

# HACA: HIV, Aging, Cognition and Functional Assessment: Assessing Functional Ability and Cognition through Technology in Older HIV-Positive Adults

Authors: Samir Sabbag, Deborah Jones, David Loewenstein, Andrew Wawrzyniak, Peggy Gonzalez, Philip Harvey, Sara Czaja

Mentors: Deborah Jones, Sara Czaja

THE MIAMI CENTER FOR AIDS RESEARCH



## Abstract

**Background:** People living with HIV have seen a dramatic increase in longevity due to the effectiveness and tolerability of ART. Neurocognitive dysfunction is found at higher rates in this population relative to non-infected individuals and their younger counterparts. This decline could impair their ability to engage in activities necessary for maintaining independent living such as managing finances, medications, and healthcare, decreasing their ability to age successfully. Most of the research in this area has included younger populations or used standardized neuropsychological measures of cognition, which correlate with the performance of everyday tasks but do not capture the complexity of these activities. Therefore, it is hard to generalize findings regarding the impact of HIV related cognitive dysfunction to real world activities in older HIV positive adults. More information is needed on the impact of HIV in the performance of everyday tasks in this population, as tasks are changing dramatically given the rapid advance of technology and the elimination of non-technological alternatives for the performance of these activities.

**Methods:** This study looks at the impact of HIV on everyday task performance by obtaining information on the ability of older HIV-infected adults to perform everyday activities through the use of novel technological measures. Specifically, computer-based simulations assessing medication (Prescription Refill Task) and financial management (ATM Task), as well as understanding physician instructions (Doctor's Task), were delivered to 41 HIV-positive and 28 HIV-negative participants between the ages of 50 and 72. Standard cognitive assessments and standard functional assessment tools were delivered to these two groups as well, including HVLT, Trail Making, Digit Symbol, Grooved Pegboard, UPSA-B.

**Results:** Patients were of comparable age and education, and had equivalent Depression Scores in the Geriatric Depression Scale. Computerized task performance was compared between the two groups. HIV-positive participants made less correct responses ( $p=.044$ ) and more errors ( $p=.041$ ) on the Doctor's Task. Total time in this task was similar in both groups. No statistical differences were observed on the ATM and Prescription Refill tasks. HIV-positive participants had lower HVLT-total recall ( $F[1.66]=7.2; p=.009$ ) and HVLT-delayed recall scores ( $F[1.66]=7.3; p=.009$ ) but similar Digit Symbol Substitution scores.

**Conclusion:** This study suggests that people affected with HIV do not have problems with tasks that require speed, but with those that require use of memory. The Doctor's Task assesses recall of instructions by a physician, which may be affected in these individuals. Focusing on the specific limitations revealed by this study, will guide the development of tailored interventions aimed at enhancing effective utilization of technology and increased independence in this population.

## Background

People living with HIV have seen a dramatic increase in longevity due to the effectiveness and tolerability of ART. This has made AIDS-defining illnesses increasingly rare, but an array of debilitating HIV-associated conditions, such as neurocognitive impairments, have risen in incidence. Cognitive measures have identified the incidence of neurocognitive decline to be over fifty percent in this population. This decline ranges across multiple cognitive domains including attention, memory, processing speed, executive functioning, and psychomotor ability. The aging process and HIV status may work synergistically to develop and maintain cognitive deficits that may affect every day functioning in areas such as financial management, employment, medication adherence, and medical appointment management.

Older adults need to perform a variety of activities that include health management, shopping, banking and money management tasks in order to live independently. The performance demands for these tasks are changing dramatically, given the rapid advance of technology and the elimination of non-technological alternatives for task performance (e.g., requirements to use a voice menu, internet service, or an ATM). Most of the research in this area has included younger populations or used standardized neuropsychological measures of cognition, which correlate with the performance of everyday tasks but do not capture the complexity of these activities. Therefore, it is hard to generalize findings regarding the impact of HIV-related cognitive dysfunction to real world activities in older HIV positive adults.

Understanding the ability of HIV+ older adults to meet these task demands and the factors that influence task performance, is essential to the development of strategies to compensate for age-related performance declines and ultimately enhance the independence of this population. There are currently a number of proven strategies to enhance cognition with cognitive remediation strategies. However, training cognition may not be the most direct path towards improvement of everyday functional skills. It is critical to identify the most important treatment target so that interventions can be optimized for efficiency and tolerability to participants.

The Center on Research and Education for Aging and Technology Enhancement (CREATE) at the University of Miami has developed simulations of tasks that mirror real-world functional demands. This battery of tasks can be used for assessment as well as remedial training. Currently, we do not have information about the feasibility of these tasks in populations affected with HIV. We believe healthy controls will perform better than HIV-positive older adults on the functional tasks. Also, performance on the computerized functional tasks will be highly correlated with paper and pencil measures of functionality and correlated standardized measures of component cognitive abilities, such as memory, attention, executive function, and visuospatial domains.

## Methods

N=69 41 HIV-positive and 28 HIV-negative Ages 50-72

Phone Screening assessing

**Inclusion criteria:** English speaker, confirmed HIV status, >6<sup>th</sup> grade reading level, age 50-80, good vision/hearing.

**Exclusion criteria:** Mod/Sev depression, chronic mental illness, current substance use, dementia, h/o head trauma, opportunistic brain infections.

Patients brought evidence of HIV status to appointment

Performed a 2-4 hour assessment that included:

a) Demographics and Technological Experience Questionnaire

b) Cognitive, Functional and Mental Health Assessments

Woodcock Johnson . UPSA-B

Trails A & B . HVLT

Digit Symbol . GDS

Grooved Pegboard

c) Computerized Functional Tasks

Doctor's Task Prescription Refill Task

ATM Task

## Results

		Demographics		
		HIV Status		Total (N=69)
	Mean, SD	Positive (N=41)	Negative (N=28)	
Age	Mean, SD	56.22, 4.77	57.69, 12.54	56.83, 8.80
	Range	50 - 65	50 - 72	50 - 72
Gender	Male	23 (56%)	15 (54%)	38(55%)
	Female	18 (44%)	13 (46%)	31(45%)
Education	Less than HS	12(29%)	4(15%)	16(23%)
	HS Graduate/GED	10(24%)	6(21%)	16(23%)
	Some College/ Associate's Degree	17(42%)	12(43%)	29(42%)
	Bachelor's and above	2(5%)	6(21%)	8(12%)
Race	Caucasian	3(7%)	12(43%)	15(22%)
	African American	36(88%)	16(57%)	52(75%)
	Other	2(5%)	0(0%)	2(3%)

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		Doctor's Task				
		Sum of Squares	df	Mean Square	F	Sig.
Total Task Time in Seconds	Between Groups	4293.169	1	4293.169	.079	.779
	Within Groups	3619936.483	67	54028.903		
	Total	3624229.652	68			
Total correct	Between Groups	66.551	1	66.551	4.199	.044
	Within Groups	1062.000	67	15.851		
	Total	1128.551	68			
Total errors	Between Groups	76.273	1	76.273	4.333	.041
	Within Groups	1179.495	67	17.604		
	Total	1255.768	68			

		HVLT and Digit-Symbol Substitution				
		Sum of Squares	df	Mean Square	F	Sig.
HVLT Learning Trials: Trial 3	Between Groups	35.834	1	35.834	7.228	.009
	Within Groups	327.225	66	4.958		
	Total	363.059	67			
HVLT Delayed Recall Trial: Trial 4	Between Groups	54.002	1	54.002	7.319	.009
	Within Groups	486.939	66	7.378		
	Total	540.941	67			
Digit-Symbol Substitution Number Correct	Between Groups	158.282	1	158.282	1.459	.231
	Within Groups	7162.350	66	108.520		
	Total	7320.632	67			

## Conclusions

Most of the research on neurocognitive functioning and HIV has addressed younger populations or used standardized neuropsychological measures. These measures correlate with the performance of everyday tasks, but do not capture the complexity of these activities, making it challenging to generalize findings regarding the impact of HIV-related cognitive dysfunction to real world activities in older HIV-infected adults. This study addressed the impact of HIV in the performance of everyday tasks in older persons. We obtained information on their ability to perform everyday activities through the use of technologically novel methods developed by CREATE at the Center on Aging.

We found that older HIV-positive adults performed worse on the Doctor's Task when compared to their HIV-negative peers with similar age, education and racial distribution. This task involves a physician giving instructions to the participant, who needs to remember them and answer questions about the encounter. This is a task that requires patients to retain a substantial amount of information in order to complete it successfully.

Regarding cognitive domains, our study did not find affected processing speed in the HIV-positive group. This can be seen in the results of the Digit Symbol Substitution test. Memory measures assessed by the HVLT revealed statistically significant lower scores in the HIV-positive group. These findings add to the growing literature showing how HIV-associated neurocognitive disorder is present in this population, especially learning efficiency and memory retrieval, which translate in impaired functionality in activities of daily living. Our findings support research in community settings that show how older HIV-positive adults are at an increased risk of decline in real world functioning, when instrumental activities of daily living and health related quality of life are measured.

Further analyses will be performed with the data obtained from this study, including correlating the functional tasks with the cognitive assessments, as well as with the various demographic variables obtained.

Our next steps would include obtaining biomarkers such as inflammatory and neuropathological markers, as well as neuroimaging studies while performing the tasks, which would increase our understanding of the way functioning is affected in this population. The computerized functional tasks could be used not only for assessment of functioning, but for functional training.

We hope that the findings of this study will ultimately guide the development of tailored interventions aimed at enhancing the independence of older HIV-positive adults, with the aim of improving their quality of life.

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