

Review Article

Can Speed of Processing Training Ameliorate Depressive Symptomatology in Adults with HIV?

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Received: August 13, 2014; Accepted: September 02, 2014; Published: September 04, 2014

Abstract

Despite advances in combination Antiretroviral Therapy (cART), adults with HIV continue to experience cognitive impairments. In addition to these cognitive impairments, research suggests as many as 40% and 20% of adults with HIV are diagnosed with depression and anxiety, respectively. The impact of these cognitive and emotional deficits increases caregiver burden, impairs occupational and driving performance, contributes to poor emotional processing, increases cognitive complaints, and reduces quality of life. Fortunately, cognitive remediation therapy improves targeted cognitive abilities along with general cognitive processes. Speed of processing training, a type of cognitive remediation therapy, has been shown to improve cognitive performance on measures of visual attention, speed of processing, and timed-task performances. Furthermore, studies suggest that speed of processing training could also enhance neuromodulatory systems which have direct implications for improving mood functions (depression and anxiety). The benefits of the improvement in these cognitive and emotional systems are a decrease or slowing in cognitive decline along with the potential to protect against clinically significant depressive symptoms. Studies support the need for deeper investigation into the short-term and long-term benefits of speed of processing training as a behavioral adjunct for the pharmacologically-burdened HIV population.

Can Speed of Processing Training Ameliorate Depressive symptomatology in adults with HIV?

Receiving a diagnosis of Human Immunodeficiency Virus (HIV), which remains a highly stigmatized disease, can create enormous emotional distress. For example, in a cross-sectional sample of 1,478 adults from a university HIV/AIDS clinic, Vance and colleagues observed that across each decade of life, approximately 40% and 20% of patients were diagnosed with depression and anxiety, respectively [1]. Although psychotropic medications and cognitive-behavioral therapies can be effective in treating such mood disturbances, another strategy that may bolster these existing therapies may be cognitive remediation therapy, more specifically – speed of processing training. Thus, the purpose of this brief article is to explain how speed of processing, which has been used in normal community-dwelling older adults, may be used in adults aging with HIV. In fact, such training may not only improve cognitive functioning in adults aging with HIV, it may also have secondary benefits to mood, internal locus of control, and everyday functioning (Figure 1).

Cognitive remediation therapy and speed of processing training

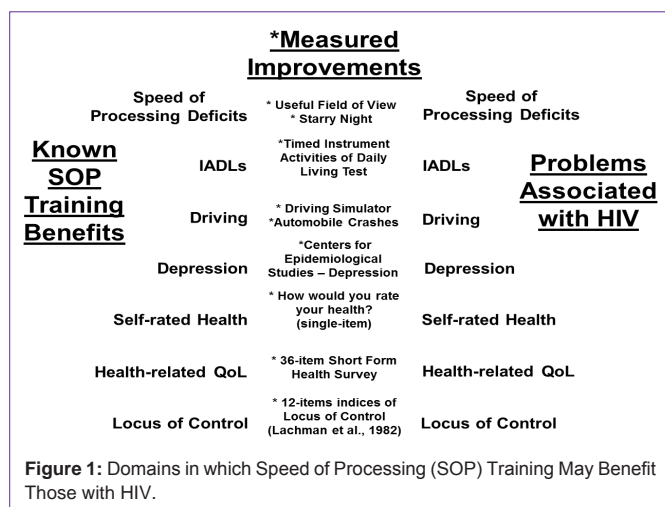
Cognitive remediation therapy is an approach in which a wide variety of mental exercises and activities are designed to improve cognition in children and adults. Cognitive remediation therapy has been used to improve overall general cognition as well as improve more specific cognitive abilities such as executive functioning, memory, language, and speed of processing. This approach can take several forms; these activities can be administered via workbooks, videotapes, computer games, the internet, as well as classroom or

group settings, depending on what type of cognitive ability is being targeted for remediation or improvement [2,3].

In the largest longitudinal study involving cognitive remediation in normal community-dwelling older adults ($N = 2,802$), a speed of processing training protocol used in the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) Study compared this protocol to those participants randomly assigned to a memory training group, a reason training group, and a no-contact control group. Overall, after as little as 10 hours of training (either computerized or in small didactic group sessions), compared to the no-contact control group these ACTIVE researchers found improvements in cognitive measures in the domain for which participants were trained; however, more robust improvements were observed for speed of processing and reasoning. This past year in a press release, (January 13, 2014), NINR/NIA announced that speed of processing training used in the ACTIVE Study enables “older people to maintain their cognitive abilities as they age,” even 10 years after training [4]. This public endorsement by these institutes testifies to the neuro-therapeutic utility, efficacy, and adaptability of this training protocol.

Cognitive Relevance to Adults with HIV

Although HIV-related dementia is not as prevalent as in the past because of widespread use of combination Antiretroviral Therapy (cART), adults with HIV continue to remain susceptible to both cortical and subcortical insults that produce cognitive impairments [5]. The virus causes elevated cortisol levels and inflammation that result in the death of glial cells. Moreover, age-associated comorbidities, HIV-associated comorbidities, and cART-induced



metabolic complications (such as hypercholesterolemia and insulin resistance) contribute to additional neurological damage [6]. For instance, in a sample of 1,555 adults with HIV from across the United States, Heaton and colleagues found that 52% experienced HIV-Associated Neurocognitive Disorders (HAND) with 33%, 12%, 5%, and 2% experiencing Asymptomatic Neurocognitive Impairment, Mild Neurocognitive Disorder, Mixed Neurocognitive Disorder, and HIV-Associated Dementia (HAD), respectively [7]. Justice and colleagues found a high prevalence of cognitive impairments in several cognitive domains (e.g., speed of processing, memory) in middle-aged and older veterans with HIV [8]. Others have also found that both viral burden and older age were significant predictors of cognitive impairment [9]. Furthermore, studies have also found cognitive declines and changes in brain functioning in adults with HIV even after only 1 year of infection [10,11]. Co-occurrence of HIV-associated and aging-related cognitive impairments increases the vulnerability of developing cognitive impairments as people age with this disease [12,13]. Wilkie and colleagues administered neurocognitive measures to 81 younger (20-39 years) and 68 older (50+ years) adults with and without HIV [14]. With the use of speed of processing measures, these researchers found that the older adults with HIV performed worse in this cognitive domain than the older adults without HIV and the younger adults with HIV. In a meta-analysis of 41 HIV neurocognitive studies [15], the cognitive domain showing the greatest decline from early to late stages of HIV for all ages was speed of processing.

As noted earlier, adults of all ages with HIV are vulnerable to speed of processing declines [15,16]. As adults living with HIV age, the level of cognitive decline increases. Any decline in speed of processing, even if mild, disrupts other cognitive domains (e.g., memory) [17] and interferes with quality of life, autonomy, and everyday functioning [15]. Speed of processing declines is associated with poorer driving performance outcomes, and more at-fault crashes in normal community-dwelling older adults [18-21] as well as in middle-aged (40+ years) and older adults with HIV [22-24], which represents a growing public health concern.

Speed of processing training in adults with HIV

Fortunately, deficits in speed of processing can be ameliorated. In a two-group pre-post experimental study, Vance and colleagues

randomly assigned 46 middle-aged (40+ years) and older adults with HIV into either a no-contact control group or a speed of processing training group [25]. Those in the speed of processing training group received up to 10 hours of computerized exercises specifically designed to improve the rate and accuracy in which one can visually process information. After approximately 5-6 weeks of training, all participants were reassessed on cognitive and everyday functioning. Compared to the no-contact control group, those in the speed of processing training group improved on two measures: 1) the Useful Field of View test, which is a measure of visual attention and speed of processing, and 2) the Timed Instrumental Activities of Daily Living Test, which is a laboratory measure of how quickly and accurately one can perform normal everyday tasks (e.g., locating select items on a shelf of food, counting out correct change).

Cognitive aging with HIV

For those aging with HIV, such training may be particularly important. Adults with HIV often experience cognitive impairments which affect safe driving [22], medication adherence [26], and Instrumental Activities of Daily Living (IADLs) [26,27]. For example, in a cross-sectional study, 26 middle-aged (40+) and older adults with HIV were administered: demographic, health, psychosocial and driving habits questionnaires; cognitive assessments; and driving simulator tests. Older age and poorer visual speed of processing performance (i.e., Useful Field of View) were related to poorer driving performance operationalized as average gross reaction time, more pedestrians hit, and driving outside the lane. More self-reported automobile accidents in the previous 2 years were associated with slower gross reaction time and higher number of collisions in the driving simulator [22]. These cognitive impairments which impact everyday functioning can likewise increase caregiver burden [28,29], impair occupational performance [30], contribute to poorer emotional processing [31,32], increase cognitive complaints [33,34], and reduce quality of life. This is particularly germane given that by 2020, 70% of adults with HIV in the United States will be 50 and older [35] – an aging trend seen worldwide [36].

Fortunately, speed of processing training is a simple, inexpensive, non-pharmacological intervention which improves the rate at which normal community-dwelling older adults process information [37,38], and has been shown to improve performance in driving [20] and instrumental activities of daily living [39]. This computerized training protocol has been demonstrated in both laboratory training and home-based settings to improve speed of processing and instrumental activities of daily living in middle-aged (40+ years) adults with HIV [25,40].

Non-Cognitive Gains from Speed of Processing Training

Based on findings from the ACTIVE Study, speed of processing can improve other health-related outcomes. These outcomes include improved self-rated health [41], shifts to internal locus of control [42], better health-related quality of life [43-45], and protection against depression [46]. As seen in Figure 1, these outcomes also reflect areas that are important to address with adults living with HIV. Such individuals tend to report poor health-related quality of life [47-49], poor self-rated health [50], decreased internal locus of control [48,51], and increased depression [1,47,52]. In fact, when compared

to memory training and reasoning training, speed of processing training positively continued to affect many of these outcomes five years after the initial training. Furthermore, from the ACTIVE Study, speed of processing training was more robust in improving these outcomes compared to memory training and reasoning training over a 1 to 5 year period. For example, using the ACTIVE data, Wolinsky and colleagues examined whether speed of processing training, in addition to improving this cognitive domain as well as everyday functioning (e.g., instrumental activities of daily living such as driving, taking medications, and housekeeping), would improve secondary outcomes [46]. When comparing speed of processing training to a no-contact control group, those who received this training were 30% less likely to exhibit clinically significant increases in depressive symptoms 1 year ($AOR = 0.700, p = .012$) and 5 years ($AOR = 0.698, p = 0.23$) after training [46]. Using the same analytical procedures, such protective effects were not observed for those who received the same amount of reasoning training or memory training. An explanation for these findings is that speed of processing “operates through sensory motor elaboration and repetition; it is known that procedural tasks like this have a broad pattern of regional brain activation than explicit memory or reasoning tasks” (p.468) [53]. In fact, with the focused engagement of attention and reward systems during such procedural learning activities, this may enhance neuromodulatory system function, resulting in better brain functions associated with mood [54-56]. Therefore, with such improved brain activation and corresponding structural changes, this could decrease or delay the risk of cognitive slowing, which is a significant predictor of overall decline. Since cognitive slowing is prevented or mitigated with speed of processing training, it may also protect against clinically significant depressive symptoms. Using the same analytical procedures, such protective effects were not observed for those who received the same amount of reasoning training or memory training. Because speed of processing training has been shown to protect normal community-dwelling older adults from depressive symptomatology, the same training may be considered as an adjunct therapy with cognitive-behavioral and pharmacological therapies to ameliorate such mood problems in adults with HIV.

Conclusion

Studies show improved speed of processing abilities in the short-term and long-term in normal older adults who receive speed of processing training [37,39,57-59]. Studies also show that this training results in short-term improvements in speed of processing in adults with HIV [25,40]. Despite well-documented HIV cognitive declines, few behavioral approaches have been attempted to improve cognitive functioning in this pharmacologically-burdened population [1]. In fact, pharmacological cognitive interventions produce adverse side effects in a population already experiencing multiple comorbidities [1]. Thus, speed of processing training is highly innovative because it has the potential to improve multiple health domains for people who are aging with HIV. These domains include cognitive functioning, locus of control, depression, and health-related quality of life; [41,42,46,60] clearly, these are all areas needed for intervention in cognitively vulnerable adults with HIV [31].

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