

Mediation Analyses of Internet-Facilitated Cognitive Behavioral Intervention for Maternal Depression

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Mediation Analyses of Internet-Facilitated Cognitive Behavioral Intervention for

Maternal Depression

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Abstract

This study evaluated the putative mediating mechanisms of an Internet-facilitated cognitive-behavioral therapy (CBT) intervention for depression tailored to economically disadvantaged mothers of preschool-age children. The CBT mediators were tested across two previously published randomized controlled trials which included the same measures of behavioral activation, negative thinking, and savoring of positive events. Trial 1 included 70 mothers with elevated depressive symptoms who were randomized to either the eight-session, Internet-facilitated intervention (Mom-Net) or to treatment as usual. Trial 2 included 266 mothers with elevated depressive symptoms who were randomized to either Mom-Net or to a motivational interviewing and referral to services condition. Simple mediation models tested each putative mediator independently followed by tests of multiple mediation that simultaneously included all three mediators in the model to assess the salient contributions of each mediator. The pattern of results for the mediating effects were systematically replicated across the two trials and suggest that behavioral activation and negative thinking are salient mediators of the Mom-Net intervention; significant mediating effects for savoring were obtained only in the simple mediation models and were not obtained in the multiple mediation models.

Key words: maternal depression, cognitive behavioral, mediation, randomized controlled trial.

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3 Mediation Analyses of Internet-Facilitated Cognitive Behavioral Intervention for
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5 Maternal Depression
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8 Over the past several decades, research has validated numerous therapeutic interventions
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10 as evidence-based practices for ameliorating social, emotional, and behavioral problems. Despite
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12 the advancement of these evidence-based practices, progress on understanding why and how the
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14 therapeutic interventions work has been more limited. Indeed, many of the psychosocial
15
16 treatments may be considered “black boxes” given limited evidence about what goes on inside
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18 the intervention package. As such, there have been numerous calls to further our understanding
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20 with respect to the targeted intervention mechanisms that mediate the treatment outcomes
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23 (Kazdin, 2007; Kraemer, Wilson, Fairburn, & Agras, 2002; U.S. Department of Health and
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25 Human Services, National Institutes of Health, National Mental Health Institute, 2015). Opening
26
27 the black box and gaining a better understanding of the targeted change mechanisms will help to
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29 advance the development of more parsimonious and effective treatment strategies including
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31 person-centered or transdiagnostic approaches.
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35 Extensive research has established cognitive-behavioral therapy (CBT) for depression as
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37 an evidence-based practice in general (Cuijpers, Muñoz, Clarke, & Lewinsohn, 2009; Gloaguen,
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39 Cottraux, Cucherat, & Blackburn, 1998) as well as specifically for mothers (Ammerman et al.,
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41 2013; Chronis-Tuscano et al, 2013; Milgrom, Schembri, Ericksen, Ross, & Gemmill, 2011). The
42
43 putative mechanisms of CBT include both behavioral and cognitive targets. With respect to
44
45 behavioral targets, a key component of CBT includes behavioral activation which aims to
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47 increase the participant’s contact with response contingent positive reinforcement from their
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49 environment and focuses on increasing activation for engaging in meaningful and pleasant
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51 activities while reducing avoidance or withdrawal from such activities (Lewinsohn, 1974;
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Jacobson, Martell, & Dimidjian, 2001). The cognitive targets of CBT include strategies to decrease negative or dysfunctional thinking (Beck, Rush, Shaw, & Emery, 1979) and to promote positive-thinking via savoring processes of positive experiences (Bryant, Chadwick, & Kluwe, 2011). In addition, research has found support for both cognitive mechanisms and behavioral activation strategies (Driessen & Hollon, 2010; Morgan, Mackinnon, & Jorm, 2013).

Despite the availability of evidence-based interventions such as CBT, the majority of individuals with depression do not access treatment (Wang et al., 2005; Wang et al., 2007). One approach to overcome treatment barriers has been through the use of internet-delivered CBT. Because online interventions allow greater flexibility to access interventions, there is potential for them to overcome barriers to usual care services. Internet-based CBT programs for depression have shown significant promise as a delivery modality (i.e., Andersson & Cuijpers, 2009; Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010; Hedman, Liotsson, & Lindefors, 2012), including interventions specifically targeting maternal depression (Danaher et al., 2013; Milgrom et al., 2016; O'Mahen et al., 2014). Given the proliferation of this nascent delivery modality, it is important to examine which CBT mechanisms are effective when delivered through remote access rather than the typical service modality of in-person therapy.

We previously developed and tested Mom-Net, an Internet-facilitated CBT intervention for depression tailored to economically disadvantaged mothers of young children. In a tightly controlled intervention development study (Sheeber et al, 2012), 70 mothers of young children with elevated depressive symptoms were randomized to either the Mom-Net intervention or a delayed intervention/facilitated treatment as usual condition (DI/TAU). Results indicated a large and significant effect (Hedges' $g = .89$) of the Mom-Net intervention over the control condition on reduction of depressive symptoms as assessed by the Beck Depression Inventory-II (BDI-II;

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2
3 Beck, Steer, & Brown, 1996). A subsequent large-scale randomized controlled trial (RCT) was
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5 conducted to evaluate the Mom-Net intervention effects under conditions that were more
6
7 pragmatic in which the telecoaching was delivered by counseling service providers at a
8
9 community mental health agency rather than research staff (Sheeber et al., 2017). Economically
10
11 disadvantaged mothers (N = 266) of preschool age children with elevated levels of depressive
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13 symptoms were randomized to either the Mom-Net intervention or to a comparison condition
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15 that included motivational interviewing and referral to community services. Results of the
16
17 second trial indicated a significant and moderately small effect (Cohen's $d = .27$) over the
18
19 comparison condition on reduction of depressive symptoms as assessed by the Patient Health
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21 Questionnaire-9 (PHQ-9; Spitzer, Kroenke, & Williams, 1999).
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26 The purpose of the present study was to evaluate the presumed CBT mediators of the
27
28 Mom-Net intervention effects across the two trials with similar populations of low-income
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30 mothers of preschoolers. As subsequently described, the CBT mediators were assessed with the
31
32 same measures in both trials, including assessments of behavioral activation, negative thinking,
33
34 and savoring of positive events. We hypothesized that improved behavioral activation,
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36 decreased negative thoughts, and increased savoring of pleasant events would fully mediate the
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38 Mom-Net intervention effects on depressive symptoms.
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42 Trial 1

43 Method

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45 **Design.** Participants were individually randomized (allocation ratio of 1:1) into two
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47 parallel intervention groups: Internet-facilitated intervention (Mom-Net) or delayed intervention/
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49 facilitated treatment-as-usual (DI/TAU). Staff were blind to allocation until assignment was
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51 revealed during a motivational interview process. Assessments were conducted at pre- and post-
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3 intervention (14 week delay). The trial was conducted with approval of an appropriate
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5 institutional review board. A more detailed description of trial methods is provided in Sheeber et
6
7 al. (2012).
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10 **Participants.** Seventy mothers of children enrolled in Head Start classrooms participated
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12 in the study. Inclusion criteria were elevated self-reported depression (≥ 21 on the Center for
13
14 Epidemiological Studies Depression Scale; CES-D; Radloff, 1977) and the ability to comprehend
15
16 spoken English. The CES-D is widely used as a screener for depression and has acceptable
17
18 psychometric properties for use in community samples (Lewinsohn, Solomon, Seeley, & Zeiss,
19
20 2000). Head Start staff gave mothers a consent letter and the CES-D. Screeners were distributed
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22 to 793 mothers, with a 70.0% completion rate. Of mothers completing the questionnaire, 40.0%
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24 ($n = 222$) were eligible for further participation; the first 70 mothers contacted by program staff
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26 expressed interest in participating. The mean participant CES-D score was 32.9 ($SD = 8.8$; range
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28 = 21.0 – 54.0). Participants were 11.1% Hispanic and 92.9% White, 47.1% had some college
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30 education, 42.9% were married or cohabitating, 48.6% had a family income less than \$15,000,
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32 and the average age was 31.0 ($SD = 6.4$; range = 19.8 – 46.7) years old. Half (50.0%) of the
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34 children were female with an average age of 4.6 ($SD = 0.7$; range = 3.3 – 6.1) years. Sixty-nine
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36 (98.6%) of the mothers completed the post-intervention survey.
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42 **Measures.** The following measures were administered via mail at pre- and post-
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44 intervention and included in the mediation analyses.
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47 **Maternal depression outcome.** The BDI-II (Beck, Steer, & Brown, 1996) provided a
48
49 continuous measure of symptoms. The BDI II has a well-established psychometric history and
50
51 has been shown to be sensitive to change (e.g., Titov et al., 2011).
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54 **Mediators.** Measures of CBT mediators included the (a) Behavioral Activation for
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MEDIATION OF COGNITIVE BEHAVIORAL INTERVENTION

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3 Depression Scale (BADs; Kanter, Mulick, Busch, Berlin, & Martell, 2007); (b) Automatic
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5 Thoughts Questionnaire (ATQ; Hollon & Kendall, 1980); and (c) Perceived Ability to Savor
6
7 Positive Outcomes (PASPO; Bryant, 1989). The BADs measures engagement in behaviors
8
9 leading to increased contact with response contingent positive reinforcement, the key element of
10
11 the behavioral activation component of CBT treatment; we used the total BADs score in the
12
13 current report. The ATQ is a widely used measure of the frequency of negative thoughts
14
15 associated with depression. The PASPO is a brief measure of the ability to savor positive events.
16
17 Each of these measures has demonstrated acceptable psychometric properties: BADs (Kanter et
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19 al., 2007; Kanter et al., 2009); ATQ (Harrell & Ryon, 1983; Hill, Oei, & Hill, 1989; Kaufman,
20
21 Rohde, Seeley, Clarke, & Stice, 2005); and PASPO (Bryant, 1989; Bryant, Smart, & King,
22
23 2005).

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28 **Interventions.** Because motivational deficits may be a barrier to participation, with the
29
30 treatment literature describing pervasive problems with attendance, homework completion, and
31
32 ultimately, drop out (Weissman & Jensen, 2002), a structured motivational interview (MI; Miller
33
34 & Rollnick, 2002) was conducted in person prior to intervention with participants in both
35
36 conditions which took 60-90 min. Brief pre-intervention MI is effective in promoting
37
38 participation across a range of interventions and populations (e.g., Nock & Kazdin, 2005;
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40 Walitzer, Dermen, & Connors, 1999).

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44 **Mom-Net.** Mom-Net consisted of eight weekly sessions focused on CBT skills for the
45
46 treatment of depression that included automated prompts for completion and a competency-
47
48 based approach requiring 80% correct responses on a mastery check before the next session
49
50 could be accessed. Relative to the original CWDC, Mom-Net had a greater emphasis on positive
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52 affect and behavioral activation (Hopko, Lejuez, Ruggiero, & Eifert, 2003; McMakin, Siegle, &
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MEDIATION OF COGNITIVE BEHAVIORAL INTERVENTION

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Shirk, 2011), lesser focus on cognitive restructuring (Hollon & Beck, 2004), and the infusion of parenting focused skills in each session. The Mom-Net CBT sessions were structured as follows: (1) intervention rationale, (2-3) behavioral activation, (4-5) interpersonal skills (e.g., social support and play skills with children), (6) savoring, (7) negative thinking, and (8) planning for the future. On average, mothers completed 6.4 ($SD = 2.6$) sessions and spent 15.1 ($SD = 6.2$) hours on the website.

Coaches scheduled weekly, 15-20 minute phone conferences with participants. Coaches assisted mothers in understanding and applying the CBT strategies. They recognized participants' accomplishments, reviewed content that the participant had not yet "mastered," and answered questions. Reluctance or barriers to engaging in the intervention were addressed within an MI framework, with coaches making reflective statements, emphasizing positive statements, helping mothers to identify if goals had changed, and problem-solving ways to meet their goals. Three of the four coaches had master's degrees and two were layperson who did not have an advanced degree. Coaches completed an average of 6.5 ($SD = 2.4$) coach calls with an average duration of 19.1 ($SD = 6.2$) minutes.

DI/TAU. Mothers randomized to the DI/TAU condition were provided with a description of community agencies that provided counseling services, and assistance in making the initial contact. The description included information about services offered, payment options (Medicaid; sliding scale; no-cost), and contact information. They were offered the Mom-Net intervention subsequent to the post-intervention assessment.

Statistical analyses. Mediation analyses were conducted with Mplus 7.1 software (Muthén & Muthén, 1998–2012) utilizing bias-corrected bootstrap resampling to obtain empirical confidence intervals (CI) to evaluate significance of indirect paths (MacKinnon,

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3 Lockwood, & Williams, 2004; Shrout & Bolger, 2002). Shrout & Bolger (2002) have argued that
4
5 bootstrap CIs offer the most statistically efficient approach to testing mediated effects. Simple
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7 mediation models tested each putative mediator independently followed by tests of multiple
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9 mediation that simultaneously included all three mediators in the model to assess the salient
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11 contributions of each mediator (see Figure 1). The total effect of the intervention condition on
12
13 post-intervention depression symptoms (denoted by c) is the sum of the direct effect (c' path)
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15 and indirect effect ($a \times b$ paths) such that $c = c' + (a \times b)$. In all models, the primary outcome
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17 and mediators were treated as change indicants such that post-intervention measures were
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19 regressed on their baseline counterparts. Standardized regression coefficients (b^*) are reported
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21 for the model paths. For the bias-corrected bootstrap estimation of the indirect effect ($a \times b$), the
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23 95% CIs are reported; the indirect effect is statistically significant ($p < .05$) if zero is not
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25 contained within the 95% CI. The missing values analysis (MVA) module of SPSS 23.0 was utilized
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27 to produce a single imputed dataset for all randomized participants on variables of interest.
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32 33 **Results and Discussion**

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35 The descriptive statistics for the pre- and post-intervention measures by study condition
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37 for Trial 1 are reported in the upper half of Table 1. The standardized coefficients for the simple
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39 mediation models are presented in upper half of Table 2. As shown in the “a path” column, the
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41 Mom-Net condition was significantly related to improved behavioral activation ($b^* = .43$, $p <$
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43 $.001$), decreased negative thinking ($b^* = -.29$, $p = .002$), and increased savoring ($b^* = .30$, $p =$
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45 $.002$). In turn, all three change indicants for the mediators were significantly related to post-
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47 intervention BDI II scores adjusted for baseline levels (b path): behavioral activation ($b^* = -.68$,
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49 $p < .001$), negative thinking ($b^* = .78$, $p < .001$), and savoring ($b^* = -.30$, $p = .006$). The overall
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51 indirect path ($a \times b$) for each mediator was also significant: behavioral activation ($b^* = -.29$,
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53 95% CI = $-.45$ to $-.17$), negative thoughts ($b^* = -.23$, 95% CI = $-.37$ to $-.07$), and savoring ($b^* = -$
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.09, 95% CI = -.21 to -.03). Further evidence for full mediation in the cases of the behavioral activation and negative thoughts variables were found given that the direct path from intervention condition to adjusted post-intervention BDI II score was reduced to non-significance (c path vs. c' path). With respect to savoring, the c' path remained significant after accounting for the indirect effect, which indicates the direct effect was only partially mediated.

The correlation between the pre-post residual change scores were: behavioral activation and negative thinking $r = -.56$, behavioral activation and savoring $r = .49$, and negative thinking and savoring $r = -.46$; all p 's < .001. The multiple mediator model provided additional evidence for the unique importance of both the behavioral activation and negative thinking mediators with significant unique indirect paths obtained ($b^* = -.16$ [95% CI = -.29 to -.03] and $b^* = -.19$ [95% CI = -.32 to -.03], respectively). The multiple mediator model did not support the unique contribution of savoring ($b^* = .01$, 95% CI = -.03 to .05). Consistent with the simple mediation models for behavioral activation and negative thinking, the multiple mediation model also provided evidence of full mediation of the association between intervention condition and post-intervention adjusted BDI II score, with the direct path (c') reduced to non-significance ($b^* = -.07$, $p > .05$).

The results for Trial 1 suggest that all three of the putative mechanisms provided some evidence for mediating the association between intervention condition and post-intervention depression symptoms. Hence, the findings provide support for the theoretical underpinnings of the CBT intervention targets. However, savoring only partially mediated the Mom-Net intervention effects in the simple mediation model and did not emerge as a salient mediator in the multiple mediation model, whereas both improved behavioral activation and decreased negative thinking uniquely mediated the intervention effects. The implication of these findings

are discussed below in conjunction with the findings from Trial 2.

Trial 2

Method

Design. Participants were individually randomized (allocation ratio of 1:1) into two parallel intervention groups: Internet-facilitated CBT intervention (Mom-Net) or Motivational Interview and Referral to Services (MIRS). Research staff were blind to randomization sequence until allocation was revealed during the motivational interview process. Assessments were conducted at pre- and post-intervention (26 week delay). The trial was conducted with approval of an appropriate institutional review board and registered with ClinicalTrials.gov. A more detailed description of trial methods is provided in Sheeber et al. (2017).

Participants. Low-income mothers of pre-school aged children ($n = 266$) participated in the study. Inclusion criteria were major or minor depression as reported on a screening assessment with the Patient Health Questionnaire 8 (PHQ-8; Kroenke & Spitzer, 2002), the ability to comprehend spoken English, and living at or below 185% of the federal poverty level. As in Trial 1, Head Start centers were our primary point of contact. Potential participants received a consent letter and the PHQ-8 (Kroenke & Spitzer, 2002). Of mothers completing the questionnaire, approximately 15% were eligible for further participation; the mean PHQ-8 score of the participant sample was 14.8 ($SD = 4.4$; range = 5.0 – 24.0). Participants were 11.7% Hispanic and 79.3% White, 58.3% had some college education, 60.2% were married or cohabitating, and the average age was 31.8 years old ($SD = 7.2$; range = 17.7 – 59.8). Approximately half (51.2%) of the children were female with an average age of 4.4 ($SD = 1.3$; range = 3.2 – 6.5) years. Of the 266 participants, 237 (89.1%) completed the post-intervention survey; rates of missing data for study variables was < 1% at baseline and 13–18% at posttest.

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3 **Measures.** The following measures were completed at pre- and post-intervention and
4 included in the mediation analyses.
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7 **Maternal Depression.** The PHQ-9 was administered as an index of depressive symptoms
8 at each full assessment point. The reliability and diagnostic accuracy of both versions of the
9 PHQ-9 are well established and the measure has been shown to be sensitive to change (Kroenke
10 & Spitzer, 2002; Kroenke, Spitzer, & Williams, 2001; Kroenke et al., 2009; Spitzer et al., 1999;
11 Titov et al., 2011).
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18 **Mediators.** The mediating measures were the same as those described in Trial 1,
19 including the BADS as a measure of behavioral activation, the ATQ as a measure of negative
20 thinking, and the PASPO as a measure of savoring.
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26 **Interventions.** As described above in Trial 1, an MI protocol was conducted prior to
27 intervention with participants in both of the following conditions.
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30 **Mom-Net.** The Mom-Net intervention was the same as described above for Trial 1.
31 However, coaches in this Trial 2 were bachelor and masters level mental health staff at a
32 community mental health agency. On average, mothers completed 6.6 ($SD = 2.4$) sessions and
33 spent 5.5 ($SD = 3.2$) hours on the website. Coaches completed an average of 6.9 ($SD = 4.8$)
34 coach calls with an average duration of 33.5 ($SD = 20.2$) minutes.
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42 **Motivational Interviewing and Referral to Services (MIRS).** The MIRS condition
43 included several features consistent with patient navigation strategies developed for chronic
44 conditions (Dohan & Schrag, 2005; Freeman & Rodriguez, 2011; Natale-Pereira, Enard,
45 Nevarez, & Jones, 2011) including depression (Diaz-Linhart et al., 2016). These include an MI
46 engagement interview, referral to community services, and ongoing monitoring and support. As
47 noted earlier, participants in the MIRS condition participated in the MI engagement interview at
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3 the conclusion of the pre-intervention assessment. Research staff then provided mothers with
4 information about, and referrals to, community providers who serve low-income individuals.
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7 Research staff offered to initiate contact with the treatment provider to make an initial
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10 appointment. Participants also received biweekly motivational calls from a coach during the
11
12 intervention period; these calls lasted an average of 20.4 minutes. Working within an MI
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14 framework, the coach: (a) checked in with mothers about the concerns they had raised in the MI;
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16 (b) queried as to what mothers were doing to seek/engage in mental health services and to
17
18 otherwise improve their mood; and (c) used reflective statements to emphasize mothers' change
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20 statements. Coaching staff consisted of two bachelor's level and one doctoral level nonclinical
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22 staff.
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26 **Statistical analyses.** The mediation analyses followed the same approach as those
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28 describe above for Trial 1.
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31 **Results and Discussion**

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33 The descriptive statistics for the pre- and post-intervention measures by study condition
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35 for Trial 2 are reported in the lower half of Table 1. The standardized coefficients for the simple
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37 mediation models are presented in the lower half of Table 2. As shown in the "a path" column,
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39 the Mom-Net condition was significantly related to improved behavioral activation ($b^* = .14$, $p =$
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41 $.01$), decreased negative thinking ($b^* = -.13$, $p = .011$), and increased savoring ($b^* = .12$, $p =$
42
43 $.016$). In turn, all three change indicants for the mediators were significantly related to post-
44
45 intervention PHQ-9 scores adjusted for baseline levels (b path): behavioral activation ($b^* = -.54$,
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47 $p < .001$), negative thinking ($b^* = .61$, $p < .001$), and savoring ($b^* = -.31$, $p < .001$). The overall
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49 indirect path (a X b) for each mediator was also significant: behavioral activation ($b^* = -.08$,
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51 95% CI = $-.14$ to $-.02$), negative thinking ($b^* = -.08$, 95% CI = $-.14$ to $-.02$), and savoring ($b^* = -$
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.04, 95% CI = -.08 to -.02). Further evidence for full mediation in the case of the behavioral activation was found given that the direct path from study condition to adjusted post-intervention PHQ-9 score was reduced to non-significance (c path vs. c' path). With respect to negative thinking and savoring, the c' path remained significant after accounting for the indirect effect, which indicates the direct effect was only partially mediated in these two simple mediation models.

The correlation between the pre-post residual change indicants were: behavioral activation and negative thinking $r = -.70$, behavioral activation and savoring $r = .42$, and negative thinking and savoring $r = -.31$; all $p < .001$. The multiple mediator model provided additional evidence for the unique importance of both the behavioral activation and negative thinking mediators with significant unique indirect paths obtained ($b^* = -.04$ [95% CI = -.10 to -.01] and $b^* = -.06$ [95% CI = -.11 to -.01], respectively). The multiple mediator model did not support the unique contribution of savoring ($b^* = -.01$, 95% CI = -.04 to .00). Consistent with the simple mediation models for behavioral activation and negative thoughts, the multiple mediation model also provided evidence of full mediation of the association between treatment condition and post-intervention adjusted PHQ-9 score, with the direct path (c') reduced to non-significance ($b^* = -.08$, $p > .05$).

Similar to Trial 1, all three of the putative mechanisms provided some evidence for mediating the association between intervention condition and post-intervention depression symptoms. However, negative thinking and savoring only partially mediated the Mom-Net intervention effects when evaluated in the simple mediation models. With respect to the multiple mediation model, both behavioral activation and negative thoughts uniquely mediated the Mom-Net intervention effects. Replicating the findings from Trial 1, savoring did not emerge as a

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3 salient mediator in the multiple mediation model.
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5 **General Discussion**

6
7 The findings from the mediation analyses were remarkably similar across the two Mom-
8 Net trials. The systematic replication of effects is rather striking given that the initial
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10 development trial would be considered more explanatory in nature whereas the subsequent RCT
11
12 would be considered as more pragmatic (cf. Glasgow, 2013). That is, the implementation of the
13
14 Mom-Net intervention in the initial trial was administered by the research staff under highly
15
16 controlled conditions whereas the implementation of the second trial was administered through a
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18 community mental health center by clinicians. In addition, the second trial included a more
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20 rigorous comparison condition that received ongoing motivational interviewing and referral to
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22 community treatment providers through biweekly phone contact with a coach. These differences
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24 between the two trials may explain the attenuated effects of the Mom-Net intervention on
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26 depression outcome as well as on the mediators in the second trial. Despite the differences
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28 between the two trials, the pattern of results for the mediating effects were similar and suggest
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30 that behavioral activation and negative thinking are salient mediators of the Mom-Net
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32 intervention, with savoring showing more limited effects.
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40 Previous studies that examined mediators of internet-based CBT for depression have
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42 found support for changes in cognitions or negative thinking mediating change in depression
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44 (e.g., Forand, Barnett, Strunk, Hindiyeh, Feinberg, & Keffe, 2018; Newby, Williams, &
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46 Andrews, 2014; and Warmerdam, van Straten, Jongasma, Twisk & Cuijpers, 2010). Forand and
47
48 colleagues (2018) also examined whether changes in behavioral activation mediated the effects
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50 of the Beating the Blues United State v2.5 (BtB) intervention compared to a waitlist control
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52 condition. In contrast to finding support for cognitive skills as a mediator of depression,
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behavioral activation did not emerge as a significant mediator in their study. The difference between the current study findings and Forand et al. (2018) could be related to the stronger emphasis on behavioral activation skills in the Mom-Net program compared to the BtB program, which has a stronger emphasis on cognitive skills training.

Behavioral activation has a rich history as an effective change mechanism for ameliorating depression and improving wellbeing (e.g., Cuijpers, van Straten, & Warmerdam, 2007; Jacobson et al., 1996; Mazzucchelli, Kane, & Rees, 2010; Morgan, Mackinnon, & Jorm, 2013). In addition, the cognitive therapy component of CBT also has extensive support as an effective change agent for decreasing negative thinking and improving depression (Hollon & Beck, 2004). However, the research evidence for the impact of savoring processes on regulating positive emotions and reducing depression is more limited (see Bryant, Chadwick, & Kluwe, 2011; Carver & Johnson, 2009. McMakin, Siegel, & Shirk, 2011). Moreover, Bryant, Chadwick, and Kluwe (2011) have argued that the current methods of measuring savoring processes and their mediating effects are inadequate and new methods are needed to investigate savoring processes in real time. The retrospective measurement of savoring processes with self-reported recall scales such as the PASPO used in the present study may not provide the most effective method to measure savoring of events as they occur.

There are additional limitations of the present study that warrant comment. Mediation is based on the premise that change in the targeted mechanisms temporally precede the change in the treatment outcome (Kazdin & Nock, 2003; Kazdin, 2007). Although both trials evaluated whether pre-post change in the mediators accounted for pre-post change in depressive symptoms, the temporal precedence criterion was not met. A previous investigation that attempted to test the temporal precedence of CBT change mechanisms found that changes in depressive symptoms

MEDIATION OF COGNITIVE BEHAVIORAL INTERVENTION

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3 were not subsequent to changes in behavioral activation or negative thinking (Stice, Rohde,
4 Seeley, & Gau, 2010). As Kazdin (2007) points out, treatment study designs that incorporate
5 more fine-grained assessments of change mechanisms at each treatment session are needed to
6 advance our understanding of change mechanisms in this regard. Relatedly, these studies
7 examined short-term outcomes. It is not clear from these findings whether changes in the
8 observed mediators will contribute to maintenance of treatment effects. Another study limitation
9 includes the lack of diversity in the two samples. Future research will be needed to determine if
10 effects generalize to more diverse samples. As well, though the intervention included a focus on
11 parenting, we did not examine change in parenting behavior or self-efficacy as mediators of
12 change. This is a direction for future research. Finally, the current investigation cannot
13 disentangle the treatment processes associated with use of the website and skill practice from
14 more general therapeutic effects of the coaching support.
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31 In terms of additional future research directions, the examination of dose-response
32 relations would help to bolster the evidence for mediating effects of the putative change
33 mechanisms (Kazdin, 2007). Accordingly, we plan to examine the association between
34 treatment outcome and Mom-Net website engagement (e.g., sessions completed, online
35 interactive skill activities completed, mood and activity tracking, number of visits) and
36 engagement in coach calls. In addition, the adaptation of the Mom-Net intervention for mobile
37 delivery (i.e., smartphones) would facilitate ecological momentary assessment of the putative
38 mediators in real time as well as delivery of just-in-time intervention content (e.g., prompting for
39 engagement and savoring of pleasant events).
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51 In closing, results of these two studies provide support for the role of increased
52 behavioral activation and reduced negative cognitions, and some support for the role of savoring
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MEDIATION OF COGNITIVE BEHAVIORAL INTERVENTION

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3 positive events as mediators of the relationship between intervention and depressive outcomes.
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5 To our knowledge, this is the first study to explore these mediators in an internet-delivered CBT
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7 intervention for maternal depression. Hence, the study advances our knowledge by peering into
8
9 the 'black box' of the intervention to identify the putative mechanisms of change.
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Table 1

Descriptive Statistics for the Baseline and Post-Intervention Measures by Study Condition for Trials 1 and 2

| | Pre-Intervention | | Post-Intervention | |
|-----------------------|----------------------|----------------------|----------------------|----------------------|
| | Mom-Net | Control | Mom-Net | Control |
| | <u><i>M (SD)</i></u> | <u><i>M (SD)</i></u> | <u><i>M (SD)</i></u> | <u><i>M (SD)</i></u> |
| Trial 1 (n = 70) | | | | |
| Depressive symptoms | 26.29 (9.95) | 25.43 (8.96) | 13.44 (10.38) | 22.54 (11.02) |
| Behavioral activation | 90.29 (24.20) | 92.29 (27.02) | 122.27 (27.18) | 98.97 (25.54) |
| Negative thoughts | 78.56 (27.47) | 81.54 (28.57) | 56.82 (27.27) | 75.31 (27.58) |
| Savoring | -0.07 (0.66) | 0.07 (0.76) | 0.18 (0.62) | -0.17 (0.68) |
| Trial 2 (n = 266) | | | | |
| Depressive symptoms | 14.03 (5.00) | 14.43 (5.98) | 6.35 (4.38) | 8.14 (5.30) |
| Behavioral activation | 89.01 (26.89) | 85.49 (29.52) | 114.55 (26.53) | 105.13 (27.93) |
| Negative thoughts | 83.21 (30.60) | 82.63 (30.62) | 56.65 (23.97) | 63.13 (27.66) |
| Savoring | -0.02 (0.69) | -.04 (0.74) | 0.09 (0.61) | -0.09 (0.69) |

Note. Depressive symptoms were measured with the Beck Depression Inventory-II in Trial 1 and the Patient Health Questionnaire-9 in Trial 2. In both trials, behavioral activation was measure with the Behavioral Activation for Depression Scale, negative thoughts were measured with the Automatic Thoughts Questionnaire, and savoring was measured with the Perceived Ability to Savor Positive Outcomes scale. The control condition included a delayed intervention/facilitated treatment-as-usual in Trial 1 and a motivation interview and referral to services in Trial 2.

Table 2

Bootstrapped Point Estimates (b*) and Confidence Intervals (CI) for the Indirect Effects and Path Coefficients for the Simple Mediation Models of Study Condition on Depressive Symptoms for Trials 1 and 2

| | Indirect (a X b) path | | | a path | | | b path | | | c path | | | c' path | | |
|-----------------------|-----------------------|------|----------------|--------|------|-------|--------|------|-------|--------|------|-------|---------|------|-------|
| | b* | SE | 95% CI | b* | SE | p | b* | SE | p | b* | SE | p | b* | SE | p |
| Trial 1 | | | | | | | | | | | | | | | |
| Behavioral activation | -0.29 | 0.08 | -0.45 to -0.17 | 0.43 | 0.09 | <.001 | -0.68 | 0.11 | <.001 | -0.42 | 0.1 | <.001 | -0.13 | 0.1 | 0.216 |
| Negative thoughts | -0.23 | 0.07 | -0.37 to -0.07 | -0.29 | 0.1 | 0.002 | 0.78 | 0.06 | <.001 | -0.38 | 0.1 | <.001 | -0.15 | 0.08 | 0.060 |
| Savoring | -0.09 | 0.04 | -0.21 to -0.03 | 0.30 | 0.1 | 0.002 | -0.30 | 0.11 | 0.006 | -0.43 | 0.1 | <.001 | -0.33 | 0.11 | 0.002 |
| Trial 2 | | | | | | | | | | | | | | | |
| Behavioral activation | -0.08 | 0.03 | -0.14 to -0.02 | 0.14 | 0.06 | 0.010 | -0.54 | 0.05 | <.001 | -0.16 | 0.06 | 0.005 | -0.08 | 0.05 | 0.082 |
| Negative thoughts | -0.08 | 0.03 | -0.14 to -0.02 | -0.13 | 0.05 | 0.011 | 0.61 | 0.05 | <.001 | -0.18 | 0.06 | 0.001 | -0.10 | 0.04 | 0.018 |
| Savoring | -0.04 | 0.02 | -0.08 to -0.01 | 0.12 | 0.05 | 0.016 | -0.31 | 0.06 | <.001 | -0.17 | 0.06 | 0.002 | -0.13 | 0.05 | 0.013 |

Note. Depressive symptoms were measured with the Beck Depression Inventory-II in Trial 1 and the Patient Health Questionnaire-9 in Trial 2. In both trials, behavioral activation was measure with the Behavioral Activation for Depression Scale, negative thoughts were measured with the Automatic Thoughts Questionnaire, and savoring was measured with the Perceived Ability to Savor Positive Outcomes scale.

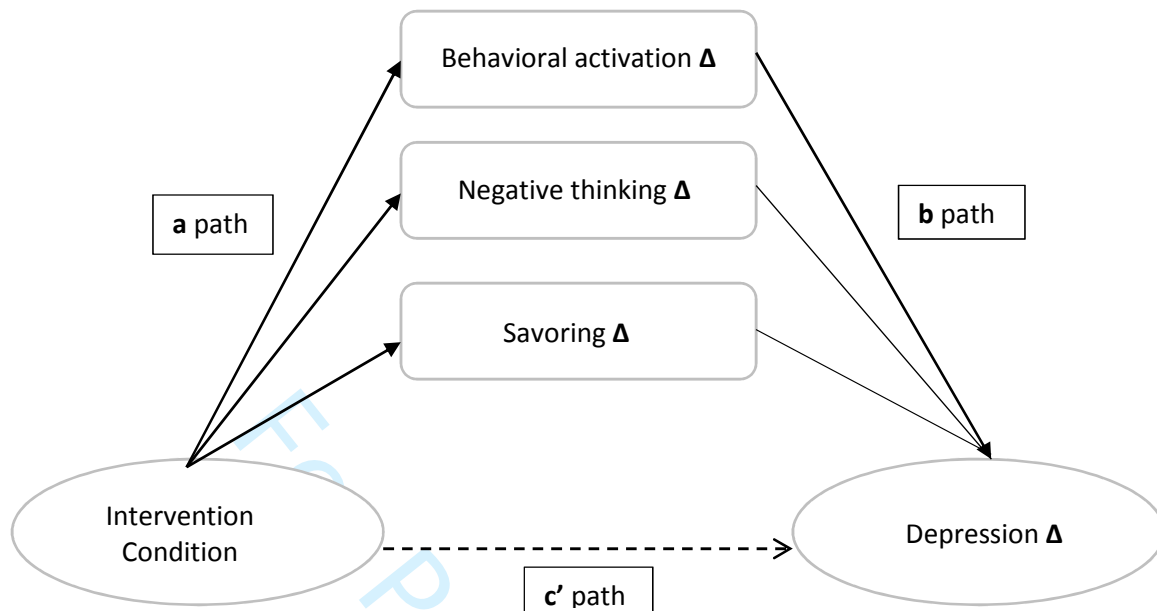


Figure 1. Multiple mediation model of intervention condition on depression symptoms at post-intervention.