AIDS and Behavior (2019) 23:753–764
https://doi.org/10.1007/s10461-019-02412-z

ORIGINAL PAPER

Feasibility and Acceptability of an Online Positive Affect Intervention for Those Living with Comorbid HIV Depression

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Published online: 30 January 2019

Abstract

Positive affect has unique beneficial effects on psychological and physical health, independent of the effects of negative affect. Interventions that explicitly target positive affect show promise for improving health outcomes in a number of chronic illnesses. In this article, we present pilot data on the acceptability and feasibility of an online intervention to increase positive affect in those living with comorbid human immunodeficiency virus (HIV) and depression. The intervention was rated both acceptable and feasible by participants. Six of nine participants completed the intervention and the subsequent follow-up assessment and a post-intervention phone call. We also present outcomes of planned comparisons of intervention effects on emotion, which indicate that positive affect increased significantly in the intervention group. Based upon results of the current study, future research should continue the development of positive affect interventions for people living with comorbid HIV and depression.

Keywords Feasibility · Acceptability · Intervention · Positive affect · Depression · Online · Internet

Introduction

As human immunodeficiency virus (HIV) has shifted from acutely terminal to a chronic health condition, prevention priorities have shifted to increasing access to care and improving health outcomes for those living with HIV [1]. Depression is a commonly experienced barrier to achieving optimal health outcomes in HIV, including suppressed viral load [1, 2]. Indeed, the prevalence of depression among people living with HIV was found to be 42% in a recent review [3]. Moreover, depression is associated with increased substance abuse [4], suboptimal medication adherence [5], increased sexual risk behavior [6], and more rapid HIV progression [7] in people living with HIV.

In contrast to depression, positive affect is a unique predictor of positive health outcomes in HIV, including increased likelihood of viral load suppression, over and above the effects of negative affective constructs like depression [8]. Positive affect and negative affect are relatively independent of one another, rather than two ends of an emotional continuum [9, 10], and as such, positive affect can and does occur even when levels of stress and negative affect are high [9–11].

Interventions that specifically target positive affect have shown promise for improving both psychological and physical health. Positive affect interventions have been developed for people living with different types of chronic illness, from diabetes [12, 13] to heart disease [14, 15], hypertension [16, 17], depression [18], and HIV [19]. Meta-analyses indicate that positive affect interventions have been effective at enhancing well-being and reducing depressive symptoms [20, 21].

We developed a multi-component positive affect intervention to help people cope with chronic health-related stress, including the stress of living with HIV [12, 19, 22–24]. Positive affect skills taught in the intervention include noticing and capitalizing on positive events, gratitude, mindfulness, positive reappraisal, focusing on personal strengths, setting and achieving attainable goals, and engaging in acts of kindness. In our largest randomized trial to date, Intervention for those Recently Informed of their Seropositive Status

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(IRISS; $N = 159$), we tested the positive affect intervention in people newly diagnosed with HIV [19]. The intervention was delivered in person by trained facilitators during individual one-on-one sessions. Over the 10 months post intervention (15 months after HIV-diagnosis), the positive affect intervention led to higher levels of past-day positive affect, reductions in intrusive and avoidant thoughts about HIV, and reduced likelihood of antidepressant use, compared to the control condition [19]. Effect sizes were in the small to medium range, consistent with meta-analytic and review findings of positive interventions in other samples [20, 25]. However, this in-person intervention required participants to have geographical proximity to the study intervention site, and for some participants, the travel was an additional burden limiting their ability to engage in the intervention. Online interventions have the benefit of bypassing these physical barriers [1]. Online intervention delivery has shown promise in HIV prevention for a number of difficult-to-reach populations [26–28] and in those with mood disorders [29–32]. Particular strengths of online interventions include continuous access at any time of day and broad reach; particularly to rural or stigmatized populations and people who might not otherwise take advantage of services or participate in research that requires in-person sessions.

As such, we conducted a randomized controlled pilot test of an online positive affect intervention, Optimizing Resilience and Coping with HIV through Internet Delivery (ORCHID), comparing the intervention to an emotion-reporting control condition. We operationalized positive affect as "subjective positively valenced feelings that range from happy, calm, and satisfied, to excited and thrilled." The ORCHID intervention provided skills intended to help people experience more positive emotion on a daily basis which, we hypothesized, improves their ability to cope with the stress of living with HIV. Our primary objectives were to determine whether the ORCHID intervention was acceptable and feasible. Secondary objectives included assessing psychological changes resulting from participating in the intervention compared to control. Given the small sample size, the analyses of the intervention effects on emotion were descriptive and exploratory.

Methods

The study was approved by Institutional Review Boards at participating institutions and registered with clinicaltrials.gov (#NCT01997008).

Participants and Procedure

To be eligible for the study, participants had to self-report being HIV-positive, have a score on the Center for Epidemiologic Studies Depression Scale (CES-D) of 10 or greater, indicating depressive symptoms above the general population norm [33], understand written English, have daily access to the internet, and have a mobile phone with texting capabilities or the ability to use email as an alternative method by which to answer texts.

The intervention and control conditions, as well as all assessments, were self-guided and completed via internet from the location of the participant's choice. Participants were recruited via a posting in the online forum section of a magazine for people living with HIV. Interested participants went to a study website and completed a brief screener that included the CES-D. The project coordinator then set up a phone call with participants who were eligible, based upon an elevated CES-D score, to explain study procedures. Participants were then sent an online consent form as well as a link to the baseline questionnaire. This questionnaire assessed depressive symptoms, positive and negative affect, perceived stress, and use of the positive emotion skills taught in the intervention.

Upon completion of the baseline questionnaire, participants were enrolled in a pre-randomization run-in period for 8 days during which they completed daily emotion measures (see below). Those who completed at least four daily questionnaires over the 8-day period were then randomized 1:1 to ORCHID or a daily emotion reporting control condition, which consisted solely of daily emotion reporting. The randomization scheme was generated by the study data manager, and study personnel were kept blind to assignment until the participant was randomized and the online content for the participant was unlocked.

Participants randomized to the intervention group took part in an online intervention, which taught eight positive affect skills over 5 weeks [12, 24, 34]. On one of the first days of each week, participants received instructional materials and activities they were asked to try over the following week. During week one, participants received instructional materials and activities for noticing positive events, capitalizing on positive events, and for gratitude. During week two, they received mindfulness instructional materials and activities. During week three, they received positive reappraisal instructional materials and activities. During week 4, they received instructional materials and activities on personal strengths and attainable goals. During week 5, they received instructional materials and activities for acts of kindness. When more than one skill was presented in a week, skills were presented in a modular manner. This is to say that each skill was taught on its own, without being interwoven with other skills taught. The order of the skills mirrors the order in the in-person intervention and was originally designed to start with simpler skills then move into more challenging ones [19, 22, 35].

Each day, participants were asked to write a brief description of how they used the skills they were learning that week. Participants in both the intervention and the emotion reporting control group were asked to log onto the study website daily, where they were prompted to report on their emotions over the past 24 h.

In addition, participants in both groups received ecological momentary assessment (EMA) prompts via text message to answer questions about their affective states. As we hypothesized that the intervention would improve the daily experience of positive affect, we tested EMA for feasibility of daily emotion assessment.

Immediately post-intervention, participants completed a questionnaire that consisted of the same assessments as the baseline. The project coordinator then conducted semi-structured interviews by phone about feasibility and acceptability of the intervention for those in the intervention condition, and for emotion reporting in the control group. During these interviews, the project coordinator requested feedback regarding which skills were most and least enjoyable and whether or not participants would recommend the intervention to a friend and to someone else with HIV. Interviews were recorded and transcribed for analysis. Participants who completed the emotion reporting control condition were interviewed about the effects of logging their emotions. Participants in both conditions were asked about perceptions of the study website.

The maximum possible payment for participation was $106. Payment was sent in the form of an amazon.com gift card delivered via email. Participants were paid $0.50 for each of the days on which they provided online emotion reports, and a bonus of $20 if they complete at least 45 reports of the 60 possible. For the text message emotion EMA reports, participants received $1 for each completed day, up to a total of $16. They received $10 for completing the baseline and follow-up questionnaires, and a bonus of $20 for completing all the assessments within the questionnaires.

Intervention Content

Positive Events and Capitalizing (Skills 1 and 2)

Positive events frequently give rise to positive emotions [36, 37]. However, even while going through extremely stressful periods, people experience positive events, which may help people cope with the stress they are experiencing [38]. Scheduling pleasant events is used in some treatments of depression [39, 40].

Capitalizing on positive events is an expressive response to positive events and can be exhibited in a number of different ways, including but not limited to, telling others about the positive event either in person and thinking about the event after its occurrence. Engaging in capitalization strengthens the positive emotional connection with the positive event, and allows a second positive emotional experience [41]. In the current intervention, participants were asked to keep a journal of positive events that they experienced and how they capitalized on these events throughout the week in which they learned this skill.

Gratitude (Skill 3)

Gratitude is defined as feeling thankful and expressing appreciation toward e.g., nature, God, or other people. The relationship between increased well-being and intentionally noting that which for one is grateful has been supported over a number of studies [42–44]. In the current intervention, participants were asked to write in a gratitude journal daily, in which they created a list of things that they were grateful for that day.

Mindfulness (Skill 4)

Mindfulness, defined as the ability to intentionally pay attention to and be non-judgmentally aware of one's feelings, physical sensations, and thoughts in the present moment [45], has been observationally associated with lower negative and higher positive emotion [46]. In the current intervention, participants were asked to select an activity every day to do mindfully, and were given guided mindfulness meditations.

Positive Reappraisal (Skill 5)

According to stress and coping theory [47], one's cognitive appraisal of a potentially stressful event and perceived resources for responding to such an event determine the extent to which an event is experienced as stressful. Throughout the literature on coping, engaging in positive reappraisal is consistently associated with an increase in positive emotions [38, 48]. As part of the current study, participants were encouraged to examine positive aspects of an undesirable situation, and keep a week-long journal noting at least one aspect of each day that they could reappraise.

Focusing on Personal Strengths (Skill 6)

The included personal strengths content is based upon secondary appraisal and self-affirmation research. Secondary appraisal is the part of the coping process in which one assesses the resources available to cope effectively with a stressful event [47]. Participants in the intervention arm of the current study were asked to record ways in which a personal strength or talent was used each day during the week in which they learned to focus on personal strengths.

Attainable Goals (Skill 7)

Perceiving progress toward goals has been associated with higher levels of positive emotion and greater satisfaction with life [49, 50], and working toward specific proximal goals (vs. more global distant goals) is associated with higher subjective well-being [51]. In the current study, participants were asked to set a goal that was attainable but not easy to be completed over the week, and to record progress daily.

Altruistic Behaviors/Acts of Kindness (Skill 8)

Altruistic behaviors such as volunteerism have been associated with a decreased risk of mortality [52, 53] and serious illness [54] in large representative samples. During the week in which participants learned and practiced this skill, they were asked to do something nice for someone else each day and record it in a daily kindness journal.

Measures

See Table 1 for Cronbach's α for measures/assessments administered at baseline and follow-up.

Acceptability and Feasibility

During the post-intervention semi-structured interview, participants in the intervention condition rated the extent to which they would recommend these skills to a friend on a scale from 0 (definitely not)—10 (definitely yes), and on the same scale, how likely they would be to recommend these skills to someone else with HIV. They also answered open-ended questions about their perceptions of the intervention and their experiences taking part in it. Example questions include "You said that you would (not) recommend this program to people with HIV. Can you say more about why?" "What ways do you think learning these skills help you change how you deal with facing stress or hassles? and "Think back to when you first started the ORCHID course. Did the program meet your expectations? How helpful was it? In what ways was it helpful?"

Table 1 Chrobach's α for internal reliability of scales/assessments

Measure	α at baseline	α at follow-up
Positive affect	0.901	0.963
Negative affect	0.860	0.886
Depressive symptoms	0.887	0.930
Perceived stress	0.481	0.868
Skill use	0.873	0.961

Participants in both the intervention and control groups were asked about logging their emotions and about using the website. Example questions include "How did you feel about logging your emotions every day," "Do you think logging your emotions every day had any effect on you," "Were there parts of the website you disliked for any other reason," and "How did you feel about logging in daily?"

Positive and Negative Affect

Positive and negative affect were assessed with the Modified Differential Emotions Scale (mDES) [55]. Participants were asked to answer how often they had felt different emotions (e.g. inspired or uplifted; sad; stressed or overwhelmed) from 1 (not at all) to 9 (all the time) over the past week (at baseline), past 2 weeks (at follow-up), and daily throughout the intervention or emotion reporting period of 5 weeks. We expanded the response scale from a five-point scale, as used by Fredrickson et al. [55], to a nine point scale to increase variability of participant responses.

Depressive Symptoms

Participants completed the CES-D, which measures depressive symptoms over the past week. Instructions ask participants to indicate how they frequently they have felt each aspect over the past week from 0 (Rarely or none of the time [less than 1 day])—4 (Most or all of the time [5–7 days]). Example items include "I was bothered by things that don't usually bother me," and "I felt depressed" [33].

Perceived Stress

Perceived stress was measured with the Perceived Stress Scale [56]. This 14-item scale measures perceived stress over the past month on a 0 (never)—4 (very often) scale. Example items include "In the last month, how often have you felt nervous and 'stressed'?" and "In the last month, how often have you dealt successfully with irritating life hassles?"

Positive Emotion Skill Use

Positive emotion skill use was measured with a 10-item assessment developed by the study team to assess use of skills taught in the intervention. Example items include "When something good happened to me, I made sure to enjoy it," as a measure of capitalizing and "Over the past week, there were many things I felt grateful for," as a measure of gratitude. Respondents answered on a scale of 1 (definitely false)—5 (definitely true). This skill use assessment was administered at baseline and follow-up.

EMA

Similar to Steptoe [57], participants were asked to rate the extent (0 = least, 6 = most) to which they were feeling positive and negative emotions: happy, excited, content, appreciative, sad, worried, and fearful. Participants in both groups received the EMA prompts four times per day on 2 days a week (one randomly selected weekday/workday, and one randomly selected weekend day/non-workday) over the course of the study.

Analysis

Qualitative data analysis was conducted by two investigators who read transcribed post-intervention semi-structured interviews. Through discussion, they selected which quotes best reflected participant responses. Quantitative analysis was conducted with SPSS v. 23.

Intent-to-treat analyses were conducted using multilevel modeling to analyze the effects of the intervention (dummy coded: intervention = 1, control = 0) on outcomes across time (dummy coded: baseline = 0, post = 1)., While multilevel models are useful for nested data, they are also useful for examining longitudinal change within individuals [58]. Longitudinal multilevel models allow detection of trends masked when the time variable is not included in a multilevel manner, and this method is able to handle missing data points. [58, 59]. Post-analysis, we calculated Cohen's *d* effect sizes for all outcomes [60]. As this is a pilot study with a small sample, results are exploratory and should be interpreted with caution. However, conducting analyses was crucial for understanding that this intervention was not causing participants harm, and helps to inform hypotheses for future studies with a greater number of participants.

Results

Twenty-one participants (2 female; M age = 45, SD = 12.83; 61.9% White, 14.3% Unstated race, 9.5% Multiracial, 9.5% Black or African American, 4.8% Asian) were randomized to the ORCHID intervention ($N = 9$) or an emotion-reporting control (N = 12) condition. While we attempted to randomize participants 1:1 in the intervention and control conditions, given the small sample size, the final groups were unbalanced. This was unintentional. See Fig. 1 for CONSORT diagram. Average time since HIV diagnosis was just under 10 years (113 months; min = 2, max = 387 months), and mean participant CES-D score indicated a high level of depressive symptoms, $M = 28.84$, $SD = 6.64$, with no significant difference between groups. Similarly, there were no significant differences between groups on positive affect as measured by mDES ($M = 4.15$, $SD = 1.29$), negative affect as measured by mDES ($M = 4.63$, $SD = 1.24$), perceived stress ($M = 3.24$, $SD = 0.57$), skill use ($M = 3.10$, $SD = 0.78$), or negative affect as measured by EMA (M = 2.60, SD = 1.13) at baseline. However, there was a significant difference between groups in positive affect as measured by EMA, such that those in the intervention condition ($M = 3.35$, $SD = 0.59$) had significantly higher positive affect overall as compared to those in the control condition ($M = 2.02$, $SD = 0.84$). We first present data on feasibility and acceptability, and then we report changes within group and between groups over time for both changes in skill use, and psychological outcomes including positive affect, negative affect, depression, and stress.

Feasibility and Acceptability

Study Completion

Nine participants were randomized into the intervention, and twelve were randomized into the emotion reporting control condition. Six of nine (67%) participants in the intervention condition completed all intervention sessions, and the number of skills participants accessed was $M = 6$, $SD = 3.16$ (range 0–8). The same six of nine participants in the intervention group who completed all sessions also completed the follow-up assessment and post-intervention phone call (67%). Ten of 12 participants in the control group (83%) completed the follow-up assessment and phone call. (See Fig. 1.)

Reasons for intervention non-completion were both life- and study-related. One intervention participant who dropped out indicated that he had health issues and was entering the hospital the next week and a second participant cited other life stress. The third participant who dropped out indicated that he was having trouble logging in.

Intervention Experience: Qualitative Results

Participants Learned and Internalized Positive Emotion Skills

Participants in the intervention condition reported not only learning the positive emotion skills but internalizing them as well. When explaining why they would recommend these skills to a friend, one participant stated, "… no matter how bad our situation may be, if you really open up your eyes and look around, there are other people that their situation is bad or worse than we are. And the best thing to do is be happy where you are today. The thing is, if you are not happy where you are, set an attainable goal to change where you are today."

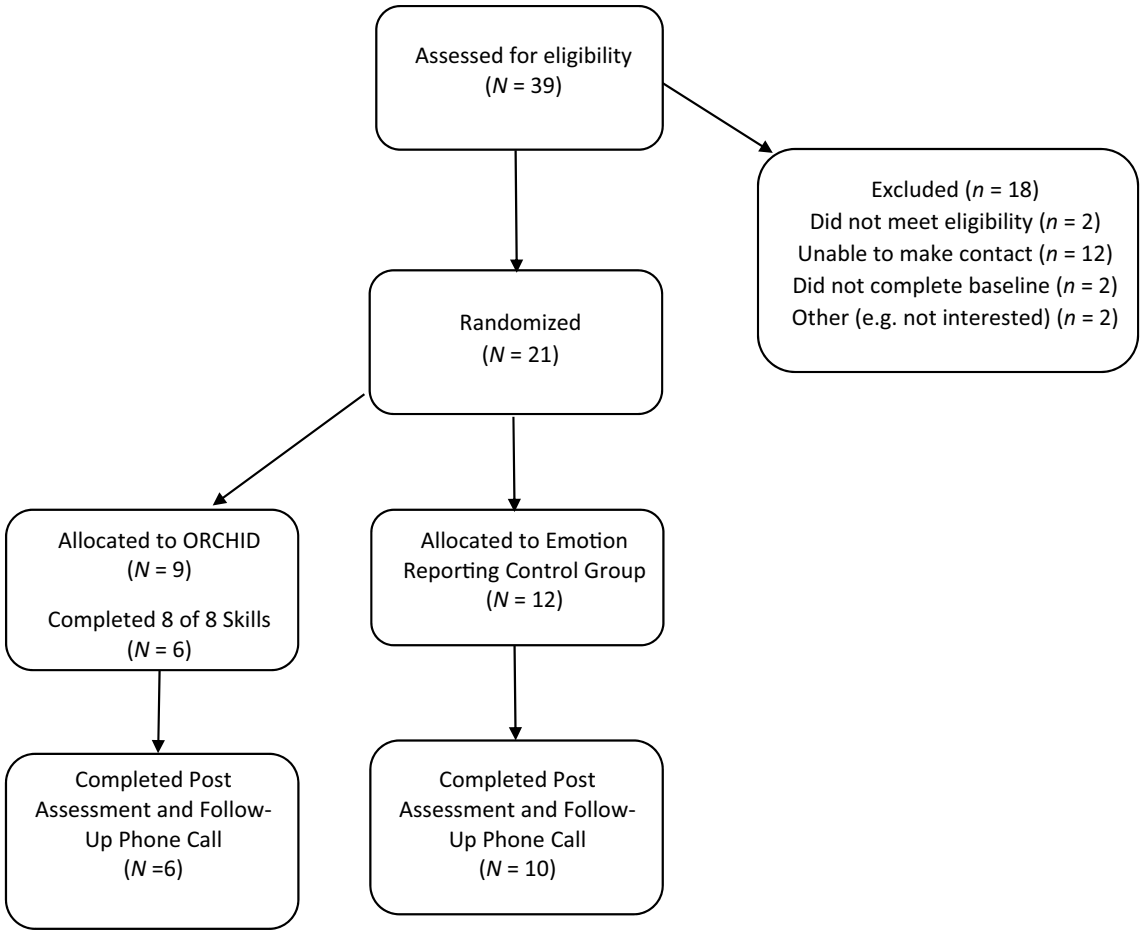

Fig. 1 Consort diagram

Participants Gained Emotional Resources They Believe are Important for People Living with Depression

Engaging in the ORCHID intervention provided participants with increased emotional resources for dealing with stress, and believe that this can be generalized to people living with depression. Specifically, one participant stated, "I think it would be great for people who are going through grief or any other thing that pulls all your emotion. It allows you to be more outgoing with it and work with it in a positive way. I think this is a wonderful tool." Another participant responded, "I do believe that [the intervention] could help [people living with depression] to look at life with a little more positive lens."

Heterogeneity of Skills is Important to Participants

When asked about their favorite skills, participants gave a wide range of responses (see quantitative results), and noted that having a range of skills to learn about is important. One participant stated, "You know, it is like going through a cafeteria line, you know not everyone wants to know about breathing awareness, or people have no interest in doing a gratitude journal. But they may say, you know what, you are absolutely right about listing positive events and I need to do that."

EMA is Acceptable to Participants

Participants mentioned that filling out the EMA responses was acceptable and feasible. One participant spontaneously stated, "Text message responses are beneficial because they always get you thinking about how you're progressing through your own day." Another said, "I kind of made the room for it. And tried to do it every day. I don't think it was really a problem. It was more like text messaging, just keeping you up on that." One other participant noted, "Text messages were very good for me. I can't speak for everybody. But, I have my phone on me so it was very convenient and fast and easy."

Improving the Intervention

When asked how to improve the experience for people with HIV going through the intervention, two participants stated that they would like more HIV-specific examples in the skill lessons. None of the other participants gave suggestions for improving the content of the intervention.

Intervention Experience: Quantitative Results

Intervention Participants Would Recommend These Skills to a Friend and to People Living with HIV

Intervention participants were asked about their experiences with the intervention. Specifically, intervention condition participants who completed the follow-up phone call ($N=6$) indicated that, on a scale from 1 to 10 (definitely not—definitely yes), they would be highly likely to recommend the skills to a friend ($M=9.5$, range 8–10).

When participants were asked how likely they would be to recommend the ORCHID program to someone with HIV, all respondents reported that they would ($M=9.83$, range 9–10). All participants also agreed that this is a reasonable program for people with HIV. Similarly, when asked, "Do you think the program would work for people with low mood or depression issues?" all intervention participants answered affirmatively.

Skill Preference

When we asked participants what their top three favorite skills were, participants gave a wide range of responses. All skills except capitalizing on positive events were mentioned, indicating heterogeneity of skill preference. Five of six respondents indicated that they would use their first favorite skill daily in an informal manner, with no response on this question from one participant.

Intervention Effects on Psychological Outcomes and Skill Use

We conducted planned comparisons of psychological outcomes and skill use between the intervention group and control group over time. See Table 2 for the estimates for each group for psychological outcomes and skill use at the baseline and follow-up assessments, as well as the Condition × Time interaction.

Table 2 Intervention effects on psychological outcomes and skill use

Outcome/group	Baseline *M* (*SD*)	Baseline *SE*	Follow-up *M* (*SD*)	Follow-up *SE*	Condition × time interaction
Positive affect					
ORCHID	4.61 (1.35)	0.45	6.49 (1.35)	0.55	b =1.72, t (34) = 1.89, p = 0.07, 95%
Control	3.81 (1.35)	0.39	3.97 (1.30)	0.41	CI − 0.13, 3.57, d = 1.33
Negative affect					
ORCHID	4.89 (1.41)	0.47	4.05 (1.40)	0.57	b = 0.41, t (34) = − 0.43, p = 0.67, 95%
Control	4.73 (1.39)	0.40	3.48 (1.33)	0.42	CI − 1.50, 2.32, d = 0.35
Depressive symptoms					
ORCHID	28.25 (7.23)	2.41	20.67 (6.81)	2.78	b = − 5.13, t (34) = − 1.09, p = 0.28, 95%
Control	29.27 (7.10)	2.05	26.82 (6.48)	2.05	CI − 14.68, 4.42, d = − 0.77
Perceived stress					
ORCHID	3.17 (0.69)	0.23	2.63 (0.69)	0.28	b = − 0.44, t (34) = − 0.95, p = 0.35, 95%
Control	3.40 (0.69)	0.20	3.30 (0.66)	0.21	CI − 1.39, 0.59, d = − 0.78
Skill use					
ORCHID	3.36 (0.87)	0.29	4.20 (0.88)	0.36	b = 0.86, t (34) = 1.46, p = 0.15, 95% CI
Control	2.83 (0.87)	0.25	2.81 (0.85)	0.27	= − 0.34, 2.06, d = 1.08
EMA positive affect					
ORCHID	3.36 (1.20)	0.40	3.93 (0.98)	0.40	b = 0.54, t (34) = 0.69, p = 0.50, 95% CI
Control	2.02 (1.32)	0.38	2.05 (1.20)	0.38	= − 1.05, 2.14, d = 0.54
EMA negative affect					
ORCHID	2.84 (1.56)	0.52	2.59 (1.27)	0.52	b = − 0.17, t (34) = − 0.17, p = 0.87, 95% CI − 2.23, 1.89, d = − 0.15
Control	2.39 (1.70)	0.49	2.30 (1.55)	0.49	

d Cohen's d effect size, *EMA* ecological momentary assessment

Positive Affect

For mDES positive affect measured at the assessment points, the Condition × Time interaction approached statistical significance for positive affect ($b = 1.72$, t (34) = 1.89, $p = 0.067$, 95% CI [− 0.13, 3.57] and the effect size for this effect was large ($d = 1.33$). Planned comparisons examining within-group trajectories of change from baseline to post found that positive affect increased significantly in the intervention group from baseline to follow-up, ($b = 1.88$, $p = 0.01$ 95% CI [0.43, 3.33]), while there was no change over time for those in the control group ($b = 0.16$, $p = 0.78$ 95% CI [− 0.99, 1.31]).

On the EMA measure of positive affect, the intervention group reported higher positive affect than did the control group at baseline, Mean difference = 1.34 $p < 0.02$, 95% CI [0.21, 2.47]. EMA positive affect increased slightly, but not significantly, in the intervention group, (Mean ORCHID group change = 0.57, $p = 0.32$, 95% CI [− 0.59, 1.73]). Similarly, there was no significant change over time for those in the control group (Mean control group change = 0.03, $p = 0.95$, 95% CI [− 1.07, 1.13]) and the between-group difference in change in positive affect over time as measured by EMA was not significant, $b = 0.54$, t (34) = 0.69, $p = 0.50$, 95% CI [− 1.05, 2.14], though the effect size for this was medium ($d = 0.54$).

Negative affect

The Condition × Time interaction ($b = 0.41$) for the mDES at the assessment points was not statistically significant and the effect size was small, t (34) = 0.43, $p = 0.67$, 95% CI [− 1.5, 2.32]; $d = 0.35$. Planned comparisons examining within-group trajectories of change from baseline to post found that participants in the intervention group did not change significantly on negative affect over time ($b = -0.84$, $p = 0.26$, 95% CI [− 0.066, 2.34]). However, contrary to hypotheses, participants in the control group decreased significantly in negative affect from baseline to follow-up ($b = -1.25$, $p = 0.04$, 95% CI [− 2.43, − 0.06]).

EMA negative affect decreased slightly, but not significantly, in the intervention group, (Mean ORCHID group change = − 0.26, $p = 0.73$, 95% CI [− 1.75, 1.24]). Similarly, there was no significant change over time for those in the control group (Mean control group change = − 0.09, $p = 0.90$ 95% CI [− 1.51, 1.24]). The between-group difference in change was not significant, $b = -0.17$, t (34) = − 0.17, $p = 0.87$, 95% CI [− 2.23, 1.89], and the effect size for this was negligible ($d = -0.15$).

Depressive Symptoms: CES-D

The Condition × Time interaction ($b = -5.13$) was not statistically significant, t (34) = − 1.09, $p = 0.28$, 95% CI [− 14.68, 4.42] although the effect size for the difference between groups over time was medium to large ($d = -0.77$.) Planned comparisons revealed that participants in the intervention group decreased significantly on depressive mood over time ($b = -7.58$, $p = 0.05$, 95% CI [− 15.08, − 0.09]) whereas participants in the control group showed a non-significant change ($b = -2.45$, $p = 0.40$, 95% CI [− 3.47, 8.38]).

Perceived Stress

The Condition × Time interaction ($b = -0.44$) was not statistically significant, t (34) = − 0.95 $p = 0.35$ 95% CI [− 1.39, 0.50] and the effect size was medium ($d = -0.78$). Planned comparisons revealed that neither the intervention ($b = -0.54$, $p = 0.15$, 95% CI [− 1.28, 0.20]) nor the control condition ($b = -0.10$, $p = 0.73$, 95% CI [− 0.69, 0.49]) changed significantly on perceived stress.

Assessment of Skill Use by Group Over Time

The Condition × Time interaction ($b = 0.86$) was not statistically significant, t (34) = 1.46, $p = 0.15$, 95% CI [− 0.34, 2.06] although the effect size for the difference in change in skill use between groups over time was large ($d = 1.08$). Planned comparisons demonstrated that an increase in skill use in the intervention group approached statistical significance, ($b = 0.84$, $p = 0.08$, 95% CI [− 0.10, 1.785]) whereas the change within the control group was non-significant, ($b = -0.02$, $p = 0.97$, 95% CI [− 0.76, 0.73]).

Discussion

To our knowledge, this is the first study of a positive affect intervention in a sample of people living with comorbid HIV and depression. This is a small study, and as such, it is important to interpret results with caution. However, there are a number of lessons learned. The qualitative and quantitative data from this small initial study suggest that the intervention is feasible and acceptable but also suggest a number of areas for focus in future studies.

Lessons Learned: Intervention

Sixty-seven percent of participants in the intervention group completed all skill modules in the current intervention and the follow-up phone call, which is consistent with findings of a systematic review completed by Christensen and colleagues [30] on adherence in online intervention RCTs with

depressed participants, in which online intervention completion by depressed participants ranged from 50 to 70%. However, efforts are underway to improve retention to online positive affect skills interventions for people living with depression [34].

When asked how to improve the experience for people with HIV going through the intervention, two participants stated that they would like more HIV-specific examples in the skill lessons. The significant heterogeneity of what people enjoyed spoke to the utility of presenting people with a number of potentially useful skills. There is evidence that allowing people to choose to activities that they believe are a good fit with them enhances positive psychological intervention effects [61], a finding which is being implemented in positive psychological interventions for people living with diabetes [13]. While the current study suggests potential utility in providing choices to people living with depression and HIV, this must be further explored.

Lessons Learned: Emotion Measurement

We included measures of past week affect in the assessments, and past day affect measured with EMA on selected days during the intervention. Overall, the only Condition × Time interaction that approached statistical significance was past week positive affect as measured by the mDES, such that positive affect improved in the intervention group more than in the control group.

Effects were not consistent across the different types of emotion measures. Within-group analyses conducted with intervention group data revealed that positive affect increased significantly as measured by the mDES, and increased slightly, but non-significantly, as measured by EMA. Negative affect, as measured by EMA, slightly but non-significantly decreased, and as measured by the mDES, did not change, Depressive symptoms decreased significantly as measured by the CESD. There was a slight but non-significant increase in skill use over time, and there were no changes in perceived stress.

Within-group analyses conducted with control group data revealed that negative affect, as measured by the mDES, decreased significantly over time, and as measured with EMA, did not change. Positive affect did not change as measured by the mDES or via EMA. There was a slight but non-significant increase in skill use, and a slight but non-significant decrease in depressive symptoms over time. There were no changes in perceived stress.

We should interpret these findings with caution given the small sample size and exploratory nature of the analyses. However, in the IRISS randomized trial, the positive affect intervention led to higher levels of past-day positive affect, and this effect was not seen when participants were asked about past week positive affect [19]. Future studies should consider including multiple approaches to emotion measures to ensure that effects are being detected, and should consider including EMA, as it is acceptable to participants and may be more sensitive to intervention effects than measures that ask participants to retrospectively report over longer periods. As only the control condition showed a decrease in negative affect, it may be beneficial for future work to explore whether decreased negative affect is a consequence of increased awareness of experienced emotions due to the study design. However, given the small sample size, we should be cautious making interpretations of any differences between conditions. In larger tests of the intervention in other samples [62], we have seen that the emotion reporting control has beneficial effects on its own, but these effects are inconsistent across studies. This could have been an artifact of small sample size, or perhaps reporting emotion is a less burdensome, effective intervention in itself. Indeed, being diagnosed and living with HIV introduces psychosocial, behavioral, and biological stressors that would be maladaptive to ignore. An important assumption underlying the ORCHID study is that the human stress response is complex and includes positive as well as negative affective responses. It is possible that this complexity may be harnessed to help enable people to improve their psychological and, perhaps, ultimately their physical health.

Limitations and Future Directions

Although the findings of the current study are intriguing, the study had weaknesses that should be clearly noted. In particular, the small sample size of this study must be taken into consideration, especially when examining the between-person standard errors of the current analyses, as sample sizes of under 50 can lead to biased estimates for these between-person standard errors in multilevel modeling [63]. However, even in very low sample sizes, parameter estimation is unbiased [63]. In addition, although some effect sizes are large, replication of these results in a larger sample size is critical in order to draw conclusions about the practical significance of the findings.

We did not query participants about non-technological barriers they experienced. While we did obtain qualitative data via phone interviews, these may have been influenced by demand characteristics, as participants were talking to study personnel. We also did not directly measure participant burden, which may have influenced text message prompt results (e.g., participants may have felt annoyed due to answering text messages about their emotions four times per day 2 days per week). In addition, three people dropped out of the intervention condition, two of whom had trouble with completion due to life stress (e.g., hospitalization), and one of whom had technical difficulties with

the study. To address these issues in studies since the completion of ORCHID [34, 62], we have simplified the login procedure, added a "frequently asked questions" (FAQ) section to study websites, and added videos to lower the barriers to remaining in the study. In addition, we could add language to the start of the intervention emphasizing how the intervention may feel like more of a burden if they are experiencing additional life stress but the intervention can help them cope with other types of stress as well so we encourage them to stick with it.

In addition, while men accounted for 76% of adolescents and adults living with HIV in the United States in 2010 according to the CDC [64], the fact that the majority of participants in the current study were male limit the generalizability of feasibility, acceptability, and exploratory results to males. Future positive affect intervention studies for people living with HIV should assess participant burden both quantitatively and qualitatively, so as to further understand how to optimize feasibility and acceptability for participants. Such studies should also ask participants about barriers they faced when completing said studies, and should allow participants to provide online, anonymous feedback. They should aim to include percentages of males and females in line with percentage of people living with HIV by gender. Given the feasibility and acceptability of the current intervention, as well as results of the planned secondary outcomes, future research should examine whether positive affect interventions can facilitate improved psychological and physical health-related behaviors and/or outcomes in those living with HIV and depression, including improved coping resources and increased engagement across the HIV continuum of care, from entering into care to maintaining a suppressed viral load.

Funding This work was Funded from a Grant to Judith T. Moskowitz from the UCSF Resource Allocation Program and was made possible with help from the Third Coast Center for AIDS Research (CFAR), an NIH funded center (P30 AI117943). Sarah M. Bassett was supported in this work by Agency for Healthcare Research and Quality Grant 5T32HS000084-20.

Compliance with Ethical Standards

Conflict of interest All the authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Research Involving Animal Rights This article does not contain any studies with animals performed by any of the authors.

References

1. White House Office of National AIDS Policy. National HIV/AIDS Strategy for the United States: updated to 2020. 2015.
2. 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 Psychiatr. 2001;58(8):721–8.
3. Nanni MG, Caruso R, Mitchell AJ, Meggiolaro E, Grassi L. Depression in HIV infected patients: a review. Curr Psychiatr Rep. 2015;17(1):530.
4. Latkin CA, Mandell W. Depression as an antecedent of frequency of intravenous drug use in an urban, nontreatment sample. Int J Addict. 1993;28(14):1601–12.
5. Ammassari A, Antinori A, Aloisi MS, Trotta MP, Murri R, Bartoli L, et al. Depressive symptoms, neurocognitive impairment, and adherence to highly active antiretroviral therapy among HIV-infected persons. Psychosomatics. 2004;45(5):394–402.
6. Marks G, Bingman CR, Duval TS. Negative affect and unsafe sex in HIV-positive men. AIDS Behav. 1998;2(2):89–99.
7. Arseniou S, Arvaniti A, Samakouri M. HIV infection and depression. Psychiatr Clin Neurosci. 2014;68(2):96–109.
8. Wilson TE, Weedon J, Cohen MH, Golub ET, Milam J, Young MA, et al. Positive affect and its association with viral control among women with HIV infection. Health Psychol. 2017;36(1):91.
9. Pressman SD, Cohen S. Does positive affect influence health? Psychol Bull. 2005;131(6):925.
10. Folkman S, Moskowitz JT. Positive affect and the other side of coping. Am Psychol. 2000;55(6):647–54.
11. Folkman S, Chesney M, Collette L, Boccellari A, Cooke M. Postbereavement depressive mood and its prebereavement predictors in HIV + and HIV–gay men. J Person Soc Psychol. 1996;70(2):336.
12. Cohn MA, Pietrucha ME, Saslow LR, Hult JR, Moskowitz JT. An online positive affect skills intervention reduces depression in adults with type 2 diabetes. J Posit Psychol. 2014;9(6):523–34.
13. Huffman JC, DuBois CM, Millstein RA, Celano CM, Wexler D. Positive psychological interventions for patients with type 2 diabetes: rationale, theoretical model, and intervention development. J Diabetes Res. 2015;2015.
14. Huffman JC, Mastromauro CA, Boehm JK, Seabrook R, Fricchione GL, Denninger JW, et al. Development of a positive psychology intervention for patients with acute cardiovascular disease. Heart Int. 2011;6(2):hi2011.
15. Peterson JC, Charlson ME, Hoffman Z, Wells MT, Wong SC, Hollenberg JP, et al. A randomized controlled trial of positive-affect induction to promote physical activity after percutaneous coronary intervention. Arch Intern Med. 2012;172(4):329–36.
16. Boutin-Foster C, Offidani E, Kanna B, Ogedegbe GO, Ravenell J, Scott E, et al. Results from the trial using motivational interviewing, positive affect, and self-affirmation in african americans with hypertension (TRIUMPH). Ethn Dis. 2016;26(1):51–60.
17. Ogedegbe GO, Boutin-Foster C, Wells MT, Allegrante JP, Isen AM, Jobe JB, et al. A randomized controlled trial of positive-affect intervention and medication adherence in hypertensive African Americans. Arch Intern Med. 2012;172(4):322–6.
18. Seligman MEP, Steen TA, Park N, Peterson C. Positive psychology progress: empirical validation of interventions. Am Psychol. 2005;60(5):410.

19. Moskowitz JT, Carrico AW, Duncan LG, Cohn MA, Cheung EO, Batchelder A, et al. Randomized controlled trial of a positive affect intervention for people newly diagnosed with HIV. J Consult Clin Psychol. 2017;85(5):409.
20. Bolier L, Haverman M, Westerhof GJ, Riper H, Smit F, Bohlmeijer E. Positive psychology interventions: a meta-analysis of randomized controlled studies. BMC Public Health. 2013;13(1):119.
21. Sin NL, Lyubomirsky S. Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: a practice-friendly meta-analysis. J Clin Psychol. 2009;65(5):467–87.
22. Moskowitz JT, Carrico AW, Cohn MA, Duncan LG, Bussolari C, Layous K, et al. Randomized controlled trial of a positive affect intervention to reduce stress in people newly diagnosed with HIV; protocol and design for the IRISS study. Open Access Journal of Clinical Trials. 2014.
23. Dowling GA, Merrilees J, Mastick J, Chang VY, Hubbard E, Moskowitz JT. Life enhancing activities for family caregivers of people with frontotemporal Dementia. Alzheimer Dis Assoc Disord. 2014;28(2):175–81.
24. Cheung EO, Cohn MA, Dunn L, Melisko M, Morgan S, Penedo FJ, et al. A randomized pilot trial of a positive affect skill intervention (lessons in linking affect and coping) for women with metastatic breast cancer. Psycho-Oncology. 2017;26(12):2101–8.
25. DuBois CM, Beach SR, Kashdan TB, Nyer MB, Park ER, Celano CM, et al. Positive psychological attributes and cardiac outcomes: associations, mechanisms, and interventions. Psychsomatics. 2012;53:15.
26. Bowen A, Williams M, Daniel C, Clayton S. Internet based HIV prevention research targeting rural MSM: feasibility, acceptability, and preliminary efficacy. J Behav Med. 2008;31(6):463–77.
27. Salyers Bull S, Lloyd L, Rietmeijer C, McFarlane M. Recruitment and retention of an online sample for an HIV prevention intervention targeting men who have sex with men: the Smart Sex Quest Project. AIDS Care. 2004;16(8):931–43.
28. Bull S, Vallejos D, Levine D, Ortiz C. Improving recruitment and retention for an online randomized controlled trial: experience from the Youthnet study. AIDS Care. 2008;20(8):887–93.
29. Clarke G, Kelleher C, Hornbrook M, DeBar L, Dickerson J, Gullion C. Randomized effectiveness trial of an Internet, pure self-help, cognitive behavioral intervention for depressive symptoms in young adults. Cogn Behav Ther. 2009;38(4):222–34.
30. Christensen H, Griffiths KM, Farrer L. Adherence in internet interventions for anxiety and depression: systematic review. J Med Internet Res. 2009;11(2):e13.
31. Andersson G. Internet–based cognitive–behavioral self help for depression. Expert Rev Neurother. 2006;6(11):1637–42.
32. Andersson G, Bergström J, Holländare F, Carlbring PER, Kaldo V, Ekselius L. Internet-based self-help for depression: randomised controlled trial. Br J Psychiatr. 2005;187(5):456–61.
33. Radloff LS. The CES-D scale a self-report depression scale for research in the general population. Appl Psychol Meas. 1977;1(3):385–401.
34. Cheung EO, Addington EL, Bassett SM, Schuette SA, Shiu EW, Cohn MA, et al. A self-paced, web-based, positive emotion skills intervention for reducing symptoms of depression: protocol for development and pilot testing of MARIGOLD. JMIR Res Protoc. 2018;7(6).
35. Moskowitz JT, Hult JR, Duncan LG, Cohn MA, Maurer S, Bussolari C, et al. A positive affect intervention for people experiencing health-related stress: development and non-randomized pilot test. J Health Psychol. 2012;17(5):676–92.
36. Murrell SA, Norris FH. Resources, life events, and changes in positive affect and depression in older adults. Am J Community Psychol. 1984;12(4):445–64.
37. Zautra AJ, Reich JW. Life events and perceptions of life quality: developments in a two? factor approach. J Community Psychol. 1983;11(2):121–32.
38. Folkman S. Positive psychological states and coping with severe stress. Soc Sci Med. 1997;45(8):1207–21.
39. Krause N. Positive life events and depressive symptoms in older adults. Behav Med. 1988;14(3):101–12.
40. Lewinsohn PM, Clarke GN, Hoberman HM. The coping with depression course: review and future directions. Can J Behav Sci. 1989;21(4):470.
41. Langston CA. Capitalizing on and coping with daily-life events: expressive responses to positive events. J Pers Soc Psychol. 1994;67(6):1112.
42. Emmons RA. Thanks!: How the new science of gratitude can make you happier: Houghton Mifflin Harcourt; 2007.
43. Emmons RA, McCullough ME. Counting blessings versus burdens: an experimental investigation of gratitude and subjective well-being in daily life. J Pers Soc Psychol. 2003;84(2):377.
44. Kashdan TB, Uswatte G, Julian T. Gratitude and hedonic and eudaimonic well-being in Vietnam war veterans. Behav Res Ther. 2006;44(2):177–99.
45. Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. Clin Psychol. 2003;10(2):144–56.
46. Brown KW, Ryan RM. The benefits of being present: mindfulness and its role in psychological well-being. J Pers Soc Psychol. 2003;84(4):822.
47. Lazarus RS, Folkman S. Stress, appraisal, and coping. New York: Springer; 1984.
48. Sears SR, Stanton AL, Danoff-Burg S. The yellow brick road and the emerald city: benefit finding, positive reappraisal coping and posttraumatic growth in women with early-stage breast cancer. Health Psychol. 2003;22(5):487.
49. Carver CS, Scheier MF. Origins and functions of positive and negative affect: a control-process view. Psychol Rev. 1990;97(1):19.
50. Lent RW, Singley D, Sheu HB, Gainor KA, Brenner BR, Treistman D, et al. Social cognitive predictors of domain and life satisfaction: exploring the theoretical precursors of subjective well-being. J Couns Psychol. 2005;52(3):429.
51. Emmons RA. Abstract versus concrete goals: personal striving level, physical illness, and psychological well-being. J Pers Soc Psychol. 1992;62(2):292.
52. Musick MA, Wilson J. Volunteering and depression: the role of psychological and social resources in different age groups. Soc Sci Med. 2003;56(2):259–69.
53. Oman D, Thoresen CE, McMahon K. Volunteerism and mortality among the community-dwelling elderly. J Health Psychol. 1999;4(3):301–16.
54. Moen P, Dempster-McCain D, Williams RM. Successful aging: a life-course perspective on women's multiple roles and health. Am J Sociol. 1992;97(6):1612–38.
55. Fredrickson BL, Tugade MM, Waugh CE, Larkin GR. What good are positive emotions in crisis? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. J Pers Soc Psychol. 2003;84(2):365.
56. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983;24(4):385–96.
57. Steptoe A, Wardle J. Positive affect measured using ecological momentary assessment and survival in older men and women. Proc Natl Acad Sci USA. 2011;108(45):18244–8.
58. Singer JD, Willett JB. Applied longitudinal data analysis: modeling change and event occurrence. Oxford: Oxford University Press; 2003.
59. West SG, Ryu E, Kwok OM, Cham H. Multilevel modeling: current and future applications in personality research. J Pers. 2011;79(1):2–50.

60. Borenstein M, Hedges LV, Higgins J, Rothstein HR. References. Chichester: Wiley; 2009.
61. Lyubomirsky S, Sheldon KM, Schkade D. Pursuing happiness: the architecture of sustainable change. Rev Gen Psychol. 2005;9(2):111.
62. Moskowitz JT, Cheung EO, Snowberg K, Verstaen A, Merrilees J, Salsman JM, et al. Randomized controlled trial of a facilitated online positive emotion regulation intervention for dementia caregivers. Health Psychol. (in press) .
63. Maas CJ, Hox JJ. Sufficient sample sizes for multilevel modeling. Methodology. 2005;1(3):86–92.
64. Prevention CfDCa. HIV Among Men in the United States 2017. https://www.cdc.gov/hiv/group/gender/men/index.html. Accessed 12 December 2018.