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The Relative Utility of Three English Language Dominance Measures in Predicting the Neuropsychological Performance of HIV+ Bilingual Latino/a Adults

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Abstract

Objective—Given the disproportionate impact of neurologic disorders such as HIV on racial/ethnic minorities, neuropsychologists are increasingly evaluating individuals of diverse linguistic backgrounds. This study compares the utility of two brief and one comprehensive language measure to account for variation in English neuropsychological performance within a bilingual population.

Method—Sixty-two HIV+ English/Spanish bilingual Latino adults completed three language measures in English and Spanish: Self-Reported Language Ability; Verbal Fluency (FAS/PMR); and the Woodcock Munoz Language Survey-Revised (WMLS-R). All participants also completed an English language neuropsychological (NP) battery.

Results—It was hypothesized that the comprehensive English/Spanish WMLS-R language dominance index (LDI) would be significantly correlated with NP performance, as well as the best predictor of NP performance over and above the two brief language measures. Contrary to our hypothesis, the WMLS-R LDI was not significantly correlated to NP performance, whereas the easily administered Verbal Fluency and Self-Report LDIs were each correlated with global NP performance and multiple NP domains. After accounting for Verbal Fluency and Self-Report LDI in a multivariate regression predicting NP performance, the WMLS-R LDI did not provide a unique contribution to the model.

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Conclusions—These findings suggest that the more comprehensive WMLS-R does not improve understanding of the effects of language on NP performance in an HIV+ bilingual Latino population.

Keywords

Language; bilingualism; HIV; neuropsychology; Hispanics/Latinos; Spanish

Introduction

Despite the recognition that proficiency in the language of evaluation contributes uniquely to neuropsychological test performance, evaluating bilingualism has not been central to neuropsychological training or discourse. Additionally, much of the research on bilingual neurocognition treats bilingualism as a dichotomous variable and is not easily translated to clinical settings, where the degree of English language proficiency varies continuously (Suarez et al., 2014). As a result, there is a lack of clarity surrounding best practices for the evaluation of linguistic minorities (Brickman, Cabo, & Manly, 2006; Elbulok-Charcape, Rabin, Spadaccini, & Barr, 2014; Rivera Mindt, Byrd, Saez, & Manly, 2010).

The Latino/a community is currently the largest and fastest growing minority group in the United States, and Spanish is the most commonly spoken non-English language in the country (Shin & Kominski, 2010; US Census Bureau, 2010). As these trends alter the demographic composition of the United States, so too will they alter the populations served by neuropsychologists, highlighting the importance of understanding the impact of English language proficiency on neuropsychological performance.

One patient population where these issues are particularly relevant are patients with HIV/AIDS, as, on the one hand, this condition can lead to neuropsychological impairment (Heaton et al., 2010), and, on the other hand, it disproportionately affects Latino/a adults (CDC, 2009). In New York, nearly one-third of people living with HIV/AIDS are Latino/a (CDC, 2009). Nationwide, Latina women have a rate of new HIV infections 4.2 times higher than non-Hispanic White females, and Latino men have a rate of new HIV infections 2.9 times higher than non-Hispanic White males (CDC, 2013). Competently providing neuropsychological services to Latino/a individuals with HIV/AIDS and other neurologic or medical disorders requires appropriate measures and procedures, and an understanding of the cultural and linguistic factors known to influence performance within Latino/a groups.

In an effort to quantify language dominance, many researchers have included various language measures in their investigations with bilingual groups. These measures can be administered in a single language to assess absolute proficiency, or be compared across two languages to assess relative proficiency or language dominance. For example, Mungas, Reed, Haan, and Gonzalez (2005) found a self-report measure of English and Spanish language ability to have broad and robust associations with scores on the *Spanish and English Neuropsychological Assessment Scales* (SENAS). English language ability was significantly positively related to higher test scores and Spanish language ability was associated with lower test scores. When ethnicity alone was entered into a model predicting SENAS scores, significant ethnicity effects were detected for 12 out of 13 tests, with non-

Hispanic White adults outperforming Latino/a adults. Entering basic demographic variables such as education, gender, and age somewhat reduced the independent effect of ethnicity, but not as dramatically as when English and Spanish ability were also entered in the model. Thus, the authors concluded that English and Spanish ability, along with education, essentially eliminated the effect of ethnicity in their sample (Mungas et al., 2005).

Rosselli et al. (2002) compared the reading and color naming speed of Spanish-dominant, balanced, and English-dominant bilingual adults with Spanish and English monolingual adults on the Stroop Color and Word Test in both languages. Generally, they found that bilinguals were slower than monolinguals in the English color naming condition. Specifically, Spanish-dominant bilinguals were significantly slower in all of the English Stroop test conditions, and English-dominant bilinguals were significantly slower in all of the Spanish conditions. So while a general conclusion was that bilinguals' overall color naming performance was slower on the Stroop Test when compared to monolinguals, introducing language proficiency showed that only those individuals with lowered proficiency in the test language were slower, and that balanced bilinguals (i.e. those individuals equally proficient in both languages) performed similarly to the English-dominant bilinguals in the English conditions and to the Spanish-dominant group in the Spanish conditions. It is to the authors' credit that a measure of language dominance was included, as the results would otherwise point to a difference between bilingual and monolingual groups, when the issue was, in fact, one of language proficiency.

The aforementioned studies are two examples of a body of literature that points to the importance of language dominance and proficiency in the neuropsychological assessment of bilingual persons. Overall, research indicates that taking language variables into account explains performance differences between Latino/a and non-Hispanic White groups, as well as performance differences between bilingual and monolingual groups of the same ethnic background (Gasquoine, Croyle, Cavazos-Gonzalez, & Sandoval, 2007; Harris, Cullum, & Puente, 1995; Harris, Tulskey, & Schultheis, 2003; Mungas et al., 2005; Rosselli et al., 2002). However, these studies have examined language using widely different instruments and methodology, ranging from self-reported language preference, to single measure assessment (i.e. Boston Naming Test), to a comprehensive multi-domain language assessment measure (e.g. Woodcock Munoz Language Survey-Revised). Thus, although there is consensus across the literature that bilingual language abilities are important to assess, there is limited guidance regarding the best measures to do so (Marian, Blumenfeld, & Kaushanskaya, 2007; Rivera Mindt et al., 2008). More research is therefore needed to help inform best practices for the neuropsychological evaluation of linguistic minorities. The American Psychological Association's 2003 Multicultural Guidelines state that clinicians should not test examinees in an inappropriate language and should make a referral if this is not possible. However, these recommendations lack guidance regarding what instruments to use to ascertain which language may be appropriate. It is clear that no examinee should be assessed in a language that they do not speak, but there is less clarity regarding bilingual examinees that are conversationally proficient in English.

This issue is important because neuropsychologists utilize test scores to differentiate between intact and impaired cognition. For example, in HIV, the diagnosis of HIV-

associated neurocognitive disorder (HAND) is based on neuropsychological impairment (defined as test scores one standard deviation below the mean) and functional impairment (Antinori et al., 2007). Differential performances between racial/ethnic groups can lead to increased likelihood that an individual within a minority group will be misclassified as neuropsychologically impaired (Harris et al., 2003; Heaton, Taylor, & Manly, 2003; Low et al., 2012; Norman, Evans, Miller, & Heaton, 2000; Taylor & Heaton, 2001). Furthermore, there is evidence for higher rates of neuropsychological impairment in Latino samples than in samples containing greater proportions of non-Hispanic White participants (Rivera Mindt et al., 2008).

Rivera Mindt et al. (2008) point to the cultural biases of neuropsychological measures, methodological and/or sampling differences across studies, bio-behavioral factors associated with different Latino/a populations, and lowered cognitive reserve as potential explanatory factors for findings of poorer neuropsychological performance in Latino/a individuals, many of whom are bilingual. Inadequate language proficiency in the test language is another likely contributor, but is often overlooked, in part due to the lack of empirical evidence supporting any particular method of assessment. However, in bilingual samples, the issue of language dominance deserves careful attention. Understanding the influence of language on neuropsychological performance would improve the identification of neuropsychological impairment and ensure that diagnoses of HAND reflect true impairment and not cultural or linguistic artifacts.

We argue that accurately assessing an individual's language dominance is an integral part of an evaluation for bilingual clients. Such an assessment can both clarify what language an individual should be tested in and aid in the interpretation of test performance, particularly when English language testing is the only available option. Although there appears to be emerging recognition in the literature of the importance of language dominance in neuropsychological assessment, empirically based guidelines are lacking. Furthermore, there are a variety of language measures to choose from, including self-report measures, single domain measures, and comprehensive batteries of multiple language domains. Administration time varies widely for these measures, from just a few minutes to closer to one hour. More information is needed to clarify whether self-report measures and/or single ability tests are sufficient, or whether comprehensive language proficiency measures best capture the effects of language on neuropsychological performance.

The aim of the current study was to compare the utility of two brief and one comprehensive language measure to account for variation in English neuropsychological performance within a bilingual (English–Spanish) HIV+ Latino/a population. By identifying the measure/s that best capture the effects of language dominance on test performance, it was our goal to make practical, empirically based recommendations regarding the most efficient way to competently assess language dominance among bilingual examinees.

We hypothesized that among HIV+ Spanish–English bilinguals: (1) higher levels of English language dominance on all language measures would be significantly and positively correlated with global and domain-specific NP performance; (2) degree of language dominance across all language measures would account for a significant amount of variance

in NP performance; and (3) the comprehensive English/Spanish WMLS-R language dominance index (LDI) would be the best predictor of NP performance over and above the self-reported and single language measures.

Methods

Participants

The current study sample included 62 HIV+ Latino/a adults who participated in the NIMHfunded *Medication Adherence Study* (MÁS; Grant #: K23MH079718; PI: M. Rivera Mindt, Ph.D.). Participants were recruited from two other HIV-related studies conducted at the Icahn School of Medicine at Mount Sinai, as well as community outreach in New York City, particularly East [Spanish] Harlem and self-referral.

All participants were HIV+, on stable antiretroviral therapy for at least 12 weeks, and self-identified as being Latino/a (any race). All participants reported some degree of fluency in both English and Spanish, and all participants had at least conversational proficiency in English. Exclusion criteria included diagnosis with any of the following conditions: severe psychiatric disorders (e.g. schizophrenia, psychosis, bipolar disorder) or significant non-HIV-related co-morbid neurologic or medical conditions (e.g. epilepsy, brain cancer or tumor, traumatic brain injury with loss of consciousness >60 min, neurosurgery, Lupus, Multiple Sclerosis, Parkinson's disease).

Procedure

All participants provided written informed consent and completed a sociocultural and diagnostic interview (including the Beck Depression Inventory- Fast Screen; Beck, Steer, & Brown, 2000), language assessment and a comprehensive neuropsychological battery. Aside from the Spanish portion of the language assessment, all study procedures were conducted in English. Blood samples were collected, from which CD4 counts and HIV plasma viral loads were assessed. Study data were collected by trained, bilingual project staff. IRB approval for the MAS study was granted by both the Icahn School of Medicine at Mount Sinai and Fordham University. All participants were administered the following measures.

Language assessment

All participants completed three different measures of English and Spanish language that were used to compare different ways of assigning language dominance. All participants reported having sufficient English and Spanish language ability to complete all measures in both languages. For each measure, we calculated a continuous language dominance index (LDI) reflective of relative English fluency by dividing the English language score by the sum of English and Spanish language scores (e.g. English/(English + Spanish)). The process of computing the LDI is illustrated in Figure 1, and the specific scores used to calculate the index for each measure are detailed below. The strengths of this index, detailed in Suarez et al. (2014), include placing language dominance on an easily interpretable scale ranging from 0 to 1, where higher values correspond to higher relative English fluency.

Self-reported language proficiency

Participants rated their English and Spanish ability on a 7-point Likert scale created for the purposes of the present study. Response options ranged from ‘almost none’ (1) to ‘like a native speaker’ (7) in the domains of reading, writing, speaking, and understanding. The domains of reading and writing were averaged to create a Written Language domain rating, and the domains of speaking and understanding were averaged to create an Oral Language domain rating. LDIs were computed for these domains only for the presentation of descriptive statistics in Table 3. All domain ratings were averaged to generate the primary variables of interest, ‘Self-Reported English Ability’ and ‘Self-Reported Spanish Ability.’ The average English Ability rating was divided by the sum of the English and Spanish Ability ratings to compute the Self-Report LDI.

Single measure of verbal fluency

Participants completed the Controlled Oral Word Association Test (COWAT) in English (FAS) and Spanish (PMR). The COWAT (Gladsjo et al., 1999) is a measure of verbal fluency in which participants are asked to list as many words as possible beginning with the letter F, A, and S in English, and given one minute to do so for each letter (Gladsjo et al., 1999). The total number of words from all three trials are summed and converted to a *T*-score with demographic corrections for age, gender, education, and race (Heaton, Miller, Taylor, & Grant, 2004). The COWAT-PMR has an identical procedure but is conducted in Spanish and utilizes the letters P, M, and R and utilizes different normative data with demographic corrections for age and education (Artiola i Fortuny, Hermosillo, Heaton, & Pardee, 1999). The FAS *T*-score was divided by the sum of the FAS and PMR *T*-scores to compute the Verbal Fluency LDI.

Comprehensive measure of language proficiency

The Woodcock-Muñoz Language Survey- Revised (WMLS-R; Woodcock, Muñoz-Sandoval, Ruef, & Alvarado, 2005) was designed to assess English and Spanish language proficiency across multiple domains. Participants completed the first four tests of the language survey in English and Spanish: Picture Vocabulary, in which participants identify and name a picture of an object; Verbal Analogies, in which participants listen to three words of an analogy and then must provide the appropriate fourth word to complete the analogy; Letter-Word Identification, in which participants identify and pronounce single letters and words; and Dictation, in which participants write letters, spell, and apply correct punctuation and capitalization rules. Picture Vocabulary and Verbal Analogies form the Oral Language subdomain, and Letter-Word Identification and Dictation form the Written Language subdomain. LDIs were computed for these domains only for the presentation of descriptive statistics in Table 3. All subtests combined provide an estimate of Broad English and Broad Spanish Ability, and take between 30 and 40 min to administer. Age-corrected norms ($M = 100$, $SD = 15$) were used and a *T*-score was provided for each domain. The Broad English Ability *T*-score was divided by the sum of the Broad English Ability and Broad Spanish Ability *T*-scores to compute the WMLS-R LDI.

The WMLS-R is a reliable and well-validated instrument with robust normative data and validation information presented in the manual (Woodcock et al., 2005). For the English

subtests, normative data were gathered from 8818 subjects ranging from age two to 80 from over 100 geographically diverse US communities. Based on this sample, the Broad English Ability score demonstrated strong split-half reliability ($r = .96$). A validation study with 200 college students found that the WMLS-R Broad English Ability score was correlated with the Oral and Written Language Scales (OWLS) ($r = .59-.67$), the WAIS-3 VIQ ($r = .81$), and the WRAT-3 ($r = .86$ and $.72$). Spanish items were translated from English, calibrated on 1,157 native Spanish speakers from around the world (e.g. US, Mexico, Argentina, Panama, Costa Rica, Colombia, and Puerto Rico), and equated to the English norms. In a sample of 197 bilingual students grades K through 3, the Spanish and English WMLS (not the revised version) were significantly correlated with the Language Assessment Scales-Oral (LAS-O) and the IDEA Oral Language Proficiency Test-Oral ($r_s = .50-.80$). When students were placed into six categories based on their language dominance, Monolingual English speakers achieved the highest WMLS English scores and the lowest WMLS Spanish scores, whereas Monolingual Spanish speakers demonstrated the opposite pattern.

Neuropsychological evaluation

Table 1 summarizes the well-validated English language neuropsychological test battery designed to assess the pattern of cognitive impairment common in HIV infection (Heaton et al., 2010). The battery consisted of nine tests in six ability domains: Executive Functioning, Processing Speed, Attention/Working Memory, Learning, Memory, and Motor Functioning (Woods et al., 2004). Analyses including Motor Functioning were reported in the tables, but will not be discussed in the text due to a lack of theoretical rationale. The seventh domain traditionally included in the battery, Language Functioning, was subsumed by the language measures, used here as predictors, and was therefore not included as an outcome measure or in calculating the Global NP T-score. Consistent with empirically supported methods, raw test scores were converted to age-, education-, and gender- corrected *T*-scores using the best available published normative data (see Table 1). All individual test *T*-scores were averaged to derive the Global NP *T*-score, which reflects global neuropsychological functioning.

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 multiple linear regressions were computed. A *p*-level of .05 was used to determine statistical significance. Regarding potential covariates, bivariate correlations revealed that Beck Depression Inventory – Fast Screen (BDI-FS; Beck et al., 2000) was significantly correlated with Global NP ($r = -.29, p = .02$), Attention/Working Memory ($r = -.38, p = .003$), Learning ($r = -.27, p = .03$), and Executive Functioning ($r = -.34, p = .01$) and was therefore included as a covariate in relevant analyses. Education was significantly correlated with Attention/Working Memory ($r = -.35, p = .01$), and Executive Functioning ($r = -.26, p = .04$), and was therefore included as a covariate in relevant analyses. Plasma HIV viral load and CD4 count were not significantly related to any neuropsychological global or domain scores (all *ps* > .05). To address concerns about differing normative data sources or lack of normative data, bivariate correlations examined the relationships between years of education, age, and gender, with all

three LDI scores (i.e. Self-Report, Verbal Fluency, WMLS-R). Neither age, education, nor gender was significantly related to any of the language LDIs.

Results

Table 2 summarizes the demographic, sociocultural, and clinical characteristics of the sample. On average, the sample was majority male, middle-aged, and high school educated. Seventeen percent of the sample met criteria for an AIDS diagnosis ($CD4 < 200$). All participants self-identified as Latino/a, with 79% of participants describing themselves as Puerto Rican. A majority of participants were born in the US, with those born outside of the US having been living in the US for an average of 29 years.

As illustrated in Table 3, the sample has slight overall English dominance, reflected by LDI values above .5. Language dominance indices (LDI) were highly variable for each measure, as indicated by the standard deviation and range. In terms of the participants' overall neuropsychological functioning, mean performance levels for the global and neuropsychological domains were in the low average to average range (T -score mean = 50, $SD = 10$).

Table 4 details the results of a series of partial correlational analyses (see table for covariates), which revealed that Verbal Fluency LDI and Self-Report LDI were significantly correlated with Global NP performance ($r = .32$ and $r = .30$, $ps < .05$). WMLS-R LDI was not significantly correlated with Global NP performance, or that of any NP domains (all $ps > .05$). Verbal Fluency LDI was significantly correlated with Processing Speed and Memory ($r = .32$, $r = .25$, $ps < .05$). Self-report LDI was significantly correlated with Processing Speed ($r = .35$, $p < .01$).

Prior to conducting a series of multiple regression analyses with the three language dominance indices as independent variables, a series of bivariate correlations were computed to examine the associations between the three variables. The results revealed significant positive associations between the three indices ranging from .63 to .83 ($ps < .01$). The effect sizes for all associations were in the large range. However, multicollinearity among these variables was not a significant problem in any of the following regression models (all VIFs < 5).

As illustrated in Table 5, multiple regression analyses revealed that the more comprehensive WMLS-R LDI did not significantly contribute to the model predicting Global NP, after accounting for the Verbal Fluency and Self-Report LDI ($F(1, 56) = 1.21$, $R^2_{\Delta} = .02$, $p > .05$). Although adding the WMLS-R LDI did not account for significantly more variance, the combined model of all three language dominance indices accounted for 21% of the variance in Global NP T -score ($F(4,56) = 3.68$, $p = .01$). This combined model significantly predicted all NP domains (all $ps < .05$) except for Learning and Memory. In terms of these domain-specific models, Verbal Fluency LDI was a trend level predictor for Memory ($b = 36.42$, $p < .10$). Self-Report LDI was a significant predictor for Processing Speed ($b = 45.64$, $p < .05$). WMLS-R LDI was not a significant predictor of any NP domains (all $ps > .10$).

Discussion

The goal of the present study was to investigate the utility of two brief and one comprehensive language measures to account for variation in English neuropsychological performance within a bilingual (English/Spanish) HIV+ Latino/a population. This issue is especially important within diverse clinical populations, as the treatment of cultural and linguistic variables can considerably impact the conclusions drawn from a neuropsychological evaluation. The impact of language dominance is a particularly nuanced question for many within our sample, who on average had balanced bilingual abilities and would most likely be tested in English in clinical and research settings.

In terms of this study's key findings, the results from the bivariate correlational analyses highlight the substantial impact of language dominance on neuropsychological performance. Those participants with higher English dominance, based on Verbal Fluency and Self-Report Language Dominance Indices (LDI), had better global and domain-specific neuropsychological performance. This partially confirmed our first hypothesis that higher levels of English language dominance would be significantly and positively correlated with global and domain-specific NP performance, with the notable exception that this relationship was not borne out for our more comprehensive measure of language proficiency, the Woodcock Muñoz Language Survey-Revised (WMLS-R). This measure was not significantly related to any global or domain-specific NP performance, which was surprising as it was the most comprehensive instrument included.

It is important to note that the robust associations between language dominance and neuropsychological performance were observed within a generally balanced bilingual Latino/a sample. Thus, the current findings suggest that some assessment of language dominance should be undertaken with *all* linguistic minority individuals (including highly proficient bilinguals) as part of routine neuropsychological evaluation. In knowing the language dominance of a patient, neuropsychologists would be better able to consider their own competence to evaluate an individual, select appropriate tests and normative data, and interpret low scores appropriately. In this study, all participants self-identified as bilingual and were capable of conversing in English, but the relationship between English language dominance and neuropsychological performance was present nevertheless. This is in line with prior research suggesting that even native-English-speaking Latinos/as experience deflated neuropsychological performance relative to non-Hispanic White peers (Boone, Victor, Wen, Razani, & Ponton, 2007). Given this positive and significant relationship, it is clearly important to recognize the unique contribution of language dominance to test performance in order to avoid over-pathologizing bilinguals and other linguistic minority individuals.

It is also important to highlight that all of the neuropsychological domains (both verbal and non-verbal), with the exception of Attention/Working Memory, were related significantly or at the trend level to language dominance as measured by either Verbal Fluency LDI or Self Report LDI. In regards to the multivariate regression model, our model of language dominance, which included the verbal fluency, self-report, and WMLS-R LDI scores, accounted for a significant amount of variance in global and domain-specific NP

performance. Contributions of the entire model ranged from 19% (Processing Speed) to 36% of the variance (Attention/Working Memory), and supported our second hypothesis that degree of language dominance across all measures would account for a significant amount of variance in NP performance. This was true for all domains except Learning (trend-level) and Memory (non-significant). The substantial contribution of language dominance to the model is consistent with the robust correlational relationship between language measures and neuropsychological outcomes. This is in line with the view that language is not a variable that can be divorced from the testing process, and that even more 'non-verbal' domains are subject to influences by language and culture (Gasquoine, 2001; Rivera Mindt et al., 2008; Rosselli & Ardila, 2003).

However, the results did not support our third hypothesis that a comprehensive battery of language dominance, the WMLS-R, would account for unique variance in neuropsychological test performance, above and beyond self-reported and single domain (verbal fluency) measures. After accounting for the Verbal Fluency and Self-Reported LDI scores, the WMLS-R LDI did not provide a unique contribution to the model. This is not to say that the WMLS-R does not explain variance in neuropsychological performance, only that it fails to uniquely contribute to the prediction of NP performance than the more quickly and easily administered verbal fluency or self-report measures. This was surprising, as the four subtests of the WMLS-R provide a measure of both Reading/Writing and Oral Language and would appear to better characterize what is a complex and multifaceted variable. Together, the current bivariate and multivariate findings do not support the utility of the WMLS-R LDI as a measure of language dominance for better contextualizing neuropsychological performance of bilingual individuals.

A possible explanation for the poor utility of the WMLS-R in this study sample is the measure's emphasis on cognitive-academic language proficiency (CALP), which goes beyond conversational proficiency to include context-reduced and more cognitively demanding language skills. Although important when assessing language proficiency in academic settings, it may be less meaningful in individuals with diverse language histories, many of whom may have limited academic experience in one or both of their languages. Conversely, verbal fluency and self report measures may more directly tap the constructs of facility of production and frequency of use, respectively. More research is needed to clarify why self-report and verbal fluency measures are more predictive of NP performance, even though all three language measures given were significantly intercorrelated. However, the findings of the current study suggest that despite the comprehensiveness of the WMLS-R, neuropsychologists would not be sacrificing any additional information by using briefer measures to capture the likely impact of language dominance on neuropsychological performance.

Clinical implications

Considering the impact of HIV/AIDS and other neurologic disorders (i.e. stroke, Parkinson's disease, traumatic brain injury, etc.) on ethnic/racial minority groups, neuropsychologists are frequently expected to competently evaluate examinees from diverse cultural and linguistic backgrounds (Burke, Brown, Lisabeth, Sanchez, & Morgenstern, 2011). The issue of

identifying important cultural and linguistic variables that influence neuropsychological performance is an issue of clinical competence and standard of care (Manly, 2008). As this study and others have shown, language dominance is undoubtedly one of those influential variables. Hence, the findings of strong relationships between language variables and neuropsychological performance reinforce the importance of assessing language dominance in order to accurately and fairly interpret the results of an evaluation, even for individuals who are proficient in English. Specifically, within an HIV+ bilingual group, greater levels of English language dominance were related to better performance on a comprehensive neuropsychological test battery.

Despite increasing recognition of language proficiency as a variable of interest, there is a lack of clarity surrounding good practices for the evaluation of bilingual individuals (Rivera Mindt et al., 2010). There is theoretical reason to believe that a comprehensive measure of language proficiency is necessary to fully capture what is a complex construct. However, the results of this investigation cast doubt on the ability of such a measure (the WMLS-R) to significantly account for variance in NP performance when compared with simpler and more briefly administered measures. As a result, when choosing between similar measures in their research and practice, neuropsychologists may be able to accurately assess language proficiency with brief measures, such as those used in this study (verbal fluency or self-report). The WMLS-R, despite being comprehensive and significantly related to other language measures, did not appear to provide additional clinically useful information in our study population.

Study limitations

The fact that all study participants were HIV+ makes the conclusions particularly relevant to the clinical questions at hand. However, it also reduces the clarity of the conclusions as the virus and other complicating factors, not just language proficiency, are at play. Although speech and language functioning is for the most part unaffected in HIV+ adults (Woods, Moore, Weber, & Grant, 2009), verbal fluency tasks such as the COWAT-FAS are also used as a way to examine the effects of the virus on brain functioning and potentially quantify the word-finding difficulties and slowed thinking reported by HIV+ adults (Lopez, Wess, Sanchez, Dew, & Becker, 1998; Mapou, Law, Martin, & Kampen, 1993; Millikin, Trépanier, & Rourke, 2004; Van Gorp, 1997). However, the use of the dominance index was designed to minimize this concern.

An additional limitation is that this study sought to compare measures that were not developed, scored, or normed in easily comparable ways. For example, while the self-report measure generated ratings and did not utilize norms, the WMLS-R and COWAT utilized normative data. The normative scores differed between these two measures, however, in that the English (FAS) and Spanish (PMR) version of the COWAT each utilized their own normative data that controlled for education, whereas the WMLS-R utilized the Rasch model to equate norms across Spanish and English versions without controlling for education. The Language Dominance Index (LDI) and inclusion of education as a covariate were designed to minimize these concerns.

A major theoretical issue is the complex nature of bilingualism. Different aspects of an individual's language history, such as fluency, daily use, and cognitive-academic language proficiency all contribute to his or her language profile, and likely impact neuropsychological performance in unique ways. Teasing these effects apart is an important goal, and could enhance the theoretical rationale for using different measures in different situations.

This study included a relatively small, linguistically balanced, and homogeneous sample. Seventy-nine percent of the study sample was of Puerto Rican descent, somewhat limiting the external validity of the current findings for Latinos/as from other countries of origin and based in other parts of the country. However, because Latinos/as of Caribbean origin/descent in the NYC region are disproportionately impacted by the HIV epidemic, this study provided important information about an understudied demographic group. In addition, 68% of the sample was male, limiting the applicability of our findings to female participants. The present study should be replicated in a more nationally representative sample in order to better understand the current findings as they relate to women.

Future directions

There is much work still to be done to: (1) disentangle the influence of language and other sociocultural variables; (2) reach a consensus surrounding the measurement tools most capable of tapping those constructs; and (3) translate findings into additional empirically based recommendations for the clinical evaluation of cultural and linguistic minorities.

Clarification of the construct of language dominance and its relationship to other related variables is a priority, but closely related and equally important is achieving a consensus surrounding the merit of different measurement tools. This study examined three common ones, but many more exist that are frequently used to quantify language dominance, including the Peabody Picture Vocabulary Test (PPVT) and Boston Naming Test (BNT; Mungas et al., 2005; Rosselli et al., 2002). In order to achieve some degree of agreement, a comparison would need to be extended to include other popular language measures.

A final direction involves translating these research findings into clinically useful guidelines. For example, the present study has identified the COWAT-FAS/PMR and self-report as tools to quantify English language dominance, and the Language Dominance Index (LDI) as a helpful index for comparing language abilities in two different languages. A useful extension of this research would be to identify a cut-off point for second language dominance over which neuropsychological performance fails to be an accurate representation of functioning. Although the current study provided findings applicable to the HIV+ community, extending these findings to a non-clinical population will also be important.

Conclusion

The present study highlights the influence of language dominance on neuropsychological performance – both in terms of global neuropsychological function and across numerous neuropsychological domains, including Executive Functioning, Processing Speed, Attention/Working Memory, Learning, and Memory. It also suggests that rather than a comprehensive multi-domain language assessment, the briefly administered COWAT-FAS and PMR and

Self Report questionnaire are sufficient to account for the effects of language dominance on task performance. This is just a first step in beginning to build an empirical foundation for the clinical assessment of linguistic and cultural minority individuals. As this country becomes increasingly diverse, it will be important to broaden the understanding of which variables, beyond traditional ones, to include as important for individuals of non-majority cultural and linguistic experiences. This involves elucidating, prioritizing, operationalizing, and translating this research into practical guidelines. Failure to do so would be a missed opportunity to move neuropsychology toward a more theoretically and clinically inclusive stance, with the necessary tools to competently examine those in need.

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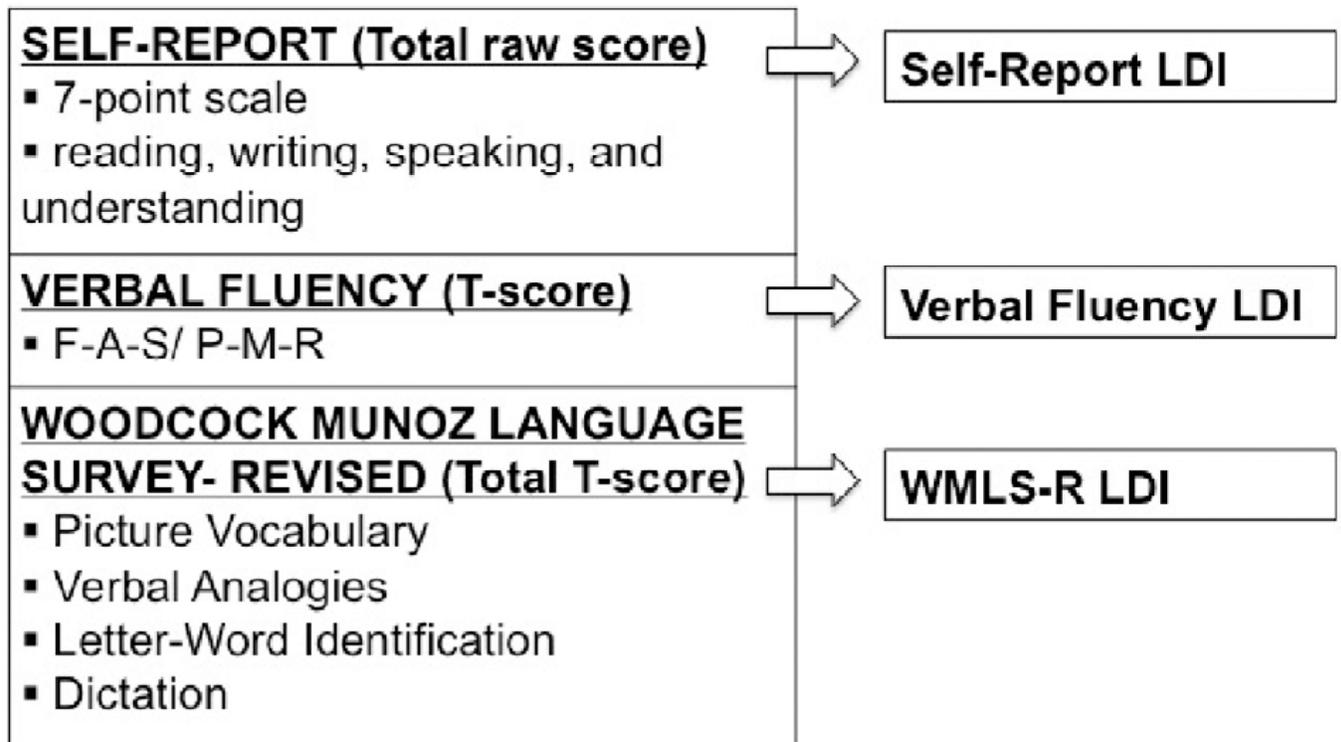


Figure 1.
Computing language dominance indices (LDI) from three English and Spanish language measures.
Note: Language Dominance Index (LDI) = English/(English + Spanish); 0= complete Spanish dominance, .5= balanced, 1= complete English dominance.

Table 1

Neuropsychological test battery and normative data sources by ability domain.

Neuropsychological domain and tests	Normative data sources
Abstraction/executive functioning	
Wisconsin card sorting task-64 item version	Kongs, Thompson, Iverson, and Heaton (2000) ^{1,2}
Trail making test (part B)	Heaton et al. (2004) ^{1,2,3,4}
Attention/working memory	
WAIS-III letter number sequencing	Heaton et al. (2003) ^{1,2,3,4}
PASAT total correct	Diehr et al. (2003) ^{1,2,4}
Learning	
Hopkins verbal learning test-revised (total recall)	Benedict et al. (1998) ¹
Brief visuospatial memory test-revised (total recall)	Benedict (1997) ¹
Delayed recall	
Hopkins verbal learning test-revised (delayed recall trial)	Benedict et al. (1998) ¹
Brief visuospatial memory test-revised (delayed recall trial)	Benedict (1997) ¹
Speed of information processing	
WAIS-III digit symbol	Heaton et al. (2003) ^{1,2,3,4}
WAIS-III symbol search	Heaton et al. (2003) ^{1,2,3,4}
Trail making test (part A)	Heaton et al. (2004) ^{1,2,3,4}
Motor functioning	
Grooved pegboard	Heaton et al. (2004) ^{1,2,3,4}

Note: Superscript number indicates which normative demographic corrections were made: ¹Age; ²Education; ³Gender; ⁴Race.

Table 2

Demographic, sociocultural, and clinical characteristics of the sample (N = 62).

	<i>M (SD)</i>	Range	% or IQR^d
Age	46 (6.2)	31–60	
Education (years)	12 (2.2)	8–18	
Gender			
Male			68%
Female			32%
Birthplace			
US			63%
Other			37%
Age when moved to US ^c	15 (11.3)	1–38	
Years living in US ^c	29 (12.3)	7–46	
Country of Origin			
Puerto Rican			79%
Dominican			3%
Cuban			2%
Mexican			6%
South American			5%
Central American			5%
CD4 count ^a	456.5	50–1,397	285.7; 577.2 [†]
CD4 <200			17%
Plasma HIV ^a viral load ^b	1.4	1.3–6.1	1.4; 2.4 ^d
Detectable (>49 copies/mL)			40%

Notes: *N* = 22;^aMedian;^bLog₁₀ transformed;^cOnly non-US born participants;^dInterquartile range.

Table 3

Language dominance indices (LDI) and neuropsychological (NP) average T-scores (N = 62).

	<i>M</i>	<i>SD</i>	Range
Language dominance indices			
Verbal fluency (COWAT)	.52	.08	.33–.68
Self-report	.54	.10	.32–.75
Oral language	.52	.07	.33–.70
Written language	.57	.15	.26–.88
WMLS-R	.52	.06	.42–.70
Oral language	.53	.06	.38–.68
Written language	.51	.06	.38–.66
Average NP <i>T</i> -scores			
Global NP	43.28	6.73	29.36–59.18
Executive function	43.37	8.24	19.00–61.00
Processing speed	46.04	9.38	26.67–66.00
Attention/working memory	43.45	7.32	29.60–63.42
Learning	41.50	9.39	25.21–66.15
Memory	42.08	9.64	19.19–62.44
Motor functioning	42.48	9.98	19.00–70.50

Note: COWAT: Controlled oral word association test; WMLS-R: Woodcock-Munoz language survey-revised.

Table 4

Correlations between global and domain neuropsychological (NP) T-scores and language dominance indices (N = 62).

	Language dominance indices		
	Verbal fluency	Self-report	WMLS-R
Global NP ^a	.32 *	.30 *	.22 ***
Executive Function ^{a,b}	.23 ***	.24 ***	.14
Processing Speed	.32 *	.35 **	.25 ***
Attention/WM ^{a,b}	.22	.19	.07
Learning ^a	.24 ***	.25 ***	.18
Memory	.25 *	.15	.13
Motor Functioning	.11	-.00	.02

^aBeck depression inventory-fast screen (BDI-FS) entered as covariate;

^bEducation entered as covariate; WMLS-R: Woodcock Munoz language survey-revised; WM = Working memory.

**
 $p < .01$

*
 $p < .05$

 $10 < p < .05$.

Table 5

Multiple regressions predicting neuropsychological (NP) T-scores from language dominance indices (N = 62).

	Verbal fluency			Self-report			WMLS-R			R^2_{Δ}
	<i>b</i>	SE		<i>b</i>	SE		<i>b</i>	SE	R^2	
Global NP _a	22.80	14.20	22.22	15.09	-26.45	25.83	.21*	.02		
Executive function ^{ab}	18.93	17.28	26.67	18.06	-35.12	30.97	.27**	.02		
Processing speed	27.25	19.87	45.64*	20.16	-46.88	35.43	.19**	.03		
Attention/WM ^{ab}	21.04	14.44	22.43	15.03	-41.01	25.77	.36**	.03		
Learning	20.69	20.55	24.66	21.85	-24.02	37.38	.15***	.01		
Memory	36.42***	21.68	14.97	22.00	-28.51	38.66	.08	.01		
Motor functioning	26.24	23.77	-13.10	23.85	-2.76	41.75	.02	.00		

Note: NP = Neuropsychological; WM = Working memory.

^a After controlling for BDI-FS, R^2_{Δ} reported;

^b After controlling for education, R^2_{Δ} reported;

*** $p < .01$;

* $p < .05$;

***.10 < $p < .05$.