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# Changes in Saving Cognitions Mediate Hoarding Symptom Change in Cognitive-Behavioral Therapy for Hoarding Disorder

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## Abstract

Cognitive-behavioral therapy (CBT) is an empirically-supported treatment for hoarding disorder (HD). However, meta-analytic studies suggest that CBT is only modestly effective, and a significant number of individuals with HD remain symptomatic following treatment. To inform the development of more effective and targeted treatments, it will be important to clarify the mechanisms of treatment response in CBT for HD. To this end, the current study examined whether change in maladaptive saving beliefs mediated symptom change in CBT for HD. Sixty-two patients with primary HD completed measures of maladaptive saving cognitions and hoarding severity at pre-, mid-, and post-CBT. Results showed that change in saving cognitions mediated change in all three domains of HD symptoms (i.e., acquiring, difficulty discarding, and excessive clutter), suggesting that cognitive change may be a mechanism of treatment response in CBT. The findings indicate that cognitive change may have an impact on treatment outcomes, and are discussed in terms of cognitive-behavioral theory of HD and potential ways in which to enhance belief change in treatment.

### Keywords

CBT; hoarding disorder; cognitive change; mechanism; mediation

Cognitive-behavioral therapy (CBT) is an empirically supported treatment for hoarding disorder (HD; Tolin, Frost, Steketee, & Muroff, 2015; Williams & Viscusi, 2016). However, rates of clinically significant change in HD symptoms are modest: A recent meta-analysis of

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CBT for HD found that only 35% of treatment-seeking patients achieve clinically significant change following treatment, leaving 65% in the pathological range (Tolin et al., 2015). Unfortunately, efforts to enhance the efficacy of CBT for HD (e.g., by including home visits) have been largely unsuccessful. Group CBT without home visits was comparably effective to individual CBT with home visits (Gilliam et al., 2011), and increasing the number of home visits from four to eight did not significantly enhance group CBT outcomes (Muroff, Steketee, Bratiotis, & Ross, 2012). Furthermore, treatment of hoarding can be lengthy (typically around 20–26 sessions) and labor-intensive, and compliance with treatment procedures is often low (Ayers, Bratiotis, Saxena, & Wetherell, 2012). Therefore, identifying both effective mechanisms of change and ineffective elements of existing protocols can inform more efficient and targeted HD treatments.

One candidate mechanism in CBT for HD is belief change, or the disconfirmation of erroneous or unhelpful beliefs that serve to maintain clinical symptoms. Prior research suggests that HD is associated with multiple overvalued beliefs about the importance of possessions. These beliefs include exaggerated sentimental attachment to or anthropomorphizing of objects; aversion to wastefulness; and fears of losing, missing or not remembering important information (Dozier & Ayers, 2014; Steketee, Frost, & Kyrios, 2003). These maladaptive beliefs are characterized by overestimation of the likelihood and severity of feared consequences, particularly fears of what may result from not saving or not acquiring objects. Such hoarding-related beliefs, as measured by the Saving Cognitions Inventory (SCI; Steketee et al., 2003), are moderately to highly correlated with severity of hoarding on self-report measures such as the Saving Inventory-Revised (SI-R; Frost, Steketee, & Grisham, 2004) and reliably differentiate hoarding from other disorders (Steketee et al., 2003; Wheaton, Fabricant, Berman, & Abramowitz, 2013). Wheaton et al. (2013) found that hoarding-related beliefs as measured by the SCI explained additional variance (26%) in SI-R scores over and above experiential avoidance and general distress (symptoms of depression and anxiety). When individual SI-R subscales were examined, the SCI explained significant variance in the acquiring and difficulty discarding subscales (reflecting the key behavioral elements of HD), but not in the clutter subscale (which may be attributable to additional error variance in this environmental consequence of hoarding behaviors). Similarly, in a laboratory study, compared to healthy control participants, those with HD reported stronger beliefs related to emotional attachment, responsibility, memory, utility, and aesthetic appeal when considering both a personal possession and a magazine given to them by the experimenter (Frost, Ong, Steketee, & Tolin, 2016). Taken together, the extant literature supports the notion that maladaptive beliefs are relevant to HD symptomatology.

The next step for this research is to determine whether change in these maladaptive hoarding-related beliefs mediates treatment outcome in CBT for HD. To our knowledge, no prior studies have examined this important clinical question. Previous studies suggest that cognitive change explains unique variance in CBT outcome and mediates change for a variety of related disorders, including depression, anxiety disorders, and obsessive-compulsive disorder (OCD; e.g., DeRubeis et al., 1990; Hofmann et al., 2007; Olatunji et al., 2013; Quilty, McBride, & Bagby, 2008; Vogele et al., 2010; Webb, Kertz, Bigda-Peyton, & Bjorgvinsson, 2013). However, in a laboratory-based discarding task, the number of items

saved were equivalent for HD participants who did and did not report a reduction in maladaptive beliefs (Frost et al., 2016). Thus, from prior clinical research it seems reasonable to expect that change in maladaptive saving beliefs may mediate symptom change in CBT for HD, although laboratory findings potentially contradict this hypothesis.

To help clarify the role of maladaptive beliefs within the context of HD treatment, the aim of the current study was to examine whether pre- to post-treatment change in hoarding-related beliefs mediates symptom change in CBT for HD. As mentioned previously, to our knowledge no prior studies have examined cognitive mediation in CBT for hoarding. Given the recent study by Frost et al. (2016), we felt it was important to assess whether cognitive change is even important to successful outcomes in CBT for HD, prior to conducting additional research to find out how best to target maladaptive beliefs in this population. In line with Wheaton and colleagues (2013), it was hypothesized that cognitive change as assessed by the SCI would mediate HD symptom change for the acquiring and difficulty discarding subscales of the SI-R, but not for the clutter subscale.

## Method

### Participants

Participants were 62 patients with a primary diagnosis of HD who came from two sources, including a waitlist-controlled trial of individual CBT for HD ($n = 35$; Steketee, Frost, Tolin, Rasmussen, & Brown, 2010), and patients who completed group CBT for HD in an outpatient specialty clinic ($n = 27$). All participants were adults 18 years of age or older whose most severe problem was non animal-related HD; patients were excluded from treatment if they presented with current psychosis or active bipolar disorder, or were judged by the intake clinician to have cognitive impairment (e.g., dementia, brain injury) severe enough to interfere with comprehension of treatment content. The waitlist-controlled trial had additional inclusion criteria that were not present in the outpatient group, including having at least moderate HD severity as assessed by the Hoarding Rating Scale-Interview (HRS-I; Tolin, Frost, & Steketee, 2010), no substance use disorder in the past six months, no concurrent psychotherapy, and no psychiatric medication in the past month. For the purposes of the current study, only individuals who completed CBT and at least the pre-treatment self-report measures were included in the analyses that follow. As reported by Steketee et al. (2010), nine of 46 total participants in the individual treatment trial dropped out before completing treatment. An additional two participants were excluded from the current study due to incomplete data, leaving a final sample of 35 participants from the parent trial. Of the 57 patients who began outpatient group treatment, 12 dropped out and an additional 18 had missing pre-treatment self-report data, leaving a final sample of 27 patients from the outpatient clinic.

### Measures

The *Anxiety Disorders Interview Schedule for DSM-IV* (ADIS-IV; Brown, Di Nardo, Lehman, & Campbell, 2001), the *Mini-International Neuropsychiatric Interview Plus* (MINI Plus; Sheehan et al., 1997; Sheehan et al., 1998), or the *Diagnostic Interview for Anxiety, Mood, and Obsessive-Compulsive and Related Neuropsychiatric Disorders* (DIAMOND;

Tolin et al., 2016) was used to determine diagnoses. All 35 participants from the parent trial (Steketee et al., 2010) completed the ADIS-IV. In the outpatient clinic group, 20 patients completed the DIAMOND and seven completed the MINI Plus. The ADIS-IV and MINI Plus are both widely used structured diagnostic interviews based on the DSM-IV criteria, and therefore did not include a specific module on HD. To verify HD diagnosis, participants who completed the ADIS-IV also completed the HRS-I. Similarly, those who completed the MINI Plus answered additional questions to confirm HD diagnosis, including the severity of clutter in the home, presence of excessive acquisition, difficulty discarding, and the distress and impairment associated with these symptoms. The DIAMOND is a newly developed structured diagnostic interview based on the DSM-5 with good reliability and validity estimates for anxiety, mood, and depressive disorders. The DIAMOND has a specific module for assessing HD, so no additional measures to determine HD diagnosis were needed.

Interviewers were advanced level psychology graduate students, psychology postdoctoral fellows, or licensed psychologists who were trained in diagnostic interviewing, including how to diagnose HD. Prior to conducting these interviews, interviewers attended didactic training on the administration of the structured interview they would be utilizing (i.e., ADIS-IV, DIAMOND, or MINI Plus). In addition, the interviewers both observed and were observed by experienced clinicians with expertise in administering the interviews. Interviewers received ongoing supervision of the diagnostic interviews from licensed psychologists with significant experience in diagnostic interviewing.

The *Saving Inventory-Revised* (SI-R; Frost et al., 2004) was administered to assess hoarding symptom severity. The SI-R is a self-report questionnaire that contains 23 items and three subscales: compulsive acquisition, difficulty discarding, and cluttered living spaces. Each item ranges from 0 to 4, with a total score ranging from 0 to 92 and higher scores indicating greater hoarding severity. Mean scores among those with clinically significant hoarding generally fall above 50, whereas mean scores among non-hoarding samples fall between 22–24. The SI-R has demonstrated adequate internal and retest reliability, as well as strong convergent and discriminant validity (Frost et al., 2004). Internal consistency estimates were acceptable for the current sample at all time points (pre-treatment, SI-R total score, $\alpha = .89$, SI-R subscales, all $\alpha s \geq .79$; mid-treatment, SI-R total score, $\alpha = .92$, SI-R subscales, all $\alpha s \geq .82$; post-treatment, SI-R total score, $\alpha = .94$, SI-R subscales, all $\alpha s \geq .86$).

The *Saving Cognitions Inventory* (SCI; Steketee et al., 2003) was used to assess participants' beliefs about saving. The SCI is a self-report measure containing 24 items and four subscales: emotional attachment (e.g., "Losing this possession is like losing a friend"), concerns about memory (e.g., "Saving this means I don't have to rely on my memory"), control over possessions (e.g., "I like to maintain sole control over my things"), and responsibility towards possessions (e.g., "I am responsible for the well-being of this possession"). Respondents rate on a Likert-type scale from 1 to 7 the extent to which they experienced each thought when attempting to discard an object within the past week, with total scores ranging from 24 to 168. The SCI has demonstrated good internal consistency and convergent and discriminant validity. Internal consistency estimates were acceptable for the current sample at all time points (pre-treatment, SCI total score, $\alpha = .94$, SCI subscales,

all αs ≥ .75; mid-treatment, SCI total score, α = .93, SCI subscales, all αs ≥ .75; post-treatment, SCI total score, α = .93, SCI subscales, all αs ≥ .72).

## Procedure

All participants were initially evaluated by a trained clinician who administered the ADIS-IV, MINI Plus, or DIAMOND (see Measures). During this evaluation visit, participants also completed the SI-R and SCI. Participants in the wait-list controlled trial were randomly assigned to begin CBT immediately or after a 12-week waiting period. There was no wait period for those who completed group CBT. All participants completed the same self-report measures to assess symptom change at mid-treatment (week 12 for patients in the individual CBT trial and week 8 for patients in the outpatient group) and at post-treatment.

The waitlist-controlled trial was approved by the local institutional review boards at Boston University and Hartford Hospital, where the study was conducted. Participants in the trial provided informed consent during their first study visit, prior to the diagnostic assessment. Because data from the outpatient group were collected as part of routine clinical care and not a research study, participants did not provide informed consent for research. Instead, there was a waiver of consent in place.

## Treatment

Therapists were advanced-level clinical psychology graduate students, masters-level social workers, psychology postdoctoral fellows, and licensed psychologists with expertise in HD. All therapists were experts in providing CBT and received extensive on-site training in providing CBT for HD, including didactic seminars and reviewing videotapes demonstrating CBT interventions relevant for treating HD. All therapists who were not licensed psychologists received weekly supervision from one of these authors (RF, GS, DT, BW, or CG), all of whom are experts in diagnosing and treating HD.

Participants received either 26 sessions of individual CBT or 16–20 sessions of group CBT. The individual treatment consisted of weekly 60-minute in-office sessions with every fourth session lasting four hours and occurring in the participant's home or at a potential acquiring location. Group sessions consisted of weekly 90-minute sessions in an outpatient clinic. Treatment was based on a cognitive-behavioral manual (Steketee & Frost, 2007). Interventions included psychoeducation about hoarding, motivational enhancement techniques (e.g., motivational interviewing), skill-building (e.g., problem solving skills training), and relapse prevention. Treatment also included cognitive restructuring to address beliefs that may interfere with discarding or non-acquiring. Specific cognitive skills included discussing the association between negative thoughts and emotions, identifying maladaptive saving beliefs in "real time" during discarding, and Socratic questioning during discarding (e.g., "Will anything terrible happen to you if you don't save this item?"). In the waitlist-controlled trial, these skills were applied flexibly based on individualized treatment plans and treatment progress. In the outpatient group, treatment was more standardized, with 2–3 sessions devoted specifically to cognitive restructuring. In both treatments, we made efforts to simplify the cognitive skills in order to enhance learning and skills acquisition, such as by providing lists and descriptions of cognitive skills that could be used during discarding and

conducting in-session skills practice using worksheets, diagrams, and flow charts. In both treatments, most of the sessions included in-session practicing of making decisions about discarding or keeping possessions, actual discarding of possessions, and resisting acquiring. In general, the treatments provided were more behavioral (i.e., focused on changing behaviors) than cognitive (i.e., focused on changing thinking).

## Statistical Analyses

To assess symptom change from pre- to post-treatment, a series of paired-samples *t* tests on SCI and SI-R total and subscale scores was conducted. To assess mediation, we employed the PROCESS macro for SPSS, an ordinary least squares regression-based approach which uses bootstrapping to generate a 95% confidence interval for the indirect effect of the independent variable on the dependent variable through the mediator variable (Hayes, 2013). PROCESS uses 5,000 bootstrap samples to generate the 95% confidence interval for the indirect effect. In all models, the independent variable was time with three levels (pre-, mid-, and post-treatment) and the dependent variable was SI-R total or subscale scores. Mediator variables were SCI total or subscale scores, which were assessed separately. As described by Hayes (2013), there is evidence of mediation if the 95% bootstrap confidence interval does not include zero.

Following Meuret, Rosenfield, Hofmann, Suvak, and Roth (2009), who conducted similar mediation models in repeated-measures open trial data, we checked for “reverse mediation”; in this case, whether changes in hoarding symptoms mediated changes in saving beliefs. These models were identical to those described above, except that the dependent variable (SI-R) and mediator variable (SCI) were reversed.

A critical consideration for mediation analyses is establishing temporal precedence of the mediator (Kazdin, 2007; i.e., that change in saving cognitions preceded change in hoarding severity). Because the SCI and SI-R were administered at the same time points throughout the study, the mediation models described above do not establish temporal precedence. Also following Meuret et al. (2009), we ran a series of hierarchical regression models to examine temporal precedence, with SI-R mid- and post-treatment scores as the dependent variables and SCI scores at the prior time point as the predictor. All regression models controlled for prior SIR scores in Step 1. To check for reverse mediation, we repeated these analyses with SCI scores as the dependent variables and SI-R scores as the predictors.

## Results

### Sample Characteristics

As shown in Table 1, most patients were female ($n = 50$, 80.7%), with a mean age of 56.55 ($SD = 7.49$) years. In addition to HD, most of the sample had comorbid diagnoses ($n = 37$, 59.7%), most commonly major depressive disorder ($n = 19$, 30.7%), social anxiety disorder ($n = 8$, 12.9%), specific phobia ($n = 7$, 11.3%), and generalized anxiety disorder ($n = 7$, 11.3%). Participants from the individual trial and the outpatient clinic group did not differ on demographic characteristics or pre-treatment symptom severity, except for psychiatric medication status.

### Treatment Outcome

As shown in Table 2, HD severity and maladaptive saving cognitions decreased significantly during treatment with medium to large effect sizes, suggesting that CBT was effective in reducing hoarding symptoms and saving beliefs.

A subsequent 2 (study: waitlist-controlled trial versus outpatient clinic group) x 2 (time: pre- and post-treatment) analysis of variance (ANOVA) revealed no significant interaction effect, indicating that the two samples did not differ with respect to change in SI-R total scores during treatment, $F(1, 57) = 0.11$, $p = .747$, $\eta_p^2 = .00$. Similarly, there was no significant interaction effect for SCI total scores, $F(1, 36) = 1.74$, $p = .196$, $\eta_p^2 = .05$.

### Mediation Models

The results of the cognitive mediation models are presented in Table 3. The SCI total and all subscale scores mediated HD symptom change for the SI-R total and all three subscale scores, indicating that decreases in maladaptive saving cognitions mediated decreases in HD severity during treatment.

The results of the reverse mediation models are presented in Table 4. The SI-R total and subscale scores mediated belief change for the SCI total and subscale scores, indicating that decreases in hoarding symptoms mediated decreases in saving beliefs during treatment.

### Temporal Precedence

The results of the hierarchical multiple regression analyses are presented in Tables 5 and 6. Pre-treatment SCI scores did not predict mid-treatment SI-R scores when controlling for pre-treatment SI-R. Mid-treatment SCI predicted post-treatment SI-R while controlling for pre- and mid-treatment SI-R, suggesting that earlier levels of maladaptive saving beliefs are associated with later hoarding severity. For the reverse mediation models, pre-treatment SI-R scores did not predict mid-treatment SCI scores when controlling for pre-treatment SCI. Similarly, mid-treatment SI-R failed to predict post-treatment SCI when controlling for pre- and mid-treatment SCI, suggesting that earlier hoarding severity is not associated with later saving beliefs.

## Discussion

The purpose of this study was to examine whether change in maladaptive hoarding beliefs mediated change in hoarding symptoms in CBT for HD. Given that CBT is only modestly effective for patients with HD, it is important to clarify the underlying mechanisms of treatment response in order to inform the development of more efficient and targeted interventions. To our knowledge, no prior studies have examined cognitive change as a potential mediator of hoarding symptom change. Consistent with our hypotheses, changes in maladaptive saving beliefs mediated changes in HD symptoms during treatment, suggesting that cognitive change may be a mechanism of treatment response in CBT for HD. In support of the reverse mediation model, changes in hoarding symptoms also mediated changes in saving beliefs, but we failed to find evidence of temporal precedence for this mediation.

As we hypothesized, we found that reductions in saving cognitions mediated reductions in symptoms of compulsive acquiring and difficulty discarding. Indeed, all domains of saving beliefs, including emotional attachment to objects, memory concerns, control over possessions, and responsibility for possessions were significant mediators of acquiring and difficulty discarding. Ayers et al. (2012) and Frost et al. (2016) found that traditional cognitive evaluation and reappraisal was not helpful in decreasing hoarding symptoms. However, it should be noted that the Ayers et al. study used an older hoarding sample (mean age was 74 years old), so the findings may not generalize to younger HD patients. Coupled with the current study's results, it could be that cognitive change is indeed important for successful outcomes in CBT for HD, but some of the more traditional cognitive restructuring techniques (e.g., questioning the validity of thoughts using Socratic questioning, as employed by Frost et al., 2016) may not be the best and most efficient way to promote cognitive change in this population. Given the executive functioning and sustained attention deficits that have been observed in HD (e.g., Ayers, Dozier, Wetherell, Twamley, & Schiehser, 2016; Tolin, Villavicencio, Umbach, & Kurtz, 2011; Woody, Kellman-McFarlane, & Welsted, 2014), it is possible that HD patients require a more concrete, simplistic intervention strategy than Socratic questioning, which may require sustained attention and working memory. In the Frost et al. (2016) study, participants were asked a series of questions about their items (e.g., plans they had to use the items, advantages and disadvantages of keeping the items, etc.) while sorting and discarding. However, these questions were not written down or used in written practice exercises; they were merely asked aloud during the discarding task, which may have required sustained attention and working memory capacity to follow. In the current study, we made efforts to simplify the cognitive restructuring skills, which may have enabled patients to grasp the material and rehearse the skills, which may in turn have enhanced cognitive change.

Contrary to our hypotheses, we found that change in maladaptive saving beliefs mediated change in clutter severity. Wheaton and colleagues (2013) reported that the SCI did not explain significant variance in the clutter subscale of the SI-R after controlling for experiential avoidance and general distress. However, Wheaton et al. used cross-sectional analyses to examine the associations between maladaptive saving cognitions and HD symptoms, whereas in the current study these associations were assessed over time. Perhaps saving beliefs do not impact clutter severity at a single time point, but influence change in clutter over the course of treatment. Our results make sense in light of cognitive-behavioral theory of HD (Frost & Hartl, 1996), which suggests that exaggerated beliefs about and emotional attachment to possessions serve to maintain saving behavior. As such, it stands to reason that changes in these beliefs may make discarding less difficult, leading to reductions in excessive clutter over the course of treatment. Clinic patients often remark that regular discarding practice gets easier over time, in part due to the realization that they are not responsible for finding a "good home" for all of their possessions and that they simply cannot keep everything they have saved. These comments seem to reflect reductions in maladaptive saving cognitions, which may have had a positive impact on decluttering progress.

It should be noted that the current findings do not speak to how cognitive change occurred, and it is possible that belief change occurred without direct restructuring or challenging of

maladaptive saving cognitions. Indeed, prior research suggests that cognitive change occurs in (e.g., Smits, Rosenfield, McDonald, & Telch, 2006) and even mediates the outcomes of (e.g., Hofmann, 2004) exposure therapy for anxiety disorders, a behavioral treatment that does not include direct cognitive restructuring. It will be interesting to investigate whether providing more concrete cognitive restructuring skills and practice worksheets and/or behavioral experiments to directly target specific saving cognitions may be beneficial for patients with HD. Alternatively, it could be that purely behavioral interventions such as exposure, skills training, or contingency management promote the greatest cognitive change in HD patients and thus should be the focus of HD treatment. Given that we found evidence of reverse mediation in the current study (i.e., changes in HD symptoms mediated changes in saving beliefs), it will be important to clarify whether behavioral or cognitive changes are more important to successful treatment outcomes in CBT for HD.

The current study had several limitations. First, certain differences between participants in the Steketee et al. (2010) sample and those from the outpatient clinic group could have impacted results. Specifically, participants in the outpatient clinic were eligible even if they were taking psychiatric medications, while those in the Steketee et al. study were not permitted to take these medications. Second, we did not investigate other potential mediators in the current study. As such, it is unclear whether other putative mechanisms (e.g., depression, motivation, self-efficacy) may have impacted change in HD symptoms during treatment. It will be important to examine the influence of multiple potential mediators in future studies in order to elucidate the most critical mechanisms of hoarding outcomes. As described by Kazdin (2007), it is important to establish temporal precedence of the mediator (in this case, that change in saving beliefs precedes change in hoarding severity). Given that the SCI and SI-R were administered at the same time points in the current study, we were unable to establish temporal precedence of the mediator here. The follow-up hierarchical multiple regression analyses to examine whether earlier saving beliefs predicted later hoarding severity do not speak to temporal precedence of *changes* in saving beliefs predicting changes in hoarding severity, but they do provide preliminary evidence that earlier levels of hoarding-related beliefs (at mid-treatment) are at least associated with hoarding severity at a later time point (post-treatment). Nevertheless, this will be an important limitation to address in future research. Additionally, given that the SCI and SI-R have shown strong bivariate correlations (e.g., Steketee et al., 2003), this potential overlap in construct measurement may have affected our results. We are not aware of other measures that assess saving-related beliefs, but it will be important to address this limitation if additional measures become available. Third, the current study did not use an objective assessment of clutter severity (e.g., viewing photographs of the participants' home interiors), so it is unclear whether participants accurately reported their clutter severity on the SI-R. Objective measures of clutter are needed in future studies. Finally, this study did not include a control condition so it is possible that nonspecific factors could have played a role in hoarding symptom change. As discussed by Kazdin (2007), putative mediators should be plausible and theoretically relevant to a given intervention. As such, it will be important to assess mediation in CBT and control interventions to find mechanisms of change that are specific to CBT and not present in control groups.

Despite these limitations, to our knowledge this study is the first to examine cognitive mechanisms of change in CBT for HD. Based on our findings, change in saving cognitions mediated overall change in hoarding severity during treatment. It will be critical to further examine this mediator and how best to target it, with the ultimate goal of improving current treatments for HD.

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## Highlights

- Cognitive-behavioral therapy (CBT) is effective for hoarding disorder (HD)
- It is important to clarify mechanisms of change to inform treatment development
- We examined whether changes in saving beliefs mediated HD symptom change during CBT
- All domains of saving beliefs mediated change in the core symptoms of HD
- Results suggest that cognitive change may be a mechanism of response in CBT

**Table 1**

Demographic Characteristics and Symptom Severity

| | **Full, *N* = 62** | | **Trial, *n* = 35** | | **Clinic, *n* = 27** | | **Comparison** |
|---|---|---|---|---|---|---|---|
| **Variable** | ***n*** | **%** | ***n*** | **%** | ***n*** | **%** | ***t* or $X^2$ (*p*)** |
| Age, *M* (*SD*) | 56.55 | 7.49 | 55.23 | 5.69 | 58.26 | 9.15 | 1.51 (.115) |
| Female sex | 50 | 80.6 | 27 | 77.1 | 23 | 85.2 | 0.63 (.427) |
| Race | | | | | | | 2.69 (.443) |
| White | 55 | 88.7 | 32 | 91.4 | 23 | 85.2 | |
| Black | 5 | 8.1 | 2 | 5.7 | 3 | 11.1 | |
| Asian | 1 | 1.6 | 1 | 2.9 | 0 | 0 | |
| Other | 1 | 1.6 | 0 | 0 | 1 | 3.7 | |
| Ethnicity | | | | | | | 4.77 (.092) |
| Hispanic/Latino | 1 | 1.6 | 1 | 2.9 | 0 | 0 | |
| Not | 58 | 93.5 | 34 | 97.1 | 24 | 88.9 | |
| Unreported | 3 | 4.8 | 0 | 0 | 3 | 11.1 | |
| Medications | | | | | | | 25.65 (<.001) |
| On medications | 14 | 22.6 | 0 | 0 | 14 | 51.9 | |
| Not | 47 | 75.8 | 35 | 100 | 12 | 44.4 | |
| Unreported | 1 | 1.6 | 0 | 0 | 1 | 3.7 | |
| Pre SI-R, *M* (*SD*) | 61.78 | 12.50 | 63.03 | 12.10 | 60.04 | 13.09 | 0.91 (.366) |
| Pre SCI, *M* (*SD*) | 93.93 | 31.02 | 91.33 | 30.07 | 97.89 | 32.70 | 0.79 (.436) |

*Note*. Full = Full sample. Comparison = Comparison between participants in the waitlist-controlled trial and in the outpatient clinic. SI-R = Saving Inventory-Revised. SCI = Saving Cognitions Inventory.

**Table 2**

Descriptive Statistics and Comparisons of Symptom Measures at Pre- and Post-Treatment

| Measure | Pre, *M*(*SD*) | Post, *M*(*SD*) | % Change | *t*(df) | *p* | *d* |
|---|---|---|---|---|---|---|
| SI-R Total | 61.44(12.32) | 43.37(15.95) | 29.41 | 9.69(58) | <.001 | 1.29 |
| SI-R Clutter | 26.69(5.62) | 19.51(7.26) | 26.90 | 9.61(61) | <.001 | 1.26 |
| SI-R Discard | 19.65(4.08) | 13.68(5.47) | 30.38 | 8.29(59) | <.001 | 1.10 |
| SI-R Acquiring | 15.29(6.14) | 10.22(5.59) | 33.16 | 7.77(60) | <.001 | 1.01 |
| SCI Total | 93.17(29.46) | 68.66(24.53) | 24.51 | 5.97(37) | <.001 | 0.98 |
| SCI Emotional | 36.10(14.21) | 23.77(11.02) | 34.16 | 6.77(38) | <.001 | 1.12 |
| SCI Memory | 19.37(7.53) | 15.30(6.68) | 21.01 | 3.44(38) | .001 | 0.56 |
| SCI Resp. | 22.08(8.13) | 16.79(7.70) | 23.96 | 4.32(38) | <.001 | 0.70 |
| SCI Control | 15.53(4.60) | 12.76(4.63) | 17.84 | 4.29(37) | .001 | 0.70 |

*Note*. SI-R = Saving Inventory-Revised. SCI = Saving Cognitions Inventory. Resp. = Responsibility. % Change = Percent change from pre- to post-treatment.

**Table 3**

Saving Cognitions as Mediators of Hoarding Symptom Change

| | SI-R | | SI-R Clutter | | SI-R Discarding | | SI-R Acquiring | |
|---|---|---|---|---|---|---|---|---|
| **Mediator** | **Effect** | **CI** | **Effect** | **CI** | **Effect** | **CI** | **Effect** | **CI** |
| SCI | −3.27 | −5.23, −1.85 | −1.22 | −2.00, −0.65 | −1.16 | −1.84, −0.64 | −0.92 | −1.61, −0.39 |
| SCI-EA | −2.99 | −4.75, −1.72 | −1.16 | −1.96, −0.61 | −1.04 | −1.65, −0.60 | −0.84 | −1.51, −0.35 |
| SCI-M | −1.99 | −3.75, −0.65 | −0.72 | −1.42, −0.24 | −0.74 | −1.35, −0.24 | −0.49 | −1.08, −0.12 |
| SCI-R | −2.21 | −3.96, −0.96 | −0.82 | −1.50, −0.33 | −0.67 | −1.22, −0.27 | −0.72 | −1.36, −0.28 |
| SCI&-C | −1.28 | −2.81, −0.36 | −0.46 | −1.08, −0.11 | −0.48 | −1.00, −0.12 | −0.33 | −0.85, −0.03 |

*Note*. CI = 95% bootstrap confidence interval. SI-R = Saving Inventory-Revised. SCI = Saving Cognitions Inventory. EA = Emotional Attachment subscale. M = Memory subscale. R = Responsibility subscale. C = Control subscale.

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**Table 4**

Hoarding Symptoms as Mediators of Change in Saving Beliefs

| | SCI | | SCI-EA | | SCI-M | | SCI-R | | SCI-C | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Mediator** | **Effect** | **CI** | **Effect** | **CI** | **Effect** | **CI** | **Effect** | **CI** | **Effect** | **CI** |
| SI-R | −10.16 | −15.18, −6.19 | −4.15 | −6.46, −2.37 | −2.43 | −3.62, −1.44 | −2.71 | −4.02, −1.70 | −1.09 | −1.75, −0.58 |
| SI-R C. | −6.80 | −11.10, −3.63 | −2.84 | −4.77, −1.36 | −1.63 | −2.67, −0.86 | −1.82 | −2.96, −1.00 | −0.67 | −1.25, −0.22 |
| SI-R D. | −9.30 | −14.38, −5.59 | −3.75 | −5.95, −2.05 | −2.34 | −3.60, −1.40 | −2.13 | −3.33, −1.21 | −1.06 | −1.71, −0.55 |
| SI-R A. | −4.30 | −8.14, − 1.78 | −1.76 | −3.48, −0.63 | −0.97 | −1.84, −0.41 | −1.37 | −2.47, −0.62 | −0.41 | −0.94, −0.05 |

*Note*. CI = 95% bootstrap confidence interval. SI-R = Saving Inventory-Revised. SCI = Saving Cognitions Inventory. EA = Emotional Attachment subscale. M = Memory subscale. R = Responsibility subscale. C = Control subscale. SI-R C. = Clutter subscale. SI-R D. = Difficulty discarding subscale. SI-R A. = Acquiring subscale.

**Table 5**

Hierarchical Multiple Regression Analyses Predicting Mid- and Post-Treatment Hoarding Severity from Saving Beliefs at the Previous Time Point

| | *B* | *SE B* | β | $\Delta R^2$ |
|---|---|---|---|---|
| Model 1 (DV: Mid-Treatment SI-R) | | | | |
| Step 1 | | | | .54 |
| Pre-Treatment SI-R | 0.90*** | 0.12 | 0.73 | |
| Step 2 | | | | .00 |
| Pre-Treatment SCI | 0.02 | 0.05 | 0.03 | |
| Model 2 (DV: Post-Treatment SI-R) | | | | |
| Step 1 | | | | .32 |
| Pre-Treatment SI-R | −0.08 | 0.26 | −0.06 | |
| Mid-Treatment SI-R | 0.71** | 0.22 | 0.60 | |
| Step 2 | | | | .09 |
| Mid-Treatment SCI | 0.20* | 0.09 | 0.35 | |

*Note*. DV = Dependent variable. SI-R = Saving Inventory-Revised. SCI = Saving Cognitions Inventory.

* $p < .05$.

** $p < .01$.

*** $p < .001$

**Table 6**

Hierarchical Multiple Regression Analyses Predicting Mid- and Post-Treatment Saving Beliefs from Hoarding Symptoms at the Previous Time Point

| | *B* | *SE B* | β | $\Delta R^2$ |
|---|---|---|---|---|
| Model 1 (DV: Mid-Treatment SCI) | | | | |
| Step 1 | | | | .49 |
| Pre-Treatment SCI | 0.66*** | 0.12 | 0.70 | |
| Step 2 | | | | .01 |
| Pre-Treatment SI-R | 0.29 | 0.31 | 0.12 | |
| Model 2 (DV: Post-Treatment SCI) | | | | |
| Step 1 | | | | .57 |
| Pre-Treatment SCI | 0.05 | 0.15 | 0.06 | |
| Mid-Treatment SCI | 0.64*** | 0.16 | 0.71 | |
| Step 2 | | | | .00 |
| Mid-Treatment SI-R | 0.08 | 0.26 | 0.04 | |

*Note*. DV = Dependent variable. SI-R = Saving Inventory-Revised. SCI = Saving Cognitions Inventory.

*** $p < .001$