.5%) were excluded from the CLOX1 normative sample for failure to meet the inclusion criteria described above, among which 50 were excluded based on domain-specific criteria alone. The final normative sample included 278 participants with a mean age and education of 59 (*SD*=11.52, range=40–93) and 12.1 (*SD*=3.94, range=0–20), respectively. Excluded cases were older, less educated, more likely to be of Hispanic origin and male, compared to the normative sample. The CLOX1 normative sample of Hispanics consisted of 106 participants, while the non-Hispanic normative sample included 172 participants.

Table 2 presents characteristics for the CLOX2 sample, as well as a comparison of the normative and excluded cases. A total of 177 cases were excluded from the sample, based on the exclusion criteria described earlier, with a resulting normative sample size of 268 participants. A total of 51 participants were excluded based on domain-specific criteria. As in the CLOX1 sample the cases excluded from the CLOX2 were significantly older, less educated, more likely to be of Hispanic origin and male, compared to normative cases.

A series of hierarchical regression analyses were conducted in order to determine the relative predictive value of key sociodemographic variables on CLOX performance, and to aid in establishing proper stratification criteria. Age, Education, Gender, and Language of administration were entered simultaneously as a first step in all regression equations.

Among Hispanics, the demographic factors accounted for a total of 7% of the variance in CLOX1 performance ($R = .26$, R squared $= .07$; $F(4, 92) = 1.72$, $p = .15$), with age being the only significant negative predictor of test performance ($\beta = -.27$, $t = -2.4$, $p < .05$). Among non-Hispanic whites, sociodemographic variables accounted for a total of 9.8% of the variance in CLOX1 scores ($R = .31$, R squared $= .098$; $F(4, 162) = 4.38$, $p = <.01$), with all key variables except language of administration significantly predicting test scores. Specifically, age was found to be a significant negative predictor of CLOX1 ($\beta = -.16$, $t = -2.17$, $p < .05$), while both education ($\beta = .15$, $t = 1.92$, $p = .05$) and female gender ($\beta = .22$, $t = 2.87$, $p = <.01$) positively predicted this outcome.

Based on these results, CLOX1 scores were stratified only by age among Hispanics. A median split was conducted on the age variable in the CLOX1 normative Hispanic sample producing fairly equivalent sample size representation across groups with at least 47 participants in each group. See Table 3. The two age groups consisted of participants who were 40–51 or 52 or more years old. The mean score for the 40–51 years old age group was 12.7 (n=57), compared to 12.4 for the 52 and more years old group (n=47).

For the non-Hispanic whites, median splits were conducted by age and education. The two age groups were 40–61 and 62 or more years old with the education groups reflecting those with 8–13 years of education and 14 or more years. Normative splits by gender are also provided. See Table 4. Average CLOX1 scores differed across the different combinations of age, education, and gender groups, with a lowest mean score of 11.5 (*SD*=2.3) for the male participants in the 62 and older and those who fell in the 8–13 years of education range. The highest mean score was 13.8 (*SD*=1.1) for female participants falling in the 40–61 age range with 8–13 years of education.

None of the sociodemographic variables were found to predict CLOX2 performance in either Hispanics or non-Hispanic Whites; therefore, no adjustments were made. Average CLOX2 for Hispanics was 13.6 (*SD*=1.2), and 14.1 (*SD*=1.1) in non-Hispanic Whites. Hispanic participants had fewer years of education, were younger, and included a greater number of females compared to non-Hispanic Whites.

Discussion

As CDTs have become widely used in the process of detecting dementia in clinical settings (Shulman, 2000), the need for research to examine the normative value and utility of this test has become essential. Additionally, the rapid increase in diversity reported by recent demographic trends (U.S. Census Bureau, 2004) indicates that further research is needed to cross-culturally examine these issues. The current study aimed at providing normative data for the CLOX in a sample of cognitively healthy Hispanic and non-Hispanic White participants. While previous studies have established the validity of this test (Kirk and Kertesz, 1991; Tuokko, Hadjistavropulous, Miller, & Beattie, 1992), no research has to our knowledge undertaken to provide normative data for these two particular ethnic groups.

The results of our study indicate that age is an important stratification marker in prediction of CLOX1 test performance. Specifically, the current results revealed that age was a strong predictor of test performance for CLOX1, and that age adjustments were necessary in both ethnic groups. This supports previous findings that age is one of the strongest predictor of neurocognitive functioning (Crowe, Clay, Sawyer, Crowther, & Allman, 2008; Schillerstrom et al., 2007; Von Gutten et al., 2007), while also being consistent with past research reporting that strength of performance on measures of executive functioning is negatively related with age (e.g., Lin-Kiat Yap, Ng, Niti, Yeo, & Henderson, 2007).

A number of studies have shown that education and gender tend to be highly predictive of performance on various neuropsychological tests (Crowe, Clay, Sawyer, Crowther, & Allman, 2008; Schillerstrom et al., 2007; Von Gutten et al., 2007). In partial agreement with these previous findings, the current study indicates that education and gender are strong predictors of test performance on CLOX1, but that this relation is only applicable to non-Hispanic Whites. This finding was unexpected given past evidence suggesting that Mexican Americans' performance on various neurocognitive measures is affected by these two variables (Heller et al., 2006). Overall, our findings suggest that the predictive value of such sociodemographic variables is not unwavering across ethnicities. These findings reinforce the view that cross-cultural differences impact performance on certain neuropsychological measures, including on CLOX1. These findings further highlight the importance of establishing ethno-culturally adapted norms, and to avoid over-generalization of empirical data based on culturally homogeneous samples.

Another surprising finding was that none of the sociodemographic variables included in the analyses (i.e., education, age, gender, or language) were found to predict test performance on CLOX2. This pattern of results suggests that normative performance on tests of visuospatial/constructional abilities does not necessitate further adjustment. Instead, results indicate that adequacy in detection of dementia based on CLOX2 performance can be achieved by relying on existing norms.

The current findings should be interpreted with caution as this study presents with a number of limitations. For one, previous studies providing norms for the CLOX used different ethno-cultural samples such that current results may not be applicable to prior findings. It would be important for future studies to attempt to replicate the current pattern of results, using larger sample sizes. Moreover, while we tested demographic variables known to be most relevant to performance on the CLOX (Crowe, Clay, Sawyer, Crowther, & Allman, 2008; Von Gutten et al., 2007), it is possible that latent variables contributed to the current pattern of results. Specifically, quality of education has been proposed to be a more accurate predictor of CLOX performance than years of education (Dotson, Kitner-Triolo, Evans, & Zonderman, 2008; Manly & Echemendia, 2007), particularly in socioeconomically disadvantaged populations with access to generally poorer educational opportunities (Crowe, Allman, Triebel, Sawyer, & Martin, 2010). It is possible that education would be a stronger predictor of performance on CLOX1 (for Hispanics) or CLOX2 had we relied on a different operationalization of this construct, using quality of education instead of years of education. Future studies should thus examine the predictive value of this variable while seeking to replicate the present findings.

A challenge inherent to research in cross-cultural neuropsychology is to determine which of the myriad of factors related to ethno-cultural issues are most important to consider in establishing test norms. While a number of factors related to ethnicity have been argued to be valuable predictors of cognitive performance, such as acculturation (Royall et al., 2002) or bilingualism (Bialystok, Craik, Green, & Gollan, 2009), these factors tend to be underrepresented in this line of research, and remain a limitation in this study. Specifically, bilingualism has been shown to have a strong influence on neurocognitive functioning (Bialystok et al., 2009), such that it would be important for future studies to provide language group based norms. In particular, given that a positive relationship has been established between bilingualism and executive functioning (Bialystok et al., 2009), it is possible that bilingual participants' performance on CLOX1 would have been higher and significantly different from their monolingual peers in this study. Future studies will thus need to provide cross-cultural normative data on the CLOX and other standard neuropsychological measures accounting for language-related differences.

Despite these limitations, this study is to our knowledge the first to provide separate normative data for a sample of English- and Spanish-speaking Hispanics and non-Hispanic Whites. As noted earlier, this represents an important first step in moving towards more socioculturally adapted and valid diagnostic decision-making. Data was also provided for a more comprehensive age and education range compared to past normative studies on the CLOX (Crowe et al., 2010; Lin-Kiat Yap et al., 2007). An additional advantage to the current study is the implementation of domain-specific inclusion/exclusion criteria. The majority of prior normative work has utilized global cognition as screening into studies to avoid circular rationale between study inclusion variables and outcome variables. However, Project FRONTIER tested a broad sample of community-dwelling adults and elders; therefore, domain-specific inclusion could be created. Given that domain-specific impairment is not an uncommon occurrence, this approach should be incorporated into future normative studies when possible.

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Key Points

Adequate normative data is needed for neuropsychological assessments with Hispanic population. The CLOX can be used with Mexican Americans. The impact of demographic variables on CLOX performance varies by task (i.e. CLOX1 versus CLOX2) and ethnicity.

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Table 1

Descriptive Statistics of CLOX1 Sample

Attributes	Complete Sample (N=445)	Excluded Sample (n=167)	Total Normative Sample (n=278)	Normative Hispanic (n=106)	Normative Non-Hispanic Whites (n=172)	Comparison of Total Normative Sample to Excluded	*p*
Age, M (*SD*), rg.	61.9 (12.5), 40–96	67.7 (12.3), 40–96	58.6 (11.4), 40–93	52 (8.0), 40–74	62.7 (11.3), 40–93	t (440)=−7.8	<.001
Education, M (*SD*), rg.	10.9	8.9 (4.9), 0–20	12.2 (3.8), 0–20	9.3 (3.7), 0–18	14 (2.6), 8–20	t (440)=7.9	<.001
Hispanics, %	43	50.9	38	100	0	X^2 =(1, N=442), d=7.7	<.01
Females, %	68.7	59.3	74.2	81.1	70	X^2 =(1, N=442), d=11.3	.001
MMSE, M (*SD*), rg.	27.5 (2.9), 12–30	25.5 (3.5), 12–30	28.76 (1.4), 24–30	28.3 (1.6), 24–30	29 (1.2), 24–30	t (439)=14.2	<.001
CDR, M (*SD*), rg.	.38 (1.0), 0–15	.93 (1.0), 0–6	0	0	0	t (440)=−15	<.001
EXIT25, M (*SD*), rg.	7.1 (4.7), 0–23	10.5 (4.8), 2–23	5.2 (3.3), 0–15	6.1 (3.6), 1–14	4.6 (3.1), 0–15	t (421)=−13.5	<.001
Trails B, M (*SD*), rg.	123.04 (71.0), 33–532	175.5 (88.6), 59–532	97.1 (40.4), 33–223	112.7 (43.5), 36–223	87.8 (35.9), 33–209	t (402)=−12.3	<.001
CLOX1, M (*SD*), rg.	12.1 (2.3), 0–15	11.2 (2.8), 0–15	12.74 (1.7), 4–15	12.6 (1.7), 4–15	12.8 (1.8), 6–15	t (436)=7.0	<.001

Notes: M = mean; *SD* = standard deviation; rg. = range; MMSE = Mini Mental Status Exam; CDR = Clinical Dementia Rating scale; EXIT25 = Executive Interview 25-item Examination; Trails B = Trails Making Test; CLOX = Executive Clock Drawing Test. X^2chi-square;d = Cohen's d. *p*-values obtained for comparison of those excluded and the normative sample using *t*-test or chi-square analysis.

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Table 2

Descriptive Statistics of CLOX2 Sample

Attributes	**Complete Sample (N=445)**	**Excluded Sample (n=177)**	**Total Normative Sample (n=168)**	**Normative Sample, Hispanics (n=106)**	**Normative Sample, Non-Hispanic Whites (n=162)**	**Comparative Analyses of Normative to Excluded**	***p***
Age, M (*SD*), rg.	61.9 (12.5), 40–96	67.1 (12.3), 40–96	58.5 (11.2), 40–93	52.9 (8.9), 40–79	62.3 (11.5), 40–93	t (439)=−7.3	<.001
Education, M (*SD*), rg.	10.9 (4.5), 0–20	9.35 (4.8), 0–20	12.1 (4.1), 0–20	8.9 (3.8), 0–18	14.1 (2.6), 8–20	t (439)=6.5	<.001
Hispanics, %	43	83	38.6	100	0	X^2 = (1, N=441), d = 2.7	.098
Females, %	68.7	60.6	73.2	80.2	69.8	X^2 = (1, N=441), d = 8.9	<.01
MMSE, M (*SD*), rg.	27.5, (2.9), 12–30	25.6, (3.5), 12–30	28.9 (1.4), 24–30	28.3 (1.6), 24–30	29.1 (1.2), 24–30	t (439)=13.5	<.001
CDR, M (*SD*), rg.	.38, (1.0), 0–15	.89, (1.0), 0–6	0	0	0	t (439)=−14.1	<.001
RBANS LO, M (*SD*), rg.	15.2, (3.9), 0–20	13.5, (4.8), 0–20	16.6 (2.7), 10–20	15.3 (2.9), 10–20	17 (2.6), 10–20	t (435)=7.8	<.001
RBANS FC, M (*SD*), rg.	14.0, (3.6), 0–20	12.4, (3.9), 0–20	15.2 (2.9), 9–20	14.6 (2.8), 9–20	15.5 (2.9), 9–20	t (437)=8.5	<.001
CLOX2, M (*SD*), rg.	13.51, (1.7), 0–15	12.9, (2.2), 0–15	13.95 (1.1), 10–15	13.6 (1.2), 11–15	14.1 (1.1), 10–15	t (437)=6.4	<.001

Notes: M = mean; *SD* = standard deviation; rg. = range; MMSE = Mini Mental Status Exam; CDR = Clinical Dementia Rating scale; RBANS = Repeatable Battery for the Assessment of Neuropsychological Status; LO = Line Orientation; FC = Figure Copy; CLOX = Executive Clock Drawing Test. X^2chi-square;d = Cohen's d. p-values obtained for comparison of those excluded and the normative sample using t-test or chi-square analysis.

Table 3

Normative data for CLOX1 Hispanic sample, by age group

Age Group	
40–51	52+
n = 57, Mean = 12.7, *SD* = 1.6	n = 47, Mean = 12.4, *SD* = 1.8

Notes: SD = standard deviation; CLOX = Executive Clock Drawing Test

Table 4

Normative data for CLOX1 non-Hispanic Whites, by age, education, and gender groups

	Age group			
	40–61		**62+**	
Education	**Females**	**Males**	**Females**	**Males**
8–13	n=32, Mean=12.9, *SD*=1.6	n=6, Mean=12.8, *SD* =1.5	n=35, Mean=12.7, *SD* =1.6	n=17, Mean=11.5, *SD* =2.3
14+	n=29, Mean=13.8, *SD* =1.1	n=16, Mean=12.5, *SD* =2.1	n=24, Mean=13.1, *SD* =2.0	n=13, Mean=12.7, *SD* =1.3

Notes: SD = standard deviation; CLOX = Executive Clock Drawing Test