Published in final edited form as:

J Clin Exp Neuropsychol. 2012 October ; 34(8): 814–825. doi:10.1080/13803395.2012.683856.

Multidimensional effects of acculturation on English-language neuropsychological test performance among HIV+ Caribbean Latinas/os

Alyssa Arentoft^{1,2}, Desiree Byrd^{3,4}, Reuben N. Robbins⁵, Jennifer Monzones^{1,6}, Caitlin Miranda¹, Ana Rosario^{1,7}, Kelly Coulehan¹, Armando Fuentes¹, Kaori Kubo Germano¹, Erica D'Aquila¹, Jake Sheynin¹, Felicia Fraser¹, Susan Morgello^{3,8}, and Monica Rivera Mindt^{1,3,4}

¹Department of Psychology, Fordham University

²Department of Psychology, West Los Angeles VA Healthcare Center

³Department of Neurology, Mount Sinai School of Medicine

⁴Department of Psychiatry, Mount Sinai School of Medicine

⁵HIV Center for Clinical and Behavioral Studies, Department of Psychiatry, Columbia University and the New York State Psychiatric Institute

⁶Department of Psychology, New Mexico VA Healthcare Center

⁷College of Arts and Science, New York University

⁸Departments of Pathology & Neuroscience, Mount Sinai School of Medicine

Abstract

Acculturation has been linked to neuropsychological performance in several ethnic groups. However, research among Latina/o samples has examined primarily Mexican/Mexican Americans, and has not examined Latina/o clinical populations of Caribbean descent. This study examined associations between a multidimensional acculturation measure and neuropsychological performance among 82 HIV+ Caribbean Latina/o adults. Multivariate results showed that U.S. acculturation significantly predicted 11–14% of the variance in Global Neuropsychological functioning, Verbal Fluency, and Processing Speed, whereas Latina/o acculturation predicted 8% of the variance in Executive Function and 6% in Motor Function (trend level associations). Both linguistic and non-linguistic cultural factors had distinct effects on neuropsychological performance.

Accurately diagnosing neuropsychological impairment is essential to treating individuals with diseases that affect the brain. Research consistently shows that ethnic minorities are more likely to be misdiagnosed as neuropsychologically impaired than non-Hispanic whites due to artificially depressed neuropsychological test scores (Boone et al., 2007; Campbell et al., 2002; Heaton et al., 2009; Manly et al., 1998a). Acculturation, the process by which individuals are influenced and changed through exposure to another culture (Zea et al., 2003), may be one factor contributing to this discrepancy. In fact, greater acculturation to majority (e.g., U.S.) culture among African Americans, Asian Americans, and Latinas/os has been significantly associated with better neuropsychological performance in a number of neuropsychological domains, including executive function, attention/working memory, verbal fluency, learning, memory, and processing speed (Arnold et al., 1994; Boone et al., 2007; Coffey, Marmol, Schock, & Adams, 2005; Harris, Cullum, & Puente, 1995; Harris,

Tulsky, & Schultheis, 2003, Kennepohl et al., 2004; Manly et al., 1998b). However, there are several important gaps in this current literature that merit further consideration.

The current literature on acculturation and neuropsychological functioning is limited by the circumscribed or unreported sampling of Latina/o participants, despite the fact that the Latina/o population is the largest and fastest growing racial/ethnic minority population in the U.S. (U.S. Census Bureau, 2006a, U.S. Census Bureau, 2006b, U.S. Census Bureau News, 2008). The U.S. Latina/o population is highly heterogeneous, with distinct subpopulations of different geographic origins (i.e., Mexico, the Caribbean, Central America, and South America) and racial admixtures (i.e., indigenous, African, and European). Each Latina/o subpopulation has a unique set of sociopolitical and cultural circumstances, as well as non-random geographic affinity (Llorente, 2007). The research accomplished to date with Latina/o adults has focused primarily on individuals of Mexican/Mexican American origin and has not examined other Latina/o groups (Coffey et al., 2005). Therefore, acculturation and neuropsychological functioning need to be assessed among other Latina/o subgroups, including those of Caribbean origin (Lopez-Class et al., 2011). Research has shown that factors considered to be proxies of acculturation, such as length of time living in U.S., years of education in the U.S. or language-related variables, such as language preference, English language competence, or bilingualism, are related to both English and Spanish-language neuropsychological test performance (Artiola i Fortuny, Heaton, & Hermosillo, 1998; Berry et al., 2003; Jacobs, et al., 1997a, 1997b; Harris, et al., 1995; Taussig et al., 1996). However, proxy variables provide only an indirect estimate of acculturation (Lopez-Class, González Castro, & Ramirez, 2011). Recent theory and research suggest that acculturation is a multidimensional construct and requires bidirectional measurement of acculturation to both the majority culture and the culture of origin (Abe-Kim, Okazaki, & Goto, 2001; Lopez-Class et al., 2011; Zea et al., 2003). Linguistic and non-linguistic cultural factors may also have distinct effects on neuropsychological performance; since they have not been examined separately and directly, they remain poorly understood. To our knowledge, no study to date has examined the associations between neuropsychological test performance and multidimensional measures of acculturation to both the dominant and non-dominant culture in Latina/o individuals.

Another limitation of the current literature is that few studies have examined the impact of acculturation in clinical populations. Prior studies have reported relationships between acculturation and neuropsychological functioning among neurologically healthy Latina/o adults (e.g., Arnold et al., 1994), heterogeneous samples including multiple clinical populations (i.e., neurologic, substance use, and psychiatric) of ethnic minority individuals (i.e., African American, Latina/o, Asian American; Boone et al., 2007), or specific clinical populations (e.g., HIV+, traumatic brain injury) within the African American community (Manly et al., 1998b; Kennepohl et al., 2004). However, research has not yet *specifically* examined these relationships within Latina/o clinical populations. This is of particular concern given that U.S. Latinas/os are disproportionately impacted by several chronic medical conditions, including HIV/AIDS (Centers for Disease Control [CDC], 2008a; CDC, 2008b), increasing their risk for neurologic complications and their need for neuropsychological services (see Rivera Mindt et al., 2010). In fact, poorer neuropsychological test performance has been reported among HIV+ Latina/o adults compared to their non-Hispanic white counterparts (Wojna et al., 2006), particularly in the area of executive function (Rivera Mindt et al., 2008). Therefore, focused research on acculturation among Latina/o cohorts is needed to help clarify these findings.

The present study sought to characterize the relationship between acculturation and neuropsychological test performance among a sample of HIV+ Latina/o adults of Caribbean origin. This study addresses the limitations of previous research by employing a

multidimensional, bidirectional measure of acculturation and a well-characterized sample of Latina/o adults of exclusively Caribbean origin.

We hypothesized that U.S. acculturation in the domains of English Language Competence, U.S. Cultural Competence, and U.S. Cultural Identity would be significantly and positively associated with global and domain-specific neuropsychological (NP) test performance. Conversely, we hypothesized that Latina/o acculturation levels in the domains of Spanish Language Competence, Latina/o Cultural Competence, and Latina/o Cultural Identity would be significantly and negatively associated with global and domain-specific neuropsychological test performance. Finally, we hypothesized that summary scores of overall acculturation to U.S. and Latina/o cultures would predict a significant amount of the variance in neuropsychological test performance using multivariate regression models.

Method

Participants

The current study sample included 82 HIV+ Caribbean Latina/o adults who participated in an NIMH-funded medication adherence study (PI: M. Rivera Mindt, PhD; K23MH079718). Participants were primarily recruited via community outreach in New York City, particularly East [Spanish] Harlem, and through self-referral. Additional recruitment occurred through clinics and related studies at the Mount Sinai School of Medicine (MSSM) in New York City.

All participants were HIV+ (confirmed by medical records), between the ages of 18–80, fluent in English and on stable antiretroviral therapy (at least 12 weeks on regimen). Only participants who self-identified as Latina/o and identified as being of Caribbean origin (e.g., Puerto Rico, Dominican Republic, Cuba) were included in the study. This study's exclusion criteria included self-reported history of any the following conditions that could impact cognition: severe psychiatric disorder (e.g., schizophrenia, psychosis, bipolar disorder) or significant non-HIV related co-morbid neurologic or medical condition (e.g., epilepsy, brain cancer or tumor, traumatic brain injury with loss of consciousness >60 minutes, neurosurgery, Lupus, Multiple Sclerosis, Parkinson's disease).

Procedure

Participants completed comprehensive neuropsychological and sociocultural evaluations. Blood samples were collected, from which CD4 lymphocyte counts [a measure of immunosuppression] and HIV plasma viral loads were assessed. All participants provided written informed consent. The study was approved by the Institutional Review Boards (IRB) of both Mount Sinai School of Medicine and Fordham University.

Neuropsychological Evaluation—Participants completed a comprehensive three hour neuropsychological test battery, which was administered and scored by trained psychometrists using standardized procedures. Table 1 summarizes the measures used, which assessed functioning in the following seven domains: verbal fluency, executive function, processing speed, attention/working memory, learning, memory, and motor function. Raw scores were converted to age-, education-, and/or gender- corrected T-scores using the best available published normative data (see Table 1). However, for consistency, Latina/o ethnicity corrections were not applied to the three WAIS-III subtests since similar ethnicity corrections were not available for the other NP tests. T-scores were then converted to global and domain specific deficit scores (DS), which provide a more sensitive index of neuropsychological impairment and are frequently used in HIV+ populations who often present with more subtle neuropsychological deficits (see Carey et al., 2004 for a

description). Deficit scores (DS) range from 0–5, with *higher* scores indicating *greater* impairment (0 = no impairment, 5 = severe impairment). Individual tests within each domain were averaged to obtain mean domain deficit scores. All neuropsychological test deficit scores were averaged to derive the Global Deficit Score (GDS), a measure of global neuropsychological functioning. Definitions of clinical impairment were based on cut-offs established by prior research (Woods et al., 2004), and a GDS score of ≥ 0.50 was considered impaired (Carey et al., 2004). Participants also completed the substance abuse modules of the Composite International Diagnostic Interview (CIDI; World Health Organization, 1997), which yields DSM-IV diagnoses of current substance abuse disorder.

Sociocultural Evaluation—Participants were interviewed regarding their sociocultural and ethnic background (e.g., country of origin, ethnicity, languages spoken, etc.), and completed the *Abbreviated Multidimensional Acculturation Scale* (AMAS; Zea et al., 2003), a self-report acculturation questionnaire. This brief questionnaire assesses both U.S. and Latina/o (i.e., culture of origin) acculturation levels, and is comprised of six subscales, three for each U.S. and Latina/o acculturation domain. Responses to individual items on each subscale are averaged to create the subscale score: 1) *Language Competence* (English and Spanish, respectively; assessed by 9 test items each; possible raw scores range from 9–36; subscale scores range from 1–4); 2) *Cultural Competence* (U.S. and Latina/o, respectively; assessed by 6 test items each, possible raw scores range from 6–24; subscale scores range from 1–4); and 3) *Cultural Identity* (U.S. and Latina/o, respectively; assessed by 6 test items each; possible raw scores range from 6–24; subscale scores range from 1–4). In all of these subscales, higher scores reflect higher levels of acculturation. From these subscales, two summary measures of acculturation were computed: 1) *Total U.S. Acculturation Score* and 2) *Total Latina/o Acculturation Score*, with possible scores ranging from 1–4 for each summary score. Cronbach's alpha coefficients ranged from .83 to .97 across AMAS subscales, and the AMAS has shown adequate validity and has been used previously with HIV+ populations (Zea et al., 2003; Zea et al., 2004).

Statistical Analyses

The Statistical Package for the Social Sciences (SPSS) Version 18.0 was used to analyze the results. All variables were normally distributed with the exception of plasma HIV viral load, which was then log transformed. Pearson correlations and linear multiple regressions were computed. A p -level of 0.05 was used to determine statistical significance. As mentioned above, average deficit scores for each neuropsychological domain and global neuropsychological functioning were used as dependent variables. Higher average deficit scores reflect worse neuropsychological functioning (i.e., negative correlations between the AMAS subscales and the NP average deficit scores suggest that higher AMAS scores are associated with better NP functioning and positive correlations suggest that higher AMAS scores are associated with worse NP functioning).

In terms of potential covariates, bivariate analyses showed that CD4 count was significantly correlated with Motor Function ($r=.27$, $p=.03$) and therefore was included as a covariate in those analyses. However, plasma HIV viral load and CD4 count were not significantly related to any other neuropsychological deficit scores (all p 's $>.10$). Scores on AMAS and NP test performance did not differ significantly between participants who met criteria for current substance abuse disorder (based on CIDI diagnosis) and those who did not (all p 's $>.10$). Also of note, the normative data for our Learning and Memory tests (see Table 1) did not provide demographic corrections for education, and Learning and Memory scores were both significantly correlated with years of formal education (Learning: $r=-.27$, $p<.01$; Memory $r=-.30$, $p<.01$). Education was also significantly associated with AMAS U.S.

Cultural Competence ($r = -.32$, $p = .01$) but no other AMAS scores (all p 's $> .10$). Therefore, education was included as a covariate in relevant analyses.

Results

Table 2 summarizes the demographic, clinical, and sociocultural characteristics of the sample. The sample was 65% male with a mean age of 46.79 years ($SD = 7.29$) and mean education of 11.84 years ($SD = 2.55$). CD4 count was < 200 for 14% of the sample. All sample participants were of Caribbean origin: 92% were Puerto Rican, 6% Dominican, and 2% Cuban. Approximately one-third of participants were born outside the U.S. Of this subsample, participants reported living in the U.S. an average of 35.22 years ($SD = 12.82$). Additionally, 95% of the sample reported being bilingual or multilingual, and 5% reported being monolingual English speakers.

As Table 3 illustrates, the overall sample endorsed high levels of acculturation to both U.S. and Latina/o culture (see AMAS Total U.S. and Total Latina/o Acculturation scores). This suggests that the sample was highly bicultural, although U.S. acculturation subscale scores tended to be slightly higher than Latina/o subscale scores (with the exception of Cultural Identity scores). Participants reported greater English language fluency than Spanish. On average, the sample met criteria for impairment (average deficit scores > 0.50) in Global Neuropsychological functioning and in all neuropsychological domains, with Learning and Memory being the most impaired.

Correlations between AMAS and Neuropsychological Functioning

Table 4 summarizes the results of a series of Pearson correlations that were computed to investigate the bivariate associations between AMAS subscale scores and neuropsychological functioning (i.e., average GDS and domain deficit scores). As Table 4 illustrates, among the AMAS U.S. acculturation subscales, higher English Language Competence was significantly associated with better Global NP ($r = -.32$, $p = .01$). Higher English Language Competence, U.S. Cultural Competence, and U.S. Cultural Identity were associated with better Verbal Fluency and better Processing Speed, although some associations were at the trend level (see Table 4). Both higher U.S. Cultural Competence ($r = -.27$, $p < .05$) and higher U.S. Cultural Identity ($r = -.24$, $p = .07$) were associated with better Attention/Working Memory, the latter at the trend level. Overall, higher AMAS Total U.S. Acculturation scores were significantly associated with better Global NP ($r = -.25$, $p = .04$), Verbal Fluency ($r = -.32$, $p = .01$), and Processing Speed ($r = -.33$, $p < .01$), with a trend observed for Attention/Working Memory ($r = -.25$, $p = .06$). No other significant or trend level associations were observed among U.S. acculturation subscales and neuropsychological domains (all p 's $> .10$).

Among the AMAS Latina/o acculturation subscales, higher Spanish Language Competence ($r = .22$, $p = .09$) and Latina/o Cultural Competence ($r = .23$, $p = .07$) were associated with worse Executive Function at the trend level. Spanish Language Competence was also associated with worse Learning at the trend level ($r = .22$, $p = .09$). In contrast, greater Latina/o Cultural Identity was associated with better Memory performance ($r = -.27$, $p = .04$). Overall, higher AMAS Total Latina/o Acculturation scores were only significantly associated with worse Executive Function ($r = .27$, $p = .03$). No other significant or trend level associations were observed (all p 's $> .10$).

Regressions Predicting Neuropsychological Functioning

Table 5 summarizes the results of a series of multiple regression analyses, which were computed to examine the combined and unique contributions of the AMAS Total U.S. and

Latina/o Acculturation scores (2 independent variables) to predict global and domain specific neuropsychological average deficit scores. Results showed that the model significantly predicted 11% of the variance in Global NP functioning ($F(6,61)=3.54, p=.04$), 12% of the variance in Verbal Fluency ($F(2,59)=4.00, p=.02$), and 14% of the variance in Processing Speed ($F(2,61)=4.62, p=.01$). In all of these cases, only U.S. Acculturation provided a significant contribution to the model (all p 's $<.05$). In addition, U.S. Acculturation provided a trend level contribution ($\beta = -.65, p=.06$) to Attention/Working Memory, although the overall model was not significant ($F(2,55)=1.83, p=.17$).

In contrast, Latina/o Acculturation provided a significant contribution to the prediction of Executive Function ($\beta = .49, p<.05$), but the overall model only showed a statistical trend ($F(2,61)=2.38, p=.10$). Finally, Latina/o acculturation predicted Motor Function at the trend level ($\beta = .56, p<.10$), and the overall model also showed a statistical trend ($F(2,61)=2.66, p=.06$). No other significant or trend level associations were observed (all p 's $>.10$).

Discussion

Among a sample of 82 highly bicultural HIV+ Caribbean Latina/o adults, both correlational and multivariate analyses showed that higher U.S. acculturation scores were associated with better global NP, verbal fluency, and processing speed, as well as attention/working memory (at the trend level). Correlational analyses showed that lower Latina/o acculturation was associated with better executive function and learning (at the trend level), while higher Latina/o acculturation was associated with better memory performance. Multivariate analyses also showed that lower Latina/o acculturation predicted better executive function and motor function (at the trend level).

These findings were consistent with prior work highlighting the impact of acculturation on neuropsychological test performance among Latina/o adults (Arnold et al., 1994; Coffey et al., 2005; Rosselli & Ardila, 2003). It is particularly notable that many of the measures associated with neuropsychological performance in this study are often considered to be "culture-free" because they are non-verbal (i.e., Digit Symbol, Symbol Search, etc.). However, they were significantly associated with acculturation.

One of the most important findings of the current study is that both linguistic *and* non-linguistic cultural factors were significantly associated with neuropsychological functioning among HIV+ Latina/o adults. This further reinforces the theory that the influence of acculturation extends beyond the effects of language. It is also notable that self-reported English language competence (based on AMAS subscale) was significantly associated with NP test performance. Consistent with the larger U.S. Latina/o population, 68% of our sample was U.S. born (~60% of U.S. Latinas/os are U.S.-born; Passel & Cohn, 2008). Our participants were English-dominant and highly bicultural (i.e., endorsed high identification to and competence in both U.S. and Latina/o culture). However, self-reported language competence still exerted an independent influence on neuropsychological test performance. These findings suggest that acculturation is a critical factor for consideration in neuropsychological test performance of Latina/o individuals, even among those who are highly acculturated to U.S. culture.

While language functioning may be an important, other cultural factors were also associated with NP test performance. Additionally, U.S. and Latina/o acculturation scores were associated with distinct and separate NP scores. For example, only non-linguistic factors (i.e., U.S. Cultural Competence and U.S. Cultural Identity) were associated with Attention/Working Memory. These results suggest that the effects of acculturation are not consistent across neuropsychological domains. While this inconsistency has been demonstrated in prior

research with healthy Mexican and Mexican-American individuals (Arnold et al., 1994), this is the first study to do so in a clinical, Caribbean Latina/o sample.

The associations between U.S. acculturation and performance on processing speed and attention/working memory are particularly intriguing. Some researchers contend that processing speed and attention/working memory mediate general cognitive abilities, including fluid intelligence (Jaeggi, Buschkuhl, Jonides, & Perrig, 2008; Salthouse, 1996). Therefore, it is possible that acculturation to U.S. culture could actually improve selective cognitive skills (i.e., processing speed and attention/working memory) that in turn could enhance more general neurocognitive abilities or fluid intelligence. It is possible that Westernized cultures (including U.S. culture), which place a strong cultural value on time and speed (Stewart & Bennett, 1991) may actually promote faster processing speed and better performance on attention/working memory tasks (which are often timed). The associations in this study between U.S. acculturation with processing speed and attention/working memory may serve as a potential mechanism to help us understand how cultural values and/or experience might alter neuropsychological test performance. Specifically, evidence suggests that cognition is not static and that it interacts with the surrounding environment and culture (Al-Namlah, Fernyhough, Meins, 2006; Luria, 1976; Vygotsky, 1981; Wertsch, 1994). Alternatively, it is also possible that better processing speed and attention/working memory might facilitate acculturation, perhaps through more efficient or rapid processing of environmental information. This could be examined in future research by prospectively following recent immigrants and assessing their acculturation levels and NP performance longitudinally.

Prior research has shown that higher U.S. acculturation is significantly, positively associated with executive function (Arnold et al., 1994; Boone et al., 2007; Coffey et al., 2005). However, this is the first study that we are aware of to report that *lower* Latina/o acculturation and cultural competence are related to *better* performance on measures of executive function. This finding may help to explain prior results (Rivera Mindt et al., 2008), which found that HIV+ Latina/o adults performed significantly worse only in the domain of executive function when compared to HIV+ non-Hispanic white adults on a comprehensive neuropsychological evaluation. This also highlights the important role of culture in performance on problem solving and conceptual reasoning tests (Luria, 1976; Vygotsky, 1981).

Interestingly, we found that *greater* Latina/o cultural identity was significantly associated with better memory performance. This finding contradicted our hypotheses, as well as the results reported in a previous study among Mexican/Mexican Americans, in which memory was not associated with acculturation (Arnold et al., 1994). To our knowledge, this is first time such a finding has been reported in the literature, and its implications are unclear. More research is needed to clarify this finding.

When acculturation was examined in a series of multiple regression analyses, total U.S. acculturation significantly predicted 11–14% of the variance in global NP, verbal fluency, and processing speed. Total Latina/o acculturation predicted 8% of the variance in executive function and 6% of the variance in motor function, reaching trend level. This may be due in part to inadequate norms, to the cultural biases inherent in tests, or perhaps to the cognitive demands of shifting cultural roles. Regardless, acculturation appears to a significant contributor to neuropsychological test performance, and may be a key factor driving previously reported discrepancies in test performance between Latina/o and non-Hispanic white individuals (e.g., Rivera Mindt et al., 2008; Wojna et al., 2006).

These findings also suggest that higher U.S. acculturation is associated with better NP performance and is more salient than acculturation to the non-dominant (Latina/o) culture. This is logical given that the neuropsychological tests used in this study (and ubiquitously in the field) were developed and normed within U.S./Western majority culture. Thus, it is also not surprising that lower Latina/o acculturation, including lower Spanish language competence, was significantly correlated with worse learning and executive functioning performance (as well as motor function in the multivariate analyses). The extant literature on language functioning reports that bilingualism can sometimes cause interference since the non-active language must be suppressed (Rivera Mindt et al., 2008). Given that our participants, on average, reported being highly fluent in both English and Spanish, their Spanish language proficiency may cause cognitive interference or competition when performing English language neuropsychological tests. For example, allocating cognitive resources to suppressing the non-active language (i.e., Spanish) may require diverting resources away from the target task. Therefore, in order to assess this more directly, future acculturation research might also examine the impact of language proficiency on neuropsychological functioning through objective language assessment.

In sum, many components of acculturation to both the dominant and non-dominant cultures—including language competence, cultural competence, and cultural identity—affect neuropsychological test performance differentially. These results support the idea that acculturation should be examined as a multidimensional construct using validated measures such as the AMAS (Zea et al., 2003). Equally important, acculturation to the dominant U.S. culture appears to be a much stronger predictor of neuropsychological performance than Latina/o acculturation, which may reflect cultural biases in tests, and therefore may be more salient for neuropsychological test interpretation (Helms, 1992). Our results further suggest that considering the impact of acculturation on neuropsychological test performance would likely improve interpretation of neuropsychological test results within this population. Even in our English-dominant, highly bicultural sample, acculturation scores accounted for a significant amount of the variance (11–14%) in global neuropsychological performance, verbal fluency, and processing speed, as well as trends in executive and motor function. These effects may have been even stronger in a less bicultural or less U.S. acculturated sample. Therefore, acculturation should be formally assessed and considered when working with Latina/o individuals, even those who are highly acculturated to U.S. culture.

Our study had several limitations. First, our acculturation measure relied on self-report. However, the acculturation measure used in this study is well-validated and previously published research has successfully utilized this measure with a similar patient population (Zea et al., 2003; Zea et al., 2004). Second, the high level of acculturation to both U.S. and Latina/o culture may have reduced the variability and restricted the range in AMAS scores, thus limiting potential associations with the neuropsychological measures. Given the relationship between acculturation and neuropsychological functioning observed in this sample, it is likely that these effects would be even stronger in less acculturated samples (as mentioned above). The relative impact of different aspects of acculturation may also vary depending on acculturation level. Third, the possible influence of substance abuse should also be considered, as this is often comorbid in HIV+ samples (Byrd et al., 2011). Although participants who met criteria for current substance abuse disorder did not differ on AMAS or neuropsychological performance in our sample, future research should examine this more thoroughly. Finally, our analyses did not control for multiple comparisons, and therefore the possibility of type I error is inflated. Future research should explore the relationships between acculturation and neuropsychological test performance in healthy control groups, as these relationships may differ in HIV+ individuals and other clinical samples.

Furthermore, research should be extended to other neurological and medical populations, as well as other racial/ethnic groups. There is a great need for this type of research as ethnic minority populations, including Latinas/os, are at greater risk for numerous diseases and disorders that impact cognition, including HIV/AIDS. Future research should also extend the current results by exploring whether or not U.S. and Latina/o acculturation levels significantly attenuate differences observed in neuropsychological test performance between Latina/o and non-Hispanic white adults. Finally, research is also needed to replicate the current findings with regard to the relationships between executive function and memory (respectively) with Latina/o acculturation. In this regard, qualitative methods may be especially useful in order to better understand these associations.

Despite its limitations, this is the first study to systematically examine the associations between distinct facets of acculturation (to both the dominant and non-dominant culture) and neuropsychological test performance using a validated, multidimensional acculturation measure within a well-characterized, clinical (i.e., HIV+) sample of Caribbean Latina/o adults. Our findings support the importance of examining acculturation to both the dominant and non-dominant cultures using a multidimensional acculturation measure, and suggest that both linguistic and non-linguistic cultural factors have separate and distinct effects on neuropsychological functioning. It is notable that acculturation significantly impacted neuropsychological test performance even among highly bicultural (including highly U.S. acculturated) individuals. Our sample is likely to reflect the large and growing segment of the U.S. Latina/o population who identify as bicultural. Currently, research suggests that 39% of U.S. Latinas/os self-identify as bicultural (Horowitz Associates, 2011). Therefore, our findings are more likely to be generalizable to these Latinas/os, and therefore clinically relevant for their neuropsychological assessment. Overall, this study highlights the multifaceted nature of acculturation and its relationship with neuropsychological functioning. In order to increase diagnostic accuracy and to improve the interpretation of neuropsychological test performance, our findings suggest that acculturation should be measured and considered when assessing culturally diverse individuals, particularly within clinical populations.

Acknowledgments

The authors wish to thank the Harlem Community Academic Partnership, the Manhattan HIV Care Network, and our participants for their contributions to our research. This research was supported by a K23 from NIMH (K23MH07971801) and an *Early Career Development Award* from the Northeast Consortium for Minority Faculty Development, both awarded to Monica Rivera Mindt, PhD; an R24 and U01 from NIMH (R24MH59724; U01MH083501) to Susan Morgello, MD; and an N01 from NIMH (N01MH22005) subcontracted to Susan Morgello, MD.

References

- Abe-Kim J, Okazaki S, Goto SG. Unidimensional versus multidimensional approaches to the assessment of acculturation for Asian American populations. *Cultural Diversity and Ethnic Minority Psychology*. 2001; 7(3):232–246. [PubMed: 11506070]
- Al-Namlah SA, Fernyhough C, Meins E. Sociocultural Influences on the Development of Verbal Mediation: Private Speech and Phonological Recoding in Saudi Arabian and British Samples. *Developmental Psychology*. 2006; 42(1):117–131. [PubMed: 16420122]
- Arnold BR, Montgomery GT, Castaneda I, Longoria R. Acculturation and performance of Hispanics on selected Halstead-Reitan neuropsychological tests. *Assessment*. 1994; 1(3):239–248.
- Artiola i Fortuny L, Heaton RK, Hermosillo D. Neuropsychological comparisons of Spanish-speaking participants from the U.S.–Mexico border region versus Spain. *Journal of the International Neuropsychological Society*. 1998; 4:363–379. [PubMed: 9656610]
- Benedict, R. *Brief Visuospatial Memory Test-Revised professional manual*. Odessa, FL: Psychological Assessment Resources, Inc; 1997.

- Benedict R, Schretlen D, Groninger L, Dobraski M, Shpritz B. Revision of the Brief Visuospatial Memory Test: Studies of normal performance, reliability, and validity. *Psychological Assessment*. 1996; 8(2):145–153.
- Berry, J. Conceptual approaches to acculturation. In: Chun, KM.; Organista, PB.; Marin, G., editors. *Acculturation: Advances in theory, measurement, and applied research*. Washington, DC: American Psychological Association; 2003. p. 83-93.
- Birman D. Biculturalism and perceived competence of Latino immigrant adolescents. *American Journal of Community Psychology*. 1998; 26:335–354. [PubMed: 9726112]
- Boone KB, Victor TL, Wen J, Razani J, Ponton M. The association between neuropsychological scores and ethnicity, language, and acculturation variables in a large patient population. *Archives of Clinical Neuropsychology*. 2007; 22:355–365. [PubMed: 17320344]
- Butters N, Grant I, Haxby J, Judd LL, Martin A, McClelland J, Pequegnat W, Schacter D, Stover E. Assessment of AIDS-related cognitive changes: Recommendations of the NIMH workshop on neuropsychological assessment approaches. *Journal of Clinical and Experimental Neuropsychology*. 1990; 12(6):963–978. [PubMed: 2286659]
- Byrd DA, Fellows RP, Morgello S, Franklin D, Heaton RK, Deutsch R, Grant I. Neurocognitive impact of substance use in HIV infection. *JAIDS*. 2011; 58(2):154–162. [PubMed: 21725250]
- Campbell AL Jr, Ocampo C, DeShawn Rorie K, Lewis S, Combs S, Ford-Booker P, Hastings A. Caveats in the neuropsychological assessment of African Americans. *Journal of the National Medical Association*. 2002; 94(7):591–601. [PubMed: 12126285]
- Carey CL, Woods SP, Gonzalez R, Conover E, Marcotte TD, Grant I, Heaton RK. Predictive validity of global deficit scores in detecting neuropsychological impairment in HIV infection. *Journal of Clinical and Experimental Neuropsychology*. 2004; 26:307–319. [PubMed: 15512922]
- Centers for Disease Control. CDC fact sheet: Estimates of new HIV infections in the United States. 2008a. Retrieved from <http://www.cdc.gov/nchhstp/Newsroom/docs/Fact-Sheet-on-HIV-Estimates.pdf>
- Centers for Disease Control. CDC HIV/AIDS facts: HIV/AIDS in the United States. 2008b. Retrieved from <http://www.cdc.gov/hiv/resources/factsheets/PDF/us.pdf>
- Coffey DM, Marmol L, Schock L, Adams W. The influence of acculturation on the Wisconsin Card Sorting Test by Mexican Americans. *Archives of Clinical Neuropsychology*. 2005; 20:795–803. [PubMed: 15916877]
- Diehr MC, Cherner M, Wolfson TJ, Miller S, Grant I, Heaton RK. The 50 and 100-item short forms of the paced auditory serial addition task (PASAT): Demographically corrected norms and comparisons with the full PASAT in normal and clinical samples. *Journal of Clinical and Experimental Neuropsychology*. 2003; 25:571–585. [PubMed: 12911108]
- Harris JG, Cullum CM, Puente AE. Effects of bilingualism on verbal learning and memory in Hispanic adults. *Journal of the International Neuropsychological Society*. 1995; 1:10–16. [PubMed: 9375204]
- Harris, JG.; Tulskey, DS.; Schultheis, MT. Assessment of the non-native English speaker: Assimilating history and research findings to guide clinical practice. In: Tulskey, SD.; Saklofske, DH.; Chelune, GJ.; Heaton, RK.; Ivnik, RJ.; Bornstein, R.; Prifitera, A.; Ledbetter, MF., editors. *Clinical interpretation of the WAIS-II and WMS-II*. San Diego, CA: Academic Press; 2003. p. 343-390.
- Heaton RK, Clifford DB, Franklin DR, Woods SP, Ake C, Vaida F, Grant I. HIV-associated neurocognitive disorders persist in the era of potent antiretroviral therapy. *Neurology*. 2010; 75(23):2087–2096. [PubMed: 21135382]
- Heaton, RK.; Miller, SW.; Taylor, MJ.; Grant, I. Revised Comprehensive Norms for an Expanded Halstead-Reitan Battery: Demographically Adjusted Neuropsychological Norms for African American and Caucasian Adults (HRB). Odessa, Florida: Psychological Assessment Resources, Inc; 2003.
- Heaton, RK.; Ryan, L.; Grant, I. Demographic influences and use of demographically corrected norms in neuropsychological assessment. In: Grant, I.; Adams, KM., editors. *Neuropsychological Assessment of Neuropsychiatric and Neuromedical Disorders*. 3. New York: Oxford University Press; 2009. p. 127-151.

- Helms JE. Why is there no study of cultural equivalence in standardized cognitive ability testing? *American Psychologist*. 1992; 47:1083–1101.
- Hess TM, Auman C, Colcombe SJ, Rahhal TA. The impact of stereotype threat on age differences in memory performance. *Journal of Gerontology: Psychological Sciences*. 2003; 58B:3–11.
- Horowitz Associates. FOCUS: Latino Report. 2011. Accessed from <http://www.horowitzassociates.com/focuslatino/>
- Jacobs DM, Sano M, Albert S, Schofeld P, Dooneief G, Stern Y. Cross-cultural neuropsychological assessment: A comparison of randomly selected, demographically matched cohorts of English- and Spanish-speaking older adults. *Journal of Clinical and Experimental Neuropsychology*. 1997a; 19:331–339. [PubMed: 9268808]
- Jacobs DM, Winston TD, Polanco CL. Assessment of verbal memory in Spanish-speaking elders: Development of two frequency-matched list learning tests. *Journal of Clinical and Experimental Neuropsychology*. 1997b; 19:119–125. [PubMed: 9071646]
- Jaeggi SM, Buschkuhl M, Jonides J, Perrig WJ. Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Sciences*. 2008; 105(19):6829–6833.
- Kennepohl K, Douglas S, Nabors N, Hanks R. African American acculturation and neuropsychological test performance following traumatic brain injury. *Journal of the International Neuropsychological Society*. 2004; 10:566–577. [PubMed: 15327735]
- Kongs, SK.; Thompson, LL.; Iverson, GL.; Heaton, RK. Test-64 Card Version, Professional Manual. Odessa, FL: Psychological Assessment Resources; 2000. *WCST-64: Wisconsin Card Sorting*.
- Levy B, Langer E. Aging free from negative stereotypes: Successful memory in China and among American Deaf. *Journal of Personality and Social Psychology*. 1994; 66:989–998. [PubMed: 8046582]
- Llorente, AM. Principles of Neuropsychological Assessment with Hispanics: Theoretical Foundations and Clinical Practice. New York: Springer; 2008.
- Lopez-Class M, González Castro F, Ramirez AG. Conceptions of acculturation: A review and statement of critical issues. *Social Science & Medicine*. 2011; 72:1555–1562. [PubMed: 21489670]
- Luria, AR. The Cognitive Development: Its Cultural and Social Foundations. Harvard University Press; 1976.
- Manly JJ, Jacobs DM, Sano M, Bell K, Merchant CA, Small SA, Stern Y. Cognitive test performance among nondemented elderly African Americans and whites. *Neurology*. 1998a; 50:1238–1245. [PubMed: 9595969]
- Manly JJ, Jacobs DM, Sano M, Bell K, Merchant CA, Small SA, Stern Y. African American acculturation and neuropsychological test performance among nondemented community elders. *Journal of the International Neuropsychological Society*. 1998b; 4:77.
- O'Bryant SE, O'Jile JR, McCaffrey RJ. Reporting of demographic variables in neuropsychological research: Trends in the current literature. *The Clinical Neuropsychologist*. 2004; 18:229–233.
- Phinney JS. Multigroup ethnic identity measure. *Journal of Adolescent Research*. 1992; 7:156–176.
- Passel, JS.; Cohn, D. US Population Projections: 2005–2050. Washington, DC: Pew Research Center; 2008. Retrieved from www.pewhispanic.org/files/reports/85.pdf
- Razani J, Burciaga J, Madore M, Wong J. Effects of acculturation on tests of attention and information processing in an ethnically diverse group. *Archives of Clinical Neuropsychology*. 2007; 22:333–341. [PubMed: 17298874]
- Robbins RN, D'Aquila E, Morgello S, Byrd D, Remien RH, Rivera Mindt M. Cultural Influences on Antiretroviral Therapy Adherence Among HIV-infected Puerto Ricans. *Journal of the Association of Nurses in AIDS Care*. (in press).
- Rivera Mindt M, Byrd D, Ryan E, Robbins R, Monzones J, Arentoft A, Morgello S. for the Manhattan HIV Brain Bank. Characterization and sociocultural predictors of neuropsychological test performance in HIV+ Hispanic individuals. *Cultural Diversity and Ethnic Minority Psychology*. 2008; 14:315–325. [PubMed: 18954167]
- Rivera Mindt M, Saez P, Byrd D. Primary challenges in the neuropsychological assessment of racial/ethnic minority individuals: A brief report. *National Academy of Neuropsychology Bulletin*. 2010; 25:1–6.

- Rosselli M, Ardila A. The impact of culture and education on neuropsychological measurements: A critical review. *Brain and Cognition*. 2003; 52:326–333. [PubMed: 12907177]
- Salthouse TA. The processing-speed theory of adult age differences in cognition. *Psychological Review*. 1996; 103(3):403–428. [PubMed: 8759042]
- Stewart, EC.; Bennett, MJ. American cultural patterns: A cross-cultural perspective. Yarmouth, ME: Intercultural Press; 1991.
- Taussig IM, Mack WJ, Henderson VW. Concurrent validity of Spanish-language versions of the Mini-Mental State Examination, Mental Status Questionnaire, Information-Memory-Concentration Test, and Orientation-Memory-Concentration Test: Alzheimer's disease patients and nondemented elderly comparison subjects. *Journal of the International Neuropsychological Society*. 1996; 2:286–298. [PubMed: 9375177]
- U.S. Census Bureau. American community survey. 2006. Retrieved from http://factfinder.census.gov/servlet/ACSSAFFacts?_sse=on&_submenuId=factsheet_1&_ci_nbr=&q_r_name=&ds_name=DEC_2000_SAFF®=&industry=
- U.S. Census Bureau. Annual estimates of the population by five-year age groups and sex for the United States: April 1, 2000 to July 1, 2006. 2006. Retrieved from <http://www.census.gov/popest/data/datasets.html>
- U.S. Census Bureau News. US Census press releases: An older and more diverse nation by midcentury. 2008. Retrieved from <http://www.census.gov/Press-Release/www/releases/archives/population/012496.html>
- Vygotsky, LS. The instrumental method in psychology. In: Wertsch, JV., editor. *The concept of activity in Soviet psychology*. Armonk, NY: Sharpe; 1981. p. 134-155.
- Wechsler, D. WAIS-III Administration and Scoring Manual. The Psychological Corporation; San Antonio, TX: 1997.
- Wertsch JV. Mediated action in sociocultural studies. *Mind, Culture, and Activity*, I. 1994:202–208.
- Wojna V, Skolasky R, Hechavarría R, Mayo R, Selnes O, McArthur J, Nath A. Prevalence of human immunodeficiency virus-associated cognitive impairment in a group of Hispanic women at risk for neurological impairment. *Journal of Neurovirology*. 2006; 12:356–364. [PubMed: 17065128]
- Woods SP, Childers M, Ellis RJ, Guaman S, Grant I, Heaton RK. A battery approach for measuring neuropsychological change. *Archives of Clinical Neuropsychology*. 2006; 21:83–89. [PubMed: 16169705]
- World Health Organization. Composite International Diagnostic Interview (CIDI), core version 2.1, January 1997. World Health Organization; Geneva: 1998.
- Zea MC, Asner-Self KK, Birman D, Buki LP. The Abbreviated Multidimensional Acculturation Scale: Empirical validation with two Latino/Latina samples. *Cultural Diversity and Ethnic Minority Psychology*. 2003; 9:107–126. [PubMed: 12760324]
- Zea MC, Reisen CA, Poppen PJ, Echeverry JJ, Bianchi FT. Disclosure of HIV-Positive Status to Latino Gay Men's Social Networks. *American Journal of Community Psychology*. 2004; 33:107–116. [PubMed: 15055758]

Table 1

Normative Data Sources for Neuropsychological Tests

Neuropsychological Domain and Tests	Normative Data Sources
Executive Function	
Wisconsin Card Sorting Task-64 Item Version	Kongs, Thompson, Iverson & Heaton, 2000
Trail Making Test (Part B)	Heaton, Miller, Taylor, & Grant, 2003
Attention/Working Memory	
WAIS-III Letter Number Sequencing	Wechsler, 1997
PASAT Total Correct	Diehr et al., 2003
Learning, Memory	
Hopkins Verbal Learning Test-Revised (Total Recall; Delayed Recall)	Benedict, Schretlen, Groninger & Brandt, 1998
Brief Visuospatial Memory Test-Revised (Total Recall; Delayed Recall)	Benedict, 1997
Motor Function	
Grooved Pegboard Time (dominant hand; non-dominant hand)	Heaton, Miller, Taylor, & Grant, 2003
Processing Speed	
WAIS-III Digit Symbol	Wechsler, 1997
WAIS-III Symbol Search	Wechsler, 1997
Trail Making Test (Part A)	Heaton, Miller, Taylor, & Grant, 2003
Verbal Fluency	
Controlled Oral Word Association Test (F-A-S; Animals)	Heaton, Miller, Taylor, & Grant, 2003

Table 2

Demographic Characteristics of the Study Sample (N = 82)

	M or %	SD	Range or IQR [†]
Age	46.79	7.29	19.21–63.13
Education (years)	11.84	2.55	5–18
Gender			
Male	65%		
Female	34%		
Birthplace			
US	72%		
Other	28%		
Ethnic Background			
Puerto Rican	92%		
Dominican	6%		
Cuban	2%		
CD4 count ^a	441	299	267; 636 [†]
CD4 ≥ 200	86%		
CD4 < 200	14%		
Plasma HIV ^a viral load ^b	1.69	1.23	1.69; 3.35 [†]
Detectable (> 49 copies/mL)	43%		
Undetectable (≤ 49 copies/mL)	57%		
Age when moved to US	11.49	9.76	0–35
Years living in US (all participants)	43.62	10.26	10.89–63.13
Years living in US (only non-US born participants)	35.22	12.28	10.89–57.41
Bilingual (English/Spanish) or multilingual	95%		
Monolingual (English)	5%		

^a median,^b log₁₀ transformed,[†] interquartile range

Table 3

Acculturation Scores and Neuropsychological (NP) Deficit Scores (N = 82)

	M or %	SD	Range
AMAS Scores			
U.S. Subscales			
Language Competence (English)	3.61	0.46	2.33–4.00
Cultural Competence	2.94	0.62	1.50–4.00
Cultural Identity	3.64	0.56	1.67–4.00
Overall U.S. Identity	3.39	0.43	2.44–4.00
Latina/o Subscales			
Language Competence (Spanish)	3.16	0.64	1.89–4.00
Cultural Competence	2.52	0.76	1.00–4.00
Cultural Identity	3.76	0.43	2.00–4.00
Overall Latina/o Identity	3.15	0.49	1.63–4.00
Global NP and Domain NP Average Deficit Scores			
Global NP	1.02	0.71	0–3.00
Verbal Fluency	0.76	1.22	0–5.00
Executive Function	0.55	0.82	0–5.00
Processing Speed	0.52	0.78	0–2.67
Attention/Working Memory	0.84	1.01	0–4.00
Learning	1.95	1.47	0–5.00
Memory	1.66	1.49	0–5.00
Motor Function	0.82	1.08	0–4.50

Note. AMAS: *Abbreviated Multidimensional Acculturation Scale*

Table 4
Correlations between neuropsychological (NP) average deficit scores and AMAS scores (N = 82)

	U.S. Acculturation				Latina/o Acculturation			
	Language Comp. (E)	Cultural Comp. ^a	Cultural Identity	Total Score	Language Comp. (S)	Cultural Comp.	Cultural Identity	Total Score
Global NP	-.32 [*]	-.18	-.15	-.26 [*]	.18	.07	-.05	.11
Verbal Fluency	-.44 ^{**}	-.22 [†]	-.24 [†]	-.32 [*]	.05	.04	-.02	.04
Executive Function	.03	.08	.04	.10	.22 [†]	.23 [†]	.19	.27 [*]
Processing Speed	-.34 ^{**}	-.25 [*]	-.29 [*]	-.33 ^{**}	.17	-.07	.03	.05
Attention/WM	-.09	-.27 [*]	-.24 [†]	-.25 [†]	-.03	-.06	.04	-.03
Learning ^a	-.15	-.02	.05	-.05	.22 [†]	.13	-.07	.14
Memory ^a	-.10	-.06	.02	-.07	.12	.00	-.27 [*]	-.03
Motor Function ^b	-.14	-.14	-.05	-.12	.15	.17	.03	.15

Note. For the NP deficit scores, higher scores reflect worse neuropsychological functioning; partial correlations controlling for

^a education,

^b CD4 count; WM = Working Memory; Comp. = Competence; (E) = English; (S) = Spanish;

^{**} $p < .01$,

^{*} $p < .05$,

[†] $.10 < p \leq .05$

Table 5

Multiple regressions predicting neuropsychological (NP) deficit scores from AMAS total U.S. and Latina/o acculturation scores (N = 82)

	Total U.S. Acculturation			Total Latina/o Acculturation		
	R ²	β	SE β	β	SE β	
Global	.11 [*]	-.56 ^{**}	.82	.33	.20	
Verbal Fluency	.12 [*]	-1.07 ^{**}	.38	.41	.35	
Executive Function	.08 [†]	.03	.27	.49 [*]	.24	
Processing Speed	.14 ^{**}	-.71 ^{**}	.24	.29	.21	
Attention/Working Memory	.07	-.65 [†]	.34	.12	.31	
Learning ^a	.03	-.31	.45	.48	.40	
Memory ^a	.01	-.20	.47	-.05	.47	
Motor Function ^b	.06 [†]	-.40	.37	.56 [†]	.33	

^a after controlling for education, R² Δ reported;

^b after controlling for educationCD4 count, R² Δ reported;

^{**} p<.01,

^{*} p<.05,

[†] .10< p .05