TREATMENT ENGAGEMENT IN SMARTPHONE-ENHANCED VS. STANDARD BEHAVIORAL ACTIVATION FOR SUBSTANCE USE

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ABSTRACT

Catherine E. Paquette: Treatment Engagement in Smartphone-Enhanced vs. Standard Behavioral Activation for Substance Use
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Background: Low engagement in group-based substance use treatment may contribute to poor post-treatment outcomes. Aiming to increase engagement in treatment skills outside clinician-administered sessions, a smartphone app was developed and integrated into a group-based, brief behavioral activation treatment (LETS ACT) for substance use. Primary Aims: To test group differences in engagement, including use of treatment materials, treatment attendance, in-session participation and comprehension, and working alliance. Methods: Hierarchical linear regression and generalized estimating equations tested condition differences among N=112 individuals randomized to LETS ACT (n=56) or smartphone-enhanced LETS ACT (n=56). Results: Participants demonstrated lower probability of planning and completing activities during (but not after) treatment using smartphones compared to paper treatment booklets. Treatment condition did not predict attendance, participation, comprehension, or working alliance. Discussion: Hypothesized benefits of smartphone technology for increasing engagement were not realized in the current study. Design decisions to streamline smartphone integration into treatment are discussed.

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LIST OF ABBREVIATIONS

BDI-II	Beck Depression Inventory – Second Edition
CBT	Cognitive Behavioral Therapy
FU1	1-Month Posttreatment Follow-Up
FU3	3-Month Posttreatment Follow-Up
LAVA	Life Areas, Values and Activities
LETS ACT	Life Enhancement Treatment for Substance Use
LETS ACT-SE	Smartphone-Enhanced Life Enhancement Treatment for Substance Use
PT	Posttreatment
SUD	Substance Use Disorder
TLFB	Timeline Follow-Back
WAI	Working Alliance Inventory

1. Introduction

The treatment of substance use disorders (SUDs) is immensely costly and yet far from optimally effective. In the United States, the total annual cost of SUD treatment is projected to reach $42.1 billion in 2020 (Substance Abuse and Mental Health Services Administration, 2014). Despite the billions spent on SUD treatment each year, low access to treatment remains a significant problem for many individuals. This is especially true for those who are low-income (Liebling et al., 2016), a group also disproportionately impacted by substance use (Boardman, Finch, Ellison, Williams, & Jackson, 2001). Indeed, recent estimates suggest that only about 12 percent of individuals in need of substance use treatment receive treatment at a specialty facility each year (Substance Abuse and Mental Health Services Administration, 2018). Even where facilities exist, many treatment settings lack the resources to provide evidence-based treatments like cognitive behavioral therapy (CBT), which typically must be administered by highly trained clinicians. Post-treatment relapse rates are high, such that individuals who engage in SUD treatment typically require multiple treatment episodes to achieve sustained abstinence (Dennis, Scott, Funk, & Foss, 2005). Accordingly, there is a need for cost-efficient evidence-based treatments that can improve SUD outcomes and can be implemented in low-resource settings.

The Life Enhancement Treatment for Substance Use (LETS ACT; Daughters, Magidson, Lejuez, & Chen, 2016) was developed to address this need. LETS ACT is a behavioral activation treatment which aims to increase substance-free environmental reinforcement through the planning and execution of value-based activities. Behavioral activation has shown efficacy when delivered by individuals without professional training in psychotherapy (Ekers et al., 2011),

making it accessible for implementation in low-resourced SUD treatment settings. LETS ACT provided as a supplement to inpatient substance use treatment has demonstrated effectiveness in reducing depressive symptoms (Daughters et al., 2008) and rates of treatment dropout (Magidson et al., 2011), as well as increasing rates of abstinence and substance-related consequences up to one year post treatment (Daughters et al., 2018).

Despite these positive initial findings, there continues to be significant room to further improve post-treatment outcomes by increasing treatment engagement and homework compliance. Although significantly lower than a contact-matched control condition, more than 50 percent of participants who received LETS ACT reported having used substances by three months post treatment. With only six group sessions, there is little individual attention to help reinforce and guide behavioral activation skills outside of clinician-administered sessions. Research suggests that homework compliance is predictive of better treatment outcomes across psychotherapy modalities (Mausbach, Moore, Roesch, Cardenas, & Patterson, 2010), including in cognitive-behavioral treatments, which include behavioral activation (Lebeau, Davies, Culver, & Craske, 2013; Rees, McEvoy, & Nathan, 2005). Other indicators of participants' engagement in treatment, such as session attendance and in-session comprehension and skill usage, have also been found to predict treatment effectiveness (Dale et al., 2011; Jarrett, Vittengl, Clark, & Thase, 2018). Thus, bolstering participants' engagement in the treatment and compliance with homework assignments could be one way to improve post-treatment outcomes.

Integrating smartphones into therapy is a promising strategy for increasing engagement and homework compliance. Features such as built-in guidance, prompts, and reminders can assist individuals in completing their homework while adhering to the format and sequence of steps indicated in the treatment (i.e., homework completion in compliance with treatment protocol).

Users of smartphone apps for addiction recovery frequently cite the portability of apps as an advantage (Savic, Best, Rodda, & Lubman, 2013), and regular use of a smartphone application is not limited in the way that paper materials are, such as by the number of copies the participant has on hand. Additionally, given the stigma associated with participation in SUD treatment (Luoma et al., 2007), participants may be more comfortable using a smartphone to complete treatment tasks compared to using printed materials, which are more easily identifiable. Indeed, the discrete nature of smartphone apps is another advantage cited by users of addiction recovery apps (Savic et al., 2013). Smartphone apps can also provide a more cost-effective way of engaging patients. For example, a study comparing a smartphone app with in-person care for stress reduction found that the app provided considerable cost savings (Luxton, Hansen, & Stanfill, 2014).

Current research suggests that interventions involving smartphone apps are feasible and well-accepted across a range of disorders and clinical populations, including those with SUDs. The majority (81 percent) of U.S. adults now own smartphones (Pew Research Center, 2019), and research among individuals in SUD treatment demonstrates rates of smartphone ownership and usage similar to the general population (Dahne & Lejuez, 2015; Tofighi et al., 2019). It is unsurprising, then, that studies examining psychological interventions involving smartphone apps have generally found the modality to be feasible in clinical populations. A recent systematic review examining digital interventions to support people in recovery from SUDs (most of which utilized mobile apps) found that these interventions were generally quite feasible to implement, and that the majority of participants reported the interventions were useful (Nesvåg & McKay, 2018). Specific outcomes used to assess feasibility and acceptability of app-based interventions vary across studies (Rathbone & Prescott, 2017). Most studies assess feasibility by characterizing

overall app engagement (e.g., the frequency of use of the app and its components) and/or treatment compliance (i.e., use of the app in a manner consistent with treatment guidelines). Acceptability is typically assessed through participant feedback, such as ratings on the usefulness of the apps and their features, or participant satisfaction ratings. The majority of users of physical and mental health intervention apps rate the apps' usability and feasibility, and their satisfaction with the apps, as "satisfactory to high" (Rathbone & Prescott, 2017).

Despite increasing use of smartphone technology in mental health treatment, data comparing smartphone-enhanced interventions to traditional paper-based interventions is lacking. Previous studies of behavioral interventions related to diet and exercise have found higher rates of homework compliance and greater behavioral change among participants randomized to interventions involving smartphone apps compared to those using paper materials (Carter, Burley, Nykjaer, & Cade, 2013; Lambert et al., 2017; Turner-Mcgrievy et al., 2013). Similar results were found in a study examining an app-based mood tracking intervention for bipolar disorder compared to paper-and-pencil mood monitoring (Depp et al., 2015). However, in a recent systematic review examining smartphone-based treatment for psychiatric diagnoses, only one of the 27 studies identified by the review compared a smartphone-based treatment to an equivalent intervention using paper treatment materials (Tønning, Kessing, Bardram, & Faurholt-Jepsen, 2019). Thus, there is a clear need for research that directly evaluates the impact of modality on factors known to influence treatment outcomes, such as treatment engagement and compliance.

Working alliance is also a mechanism of treatment effectiveness that is associated with treatment engagement (Holdsworth, Bowen, Brown, & Howat, 2014; A. O. Horvath, Del Re, Fluckiger, & Symonds, 2011) and treatment outcomes (Fluckiger, Del Re, Wampold, & Horvath,

2018). Despite this, few studies have examined the impact of smartphone use in treatment on working alliance. Evidence suggests that therapists have concerns that technology use in therapy could damage rapport (Becker & Jensen-Doss, 2013). Indeed, one study examining *therapists'* use of technology during treatment found that alliance and treatment retention were poorer when the therapist used a computer during an intake session (Rosen, Nakash, & Alegría, 2016); however, another study found no differences in therapeutic alliance when comparing therapist use of a tablet or computer versus pen and paper during an intake session (Wiarda, McMinn, Peterson, & Gregor, 2014). Importantly, the effect of technology use on therapeutic alliance may depend upon whether the therapist uses the technology versus the integration of technology into the treatment. Indeed, one study found that when internet-based resources were integrated into treatment as a supplement to therapy, this use of technology had a positive effect on alliance (Lopez, 2015). Thus, while there is some support for the hypothesis that technology use integrated in treatment may bolster alliance, there remains a gap in research testing this hypothesis in the context of smartphone-enhanced treatments.

The current study aimed to test the use of a smartphone app, compared to paper and pencil treatment materials, on substance use treatment engagement. This study was part of a larger randomized controlled trial testing the effectiveness of a smartphone-enhanced behavioral activation treatment for substance use (LETS ACT-SE) compared to standard LETS ACT. The primary aim of the current study was to test group differences in both overall engagement with treatment materials and use of materials in a manner compliant with treatment guidelines during and after treatment, up to a three-month follow-up. It was expected that the degree and frequency of engagement with treatment materials would decrease significantly in both conditions over time, but that this decrease would be greater in the standard treatment; additionally, engagement

with treatment materials was expected to be higher in LETS ACT-SE versus LETS ACT at each time point (post-treatment, one-month, and three-month follow up). A secondary aim was to compare the two conditions on four additional factors related to engagement in treatment: 1) treatment attendance, 2) in-session participation, 3) in-session comprehension, and 4) working alliance. It was expected that LETS ACT-SE would be associated with higher rates across all four outcomes. As a tertiary aim, this study further explores the feasibility and acceptability of the LETS ACT smartphone app by characterizing app component participant feedback, including participant ratings of engagement, usefulness and reasons for nonuse.

2. Methods

2.1. Study design

This was a single-site three-arm trial conducted at an intensive outpatient substance use treatment center in Raleigh, NC. All participants (N=218) received treatment as usual (TAU) and were randomized by group to receive LETS ACT (n=79), LETS ACT-SE (n=74), or assessments only (n=65). Research assessments occurred at pre- and post-treatment (PT) and at 1-, 3-, 6- and 12-month post-treatment follow-ups; the current study uses data from PT, 1-month (FU1), and 3-month (FU3) follow-ups. All study procedures received Institutional Review Board approval.

2.2. Sample and recruitment

Patients at the outpatient treatment facility were primarily low-income individuals with a range of SUD diagnoses who were enrolled in treatment voluntarily. Patients were recruited by the research team weekly at the treatment center, both through announcements at the end of the TAU treatment groups, and by study recruiters approaching individuals after these groups released. Interested individuals were assessed for eligibility, provided informed consent, and completed the pre-treatment assessment. Randomization occurred at the group level using a

computerized urn randomization program, and participants were blind to condition. Study exclusion criteria were: (1) aged over 65 or under 18, (2) < fifth grade English reading level (i.e., score less than 42 on the Wide Range Achievement Test; Jastak & Wilkinson, 1984), (3) current psychotic symptoms (measured by the MINI-K; Sheehan et al., 1998), (4) completion of > six weeks of TAU, and (5) the inability to give informed, voluntary, written consent to participate. Following treatment, participants had the option to complete follow-up assessments at the outpatient treatment facility or a public location with adequate privacy (e.g. public library).

2.3. Intervention

2.3.1. LETS ACT. LETS ACT (Daughters et al., 2016) is provided in small groups of six or fewer participants twice weekly over three weeks (six sessions total). Each session begins with a discussion of the treatment rationale, which involves describing the cycle of negative mood, urges, and maladaptive behaviors (e.g., substance use), and eliciting examples from participants of how this cycle is experienced. Participants learn that the goal of treatment is to break this cycle by engaging in healthy, rewarding behaviors. They are taught that when an individual becomes more active and is regularly engaging in activities that generate a sense of enjoyment and/or accomplishment, they are less likely to have urges to use substances or engage in other maladaptive behaviors in response to difficult emotions. Following the treatment rationale, participants engage in activity monitoring, which involves recording daily activities and rating them on enjoyment and importance in order to identify patterns of inactivation and opportunities to increase exposure to activities that provide pleasure and mastery.

Next, emphasis shifts to identifying value-based activities within a variety of life areas – a component of treatment called Life Areas, Values, and Activities (LAVA). LAVA involves identifying activities associated with specific Values and Life Areas. Participants are given a

worksheet with seven common Life Areas listed (Education and Work, Emotional Health, Hobbies and Recreation, Household, Physical Health, Relationships, and Spirituality), as well as the option to add new Life Areas. Participants are guided through the LAVA activity by first selecting a Life Area that is important to them (e.g., Physical Health), then identifying a Value they hold related to that Life Area by answering the question, "What is important to me within this Life Area?" (e.g., "It is important to me to increase energy and strength"). Participants are then led in generating specific and measurable activities that align with their Values, with an emphasis on balancing activities that are enjoyable and important ("In order to have energy and strength (Value), I will walk in the park for 30 minutes (activity)"). During earlier sessions, participants focus on tracking their daily activities and creating their LAVA lists. In later sessions, the focus shifts to planning and implementing these activities in a Daily Plan (Figure 1), problem-solving challenges to adherence, and post-treatment planning.

Participants are given homework assignments after each session, which include specific instructions for continued use of each component. For example, after the introduction of LAVA at session two, participants are asked to record at least one Value and activity for their chosen Life Areas. After the introduction of the Daily Plan at session three, participants are asked to plan and complete at least one activity per day for the remainder of treatment, which they record in their Daily Plan in conjunction with a relevant Life Area, a relevant Value, prospective enjoyment and importance ratings, and a specific day/date/time for completion. They are also asked to check off completed activities at the end of each day. During and between sessions, participants use paper treatment booklets (distributed at session one) and/or paper worksheets (distributed to individuals who lose or forget to bring booklets) to complete treatment activities and homework. Participants are encouraged to continue planning and completing activities (and

to continue using the paper booklet to do so) after the completion of treatment; however, they are not given any specific assignments to complete during the follow-up period.

2.3.2. Smartphone-Enhanced LETS ACT (LETS ACT-SE). The LETS ACT-SE condition involves the same components as the LETS ACT condition, except for the use of Apple iPhone 6 smartphones containing the LETS ACT app in place of paper booklets. Both LETS ACT groups use the same paper materials during the first session. At session two, LETS ACT-SE participants are given a brief introduction to the smartphones and LETS ACT app, as well as a packet of information about basic features of the phones and instructions for use (e.g., how to make a phone call). Participants who are absent at session two are given the phone and instructions at the next treatment session they attend. Similar to the booklet treatment protocol, participants are introduced to each treatment component on the app during treatment sessions, with a quick tutorial provided by the therapist, followed by opportunities for in-session practice. Paper materials are only used in session to introduce a treatment concept prior to practicing it on the smartphones, and any individuals who lose their smartphone or forget to bring it to treatment are provided the equivalent paper forms. Homework assignments are equivalent to those in LETS ACT, except that participants are asked to use the smartphone app to record their homework. Participants are informed that the smartphones are theirs to use until their FU3 appointment, at which time they return the phones to the research team. Phone plans are set up and paid for by the research study; the plans include unlimited calls and text messages, and four gigabytes of wireless data per month.

2.3.3. Treatment as Usual (TAU). All study participants were enrolled in a Substance Abuse Intensive Outpatient Program (SAIOP), in which treatment is based on the Matrix Model of Intensive Outpatient Treatment (Rawson et al., 1995). The program includes group therapy

(with average of eight to 10 patients per group) for three hours per day, three days per week, as well as weekly individual appointments with a case manager and up to two optional individual counseling sessions per week. Although group sessions do not have a set curriculum, they typically include a check-in during which clients rate themselves spiritually, physically, and emotionally, followed by psychoeducation (e.g., related to relapse prevention), and concluding with a time for group members to verbally process and share. Medication-assisted treatment and harm reduction interventions are also integrated in the curriculum. Urine drug testing is implemented throughout treatment, and any positive drug tests are discussed openly within the group therapy sessions. Continued use of substances (aside from nicotine) is grounds for dismissal from the program.

2.4. App design and components

The LETS ACT app was designed to mimic the paper treatment materials used in LETS ACT, with a number of added features to facilitate theory-driven treatment engagement. The key LETS ACT app components include: LAVA library; Plan Ahead/Daily Plan; Weekly Progress; and an Emergency button. Key features are accessible via icons on the home screen of the app (Figure 3). Additional features include a Help page and a data collection mechanism for mood and substance use tracking. Upon opening the app for the first time each day, the user is prompted to rate their current mood and report any substance use (with the exception of nicotine) since the last time they opened the app.

2.4.1. LAVA. The LAVA app feature (Figure 2a) guides the user through the three steps involved in selecting Value-based activities (described in Section 2.3.1.), reflecting the way the LAVA activity is taught during the treatment. This step-by-step process was designed to increase the likelihood that selected activities are Value-based. After selecting the LAVA icon,

the user is presented with a list of Life Areas and an option to add a new Life Area. By tapping on a Life Area, the user is prompted to add a new Value (Figure 2b). Once complete, the Value will be listed in orange underneath the associated Life Area on the LAVA screen, and the participant can add an activity by selecting the Value. Users are able to enter multiple Values within each Life Area, and multiple activities under each Value.

2.4.2. Plan Ahead and Daily Plan. Planning specific Value-based activities is central to the LETS ACT treatment, and the app includes two features that assist with this. The Plan Ahead feature, accessible by an icon at the bottom of the screen, allows the user to schedule Value-based activities for specific days and times. By tapping a plus sign, the user is brought to the list of Life Areas, where they can either select an activity previously entered in the LAVA feature, or go through the LAVA steps to enter a new activity (i.e., by first selecting a Life Area, then entering a Value and corresponding activity). Once an activity is selected, the user is prompted to rate the activity on Enjoyment (the degree to which they expect it will be pleasurable) and Importance (the degree to which it aligns with their goals). Lastly, the user can select a specific date and time to complete the activity, with an option to repeat the activity daily and/or weekly. By completing the entry, the activity is entered into the user's Daily Plan (Figure 3). The user can see any upcoming activities planned for a specific day (or select another date to see activities planned for that date) on the Plan Ahead screen (Figure 4).

The Daily Plan is the home screen of the app (Figure 3). On this screen, the days of the week are listed, and any activities planned for the coming week will appear underneath that day. This feature allows the user to easily see what activities they have planned for the coming week, and to mark activities as complete by selecting a checkbox that appears at the assigned time for completion. This checkbox remains by the activity from the time that it is scheduled until

midnight on the same day. At midnight, if the activity has not been marked as complete, it is recorded as incomplete and the activity is removed from the Plan Ahead and Daily Plan screens.

2.4.3. Weekly Progress. On the Daily Plan (home) screen, an option in the top right corner allows the user to view their weekly progress, or the percentage of planned activities that they completed in the previous week (Figure 5). An overall percentage is displayed at the top of this screen, as well as percentages for each day of the week underneath. Additionally, this screen displays feedback and suggestions based on the user's progress. In addition to the Weekly Progress page, the Daily Plan screen features a "Today Progress" bar which fills in with orange based on the percentage of completed activities for the current day (Figure 3).

2.4.4. Emergency button. The Emergency button appears as a red siren at the top left of the Daily Plan screen (Figure 3) and allows the user to create a list of "emergency activities," or healthy coping behaviors they can employ while experiencing difficult emotions and/or urges (e.g., urges to use substances). The emergency screen lists the user's emergency activities, which can be quickly added to the Daily Plan by selecting an activity title. Once selected, an activity is marked as being completed at that specific date and time on the Daily Plan screen.

2.4.5. Help. The Help icon (Figure 6) is displayed at the bottom of the app screen. It brings the user to a page with a list of frequently-asked questions and their answers, including information about the primary treatment components (e.g., "What is a Value?") and instructions for using the app features (e.g., "How can I schedule an activity into Plan Ahead?").

2.5. Measures and Outcome Variables

2.5.1. Covariates. Sociodemographic information (including age and education level) was assessed at all time points. These factors were included as covariates given their relationship to use of smartphones and health-related apps in previous research (Carroll et al., 2017; Garnett

et al., 2018; Schnall, Cho, & Webel, 2017; Zeng, Vilardaga, Heffner, Mull, & Bricker, 2015). Pre-treatment substance use and depressive symptoms have also been found to be associated with lower use of a health-related smartphone app (Zeng et al., 2015), so they were also included as covariates. Past-month substance use (i.e., number of days of use) was assessed at baseline using the Timeline Follow-Back (TLFB; Sobell, Maisto, Sobell, & Cooper, 1979). The TLFB uses a calendar format and semi-structured interview style to collect information about the type and amount of substance used during a specific time period, and has good test-retest reliability, convergent and discriminant validity, and agreement with urine assays (Hjorthoj, Hjorthoj, & Nordentoft, 2012). Depressive symptoms were assessed with the Beck Depression Inventory (BDI-II; Beck, Steer, Ball, & Ranieri, 1996). The BDI-II is a 21-item self-report scale used to assess the presence and severity of depressive symptoms. The BDI-II is a widely-used, empirically validated measure with high reliability (Yuan-Pang & Gorenstein, 2013).

2.5.2. Engagement with treatment materials. Variables related to engagement with treatment materials were derived from participants' actual app and treatment booklet usage. LETS ACT-SE participant app data was automatically uploaded to Google Analytics at 12:00am each day when study smartphones were connected to the internet (either via a wireless internet connection or wireless data), then manually downloaded by the research team daily. Data was collected from the date of phone distribution (at session two) until the date of phone collection (FU3). LETS ACT participant treatment booklets were photographed by the research team page-by-page at PT and FU1. Treatment booklets were also collected from all participants at FU3, and all entries from the booklets were entered into an excel spreadsheet by research assistants. To examine engagement, two categories of outcome variables were derived from app and booklet data: 1) Overall use of treatment materials (the quantity and frequency of app and booklet usage)

and 2) Valid use of treatment materials (quantity and frequency of app and booklet usage *in a manner compliant with treatment guidelines*). These variables are outlined in Table 1 and described in detail below.

2.5.2.1. Overall use of treatment materials. Three "degree of use" variables and two "frequency of use" variables represent engagement in the three activities *most* essential to the LETS ACT treatment, i.e., creating a LAVA library, planning activities, and completing activities. Overall use of LAVA components was assessed by calculating participant entries in the smartphone app and treatment booklets (see Section 2.1), representing the total quantity of entries from the time the materials were distributed to the time they were collected (at or after FU3). Overall use of LAVA components includes three variables: 1) the total number of Life Areas with at least one Value recorded, 2) the total number of Values recorded in the LAVA library, and 3) the total number of activities recorded in the LAVA library. Frequency of activity planning was defined as the number of days since the previous time point (Time 1 = Session 3 to PT; Time 2 = PT to FU1; Time 3 = FU1 to FU3) with at least one activity planned. Similarly, frequency of activity completion was defined as the number of days since the previous time point with at least one activity planned and marked as completed. For activities to be counted as "planned," the activities must have been recorded with a date in the Daily Plan.

2.5.2.2. Valid use of treatment materials. In addition to overall use of treatment materials, the current study examined use of treatment materials in a manner consistent with treatment guidelines (see section 2.3.1. for details regarding homework assignments). To assess whether entries in the smartphone app and booklets were valid (i.e., consistent with treatment guidelines), each entry was examined to determine whether the entry actually represented the basic treatment concept it was intended to represent. For example, a "valid" Value was an entry that could

reasonably be interpreted as the participant's judgment of what is important to them (and *not* an activity or Life Area). Similarly, a valid activity was an entry that represented a distinct action or task (and *not* a Value or Life Area). To illustrate, an entry under "Values" that read "keep body strong" was considered valid, while an entry that read "play basketball" was considered invalid because it represents an activity rather than a Value. Validity of entries (yes/no) was assessed by two independent raters, with disagreements resolved by a third reviewer. Entries determined to be invalid (i.e., validity rating = 0) were excluded in this analysis.

Similar to "overall use" variables, variables representing valid use of LAVA were summed, representing the total quantity of entries from the time the materials were distributed to the time they were collected. Three variables were used to quantify valid use of LAVA components: 1) the total number of Life Areas with at least one valid Value, 2) the total number of valid Values recorded, and 3) the total number of valid activities recorded. Valid "frequency of use" variables were quantified by calculating the total days since the previous time point (Time 1 = Session 3 to PT; Time 2 = PT to FU1; Time 3 = FU1 to FU3) with any valid activities recorded (or recorded and marked completed) in the Daily Plan. Valid activity planning was defined as the number of days since the previous time point with at least one valid activity planned with: 1) a date and time *and* 2) a valid Value. Valid activity completion was defined as the number of days since the previous time point with at least one valid activity planned with: 1) a date and time, *and* 2) a valid Value, *and* 3) a completion mark. As a note, to be fully compliant with homework assignments during treatment, participants should have planned and completed at least one activity per day (i.e., 100 percent of days with at least one activity planned and completed) from session three (when Plan Ahead homework is first assigned) to PT; the current analysis examined valid activity planning and completion from session three to FU3.

2.5.3. Treatment attendance, participation, and comprehension. A questionnaire completed by study therapists after each treatment session was used to record participant attendance at the session (i.e., present/absent) as well as to assess each participant's level of participation and comprehension during the session, as rated by the therapist. Participation was rated on a scale of 1 to 5, with 1 indicating the participant did not participate at any point in the session, and 5 indicating that the individual participated and was engaged throughout the session. Similarly, comprehension was rated on a scale of 1 to 5, with a score of 1 indicating that the participant did not demonstrate understanding of *any* of the session content, and a score of 5 indicating the participant demonstrated an understanding of the *entire* session content.

2.5.4. Working alliance. The Working Alliance Inventory (WAI; Adam O. Horvath & Greenberg, 1989; Martin, Garske, & Davis, 2000), which assesses the quality of the therapeutic alliance, was administered at PT. The WAI is a 12-item self-report measure with three subscales: Goals (the frequency with which a client and therapist agree on the outcomes of the intervention), Tasks (frequency with which a client and therapist agree on the specific activities/tasks that make up the therapy), and Bond (extent to which a client and therapist possess mutual trust, acceptance and confidence). Items are rated on a scale of 1 (seldom) to 5 (always), with higher scores indicating stronger working alliance. The WAI demonstrates good test-retest reliability (Hanson, Curry, & Bandalos, 2002).

2.5.5. Treatment component usefulness and reasons for not using. A questionnaire administered at PT assessed participant feedback about the treatment and its individual components. For each treatment component, participants rated the degree to which they agreed that the component was a useful part of treatment on a scale of 1 (strongly disagree) to 5 (strongly agree). The measure also included questions which assessed potential reasons for *not*

utilizing each component. Participants could choose any applicable reasons from a list (e.g., did not remember to use the feature, did not think it would be helpful, difficult to understand how to use it), record their own reason under "other," or indicate that the question did not apply to them because they did use that component. An additional question inquired as to any reasons participants did not use the app at least three times per week. Similarly, participants could select from a list of reasons, select "other," or indicate that it did not apply because they did use the app at least three times per week.

2.5.6. Self-reported use of app components. A questionnaire administered at PT assessed participant self-reported app engagement during the past week. For each treatment component, participants indicated the number of days in the past week that they practiced or utilized that component outside of treatment. At follow-up assessments (i.e, FU1 and FU3), participants were given a similar questionnaire that assessed engagement with the app components during the past month. This included the average number of days per week that the participant used each component of the LETS ACT app, as well as details about their use (e.g., the number of activities scheduled and completed, and the number of days per week with at least one activity scheduled; see Table 1).

2.6. Statistical Analyses

Data were analyzed using SPSS version 25.0 and SAS version 9.4. First, descriptive statistics were calculated for all variables used in subsequent statistical analyses. This included means, standard deviations, and range for continuous variables, and percentages for all categorical variables. Covariates for each analysis were selected a priori based on theory as well as previous literature on treatment engagement (see Section 2.5.1.). In line with best-practice recommendations for a priori model building (Raab, Day, & Sales, 2000), covariates were

included in each analysis regardless of their associations with dependent variables or significance as predictors in each model.

2.6.1. Aim 1 Analysis.

2.6.1.1. Aim 1a (LAVA). Hierarchical linear regression analyses were used to compare use of treatment materials (i.e., overall use of LAVA components *and* valid use of LAVA components; see Table 1) in LETS ACT versus LETS ACT-SE. To test the hypothesis that LETS ACT-SE would be associated with greater use of treatment materials compared to standard LETS ACT, a separate analysis with condition as the independent variable was conducted for each dependent variable. Covariates including participant age, years of education, substance use, and depressive symptoms were included in each respective analysis. The analytic approach for LAVA variables examined all homework completed up until booklets were returned (at or after FU3) because LAVA entries in treatment booklets were undated, and a minority (7%) of participants in the booklet condition returned their booklets at all three time points, which precluded an analysis of LAVA entries over time.

2.6.1.2. Aim 1b (Activity planning and completion). Generalized Estimating Equations were used to compare change and mean days of activity planning and completion (i.e., overall activity planning/completion *and* compliant activity planning/completion; see Table 1) in LETS ACT versus LETS ACT-SE from PT to FU3. GEE was chosen due to the nested nature of the data (i.e., time nested in person) and its suitability to non-normal data distributions, including "count" data, which often includes numerous 0s.

For the activity planning and completion analyses, GEE models estimated the effect of condition on the probability of homework completion, with the primary outcomes (i.e., events variables) defined as the number of days the participant planned or completed any activities

during each time period. A variable representing the total days within each time period was included as the trials variable, since the number of days between assessment points varied across participants. A binomial probability distribution was selected, and participant was included as a random effect. Covariates included as fixed effects were age, years of education, number of days of substance use in the past 30 days, and BDI total score, all of which were assessed at baseline. To test the hypothesis that activity planning and completion would decrease significantly in both conditions over time, time was also included as a fixed effect (coded as an ordinal variable, with Time 1 = Session 3 to PT, Time 2 = PT to FU1, and Time 3 = FU1 to FU3), and a treatment condition by time interaction term was added to test if change over time differs by treatment. Odds ratios and estimated marginal means were included in the parameter estimates.

2.6.2. Aim 2 Analysis.

Generalized Estimating Equations (GEE) were also used to test the hypotheses that LETS ACT-SE would be associated with higher rates of attendance, participation, comprehension, and working alliance compared to standard LETS ACT. This approach was selected for three primary reasons. First, each of these analyses involved clustered data; specifically, participants were clustered within a group in the attendance analysis, and observations were clustered within a participant in analyses of participation, comprehension, and working alliance (in the case of working alliance, each item on the WAI was treated as an "observation"). However, the effects of clustering were not relevant to the research question, and thus clustering was viewed as a nuisance. Because GEE does not specifically include a cluster effect in the model (it instead separately models the mean across clusters and the within-cluster association), it essentially treats clustering as a nuisance that needs to be accounted for rather than an effect of interest (McGahan, 2017). Second, GEE is well suited to handle non-normal data, including binomial

and ordinal data. Third, GEE is an optimal analysis method with large numbers of clusters (e.g., over 40), and with many clusters of a small size (Teerenstra, Lu, Preisser, van Achterberg, & Borm, 2010), making it well suited to the structure of the current data. Specifically, in the attendance analysis, there were 44 groups with up to 6 participants per group; in the participation and comprehension analyses, there were 105 subjects with up to 5 observations (i.e., ratings from each attended session) per subject; and in the working alliance analysis, there were 92 subjects with 12 observations (i.e., items on the WAI) per subject. Additional model specifications for each of these analyses are described below.

For the attendance analysis, a GEE model estimated the effect of condition on the probability of attendance, with the primary outcome (i.e., events variable) defined as the number of sessions attended after Session 2. This outcome variable was chosen because smartphones were distributed at Session 2 in the LETS ACT-SE condition, and thus any differences in attendance attributable to the effect of condition were expected to emerge after this point. A variable representing the total sessions offered to each participant's group after Session 2 was included as the trials variable, since some groups were offered the full 6 sessions and others were only offered a total of 5 sessions (e.g., due to holidays or weather closures). A binomial probability distribution was selected, and Group was included as a random effect. Covariates included as fixed effects were age, years of education, number of days of substance use in the past 30 days, and BDI total score, all of which were assessed at baseline.

For the participation and comprehension analyses, GEE models estimated the effect of condition on in-session participation and comprehension, which was rated by the therapist for each participant after every session attended. The outcome variables for participation and comprehension included ratings for every session after the first (i.e., sessions two through six),

since smartphones were distributed at session two. Subject ID was included as a random effect to account for the clustering of observations within participants. A multinomial (ordinal) probability distribution was selected, with a cumulative logit link function. Covariates included as fixed effects were age (mean-centered), years of education, number of days of substance use in the past 30 days, BDI total score, therapist, and an age by condition interaction.

For the analysis of working alliance, GEE models estimated the effect of condition on WAI scores, which were assessed at PT. Subject ID was included as a random effect to account for the clustering of observations (in this case, items on the WAI) within participants, and WAI item number was included as a random effect to allow for variance in the means across items. A multinomial (ordinal) probability distribution was selected, with a cumulative logit link function. Covariates included as fixed effects were age, years of education, number of days of substance use in the past 30 days, BDI total score, and therapist. In this analysis, because the outcome (WAI) was assessed at only one time point, a separate variable was created for each therapist representing the proportion of total sessions provided to the participant by that therapist; eight of these therapist variables were included in the model, with the ninth used as the reference category. Only participants who had received treatment materials (i.e., those who attended at least one session after the first) were included in the analysis.

Across GEE models, odds ratios were calculated in SPSS. Marginal means were also estimated in SPSS for the binomial models. For all ordinal logistic models (i.e., participation, comprehension, and working alliance), estimated marginal means were calculated in SAS version 9.4 and are presented to aid in interpretation of the results. First, the modeled probabilities for each response category were obtained for each of the treatment conditions for a subject at average age, education, substance use, and depression. The response categories were

quantified 1 to 5, and marginal means were obtained by summing the product of the modeled probabilities of the quantified response category variables.

2.6.3. Aim 3 Analysis.

To further explore the feasibility and acceptability of the LETS ACT app, summary statistics (e.g., mean, median, standard deviation) were calculated to characterize participant ratings regarding the usefulness of each app component, as well as self-reported engagement with each component (i.e., past-week use of app components at PT and average weekly use of app components in the past month at FU1 and FU3). Paired-sample t-tests were used to examine differences in the mean ratings for app usefulness across components. Reasons for not using each app component, as well as reasons for low weekly use of the app, were also summarized.

2.6.4. Power analysis.

2.6.4.1. Hierarchical Linear Regression. Post hoc power for the hierarchical linear regression analyses was calculated using G*Power, Version 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) with desired power=0.8 and an alpha of 0.05. With five predictors in a fixed model calculating R^2 increase, and with the total sample size of N=67 used in Aim1a analyses (LETS ACT=32, LETS ACT-SE=35), the multiple regression analyses were adequately powered (power $\geqslant$0.80) at a threshold of $p<0.05$ to detect significance with a small-to-medium effect size of f^2=0.12. Very little previous research has examined between-group differences in treatment engagement variables (e.g., homework compliance, attendance, participation, or alliance) between equivalent treatment groups using paper materials versus smartphone apps; however, the few previous studies that have examined differences in technology-enhanced versus standard interventions found effect sizes in the small-to-medium to large range, from *d*=0.41 to *d*=1.15 (Carter et al., 2013; Jones, 2014; Turner-Mcgrievy et al., 2013).

2.6.4.2. GEE models. Power for the GEE analyses was estimated using simulations run in SAS version 9.4. To estimate power, obtained parameter values from the model examining participation were entered in the simulation. The magnitude of the condition effects was modified to the point where the estimated power by the simulation was 80%. With those condition effects and all other parameter values equal to the observed model effects, the expected marginal mean values were obtained for a neutral subject in each condition (i.e., a subject with average values on all variables except condition). With the sample size of N=105 used in the participation analysis, the simulation suggested that the ordinal logistic models would be adequately powered (>.80) to determine significance with a marginal mean difference of approximately 0.27. Since the minimum clinically meaningful effect would be a difference of one point on the five-point scales for participation, comprehension, and working alliance, a mean difference of this size was considered a relatively small effect.

3. Results

3.1. Sample characteristics

Of 112 participants who received treatment materials (booklet: *n*=56; smartphone: *n*=56), 41 (36.6%) were female. Most participants identified as White/Caucasian (55.4%) or Black/African American (34.8%). Average age was 41.54± 11.26 (range: 20-65), and participants had an average of 12.6± 2.53 years of education (range: 1-21). In terms of substance use, participants reported an average of 3.3± 6.42 days of substance use in the past 30 days at baseline (range: 0-30). The most common DSM-5 substance use disorders included Alcohol Use Disorder (67.9%), Cocaine Use Disorder (58.0%), Opioid Use Disorder (43.8%), and Cannabis Use Disorder (40.2%). On average, participants reported mild symptoms of depression with a mean BDI score of 13.02 (range: 0-51).

3.2. Aim 1.

3.2.1. Missing data. Missing data were observed in both treatment conditions (Figure 7). In the booklet condition, missing data were due to withdrawal prior to PT (n=3), failure to bring the booklet to *any* assessment (n=19), and failure to return the hardcopy booklet at or after FU3 (n=10). In the smartphone condition, among participants with no app data retrieved, missing data were due to programming/server issues (n=9), phones reported lost or stolen (n=4), incarceration (n=1), and unknown causes (n=9). Among participants believed to have incomplete app data, missing data were due to app programming issues during the first year of data collection (n=8), voluntary or executive withdrawal (n=3), smartphones reported lost or stolen during the follow-up period (n=6), and technical issues with smartphones that may have interfered with homework completion (n=2).

3.2.2. Overview of homework completion. In total, homework data were retrieved from 67 of 112 participants (59.8%). Of 56 participants who were provided with a smartphone, homework data were available from 35 participants. This included 32 participants with LAVA entries (i.e., Values and/or activities), and 28 participants with at least one planned activity. Of 56 total participants who were given a booklet, homework data were available from 32 participants. This included 28 participants with LAVA entries, and 30 participants with at least one planned activity. A summary of homework completion across conditions is provided in Table 2.

3.2.3. Aim 1a Results. Results from the model examining between-group differences in overall use of the LAVA library are reported in Table 3. For each hierarchical linear regression model, covariates including age, years of education, symptoms of depression (BDI-II) and pretreatment substance use (number of days used in the past 30 days) were entered in Step 1, and

Condition was entered in Step 2. In the model examining the number of Life Areas with at least one Value recorded, the addition of condition did not result in a significant increase in the variance explained by the model (ΔR^2 =.000, p=.891), and the final model did not significantly predict the outcome (F(5,61)=.333, p=.891). Condition was not a significant predictor of LAVA use, controlling for covariates (b=-.086, p=.891). In the model examining the total number of Values recorded in LAVA, there was also no significant increase in the variance explained by the model after the addition of condition (ΔR^2 =.030, p=.155); condition was not a significant predictor of Values recorded, controlling for covariates (p=.155), and the final model did not significantly predict the outcome (F(5,61)=1.740, p=.139). Similarly, in the model examining the total number of activities recorded in LAVA, there was no significant increase in the variance explained by the model after the addition of condition (ΔR^2 =.006, p=.546), and condition was not a significant predictor of activities recorded (p=.546), nor was the overall model significant (F(5,61)=1.047, p=.399).

Each regression analysis was run again after restricting the outcome variables to only valid entries in LAVA (see Table 1 for specific definitions). In the model examining the number of Life Areas with at least one valid Value recorded, increase in the variance explained by the model after adding condition was still not significant (ΔR^2 =.002, p=.717), and condition not a significant predictor of LAVA use, controlling for covariates (b=-.221, p=.717). Restricting the outcome to only valid Values recorded in LAVA also did not change the direction or significance of the results. There was still not a significant increase in the variance explained by the model after the addition of condition (ΔR^2 =.024, p=.201), and condition was not a significant predictor of valid Values recorded (p=.201). Similarly, restricting the outcome to only valid activities recorded in LAVA did not change the direction or significance of the results. The

increase in the variance explained by the model after the addition of condition was not significant (ΔR^2 =.016, p=.317), and condition was not a significant predictor of activities recorded (p=.317).

3.2.4. Aim 1b Results.

3.2.4.1. Activity Planning. In terms of total model effects, the average effect of treatment condition was not a significant predictor of overall activity planning (p=.192). Overall, the estimated marginal mean activity planning for LETS ACT was 0.25 (*SE* = .060, 95% CI .15 - .39), while the estimated marginal mean for LETS ACT-SE was 0.15 (*SE* = .049, 95% CI .07 - .27). This indicates that participants in the booklet condition had a 25% probability of planning an activity on any one day, while participants in the smartphone condition had a 15% probability of planning an activity. The condition by time interaction was also not significant (p=.125). The effect of time, however, was significant, such that participants were significantly less likely to plan activities over time (p<.001). Pairwise comparisons indicated that there was a significant decrease in activity planning between PT and FU1 (p<.001) as well as between FU1 and FU3 (p<.001). Additionally, pairwise comparisons showed a significant difference between conditions at PT (p=.004), such that the booklet condition had significantly more activity planning during treatment than the smartphone condition, while the condition differences at subsequent time points were not significant (FU1 p=.401; FU3 p=.953). Parameter estimates from the GEE analyses examining overall activity planning and completion are reported in Table 4.

Restricting the outcome to include only valid activity planning did not change the direction of the results. The average effect of treatment condition was still not significant in the model (p=.693), nor was the condition by time interaction (p=.387). Overall, the estimated marginal mean valid activity planning was 0.16 for LETS ACT (*SE* = .046, 95% CI .08 - .27)

compared to 0.13 for LETS ACT-SE (*SE* = .044, 95% CI .07 - .24). Pairwise comparisons still showed a significant decrease in activity planning between PT and FU1 ($p<.001$) as well as between FU1 and FU3 ($p<.001$). However, the difference between conditions at PT was no longer significant ($p=.096$). Estimated marginal means for both overall and valid activity planning by condition and time point are provided in Table 5.

3.2.4.2. Activity Completion. The average effect of treatment condition was a significant predictor of overall activity completion ($p=.03$), such that the booklet condition more frequently completed activities compared to the smartphone condition. Overall, the estimated marginal mean activity completion for LETS ACT was 0.19 (*SE* = .048, 95% CI .12 - .30), while the estimated marginal mean for LETS ACT-SE was 0.04 (*SE* = .028, 95% CI .01 - .15). This indicates that participants in the booklet condition had a 19% probability of completing an activity on any one day, while participants in the smartphone condition had a 4% probability of completing an activity. The condition by time interaction was not significant ($p=.447$). The effect of time was significant, however, such that participants were significantly less likely to plan activities over time ($p<.001$). Pairwise comparisons indicated that there was a significant decrease in activity planning between PT and FU1 ($p=.001$) but not between FU1 and FU3 ($p=.097$). Again, pairwise comparisons showed a significant difference between conditions at PT ($p=.004$), such that the booklet condition had significantly more activity planning during treatment than the smartphone condition, while the condition differences at subsequent time points were not significant (FU1 $p=.117$; FU3 $p=.162$).

Restricting the outcome to include only valid activity completion changed the significance but not the direction of the results. The average effect of treatment condition was no longer significant in the model ($p=.104$), nor was the condition by time interaction ($p=.855$).

Overall, the estimated marginal mean valid activity completion was 0.13 for LETS ACT (*SE* = .034, 95% CI .07 - .21) compared to 0.04 for LETS ACT-SE (*SE* = .027, 95% CI .01 - .14). Pairwise comparisons still showed a significant decrease in activity planning between PT and FU1 (p=.003) as well as between FU1 and FU3 (p=.01). Additionally, the difference between conditions at PT was still significant (p=.007), such that participants in the booklet condition had a significantly higher proportion of days with completed activities during treatment. Estimated marginal means for both overall and valid activity completion in each condition at each time point are provided in Table 5.

3.3. Aim 2.

3.3.1. Missing data. Missing data were observed in the Therapist Questionnaire (including ratings of participation and comprehension), as well as in participant self-report data (including the WAI); there were no missing attendance data. In the Therapist Questionnaire, participation and comprehension ratings were missing for 12 participants at 1 session each due to therapist data entry errors. Regarding participant self-report data, the WAI was missing for 15 participants due to missed assessments (n=6), survey programming errors (n=5), participant refusal (n=2), and dropout (n=2).

3.3.2. Overview of factors related to treatment engagement. Across conditions, participants attended, on average, 63.77% of the treatment sessions offered after session two (mean=2.44±1.52 sessions; range=0-4). The average rating for in-session participation across sessions two through six was 4.31±0.85 out of 5, reflecting participation throughout the session, while the average for in-session comprehension was 4.15±0.85 out of 5, indicating participants demonstrated an understanding of the majority of content covered during the session. Participants who attended at least one of sessions two through six had an average working

alliance (WAI) score of 48.13±9.57 (range=13-60); this corresponds to an average of 4 out of 5 across the 12 WAI items, or a response of "very often" to positively-worded questions about the client's working alliance with their therapist.

3.3.3. Attendance. Results from the GEE analysis examining treatment attendance are reported in Table 6. Treatment condition was not a significant predictor of attendance. Notably, however, the estimated marginal mean attendance for LETS ACT was 0.72 (*SE* = .060, 95% CI .59 - .83), while the estimated marginal mean for LETS ACT-SE was 0.59 (*SE* = .058, 95% CI .47 - .70). This indicates that participants in the booklet condition had a 72% probability of attending any one treatment session after Session 2, while participants in the smartphone condition had a 59% probability of attending any one treatment session after Session 2 (mean difference=13%). Depression scores were the only significant predictor of treatment attendance in the model, such that higher BDI Total Scores were associated with an increased probability of attendance at any individual session after Session 2.

3.3.4. Participation and Comprehension. Results from the GEE analyses examining in-session participation and comprehension are reported in Table 6. Treatment condition was not a significant predictor of either participation *or* comprehension. The estimated marginal mean participation score for LETS ACT was 4.42, while the estimated marginal mean for LETS ACT-SE was 4.32 (mean difference=0.10). The estimated marginal mean comprehension scores for LETS ACT and LETS ACT-SE were 4.24 and 4.11, respectively (mean difference=0.13). Age was a significant predictor of comprehension (but not participation), such that older age was associated with lower comprehension ratings in sessions two through six; however, the age by condition interaction was not significant. Depression was also a significant predictor of

comprehension (but not participation), such that higher BDI scores were associated with higher comprehension ratings.

3.3.5. Working Alliance. Results from the GEE analysis examining working alliance are reported in Table 6. Treatment condition was not a significant predictor of working alliance. The estimated marginal mean working alliance score for LETS ACT was 4.07, while the estimated marginal mean score for LETS ACT-SE was 4.24 (mean difference=0.17).

3.4. Aim 3.

3.4.1. Self-reported app engagement. Of the 54 participants who received a smartphone and for whom self-report data were obtained, 39 (72%) reported any app use at PT, 37 (69%) reported any app use at FU1, and 20 (37%) reported any app use at FU3. Considering only those participants who reported app use at each time point, 21 (54%) reported using the app at least 3 times per week at PT. Of those who used the app fewer than 3 times per week, common reasons included forgetting (27%) and that it was difficult to use (10%). Participants with any app use at PT reported using the LAVA Library, Plan Ahead, and Weekly Progress features an average of 4.18 (SD=2.19), 4.26 (SD=2.19), and 3.92 (SD=2.37) days per week, respectively; by the 3-month follow-up (FU3), participants reported using these features 3.31 (SD=2.57), 3.89 (SD=2.68) and 3.31 (SD=2.73) days per week on average (Figure 8). The Emergency button was used 1.05 (SD=1.88) and 0.81 (SD=1.80) days per week at PT and FU3, respectively, and the Help page was used 1.44 (SD=1.98) and 0.94 (SD=1.98) days per week at PT and FU3, respectively.

3.4.2. App component usefulness. For each app component, participants rated their agreement with the statement that the app component was “a useful part of treatment” on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree). Average ratings across all app components

indicated that participants generally agreed that each component was useful (LAVA Library Mean=4.39, SD=0.72; Plan Ahead Mean=4.33, SD=0.63; Emergency Button Mean=3.97, SD=1.00; Weekly Progress Mean=4.22, SD=0.89; Help Icon Mean=3.94, SD=0.87). Paired t-tests comparing usefulness ratings between components indicated that ratings for the LAVA Library were significantly higher on average than the Emergency Button ($t(40)=2.56$, SE=0.13, p=.01) and Help Page ($t(40)=3.59$, SE=0.87, p=.001), and ratings for the Plan Ahead feature were significantly higher than the Help Page ($t(39)=2.69$, SE=0.76, p=.01).

3.4.3. Reasons for not using app components. For all components, forgetting and not having the smartphone when the participant needed to use the feature were among the most frequently endorsed reasons for lack of utilization. However, for the Help page, the most frequently endorsed reason was lack of need for the feature (n=19), while forgetting and not having the smartphone were the second-most endorsed reasons (n=3 each). Table 7 shows the distribution of reasons endorsed by participants for not scheduling activities.

4. Discussion

4.1. Use of treatment materials

The current study tested group differences in engagement with treatment materials between a smartphone-enhanced behavioral activation treatment for substance use and the standard treatment using paper homework booklets. During and after treatment, participants created a library of value-based activities; comparisons of participant use of this library indicated that condition was not a significant predictor of overall or valid use of the library. The key component of the behavioral activation homework involved planning and completing these value-based activities both during and after treatment. As hypothesized, the frequency of engagement with treatment materials for planning and completing activities decreased

significantly in both conditions over time. However, contrary to expectations, this decrease was not greater in the standard treatment. Instead, both activity planning and completion were found to be higher in the booklet versus the smartphone condition at post-treatment; the differences by the one-month and three-month follow ups were in the same direction but no longer significant.

Restricting analyses to consider only "valid" entries in the app or booklet (i.e., those rated as compliant with treatment guidelines) did not alter the direction of the results; however, the condition differences at PT for activity planning were no longer significant, nor was the average effect of condition on activity completion. One hypothesized benefit of smartphone apps for homework completion is an increase in the likelihood that participants complete homework outside of treatment in a manner that is consistent with treatment guidelines. In previous studies of LETS ACT using paper treatment booklets, some participants were observed filling in their daily activities without identifying related Life Areas and Values despite the booklet having spaces to record Life Areas, Values, and activities. The LETS ACT app was designed to guide the user through the LAVA activity by requiring the entry of a Value before adding a new (value-based) activity. The current analysis suggests that even when considering only "valid" entries which comply with these treatment guidelines, booklet participants were still just as likely to plan and complete activities as those in the smartphone group, and indeed they had a higher probability of marking their activities completed during treatment. Thus, the app features aiming to increase compliance with treatment guidelines were not effective at offsetting the overall greater levels of engagement demonstrated by those who used treatment booklets.

Together, results from these analyses suggest the hypothesized benefits of smartphone technology for increasing homework compliance (specifically, use of treatment materials for completing homework) were not realized in the current study. Significant differences between

conditions were only observed during treatment (up until PT). Given that some time during treatment sessions was spent planning activities, lower activity planning at PT may reflect the logistical challenges for therapists in orienting smartphone groups to the app and troubleshooting app-related questions; use of time during sessions for these purposes may have detracted from time spent planning activities. Additionally, the programming of the app required participants to mark activities completed on the same day they were planned; it is possible that participants in the booklet group were more likely to mark their activities completed because they had more time to do so. Additional study-specific factors which could have affected engagement with the treatment app are discussed in section 4.4., below.

4.2. Other indicators of treatment engagement

In addition to engagement with the treatment materials, condition differences were examined in four other indicators of treatment engagement, including treatment attendance, in-session participation and comprehension ratings, and working alliance. Analyses for each of these outcomes failed to find evidence of a significant effect of condition, despite having sufficient power to detect even a relatively small effect (e.g., one-quarter of a point on a 5-point scale). Indeed, marginal mean differences were less than one-fifth of a point on the 5-point scales for participation, comprehension, and working alliance, demonstrating an effect that is clinically insignificant. Accordingly, there was no support for the hypothesis that smartphone-enhanced treatment would be associated with greater engagement across these indicators, but there was also no evidence that integrating smartphones into treatment had a negative impact on participants' in-session engagement or sense of alliance with their therapist (regardless of participant age). This may be relevant for practitioners who are concerned about the possible

drawbacks of introducing technology into psychotherapy sessions (Becker & Jensen-Doss, 2013).

4.2. Self-reported app use

With regards to self-reported app use, the majority of participants reported continuing to use their LETS ACT app until one month post treatment, but this proportion decreased to 37% by three months post-treatment. While equivalent data on booklet use were not available, a previous analysis using the same sample found that participants' *self-reported* homework completion (i.e., activity planning) also decreased significantly in both app and booklet conditions from post treatment to the 3-month follow up (Paquette et al., 2019). Research suggests that it is typical for mobile app usage to drop off quickly. Indeed, recent data indicates that approximately 21% of app users use an app only once; user retention, on average, is 40% after one month and 26% after three months (Rodde, Cronin, & Noone, 2018). It appears, then, that the LETS ACT app follows a similar rate of decline in use to apps more broadly, though the mean retention was somewhat greater (which may be expected given the integration of the app into treatment, as opposed to a standalone app).

Regarding specific app components, participants generally agreed that each app component was a useful part of their treatment. The LAVA Library and Plan Ahead feature, which were both essential to the core homework of activity planning, were the most used components and were also rated as more useful compared to features such as the Emergency Button and Help Page. When participants did not use their apps or the individual app components, they generally reported this was due to either forgetting or to not having the smartphone with them. Both reasons for nonuse may reflect drawbacks of giving participants a study smartphone rather than downloading the app on participants' own phones. Forgetting to

use the app also suggests further opportunity for integration of features such as built-in reminders and messages; indeed, previous data suggest that such features (e.g., in-app messaging) are associated with up to 3.5 times higher user retention (Hoch, 2015). Participants not having their smartphones with them may also reflect challenges inherent to maintaining treatment engagement among low-income people with substance use disorders, many of whom experience significant instability in their daily lives. Some participants were incarcerated or hospitalized during the follow-up period, others had smartphones that were lost or stolen, and still others reported that they were nervous about losing their smartphones and chose to store them in a safe place, making them inconvenient to use regularly.

4.4. Challenges with Smartphone Technology

One critical decision in smartphone-enhanced intervention research is whether to provide smartphones for each participant to ensure consistent phone access or to offer an app that participants can download on their own phones in order to prioritize utility, ease of use, and generalizability. Research suggests that low-income people who use drugs have high rates of smartphone ownership, but that they tend to cycle through smartphones and have inconsistent access to wireless data (Tofighi et al., 2019), which presents a challenge for assessing the effectiveness of a smartphone-enhanced intervention. The current study opted to provide smartphones to participants, but found that participants often forgot to use them, which may be in part because they were not using the study phone as their primary phone. Giving participants the option to *either* download the app on their own phone *or* use a study smartphone may ultimately be ideal, although it requires significant resources (i.e., developing app versions for both android and iOS smartphones). Additionally, the current study suggests that it may be beneficial to build in time outside of treatment sessions to orient participants to the treatment app

(especially if they are also using a new phone and operating system), so that time in sessions can be focused on the the core components of treatment, e.g., activity planning.

In addition to challenges with smartphones at the participant level, the current study also encountered problems with the technology that resulted in missing data, including smartphones that stopped working and data lost due to failure to automatically upload, as well as lost by a cloud storage system. In part, this reflected the challenges of creating and debugging a new smartphone app; programming and piloting the app were complex, and programming changes had to be made during the first year of data collection, which resulted in some lost and unusable data, as well as data inconsistencies between first and second app iterations. It was sometimes difficult to identify the causes or extent of missing data; there were nine participants who received a smartphone, but for unknown reasons their data were never retrieved from the cloud storage system. Study staff identified one participant who turned their phone off every night, such that the phone never uploaded data to the server because this automatic process happened only at midnight each night; in this particular case the participant was asked to keep their phone on overnight, and the data were retrieved; however, this may also have been a cause of lost data among earlier participants before the problem was identified. Furthermore, it is possible that different causes of missing data between the two treatment conditions may have impacted the current study's results; for example, those in the booklet condition who completed their homework may have been most likely to turn in their booklets at assessments. In contrast, reasons for missing data in the smartphone group may have been less related to app use and more to technical issues (e.g., problems with automatic uploading). While the proportions of participants with missing data were similar between conditions, it is unknown to what extent the reasons for missing data differed.

The current study's results must be interpreted in the context of its limitations. The study sample was recruited from an intensive outpatient treatment center serving a primarily low-income, high-school-educated clientele, and participation in the current intervention was offered in addition to standard treatment; the results may not be generalizable to other populations or treatment settings. Due to missing app and booklet data, analyses of homework completion utilized a subsample (approximately 60%) of all participants who received treatment materials. However, condition differences were generally in the same direction across outcome variables (including participant attendance, participation, and comprehension, which utilized a greater proportion of the treatment sample), lending confidence to the findings. Indeed, the comprehensive examination of multiple indicators of treatment engagement is one of the study's strengths.

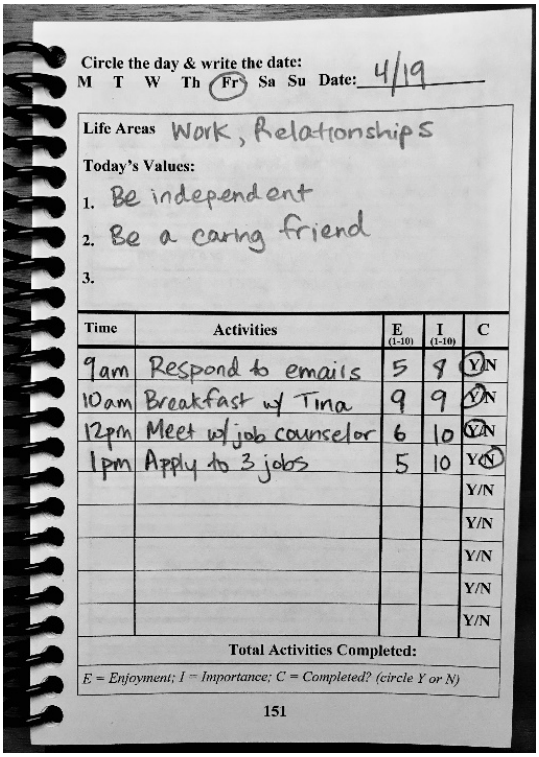
4.5. Conclusions

There is a clear need for evidence-based SUD treatments that can be delivered at low cost, and it is essential to find new and effective ways to engage participants in these treatments. Despite notable growth in the area of app-based psychological interventions, very little research has examined the impact of introducing smartphones into in-person therapy, and few studies have directly compared smartphone-based versus equivalent paper-based treatments. The current study did not find evidence that smartphones change the way participants engage during sessions or their perceived bond with the therapist, but did find that the modality may impact the likelihood of completing homework. These findings must be interpreted in light of the specific study methods (e.g., the provision of study smartphones to all participants); future research should examine potential differences when allowing participants to download treatment apps on their own smartphones. Studies are also needed which examine specific treatment contexts and

participant characteristics that may be associated with receiving more benefit from app-based versus paper-based materials.

FIGURES

Figure 1. Treatment Booklet Daily Plan



Circle the day & write the date:
M T W Th (Fr) Sa Su Date: 4/19

Life Areas Work, Relationships

Today's Values:
1. Be independent
2. Be a caring friend
3.

Time	Activities	E (1-10)	I (1-10)	C
9am	Respond to emails	5	8	(Y)N
10am	Breakfast w/ Tina	9	9	(Y)N
12pm	Meet w/ job counselor	6	10	(Y)N
1pm	Apply to 3 jobs	5	10	Y(N)
				Y/N
				Y/N
				Y/N
				Y/N
				Y/N

Total Activities Completed:

E = Enjoyment; I = Importance; C = Completed? (circle Y or N)

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Figure 2a. LAVA

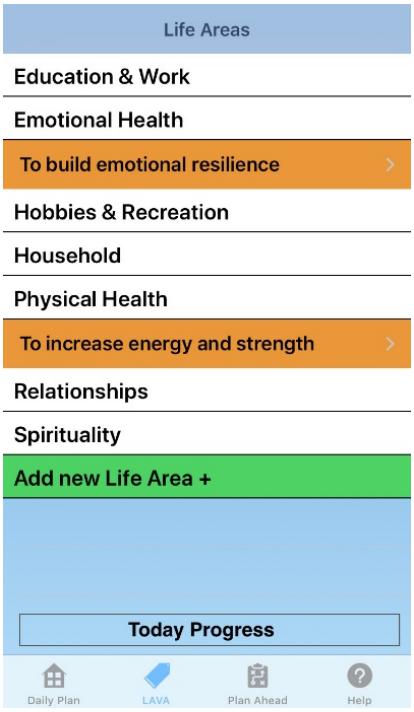


Figure 2b. Activity Prompt in LAVA

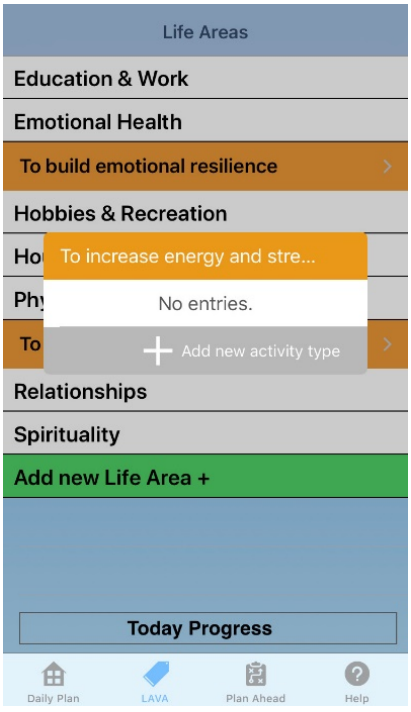


Figure 3. Daily Plan with completed activity

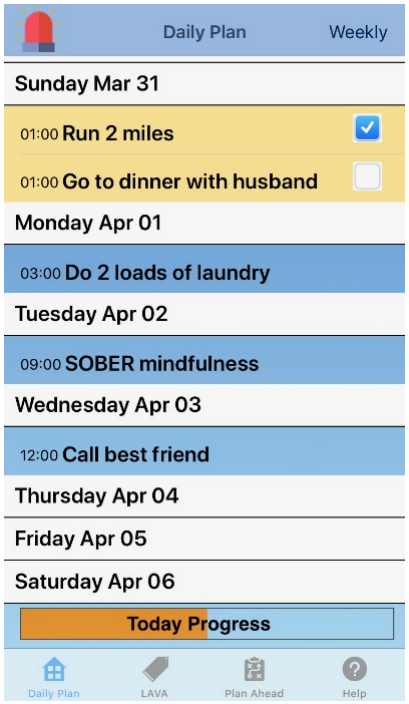


Figure 4. Plan Ahead

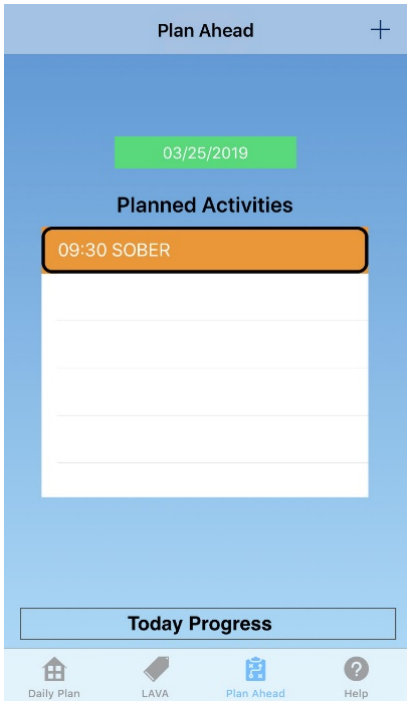


Figure 5. Weekly Progress

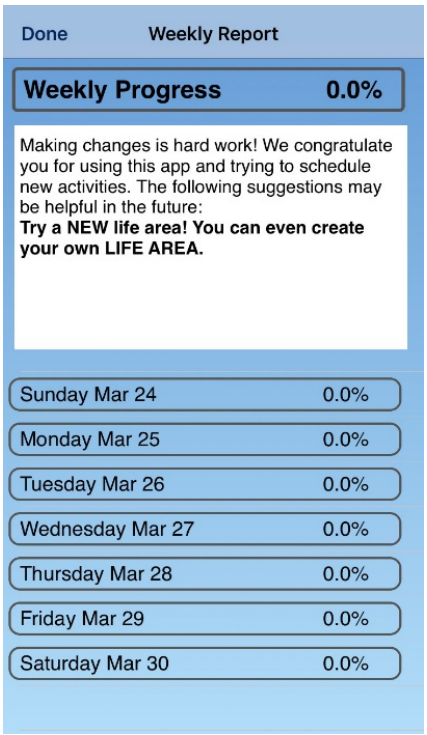


Figure 6. Help Page

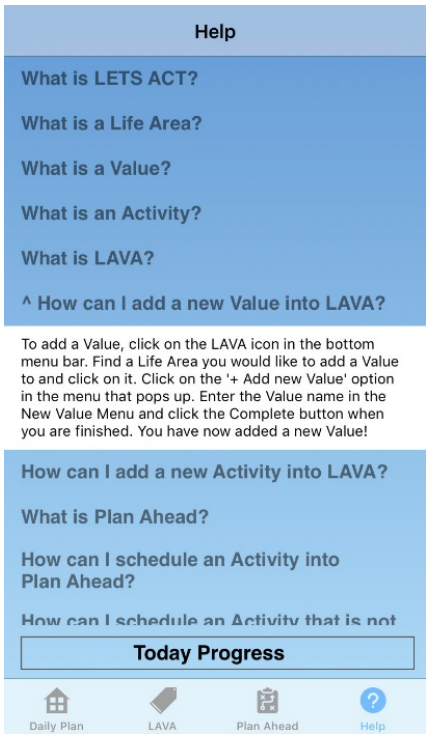


Figure 7. Missing Data Consort Diagram

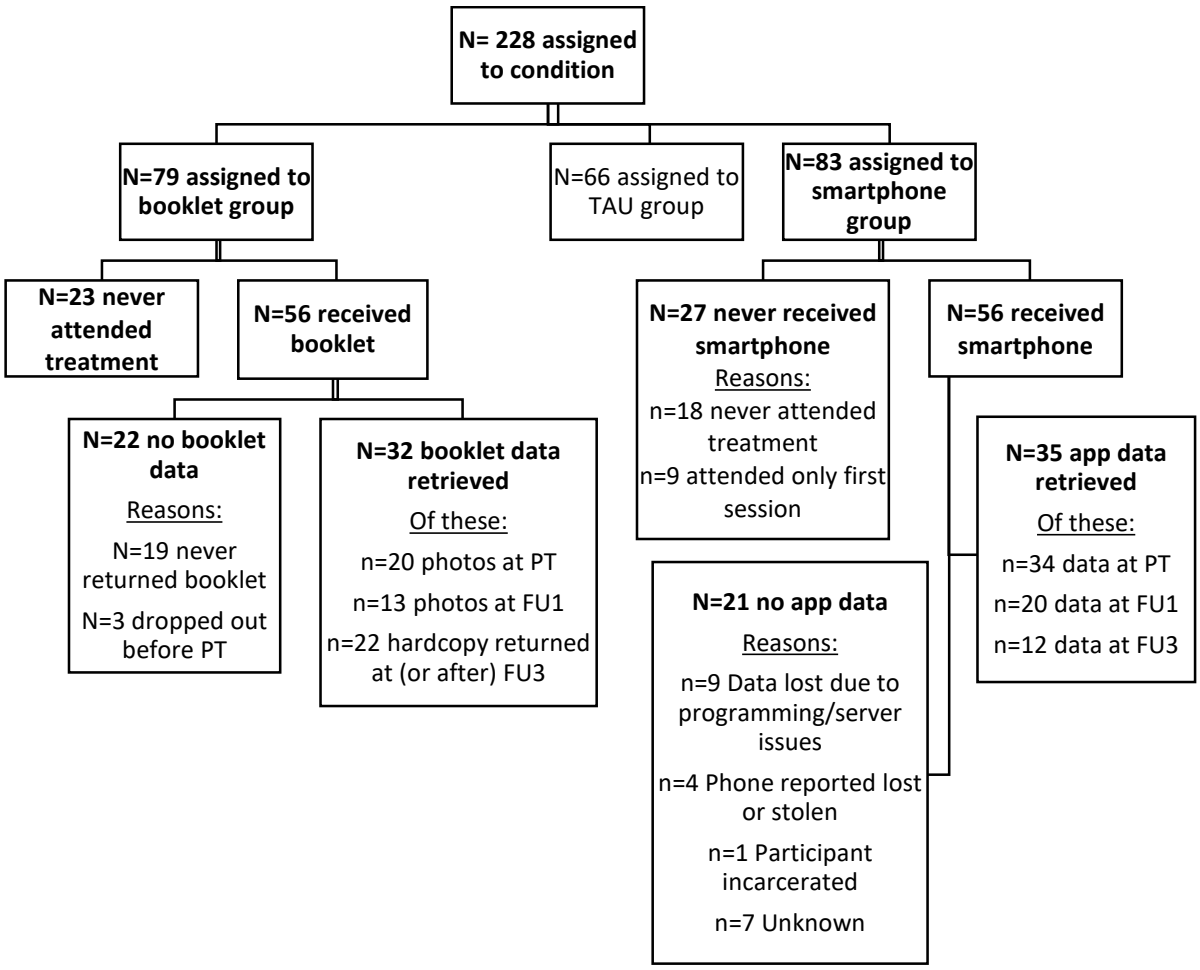
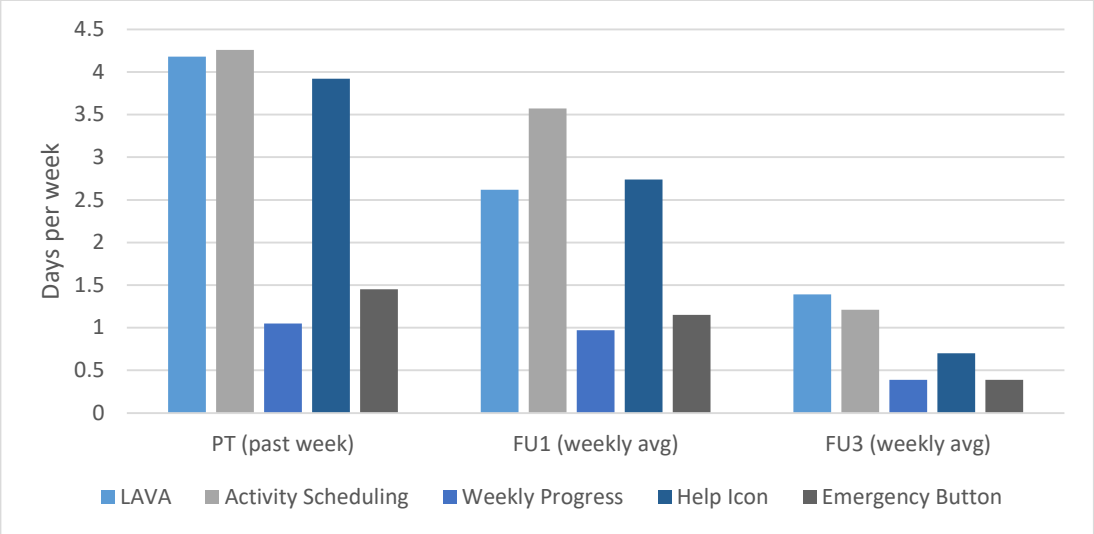


Figure 8. Weekly App Use by Component



TABLES

Table 1. Outcome Variables and Measures

Construct	Measure / Source	Variable Description		Scale/Possible Value Range	Time Points
Aim 1. Homework Compliance					
Aim 1a. Degree of Use of Treatment Materials (LAVA)					
		Overall Use	Valid Use		
LAVA Components	App & booklet data	Multiple: Total # of 1. Life Areas w/ ≥ 1 Value or Activity recorded 2. Values recorded in LAVA 3. Activities recorded in LAVA	Multiple: Total # of 1. Life Areas w/ ≥ 1 valid Value or Activity 2. Valid Values recorded in LAVA 3. Valid Activities recorded in LAVA	1. 0 – 7 2. 0 – 88 3. 0 – 88	FU3
Aim 1b. Frequency of Use of Treatment Materials (Activity Planning and Completion)					
		Overall Use	Valid Use		
Activity Planning	App & booklet data	# days (since previous time point) with ≥ 1 Activity planned	# days (since previous time point) with ≥ 1 valid Activity planned with: 1) a date and time + 2) a valid Value	0 - 100.00%	PT, FU1, FU3
Activity Completion	App & booklet data	# days (since previous time point) with ≥ 1 Activity w/ a completion mark	# days (since previous time point) with ≥ 1 valid Activity planned with: 1) a date and time + 2) a valid Value + 3) completion mark	0 - 100.00%	PT, FU1, FU3
Aim 2. Factors Related to Treatment Engagement					
Treatment Attendance	Therapist Questionnaire	Percent of sessions attended after Session 2		25.00 – 100.00%	PT
In-Session Participation	Therapist Questionnaire	Average participation rating across all attended sessions after Session 1		Scale of 1 (did not participate at any point in the session) to 5 (participated and was engaged throughout the session)	PT
In-Session Comprehension	Therapist Questionnaire	Average comprehension score across all attended sessions after Session 1		Scale of 1 (did not demonstrate understanding of any of the session content) to 5 (demonstrated an understanding of the entire session content)	PT
Working Alliance	Working Alliance Inventory (WAI)	Overall score indicating the strength of the working alliance		Overall score range: 12 – 60 (higher scores indicate stronger alliance)	PT

Table continues

Construct	Measure / Source	Variable Description	Scale/Possible Value Range	Time Points
*Aim 3. App Component Participant Feedback				
App Component Usefulness	Treatment Evaluation Questionnaire	Degree to which participant agrees each component was a useful part of treatment: 1. LAVA library 2. Plan Ahead 3. Emergency 4. Weekly Progress 5. Help	Scale of 1 (strongly disagree) to 5 (strongly agree)	PT
Reasons for not utilizing app components	Treatment Evaluation Questionnaire	Reasons for not utilizing: LAVA library, Plan Ahead, Emergency, Weekly Progress, Help	Can select all that apply from a list of reasons, select "other," or indicate that it does not apply because the participant did use that component.	PT
Reasons for low weekly app use	Treatment Evaluation Questionnaire	Reasons for not using the app at least three times a week	Can select all that apply from a list of reasons, select "other," or indicate that it does not apply because the participant did use the app at least 3x/week.	PT
Past-week use of app components	Treatment Evaluation Questionnaire	Multiple (all <u>past week</u>): 1. # days created new Life Areas, Values, and activities using the LAVA library 2. # days scheduled ≥1 activity into Daily Plan using Plan Ahead 3. # days used the Emergency Button ≥1 time 4. # days viewed Weekly Progress 5. # days viewed Help icon	0 – 7 days	PT
Average weekly use of app components in past month	Treatment Adherence Questionnaire	Multiple (all <u>past month</u>): 1. Average # days/week entered Life Areas, Values, and activities using LAVA icon 2. Average # days/week used Daily Plan icon 3. Average # activities planned > 1 week in advance using Plan Ahead icon 4. Average # days/week used Emergency button 5. Average # days/week viewed Weekly Progress 6. Average # days/week viewed Help page	0 – 7 days	FU1, FU3

**Only assessed within LETS ACT-SE*

Table 2. Average homework completion across conditions

	PT		FU1		FU3	
	LETS ACT	LETS ACT-SE	LETS ACT	LETS ACT-SE	LETS ACT	LETS ACT-SE
Overall Use						
LAVA Components						
Life Areas w/ ≥ 1 Value recorded	.	.	.	.	4.28±2.26	4.26±2.43
Values recorded in LAVA	.	.	.	.	8.38±6.60	12.83±12.66
Activities recorded in LAVA	.	.	.	.	12.53±10.09	12.31±23.16
Activity Planning and Completion						
% days with any activities planned	58.30±30.71	29.56±17.47	22.92±38.15	16.88±28.89	10.99±28.37	10.19±20.86
% days with any activities completed	43.79±34.42	10.85±16.18	18.44±34.36	06.19±17.39	10.34±26.96	3.12±11.04
Valid Use						
LAVA Components						
Life Areas w/ ≥ 1 Value recorded	.	.	.	.	4.09±2.16	3.97±2.40
Values recorded in LAVA	.	.	.	.	7.41±5.37	10.57±10.19
Activities recorded in LAVA	.	.	.	.	10.34±7.90	8.571±13.71
Activity Planning and Completion						
% days with any activities planned	37.51±27.74	23.18±18.24	14.55±30.20	13.16±26.43	8.06±23.02	9.83±20.87
% days with any activities completed	28.15±25.35	8.69±.16	13.39±.27	4.18±15.18	7.67±.22	2.91±10.14

Table 3. Regression Analyses Predicting Overall Use of Treatment Materials (LAVA)

Source	***B***	***SE B***	β	*t*	*p*
Dependent Variable: Life Areas w/ ≥ 1 Value recorded					
Step 1					
(Intercept)	4.304	1.796		2.396	.020
Age	.015	.026	.075	.580	.564
Years of Education	-.023	.105	-.027	-.217	.829
BDI Total Score	-.023	.027	-.106	-.845	.402
Days Used (past 30)	-.027	.045	-.079	-.604	.548
Note. ΔR^2 =.026, Sig. =.795					
Step 2					
(Intercept)	4.468	2.166		2.063	.043
Age	.016	.027	.078	.589	.558
Years of Education	-.027	.110	-.032	-.244	.808
BDI Total Score	-.023	.027	-.108	-.849	.399
Days Used (past 30)	-.026	.046	-.075	-.564	.575
Condition	-.086	.626	-.019	-.138	.891
Note. ΔR^2 =.000, Sig. =.891					
Dependent Variable: Values recorded in LAVA					
Step 1					
(Intercept)	14.907	7.716		1.932	.058
Age	.152	.114	.168	1.341	.185
Years of Education	-.670	.451	-.181	-1.486	.142
BDI Total Score	-.117	.116	-.122	-1.009	.317
Days Used (past 30)	-.186	.192	-.122	-.970	.336
Note. ΔR^2 =.095, Sig. =.179					
Step 2					
(Intercept)	7.664	9.153		.837	.406
Age	.131	.114	.145	1.157	.252
Years of Education	-.494	.464	-.133	-1.065	.291
BDI Total Score	-.097	.116	-.101	-.834	.408
Days Used (past 30)	-.237	.193	-.155	-1.224	.226
Condition	3.810	2.644	.184	1.441	.155
Note. ΔR^2 =.030, Sig. =.155					
Dependent Variable: Activities recorded in LAVA					
Step 1					
(Intercept)	24.239	13.518		1.793	.078
Age	.193	.199	.123	.969	.336
Years of Education	-1.470	.790	-.229	-1.861	.068
BDI Total Score	-.063	.204	-.038	-.309	.758
Days Used (past 30)	-.185	.336	-.070	-.552	.583
Note. ΔR^2 =.073, Sig. =.308					
Step 2					
(Intercept)	29.656	16.258		1.824	.073
Age	.208	.202	.133	1.034	.305
Years of Education	-1.602	.823	-.249	-1.946	.056
BDI Total Score	-.078	.206	-.047	-.380	.705
Days Used (past 30)	-.148	.343	-.056	-.430	.669
Condition	-2.849	4.696	-.080	-.607	.546
Note. ΔR^2 =.006, Sig. =.546					

Table 4. Condition Effects on Activity Planning and Completion (Parameter Estimates)

Source	***B***	***SE B***	95% Wald Confidence Interval		Odds Ratio (95% CI)	*p*
			Lower	Upper		
Dependent Variable: Overall Activity Planning						
(Intercept)	-5.463	1.615	-8.628	-2.298	.004 (.000-.100)	.001
Condition (Booklet)	.044	.746	-1.417	1.505	1.045 (.242-4.506)	.953
Time 1	1.373	.496	.400	2.345	3.945 (1.492-10.435)	.006
Time 2	.540	.322	-.090	1.170	1.716 (.914-3.223)	.093
Time 3 (Ref.)	.	.	.	.	1	
Age	.073	.029	.016	.129	1.076 (1.017-1.138)	.011
Years of Education	.005	.064	-.121	.130	1.005 (.886-1.139)	.944
Days Used (past 30)	-.029	.060	-.147	.088	.971 (.863-1.092)	.624
BDI Total Score	.000	.029	-.056	.056	1.000 (.946-1.058)	.995
Condition (Booklet) * Time 1	1.447	.713	.050	2.844	4.250 (1.051-17.187)	.042
Condition (Booklet) * Time 2	.487	.515	-.522	1.497	1.628 (.593-4.468)	.344
Condition*Time *(All other)*	.	.	.	.	1	.
Dependent Variable: Overall Activity Completion						
(Intercept)	-6.652	1.748	-10.078	-3.225	.001 (4.198E-5 - .040)	.000
Condition (Booklet)	1.298	.929	-.522	3.118	3.661 (.593-22.590)	.162
Time 1	1.330	.729	-.099	2.759	3.781 (.905-15.790)	.068
Time 2	.692	.573	-.431	1.814	1.997 (.650-6.134)	.227
Time 3 (Ref.)	.	.	.	.	1	.
Age	.068	.033	.004	.133	1.071 (1.004-1.142)	.038
Years of Education	-.021	.079	-.175	.134	.980 (.839-1.143)	.793
Days Used (past 30)	-.014	.068	-.147	.119	.986 (.863-1.126)	.837
BDI Total Score	.023	.032	-.040	.087	1.024 (.961-1.091)	.472
Condition (Booklet) * Time 1	.871	.926	-.943	2.685	2.389 (.389-14.664)	.347
Condition (Booklet) * Time 2	.116	.722	-1.300	1.531	1.123 (.273-4.624)	.873
Condition*Time *(All other)*	.	.	.	.	1	.

Table 5. Condition*Time Effects on Activity Planning and Completion (Estimated Marginal Means)

Condition	Stage (Time)	Mean	*SE*	95% Wald Confidence Interval	
				Lower	Upper
Dependent Variable: Probability of Daily Activity Planning					
Booklet	PT	.61	.078	.45	.75
	FU1	.21	.065	.11	.36
	FU3	.09	.041	.03	.21
SE	PT	.26	.058	.17	.39
	FU1	.13	.055	.06	.28
	FU3	.08	.042	.03	.21
Dependent Variable: Probability of Daily Activity Completion					
Booklet	PT	.44	.090	.28	.62
	FU1	.16	.051	.09	.29
	FU3	.08	.035	.03	.18
SE	PT	.08	.046	.03	.23
	FU1	.05	.036	.01	.19
	FU3	.02	.018	.01	.10
Dependent Variable: Probability of Daily Planning of Valid Activities					
Booklet	PT	.36	.063	.25	.49
	FU1	.13	.049	.06	.26
	FU3	.07	.036	.02	.18
SE	PT	.21	.053	.13	.33
	FU1	.11	.052	.04	.26
	FU3	.09	.045	.03	.23
Dependent Variable: Probability of Daily Completion of Valid Activities					
Booklet	PT	.26	.052	.17	.37
	FU1	.12	.039	.06	.22
	FU3	.06	.030	.02	.15
SE	PT	.07	.043	.02	.22
	FU1	.03	.034	.00	.21
	FU3	.02	.019	.01	.11

Table 6. Condition effects on attendance, participation, and working alliance

Source	***B***	***SE B***	95% Wald Confidence Interval		Odds Ratio (95% CI)	*p*
			Lower	Upper		
Dependent Variable: Treatment Attendance						
(Intercept)	.327	.824	-1.288	1.941	1.386 (.276-6.965)	.692
Condition (Booklet)	.616	.393	-.154	1.386	1.851 (.857-3.998)	.117
Age	.012	.013	-.013	.038	1.012 (.987-1.039)	.349
Years of Education	-.066	.060	-.184	.052	.936 (.832-1.054)	.274
Days Used (past 30)	-.052	.028	-.107	.004	.950 (.899-1.004)	.067
BDI Total Score	.041	.019	.004	.078	1.042 (1.004-1.081)	.031
Dependent Variable: In-Session Participation						
Condition (Booklet)	.400	1.099	-1.753	2.554	1.261 (.560-2.841)	.716
Age	.027	.019	-.010	.065	1.028 (.990-1.067)	.152
Years of Education	-.001	.059	-.117	.115	.999 (.889-1.122)	.985
Days Used (past 30)	-.004	.019	-.042	.034	.996 (.959-1.035)	.842
BDI Total Score	.011	.015	-.018	.040	1.011 (.982-1.040)	.473
Therapist 1	-1.788	1.040	-3.826	.250	.167 (.022-1.283)	.085
Therapist 2	-2.548	.933	-4.378	-.719	.078 (.013-.487)	.006
Therapist 3	-.777	1.009	-2.754	1.199	.460 (.064-3.318)	.441
Therapist 4	-1.905	.918	-3.705	-.106	.149 (.025-.900)	.038
Therapist 5	-2.532	1.210	-4.904	-.161	.079 (.007-.852)	.036
Therapist 6	-2.634	.941	-4.478	-.791	.072 (.011-.453)	.005
Therapist 7	-.676	.966	-2.569	1.218	.509 (.077-3.379)	.484
Therapist 8	-2.435	.929	-4.255	-.615	.088 (.014-.541)	.009
Therapist 9 (Ref.)	.	.	.	.	.	.
Age*Condition (Booklet)	-.004	.027	-.056	.048	.996 (.945-1.050)	.881

Table continues

Source	*B*	*SE B*	95% Wald Confidence Interval		Odds Ratio (95% CI)	*p*
			Lower	Upper		
Dependent Variable: In-Session Comprehension						
Condition (Booklet)	-.825	1.167	-3.112	1.462	1.361 (.654-2.835)	.480
Age	-.042	.020	-.080	-.003	.959 (.923-.997)	.034
Years of Education	.082	.046	-.008	.171	1.085 (.992-1.187)	.073
Days Used (past 30)	-.013	.021	-.054	.029	.987 (.947-1.029)	.543
BDI Total Score	.031	.015	.002	.060	1.031 (1.002-1.061)	.034
Therapist 1	-.882	.880	-2.607	.844	.414 (.074-2.325)	.317
Therapist 2	-1.824	.828	-3.447	-.202	.161 (.032-.817)	.028
Therapist 3	.711	.830	-.916	2.338	2.036 (.400-10.358)	.392
Therapist 4	-.344	.697	-1.709	1.022	.709 (.181-2.778)	.622
Therapist 5	-.670	1.052	-2.731	1.391	.512 (.065-4.021)	.524
Therapist 6	-.902	.735	-2.344	.539	.406 (.096-1.714)	.220
Therapist 7	1.375	.820	-.232	2.981	3.954 (.793-19.710)	.094
Therapist 8	-.350	.867	-2.048	1.348	.705 (.129-3.851)	.686
Therapist 9 (Ref.)	.	.	.	.		.
Age*Condition (Booklet)	.027	.027	-.026	.080	1.027 (.974-1.083)	.323
Dependent Variable: Working Alliance						
Condition (Booklet)	-.348	.382	-1.096	.401	.706 (.334-1.493)	.362
Age	.008	.014	-.018	.035	1.009 (.982-1.036)	.537
Years of Education	-.021	.070	-.153	.110	.979 (.859-1.116)	.748
Days Used (past 30)	-.029	.021	-.071	.013	.971 (.931-1.013)	.170
BDI Total Score	-.007	.013	-.033	.019	.993 (.968-1.020)	.613
Therapist 1	-1.306	.830	-2.932	.319	.271 (.053-1.376)	.115
Therapist 2	-.635	.588	-1.788	.518	.530 (.167-1.679)	.280
Therapist 3	-.476	.681	-1.811	.860	.621 (.163-2.363)	.485

Table continues

Source	***B***	***SE B***	95% Wald Confidence Interval		Odds Ratio (95% CI)	*p*
			Lower	Upper		
Dependent Variable: Working Alliance						
Therapist 4	.060	.551	-1.020	1.140	1.062 (.361-3.126)	.913
Therapist 5	.369	1.162	-1.909	2.647	1.447 (.148-14.116)	.751
Therapist 6	.053	.564	-1.053	1.159	1.054 (.349-3.185)	.926
Therapist 7	-.473	.607	-1.664	.717	.623 (.189-2.048)	.436
Therapist 8	-.117	.661	-1.413	1.178	.889 (.243-3.248)	.859
Therapist 9 (Ref)	.	.	.	.		.

Table 7. Reasons for not scheduling activities

If there were days when you did NOT have an activity scheduled, it was because: (check all that apply)	Frequency	%
This does not apply to me because I scheduled an activity into my Daily Plan on most days.	18	38
I did not remember to use the Daily Plan.	19	40
I did not have the smartphone with me when I needed to fill it out.	6	13
Filling it out took too much time/ effort.	4	9
I had technical difficulties with the smartphone.	3	6
I did not think it would be helpful to me/ my treatment goals.	1	2
Filling it out made me uncomfortable.	1	2
It was difficult to understand how to use it.	2	4
Other:	9	19
Lost/don't have phone	1	
Incarcerated/Hospitalized	3	
Other/undisclosed	5	

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