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Depression, Cognition, and Self-Appraisal of Functional Abilities in HIV: An Examination of Subjective Appraisal Versus Objective Performance

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Abstract

Depression frequently co-occurs with HIV infection and can result in self-reported overestimates of cognitive deficits. Conversely, genuine cognitive dysfunction can lead to an under-appreciation of cognitive deficits. The degree to which depression and cognition influence self-report of capacity for instrumental activities of daily living (IADLs) requires further investigation. This study examined the effects of depression and cognitive deficits on self-appraisal of functional competence among 107 HIV-infected adults. As hypothesized, *higher* levels of depression were found among those who over-reported problems in medication management, driving, and cognition when compared to those who under-reported or provided accurate self-assessments. In contrast, genuine cognitive dysfunction was predictive of under-reporting of functional deficits. Together, these results suggest that over-reliance on self-reported functional status poses risk for error when diagnoses require documentation of both cognitive impairment and associated functional disability in everyday life.

Keywords

Depression; Self-report; Functional ability; Cognition; HIV

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INTRODUCTION

HIV-associated cognitive impairments include deficits in attention/working-memory, information processing, learning and memory, and executive function (Woods, Moore, Weber, & Grant, 2009). Consequently, cognitive impairment can interfere with the capacity to perform instrumental activities of daily living (IADLs). IADL impairments among HIV-infected individuals have been repeatedly documented in the areas of medication adherence, driving, employment, finance management, cooking, and shopping (Heaton, Marcotte, et al., 2004; Hinkin et al., 2002; Marcotte et al., 1999). While performance-based measures of cognition are increasingly used to assess neuropsychological dysfunction, self-reported measurements continue to dominate assessment of IADL status, particularly in the early stages of HIV infection when identifying the degree of functional impairment can be unclear (Bassel, Rourke, Halman, & Smith, 2002; Carter, Rourke, Murji, Shorre, & Rourke, 2003).

Inconsistencies between subjective cognitive complaints and actual impairment of neuropsychological (NP) performance have been well documented and thus call into question the reliability of self-reported cognitive deficits (Hinkin et al., 1996; van Gorp et al., 1991; Wilkins et al., 1991). This is particularly disconcerting given the heavy reliance on self-report for diagnosing HIV-Associated Neurocognitive Disorders (HAND; Antinori et al., 2007) and for assessing the presence of IADL impairments more generally, particularly in the HIV+ population. In particular, the use of instruments that utilize caregiver reports have been studied more thoroughly in the geriatric dementia population (e.g., Cummings et al., 1994; Okura et al., 2010). Factors influencing self-reported IADLs have not been as thoroughly studied in the HIV literature despite the serious consequences that can result from IADL decrements. For example, suboptimal adherence to HIV medications can lead to increased viral replication (Perno et al., 2002), emergence of treatment resistant viral strains (Harrigan et al., 2005) and, ultimately, heightened risk of death (Lima et al., 2007). In a similar manner, failure to recognize or appreciate driving impairments can result in serious patient or public safety risks by increasing the likelihood of on-road accidents (Marcotte et al., 2006).

Hence, there is a pressing need to identify factors that influence the accuracy of self-reported functional abilities. Among various neurological populations, depression and lack of awareness of one's deficits have been shown to differentially impact self-reported cognitive complaints and thus contribute to discrepancies with observed NP performance (Antoine, Antoine, Guermonprez, & Frigard, 2004; Hoth et al., 2007; Smith, Henderson, McCleary, Murdock, & Buckwalter, 2000; Starkstein, Sabe, Chemerinski, Jason, & Leiguarda, 1996). Of interest to this study was whether depression and cognitive impairment lead to discrepancies between self-reported versus performance-based assessment of functional abilities in the areas of medication management and driving.

HIV and depression

HIV-infected (HIV+) individuals demonstrate higher rates of depression than the general population (Basu, Chwastia, & Douglas, 2005; Ciesla & Roberts, 2001; Rabkin et al., 1997; Satz et al., 1997). Surprisingly, although depression has been linked to greater NP deficits in a wide range of disorders (see reviews by Burt, Zembar, & Niederehe, 1995; Cassens, Wolf, & Zola, 1991), it does not appear to be associated with increased NP impairment in HIV (Cysique et al., 2007; Goggin et al., 1997; Grant et al., 1993; Hinkin et al., 1992; Mapou et al., 1993; Mason et al., 1998; Millikin, Rourke, Halman, & Power, 2003; von Giesen, Baecker, Hefter, & Arendt, 2001). Nevertheless, depression in HIV+ individuals is frequently associated with increased cognitive complaints (Carter et al., 2003; Cysique et al., 2007; Hinkin et al., 1996; Hinkin, Castellon, Van Gorp, & Satz, 1998; Rourke, Halman, Mark et al., 1999; Sadek, Vigil, Grant, Heaton, & HNRC Group, 2007). In general, patients

with depression often demonstrate cognitive distortions about their own abilities, and this phenomenon may explain why depressed individuals tend to overestimate disability in their daily functioning (Ammassari et al., 2004; Haubrich et al., 1999; Paterson et al., 2000; Ragland, Satariano, & MacLeod, 2005; Windsor, Anstey, Butterworth, Luszcz, & Andrews, 2007).

HIV, cognition, and deficit awareness

Depressed mood, however, is not the only factor associated with compromised self-report. Individuals with formally documented neurocognitive impairment tend to report lower levels of depression and under-report their cognitive difficulties (Hinkin et al., 1996; Rourke, Halman, & Bassel, 1999; van Gorp et al., 1991). These types of reporting errors are particularly likely to occur with patients having impairments in abilities presumed to be mediated by frontal executive systems, thus supporting a neurological basis for lack of awareness (Rosen et al., 2009; Snowden, Neary, & Mann, 2002).

Also among HIV+ samples, discrepancies between self-reported and objective measures of medication adherence (e.g., electronic monitoring devices) have also been observed. Results comparing these two methods have shown that self-reported adherence rates are consistently higher (ranging from 18 to 34 percentage points) than adherence rates obtained through electronic monitoring recordings of real-world medication adherence (for review see Simoni, Frick, & Huang, 2006). Few studies have looked at factors associated with discrepancies between self-report and electronic monitoring of medication adherence. However, one preliminary study conducted by our group found that discrepancies between electronic monitoring and self-report estimates were associated with lower cognitive functioning and externalized locus of control (Levine et al., 2006).

Inconsistencies between self-reported and objective functional performance have already been documented among patients who have progressed from Mild Cognitive Impairment (MCI) to Alzheimer's disease (AD) (Albert, Tabert, Dienstag, Pelton, & Devanand, 2002; Roberts, Clare, & Woods, 2009). In a study by Okonkwo and colleagues (2009), individuals with MCI overestimated their financial and driving abilities, suggesting that diminished awareness may be a marker of increasing cognitive decline.

Performance-based methods for assessing functional abilities in HIV have included the Medication Management Task (MMT; Albert et al., 1999; Heaton et al., 2004) and PC-based driving simulation tasks (Marcotte et al., 1999, 2004, 2006). These functional assessment methods are gaining popularity in the HIV literature, since they have been shown to be more reliable and objective measures of "real-world" performance (Heaton et al., 2004; Marcotte et al., 1999). The MMT measures the ability to manage medications by performing laboratory tasks requiring responses to questions related to refill, instructions on when and how to take the medications, and dosage based on pill bottle label instructions. Driving simulators provide an opportunity to safely place individuals into both common and emergency driving situations and to approximate and evaluate real-world driving behaviors (Marcotte et al., 2004).

To our knowledge, there are no studies examining psychiatric and cognitive factors contributing to discrepancies between self-report versus objective measures of everyday functional abilities in HIV-infected samples. However, we expect that depression and cognition will differentially influence self-reported functional abilities in the areas of medication management and driving capacity in a fashion similar to that observed for cognitive complaints and neuropsychological performance.

The purpose of the current study was to examine whether depression and cognitive dysfunction influenced discrepancies between self-reported and objective IADL functioning among HIV-infected adults. Although not a primary study aim, we also examined whether depression accounted for discrepancies between self-reported and current neuropsychological functioning. We predicted that (1) *Higher* levels of *depression* would be found among those who consistently *over-report* impairments in medication adherence, driving, and neuropsychological functioning compared to those who consistently under-report or provide accurate self assessments; (2) Impaired *cognition* would be found among those who *under-report* impairments in medication management and driving when compared to over-reporters and those who accurately report impairments; (3) Depression and cognitive impairments associated with frontal systems functioning (i.e., attention/working memory, information processing speed, and executive functions) would most accurately classify self-reported assessment groups.

METHOD

Participants

Participants included 107 HIV+ adults who were recruited from community agencies and medical centers within the Los Angeles area. Individuals presenting with a history of psychosis within the past year or alcohol/illicit substance abuse or dependence within the last month were excluded based on results of data collected using the Structured Clinical Interview for DSM-IV, Axis I Disorders (SCID; First, Spitzer, Gibbon, & Williams, 1995). Participants were also excluded if they presented with history of traumatic brain injury with loss of consciousness greater than 30 minutes, or with medical comorbidities apart from HIV that are believed to affect cognitive function (e.g., brain anoxia, kidney dysfunction, CNS opportunistic infections, seizures, or hepatitis C virus). Individuals presenting with known cerebrovascular events (e.g., strokes) were also excluded. Please see Table 1 for demographics and characteristics of the entire sample.

Procedure

Participants were administered the Beck Depression Inventory, Second Edition (BDI-II; Beck, 1987) to assess current level of depression, the Patient Assessment of Own Functioning Inventory (PAOFI; Chelune, Heaton, & Lehman, 1986) to assess perceived cognitive decline since illness onset, the Medication Management Task-Revised (Heaton, Marcotte et al., 2004) to assess both self-reported medication management and performance-based capacity for accurate medication management, a driving history questionnaire to assess perceived decline in a driving ability since illness onset, and a laboratory computer-based driving simulator to approximate actual driving ability.

Self-reported cognitive status—Participants were then classified into self-reported cognitive status groups (reported decline $n = 58$; reported no decline $n = 39$) based on their response (i.e., Yes/No) to item #34 from the Patient Assessment of Functioning Inventory (PAOFI; Chelune et al., 1986) assessing whether they perceived a decline in cognitive functioning since the onset of illness. Ten participants responded “Don’t know” to this question and therefore were not included in the discrepancy analysis. In addition, PAOFI total score was used to examine the degree of association between self-reported cognitive functioning, depression, and neuropsychological performance (see Table 2).

Neuropsychological performance—All participants completed a comprehensive neuropsychological test battery administered by trained psychometrists who were supervised by a board certified neuropsychologist (CHH). (See Table 2 for a list of neuropsychological tests.) Test scores were converted to demographically corrected *T*-scores (with a mean of 50

and a standard deviation of 10) using published normative data (see Table 2) and grouped by neurocognitive domain. Deficit scores were then calculated using an algorithm developed by Heaton and colleagues (Heaton, Miller et al., 2004) that assigns an impairment rating to *T* scores as follows: $T > 39 = 0$; $39 \geq T \geq 35 = 1$; $34 \geq T \geq 30 = 2$; $29 \geq T \geq 25 = 3$; $24 \geq T \geq 20 = 4$; $T < 20 = 5$. Deficit scores for each neuropsychological test were then averaged into one score to reflect global impairment (GDS). Individuals were classified as either cognitively unimpaired or impaired based on a deficit score cutoff of 0.5 for impairment. The global deficit score approach has been demonstrated as having good predictive validity for detecting cognitive impairments in HIV-infected individuals (Carey et al., 2004). Groups typifying each reporting style were created by comparing participants' self-report (i.e., decline vs no cognitive decline) to objective neuropsychological impairment classification (i.e., impaired versus unimpaired based on GDS) yielding the following groups: *Accurate self-assessors* ($n = 41$) who can be further subdivided as either unimpaired and reported no decline ($n = 25$) or impaired and reported decline ($n = 16$); *Over-reporters* (unimpaired but reported decline, $n = 27$); and *Under-reporters* (impaired but reported no decline, $n = 35$).

MEDICATION MANAGEMENT ASSESSMENT

Medication Management Task – Revised

Participants were administered the Columbia Medication Management Task – Revised (Heaton, Marcotte et al., 2004), in which they were asked to perform tasks and respond to questions about five different medications based on pill bottle labels, the number of pills in each bottle, and directions on package inserts. Self-reported medication management was based on participants' responses to questions from the MMT-R that assessed whether they perceived a decline in their ability to manage medications. A majority of our participants ($n = 99$) reported no problems in managing their medications, whereas a small number ($n = 8$) of participants either reported difficulty with managing their medications or that they received assistance with medication management.

The performance segment of the MMT-R required participants to determine information such as when a refill is needed, which medications need to be taken with food, how many pills are required to take the correct dosage, and how to correctly place pills in a pill box based on the instructions listed on the labels. Participants' total points (out of a maximum of 17) earned on the MMT-R task were used as the outcome variable to reflect overall performance. A cutoff score of 11, which corresponded to 1 standard deviation below the average score ($M = 13.69$) for cognitively normal participants, was used to classify good ($n = 82$) versus bad ($n = 24$) performance. MMT-R performance data were missing for one of our participants. Reporting groups were created based on self-reported versus observed difficulties in medication management: *Accurate self-assessors* $n = 72$: self-reported no medication management problems/performed normal on MMT-R ($n = 71$), self-reported medication management problems/performed poorly on MMT-R ($n = 1$); *Over-reporters* $n = 7$; *Under-reporters* $n = 26$. In addition to examining self-report of medication management, self-reported medication adherence was assessed to capture information about perceived medication-taking behaviors more generally. Self-reported medication adherence was gathered from the AIDS Clinical Trial Group (ACTG) questionnaire, which provides data regarding percentage of self-reported antiretroviral medication doses taken over the last 30 days. Percent adherence was calculated by subtracting the number of reported missed doses within the last 30 days from the total number of doses prescribed, dividing this number by the total number of doses prescribed, and multiplying it by 100. Based on a frequently used criterion in the literature (Simoni et al., 2006), a cutoff of 95% was used to classify participants into good adherers ($n = 72$) versus poor adherers ($n = 31$). Adherence data were missing for four participants.

Discrepancies between self-reported medication adherence and performance on MMT-R were also evaluated. Discrepancy groups were created based on self-reported adherence versus observed difficulties in medication management: consistent (i.e., self-report matched MMT-R performance) $n = 69$: negative discrepancy (i.e., self-reported suboptimal adherence, performed normally on MMT) $n = 16$; positive discrepancy (i.e., self-reported optimal adherence, but performed poorly on MMT) $n = 17$.

Self-reported driving ability—Participants were classified into self-reported driving impairment groups (reported decline $n = 66$; reported no decline $n = 25$) based on their response (i.e., Yes/No) to an item from a driving history questionnaire assessing whether they perceived a decline in driving ability since the onset of illness. Five participants were unable to respond to this question because they did not drive prior to illness onset and were therefore excluded from the driving discrepancy analysis.

Driving performance—Participants completed a laboratory-based driving simulator task (STISIM driving version 2.0 software; Rosenthal, Parseghian, Allen, & Stein, 1995; Systems Technology, Inc, Hawthorne, CA). For this simulation participants completed the second phase, the *Routine and Emergency Driving* task, which is designed to simulate city–country driving (Marcotte et al., 1999). During this phase participants must pass cars, stop at traffic lights, follow curving roads, drive around stalled automobiles, and avoid potential accidents (e.g., a pedestrian stepping onto the road, a car in front slamming on its brakes). Data regarding speed and accidents were collected by the software program and employed as outcome variables.

Driving performance was evaluated using a composite error score that included the number of: (a) off-road accidents, (b) speeding tickets, (c) collisions, and (d) pedestrian hits recorded during the simulation. Based on a cutoff score (3.4) that represented one standard deviation below the average performance ($M = 2.2$) for our internal sample of cognitively normal participants, participants were classified as either good drivers ($n = 67$) or poor drivers ($n = 19$). The driving simulator task was discontinued for five participants due to difficulties following task instructions. Reporting groups were then created based on self-reported versus observed driving performance: *Accurate self-assessors* $n = 50$: self-reported no driving impairments/performed normal on driving simulator ($n = 49$); reported driving impairments/performed poorly on driving simulator ($n = 1$); *Over-reporters* $n = 23$; *Under-reporters* $n = 13$.

Statistical analyses

The false discovery rate (FDR) approach was used to correct for multiple comparisons (see Benjamini & Hochberg, 2000 for review). Instead of controlling for the chance of *any* false positives (e.g., Bonferroni method), FDR controls for the expected proportion of false positives within a total number of comparisons.

The adjusted alpha level to correct for 25 comparisons using $p = .05$ in our calculation was .036. Hence, all p-values below .036 were considered statistically significant. Preliminary analyses revealed no significant demographic group differences between functional discrepancy groups (see Table 2). However, there were demographic associations with study variables; age was negatively correlated with MMT-R performance, $r(106) = -.192$, $p = .04$, whereas estimated duration of HIV infection was positively associated with MMT-R performance, $r(106) = .242$, $p = .01$.

Distributions of Medication Management Task (MMT) total scores, medication adherence rates, driving errors, and global neuropsychological T-scores were evaluated for normality, skewness, and kurtosis. All variables were normally distributed according to these statistics.

For discriminant analyses, assumptions pertaining to linearity, multivariate normality, and equal population covariance among predictor groups were verified and met.

Primary study statistical procedures were as follows: (1) ANOVA was used to examine depression among self-reported driving, medication, and cognitive impairment groups; (2) Partial correlations were used to examine the relationships between depression scores, cognition, and performance on the MMT-R and Driving Simulator; (3) Cross tabulations were used to identify which participants consistently under-reported, over-reported, or were accurate in their self-assessments in at least two out of the three functional measures (i.e., cognition, medication management, and driving); (4) Participants were recoded into groups of consistent *Accurate self assessors* $n = 56$, *Over-reporters* $n = 22$, and *Under-reporters* $n = 12$. (Note: We were unable to classify seven of our participants due to inconsistent responding across the three functional measures, and due to the small number of participants whose self-reports of functional impairments were confirmed by functional performance measures, we were unable to split accurate self-reporters into impaired versus unimpaired.) (5) Discriminant function analysis was then used to determine the independent predictive value of depression and cognition status on self-report consistency groups

RESULTS

Depression, cognition and self-reported functional capacity vs functional performance self-reported driving ability

Participants who self-reported a decline in driving ability demonstrated higher levels of depression than those who reported no decline, $F(1, 89) = 13.56$; $MSE = 75.74$, $p < .001$, $\eta_p^2 = 0.13$. Self-reported driving groups did not differ in global neuropsychological functioning ($p > .05$).

Self-reported driving vs driving performance—Surprisingly, participants who reported no decline in driving ability exhibited a *greater* number of errors on the driving simulator task when compared to participants who reported decline, $F(1, 84) = 4.75$, $MSE = 1.63$, $p = .03$, $\eta_p^2 = 0.05$. Those who over-reported problems in driving (i.e., those who complained of difficulties that were not objectively verified) demonstrated *higher* depression scores than those who under-reported problems or were accurate in their self-assessments, $F(2, 83) = 4.29$, $MSE = 81.15$, $p = .01$, $\eta_p^2 = 0.09$. Contrary to expectation, reporting groups (i.e., Accurate self-assessors, Over-reporters and Under-reporters) did not significantly differ in neuropsychological functioning ($p > .05$).

Self-reported medication management—Participants who reported problems managing their medications demonstrated higher levels of depression than those who did not report problems, $F(1, 105) = 6.65$, $MSE = 82.49$, $p = .01$, $\eta_p^2 = 0.05$. However, participants who complained of medication management difficulties in their everyday lives did not differ in MMT-R performance from participants who denied experiencing medication management difficulties or in global neuropsychological functioning ($p > .05$).

Participants who over-reported deficits in medication management demonstrated the highest levels of depression when compared to under-reporters or accurate self-assessors, $F(2, 103) = 4.46$, $MSE = 86.15$, $p = .01$; $\eta_p^2 = 0.07$. Under-reporters performed more poorly on measures of neuropsychological functioning than over-reporters and accurate self-assessors, $F(2, 103) = 26.92$, $MSE = 31.73$, $p < .001$, $\eta_p^2 = 0.31$.

We recognize that our statistical analyses with regard to self-reported medication management is limited due to the small number ($n = 8$) of participants who reported problems. Nevertheless, inspection of group BDI-II scores revealed a dramatic difference

between self-report groups, with higher scores among those who reported problems (M = 23.25 vs$M$ = 11.63). Furthermore, higher depression scores were found among participants who over-reported deficits in medication management.

Self-reported medication adherence—To expand on the analysis above, we also examined the difference between self-reported medication adherence and objective performance on the MMT-R. Although it can be argued that these variables reflect distinct constructs, their similarity lies in the assessment of behaviors that are involved in accurately self-administering medications. Interestingly, we found similar results in that participants who reported poor adherence to their medication regimen exhibited higher levels of depression than participants who reported good adherence, $F(1, 101) = 10.33$, $MSE = 80.10$, $p = .002$, $\eta_p^2 = 0.08$. It is possible that depression resulted in poor adherence rates for these participants; nevertheless, adherence groups did not differ in MMT performance or global neuropsychological functioning ($p > .05$).

Depression and cognitive complaints versus objective cognitive performance

Self-reported cognition—Participants who reported declines in cognition were significantly more depressed than those who reported no decline, $F(1, 95) = 17.03$, $MSE = 66.17$, $p < .001$; $\eta_p^2 = 0.14$.

Self-report cognition vs neuropsychological performance—As expected, over-reporters (i.e., participants who complained of cognitive deficits that were not demonstrated on objective neuropsychological testing) exhibited higher levels of depression than under-reporters and accurate self-assessors, $F(2, 100) = 5.68$, $MSE = 70.42$; $p = .01$, $\eta_p^2 = 0.10$. However, under-reporters did not significantly differ in neuropsychological performance from accurate assessors who self-reported cognitive deficits. See Table 3 for means and standard deviations.

Depression, neuropsychological functioning, and performance on functional tasks

Despite depression being a powerful predictor of subjective complaints of functional decline, current level of depression was not significantly associated with objective performance on the MMT-R, $r(106) = .171$; $p = .15$, driving simulator performances, $r(86) = -.081$, $p = .52$, or measures of global neuropsychological functioning, $r(107) = -.022$, $p = .82$. However, neuropsychological functioning was significantly associated with total MMT-R score, $r(106) = .617$, $p < .001$, and number of errors produced on the driving simulator, $r(86) = -.219$, $p = .024$.

Predictors of overall self-report/performance discrepancies—For participants who consistently over-reported ($n = 22$) or under-reported ($n = 12$) functional impairments in medication management and driving, One-way ANOVA revealed differences in current depression, $F(1, 32) = 6.01$; $p = .003$; $\eta_p^2 = 0.12$, and neuropsychological performance in domains of attention, $F(1, 32) = 3.87$; $p = .025$; $\eta_p^2 = 0.08$, information processing speed, $F(1, 32) = 4.23$, $p = .01$; $\eta_p^2 = .09$, language, $F(1, 32) = 8.77$, $p = .006$; $\eta_p^2 = 0.21$, learning and memory, $F(1, 32) = 30.34$, $p < .0001$; $\eta_p^2 = 0.17$, executive functioning, $F(1, 32) = 9.50$, $p < .0001$; $\eta_p^2 = 0.18$, and motor functioning, $F(1, 32) = 11.25$; $p < .0001$; $\eta_p^2 = 0.20$. As expected, under-reporters of functional deficits performed significantly more poorly across the aforementioned cognitive domains, whereas over-reporters demonstrated higher levels of current depression. See Table 3 for means and standard deviations.

Depressive symptoms, cognition, and discrepancy classification—The next series of analyses examined the differential predictive value of depression and cognition on self-reporting style among the subset of participants who consistently over-reported or

under-reported functional deficits in medication management and driving. Discriminant Function Analysis using the leave-one-out (LOO) jackknife classification approach (see Huberty, 1994, for review) revealed that depression and the cognitive domains of attention, information processing speed, learning and memory, verbal functioning, motor functioning, and executive functioning were significant predictors of reporting style (i.e., over-reporters, under-reporters) ($\lambda = 0.40$, $\chi^2 = 25.47$, $p < .001$, $\eta_p^2 = 0.59$). The classification results show that the model correctly predicted 85.7% of over-reporters and 78.9% of under-reporters, with an overall classification rate of 81.8%.

DISCUSSION

The current study expands on findings in the self-appraisal literature by addressing the ways in which depression and cognition influence and mediate self-reported IADL functioning (i.e., medication management and driving), and whether objective measurements confirm these self-reports in an HIV-infected sample.

Our results demonstrate that individuals with depressive symptoms tend to inaccurately over-report cognitive and functional impairments. Specifically, those who over-reported cognitive and functional deficits demonstrated the highest levels of depression relative to other appraisal groups. Alternatively, individuals who under-reported deficits in cognitive and functional abilities reported the lowest levels of depression. Although neurocognitive functioning was strongly related to performance on driving and medication management, depression was not, suggesting that poor performance on laboratory-based measures of functional abilities are more sensitive to cognitive deficits than mood status. As previously discussed, we were unable to subdivide accurate self-reporters into functionally unimpaired and impaired groups due to the small cell sizes of participants whose self-reported functional impairments were confirmed by functional performance; that is, a majority of accurate self-reporters demonstrated normal functional performance. Because we were unable to make comparisons between under-reporters and participants who accurately reported impairments, it was not possible to establish whether poor cognition results in a “true” lack of awareness of functional deficits in medication management and driving.

Nonetheless, we examined differences in cognitive functioning between participants who consistently under-reported, over-reported, and were accurate in their self-assessments of functional abilities (i.e., medication management and driving). We found that under-reporters were more cognitively impaired than over-reporters and accurate self-assessors, suggesting that cognitive impairment may play an even greater role in self-report of functional abilities. Our findings related to depression were consistent across all analyses, thereby indicating that depressive symptoms are more likely to lead to inaccurate self-report of functional deficits than neuropsychological functioning. Moreover, our participants were not formally diagnosed with depression; rather they presented with a range of depressive symptoms. This suggests that a clinical diagnosis of depression is not necessary for overestimations of functional disability to occur. As a whole, our sample of participants demonstrated normal to mildly impaired levels of cognitive functioning. It remains possible that only at greater levels of cognitive impairment does diminished awareness of functional deficits become more apparent, which is consistent with findings from Marcotte and colleagues (2004) demonstrating that a subset of HIV+ drivers who failed the on-road driving simulator were unaware of their poor performance.

This study found that depressive symptoms, learning and memory, attention/working memory, information processing speed, language, motor functioning, and executive functioning most accurately classified over-reporters and under-reporters, which is consistent with previous studies that have linked these domains to impaired awareness

suggesting dysfunctions in frontal circuitry, as well as HIV-associated cognitive impairment. This finding highlights the importance of these cognitive and psychiatric variables when predicting the ability to provide accurate self-report of functional abilities.

Consistent with expectations, there were no significant relationships between self-reported functional abilities and objective functional task performance. Considering the previous findings, it is plausible that psychiatric factors and cognition may account for the lack of relationship in self-appraisal and awareness of functional abilities. Our findings are in accordance with previous studies linking discrepancies between subjective ratings versus objective neuropsychological performance with depression among individuals with HIV (Carter et al., 2003; Heaton, Marcotte et al., 2004; Hinkin et al., 1996; Moore et al., 1997; van Gorp et al., 1991).

We recognize that laboratory-based measures of functional capacity may not fully represent actual functional abilities, so the extent to which we can make inferences about functional capacity is limited. Future investigations comparing performance on functional measures to real-world performance (e.g., comparing simulated driving performance to on-road driving, such as was done by Marcotte et al., 2004) would help to clarify the accuracy of performance-based functional measures. Although we did not have access to informant ratings in this study, comparing informant ratings to functional performance would also help to address the predictive value of these functional measures.

Despite these limitations, several interesting results from the current study have implications for working with individuals infected with HIV. First, our findings suggest that the neurocognitive and psychiatric aspects of HIV/AIDS are largely independent of one another (Grant et al., 1993; Hinkin et al., 1992; Mapou et al., 1993; Mason et al., 1998; von Giesen et al., 2001). As such, cognitive complaints or self-reported functional ability may not be accurate assessments of true performance. Rather, functional complaints may indicate mood disturbances, such as anhedonia, that could interfere with everyday functioning independently of functional ability.

Under-reporters constituted approximately 13% of participants who were consistent in self-reporting style. Not only is this concerning in the context of patient welfare, but also patient unawareness may be misinterpreted by the clinician as a “stable” or “improved” level of functioning. Inaccuracies in self-report highlight the importance of integrating objective laboratory based measures of functional abilities in clinical assessments of individuals with illnesses, such as HIV, that often co-occur with depression (Castellon et al., 2006). Clinically, this is important when evaluating functional decline, as over-reliance on self-report may lead to inaccurate diagnostic conclusions.

The ability to function independently is an important consideration when determining a diagnosis of HIV-associated Neurocognitive Disorder (HAND; Antinori et al., 2007). As outlined in the HAND nosology, in order to diagnose HIV-associated mild neurocognitive disorder, cognitive impairment must produce mild interference with daily functioning. This may be established using performance-based measures based functional measures such as those in the current study, as well as by patient self-report or observation by others. As demonstrated by this study and others, relying on self-report among depressed individuals can lead high rates of false positives.

In sum, our findings underscore the importance of considering depression and cognitive ability when assessing self-reports of functional status among individuals with HIV. More importantly, findings from our study suggest that using objective IADL measures such as the Medication Management Task may more accurately detect declines in functional ability than self-report. Just as over-reliance on subjective self-report of cognitive status can lead to

diagnostic error, over-reliance on patients' self-reported claims of functional decline, or lack thereof, should be avoided.

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Table 1

Demographic characteristics of the whole sample (*N*=107)

Variable	
Age	49.1 (11.1)
Education	13.7 (2.2)
% Male	81%
Ethnicity	
Caucasian	33.6%
African American	47.7%
Hispanic	13.1%
Asian American	2.0%
Native	2.0%
Other	2.0%
*Recent Cluster of Differentiation 4 (CD4)	420.0 (400.25)
*Nadir CD4	150.0 (227.3)
%Undetectable viral load	63%
%Independently manage medications	95%
†%Meets Acquired Immune Deficiency Syndrome (*AIDS*) *Criteria*	80%
Number of years infected	13.05 (6.1)
Beck Depression Inventory (BDI)-II total score	11.9 (9.3)
Medication Management Task total score	13.9 (3.7)
Driving errors total score	2.4 (1.3)
Neuropsychological T-score	42.8 (6.7)
**% cognitively impaired	47.3%

*Median and Interquartile Range.

†(*based on opportunistic infection (OI) or CD4 < 200*).

**(Global Deficit Score >0.5).

Table 2

Neuropsychological battery

Domain	Test name	Variable used	Normative data (citation)
Language	Controlled Oral Word Association Test	FAS/Animals	Heaton, Miller et al., 2004
	Boston Naming Test	Total Score	Heaton, Miller et al., 2004
Executive functioning	Trail Making Test	Part B	Heaton, Miller et al., 2004
	Wisconsin Card Sorting Test	Perseverative Errors	Heaton et al., 1993
	Stroop Color and Word Test	Interference	Golden, 1978
Information processing speed	Trail Making Test	Part A	Heaton, Miller et al., 2004
	Wechsler's Adult Intelligence Scale-III (WAIS-III)	Digit Symbol Coding	Taylor & Heaton, 2001
	(WAIS-III)	Symbol Search	Taylor & Heaton, 2001
	Conners' Continuous Performance Test-2 (CPT-II)	Reaction Time	Conners and MHS Staff, 2000
Attention and working memory	Paced Auditory Serial Addition Test (PASAT)	Total Score	Dieher et al., 2003
	CPT-II	Omissions and Comissions	Conners and MHS Staff, 2000
	WAIS-III	Letter–Number Sequencing	Taylor & Heaton, 2001
Learning and memory	Hopkins Verbal Learning Test – Revised (HVLT-R)	Total Learning Score and Recall	Brant & Benedict, 2001
	Brief Visual Memory Test – Revised (BVMT-R)	Total Learning Score and Recall	Benedict, 1997
Visuospatial functioning	WAIS-III	Block Design	Taylor & Heaton, 2001
Motor functioning	Grooved Pegboard	Dominant and Non-Dominant Hand Score	Heaton, Miller et al., 2004

Table 3

Characteristics of functional discrepancy groups

Variable	Disability Over-reporters (*n* = 22)	Disability Under-reporters (*n* = 12)	Accurate (*n* = 56)	**Results
Age	49.5 (5.5)	52.7 (9.4)	50.9 (10.7)	Not Significant
Education	13.8 (3.0)	12.7 (1.4)	13.7 (2.2)	Not Significant
Male (%)	85%	81%	82%	Not Significant
Ethnicity				
Caucasian	29%	30%	38%	Not Significant
African American	57%	60%	41%	Not Significant
Hispanic	14%	9%	13%	Not Significant
Asian American	0	0	3%	Not Significant
Native	0	0	3%	Not Significant
Other	0	1%	2%	Not Significant
*Cluster Differentiation 4 (CD4)	369.0 (376)	440.0 (371)	440.0 (377)	Not Significant
*Nadir CD4	197.0 (173.5)	150.0 (180)	143.5 (275.2)	Not Significant
% Undetectable viral load	78%	75%	77%	Not Significant
†% Meets Acquired Immune Deficiency Syndrome (AIDS) Criteria	95%	91%	86%	Not Significant
# Years infected	13.14 (7.3)	12.1 (8.4)	13.2 (6.1)	Not Significant
% Independently manage medications	79%	100%	97%	Not Significant
**Beck Depression Inventory -II	19.6 (10.9)	9.0 (9.7)	9.6 (7.5)	a > b,c
**Medication Management Task total	15.0 (2.8)	8.0 (3.5)	14.4 (3.1)	b < a,c
**Driving Errors	2.1 (1.6)	4.0 (1.7)	2.2 (1.4)	b > a,c
**Global Neuropsychological T-score	46.7 (5.0)	35.7 (6.0)	44.2 (5.8)	b < a,c
**Attention T-score	46.7 (10.3)	36.1 (18.3)	42.4 (9.1)	b < a,c
**Processing Speed T-score	45.5 (8.7)	38.6 (10.0)	46.8 (8.9)	b < a,c
**Learning and Memory T-score	45.1 (7.58)	28.8 (9.2)	41.3 (10.9)	b < a,c
**Executive T-score	50.0 (6.6)	37.4 (8.6)	47.8 (7.4)	b < a,c
**Motor T-score	49.0 (7.3)	39.4 (8.9)	45.1 (8.2)	b < a,c
**Verbal T-score	52.6 (7.8)	43.5 (9.4)	47.5 (8.5)	b < a,c
**††Patient Assessment of Functioning (PAOF) total score	12.3 (7.2)	7.2 (6.8)	6.15 (5.5)	a > b,c
**% cognitively impaired (Global Deficit Sscore > 0.5)	14%	100%	38%	b > a,c

*Median and interquartile range.

†Based on opportunistic infection (OI) or CD4 < 200.

††Higher scores represent more cognitive complaints.

** $p < .036$; a = over-reporters; b = under-reporters; c = accurate self-assessors.