



# The Impact of a Behavioral Activation Online Micro Intervention on Mood and Activity Level

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## Abstract

Previous studies on Behavioral Activation (BA) Online Micro Interventions (OMIs) reported immediate mood benefits but no lasting effects, while the mechanisms by which these interventions improve mood are unknown. This study aimed to analyze the OMI's impact on self-reported mood and depressive symptoms. A total of 838 participants (mean age = 35.86) were randomized into either BA condition, BA with reminders (BAR), or Waitlist control (WLC). Participants in the BA and BAR conditions showed a significant and small improvement in mood ( $t(476) = -7.23, p < .001, d = .25$ ) from baseline to immediate post. There were no significant differences by condition in self-reported mood ( $F(113) = .61, p = .543$ ) and PROMIS scores ( $F(119) = 1.57, p = .213$ ) from baseline to one week follow-up. Self-reported activity levels significantly increased at the seven-day follow-up for both the BA and BAR conditions ( $F(58) = 8.28, p = .006$ ). Change in activity level significantly predicted self-reported mood at follow up ( $F(56) = 5.07, p = .03, r = .29, \text{Adjusted R-squared} = .068$ ), but did not significantly predict PROMIS scores at follow up ( $F(59) = .13, p = .72, r = -.05, \text{adjusted r-squared} = -.015$ ). Reminders did not improve completion rates ( $p = .233$ ). Our results found that the Behavioral Activation OMI had a small but significant immediate effect on self-reported mood for participants in the active conditions. While there were no significant differences in mood and depression across conditions at one week follow-up, there was a significant increase in the number of activities they engaged in at one week follow-up. Overall results of a BA OMI were promising.

**Keywords** Online Interventions · Behavioral Activation · Mood · Activities · Reminders

## Introduction

Clinical depression has a lifetime prevalence rate between 10 and 15%, worldwide (Lépine & Briley, 2011). Approximately 6.7% of the adult population in the United States had one or more major depressive episodes in 2016 (National Institute

of Mental Health, 2017). Behavioral Activation (BA) is an evidence-based treatment for depression (Cuijpers et al., 2007; Dimidjian et al., 2011; Hershenberg et al., 2015; Lejuez et al., 2011; Mazzucchelli et al., 2010). However, there are several barriers that limit access to treatment, such as geographic location, stigma, time constraints, cost, clinician availability, scheduling, and availability of services (Berger et al., 2011; Dever Fitzgerald et al., 2010; Otte et al., 2016). Finding ways of delivering BA to large populations is needed.

Internet-based interventions can address treatment barriers (Muñoz et al., 2015) and have been shown to be effective in treating depression while providing opportunities for equitable access (Andersson & Cuijpers, 2009). However, internet interventions for depression tend to present high attrition rates (Christensen et al., 2009), and most users do not return to the site after the first two sessions (Titov et al., 2013). Such attrition rates may suggest that users do not perceive enough benefits to return to the site. In response to such problems, researchers have been testing Online Micro Interventions (OMIs).

## Highlights

- Online Micro Interventions (OMI) had a small and significant immediate impact on self-reported mood.
- No effects of condition were observed for mood or depressive symptoms at one week follow-up.
- Participants in the active conditions reported a significant increase in the number of activities they engaged in at one week follow-up.
- Change in activity level significantly predicted self-reported mood at follow up.
- Reminders did not improve completion rates.

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OMIs are defined as brief interactions lasting between five to fifteen minutes that aim to produce immediate or short-term improvements (Bunge et al., 2016, 2017, 2018). Finding brief interventions that yield a small benefit to the user may increase the chances that they will return for further engagement. Since OMI studies are completed in a short period of time and do not require long term follow up, they allow researchers to receive rapid feedback on the intervention and to test new iterations at a much faster pace than what's required for full length interventions. This is congruent to the concept of agile design utilized in the development of most digital tools (Pereira et al., 2018).

In recent years, many studies have been conducted on the impact of OMIs on mood and depressive symptoms (Bunge et al., 2016, 2017, 2018; Elefant et al., 2017; Tilden et al., 2020). Elefant et al. (2017) found that participants reported an immediate increase in mood and reductions in distress after completing an OMI, however the improvements did not last. Bunge et al. (2016), tested four OMIs designed to improve mood and reduce depressive symptoms. All OMIs showed improvements in depressive symptoms at one week follow-up but there were no significant differences between the active control groups. Since participants rated the BA intervention as the most useful intervention, a subsequent study (Bunge et al., 2017) compared BA OMI to a waitlist control group. Participants with mild to moderate depression found immediate improvements in their self-reported mood, confidence, and motivation but the effects were not observed for depressive symptoms based on the PHQ-9 (Bunge et al., 2017).

While the previous studies suggest that OMIs produce an immediate benefit (Bunge et al., 2016, 2017, 2018; Elefant et al., 2017), new studies are needed to try to increase the therapeutic power of the intervention, understand the mechanisms by which OMI on behavioral activation works, and to produce effects that can last longer. To increase the effect of the intervention, newer and better interventions need to be developed. In order to understand the mechanisms of OMIs, researchers need to assess if behavioral change occurs after utilizing an OMI and if it is associated with symptom improvements. Also, reminders can be added to the intervention to test whether they contribute to maintaining the effects of the intervention. Previous studies on digital interventions have shown that participants who received periodic emails with a prompt to revisit the website had significantly higher rates of return than participants who did not (Schneider et al., 2012; Greaney et al., 2012). One major caveat to using email reminders is that due to the increasing number of spam and advertising emails a person receives, there is a tendency for people to ignore and delete emails without much attention or even being read (Schneider et al., 2012).

The aim of this study is to build off previous research on OMIs by increasing the therapeutic power of the

intervention. This was done by incorporating a scheduling calendar to the BA intervention, assessing the activity level of the participants, and sending email reminders throughout the week. More specifically, this study: 1) analyzed the OMI's impact on self-reported mood from pretest to immediate posttest, as well as self-reported mood and depression scores from pretest to one week follow-up; 2) evaluated the impact of the OMI on the number of activities engaged in by participants; 3) explored if there is an association between a change in activity level and a change in mood and depression scores; and 4) analyzed follow up completion rates by condition, to determine the impact of reminders on completion rates.

## Methods

### Participants

Participants were recruited through Amazon's Mechanical Turk (AMT), a crowdsourcing internet platform, which has been found to be an effective and valid method for recruiting a diverse sampling of adult populations (Buhrmester et al., 2011). Recruitment took place on August 11th, 2020. Eligible participants were required to be residents of the United States, aged 18+ years.

### Measures

#### Demographic Questionnaire

Participants were asked to share their ethnicity, gender identity, age, zip code, and country of residence.

#### Depression

Depression was assessed using the Patient-Reported Outcomes Measurement Information System (PROMIS), a brief, 4-item self-report on symptoms of depression. The PROMIS has a high convergent validity with the Center for Epidemiologic Studies Depression Scale (CESD; Pilkonis et al., 2014) and the Patient Health Questionnaire 9 (PHQ-9; Kroenke et al., 2020). Additionally, it has a high level of internal consistency, at 0.95 (Vilagut et al., 2015). Furthermore, the PROMIS has proven to be a valid measure in both clinical and general populations (Pilkonis et al., 2014; Sunderland et al., 2018). The four items on the PROMIS state: "I feel worthless," "I feel helpless," "I feel depressed," and "I feel hopeless." Responses are structured in the form of a 4-point Likert scale (Never, Sometimes, Often, and Always) ranging in value from 1 to 4, respectively.

## Mood

Participants were asked questions about current mood on a 9-point sliding Likert scale. Participants were also asked, “How would you describe your mood right now?” Responses ranged from 1 (Extremely Negative) to 9 (Extremely Positive).

## Motivation, Confidence, and Usefulness

To assess motivation, participants were asked, “How motivated are you to do something to improve your mood?”. Responses ranged from 1 (Not at all) to 9 (Extremely). To measure confidence levels, participants were asked, “How confident are you that you can do something to improve your mood?”. Responses ranged from 1 (Not at all) to 9 (Extremely). After the intervention, participants in the active condition were also asked how useful the intervention was on a 5-point Likert scale (1 = not useful, 2 = slightly useful, 3 = moderately useful, 4 = very useful, 5 = extremely useful).

## Activity Measure

Participants in the BA and BAR conditions were asked about the number of activities they had recently engaged in (See Fig. 1). Participants were asked to record the number of pleasant, meaningful, and mastery activities that they had performed each day over the past three days (today, yesterday, and two days ago) with responses ranging from 0 to 7+ activities. Pleasant activities were defined as “something that you enjoy (such as listening to music you like or playing games)”, mastery activities were defined as “something that you can practice and improve (such as exercise or cooking)”, and meaningful activities as “something that you value (such as volunteering or spending time with family)”. In this section, participants were also asked how much they enjoyed each of the past two days on a 5-point Likert scale (1 = not at all, 2 = slightly, 3 = moderately, 4 = very much, 5 = extremely).

## Intervention

Participants were first presented with a brief psychoeducation on the difference between helpful versus harmful activities and the power of activities to impact mood (See Fig. 2a). Following this, the participants were asked to select, from 16 options, the types of activities that they like to do (See Fig. 2b), which generated an extensive list of activity recommendations. Finally, participants were requested to schedule mood-boosting activities into a calendar for the upcoming week (See Fig. 2c). The calendar provided three time slots per day: morning, afternoon, and evening.

## One Week Follow-Up

All participants received a follow-up email asking them to rate their current mood on a 9-point Likert scale. Participants were also asked to rate their motivation, confidence, and complete the PROMIS. Individuals in the active conditions were also asked to complete the activity measure.

## Procedures

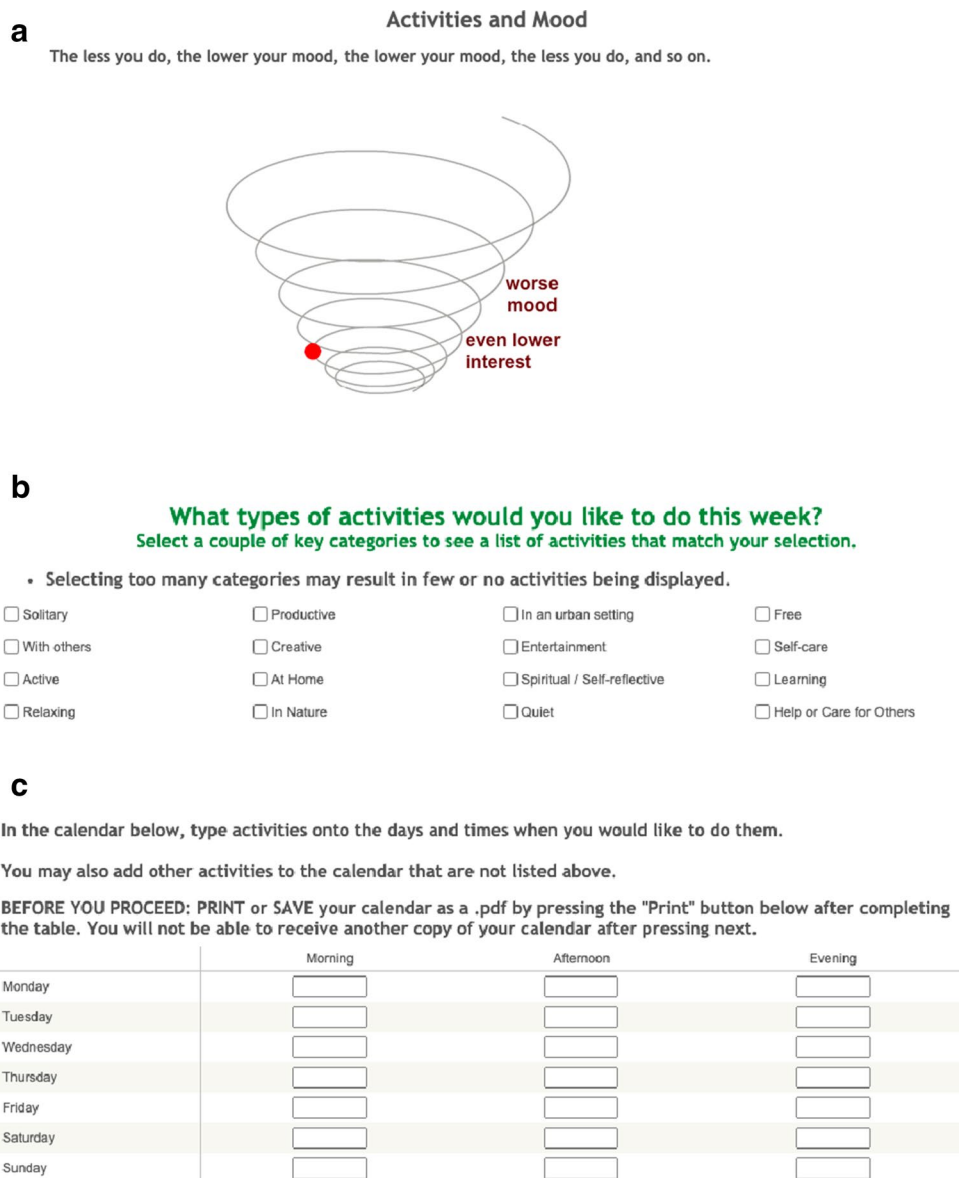
The study recruited participants from the United States, aged 18 and older, through Amazon’s Mechanical Turk (AMT). Participants were provided with a link directing them to the informed consent portion of the webpage. In order to proceed, participants were required to electronically sign, indicating their consent. Once signed, participants filled out a basic demographic questionnaire, the PROMIS-4, mood questions, activity measure, motivation question, and confidence question. Participants were then randomly assigned into one of three conditions: BA, BAR or WLC.

The participants in the WLC were then directed to a screen thanking them for their participation and informing them that they would receive a reminder to complete the post-test survey in one week. Participants in the active treatment conditions (BA and BAR) were then directed to the psychoeducation webpage on using behavioral activation to improve mood and reduce depression. These participants then completed the activity scheduling exercise, wherein the participants selected behaviors that they would like to

**Fig. 1** Survey question on types and frequency of activities

	How many mastery activities did you do?	How many meaningful activities did you do?	How many pleasant activities did you do?	How much did you enjoy your day?
Today	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Yesterday	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
2 days ago	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

**Fig. 2** Behavioral Activation intervention. **a** Psychoeducation on Downward Spiral. **b** Preferred activity types. **c.** Calendar



increase throughout the week and then filled out the calendar. Participants in the active conditions then completed questions on current mood, motivation, confidence, and usefulness of the information provided.

On days 3 and 5, participants in the BAR condition received an automated email reminder, encouraging them to continue their behavioral activation and were asked to complete the activity measure, mood in the last two days, current mood, confidence, and motivation. On day 7, participants in all three conditions received an email to complete the follow-up survey, which included mood in the last week, current mood, confidence, motivation, and the PROMIS. Participants in the active conditions also completed an activity measure.. Participants received \$0.25 in compensation upon completion of each survey. The study was approved by the IRB at Palo Alto University.

**Statistical Analysis**

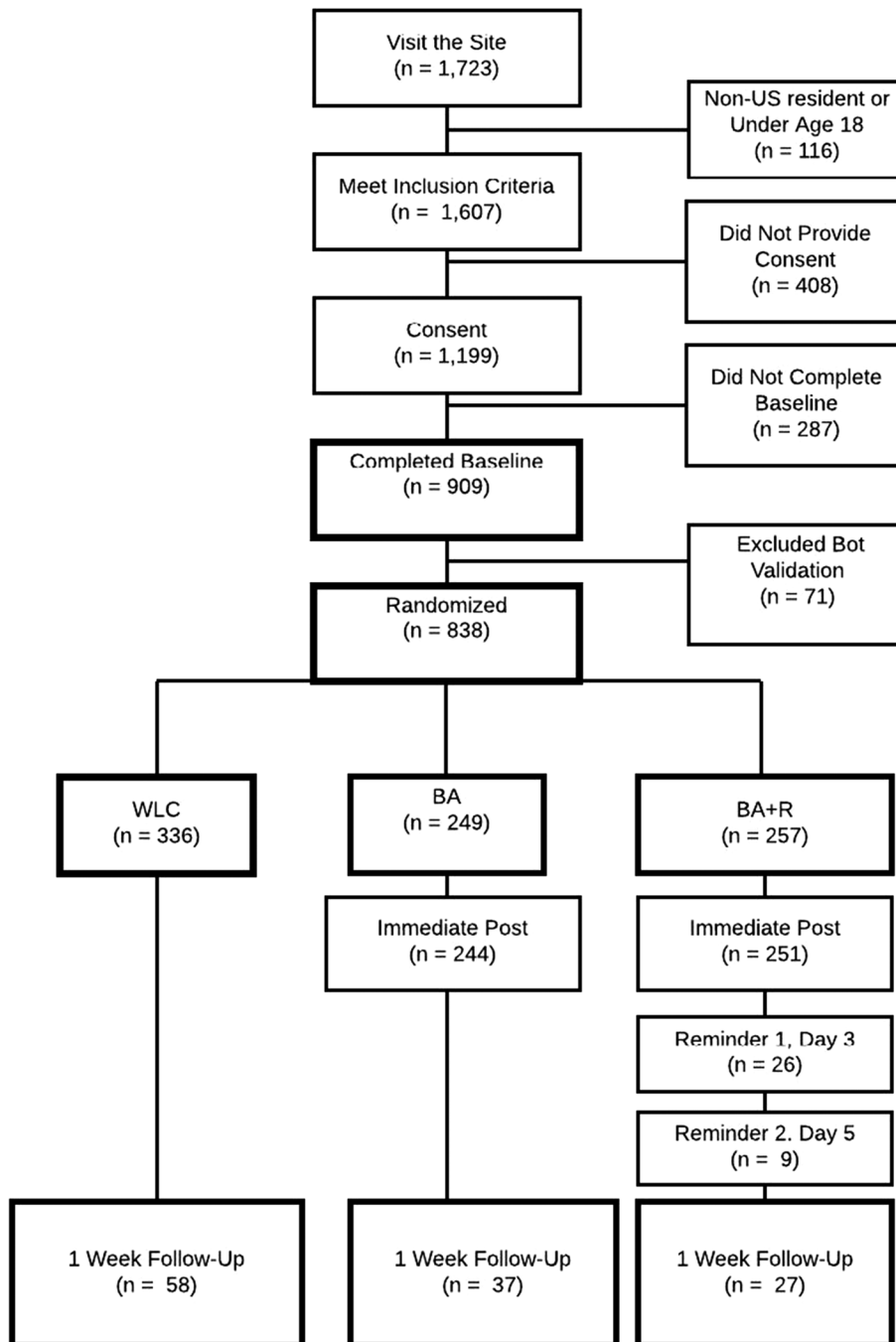
Repeated measures ANOVAs were used to evaluate the mean differences in self-reported mood, PROMIS scores, and number of activities engaged in, from pre-test to one-week follow-up, across all three conditions. A repeated measures ANOVA was also used to evaluate the differences in study completion rate across the three conditions. In each of these analyses, time was used as the within-subject factor (baseline vs one-week follow-up), while condition was used as the between-subjects factor (BA vs BAR vs WLC). For the follow-up completion rates a post hoc analysis was performed using Tukey’s HSD. To analyze the mean differences in self-reported mood from pretest to immediate post-test, for active conditions only, a paired-sample t-test was

performed. In this case, time was the within-subjects factor (baseline vs immediate post-test) and condition was the between-subjects factor (BA vs BAR). In addition, individual multiple linear regressions were used to assess if there was an association between the change in participants' number of activities and their change in mood and depression scores. In each regression, the independent variable was the change in number of activities. All of the analyses were performed in SPSS.

### Results

A total of 1,718 individuals visited the site, of those 1,196 participants provided consent and met inclusion criteria, 909 participants completed the baseline survey, and 71 participants were excluded due to not passing the bot validation question (See Fig. 3). The mean intervention completion time of participants was analyzed to identify outliers; the average completion time was 7.79 (SD 8.11) minutes, there

Fig. 3 Consort diagram





were no participants that completed the intervention over two standard deviations, thus there were no participants excluded due to deviations in time completion. The total number of participants randomized was 838. The mean age for the study was 35.86 (range = 19–79,  $SD = 11.261$ ); 427 (50.9%) were female; 279 (33.3%) identified as Hispanic/Latino, 103 (12.3%) as African American/Black, 655 (78.2%) as White, Asian 40 (4.8%), American Indian/Alaskan Native 26 (3.1%), and Native Hawaiian/Pacific Islander 2 (0.2%), and Other 12 (1.4%).

A total of 248 participants were randomized into the BA group ( $M_{age} = 35.84$ , range = 19–79,  $SD = 10.851$ ); 133 (53.6%) were female; 115 (46.4%) were male; 94 (37.9%) identified as Hispanic/Latino, 31 (12.5%) as Black/African American, 190 (76.6%) as White/Caucasian, 18 (7.3%) as Asian, 4 (1.6%) as American Indian/Alaskan Native, 1 (0.4%) as Native Hawaiian/Pacific Islander, and 3 as Other 3 (1.2%). In the BAR group ( $n = 254$ ), the mean age was 36.63 (range = 18–66,  $SD = 11.898$ ), (123 male (48.8%) and 131 female (51.6%)), 73 were Hispanic/Latino (28.7%), 8 American Indian/Alaskan Native (3.1%), Asian was 12 (4.7%), Black/African American 28 (11%), White/Caucasian 205 (80.7%), and 1 was other (0.4%). In the WLC group ( $n = 336$ ), the mean age was 35.28 (range = 18–72,  $SD = 11.059$ ), (173 male (51.5%) and 163 female (48.5%)), 112 were Hispanic/Latino, 14 American Indian/Alaskan Native (4.2%), Asian was 10 (3%), Black/African American 44 (13.1%), Native Hawaiian/Pacific Islander 1 (0.3%), White/Caucasian 259 (77.1%); 8 were other (2.4%). The overall average completion rate was 14.2%, with the completion rates by condition at 17% for WL, 15% for BA, and 9.8% BAR.

**Impact of the OMI on self-reported mood and PROMIS** A paired sample t-test comparing self-reported mood from pretest ( $M = 6.42$ ,  $SD = 1.60$ ) to immediate posttest ( $M = 6.81$ ,  $SD = 1.47$ ) for participants in the BA and BAR conditions showed that, on average, they reported a significant improvement in mood and the effect size was small to medium ( $t(476) = -7.23$ ,  $p < 0.001$ ,  $d = 0.25$ ). Additionally, the results of a repeated-measures ANOVA showed a significant increase in self-reported mood from pre-test ( $M = 5.53$ ,  $SD = 1.62$ ) to one week follow-up ( $M = 6.32$ ,  $SD = 1.81$ ). For participants in all three conditions, there was a medium to large effect size ( $F(113) = 18.16$ ,  $p < 0.001$ ,  $\eta^2 = 0.138$ ) and no significant differences by condition from pretest to one week follow-up ( $F(113) = 0.61$ ,  $p = 0.543$ ). For PROMIS scores, the results of a repeated-measures ANOVA showed a significant decrease from baseline ( $M = 8.69$ ,  $SD = 2.7$ ) to follow-up ( $M = 6.94$ ,  $SD = 2.70$ ) for participants in all three conditions ( $F(119) = 51.56$ ,  $p < 0.001$ ) with no significant difference by condition, ( $F(119) = 1.57$ ,  $p = 0.213$ ).

**Impact of the OMI on number of activities** A repeated measures ANOVA was conducted to assess the impact of the intervention and regular reminders on activity levels. Self-reported activity levels at baseline ( $M = 15.08$ ,  $SD = 8.57$ ) significantly increased at the seven-day follow-up ( $M = 17.52$ ,  $SD = 8.95$ ) for both the BA and BAR groups ( $F(58) = 8.28$ ,  $p = 0.006$ ). However, there was no significant difference by condition ( $F(58) = 2.63$ ,  $p = 0.11$ ) which suggests that the reminders did not have an impact on activity level.

**Activity Level, Mood and Depression** Separate regressions were conducted to assess if an increase in participants' self-reported number of activities was associated with an increase in self-reported mood and depression scores. Change in activity level significantly predicted self-reported mood at follow up ( $F(56) = 5.07$ ,  $p = 0.03$ ,  $r = 0.29$ , Adjusted R-squared = 0.068), but did not significantly predict PROMIS scores at follow up ( $F(59) = 0.13$ ,  $p = 0.72$ ,  $r = -0.05$ , Adjusted R-squared = -0.015).

**Follow-up completion rate by condition** A repeated measures ANOVA was conducted to evaluate the impact of reminders on the follow-up completion rate of participants. Results showed a significant difference in completion rates between the conditions ( $F(2) = 3.10$ ,  $p < 0.05$ ). The WL condition had the highest completion rate ( $M = 0.17$ ,  $SD = 0.38$ ), followed by the BA condition ( $M = 0.15$ ,  $SD = 0.36$ ), then BAR ( $M = 0.10$ ,  $SD = 0.30$ ). A post hoc analysis using Tukey's HSD indicated that there was not a significant difference in completion rates between the BA and BAR conditions ( $p = 0.233$ ), but there was a significant difference between the WL and BAR conditions ( $p = 0.038$ ).

## Discussion

Our results indicated that the brief OMI had a significant immediate impact on self-reported mood for participants in the BA and BAR conditions, with a small effect size ( $d = 0.25$ ). Given that this intervention is very brief, this small change in mood scores cannot be attributed to the passage of time, and therefore this result provides partial support for the ability of OMIs to provide changes in mood. This small finding on the brief OMI is consistent with previous OMI studies, which also found significant increases in mood from pre to immediate post intervention (Bunge et al., 2016; Bunge et al., 2017; Elefant et al., 2017). The present study adds to the current literature on the impact of brief interventions that can be used to provide immediate mood benefits and can be used as an introduction to engage in other interventions once participants have a higher mood.

This brief OMI also had a significant impact on self-reported mood and depressive symptoms at one week follow-up, but there were no significant differences by conditions. Given that this analysis compared the active conditions to the waitlist condition, these results indicate that the effects of this OMI may not persist over a week's time. Again, this is consistent with previous studies, which demonstrated that OMIs tend to have an immediate but not a long-term effect on mood and depression (Elefant et al., 2017). Next steps in OMI research may consider either increasing the dosage of the intervention or analyzing its impact at follow-up that is less than a week later (e.g. three days).

Interestingly, participants in the active conditions reported a significant increase in the number of activities they engaged in a one week follow-up, but without significant differences between the active conditions. This is a promising result, as it demonstrates that the OMI increased the activity levels of participants, a key ingredient in behavioral activation. While the effects of the OMI on participants' mood and depressive symptoms were not apparent at one week followup, there is potential for the OMI to have a longer-term impact if participants engage in consecutive interventions, as that could lead to consistent increases in activity levels. Furthermore, an increase in participants' self-reported number activities was associated with a significant increase in self-reported mood at one week follow-up. This, again, highlights the potential of OMIs to impact mood. While this association was not observed between activity levels and reported depressive symptoms, it is possible that increasing the dose of the intervention may be required to produce changes in a larger set of depressive clinical symptoms.

The results regarding follow-up completion rates by condition were unexpected. The overall completion rate was 14.2%, a low percentage compared to previous OMI studies (Bunge et al., 2016, 2017). Furthermore, the WL condition had the highest completion rate, followed by the BA and BAR conditions, respectively. Results indicated a significant difference in completion rates between the WL and BAR conditions only. It is possible that these results indicate that the OMI did not sufficiently engage these participants. Though high attrition rates are the norm for internet interventions in general, researchers should investigate factors such as low participant motivation or the inclusion of participants who lack any interest in the study. Researchers should take responsibility for attrition rates, rather than attributing attrition problems to the participants. It is possible that a better design and more interactive intervention style may lead to greater completion rates. Additionally, the difference in completion rates between active and wait list conditions could signal that those who had already seen the intervention lacked interest in seeing it again. Once more, this highlights the need to improve the

engaging nature of the interventions, if OMIs are intended to increase the chance of participants returning to the site. On top of this, OMIs should look for alternative ways to send reminders, such as text messages, to the participants without wearing them out.

## Limitations and Future Directions

One important limitation to this study is that participants were recruited through AMT, and there are questions about the reliability of participants recruited in this way. Though there is evidence suggesting that AMT users provide quality responses (Buhrmester et al., 2011), there is also research showing the opposite (Bunge et al., 2018). As a result, it is unclear whether the results from this study can be generalized to a wider population. Future research on OMIs should recruit participants from unpaid internet resources to determine if there are different effects.

A second limitation to this study is that the completion rate was considerably low. While this is the case for many digital interventions, previous OMI studies yielded higher completion rates, at 30% and 60% (Bunge et al., 2016, 2017). Therefore, the real effect of the intervention at one-week followup is uncertain. Future researchers should explore different methods of reaching participants at follow-up, for example, by sending reminders by text message instead of email.

A third limitation of this study is that, due to technical problems, it was required that the PROMIS scores be adjusted. The effect of depression scores may not have been significant in regression analyses in OMIs due to the adjusted scores. Future studies should examine the moderating effects of depression on OMIs by including a full measure of depression to examine if there are unique effects of specific depressive symptoms on mood and behavioral activation.

Finally, another limitation of this study is that the participants at baseline tended to report high mood levels ( $M=6.39$ ), higher than in two previous OMI studies (Bunge et al., 2017; Bunge et al., 2017). Therefore, a ceiling effect could have been observed. This particular study did not screen for depression levels before randomization. Future studies on OMIs could benefit from screening participants based on specific levels of depressive symptoms to examine the effectiveness of OMIs for individuals with different levels of depression.

## Conclusion

Behavioral Activation OMIs have the potential to improve individuals' mood by reducing barriers to access. Our results found that the Behavioral Activation OMI had a small but

significant immediate effect on self-reported mood for participants in the active conditions. While there were no significant differences in mood and depression across conditions at one week follow-up, there was a significant increase in the number of activities they engaged in at one week follow-up. Email reminders were not associated with improved engagement. Since participants reported improvements on their mood and there is a robust body of research showing that increased activity level is associated with mood improvements (Ekers et al., 2014), the overall results are promising. Future studies on OMI may need to increase the dose of the intervention, add subsequent interventions, utilize follow-up periods shorter than a week's time and change the method of sending reminders.

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**Data Availability** Data is available upon request.

## Declarations

**Ethical Approval** The study was approved by the IRB at Palo Alto University.

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

**Conflict of Interest** The authors declare they have no financial interest.

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