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Speed of Processing Training with Middle-Age and Older Adults with HIV: A Pilot Study

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Abstract

Adults with HIV are at risk for deficits in speed of processing that can interfere with performing instrumental activities of daily living. In this pilot study, 46 middle-age and older adults with HIV were assigned to 10 hours of computerized speed of processing training ($n = 22$) or to a no-contact control condition ($n = 24$). ANCOVAs were used to examine treatment effects on a neurocognitive battery and the Timed Instrumental Activities of Daily Living (TIADL) Test. Treatment effects were detected on the Useful Field of View® Test, $F(1, 43) = 4.29$, $p = .04$ and the TIADL Test, $F(1, 43) = 5.02$, $p = .03$; those in the experimental condition improved on these measures. Many of the participants also indicated that they felt the training improved their cognitive functioning. This study demonstrated that speed of processing training may improve cognitive and everyday functioning in this growing population.

Keywords

aging; cognitive intervention; cognitive remediation therapy; cognitive training; instrumental activities of daily living; speed of processing training

Due to the life extending benefits of effective antiretroviral therapy (ART), there has been an increased prevalence of adults and older adults living with HIV in the United States. Specifically, more than 25% of people living with HIV in the United States are older than 50 years of age (Centers for Disease Control and Prevention [CDC], 2008), and this prevalence

Conflict of Interest Statement

Karlene Ball owns stock in the Visual Awareness Research Group and Posit Science, Inc., the companies that market the Useful Field of View Test and speed of processing training software now called Insight, and she serves as a member of the Posit Science Scientific Advisory Board. No other authors have a conflict of interest.

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is expected to increase to more than half of the HIV population by 2015 (Kirk & Goetz, 2009). Although ART has dramatically decreased HIV-related dementias and has vastly extended life, many concerns remain that, as people age with HIV, they will be more vulnerable to age-related cognitive deficits that impair everyday functioning. Declines in speed of processing are a particular concern because this cognitive domain is sensitive to the effects of both HIV and aging (Reger, Welsh, Razani, Martin, & Boone, 2002). Wilkie and colleagues (2003) administered a number of neuropsychological measures to 81 younger (20–39 years) and 68 older (50+ years) adults with and without HIV and found that the older adults with HIV performed the worst. In an 8-year longitudinal study, Baldewicz and colleagues (2004) examined the neuropsychological functioning of adults with and without HIV and found significant declines in speed of processing in the HIV-infected group. Likewise, a meta-analysis of 41 studies on the neuropsychological sequelae of HIV infection found that speed of processing was one of the cognitive domains demonstrating the greatest decline from early to late stages of HIV (Reger et al., 2002). Thus, adults aging with HIV may be at an increased risk for speed of processing declines.

Review of the Literature

Everyday Functioning and HIV

Studies have examined how neuropsychological functioning in adults with HIV impacts everyday functioning abilities such as medication adherence, financial management, and instrumental activities of daily living (IADL). Ettenhofer and colleagues (2009) recruited 431 adults with HIV and examined whether cognitive functioning could predict medication adherence, as measured by microchip-embedded pill bottle caps. Those who were older (50+ years) were more adherent to their ART regimens; however, when examining which cognitive abilities were associated with poorer medication adherence in the older group, deficits in executive functioning, motor functioning, and speed of processing were all found to be predictive.

Driving difficulties have also been observed in adults with HIV. In a sample of 42 adults with HIV and 21 adults without HIV, Marcotte and colleagues (2006) examined whether a specific measure of speed of processing and attention, the Useful Field of View (UFOV®) Test, was predictive of driving impairments in adults with HIV. These researchers found that adults with HIV experienced poorer performance on the UFOV® Test and other neuropsychological measures; the deficits were also predictive of more automobile accidents.

Deficits in other everyday functioning activities, such as IADLs, have also been found in adults with HIV. Vance, Wadley, Crowe, Raper, and Ball (2011) compared cognitive and everyday functioning with a group of 201 older and younger adults with and without HIV (M = 45.25; SD = 7.61; range = 23.67–66.92). Age by HIV status interactions were observed on five cognitive measures, which demonstrated pronounced cognitive deficits in older adults with HIV. Also, poorer cognitive performance predicted poorer performance on the Timed Instrumental Activities of Daily Living Test (TIADL), which is a speeded measure of everyday functioning.

Cognitive Intervention

With speed of processing declines observed in adults with HIV, current training techniques used in the normal older adult population may also prove to be effective in improving performance in adults with HIV. Such cognitive training techniques become especially germane because the number of older adults with HIV is dramatically increasing (Kirk & Goetz, 2009), and older adults with HIV may be particularly vulnerable for developing speed of processing deficits (Baldewicz et al., 2004; Reger et al., 2002). Such behavioral interventions may be more advantageous than pharmaceutical interventions given the extant pill burden among those with HIV as well as metabolic and potential drug interactions with HIV medications (Kirk & Goetz, 2009; Vance, Mugavero, Willig, Raper, & Saag, 2011).

Speed of processing training, a type of cognitive remediation therapy, has been developed and studied extensively in older adults (Ball, Edwards, & Ross, 2007). Speed of processing training is computerized and easy to use; it has resulted in marked improvements in those who undergo cognitive remediation. In this intervention, participants play various computer games designed to tap into speed of processing and visual attention, such as identifying a central and peripheral stimuli on the screen. The task becomes more difficult: the inspection time of the stimuli is reduced as the participant correctly completes the task. Thus, the intervention is tailored to each participant's level of performance. Older adults who have undergone such training have demonstrated improved speed of processing, sustained visual attention (Ball et al., 2002), and faster complex reaction time (Roenker, Cissell, Ball, Wadley, & Edwards, 2003). This training has also demonstrated transfer to better self-reported health (Wolinsky et al., 2006), fewer health expenditures (Wolinsky, Mahncke, et al., 2009), reduced risk of depression (Wolinsky, Vander Weg, et al., 2009), and improved internal locus of control for cognitive-specific abilities in older adults (Wolinsky et al., 2010). Also, older adults who have undergone training demonstrate improved performance on IADL tasks (Ball, Edwards, & Ross, 2007), improved driving safety via fewer dangerous maneuvers (Roenker et al., 2003), and 50% reduced risk of at-fault crashes (Ball, Edwards, Ross, & McGwin, 2010). Some of these transfer effects have been maintained across a 5-year period. Because speed of processing training has repeatedly been effective in older adults, it may also improve cognitive functioning in middle-age and older adults with HIV (Vance, Wadley, et al., 2011).

Summary

Altogether, the literature has suggested that adults aging with HIV may be at risk for speed of processing decrements. Furthermore, speed of processing declines may translate to poorer performance on several everyday activities such as medication adherence, performance of IADLs, and driving. Given the growing prevalence of adults and older adults living with HIV in the United States, examining speed of processing declines in this population has significant public health implications, particularly with regard to driving safety. While there is much evidence in the literature on speed of processing declines and their translation to everyday functioning in adults with HIV, based on a thorough search of the literature, no studies have examined non-pharmaceutical speed of processing interventions for this population. Given the efficacy of this type of intervention in older adults without HIV and the vulnerability of this cognitive domain in adults aging with HIV, our study applied computerized speed of processing intervention to a sample of adults with HIV in order to fill in the gaps in the literature and address a relevant and emerging public health issue.

Purpose

The feasibility of speed of processing training in middle-age and older adults with HIV was tested in a translational pilot study with three aims. Aim 1 was to determine whether speed of processing training, which has traditionally been used in community-dwelling older adults, would be effective in improving speed of processing performance in middle-age and older adults with HIV. Prior studies in cognitive aging have indicated that older adults who received speed of processing training made significant improvements in their speed of processing abilities (Ball et al., 2007). Even when speed of processing training was as brief as 10 1-hr sessions, improvements in speed of processing were robust over several years (Ball et al., 2002). Therefore, it was hypothesized that speed of processing training would benefit adults with HIV to improve this cognitive ability compared to those who did not

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receive such training. Aim 2 was to determine if speed of processing training would also transfer to a laboratory measure of everyday functioning (i.e., TIADL Test). It was hypothesized that participants who received speed of processing training would improve on the TIADL Test compared to those who did not receive such training. Finally, as this was a pilot and feasibility study, Aim 3 was to examine the attrition trends of this sample as well as subjective perceptions of improvement in this intervention group.

Method

Participants

Participants were recruited through a larger R03 study designed to examine neuropsychological differences between younger and older adults with and without HIV. Participants with HIV infection were recruited through the university's HIV clinic through brochures, flyers, and word of mouth (i.e., snowball sampling) as is typical of HIV studies. Participants were telephone screened to ensure they met study eligibility criteria. The inclusion criteria included: participants being at least 40 years of age, proficient in English, and having been diagnosed with HIV for at least 1 year. Changes in brain metabolism are observed in adults with HIV even after only 1 year of being diagnosed (Lentz et al., 2011). Exclusion criteria included: being homeless, mentally impaired (e.g., Alzheimer's disease, dementia, mental retardation, brain damage), deaf or blind, undergoing chemotherapy or radiation, having experienced brain trauma with loss of consciousness for greater than 30 minutes, and having any other significant neuromedical co-morbidities (e.g., schizophrenia, bipolar disorder). Medical chart extraction confirmed that participants did not have these neuromedical co-morbidities. These exclusions were similar to other neurocognitive studies of HIV and safeguarded against neuropsychological problems that could obscure the effects of HIV and aging on otherwise normal cognitive functioning.

Design and Procedure

After completion of telephone screening in which study eligibility criteria were confirmed, a baseline in-person appointment at the research center was scheduled with each participant for the neuropsychological battery administration. Participants signed institutional review board (IRB) for human use-approved consent forms at the initial visit. Participants were compensated $50 by mail for their time and effort. Immediately after the appointment, only the older adults with HIV (40+ years) were informed about the training study. Age 40 and older was chosen because subtle cognitive deficits in HIV may begin to emerge in adults around this age (Vance, Wadley et al., 2011); therefore, older adults with HIV may benefit more from speed of processing training compared to younger adults with HIV who have less impairment due to the interaction of age with HIV. If they were willing to participate, participants signed another IRB-approved consent form for the current intervention study. At this point, participants were randomized to either the speed of processing training group or to the no-contact control group. Those in the speed of processing training group were asked to return to the research center for additional study appointments and were instructed how to use the training protocol. In order to minimize attrition, participants were compensated $10 for each 1-hour training session up to 10 hours. Upon completing the speed of processing training, participants were scheduled for an abbreviated version of the baseline assessment. Again, participants were compensated $50 by mail for their time and effort for this second (posttest) assessment.

Those participants randomly assigned to the no-contact control group were contacted approximately 5 weeks after the baseline appointment to schedule a posttest assessment. In studying speed of processing training in older adults, Wadley and colleagues (2006) found

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that those assigned to a no-contact control group performed similarly to a social-contact Internet training group.

Intervention

The speed of processing training was self-administered with a touch-screen monitor using the Posit Science "INSIGHT" computer program (www.positscience.com). Participants watched an initial presentation provided by the program that gave them a basic rationale and instructions about the training protocol. The five games that were used to improve the participants' visual speed of processing included Bird Safari, Jewel Diver, Road Tour, Sweep Seeker, and Master Gardener. Although each game varied slightly in stimuli presentation and in specific task completion, all shared the same visually-based speed component that became increasingly difficult (faster). Participants responded by identifying either what object they saw or where they saw it (location on the screen). In this gaming platform, if participants responded correctly, they would earn points and would receive a pleasant sound; if participants responded incorrectly, they would not receive points and would receive a clunking sound. In all of the games, the program would respond either by making the exercise easier if the participants were consistently missing the answers or by making it more difficult if they were consistently answering correctly. This double staircase process ensured that participants were always operating near their threshold abilities of visual speed of processing. By operating at near threshold ability, the goal of the program designers was that participants would then stretch and increase this cognitive ability. Participants were allowed to play all of the games, but they were encouraged to spend most of their time on the Road Tour game. Road Tour most closely approximated the traditional speed of processing training method used in earlier research (Ball et al., 2007). The basic parameters for this specific type of speed of processing training protocol have been described elsewhere (e.g., Ball et al., 2002).

Instruments

Demographic Questionnaire

An experimenter-generated measure was used to gather data on background characteristics. These included gender, ethnicity, age, education, and income.

Health Information

An experimenter-generated measure was used to assess health-related information such as number of prescribed medications. Specific questions concerning HIV were also asked, including years diagnosed with HIV, current HIV viral load, and current CD4+ T lymphocyte count. This information was verified with patient medical chart database extraction where nadir CD4+ T lymphocyte count was also determined. In general, participant self-reports of HIV viral load ($r = .56$, $p = .008$) and CD4+ lymphocyte count ($r = .75$, $p < .001$) were quite accurate; when there were discrepancies, information from the medical charts was used.

Addiction Severity Index

The Addiction Severity Index, a widely accepted and gold standard measure of alcohol and drug use, was used to compare the severity of drug and alcohol use in our sample. Questions are used to survey the amount and type of alcohol and drug use. Composite scores are created for alcohol and drug use; higher scores indicate greater addiction severity. Inter-rater reliability is quite high for the alcohol ($r = 0.88$) and drug use ($r = 0.89$) composites. Test-retest within 3 days showed no significant differences ($p > .10$; McLellan et al., 1992).

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Cognitive Measures

Three cognitive measures and one functional measure were administered at baseline and posttest. These tests were: the UFOV®, the Finger Tapping Test, Wisconsin Card Sorting Test, and the Timed Instrumental Activities of Daily Living. These measures were used as outcome measures to determine the efficacy of the intervention.

Useful Field of View (UFOV®) Test—The UFOV® Test is a measure of visual speed of processing. It is administered on a computer monitor with touch-screen technology with four increasingly complex subtests. For each subtest, several presentations ranging from 17 to 500 milliseconds are displayed in order to determine the speed in which visual information is processed. For subtest 1, participants are instructed to identify a central target (truck or car) presented in a fixation box. For subtest 2, participants are instructed to identify the central target and to locate a simultaneously presented peripheral target (car). For subtest 3, participants are instructed to do the same activity as in the second subtest, except that the peripheral target is now embedded in distractors, making the task more difficult. For subtest 4, the central box now has two objects (truck and/or car); participants are instructed to determine whether the two objects in the central field are the same (truck, truck; car, car) or different (truck, car), as well as to locate a peripheral object (car) embedded in the surrounding clutter. For each subtest, a double staircase method is used to determine the presentation speed in which participants correctly complete the task 75% of the time. The optimal presentation speed is the score in milliseconds. The optimal presentation speed for all four subtests is combined; fewer milliseconds to correctly perceive the target reflect a faster visual speed of processing. An association coefficient between 0.74 and 0.81 indicates good test-retest reliability (Edwards, Vance, et al., 2005).

Finger Tapping Test—The Finger Tapping Test is a widely used psychomotor test that measures how quickly a participant can tap a finger in 10 seconds averaged over 5 consecutive trials for each hand; from this, the average is taken. The score used in this study was the overall average across both hands. Higher average number of taps is indicative of better psychomotor performance. This test is highly reliable for men ($r = 0.94$) and women ($r = 0.86$; Spreen & Strauss, 1998).

Wisconsin Card Sorting Test—Computer version 4 was used in our study. The Wisconsin Card Sorting Test is a computerized test of executive functioning whereby participants are required to sort cards according to different principles (color, form, or number) during test administration. After matching a response card to a stimulus card, the participant is told whether the choice is correct or incorrect. The participant continues card matching until 10 cards in a row are matched, and the computer then surreptitiously changes the sorting principle and the participant needs to figure out the principle; there are 6 possible categories to complete. In this computer version, once a participant has completed all 6 categories, the test terminates. If the participant does not complete all 6, the computer terminates the test after 128 trials. In our study, the total percentage of correct responses was used as the score. This test is highly related to other measures of executive functioning and has modest test-retest reliability of 0.56 after 1 year. (Lineweaver, Bondi, Thomas, & Salmon, 1999).

Timed Instrumental Activities of Daily Living (TIADL)

The TIADL is a laboratory measure of everyday functioning. Specifically, it measures both the time needed to complete 5 normal activities that one typically does in life and the accuracy with which those activities are completed. These 5 activities include finding 2 food items on a shelf of food, using coins to count out correct change, finding the telephone number of a person in a telephone book, finding and reading the directions on a medicine

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bottle, and finding ingredients on a can of food. For each activity, the amount of time (seconds) necessary to complete each activity is used as the score. If a participant is unable to complete the activity within the pre-set limit (e.g., 2 minutes), the activity is then halted and the participant is prescribed the maximum preset time limit as the score for that activity. If a participant completes the activity within the pre-set time limit but does so incorrectly, a time penalty is added. This time penalty is one standard deviation of time that is derived from the scores of those participants who completed that activity within the pre-set time limit. The final time scores are transformed into a *z*-score for all 5 activities in order to provide a TIADL composite score; such standardization ensures that the activities are equally weighted. Because *z*-scores are used, composite scores can be expressed in negative and positive coefficients; lower composite scores indicate better performance on this test. This measure has good test-retest reliability ($r = .64$; Owsley, Sloane, McGwin, & Ball, 2002).

Exit Survey

This experimenter-generated measure was used to assess participants' perceptions about whether the intervention improved their mental function. Specifically, this survey includes questions about what the participants did and did not like about the training, as well as whether they felt the training improved a variety of cognitive domains as well as overall mental functioning.

Data Analysis

Data were examined using SPSS 14. Descriptive and analysis of covariance (ANCOVA) were used to examine group differences from baseline to posttest; baseline performance was used as the covariate. Assumptions of normality, homogeneity of variance, and linearity were satisfied using ANCOVAs to test for treatment effects. Alpha was set at $p < .05$. Incidents of missing data were rare (1 for Finger Tapping Test at baseline and 1 for posttest, 1 for Wisconsin Card Sorting Test at posttest); because of these rare events, list-wise deletion was used in the following analyses rather than imputing the data.

Results

Demographics and Differences between Groups

The average age of the sample was 51.55 years ($SD = 7.38$). The age ranges for the two groups were very similar (no-contact control group age range = 41.11–70.64; speed of processing training group age range = 40.71–69.95). Twenty-seven (58.7%) participants were Caucasian and 19 (41.3%) were African American. Thirty-four (73.9%) of the participants were men. No significant baseline differences were detected between the no-contact control group and the speed of processing group on any of the demographic or HIV variables (age, race, education level, years diagnosed with HIV, current CD4+ T lymphocyte count, nadir CD4+ T lymphocyte count, number of prescribed medications, being prescribed ART medications, and addiction severity; see Table 1). Because there were no group differences found between the training and control groups for demographic and HIV variables, only baseline performance was used as a covariate. Furthermore, there were no significant baseline differences between the groups on the neuropsychological measures or the TIADL measure (*p*-values not shown).

In general, the sample was moderately healthy as exhibited by average current CD4+ T lymphocyte counts between 200 and 500 cells/mm^3. A CD4+ T lymphocyte count of 200 cells/mm^3 or lower is indicative of AIDS; however, in the total sample, six (13.04%) had a current CD4+ T lymphocyte count of 200 cells/mm^3 or lower. Forty-four (95.65%) participants had been prescribed HIV antiretroviral medication. Likewise, an HIV viral load

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less than 50 copies/mL (aka, "undetectable") is a marker of excellent HIV viral suppression, which is attributed to ART (Kirton, 2001). In our sample, 14 (30.43%) participants had an undetectable viral load.

Nadir CD4+ T lymphocyte count is very important from a neurological perspective. Studies have indicated that once the CD4+ T lymphocyte count drops below 200 cells/mm^3 (diagnostic for AIDS), irreparable damage to the nervous system including the brain occurs, which is expressed as poorer cognitive functioning. Much of this damage persists even when ART allows the immune system to reconstitute with CD4+ T lymphocytes that far exceed 200 cells/mm^3 (Robertson et al., 2007). In our sample, 12 no-contact control participants and 12 speed of processing participants (52.17% of the total sample) had a nadir CD4+ T lymphocyte count of less than 200 cells/mm^3; these data suggest that a substantial number may have had more profound neurological damage due to HIV. However, since there was an equal proportion of the training and control groups with nadir CD4+ T lymphocyte counts below 200 cells/mm^3, this was justification for not controlling for this variable.

Training Effects

Participants randomized to the speed of processing group spent between 2 and 10 hours ($M = 9.32$, $SD = 2.21$) on the intervention. Table 2 displays the neuropsychological and TIADL mean scores. Baseline to posttest group differences were not detected for the Wisconsin Card Sorting Test, $F(1, 42) = 0.40$, $p = .53$, power = .10. Differences were detected on UFOV® Test, $F(1, 43) = 4.29$, $p = .04$, power = .53; TIADL Test, $F(1, 43) = 5.02$, $p = .03$, power = .59; and the Finger Tapping Test, $F(1, 42) = 6.35$, $p = .02$, power = .69. Specifically, participants in the speed of processing training group experienced improved speed of processing, via the UFOV® Test, and improved everyday functioning, via the TIADL Test. Regarding the Finger Tapping Test, surprisingly, those in the no-contact control group experienced slight improvements in this measure of psychomotor speed.

Attrition and Perceptions of Improvement

Originally, 58 HIV-infected adults ages 40 years and older were randomized to one of the two conditions; however, 12 were lost to attrition. Differential attrition was not predicted by group assignment ($p > .05$). The loss represented an attrition rate of 19.30% over a 5- to 6-week period. Exact reasons for attrition are not well documented because most of the participants never responded to letters or telephone messages; in many cases, their phones were disconnected.

Of those 22 who completed the intervention arm, participants were asked, "*Do you feel playing these games improved your: (a) mental abilities, (b) memory, (c) attention, and (d) speed of processing?*" Responses ranged from *1 (not all) to 5 (extremely)*. Most participants reported that they felt the training had improved their functioning moderately or better on mental abilities ($n = 20$; 90.90%), memory ($n = 20$; 90.90%), speed of processing ($n = 20$; 90.90%), and attention ($n = 21$; 95.45%).

Discussion

The purpose of our study was to examine the efficacy and feasibility of using a well-known cognitive remediation therapy from the gerontology literature (i.e., speed of processing training) and translating it to a new clinical population (i.e., middle-age and older adult with HIV) in which speed of processing deficits had been well documented. For Aim 1, we found that the participants who received the speed of processing training improved on the UFOV® Test, a visual speed of processing measure, compared to the no-contact control group. Likewise for Aim 2, we found that these same participants improved on the TIADL Test, a speeded everyday functioning task. It was not surprising that the training effects did not transfer to the Wisconsin Card Sorting Test, a measure of executive functioning, as it has been shown that this speed of processing intervention may not transfer to other cognitive domains (Ball et al., 2002). Regarding the Finger Tapping Test, because this intervention was not a psychomotor intervention, it was not surprising that training did not have a beneficial effect on this measure. The fact that the control group significantly improved on this measure was unexpected; however, this could simply have been due to measurement error or situational differences between participants such as fatigue and motivation. Regardless, findings concerning the speed of processing training were encouraging and paralleled findings in the larger gerontology literature that has also demonstrated that intervention can improve UFOV® and TIADL performance in HIV-uninfected community-dwelling older adults.

Clinical Implications

Given that the findings of our study reflect those in the gerontology literature, this intervention may prove to be a cost-effective and medically non-invasive technique for helping many adults with HIV suffering from neurological sequelae to improve cognitive and everyday functioning. Other gerontology studies using speed of processing training have shown improvements in health-related quality of life, driving simulator performance, on-the-road driving behavior, and locus of control (Ball et al., 2007). The intervention simply requires a touch-screen monitor or mouse and monitor, computer, and speed of processing software. Many patients experiencing speed of processing deficits may be able to self-administer treatment in the privacy of their own homes. Thus, this could give nurse practitioners and clinicians a ready-made computer program to dispense to patients. Although additional testing with larger samples is needed to test these conclusions in people living with HIV, our findings support a very realistic and feasible intervention that may improve cognitive and everyday functioning and thus augment quality of life.

Our study also has implications for health care providers, including nurses, nurse practitioners, and physicians. Cognitive and neuropsychological problems associated with HIV have been well documented in the literature; in fact, 30% to 60% of adults with HIV experience cognitive impairments at some point in the illness (Thames et al., 2011). Unfortunately, few interventions, especially behavioral interventions, have been attempted to improve cognitive functioning in patients with HIV (Vance, Fazeli, Moneyham, Keltner, & Raper, in press). Our study demonstrates that cognitive functioning can be improved through cognitive remediation therapy, specifically speed of processing training, but other cognitive remediation programs that focus on memory, reasoning, and global cognition may also be effective. In addition, other techniques for improving cognition in adults with HIV, such as physical exercise, intellectual stimulation, improved nutrition and sleep hygiene, reduced alcohol and substance use, and treatment of depression and mood disturbances, may also yield positive results. In fact, Vance, Eagerton, Harnish, McKie-Bell, and Fazeli (2011) suggested that cognitive prescriptions, a behavioral technique to improve a host of lifestyle factors (i.e., physical exercise, sleep hygiene, treatment for depression), may be used to ameliorate cognitive dysfunction in populations susceptible to neuropsychological problems. Such cognitive prescriptions to improve cognitive functioning in adults with HIV may also prove helpful; however, more data are needed to determine if this approach is feasible and effective in people living with HIV infection. Yet, such approaches provide clinicians with insights into how to intervene to improve cognitive functioning in this population, especially as they grow older and are more vulnerable to age-related cognitive declines (Vance, Wadley, et al., 2011).

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Strengths and Limitations

All studies have limitations; this study was not without exception. First, attrition was rather high in this study, at nearly 20%. The reasons for this were not obvious because it was not possible to get in touch with the participants who dropped out of the study. Anecdotally, it was suspected that many of the participants were indigent and may have been living in chaotic environments that could have kept them from having consistent access to a working phone or transportation in order to fully participate in this study. Second, the study was based upon a small sample; however, because significance was found even with such a small sample, this suggested that speed of processing training may be a very robust intervention. Third, many participants reported that they felt the speed of processing training improved their mental functioning, but these results may have reflected social desirability. Fourth, future studies would benefit from having a social-contact control group and perhaps an alternative therapy for comparison with the speed of processing training. Fifth, two of the outcome measures (WCST and TIADL) had relatively low to moderate test-retest reliability. Further work is also needed to examine neurological mechanisms (i.e., neurogenesis, brain derived neurotropic factor) that can produce cognitive changes in response to training. Finally, it was not clear how or why those in the no-contact control group improved on the Finger Tapping Test; however, the change was very small and may have been a statistical artifact. This point was further compromised by not correcting for alpha inflation due to the small sample size in our pilot study; alpha inflation in such a small sample is generally not considered because it can be too restrictive.

Conclusion

Although ART has extended the lives of many people infected with HIV, neurological sequelae are a common occurrence, especially as people age with this disease. By 2015, nearly half of people with HIV will be 50 and older (Kirk & Goetz, 2009); this means that nurses and other clinicians will need to address the cognitive problems that will emerge in many of their patients (Vance, Fazeli, et al., in press). Therefore, it is imperative to find affordable and effective strategies to ameliorate or compensate for cognitive losses. Non-pharmaceutical approaches are favored because of the detrimental impact of pill burden and the renal, kidney, and liver diseases common in this clinical population (Vance, Mugavero, et al., 2011). Cognitive remediation therapy, such as speed of processing training, represents one possible tool that may be used in conjunction with lifestyle changes (e.g., increased physical activity, depression reduction) to develop individualized cognitive prescriptions designed to improve and maintain cognitive health of people as they age with HIV (Vance, Eagerton, et al., 2011).

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Clinical Considerations

- Adults aging with HIV may be at risk for cognitive declines, especially in speed of processing, which can affect everyday functional abilities.
- A cognitive intervention may improve speed of processing and everyday functional abilities in middle-age and older adults with HIV.
- While further research is needed, nurses should be aware of potential cognitive disturbances in this at-risk population and consider feasible intervention strategies, such as cognitive remediation therapy.

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Table 1

Demographic and Health Characteristics by Group Randomization (*N* = 46)

	No-Contact Control Group (*n* = 24)		Speed of Processing Group (*n* = 22)		
Variable	***n* (%)**	**Mean *(SD)***	***n* (%)**	**Mean *(SD)***	***p*-values**
Age		52.88 (7.71)		50.11 (6.88)	*p* = .21
Gender					*p* = .62
Male	17 (70.8%)		17 (77.3%)		
Female	7 (29.2%)		5 (22.7%)		
Race/Ethnicity					*p* = .21
Caucasian	12 (50.0%)		15 (68.2%)		
African American	12 (50.0%)		7 (31.8%)		
Education (years)		13.13 (2.88)		13.32 (2.10)	*p* = .80
Household Income ($10K)		2.04 (1.63)		1.77 (1.51)	*p* = .57
Years Diagnosed with HIV		16.30 (6.83)		13.01 (8.12)	*p* = .14
HIV Viral Load (copies/mL)		1,936.78 (6,544.28)		8,357.86 (18,911.48)	*p* = .15
Current CD4+ T Lymphocyte Count/mm^3		433.75 (220.09)		471.27 (291.73)	*p* = .62
Nadir CD4+ T Lymphocyte Count/mm^3		207.29 (178.63)		142.18 (172.82)	*p* = .22
Number of Prescribed Medications		5.83 (3.41)		6.09 (3.01)	*p* = .79
Prescribed ART					*p* = .95
Yes		23 (95.83%)		21 (95.45%)	
No		1 (4.17%)		1 (4.55%)	
Addiction Severity Index					
Alcohol Use Composite		0.16 (0.39)		0.15 (0.27)	*p* = .95
Drug Use Composite		0.03 (0.05)		0.03 (0.06)	*p* = .96

Note. ART = Antiretroviral Therapy; *SD* = standard deviation; $10K = ten thousand dollars.

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Table 2

Neuropsychological and TIADL Baseline and Posttest Scores (*N* = 46)

	No-Contact Control Group (*n* = 24)		**Speed of Processing Group (*n* = 22)**	
	Baseline Mean (*SD*)	**Posttest Mean (*SD*)**	**Baseline Mean (*SD*)**	**Posttest Mean (*SD*)**
UFOV® Test *	868.96 (342.03)	753.75 (353.17)	758.09 (362.51)	545.68 (299.46)
Finger Tapping Test	48.56 (7.47)	52.78 (8.32)	52.00 (6.27)	50.44 (7.67)
Wisconsin Card Sort Test	51.40 (17.95)	56.82 (19.14)	51.69 (19.67)	53.98 (20.47)
TIADL Test (*z*-scores) *	0.44 (4.00)	1.03 (3.92)	−0.49 (2.57)	−1.13 (2.00)

Note. *SD* = standard deviation; TIADL = Timed Instrumental Activities of Daily Living Test; UFOV® = Useful Field of View Test.

* Lower scores indicate better functioning.