Published in final edited form as:
J Neurosci Nurs. 2014 February ; 46(1): 23–33. doi:10.1097/JNN.0000000000000034.

Predictors of Improvement Following Speed of Processing Training in Middle-aged and Older Adults with HIV: A Pilot Study

Jaspreet Kaur, BS [Graduate Student],
Department of Psychology & Edward R. Roybal Center for Translational Research in Aging and Mobility, Holly Mears Building, 924 19th Street South, UAB, Birmingham, AL 35294, Office: 205-975-0083

Joan E. Dodson, PhD [Research Associate],
Department of Psychology & Edward R. Roybal Center for Translational Research in Aging and Mobility, Holly Mears Building, 924 19th Street South, UAB, Birmingham, AL 35294, Office: 205-934-2551

Laura Steadman, EdD, CRNP, MSN, RN [Assistant Professor], and
University of Alabama at Birmingham School of Nursing & Adult/Acute Health Chronic Care & Foundations, Room 550, 1530 3rd Avenue South, Birmingham, AL 35294-1210, Office: 205-996-7670, Fax: 205 995-9165

David E. Vance, PhD, MGS [Associate Professor]
School of Nursing, Room 456, 1701 University Boulevard, University of Alabama at Birmingham (UAB), Birmingham, AL 35294, Office: 205-934-7589, Fax: 205-996-7183

Jaspreet Kaur: jaspreet@uab.edu; Joan E. Dodson: joan3d@uab.edu; Laura Steadman: lstead@uab.edu; David E. Vance: devance@uab.edu

Highly Active Antiretroviral Therapy (HAART) has radically reduced HIV-related mortality (Vance & Robinson, 2004), resulting in greater numbers of older adults with this disease. Based upon the Centers for Disease Control (CDC) and Prevention's 2005 data (CDC, 2008), adults 50 years and older in the United States comprised 15% of all new cases of HIV/AIDS, 24% of existing cases, and 35% of AIDS-related mortality. It is estimated by 2015 nearly half of those with HIV will be 50 and older (Kirk & Goetz, 2009), thus highlighting the need for research focused on the changes in cognition resulting from potential interactions of the disease and aging processes. More importantly, these statistics also highlight the growing need for research focused on interventions that can maintain the cognitive, and thus everyday functional abilities of this population.

Cognitive Problems Associated with Aging with HIV

Despite the effectiveness of HAART in extending life for those infected, concerns remain that as people age with this disease, many will experience more severe cognitive problems that will interfere with everyday functioning and quality of life (Valcour & Sacktor, 2004; Vance, Wadley, Crowe, Raper, & Ball, 2011). Heaton and colleagues (2010) examined

Correspondence to: Jaspreet Kaur, jaspreet@uab.edu.

neuropsychological functioning in several cognitive domains (e.g., attention/working memory, verbal fluency) including speed of processing. In this study of 1,555 adults with HIV (M_{age} = 43.2), 52% exhibited neuropsychological impairment. These researchers found that 33% of them had asymptomatic neurocognitive impairments, 12% had mild neurocognitive disorders, and 2% had severe HIV dementia. Other studies have found similar rates of neuropsychological impairments (e.g., Heaton et al., 2004; Trépanier et al., 2005).

Impairments in speed of processing appear to be one of the cognitive domains most affected by HIV; these impairments may even be more profound in older adults aging with this disease (Reger, Welsh, Razani, Martin, & Boone, 2002). For example, in a longitudinal study, Baldwizcs and colleagues (2004) followed adults with (n = 59) and without (n = 55) HIV over an 8-year period. They found a significant decline in speed of processing in adults with HIV compared to those without the disease. Furthermore, Reger and colleagues conducted a meta-analysis of 41 studies on neuropsychological impairments of HIV infection. These researchers found those with HIV performed significantly worse on measures of problem solving and executive functioning, motor functioning, and speed of processing compared to those without HIV. In addition, it has been observed in normal, community-dwelling older adults without HIV that speed of processing is important to perform instrumental activities of daily living such as driving (Ball, Edwards, & Ross, 2007).

Speed of Processing Training

Unfortunately, despite recognized impairments in speed of processing in middle-aged and older adults with HIV, few studies have attempted to ameliorate this problem (Vance, Fazeli, Moneyham, Keltner, & Raper, in press). Fortunately, speed of processing training, a type of cognitive remediation therapy, has been shown to be effective in improving speed of processing in normal community-dwelling older adults, which transfers to everyday functioning, improved mood, and driving safety (Ball et al., 2007; Wolinsky et al., 2009). Based upon the principles of neuroplasticity, cognitive remediation therapies stimulate brains in a manner that builds new and stronger connections between neurons, from which cognitive abilities are improved (Vance & Wright, 2009). Typical cognitive remediation therapies consist of several sessions of computerized exercises administer over a period of time. These remediation therapies are specifically designed to extend one's cognitive abilities in a certain domain through repetitive exercise and instruction. In general, speed of processing training, consists of presenting visually complex information to participants and having them interact in a prescribed manner to such rapidly presented stimuli and providing them direct and timely feedback.

Recently, in a sample of 46 middle-aged and older adults with HIV, Vance, Fazeli, Ross, Wadley, and Ball (in press) randomized participants into one of two groups: 1) speed of processing training, or 2) no-contact control. These researchers examined whether speed of processing training enhanced the participants' cognitive abilities and whether such improvements in speed of processing also transferred to a laboratory measure of everyday functioning called the Timed Instrumental Activities of Daily Living (TIADL) Test. This test is a timed measure consisting of various activities such as finding food items on a shelf of food, locating a telephone number in a phone book, and so forth. This measure and other cognitive measures were administered at baseline and approximately 4-6 weeks later, immediately after the speed of processing training was completed, in a typical two-group pre-post experimental design. The speed of processing training was self-administered using the INSIGHT™ computer program that utilized five different games or exercises (i.e., Bird Safari, Jewel Diver, Road Tour, Sweep Seeker, and Master Gardener) that were specifically designed to increase the participants' visual speed of processing (see Method for more detail). All of the games operated by either increasing difficulty if participants answered correctly or decreasing difficulty if participants answered incorrectly (i.e., double-staircase method). This method is thought to promote positive neuroplasticty in the brain with the goal of increasing the participants' visual speed of processing. As a result, Vance and colleagues found that participants in the speed of processing group significantly improved their visual speed of processing translating to improvements in the TIADL compared to those in the no-contact control group. From this study, it is encouraging to find that speed of processing training may be effective in improving cognitive and everyday functioning in adults with HIV.

Purpose

Although the benefits of this cognitive remediation therapy are promising in this clinical population, many predictors are known to impact cognitive functioning in adults with HIV (e.g., age, educational level, income, substance use, and co-morbidities; Vance, Fazeli, Moneyham et al., in press) that may result in differential training gains from this speed of processing training. Thus, the primary purpose of this secondary data analysis was to identify predictors of speed of processing training gains in those who received speed of processing training as seen in the previous study (Vance, Fazeli, Ross et al., in press). Secondary aims also included analysis of: (1) participants' reports of what was enjoyable about this intervention, and (2) the relationship between self-reported attitudes towards training and cognitive gains. This information can be used by nurses, nurse clinicians, nurse practitioners, occupational therapists, and psychologists to improve delivery of such cognitive remediation therapies in other venues (i.e., clinics, adult daycare centers).

Method

Participants

Participants were recruited through a campus HIV/AIDS clinic using flyers, brochures, and word of mouth. Participants called the researchers and were screened over the phone. To be eligible for the study, the participants had to be 40 years or older, English speaking, and diagnosed with HIV for over 1 year. To control for confounds that could affect cognition, the participants could not be homeless, have frank cognitive impairments (i.e., mental retardation, Alzheimer's diseases, and HIV-related dementia), be legally deaf or blind, have experienced a loss of consciousness due to a brain trauma greater than 30 minutes, have a severe neuromedical comorbidity (i.e., bipolar disorder, schizophrenia), or currently experience chemotherapy or radiation treatment. These eligibility criteria reflect other cognitive studies on HIV to ensure that the results are not confounded by multiple causes of cognitive impairment.

Design and Procedure

Eligible participants were scheduled to come to the center where they gave consent using a university Institutional Review Board (IRB) approved form; after which, they were administered a 2-hour baseline battery of cognitive and everyday functioning tests. Participants were compensated $50 for this initial visit by a check through the mail. After the baseline interview, participants were informed of the speed of processing training study; those that decided to continue were administered another IRB consent form for this intervention study and randomized into one of two groups: 1) speed of processing training, or 2) no-contact control. Randomization occurred by asking the participants to pick one blank envelop from a stack that, once opened, stated clearly which group they were assigned; the assignments in the envelopes were 1-to-1 (speed of processing to no-contact control).

Those in the speed of processing training group received $10 for each 1-hour training session up to ten hours. Usually, training was completed within a 4-6 week period. After completing the training, participants' received an abbreviated version of the baseline assessment at posttest. Similarly, the no-contact control group was contacted 5 weeks after the baseline visit for their posttest assessment. As with the baseline visit, all participants received $50 by mail for their time and effort for the posttest assessment.

Intervention

The speed of processing training was self-administered using the computer program INSIGHT™ as previously mentioned (Vance, Fazeli, Ross et al., in press). Using a computer touch-screen monitor, the INSIGHT games were Road Tour, Bird Safari, Jewel Diver, Sweep Seeker, and Master Gardener that were specifically designed to increase the participants' visual speed of processing; immediate feedback was provided with each of these games. However, the participants were encouraged to spend more time playing the Road Tour game because it was modeled after the original speed of processing training that has demonstrated transfer to improved cognitive and everyday functioning in older adults (Ball et al., 2002). The training effects for this type of speed of processing intervention have been shown in other studies (e.g., Edwards, Wadley et al., 2005; Wolinsky et al., 2009).

Road Tour is a game whereby participants had to focus on a central and peripheral task simultaneously. In the central task, participants were quickly presented a combination of a car and/or truck and instructed to respond whether they were the same or different (i.e., car, car = same; truck, truck = same; car, truck = different). At the same time, a Route 66 sign would be presented in one of eight peripheral locations on the screen. Difficulty changed (e.g., car and truck morphed to be more similar, speed of presentation) based upon whether participants correctly ascertained the central target was same/different and correctly identified where the Route 66 sign was located.

Bird Safari is a game whereby participants had to match a central bird to one of eight birds from the surrounding periphery of the screen. Difficulty changed (e.g., peripheral birds got farther away from the center, became similar to the central bird) based upon whether the participants were making correct matches.

Jewel Diver is a game whereby participants were shown jewels that were then hidden by bubbles; participants had to keep track of the bubbles that contained the hidden jewels and not confuse them with distractor bubbles that were empty. At the end of each trial, participants had to click on the bubbles that held the jewels and points were awarded correspondingly. Difficulty changed (e.g., number of bubbles hiding jewels) based upon whether the participants correctly selected the bubble that had the jewels versus those that did not.

Sweep Seeker is a game whereby participants had to click on a tile to connect other similar tiles to form 3 or more connecting tiles in order to win points. To be able to successfully click on the tile and secure it, participants were first given a visual stimulus that looked like "sound waves" (similar to a Doppler effect) that appeared to be moving either in or out to itself; when prompted, if the correct answer was provided (i.e., IN or OUT), the tile was secured but if the incorrect answer was provided, then the tile was blocked for several trials. Difficulty changed (i.e., speed of presentation of sound waves) based upon whether participants correctly perceived the sounds waves were moving with an in or out motion.

Master Gardener is a game whereby participants had to click on tiles within a garden setting that would show a picture (i.e., shrub) that was under the tile and then hide it later. To be able to progress, matching tiles had to be clicked in tandem; this is a matching game similar to the game Tai Pai. It challenges visual working memory by adding the number of pictured tiles one sees, spreading the matches farther apart.

Instruments

Demographic Questionnaire—Age, race, gender, years of education, and household income (0 = $0 - $10,000; 1 = $10,001 - $20,000, etc.) were collected through self-report.

Health Information—Health information was collected from a modified instrument from the Cardiovascular Health Study (Fried et al., 1991). Participants were asked to indicated if they had ever taken medication or had been diagnosed or treated for a variety of medical conditions (i.e., diabetes, hypertension, high cholesterol). Participants were asked to list all current medications; the number of medications were summed. HIV-related information, such as current HIV viral load, CD4+ lymphocyte count, and years diagnosed with HIV, were also assessed through self-report. Medical chart extraction was used to confirm participants' self-report of current viral load and CD4+ lymphocyte count. In general, participants were fairly accurate about their HIV viral load (n = 10; r = .68, p = .03; 16 participants ventured a guess of their viral load and viral load from the clinic was available for 15 participants) but not their CD4+ lymphocyte count (n = 13; r = -.22, p = .48; 16 participants ventured a guess of their CD4+ lymphocyte count and this count from the clinic was available for 19 participants); however, the medical chart data were used if there were inconsistencies with the self-report.

Addiction Severity Index—This measure assessed the participants' alcohol and drug use. Overall, separate composite scores for alcohol use and drug use were generated; higher scores represent greater alcohol and drug addiction. This measure has good test-retest reliability within a 3-day period ($p > .10$) (McLellan et al., 1992).

Profile of Mood States—The Profile of Mood States questionnaire measures the participants' mood and psychological distress. Participants are provided a list of 65 words or phrases (i.e., friendly, bad tempered, nervous) and asked to rate how much they felt that way within the past week ranging from 0 = *not at all* to 4 = *extremely*. This study used the total disturbance score in the analyses; higher scores represent poorer mood and negative affect. Internal consistency (Cronbach's $\alpha = 0.93$) is good (McNair, Loor, & Droppelman, 1992).

Useful Field of View (UFOV®) Test—The UFOV® is a computer-administered test that measures visual speed of processing. It is used for predicting ability to successfully perform everyday activities such as driving a vehicle. It consists of four (subtests 1-4) increasingly complex visual processing tasks; during these tasks, using a double-staircase method, participants received a score in the amount of time they can successfully complete the task 75% of the time. The four tasks range from 17-500 milliseconds (ms). On subtest 1, participants identified a target presented in a centrally located target within a fixation box (i.e., whether it is a car or truck). In subtest 2, participants identified the centrally located target, and simultaneously presented a peripheral target (i.e., car) displayed on the outer edge of the computer monitor. In subtest 3, participants continued to do the same thing as the second subtest with the exception that the peripheral target was embedded in distracters (i.e., triangles), making locating the target more difficult. In subtest 4, there were two centrally located targets presented in the fixation box (i.e., car and/or truck). Participants had to determine if the central targets were the same (i.e., car, car; truck, truck) or different (i.e., car, truck), but must also locate the position of the simultaneously presented peripheral target. The composite of all the subtest scores were combined; lower ms represent faster visual speed of processing. This measure has good test-retest reliability of 0.74 and 0.81 (Edwards, Vance et al., 2005).

Finger Tapping Test—The Finger Tapping Test is a psychomotor test that measures how quickly participants can tap their finger in ten seconds. It was administered in 5 consecutive trials for each hand, and the average of these trials was taken for an overall score. The higher the average, the better the participants' psychomotor performance, with a good reliability for men ($r = 0.94$) and women ($r = 0.86$) (Lezak, 1995; Spreen & Strauss, 1998).

Wisconsin Card Sorting Test—The Wisconsin Card Sorting Test is a computerized test that consists of response cards (up to 128 cards in all), with participants sorting the cards according to unique principles (i.e., number, form, or color). Participants selected from one of four stimulus cards that best matched the response card; then participants were provided feedback by the computer if their response to the matching card was correct or incorrect. Then, the participants had to continue matching cards until 10 cards in a row were matched. Then, the test changed the matching principle, and the participants had to figure out which principle was now being used based on the feedback and had to continue matching until 6 cards in a row were matched correctly. Afterwards, the matching principle changed again automatically and the process was repeated. The percent number of correct was used for the analysis. This test has acceptable test-retest (r = 0.56) after one year, and has been highly related to other measures of executive functioning (Greve, 2001; Lineweaver, Bondi, Thomas, & Salmon, 1999).

Hopkins Verbal Learning Test – Revised—This test measures verbal memory. Participants were given three learning/free recall trials with 12 words, 4 from each of 3 semantic categories (i.e., animals, gems, dwellings). After the three trials, participants were then given the Finger Tapping Test in this study as a time delay; then they were given the recognition trial of the previously presented words with a *yes*/*no* response. Furthermore, the recognition trial included the original list of words with 12 distracters, 6 from within the semantic categories and 6 from outside of those categories; the total number of correct was used in the analyses. Test-retest reliability over 9 months in older adults was acceptable (r = .50) (Rasmusson, Bylsma, & Brandt, 1994).

Timed Instrumental Activities of Daily Living—This is a measure of higher-order everyday functioning. It measures the time required (seconds) and accuracy to complete 5 normal tasks that one may do in normal life. These five tasks include: counting out correct change with coins, locating a telephone number in a telephone book, locating ingredients on cans of food (3 times), locating two food items on a grocery shelf, and locating and reading the directions on medicine bottles (2 times). If participants completed the tasks correctly, then time needed to complete the task was used. However, if participants completed the task incorrectly, time penalties were added to the participants' scores. Extensive detail regarding the time penalties and coding are provided elsewhere (Owsley, McGwin, Sloane, Stalvey, & Wells, 2001; Owsley, Sloane, McGwin, & Ball, 2002). The time of the five tasks were transformed into *z*-scores to form a single composite score which was used in the analyses. This measure has good test-retest reliability of 0.64 (Owsley, McGwin et al.; Owsley, Sloane et al.).

Exit Survey—This experimental measure was used to examine what participants liked and disliked (1 = *not all;* 5 = *extremely*) about the study procedures and intervention (Table 3).

Data Analysis

Data were examined using SPSS 20. Training gains for UFOV® and TIADL were calculated by subtracting the baseline score from the posttest score (i.e., UFOV® Change Score = UFOV® Baseline – UFOV® Posttest; TIADL Change Score = TIADL Baseline – TIADL Posttest); higher scores reflect better functioning. Assumptions of normality and linearity were met in order to examine the correlations between the change scores of UFOV® and TIADL on the predictors. Significance for the correlations were examined at ≤ .01 (i.e., very significant), ≤ .05 (i.e., significant), and ≤ .10 (i.e., trend).

Results

There were 22 middle-aged and older adults in the speed of processing training group. As seen in Table 1, approximately 77% of the sample were men, 68% were Caucasian, the mean age was 50 years, and the mean year income was approximately $17,000. Concerning their HIV status, the mean years diagnosed with HIV was 13 years, and nearly 95% were prescribed HAART. A CD4+ lymphocyte count of 200 ml or below is indicative of AIDS; therefore, since the mean count was 471 (SD = 291.73), most of the participants were relatively healthy in relation to their HIV disease management.

Pearson's correlations were used to examine the effect of predictors on training gains. As seen in Table 2, baseline performance on UFOV® and TIADL were significantly correlated to training gains in these measures. Specifically, those who scored worse on UFOV® at baseline experienced more UFOV® (r = .56, p < .01) and TIADL (r = .44, p < .05) training gains. Similarly, those who scored worse on TIADL at baseline experienced more TIADL training gains (r = .67, p < .01). Baseline performance (not shown) between UFOV® and TIADL were highly correlated (r = .70, p < .001); this indicated that speed of processing was important for how quickly IADLs were performed.

In addition, TIADL training gains were significantly correlated with HIV viral load (r = .57, p < .01) and HIV medication adherence (r = .63, p < .01); higher HIV viral load and poorer medication adherence were related to more TIADL training gains. TIADL training gains were significantly correlated with number of years diagnosed with HIV (r = .45, p < .05); higher number of years diagnosed was related to more TIADL training gains. TIADL training gains were significantly correlated with the Wisconsin Card Sorting Test (r = -.36, p <. 10); lower scores on the Wisconsin Card Sorting Test were related to more TIADL training gains. There was a trend between UFOV® training gains and the Addiction Severity Index drug use composite score (r = -.40, p < .10); lower drug use was related to more UFOV® training gains. No other correlations were significant.

Satisfaction with Training

Feedback about the speed of processing training protocol for the 22 who participated in this group is reported in Table 3. Most participants (n = 20; 90.90%) reported they enjoyed playing the games associated with the speed of processing training *moderately*, *very much*, or *extremely*. Likewise, most participants (n = 19; 86.36%) found it was convenient to come to the center to play the games, at least *moderately* or greater. When asked how much they would pay to play with these games, the average amount was $6.59; however, this ranged from zero to $25. Most participants ($n$ = 19; 86.36%) reported they would recommend this training to their friends and family with a rating of *moderately* or greater.

Overall, participants were administered questions about how much they felt the training improved (*1 = not all; 5 = extremely*) their mental abilities, speed of processing, attention, and memory. Most participants reported that they improved *moderately* or greater functioning on general mental abilities (n = 20; 90.90%), speed of processing (n = 20; 90.90%), attention (n = 21; 95.45%), and memory (n = 20; 90.90%).

Correlations were also calculated to examine the relationships between perception of speed of processing training (i.e., the games) and the training gains. UFOV® training gains were significantly correlated with enjoyment of the games (r = .52, p < .05), whether participants would recommend the games to their friends and family (r = -.46, p < .05), and feeling that these games improved their mental abilities (r = -.44, $p < .05$). In other words, the more participants enjoyed the games, the more they improved on UFOV®. However, those less likely to recommend the games or felt their mental abilities did not improve actually improved more on UFOV®. There was a trend between TIADL training gains with the amount of money they would pay to play these games (r = -.39, $p < .10$); the lower the amount of money they would pay was related to greater TIADL training gains.

Discussion

Primary Purpose

The purpose of this study was to identify predictors of speed of processing training gains in middle-aged and older adults with HIV. We found that those who performed more poorly at baseline on the UFOV® and TIADL experienced more training gains in response to the intervention. These results are encouraging in that it shows those middle-aged and older adults with HIV who are experiencing problems with speed of processing and everyday functioning may benefit from this training. This is particularly relevant given that speed of processing impairments and problems with everyday functioning are common in this clinical population (Hardy & Vance, 2009; Heaton et al., 2004).

In general, demographic factors were not predictive of training gains in UFOV® or TIADL. This finding reflects Ball and colleagues' (2007) work whereby they combined data from six studies (N = 2,039 community-dwelling older adults without HIV) on speed of processing training and found that education and other demographic factors were not predictive of training gains. These results suggest that research emphasis should be focused on other areas that may impact training gains.

In addition, we found that higher HIV viral load and poorer medication adherence was predictive of greater TIADL training gains. These findings could have two implications. First, those adults with poorer HIV disease management (i.e., high viral load, poor medication adherence) can still benefit cognitively from this simple and non-invasive intervention administered over approximately 10 hours. Second, this may also indicate that those more medically compromised may have more cognitive impairments, and thus have room neurologically to benefit from this training (i.e., avoiding ceiling effects). This is particularly important given that those who exhibit poorer HIV disease management experience more cognitive problems (Ettenhofer et al., 2009). Furthermore, more years diagnosed with HIV was also reflective of greater TIADL training gains. As with poorer HIV disease management, more years living with HIV may compromise the nervous system and brain (Hardy & Vance, 2009). Therefore, these participants may have more room cognitively to improve (i.e., avoiding ceiling effects).

We also found that participants who scored lower initially on the Wisconsin Card Sorting Test experienced greater improvement on the TIADL Test. This suggests that those who were more cognitively compromised, as exhibited by poorer executive functioning, had more room to improve (i.e., ceiling effects) due to the speed of processing training. Unfortunately, in the primary study (Vance, Fazeli, Ross et al., in press), improvement on this executive functioning measure was not detected for the speed of processing training group; this suggests that speed of processing training does not generalize to improvement on other cognitive domains.

Lastly, we found that fewer illegal and recreational drugs used (i.e., Addiction Severity Index – drug use composite score) correlated to better UFOV® training gains. Perhaps, the use of fewer such drugs allows the neurons and glial cells to better function and benefit from such cognitive remediation therapy (Fields, 2009).

Secondary Purpose

The secondary aim of this study was to identify what participants enjoyed about the speed of processing training and whether they experienced any subjective cognitive changes as a result of such training. In general, participants reported that they enjoyed playing the games and would pay at least a small nominal amount to do so; this is a particularly encouraging indicator of enthusiasm given that this sample was largely indigent as exhibited by an average yearly household income of $17K (Table 1). In addition, most participants indicated that that they would recommend this training to family or friends. Many middle-aged and older adults with HIV receive much of their support from other middle-aged and older adults with HIV (Shippy & Karpiak, 2005); having such an enthusiastic response to such training may facilitate its adoption in this clinical population. Given such positive feedback, this response suggests that this intervention may encourage adherence to this, and possibly, other cognitive remediation protocols in those aging with HIV. Knowing that older adults with HIV are more vulnerable of developing cognitive problems (Hardy & Vance, 2009), this cognitive remediation therapy may be well received and reduce cognitive problems in this clinical population.

It was also observed that many of the participants indicated that their cognitive functioning was improved as a result of this speed of processing training. This finding is also encouraging because nearly 30% of those with HIV report some sort of subjective cognitive problems which interfere with their everyday functioning and quality of life (Vance, Ross, & Downs, 2008). In a sample of 2,802 community-dwelling older adults without HIV, who received speed of processing, memory, or reasoning training or no training, Wolinsky and colleagues (2009, 2010a, 2010b) found that speed of processing training was significantly beneficial on reducing depression and increasing locus of control and health-related quality of life over time compared to those assigned to the no-contact control group. Therefore, cognitive remediation therapies, such as presented in this study, may be of particular use in improving everyday functioning in this growing HIV population.

Perceptions of the training were examined in relation to the actual training gains. It was found that those who enjoyed the training improved more on UFOV®; this seems logical in that those who enjoyed it may have engaged more vehemently in the exercises and thus experienced more UFOV® improvements. Surprisingly, two relationships emerged showing those who improved on UFOV® were also more likely not to recommend the training to others and did not feel their overall mental ability improved. There are two possibilities for this result. First, even though the majority improved *moderately* or more due to training (M = 3.77), those who did not may have skewed the relationship negatively. Second, metacognitive abilities (i.e., thinking about thinking) have been shown to be compromised in nearly 1/3 of those with HIV (Vance et al., 2008). Therefore, many of these participants might not be aware of the cognitive improvements they experienced even though their objective performance improved. Thus, by not being cognizant of such improvement, this may explain why some participants did not report overall mental improvement or be willing to recommend this protocol to family and friends.

Limitations and Strengths

There are a few noted limitations and strengths in this study. First, a small sample size was used which limits generalizability to the larger HIV population. Second, a majority of the participants were indigent; therefore, this also limits generalizability of the study to those with more resources. Finally, due to the small sample size, correcting for alpha inflation was not feasible (Kramer & Rosenthal, 1999); therefore, some of the findings might reflect Type 1 error.

A few strengths are noted. First, standardized and well-accepted measures of psychosocial and neuropsychological performance were used. Second, this study is the first of its kind to investigate what predictors influence speed of processing training in middle-age and older adults with HIV.

Conclusion

HIV participants attended a research center in order to play the therapeutic computer games (i.e., speed of processing training). Given its effectiveness, especially in improving everyday functioning in medically and cognitively-vulnerable adults with HIV, nurses and nurse practitioners could administer this cognitive remediation therapy on a CD for patients to use in the privacy of their homes (Vance, McNees, & Meneses, 2009). This cognitive remediation therapy is easy to use, inexpensive (i.e., $10/month; www.BrainHQ.com), enjoyable, and self-explanatory. In addition, the games do not contain any labels regarding HIV, which may be useful for those experiencing HIV stigma. Several gerontological studies show that this speed of processing protocol has been shown to improve locus of control, on-the-road driving behavior, driving simulator performance, and health-related quality of life (Ball et al., 2007; Wolinsky et al., 2009, 2010a, 2010b). Given the efficacy of speed of processing training in normal older adults, translational studies on similar cognitive remediation therapies have shown feasibility and/or effectiveness in other clinical populations including traumatic brain injury (Serino, Ciaramelli, Di Santantonio, & Ládavas, 2006), schizophrenia (Murthy et al., 2012), mild cognitive impairment (Valdé, O'Connor, & Edwards, 2012) and breast cancer survivors (Von Ah et al., 2012). Optimally, these benefits may also be observed in middle-aged and older adults with HIV who receive this training; however, more research with a larger sample of adults with HIV is needed.

References

Baldewicz TT, Leserman J, Silva SG, Petitto JM, Golden RN, Perkins DO, Evans DL. Changes in neuropsychological functioning with progression of HIV-1 infection: Results of an 8-year longitudinal investigation. AIDS and Behavior. 2004; 8(3):345–355.10.1023/B:AIBE.0000044081.42034.54 [PubMed: 15475681]

Ball K, Berch DB, Helmers KF, Jobe JB, Leveck MD, Mariske M, Willis SL. Effects of cognitive training interventions with older adults: A randomized controlled trial. Journal of the American Medical Association. 2002; 288(18):2271–2281.10.1001/jama.288.18.2271 [PubMed: 12425704]

Ball K, Edwards JD, Ross LA. The impact of speed of processing training on cognitive and everyday functions. Journals of Gerontology Series B: Psychological and Social Sciences. 2007; 62(S1):19–31.

Centers of Disease Control and Prevention. HIV/AIDS among persons aged 50 and older: CDC HIV/AIDS facts. Washington, DC: U. S. Department of Health and Human Services; 2008. Retrieved fromhttp://www.cdc.gov/hiv/topics/over50/index.htm

Edwards JD, Vance DE, Wadley VG, Cissel GM, Roenker DL, Ball KK. Reliability and validity of the Useful Field of View test scores as administered by personal computer. Journal of Clinical and Experimental Neuropsychology. 2005; 27(5):529–543.10.1080/13803390490515432 [PubMed: 16019630]

Edwards JD, Wadley VG, Vance DE, Wood K, Roenker DL, Ball KK. The impact of speed of processing training on cognitive and everyday performance. Aging and Mental Health. 2005; 9(3):262–271.10.1080/13607860412331336788 [PubMed: 16019280]

Ettenhofer ML, Hinkin CH, Castellon SA, Durvasula R, Ullman J, Lam M, Foley J. Aging, neurocognition, and medication adherence in HIV infection. American Journal of Geriatric Psychiatry. 2009; 17(4):281–290.10.1097/JGP.0b013e31819431bd [PubMed: 19307857]

Fields, RD. The other brain. New York: NY: Simon & Schuster; 2009.

Fried LP, Borhani NO, Enright P, Furberg CD, Gardin JM, Kronmal RA, Newman A. The Cardiovascular Health Study: Design and rationale. Annals of Epidemiology. 1991; 1(3):263–276. [PubMed: 1669507]

Greve KW. The WCST-64: A standardized short form of the Wisconsin Card Sorting Test. The Clinical Neuropsychologist. 2001; 15(2):228–234.10.1076/clin.15.2.228.1901 [PubMed: 11528544]

Hardy D, Vance D. The neuropsychology of HIV/AIDS in older adults. Neuropsychology Review. 2009; 19(2):263–272.10.1007/s11065-009-9087-0 [PubMed: 19247836]

Heaton RK, Clifford DB, Franklin DR Jr, Woods SP, Ake C, Vaida F, Grant I. HIV-associated neurocognitive disorders persist in the era of potent antiretroviral therapy (CHARTER Study). American Academy of Neurology. 2010; 75:2087–2096.10.1212/WNL.0b013e318200d727

Heaton RK, Marcotte TD, Mindt MR, Sadek J, Moore DJ, Bentley H, Grant I. The impact of HIV-associated neuropsychological impairment on everyday functioning. Journal of the International Neuropsychological Society. 2004; 10:317–331.10.1017/S1355617704102130 [PubMed: 15147590]

Kirk JB, Goetz MB. Human immunodeficiency virus in an aging population, a complication of success. Journal of the American Geriatric Society. 2009; 57(11):2129–2138.10.1111/j.1532-5415.2009.02494.x

Kramer, SH.; Rosenthal, R. Effect sizes and significance levels in small-sample research. In: Holye, RH., editor. Statistical strategies for small sample research. Thousand Oaks, CA: Sage; 1999. p. 59-79.

Lezak, MD. Neuropsychological assessment. 3rd. New York, NY: Oxford University Press; 1995.

Lineweaver TT, Bondi MW, Thomas RG, Salmon DP. A normative study of Nelson's (1976) modified version of the Wisconsin Card Sorting Test in healthy older adults. The Clinical Neuropsychologist. 1999; 13(3):328–347.10.1076/clin.13.3.328.1745 [PubMed: 10726604]

McLellan AT, Kushner H, Metzger D, Peters R, Smith I, Grissom G, P, Argeriou M. The Fifth Edition of the Addiction Severity Index. Journal of Substance Abuse and Treatment. 1992; 9(3):199–213.10.1016/0740-5472(92)90062-S

McNair, DM.; Loor, M.; Droppelman, LF. Profile of Mood States manual. San Diego, CA: Educational and Industrial Testing Services; 1992.

Murthy NV, Mahncke H, Wexler BE, Maruff P, Inamdar A, Zucchetto M, Alexander R. Computerized cognitive remediation training for schizophrenia: An open label, multi-site, multinational methodology study. Schizophrenia Research. 2012; 139(1-3):87–91. [PubMed: 22342330]

Owsley C, McGwin G, Sloane M, Stalvey B, Wells J. Timed Instrumental Activities of Daily Living (TIADL) Tasks: Relationship to visual function in older adults. Optometry and Vision Science. 2001; 78(5):350–359.10.1097/00006324-200105000-00019 [PubMed: 11384013]

Owsley C, Sloane M, McGwin G Jr, Ball K. Timed Instrumental Activities of Daily Living Tasks: Relationship to cognitive function and everyday performance assessments in older adults. Gerontology. 2002; 48(4):254–265.10.1159/000058360 [PubMed: 12053117]

Rasmusson DX, Bylsma FW, Brandt J. Stability of performance of the Hopkins Verbal Learning Test. Archives of Clinical Neuropsychology. 1994; 10(1):21–26.10.1093/arclin/10.1.21 [PubMed: 14588448]

Reger M, Welsch R, Razani J, Martin DJ, Boone KB. A meta-analysis of the neuropsychological sequelae of HIV infection. Journal of the International Neuropsychological Society. 2002; 8(3): 410–424.10.1017/S1355617702813212 [PubMed: 11939699]

Serino A, Ciaramelli E, Di Santantonio A, Ládavas E. A rehabilitative program for central executive deficts after traumatic brain injury. Brain and Cognition. 2006; 60(2):213–214. [PubMed: 16646127]

Shippy RA, Karpiak SE. The aging HIV/AIDS population: Fragile social networks. Aging and Mental Health. 2005; 9(3):246–254.10.1080/13607860412331336850 [PubMed: 16019278]

Spreen, O.; Stauss, E. A compendium of neuropsychological tests: Administration, norms, and commentary. 2nd. New York: Oxford University Press; 1998.

Trépanier LL, Rourke SB, Bayoumi AM, Halman MH, Krzyzanowski S, Power C. The impact of neuropsychological impairment and depression on health-related quality of life in HIV-infection. Journal of Clinical and Experimental Neuropsychology. 2005; 27(1):1–15. [PubMed: 15814439]

Valcour, VG.; Sacktor, N. HIV-associated dementia and aging. In: Emlet, CA., editor. HIV/AIDS and older adults: Challenges for individuals, families, and communities. New York, NY: Springer; 2004. p. 52-72.

Valdés EG, O'Connor ML, Edwards JD. The effects of cognitive speed of processing training among older adults with psychometrically-defined mild cognitive impairment. Current Alzhiemer's Research. 2012 Epub ahead of print.

Vance DE, Fazeli PL, Moneyham L, Keltner NL, Raper JL. Assessing and treating forgetfulness and cognitive problems in adults with HIV. Journal of the Association of Nursing in AIDS Care. in press.

Vance DE, Fazeli PL, Ross LA, Wadley V, Ball K. The effects of speed of processing training on middle-aged and older adults with HIV. Journal of the Association of Nurses in AIDS Care. in press.

Vance DE, McNees P, Meneses K. Technology, cognitive remediation, and nursing: Directions for successful cognitive aging. Journal of Gerontological Nursing. 2009; 35(2):50–56.10.3928/00989134-20090201-09 [PubMed: 19263921]

Vance DE, Robinson PF. Reconciling successful aging with HIV: A biopsychosocial overview. Journal of HIV/AIDS and Social Services. 2004; 3(1):59–78.10.1300/J187v03n01_06

Vance DE, Ross LA, Downs CA. Self-reported cognitive ability and global cognitive performance in adults with HIV. Journal of Neuroscience Nursing. 2008; 40(1):6–13.10.1097/01376517-200802000-00003 [PubMed: 18330405]

Vance D, Wadley V, Crowe M, Raper J, Ball K. Cognitive and everyday functioning in older and younger adults with and without HIV. Clinical Gerontologist. 2011; 34:413–426.10.1080/07317115.2011.588545 [PubMed: 22563140]

Vance DE, Wright MA. Positive and negative neuroplasticity: Implications for promotion of cognitive health in aging. Journal of Gerontological Nursing. 2009; 35(6):11–17. doi: 10.3928100989134-20090428-02. [PubMed: 19537290]

Von Ah D, Carpenter JS, Saykin A, Monahan P, Wu J, Yu M, Unverzagt F. Advanced cognitive training for breast cancer survivors: A randomized control trial. Breast Cancer Research and Treatment. 2012; 135(3):799–809. [PubMed: 22918524]

Wolinsky FD, Mahncke H, Vander Weg NW, Martin R, Unverzagt FW, Ball KK, Tennstedt SL. Speed of processing training protects self-rated health in older adults: Enduring effects observed in the multi-site ACTIVE randomized controlled trial. International Psychogeriatrics. 2010a; 22(3):470–478.10.1017/S1041610209991281 [PubMed: 20003628]

Wolinsky FD, Vander Weg MW, Martin R, Unverzagt FW, Ball KK, Jones RN, Tennstedt SL. The effect of speed-of-processing training on depressive symptoms in ACTIVE. Journals of Gerontology Series A: Biological Science and Medical Science. 2009; 64(4):468–472.10.1093/gerona/gln044

Wolinsky FD, Vander Weg NW, Unverzagt FW, Willis SL, Marsiske M, Rebok GW, Tennstedt SL. Does cognitive training improve internal locus of control among older adults. Journals of Gerontology Series B: Psychological Science and Social Science. 2010b; 65(5):591–598.10.1093/geronb/gbp117

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 1
Demographic and Health Characteristics of the Speed of Processing Group (N = 22)

Variable	*n* (%)	Mean *(SD)*
Age		50.11 (6.88)
Gender		
Male	17 (77.27%)	
Female	5 (22.73%)	
Race/Ethnicity		
Caucasian	15 (68.18%)	
African American	7 (31.82%)	
Education (years)		13.32 (2.10)
Household Income ($10K)		1.77 (1.51)
Years Diagnosed with HIV		13.01 (8.12)
HIV Viral Load		8,357.86 (18,911.48)
Current CD4+ Lymphocyte Count		471.27 (291.73)
Nadir CD4+ Lymphocyte Count		142.18 (172.82)
Number of Prescribed Medications		6.09 (3.01)
Number of Medical Conditions		3.05 (1.76)
Prescribed HAART Medications		
Yes	21 (95.45%)	
No	1 (4.55%)	
Addictions Severity Index		
Alcohol Use Composite		0.15 (0.27)
Drug Use Composite		0.03 (0.06)

Notes. HAART = Highly Active Antiretroviral Therapy; *SD* = standard deviation; $10K = ten thousand dollars.

Table 2

Correlation Matrix between Predictors and Training Gains (N = 22)

	Useful Field of View (UFOV®) Training Gains	Timed Instrumental Activities of Daily Living Training Gains
Age	.33	.33
Gender *(0 = Women; 1 = Men)*	.13	-.03
Race *(1 = African American; 2 = Caucasian)*	-.07	.05
Education *(years)*	.18	.24
Household Income *($10K)*	-.02	-.27
Years Diagnosed with HIV	.06	.45**
HIV Viral Load	.04	.57***
Current CD4+ Lymphocyte Count	.05	-.01
Nadir CD4+ Lymphocyte Count	.24	-.01
Number of Prescribed Medications	.08	-.02
Number of Medical Conditions	-.07	.15
Prescribed HAART Medications *(0 = No; 1 = Yes)*	-.33	-.33
HIV Medication Adherence	-.27	.63***
Alcohol Use Composite	.01	-.20
Drug Use Composite	-.40*	-.02
Profile of Mood States	-.13	.13
Useful Field of View Test (UFOV®)	.56***	.44**
Wisconsin Card Sorting Test	.04	-.36*
Hopkins Verbal Learning Test	-.07	.10
Finger Tapping Test	-.16	.12
Timed Instrumental Activities of Daily Living (TIADL)	.31	.67***

Notes. Cognitive measures presented here were administered at baseline.

* $p < .10$,

** $p < .05$,

*** $p < .01$.

Table 3

Perception of Speed of Processing Training and Their Relationship to Training Gains (N = 22)

Exit Survey Questions	Mean (*SD*)	UFOV®	TIADL
How much do you enjoy these games? *(1 = not at all; 5 = extremely)*	3.64 (0.85)	-.52**	-.13
How convenient was it for you to come to center to play these games? *(1 = not all; 5 = extremely)*	3.82 (0.96)	.17	-.03
How much would you pay to play with these games? ($)	6.59 (6.95)	-.24	-.39*
Would you recommend these games to your friends and family? *(1 = not all; 5 = extremely)*	3.55 (1.14)	-.46**	-.12
Do you feel playing these games improve your mental abilities? *(1 = not all; 5 = extremely)*	3.77 (0.81)	-.44**	-.33
Do you feel playing these games improved the speed in which you process information? *(1 = not all; 5 = extremely)*	3.59 (0.80)	-.24	-.09
Do you feel playing these games improved your attention? *(1 = not all; 5 = extremely)*	3.95 (0.84)	-.25	.17
Do you feel playing these games improved your memory? *(1 = not all; 5 = extremely)*	3.64 (0.85)	-.27	-.08

Notes. SD = standard deviation; Timed Instrumental Activities of Daily Living = TIADL; Useful Field of View (UFOV®). Range: *1 = not at all; 2 = a little; 3 = moderately; 4 = very much; 5 = extremely*.

* $p < .10$,

** $p < .05$,

*** $p < .01$.