Individualized Web-Based Attention Training with Evidence-Based Counseling to Address HIV Treatment Adherence and Psychological Distress: An Exploratory Study

Eric Houston, Javad Salehi Fadardi, Nina T. Harawa, Chris Argueta, Sukrit Mukherjee

Corresponding Author:
Eric Houston
Phone: +1323-563-5862
Email: erichouston@cdrewu.edu

Abstract

Background: The prevalence of mood and trauma-stress-related disorders is disproportionately higher among people living HIV compared to individuals without the virus. Poor adherence to HIV treatment and heightened psychological distress have been linked to symptoms associated with these disorders.

Objective: The objective of this exploratory pilot study was to develop and implement an intervention that combined individualized web-based attention training with evidence-based counseling to promote HIV treatment adherence and reduce psychological distress. The study targeted African American and Latino young men who have sex with men (YMSM), two population groups in the United States that continue to experience disparities in HIV treatment outcomes.

Methods: Study participants with elevated symptoms of depression and suboptimal adherence to antiretroviral therapy (ART) were recruited primarily through referrals from Los Angeles health and social service providers as well as postings on social media. Participants enrolled in the four-week intervention received weekly counseling for adherence and accessed web-based attention training on a daily basis using their own mobile devices or computers. Individualized attention training provided participants with structured practice in reorienting their attention away their own from negative or emotionally-charged stimuli associated with poor adherence and diverting it toward positive or neutral stimuli linked to favorable adherence behaviors.

Results: Of the 14 participants who began the intervention, twelve (86%) completed all sessions and study procedures. Using a pretest-posttest design, findings indicated significant improvements in depressive symptoms, ART adherence, and attentional processing speed.

Conclusions: Findings support the feasibility of web-based attention training combined with counseling to improve ART adherence among patients with psychological distress. Future research should include a larger sample, a control group, and longer-term follow-up.

(JMIR Preprints 19/02/2020:18328)
DOI: https://doi.org/10.2196/preprints.18328

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Individualized Web-Based Attention Training with Evidence-Based Counseling to Address HIV Treatment Adherence and Psychological Distress: An Exploratory Study

Abstract

Background: The prevalence of mood and trauma-stress-related disorders is disproportionately higher among people living HIV compared to individuals without the virus. Poor adherence to HIV treatment and heightened psychological distress have been linked to symptoms associated with these disorders.

Objective: The objective of this exploratory pilot study was to develop and implement an intervention that combined individualized web-based attention training with evidence-based counseling to promote HIV treatment adherence and reduce psychological distress. The study targeted African American and Latino young men who have sex with men (YMSM), two population groups in the United States that continue to experience disparities in HIV treatment outcomes.

Method: Study participants with elevated symptoms of depression and suboptimal adherence to antiretroviral therapy (ART) were recruited primarily through referrals from Los Angeles health and social service providers as well as postings on social media. Participants enrolled in the four-week intervention received weekly counseling for adherence and accessed web-based attention training on a daily basis using their own mobile devices or computers. Individualized attention training provided participants with structured practice in reorienting their attention away their own from negative or emotionally-charged stimuli associated with poor adherence and diverting it toward positive or neutral stimuli linked to favorable adherence behaviors.

Results: Of the 14 participants who began the intervention, twelve (86%) completed all sessions and study procedures. Using a pretest-posttest design, findings indicated significant improvements in depressive symptoms, ART adherence, and attentional processing speed.

Conclusions: Findings support the feasibility of web-based attention training combined with counseling to improve ART adherence among patients with psychological distress. Future research should include a larger sample, a control group, and longer-term follow-up.

Keywords: Depression; trauma; HIV; attention training; implicit cognition

Introduction

People living with HIV (PLH) are disproportionately affected by depression and posttraumatic stress disorder (PTSD; 1,2). Compared to the general population, studies have estimated prevalence rates among PLH at two to three times higher for depression and up to nine times higher for PTSD (3,4). While both disorders adversely affect adherence to antiretroviral therapy (ART), symptoms of depression and PTSD, even at subclinical levels, weaken an individual's ability to effectively self-regulate the attention and cognitive processes required for consistent goal-directed behavior, such as following a long-term treatment regimen (5-7).

Research indicates that poor ART adherence and engagement with HIV medical care are connected to difficulties that HIV patients face in controlling negative thoughts, memories, and impulses to effectively manage their attentional focus (8-12). To meet the challenges associated with attaining their treatment goals, patients must learn to effectively employ cognitive self-regulatory skills, including attention control and the ability to flexibly shift attentional focus from emotionally negative health-compromising thoughts toward those that are positive or neutral and associated with favorable health outcomes (13,14).

Little research has focused on the development of interventions designed specifically to build the cognitive self-regulatory skills needed for optimal ART adherence. There is, however, a growing body of empirical and theoretical evidence that demonstrates the efficacy of attention training approaches in developing these skills, thereby promoting consistent goal-directed behavior related to a wide variety of health concerns, including smoking, problem drinking, substance abuse, eating disorders, overweight, and obesity (15-17). Similarly, attention training procedures have demonstrated efficacy in addressing several mental health problems for both adults and adolescents, including anxiety disorders and major depression (18-20). Such approaches provide structured training designed to strengthen an individual's ability to shift his or her attentional focus away from stimuli that provoke thoughts and memories associated with treatment avoidance and psychological distress and toward stimuli that promote treatment engagement and emotional well-being. In addition, the indirect nature of attention training approaches makes them appropriate for addressing the implicit or nonconscious thoughts, beliefs, and memories that are related to depressive and trauma symptoms (21,22).

Despite promising research indicating the value of attention training in addressing both psychological and physical health outcomes, there is a paucity of research focused on the application of attention training among HIV patients with comorbid psychiatric symptoms (23). Attention training is a clinically relevant approach given that negative attention biases are closely linked to depressed mood and a tendency for threat vigilance in connection with trauma. The training of attention away from salient negative stimuli and toward neutral or positive stimuli could be used to improve treatment adherence, increase engagement with HIV medical care, and promote mental health functioning. To enhance treatment outcomes and the durability of attention training effects, individualized stimuli could be presented during each session, thereby addressing the salient thoughts, beliefs, memories and images that trigger specific types of behavior or emotional responses for a given patient. Research indicates that individualized stimuli trigger stronger attention biases among study participants than general stimuli (24,25).

We conducted an exploratory pilot study to develop and implement an intervention consisting of a four-week, web-based attention training program combined with evidence-based counseling to improve ART adherence and reduce psychological distress among HIV patients. Individualized, web-based attention training, in combination with evidence-based counseling, has the potential to serve as an accessible approach that could be widely disseminated to reach individuals at risk for poor treatment outcomes due to suboptimal ART adherence or psychological distress. As a first step in exploring this potential role, the study sought to develop and determine whether such an intervention

approach could be efficiently deployed and conveniently delivered to patient populations disproportionately affected by HIV. African American and Latino young men who have sex with men (YMSM) represent two vulnerable patient populations in the United States that suffer from persistent elevated viremia, disproportionately high HIV transmission rates, and low levels of engagement in the HIV care continuum (26). Given the need for effective cognitive self-regulatory skills in maintaining consistent adherence and engagement with care amid elevated psychological distress and multiple psychosocial stressors (e.g., HIV stigma, experiences of trauma, childhood abuse), the study provided an opportunity to evaluate the viability of intervention featuring web-based individualized attention training to reach these vulnerable patient populations.

Method

Participants

The sample consisted of participants recruited for Project STEP ("Steps Toward Embodying Positivity"), an intervention designed to address HIV treatment adherence and depressive symptoms among African-American and Latino YMSM living with HIV in the Los Angeles metropolitan area. Participants in the intervention, which combined individualized web-based attention training with evidence-based counseling, were recruited primarily through referrals from health and social service providers, and postings on social media used by the target population (e.g., Adam4Adam, Craigslist, Grindr).

Individuals who expressed interest in joining the study were screened in person or by phone to determine if they met the following eligibility criteria: (a) African American or Latino male; (b) ages 18 through 29 years old, inclusive; (c) self-identification as gay, bisexual, or same-gender loving; and (d) depressive symptoms at mild or higher levels of severity based on self-report measures or suboptimal ART adherence, two psychological and behavioral risk factors for poor HIV treatment outcomes that the intervention was designed to address.

Procedure

Upon meeting the inclusion criteria, participants were administered informed consent and then enrolled in the study. Assessments and interviews with participants were conducted by a study team member during face-to-face meetings. After completing procedures to elicit and assess their individualized stimuli (i.e., brief thoughts related to treatment and mood changes), participants were scheduled for a second study meeting in which they were given an attention training tutorial and assessed for baseline reaction time performance. Upon finishing four weeks of attention training, participants were scheduled for a post-training assessment within a week of their final training session. Participants received $50 each for completion of the baseline and final assessments and $5 for each weekly meeting attended. All procedures for recruitment, data collection, and confidentiality were reviewed and approved by the Institutional Review Board of [text removed for blind review].

Measures

We collected study data through use of a self-administered computerized survey that participants completed during baseline and post-training study visits. To gauge the preliminary impact of the intervention, the computerized survey included measures of depressive symptoms and adherence. To describe our sample, we administered questionnaires tapping demographic and health-related characteristics, anxiety and trauma symptoms, and psychosocial stressors (e.g., HIV stigma and childhood sexual abuse). Participants completed survey items within 30 minutes on the average.

Demographics

Participants provided basic sociodemographic data by completing a 22-item questionnaire that requested information related to age, ethnicity, education, employment, income, HIV serostatus, healthcare usage and other personal characteristics.

Depressive symptoms

Depressive symptoms during the previous two weeks were measured using the Patient Health Questionnaire-9 (PHQ-9; 27). The PHQ-9 is a well-validated and widely-used brief instrument for assessing and monitoring depression severity. Depression scores derived from the PHQ-9 correspond

to minimal (≤ 4), mild (5–9), moderate (10–14), moderately severe (15–19), or severe (≥20). Based on systematic reviews and a meta-analysis of the PHQ-9, a cutoff score of 10 or greater has been described as indicative of meeting diagnostic criteria for depression (27,28). The instrument had a Cronbach's alpha of .89.

Adherence

Self-reported adherence was assessed using a modified version of the visual analogue scale (VAS; 29,30). In the scale used in this study, participants were presented with a horizontal number line divided into four segments to represent the percentage of HIV medication doses taken during the previous four days (i.e., 0-25%; 25-50%; 50-75%; and 75-100%). Using the number line, participants were instructed to indicate their adherence within one of the four categories. The final category encompassed moderate and high levels of adherence. Recent research suggests that newer formulations of ART may allow some patients to achieve virologic suppression and immunological benefits with relatively moderate adherence levels (31-35).

Trauma symptoms

The Posttraumatic Stress Checklist-Civilian Version (PCL-C; 36) was used to measure trauma symptoms. The PCL is a 17-item self-report measure of PTSD symptoms. Participants were asked to respond to each item using a 5-point Likert scale response format. Scores on the instrument range from 17 to 85, with higher scores indicating greater symptom severity. A score of 30 has been recommended as the minimum threshold for the further evaluation of PTSD symptoms among individuals in a civilian population (37).

Anxiety

The Modified Mini Screen (MMS; 38) was administered to gauge anxiety symptoms. MMS is a 22-item scale designed to identify individuals who may have psychiatric symptoms at levels that warrant further evaluation. We used nine items from the scale to assess anxiety symptoms among participants, with scores of six or greater indicating elevated levels of anxiety.

Childhood sexual abuse

Two items from the Child Sexual Abuse Index (CSAI; 39) were used to identify participants who had been subjected to sexual abuse during childhood. Specifically, participants were asked to indicate whether before the age of 18 they experienced (1) unwanted sexual events; and/or 2) sexual abuse or molestation. The CSAI also includes additional items in which participants indicated the type of sexual abuse, whether it involved violence or physical force, their age when the abuse occurred, and their relationship to the perpetrator(s).

HIV stigma

To assess the presence of HIV stigma, we used the AIDS-Related Stigma Scale (40). Participants were asked to respond (yes/no) to six dichotomous items pertaining to internalized negative beliefs and perceptions about people living with HIV.

Attention Training: Project STEP

The goal of attention training through Project STEP was twofold. First, it was designed to increase treatment adherence by teaching participants how to maintain their focus on thoughts that were approach-oriented with regard to treatment and away from thoughts that were avoidance-oriented. Second, to reduce depressive symptoms, attention training also sought to increase a participant's skill in quickly diverting attention away from those thoughts perceived as having an emotionally-negative valence and directing it toward thoughts that were perceived as neutral or having an emotionally-positive valence. Attention training, delivered via a web-based application (app), used the participant's own thoughts identified during an individualized assessment procedure.

During the assessment procedure, we elicited a wide range of personal thoughts and perceptions about treatment from participants through individual interviews. Thoughts related to positive and negative changes in the participant's emotional states were also elicited. Individual interviews were followed by administration of a computerized program in which participants were asked to quickly rate the similarity of paired combinations of their treatment-related thoughts as they appeared in

random order on the computer screen. The computerized rating procedure is consistent with other research designed to identify implicit cognitive processes (41-43). Ratings were subjected to multidimensional scaling analysis (MDS) to generate two-dimensional mappings that depicted how a participant's treatment-related thoughts, memories, and mental associations were associated with either treatment adherence or treatment avoidance. MDS has been used in the assessment of implicit cognitive processes identified and evaluated as an approach for the assessment of implicit cognitive processes (8,42,44). Both implicit and explicit cognitive processes were captured through the assessment procedure.

Modified dot-probe task. Attention training was delivered through a modified version of the dot-probe task, a spatially oriented computerized procedure employed to retrain attentional focus. Using a web-based version of the task developed for the present study, participants accessed the dot-probe task via their computer or mobile device and completed sessions at home. At the start of a training session trial, participants were asked to view the screen of their device and watch a fixation cross that was situated in the center of the screen. After 1,000 milliseconds (ms), two stimuli consisting of contrasting thoughts that were elicited during individualized assessments, replaced the cross and appeared simultaneously on opposite sides of the screen for approximately 2,500 ms. Then, a dot-probe appeared on the screen in the location of one of the previous stimuli. At this time, participants were required to indicate the location of the dot-probe as quickly as possible by clicking on their cursor or touching the screen of their device. The probe always appeared in the location of the stimuli that were treatment approach-oriented and conveyed a neutral or positive emotional tone, thereby training participants to respond to these types of stimuli rather than to negative and treatment avoidance-oriented stimuli.

Each individualized training session lasted approximately 15 minutes and was presented in four blocks. A single training block was composed of 50 trials, with a trial consisting of each sequence from the appearance of the fixation cross to the onset of the dot-probe. Completion of a training session required that the participant finish all four blocks. Participants, who received a tutorial practice session on the use of the attention training program prior to beginning the intervention, were provided information on the rationale behind attention training, an explanation of attention training procedures, and explicit instructions in which both speed and accuracy were emphasized. To ensure they understood how to use the computerized program, participants were required to have an accuracy rate of 80% during the tutorial practice session before proceeding to actual intervention training. During the intervention, trial-by-trial feedback in the form of beep alerts was provided during attention training sessions during the intervention to aid participants in reorienting their attentional focus. At the end of each block of training, participants were presented with a screen that showed their reaction time and accuracy rate for that specific training session. Participants were asked to complete at least three individualized training sessions at home on a daily basis for four consecutive weeks. With repeated trials, participants were expected to implicitly learn how to redirect or retrain their attentional focus toward neutral, positive and approach-oriented stimuli and away from treatment avoidance-oriented stimuli associated with negative emotional states and poor health behaviors. To evaluate changes in the amount of time a participant required to shift their attentional focus from avoidance-oriented or negative thoughts toward those that were approach-oriented or positive/neutral (i.e., attentional processing speed), we used reaction time measures collected during baseline and post-training administrations of the modified dot-probe task.

Weekly counseling. In addition to attention training, participants received weekly counseling related to HIV treatment adherence and cognitive self-regulation. Two intervention counselors, who matched the age, gender, and ethnic characteristics of the sample, were trained and supervised by the PI, a licensed clinical psychologist. The first of four counseling sessions focused on psychoeducational content, such as the role of thoughts in health behavior and affect. Participants were given information on techniques to identify and monitor their thoughts and encouraged to discuss how attention training could be used to effectively manage their thought processes. During the following

three meetings, participants were presented with selected modules adapted from the Treatment Advocacy Program (TAP; 45-47), an evidence-based individual level counseling intervention for people living with HIV. Modules were delivered by counselors in the form of Powerpoint slides via a laptop computer or ipad. TAP modules selected for this study provided participants with behavioral strategies and information pertaining to ART adherence, mood management, and alcohol and substance use. Participants were also given information on local resources and provided with referrals when needed.

Data analytic strategy

Data analysis was performed using IBM SPSS 22.0. Due to the exploratory nature of the study and the corresponding small sample size, data analysis focused primarily on descriptive statistics. The full sample consisted of individuals who were enrolled into the study and completed baseline questionnaires. We examined data from the full sample (n=20) to characterize participants who met eligibility criteria and completed baseline measures. Most analyses presented in this report, however, are based on data from participants who completed the attention training intervention and final assessments (n=12). To compare participant characteristics based on study completion status, we used the chi-squared statistic for categorical variables and independent samples t-test for continuous variables. The chi-squared statistic was also used to examine changes in adherence among participants from pre- to post-training assessments.

We used t-tests to examine changes in mean numbers of depressive symptoms, reaction times, and accuracy scores. Reaction time analyses included reaction times only from correct responses. To reduce the influence of outliers, we eliminated reaction times that were 1.5 standard deviations above or below a participant's mean response time. This approach is consistent with other published research (48). The alpha level for all statistical tests was set at 0.05.

Results

Sample description

African Americans comprised the majority of the full sample (60%, n=12) and Latinos represented 40% (n=8). Mean participant age was 27 years (SD=1.7). Most participants identified as gay (74%) or bisexual (26%). Sixty-seven percent of participants indicated that they had completed high school, a high school equivalency credential, or some college, and 22% reported graduating from college. Fifty-six percent of the sample had annual incomes below $20,000.

Adherence in the full sample was considerably below optimal levels, with the majority of participants reporting adherence rates less than or equal to 75%. Participants experienced high levels of psychological distress. The mean depressive symptom score, in the moderate range based on the PHQ-9 (M=11.95; SD=6.6), was above the threshold widely used to suggest further evaluation for major depression. Fifty-five percent of participants in the full sample (n=11) reported elevated symptoms of anxiety. With regard to trauma symptoms, 40 percent (n=8) had symptoms at or above recommended screening level cutoffs for PTSD. Forty-five percent (n=9) reported unwanted sexual events, sexual abuse or molestation before the age of 18. Eighty percent (n=16) reported experiencing internalized HIV stigma.

Of the 20 participants enrolled, six were excluded as they failed to attend a required study meeting for orientation to attention training procedures. Based on the remaining 14 participants who began attention training, the study completion rate was 86% (two participants dropped out for unknown reasons before completing the protocol). There were no statistically significant differences between enrolled participants who completed the intervention and those who were excluded or dropped out with regard to demographics, adherence, depressive symptoms and other assessed variables.

Attention training

Participants were encouraged to complete at least three attention training sessions on a daily basis, a total of 84 sessions during the intervention. The median number of training sessions among intervention completers was 48. All 12 study participants who completed the intervention attended each of the four weekly meetings with a study counselor.

Table 1 shows changes in attentional processing speed among study participants. Attentional processing was based on mean reaction times scores grouped by assessment period (baseline versus post-training) and by stimuli pairing type (i.e., positive-neutral, negative-neutral, positive-negative, and neutral-neutral). Participant reaction time to correctly identify the location of the dot-probe in each of the four stimuli pairings significantly declined from the baseline to post-training assessments. Participants experienced the greatest reduction in reaction times for the positive-negative stimulus pairings (369 ms), followed by positive-neutral pairings (353 ms).

Table 1. Mean dot-probe reaction time (SD) to stimuli presented at baseline and post-training assessments (n=12)

Stimuli pairing	Assessment		Test Statistic	*P*
	Baseline	Post-Training		
Positive-Neutral	2,553 (693)	2,200 (375)	-3.251	.01
Negative-Neutral	2579 (770)	2255 (414)	-2.71	.02
Positive-Negative	2,561 (677)	2,192 (368)	-3.482	.01
Neutral-Neutral	2,483 (683)	2175 (331)	-3.232	.01

Note: SD=Standard deviation; reaction times reported in milliseconds (ms).

Accuracy scores for each of the four types of stimuli pairings during the baseline and post-training assessments were calculated to provide a measure of the rate participants correctly responded when prompted to indicate the location of the dot-probe. The only statistically significant change in accuracy scores from baseline to post-training assessments, however, occurred when participants responded to positive-negative stimuli pairings (94% versus 98%), t(10)=4.05, *P*=.002.

Treatment adherence

We examined the relationship between attention training and ART adherence before and after the intervention by examining participant adherence rates based on a threshold of 75%. We categorized participants with adherence at or below this threshold as having “low” adherence and those with adherence above the threshold as having “moderate/high” adherence. At baseline, 42% (n=5) of participants who completed the intervention had low adherence versus 58% (n=7) with moderate/high adherence. During the post-training assessment, however, these percentages had shifted significantly with 75% (n=9) reporting adherence in the moderate/high range (see Table 2).

Table 2. Changes in ART adherence and number of depressive symptoms among intervention participants (n=12)

Characteristic	Baseline	Post-Training	Test Statistic	*P*
Adherence rate (%)			5.6	.02
≤75%	42	25		
>75%	58	75		
Depressive symptoms (Mean, SD)	13.4 (6.8)	8.6 (7.5)	3.71	.003
Symptom severity (%):				
Minimal (0-4)	8	25		
Mild (5-9)	25	50		

Moderate (10-14)	17	0	
Moderately-severe (15-19)	33	17	
Severe (20-27)	17	8	

Note: SD=Standard deviation

Depressive symptoms

Mean depressive symptoms among participants who completed the intervention declined significantly by 36% based on the PHQ-9, from 13.4 (SD=6.8) before starting the intervention to 8.6 (SD=7.5) after completion. The mean baseline score, which was in the moderate range with regard to depressive symptom severity, exceeded the cutoff of 10 widely used to suggest further diagnostic evaluation for major depression. The mean post-training score, which fell below this cutoff, was clinically significant in that it represented an overall downward shift in symptom severity from the moderate to the mild range. As Table 2 shows, compared to pre-intervention levels, there was a marked drop in the percentages of participants who experienced depressive symptoms in the moderate, moderately-severe, and severe ranges upon completing the study.

Discussion

In this exploratory pilot study, we aimed to develop and implement an intervention consisting of individualized, web-based attention training combined with evidence-based counseling to promote adherence to ART and reduce depressive symptoms among HIV patients experiencing elevated levels of psychological distress. Findings indicate that web-based attention training in addition to counseling can be efficiently deployed and conveniently delivered to a vulnerable HIV patient population with suboptimal ART adherence and disproportionately high rates of depressive and PTSD symptoms. The intervention implemented in this study had a high completion rate (86%), indicating strong viability as a clinical approach. Participants were able to access an individualized attention training program through their own mobile devices or computers, completing a median of 48 sessions during the four-week attention training program, or the equivalent of approximately two sessions per day. Attention training combined with evidence-based counseling yielded considerable therapeutic benefits to intervention participants. We found statistically significant improvements among participants in ART adherence from pre- to post-training. In addition, we found both statistically and clinically significant reductions in depressive symptoms. Findings also showed notable improvements in attentional processing speed based on reaction time measures. Research suggests that improvements in processing speed play an important role in promoting everyday functioning and quality of life (49,50).

While participants in this study were assessed at only two time intervals, the study effectively employed strategies that could be used to maximize the benefits of attention training and strengthen the long-term durability of intervention outcomes. Our intervention used specific strategies (i.e., performance feedback) to enhance the learning experience of study participants, drawing from recent research involving attention training (51-60). Based on goal setting theory (61), these strategies included providing participants with explicit instructions, a clear statement of the training goal, and trial-by-trial feedback on performance (e.g., reaction time changes; response accuracy rate). This study illustrates how individualized, web-based attention training for HIV patients with psychological distress could be employed in combination with psychotherapy.

Participants in this study represented those who could most benefit from attention training due to the cognitive burden posed by multiple psychosocial stressors (e.g., clinically-significant depressive symptoms, experiences of trauma and abuse, internalized HIV stigma). Future studies, however, should be based on larger samples that include women and individuals representing a wider range of ages, geographic locations, and behavioral risk groups. Although studies support the validity of self-report measures of adherence (62), findings in this investigation could be bolstered by future research that incorporates biomedical measures of adherence. In addition, future studies should be designed to examine measures of cognitive self-regulation related to attention control, cognitive

flexibility, and attention bias. Such measures would be derived based on administration of a standard dot-probe task where all stimuli are targeted with equal probability. This preliminary pilot study did not administer the standard dot-probe task. Finally, to better understand the role of attention training in HIV patient outcomes, research should be conducted that tracks participants over longer time intervals with a design that incorporates other approaches and a control group.

Attention training has shown much promise as an approach to improve outcomes associated with a range of health behaviors and psychological disorders (15-20,23,63). This exploratory study contributes to the literature on attention training by showing its clinical applications in addressing the impact of depressive and trauma symptoms on HIV treatment adherence. We were able to provide evidence of the utility of individualized, web-based attention training to yield favorable improvements in adherence and psychological distress in two vulnerable populations of HIV patients. Our findings provide support for additional exploration of this promising application.

Acknowledgments

[Text removed for blind review]

References

1. Bing EG, Burnam MA, Longshore D, Fleishman JA, Sherbourne CD, London AS, et al. Psychiatric disorders and drug use among human immunodeficiency virus–infected adults in the United States. *Arch Gen Psychiatry.* (2001) 58:8, 721–7282.
2. Israelski DM, Prentiss DE, Lubega S, Balmas G, Garcia P, Muhammad M, et al. Psychiatric co-morbidity in vulnerable populations receiving primary care for HIV/AIDS. *AIDS Care*. (2007) 19:2, 220-225. doi.org/10.1080/09540120600774230
3. Applebaum AJ, Bedoya CA, Hendriksen ES, Wilkinson JL, Safren SA, O'Cleirigh C. Future directions for interventions targeting PTSD in HIV-infected adults. *J Assoc Nurses AIDS Care*. (2014) 26:2,127–138. doi:10.1016/j.jana.2014.11.001
4. Chander G, Himelhoch S, Moore RD. Substance abuse and psychiatric disorders in HIV-positive patients. *Drugs.* (2006) 66:6, 769-89. doi:10.2165/00003495-200666060-00004
5. Blashill AJ, Perry N, Safren SA. Mental health: A focus on stress, coping, and mental illness as it relates to treatment retention, adherence, and other health outcomes. *Curr HIV/AIDS Rep.* (2011) 8, 215-222. doi:10.1007/s11904-011-0089-1
6. Boarts JM, Sledjeski EM, Bogart LM, Delahanty, D.L. The differential impact of PTSD and Depression on HIV disease markers and adherence to HAART in people living with HIV. *AIDS Behav*. (2006) 10:3, 253-261. doi.org/10.1007/s10461-006-9069-7
7. Vranceanu AM, Safren SA, Lu M, Coady WM, Skolnik PR, Rogers WH, et al. The relationship of post-traumatic stress disorder and depression to antiretroviral medication adherence in persons with HIV. *AIDS Patient Care STDs.* (2008) 22:4, 313-321. doi.org/10.1089/apc.2007.0069
8. Houston E, Lyons T, Wolfe B, Rolfsen N, Williams M, Rucker M, et al. Implicit cognition among patients lost to follow up for HIV care: A preliminary study. *Open AIDS J.* (2016) 10:1, 83-92. doi:10.2174/1874613601610010083
9. McIntosh RC, Tartar JL, Widmayer S, Rosselli M. Negative attention bias and processing deficits during the cognitive reappraisal of unpleasant emotions in HIV+ women. *J Neuropsychiatry Clin Neurosci.* (2015) 27:1, e32-9. doi: 10.1176/appi.neuropsych.13090222.
10. Novara C, Casari S, Compostella S, Dorz S, Sanavio E, Sica C. Coping and cognitive processing style in HIV-positive subjects. *Psychother Psychosom*. (2000) 69:6, 316-21.
11. St Quinton T, Brunton JA. Implicit processes, self-regulation, and interventions for behavior change. *Front Psychol*. (2017) 8: 346. doi:10.3389/fpsyg.2017.00346
12. Webb TL, Chang BPI, Benn Y. The ostrich problem: Motivated avoidance or rejection of information about goal progress. *Soc Personal Psychol Compass*. (2013) 7:11, 794-807. doi.org/10.1111/spc3.12071
13. Hall PA, Marteau TM. Executive function in the context of chronic disease prevention: theory, research and practice. *Prev Med.* (2014) 68, 44-50. doi: 10.1016/j.ypmed.2014.07.008.
14. Satpute AB, Ochsner KN, Badre K. The neuroscience of goal-directed behavior. In: Aarts H, Elliot AJ, editiors. *Frontiers of social psychology. Goal-directed behavior.*New York, NY: Psychology Press (2012).
15. Cox WM, Fadardi JS, Intriligator JM, Klinger E. Attentional bias modification for addictive behaviors: clinical implications. *CNS Spectr.* (2014) 19, 215-224. doi: 10.1017/S1092852914000091
16. Kakoschke N, Kemps E, Tiggemann M. Attentional bias modification encourages healthy eating. *Eating Behav.* (2014) 15, 120–124. doi: 10.1016/j.eatbeh.2013.11.001
17. Lopes FM, Pires AV, Bizarro L. Attentional bias modification in smokers trying to quit: A longitudinal study about the effects of number of sessions. *J Subst Abuse Treat.* (2014) 47, 50–57. doi: 10.1016/j.jsat.2014.03.002
18. Beevers CG, Clasen PC, Enock PM, Schnyer DM. Attention bias modification for major depressive disorder: Effects on attention bias, resting state connectivity, and symptom change. *J Abnorm Psychol.* (2015) 124:3, 463–475. doi: 10.1037/abn0000049
19. Kuckertz JM, Amir N, Boffa J W, Warren CK, Rindt SE, Norman S, et al. The effectiveness of an

attention bias modification program as an adjunctive treatment for Post-Traumatic Stress Disorder. *Beh Res Ther.* (2014) 63, 25–35. doi: 10.1016/j.brat.2014.09.00
20. Yang W, Ding Z, Dai T, Peng F, Zhang JX. Attention Bias Modification training in individuals with depressive symptoms: A randomized controlled trial. *J Behav Ther Exp Psychiatry.* (2015) 49:Pt A, 101-11. doi: 10.1016/j.jbtep.2014.08.005
21. Bar-Haim Y. Research Review: attention bias modification (ABM): a novel treatment for anxiety disorders. *J Child Psychol Psychiatry.* (2010). 51:8, 859-70. doi: 10.1111/j.1469-7610.2010.02251.
22. Joormann J., Quinn ME. Cognitive processes and emotion regulation in depression. *Depress Anxiety.* (2014). 31:4, 308-15. doi: 10.1002/da.22264
23. Houston E, Argueta C, Shoptaw S. HIV and depression: A potential role for attention training in prevention and treatment. *J HIV AIDS.* (2018). 4:2, 2-6. doi: 10.16966/2380-5536.152
24. Fadardi JS, Cox WM, Klinger E. Individualized versus general measures of addiction-related implicit cognitions. In: Wiers RW, Stacy AW, editors. *Handbook of Implicit Cognition and Addiction*. Thousand Oaks, CA: Sage Publications, Inc. (2006). pp. 121-33
25. Wisco BE. Depressive cognition: Self-reference and depth of processing. *Clin Psychol Rev*. (2009). 29:4, 382-392. doi.org/10.1016/j.cpr.2009.03.003
26. Christopoulos KA, Das M, Colfax GN. Linkage and retention in HIV care among men who have sex with men in the United States. *Clin Infect Dis.* (2011). 52 Suppl 2, S214-22. doi: 10.1093/cid/ciq045
27. Kroenke K, Spitzer RL, Williams JB, Löwe B. The Patient Health Questionnaire somatic, anxiety, and depressive symptom scales: A systematic review. *Gen Hosp Psychiatry*. (2010). 32, 345-359. doi: 10.1016/j.genhosppsych.2010.03.006
28. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* (2001). 16, 606- 613.
29. Giordano TP, Guzman D, Clark R, Charlebois ED, Bangsberg DR. Measuring adherence to antiretroviral therapy in a diverse population using a visual analogue scale. *HIV Clin Trials.* (2004). 5, 74–79.
30. Kalichman SC, Amaral CM, Swetzes C, Jones M, Macy R, Kalichman MO, et al. A simple single-item rating scale to measure medication adherence: further evidence for convergent validity. *J Int Assoc Physicians AIDS Care*. (2009). 8:6, 367-74. doi: 10.1177/1545109709352884
31. Gordon LL, Gharibian D, Chong K, Chun H. Comparison of HIV virologic failure rates between patients with variable adherence to three antiretroviral regimen types. *AIDS Patient Care STDs.* (2015). 29:7, 384-8. doi: 10.1089/apc.2014.0165
32. Kobin AB, Sheth NU. Levels of adherence required for virologic suppression among newer antiretroviral medications. *Ann Pharmacother*. (2011). 45:3, 372–379.
33. Shuter J. Forgiveness of non-adherence to HIV-1 antiretroviral therapy. *J Antimicrob Chemother*. (2008). 61:4, 769–773. doi: 10.1093/jac/dkn020
34. Shuter J, Sarlo JA, Kanmaz TJ, Rode RA, Zingman BS. HIV-infected patients receiving lopinavir/ritonavir-based antiretroviral therapy achieve high rates of virologic suppression despite adherence rates less than 95%. *J Acquir Immune Defic Syndr.* (2007). 45:1, 4-8.
35. Viswanathan S, Justice AC, Alexander GC at al. Adherence and HIV RNA suppression in the current era of highly active antiretroviral therapy. *J Acquir Immune Defic Syndr*. (2015). 69:4, 493-8.
36. Weathers FW, Huska JA, Keane TM. PCL-C for DSM-IV. Boston, MA: National Center for PTSD, Behavioral Science Division. (1991).
37. US Department of Veterans Affairs (VA), National Center for PTSD (2012). Using the PTSD checklist for DSM IV (PCL). Retrieved from: https://www.ptsd.va.gov/professional/assessment/documents/PCL_handoutDSM4.pdf
38. Alexander, M. J., G. Haugland, S. P. Lin, D. N. Bertollo, & F. A. McCorry. Mental health screening in addiction, corrections and social service settings: Validating the MMS. *International Journal on the Addictions*. (2008). *6*:1,105–19. doi: 10.1007/s11469-007-9100-x

39. Jonzon E, Lindblad F. Risk factors and protective factors in relation to subjective health among adult female victims of child sexual abuse. *Child Abuse Negl.* (2006). 30,127–43.
40. Kalichman SC, Simbayi LC, Cloete A, Mthembu PP, Mkhonta RN, Ginindza T. Measuring AIDS stigmas in people living with HIV/AIDS: the internalized AIDS-related stigma scale. AIDS Care. (2009). 21:1, 87-93. doi: 10.1080/09540120802032627
41. Cacioppo, J.T., von Hippel, W., & Ernst, J.M. Mapping cognitive structures and processes through verbal content: the thought-listing technique. *J Consult Clin Psychol.* (1997). *65*:6, 928-40.
42. Lease AM, McFall RM, Treat TA, Viken RJ. Assessing children's representations of their peer group using a multidimensional scaling technique. *J Soc Pers Relat.* (2003). 20, 707-28. doi: 10.1177/0265407503206001
43. Stacy AW, Newcomb MD, Ames SL. Implicit cognition and HIV risk behavior. *J Behav Med.* (2000). 23:5, 475-99.
44. Jones LE, Koehly LM. Multidimensional scaling. In: Keren G, Lewis C, editors. *A Handbook for Data Analysis in the Behavioral Sciences: methodological issues* (pp.95-164). Hillsdale, NJ: Erlbaum. (1993).
45. CDC (2015). Compendium of evidence-based effective HIV behavioral interventions: Treatment Advocacy Program. Available at: https://www.cdc.gov/hiv/pdf/research/interventionresearch/compendium/rr/TAP_BEST_RR.pdf
46. McKirnan DJ, Tolou-Shams M, Courtenay-Quirk C. The treatment advocacy program: A randomized controlled trial of a peer-led safer sex intervention for HIV-infected men who have sex with men. *J Consult Clin Psychol*. (2010). 78:6, 952–963. doi: 10.1037/a0020759
47. Raja S, McKirnan D, Glick N. The treatment advocacy program--Sinai: a peer-based HIV prevention intervention for working with African American HIV-infected persons. *AIDS Behav.* (2007). 11:5 Suppl, S127-37.
48. Donaldson C, Lam D, Mathews A. Rumination and attention in major depression. *Behav Res Ther.* (2007). 45, 2664–2678.
49. Kaur J, Dodson JE, Steadman L, Vance DE. Predictors of improvement following speed of processing training in middle-aged and older adults with HIV: a pilot study. *J Neurosci Nurs.* (2014). 46:1, 23-33. doi: 10.1097/JNN.0000000000000034
50. Vance DE, Fazeli PL, Ross LA, Wadley VG, Ball KK. Speed of processing training with middle-age and older adults with HIV: a pilot study. *J Assoc Nurses AIDS Care*. (2012). *23*:6, 500-10. doi: 10.1016/j.jana.2012.01.005
51. Amir N, Kuckertz JM, Strege MV. A pilot study of an adaptive, idiographic, and multi-component attention bias modification program for social anxiety disorder. *Cogn Ther Res.* (2016). 40:5, 661-71.
53. Grafton B, Mackintosh B, Vujic T. When ignorance is bliss: Explicit instruction and the efficacy of CBM-A for anxiety. *Cogn Ther Res.* (2014). 38, 172–188. doi.org/10.1007/s10608-013-9579-3
53. Krebs G, Hirsch CR, Mathews A. The effect of attention modification with explicit vs. minimal instructions on worry. *Behav Res Ther*. (2010). 48, 251–256. doi: 10.1016/j.brat.2009.10.009.
54. Kuckertz JM, Amir N. Attention bias modification for anxiety and phobias: Current status and future directions. *Curr Psychiatry Rep*. (2015). 17:2, 1–8. doi: 10.1007/s11920-014-0545-x.
55. Lazarov A, Abend R, Seidner S. The effects of training contingency awareness during attention bias modification on learning and stress reactivity. *Behav Ther.* (2017). 48, 638–650. doi: 10.1016/j.beth.2017.03.002.
56. MacLeod C, Clarke PJ. The attentional bias modification approach to anxiety intervention. *Clin Psychol Sci.* (2015). 3:1, 58–78. doi.org/10.1177/2167702614560749
57. Mobini S, Mackintosh B, Illingworth J. Effects of standard and explicit cognitive bias modification and computer-administered cognitive-behaviour therapy on cognitive biases and social anxiety. *J Behav Ther Exp Psychiatry.* (2014). 45, 272e279. doi: 10.1016/j.jbtep.2013.12.002
58. Nishiguchi Y, Takano K, Tanno Y. Explicitly guided attentional bias modification promotes

attentional disengagement from negative stimuli. *Emotion.* (2015). 15, 731–741. doi: 10.1037/a0039117
59. Phillips, W.J., Hine, D.W., Thorsteinsson, E.B. Implicit cognition and depression: a meta-analysis. *Clin Psychol Rev.* (2010). *30*:6, 691-709. doi: 10.1016/j.cpr.2010.05.002.
60. Vazquez C, Blanco I, Sanchez A. Attentional bias modification in depression through gaze contingencies and regulatory control using a new eye-tracking intervention paradigm: Study protocol for a placebo-controlled trial. *BMC Psychiatry.* (2016). 16, 439.
61. Locke EA, Latham GP. A theory of goal setting & task performance. Englewood Cliffs, NJ, US: Prentice-Hall, Inc. (1990).
62. Simoni JM, Kurth AE, Pearson CR, Pantalone DW, Merrill JO, Frick PA. Self-report measures of antiretroviral therapy adherence: A review with recommendations for HIV research and clinical management. *AIDS Behav. (*2006).10:3, 227–245.
63. Friese M, Hofmann W, Wiers RW. On taming horses and strengthening riders: Recent developments in research on interventions to improve self-control in health behaviors. *Self Identity.* (2011). 10:3, 336-351. doi: 10.1080/15298868.2010.536417