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Perceived emotion regulation and emotional distress tolerance in patients with hoarding disorder

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Abstract

Emotional distress tolerance (EDT) and emotion regulation (ER) appear to be highly relevant to hoarding pathology, as excessive saving and/or acquiring may be motivated by emotional avoidance or other attempts to regulate negative affect. While findings with nonclinical samples have suggested that EDT/ER predicts hoarding symptoms, there is little data on clinical samples. The aim of the current study was to examine several self-report measures of EDT and ER in individuals with HD ($n = 87$) and age-matched nonclinical controls ($n = 46$), and to explore whether this was predictive of treatment compliance and/or outcome in group CBT for HD. Results suggested that, the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) total score, DERS goals and awareness subscales, and Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002) were predictive of hoarding severity. However, EDT/ER did not change with treatment, did not mediate treatment outcome, and did not predict treatment retention, compliance, or outcome. Results suggest that some EDT/ER constructs, such as uncertainty intolerance, difficulty persisting in goal behaviors when upset, and low emotional awareness, may explain significant variance in HD symptoms, although they did not appear to be mechanisms of change in CBT for HD.

Keywords

hoarding disorder; emotion regulation; distress tolerance; cognitive-behavioral therapy; uncertainty

Introduction

Hoarding disorder (HD) represents a substantial public health burden (Frost, Steketee, & Williams, 2000; Tolin, Frost, Steketee, Gray, & Fitch, 2008). Current best-practice treatment

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for HD is only moderately effective, with most treatment completers continuing to exhibit clinically significant hoarding symptoms following treatment (Tolin, Frost, Steketee, & Muroff, 2015). Identifying manipulable maintaining factors appears critical to the development of effective treatments for HD. One such target construct with substantial face validity to explain some HD pathology is emotional distress tolerance (EDT). EDT has been a significant topic of interest over the past two decades as a transdiagnostic risk factor for several forms of psychopathology. EDT can be conceptualized as one's ability to withstand negative affective states; this includes one's ability to refrain from behavioral or cognitive efforts to avoid or suppress emotions, as well as metacognitive beliefs about the acceptability of emotional states (Simons & Gaher, 2005). Low self-reported EDT (which is typically measured by the self-report Distress Tolerance Scale; Simons & Gaher, 2005) has been reliably associated with behaviors that may function as maladaptive emotion regulation strategies, such as substance use (e.g., Allan & Schmidt, 2015), compulsive hair pulling (e.g., Arabatzoudis, Rehm, Nedeljkovic, & Moulding, 2017), non-suicidal self-injury (e.g., Anestis, Pennings, Lavender, Tull, & Gratz, 2013) and binge-restrict eating patterns (e.g., Anestis, Selby, Fink, & Joiner, 2007). A related and likely overlapping construct to EDT that may also have relevance to HD is emotion regulation (ER). ER can be conceptualized as one's ability to self-regulate (i.e., adaptively manipulate upward or downward) affective states via strategies such as stimulus control, cognitive reappraisal or emotional suppression (Gross, 1998; Gross & Munoz, 1995). Similar to low EDT, poor ER skills are associated with a wide variety of psychopathology, such as depression, anxiety, substance use, and eating disorders (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Berking et al., 2011; Radkovsky, McArdle, Bocking, & Berking, 2014).

EDT/ER constructs appear highly relevant to current conceptualizations of HD, and many researchers have speculated that EDT and ER may be significant maintaining factors and targets for HD treatment (Fernandez de la Cruz et al., 2013; Raines, Boffa, Allan, Short, & Schmidt, 2015; Wheaton, Fabricant, Berman, & Abramowitz, 2013). Excessive acquisition and saving behaviors may be topographical representations of underlying maladaptive emotion regulation strategies. Clinical observation suggests that individuals with HD appear to rely heavily on avoidance-based coping in response to intense negative affect, particularly when making decisions about whether to keep or discard possessions. Anecdotally, within our HD treatment groups we have noticed that participants often refuse to discard objects they can readily recognize as unneeded for their own lives and not likely to be kept by others, stating that they simply fear the emotional experience of doubt/anxiety, guilt, and/or sadness that may result. While several authors have posited potential neurobiological deficits in decision-making regarding possessions (e.g., Lawrence et al., 2006; Saxena et al., 2004; Tolin et al., 2012), what looks like behavioral indecisiveness may be the result of difficulty regulating/tolerating the emotional distress associated with discarding and decision making. Several authors have also pointed out that excessive acquiring behaviors often appear to be motivated by a desire to regulate affect (Hamblin et al., 2015; Shaw, Timpano, Steketee, Tolin, & Frost, 2015; Tolin, Levy, Wootton, Hallion, & Stevens, 2018).

Prior studies of hoarding behaviors and EDT/ER

Most of the extant research on the relationship between EDT/ER and hoarding behaviors has been conducted with unselected undergraduate or other nonclinical samples in which there are likely to be few individuals meeting the clinical threshold for HD. In these studies of nonclinical samples, higher scores on measures of hoarding behaviors have been found to be related to lower self-reported EDT (Timpano, Buckner, Richey, Murphy, & Schmidt, 2009), higher scores in EDT/ER constructs such as anxiety sensitivity (Coles, Frost, Heimberg, & Steketee, 2003; Timpano et al., 2009), and intolerance of uncertainty (Oglesby et al., 2013; Wheaton, Abramowitz, Jacoby, Zwerling, & Rodriguez, 2016).

A small number of studies have examined self-reported EDT and/or ER in clinical samples of individuals with HD, four of which involved direct comparisons of HD samples and controls. Fernandez de la Cruz et al. (2013) examined self-reported ER and avoidance/suppression of emotional experience (via the DERS, and the Acceptance and Action Questionnaire-II [AAQ-II]; Bond et al., 2011) with individuals diagnosed with HD ($n = 24$), individuals with OCD ($n = 17$) and individuals with co-occurring OCD and HD ($n = 19$). The three clinical groups had poorer ER and greater emotional avoidance than did the nonclinical controls, but the clinical groups did not differ from each other on these measures. The clinical groups scored higher than did controls on all the subscales of the DERS except for the “lack of awareness of emotions” subscale. They also found that hoarding severity was specifically correlated with the “difficulty engaging in goal-directed behavior” subscale.

De la Cruz et al. did not control for co-occurring anxiety and depression symptoms, which in several studies (e.g., Timpano et al., 2009; Wheaton et al., 2013) have explained significant variance in EDT/ER. Tolin et al. (2018) compared the DERS in individuals with hoarding ($n = 77$) and age- and gender-matched nonclinical controls ($n = 45$). Individuals with HD had higher scores than did controls on all of the DERS subscales (aside from the awareness subscale, which they removed, citing inadequate psychometric properties) and total score. Wheaton et al. (2013) examined the AAQ-II with individuals with HD ($n = 33$), individuals with anxiety disorders ($n = 32$) and healthy controls ($n = 30$). Controlling for anxiety and depressive symptoms, Wheaton et al. found that the HD and anxiety disorders groups both had significantly higher experiential avoidance than controls. However, in a separate but similar study, Wheaton et al. (2016) found that intolerance of uncertainty (as measured by the Intolerance of Uncertainty Scale; IUS; Buhr & Dugas, 2002) was significantly higher in an HD sample than in a mixed anxiety sample and in a group of healthy controls, suggesting that IUS in particular may be a domain of EDT that may separate HD from anxiety pathology. Finally, (Grisham et al., 2018) administered the Anxiety Sensitivity Inventory (ASI-3; Taylor et al., 2007), Distress Tolerance Scale (DTS; Simons & Gaher, 2005), and IUS, and found that only the DTS was predictive of hoarding severity. Unfortunately, Grisham et al. did not include a nonclinical or clinical comparison group.

Taken together, these studies provide a puzzling picture, with the studies on nonclinical samples largely suggesting positive relationships between ER/EDT constructs and HD symptoms, and existing studies on clinical samples suggesting that EDT may be a vulnerability factor for HD (as for a variety of pathology). IUS in particular may provide more specificity as a predictive factor for HD, obsessive-compulsive disorder, and

generalized anxiety disorder (Mathes et al., 2017). In addition, to our knowledge, no studies have examined whether these ER/EDT measures are predictive of behavioral correlates, such as treatment retention and completion of behavioral discarding tasks. Individuals with hoarding behaviors have often been described as having relatively low treatment adherence (Bloch et al., 2014; Maher et al., 2012; Mataix-Cols, Marks, Greist, Kobak, & Baer, 2002); it is possible that difficulty complying with cognitive-behavioral treatment recommendations may be related to difficulty tolerating emotional experiences. If HD is characterized by emotional distress intolerance and behavioral avoidance as a strategy to cope with negative affect, it might be expected that patients with low EDT may be more likely to not be retained in treatment or to simply refrain from completing decluttering homework assignments. Finally, the relationship between ER/EDT has not yet been examined thoroughly with clinical hoarding populations. Thus, it remains unclear how these measures may overlap or specifically relate to hoarding pathology.

The primary aim of the present study was to examine several ER/EDT measures in a treatment-seeking sample of individuals with HD, to determine whether individuals with HD score higher on these measures than do nonclinical controls, and whether these measures have substantial correlational overlap. A second aim was to explore whether ER/EDT constructs relate to treatment outcome. The cognitive-behavioral manual used to target HD in this sample (Boedhoe et al., 2017) included ER/EDT skills (such as mindful awareness, distancing, practice identifying and tolerating strong emotional sensations, skills for pacing/self-soothing, etc.) as a primary component of treatment. A goal was to assess whether these targeted constructs changed across treatment, and whether improvement in HD symptoms were mediated by ER/EDT improvements. Finally, a goal was to assess whether ER/EDT deficits were predictive of treatment retention or homework completion (which largely consisted of assigned behavioral sorting and discarding practice).

To examine these research questions, we used four separate self-report measures of emotion tolerance and regulation, which are likely to have some overlap but also that have evidence as distinct constructs with potentially separate predictive validity. It was predicted that individuals with HD would have lower baseline EDT and ER as compared with nonclinical controls. As a secondary part of this aim, we sought to do exploratory analysis to gauge the interrelationships between these measures to assess whether they may be highly convergent within this sample, or more likely to be assessing distinct constructs with independent explanatory power. In our exploratory secondary aim we sought to examine whether EDT/ER constructs were predictive of treatment outcome. We predicted that low EDT and ER would be predictive of poor retention and compliance in CBT, and that EDT and ER changes would mediate treatment outcomes.

Method

Participants

Participants included 133 individuals who participated in a randomized clinical trial examining the neural mechanisms of response to CBT for hoarding (fMRI outcomes will be reported separately in an upcoming manuscript); 87 participants had a primary diagnosis of HD of at least moderate severity, and 46 participants were age- and sex-matched nonclinical

controls. HC participants were matched to the HD group by recruiting in batches, and attempting to match the distribution of the HD sample. HD patients ranged in age from 22 to 65 years old ($M = 53.99$, $SD = 9.24$) and were primarily female ($n = 72$, 82.8%). Similarly, nonclinical controls ranged in age from 40 to 65 years old ($M = 53.33$, $SD = 7.15$) and were predominantly female ($n = 34$, 73.9%). See Tolin et al. (2018) for full details on the sample.

Participants were required to (1) be between ages of 18–65; (2) right-handed, (3) have no a suicide attempt in the past 12 months; current suicidal, psychotic, or other severe psychiatric symptoms that would necessitate hospitalization or be a significant risk of self-harm or harm to others; or current or previous hospitalization for a psychiatric condition within the past year; (4) past or present bipolar disorder, psychotic disorder, or past-year substance use disorder, (5) absence of history of traumatic brain injury resulting in a loss of consciousness greater than 5 minutes; (6) cognitive dysfunction that would interfere with capacity to consent or participate in the trial; or (7) claustrophobia, metal in the body, or other contraindications for fMRI scanning. Participants in the HD sample were also required to (1) have a primary diagnosis of HD of at least moderate severity on the *Diagnostic Interview for Anxiety, Mood, and Obsessive-Compulsive and Related Neuropsychiatric Disorders* (DIAMOND); (2) be either on no psychiatric medication or on a stable dose of psychiatric medications for at least 8 weeks; (3) be willing and able to abstain from the use of stimulant or benzodiazepine medications on the day of testing, and (4) have had no more than 10 prior sessions of CBT for HD, and (5) live in a setting where the participant has control over the presence of clutter. Nonclinical control participants were required to have no current or past psychiatric diagnosis or treatment.

Measures

Diagnostic Interview for Anxiety, Mood, and Obsessive-Compulsive and Related Neuropsychiatric Disorders (Tolin, Gilliam, et al., 2018). The DIAMOND is a structured clinical interview for DSM-5 diagnoses. In addition to diagnostic information, the DIAMOND also provides severity ratings for each diagnosis. Psychometric evaluations of the DIAMOND support the interview's reliability and validity (Tolin, Gilliam, et al., 2018). The DIAMOND HD diagnosis shows excellent inter-rater reliability ($\kappa = 0.86$), very good test-retest reliability ($\kappa = 0.64$), and strong convergence with the Saving Inventory-Revised.

Saving Inventory-Revised (Frost, Steketee, & Grisham, 2004) The SI-R is a 23-item self-report measure of hoarding symptoms. The SI-R contains three subscales, which examine the core features of hoarding: excessive acquisition, saving, and clutter. Participants are asked to report how closely each item matches their experience within the past week on a Likert-type scale ranging from 0 (*None*) to 4 (*Almost all/complete*). Previous research supports the utility of this measure as an accurate assessment of compulsive hoarding (Frost et al., 2004). Internal consistency for the SI-R in the present sample was: total $\alpha = 0.98$, clutter $\alpha = 0.98$; saving $\alpha = 0.96$; acquisition $\alpha = 0.94$.

Distress Tolerance Scale (DTS; Simons & Gaher, 2005). The DTS is a 15-item self-report measure of EDT, or the degree to which individuals experience negative emotions as intolerable (e.g., “When I feel distressed or upset, all I can think about is how bad I feel”). Items are rated on a Likert-type scale ranging from 1 (*Strongly Agree*) to 5 (*Strongly*

Disagree). Scores range from 15 to 75, with higher scores reflecting higher EDT. The DTS has evidenced good reliability and internal consistency in clinical samples (Hsu, Collins, & Marlatt, 2013). It should be noted that the DTS was added into the assessment battery later on in the trial, so it was completed by a smaller number of participants (total $n = 78$; HD group $n = 56$). Internal consistency for the DTS in the current sample was 0.91.

Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) The DERS is a 36-item self-report measure developed to assess emotion dysregulation. The DERS contains six subscales: (1) Nonacceptance (the nonacceptance of emotional responses; “When I’m upset, I feel ashamed at myself for feeling that way”), (2) Goals (difficulty engaging in goal-directed behavior; “When I’m upset, I have difficulty focusing on other things”), (3) Impulsivity (difficulties in impulse control when emotionally dysregulated; “I experience my emotions as overwhelming and out of control”), (4) Awareness (lack of emotional awareness; “When I’m upset, I acknowledge my emotions”), (5) Strategies (limited access to emotion regulation strategies; “When I’m upset, I believe that I will remain that way for a long time”, and (6) Clarity (lack of emotional clarity; “I have no idea how I am feeling”). Items are rated on a Likert-type scale ranging from 1 (*Almost never*) to 5 (*Almost always*), with greater scores reflecting greater emotion dysregulation in each domain. Evaluations of the DERS support its reliability and validity (Gratz & Roemer, 2004). The DERS had strong internal consistency in the present sample (Non-Acceptance, $\alpha = 0.95$; Goals, $\alpha = 0.90$; Impulsivity, $\alpha = 0.87$; Awareness, $\alpha = 0.88$; Strategies, $\alpha = 0.93$ Clarity, $\alpha = 0.87$; Total, $\alpha = 0.97$).

Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). The ERQ is a 10-item self-report measure developed to assess emotion regulation strategies. The ERQ was included to examine its convergent validity with the other measure of emotion regulation, the DERS, for an HD sample. The ERQ does not have a total score but rather consists of two subscales, which examine the use of cognitive reappraisal (“I control my emotions by changing the way I think about the situation I’m in”) and expressive suppression (“When I am feeling negative emotions, I make sure not to express them”) to regulate affect. Items are responded to on a Likert-type scale ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*). Scores on the 6-item reappraisal subscale can range from 6 to 42; the 4-item suppression scale can range from 4 to 28; with higher scores suggesting greater use of the emotion regulation strategy. Previous research supports the utility of the ERQ, with research providing support for its test-retest reliability, and convergent and discriminant validity (Gross & John, 2003). Note that the ERQ was added into the assessment battery later on in the trial, so it was completed by a smaller number of participants (total $n = 86$; HD group $n = 71$). Internal consistency in the present sample was acceptable (cognitive reappraisal, $\alpha = 0.85$; expressive suppression, $\alpha = 0.77$).

Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002). The IUS is a 27-item self-report measure developed to measure cognitive and behavioral intolerance of uncertainty. Participants are asked to describe the extent to which each item describes them (“When it’s time to act, uncertainty paralyzes me” and “Uncertainty makes me vulnerable, unhappy, or sad.”) Items are responded to on a Likert-type scale ranging from 1 (*Not at all characteristic of me*) to 5 (*Entirely characteristic of me*), with higher scores reflecting greater intolerance

of uncertainty. The IUS has been shown to have good reliability and validity (Buhr & Dugas, 2002). In the present sample, internal consistency for the IUS was 0.95.

Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1995). The DASS is a 42-item self-report measure developed to assess three types of negative emotional states: depression, anxiety, and stress. Items are rated on a Likert-type scale ranging from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much, or most of the time*) concerning the frequency of symptoms in the last week. Scores can range from 0–42 for each subscale, with higher scores reflecting greater levels of negative affect. Prior psychometric work with the DASS supports its utility in both clinical and community samples (Antony, Bieling, Cox, Enns, & Swinson, 1998). Internal consistency for the DASS ranged from good to excellent ($\alpha = 0.91$ for depression, $\alpha = 0.81$ for anxiety, $\alpha = 0.90$ for stress).

The Patient Exposure and Response Prevention Adherence Scale-Hoarding (PEAS-H) was used to examine homework compliance. The PEAS-H, adapted from the original PEAS for obsessive-compulsive disorder (Simpson et al., 2010), was completed by the study therapists, and contains three items, including the percent of sorting/discarding assignments attempted by the patient, ranging from 1 (0%; *None*) to 7 (100%; *All that were assigned*), the percentage of acquiring urges resisted, ranging from 1 (0%; *None*) to 7 (*Most; >90% successful with acquiring and/or no urges*) and how well the patient did in completing their assigned homework, ranging from 1 (*Refused*) to 7 (*Excellent*). Scores can range from 0 to 27, with higher scores reflecting greater homework compliance.

Procedure

HD participants were recruited from the clinic, newspaper advertisements, and community flyers/lectures. HC participants were recruited by newspaper advertisements and flyers. All participants were screened over the phone and upon eligibility were invited to come in person for an intake assessment. Participants were consented during the intake visit, and subsequently completed brief cognitive/IQ screeners to ensure cognitive capacity for informed consent. The randomized trial was conducted in accordance with Declaration of Helsinki codes for participation of experiments involving human participants and informed consent was obtained from all participants. Participants then completed a diagnostic interview with an independent evaluator to ascertain HD diagnosis (for HD participants) or to confirm no current or lifetime psychiatric diagnosis (HC participants). Study questionnaires and fMRI scanning were completed at a subsequent scheduled appointment. All study procedures were approved by the authors' Hospital Institutional Review Board.

All HD patients participated in a 16-week group cognitive-behavioral treatment program. Sessions were once-weekly and 90 minutes in length. Treatment followed a published manual (Boedhoe et al., 2017) and client workbook (McKay & Tolin, 2017). The treatment focused on psychoeducation about hoarding, development and practice of decisional and organizational skills, identification of unhelpful thinking patterns, practice in EDT skills such as objective description and acceptance of emotional experience, and inventorying of values to pursue committed action despite distress; tools to enhance and maintain motivation, and frequent in-session sorting and discarding practice applying these skills. Outcomes of the treatment are reported on in Tolin et al., (in press).

Data Analysis

Prior to analyses, data were checked for outliers, normality, and multicollinearity. Skewness and kurtosis values for the variables of interest were in the acceptable range, indicating normal distributions. However, several of the ER measures/subscales were strongly correlated, precluding our ability to conduct simultaneous entry regression models. As such, all regressions were conducted with each ER measure separately. Given the number of analyses performed, we set a conservative alpha level of .001 to determine statistical significance.

First, using independent samples *t* tests and Cohen's *d* effect sizes, we compared the HD and HC groups on the EDT/ER measures at baseline. To determine whether these group differences were better accounted for by general negative affect, a series of one-way analyses of covariance (ANCOVAs) were conducted on the emotion regulation measures while controlling for DASS-depression and DASS-anxiety scores. Second, we conducted a series of hierarchical multiple regression analyses on the entire sample to examine whether the emotion regulation measures predicted HD severity when controlling for DASS-depression and DASS-anxiety. Third, to examine whether EDT/ER predicted treatment dropout, we conducted a series of exploratory logistic regression analyses, with retention

(coded as yes vs. no) as the dependent variable and the ER measures as the predictor variables (separately, due to multicollinearity as described above). Fourth, among treatment completers, we examined whether there were pre- to post-treatment changes in the ER measures using paired samples *t* tests and Cohen's *d* effect sizes. In the completer sample, we also used regression analyses to assess whether the ER measures at baseline predicted homework compliance on the PEAS.

Finally, to assess mediation of pre- to post-treatment change in HD severity, 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, which determines (with 95% confidence) whether the indirect effect of the independent variable on the dependent variable through the mediator is different from zero (in other words, no mediation effect).

The indirect effect expresses how much the dependent variable changes as a function of the independent variable's effect on the mediator, which in turn affects the dependent variable (Hayes, 2009). In all models, the independent variable was pre-treatment HD severity, and the dependent variable was post-treatment HD severity, both as measured by the SI-R. The emotion regulation measures (DTS, DERS, ERQ, and IUS) were the mediator variables at the mid-treatment assessment point (separately), thus establishing temporal precedence. As described by Hayes (2013), there is evidence of mediation if the 95% bootstrap confidence interval does not include zero.

Results

Group Comparisons

Comparing scores at baseline, the HD group had significantly poorer EDT/ER across measure total scores and subscales than did the HC group, with the exception of the ERQ subscales; see Table 1 for group differences on EDT/ER measures at baseline). When DASS-anxiety and DASS-depression were controlled, differences on the IUS total, $F(1, 118) = 17.23, p < .001, \eta^2_p = 0.13$; DERS total, DERS goals, and DERS awareness remained significant (all $F_s \geq 9.05$, all $p_s < .001$, all $\eta^2_p \geq 0.07$).

Convergent Validity

We then examined convergent validity between the various emotion regulation measures to assess the extent of overlap in these constructs within this sample. As can be seen in Table 2, the EDT/ER measures were generally moderately correlated with one another, with the exception of the ERQ emotional suppression subscale, which showed only weak associations with the other measures.

EDT/ER and Hoarding Severity

As shown in Table 3, the IUS and several DERS subscales predicted HD severity after controlling for anxiety and depression symptoms. The DTS and ERQ were not significant predictors of HD after including the covariates.

Treatment Retention, Compliance, and Outcome

Sixteen HD patients (18.4%) dropped out of treatment, either prior to beginning treatment ($n = 9$) or during treatment ($n = 7$). An additional 13 patients (14.9%) were withdrawn from the study due to noncompliance with treatment procedures (i.e., > 4 instances [sessions] of failing to complete at least 30% of assigned homework, and/or attend session), leaving a total of 29 patients who did not complete treatment. The logistic regression analyses revealed that none of the EDT/ER measures significantly predicted treatment retention (all $B_s \leq 0.07$, all $p_s > .001$, all ORs ≤ 1.07).

Regression analyses revealed that none of the EDT/ER measures at baseline predicted average homework compliance ratings on the PEAS-H.

As can be seen in Table 4, among treatment completers, after correction for multiple comparisons ($p < .001$), none of the measures showed significant change from pre- to post-treatment, although the IUS neared significance.

Mediation Analyses

Results of the mediation analyses showed that all confidence intervals included zero, indicating that none of the mid-treatment emotion regulation measures mediated pre-post change in HD severity (SI-R total and subscale scores).

Discussion

The present study examined several measures of EDT/ER in a sample of individuals with hoarding disorder, and whether EDT/ER measures were predictive of treatment outcome, compliance, attendance, and other EDT/ER measures. Most of the EDT/ER measures were predictive of hoarding symptoms; however, when anxiety and depressive symptoms were controlled in a regression model, only the domains of intolerance of uncertainty (as measured by the IUS), the DERS total score, and some DERS subscales (goals, awareness) remained predictive of hoarding severity. Therefore the DERS and IUS appeared to be the only EDT/ER measures specific to HD, explaining 5–13% of the variance in HD severity. Results on the IUS are largely consistent with the few prior comparisons of HD and other samples in suggesting high IUS is often predictive of hoarding symptoms but may not differ between individuals with HD and other pathology such as OCD or GAD (Mathes et al., 2017). Surprisingly, unlike the results of (Grisham et al., 2018) DTS was not predictive of HD severity, suggesting that in this sample, emotion regulation deficits and particular emotion regulation strategies were more relevant to explaining HD pathology than EDT was.

None of the EDT/ER measures appeared to change significantly across the course of treatment. While some measures neared significance, they did not survive correction for multiple comparisons. In addition, none of the EDT/ER measures mediated treatment outcome. This was evidenced despite the treatment leading to significant improvement in HD symptoms on par with most prior trials of CBT for HD (Tolin et al., in press). Therefore, while it appears that some domains of emotion regulation and intolerance of uncertainty may be vulnerability factors for HD (and potentially similar pathology), they are unlikely candidates for mechanisms of change within HD treatment, as they were unrelated to change in HD symptoms. This was a surprising finding, as several sessions of the treatment package focused on emotion regulation skills borrowed from acceptance- and mindfulness-based therapies, including practicing identifying and describing emotions nonjudgmentally (distancing), inventorying personal values and how these align with decluttering, and “riding the wave” of emotions while taking action towards values. It may be that the practice in these skills was simply too brief to develop fully, as only a portion (approximately 4 sessions) of the class curriculum focused on teaching skills for managing distress, although these skills were practiced throughout. These skills are often quite abstract and rely on metacognitive ability to monitor and label internal experience. We suspect that individuals with HD may benefit from these skills and rehearsal in application, but anecdotally found that they had difficulty applying the skills without direct coaching. Comprehension and use of the EDT skills was not measured and it is unclear how much patients understood, practiced, and adopted these skills over the course of treatment.

In addition, none of the EDT/ER measures were predictive of treatment retention or completion of discarding homework assignments. That is, low self-reported EDT and difficulty in regulating emotions did not appear to be related to how much participants engaged in behavioral efforts to discard. Therefore, treatment modules targeting EDT/ER may not be necessary to promote treatment retention and participation in discarding for HD samples. It may also be the case that self-reported (i.e., perceived) EDT and emotion regulation are not reflective of actual behavioral efforts to tolerate or regulate emotions.

Aside from (Grisham et al., 2018), this is the only study to use the DTS to examine EDT in a sample of individuals with HD. The DTS had a high correlation with the DERS, suggesting that there is a significant relationship between EDT and ER in this sample, although only the DERS was predictive of HD symptoms. Of the included measures, the ERQ subscales had the lowest correlations with other EDT/ER measures. It is unclear why the ERQ, and DERS (or DERS subscales), both measures of emotion regulation, were not well-related. The ERQ subscales reflect two separate and specific methods of emotion regulation, cognitive reappraisal and expressive suppression (attempts to hide expression of emotions to others), which may not reflect the emotion regulation mechanisms which may be most relevant for HD samples. Therefore, based on this and the results of the specific DERS subscales there may be more specific dimensions of ER that are impacted in HD, particularly difficulty engaging in goal-directed behavior when upset (the goals subscale of the DERS) and tolerating uncertainty. These findings seem intuitive, as difficulty with self-control is likely to impede one's ability to initiate and sustain behavioral efforts to discard. In addition, some dimensions may have specific explanatory power for different aspects of the hoarding syndrome, (i.e., SI-R scales of saving, impulsive acquiring, or presence of clutter). Results suggested a relative lack of specificity of DERS subscale to SI-R domain, as the goals subscale predicted all three symptom domains, and IUS predicted both saving and acquiring. The DERS awareness subscale was the only scale that had individual significance, and it was for acquiring, suggesting that lack of awareness of one's emotional experience is somehow tied to excessive acquisition. This does not appear to be via impulsivity (e.g., impulsive emotional purchases) as the impulsivity scale was not significantly predictive of HD symptom domains.

Strengths of the study include the use of several measures to assess emotion regulation and tolerance, all of which were validated, reliable, commonly used measures. The sample consisted of a large sample of patients with HD with age- and gender-matched controls. There are, however, several limitations of the current study. One limitation is the self-report nature of the EDT/ER measures. Unfortunately, there are few validated tasks that assess EDT, and these behavioral tasks (e.g., frustration intolerance tasks such as mirror tracing persistence) did not appear to tap into broad EDT deficits as we conceptualized them. Measures of other forms of distress, such as physical pain/temperature tolerance, appear to have little relationship with (perceived) EDT (Anestis et al., 2011). In addition, self-reported EDT, rather than behavioral measures, appear to be more reliably associated with relevant outcomes (e.g., symptom severity, comorbidity rates, quality of life; (Anestis et al., 2011; Marshall-Berenz, Vujanovic, Bonn-Miller, Bernstein, & Zvolensky, 2010). It is possible that EDT/ER deficits in HD are highly specific to context. There is some evidence that difficulties with EDT, ER, and decision making more broadly may be impaired in HD individuals only when the task is related to processing outcomes for personal possessions. Several studies (An et al., 2009; Tolin, Kiehl, Worhunsky, Book, & Maltby, 2009; Tolin et al., 2012) have found behavioral and neurobiological disparities between individuals with hoarding and control participants, but several found that these differences were apparent only when the task was a possession-oriented task, such as making a decision to keep or discard a personal possession. Therefore, individuals with hoarding behaviors may have comparatively lower EDT or ER abnormalities in some of these highly specific tasks but not

as a global trait. Measures such as the DTS likely assess a trait-like dimension of EDT and have been shown to be relatively stable across time (Simons & Gaher, 2005) and may not be able to tap into this irregular pattern.

The analyses of mediation effects and logistic regression examining treatment retention may have some power limitations. However, bootstrapping may be a more powerful test of mediation (i.e., requiring lower sample sizes) than other commonly used mediation methods (Fritz & Mackinnon, 2007; Pan, Liu, Miao, & Yuan, 2018). In addition, based on the odds ratios of the effect, using the sample calculation tables provided by (Hsieh, 1989), sample sizes upwards of 2,000 would have been unlikely to detect an effect in the logistic regression examining treatment retention. Therefore, while the logistic regression was considered exploratory, there appears to be a lack of an effect that would be detectable even with a very large sample. Sample size was not large enough to examine more nuanced treatment retention/compliance variables, but we feel this is a question should be examined further by future studies given the increasing emphasis on EDT and ER as treatment targets in HD.

Another limitation may be that HD participants were treatment-seeking; the sample was consistent with most prior samples of treatment-seeking individuals with HD: primarily Caucasian and female. It is unclear whether the present results would generalize to non-treatment seeking patients, patients more diverse in race or gender. In addition, due to the age restrictions of the larger clinical trial, all participants were aged 65 or younger. It is unclear whether the results of the current study will apply to older individuals with hoarding, since there is a small amount of research suggesting that geriatric individuals with hoarding may differ in qualities such as functional impairment and degree of treatment response (Ayers, Wetherell, Golshan, & Saxena, 2011; Steketee, Frost, & Kim, 2001). Finally, the current study also did not include a comparison sample of individuals with non-HD psychopathology, which would be ideal to assess whether these EDT/ER domains were specific to HD or are also representative of other pathology.

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Highlights:

- Emotional distress tolerance and emotion regulation were compared between hoarding patients and controls
- Intolerance of uncertainty and some subscales of emotion regulation predicted hoarding symptoms
- Distress intolerance did not predict hoarding when controlling for depression and anxiety
- Emotional tolerance and regulation did not predict retention, compliance, or outcome in CBT for HD

Table 1

Group Differences at Baseline on EDT/ER Measures

Measure	HD, <i>M (SD)</i>	HC, <i>M (SD)</i>	<i>t(df)</i>	<i>p</i>	<i>d</i>
DTS	50.17 (13.89)	64.46 (10.86)	-4.46(75)	< .001	-1.15
ERQ Reappraisal	29.61 (6.57)	33.16 (7.52)	2.29(85)	.024	-0.50
ERQ Suppression	12.64 (5.62)	11.52 (4.73)	0.95(85)	.347	0.22
IUS	61.03 (20.44)	38.37 (7.78)	8.77(108.27)	< .001	1.47
DERS Total ^a	84.44 (27.51)	52.83 (12.08)	8.77(113.10)	< .001	1.49
DERS Non-Acceptance ^a	13.25 (6.56)	8.02 (2.60)	6.22(108.62)	< .001	1.05
DERS Goals ^a	15.01 (4.74)	9.15 (2.95)	8.45(120.75)	< .001	1.48
DERS Impulsivity ^a	11.61 (5.02)	7.30 (1.92)	6.75(106.96)	< .001	1.13
DERS Awareness ^a	16.99 (4.62)	13.30 (3.33)	5.11(116.64)	< .001	0.92
DERS Strategies ^a	16.79 (6.66)	10.04 (2.71)	7.87(109.69)	< .001	1.33
DERS Clarity ^a	11.99 (2.76)	9.65 (1.37)	6.25(117.83)	< .001	.07

Note. HD = Hoarding disorder group. HC = Healthy controls group. DTS = Distress Tolerance Scale. DERS = Difficulties in Emotion Regulation Scale. ERQ = Emotion Regulation Questionnaire. IUS = Intolerance of Uncertainty Scale. To correct for multiple comparisons, alpha was conservatively set at $p < .005$.

^a = Results previously reported in Tolin, Levy, et al. (2018) and are included for purposes of comparison.

Table 2

Correlations Between EDT/ER Measures

	DTS	IUS	DERS Total	ERQ CR	ERQ ES
DTS	---				
IUS	-0.68**	---			
DERS Total	-0.83**	0.70**	---		
ERQ-CR	0.52**	-0.35*	-0.57**	---	
ERQ-ES	-0.21	0.22	0.27	-0.27	---

Note: DTS = Distress Tolerance Scale; IUS = Intolerance of Uncertainty Scale; DERS = Difficulties in Emotion Regulation Scale; ERQ-CR = Emotion Regulation Questionnaire-Cognitive Reappraisal subscale; ERQ-ES = Emotion Regulation Questionnaire-Emotional Suppression subscale. DERS subscale scores are available in Tolin et al. (2018).

Table 3

Hierarchical Multiple Regression Analyses Predicting SI-R total and subscales

Predictor	SI-R Total		SI-R Clutter		SI-R Saving		SI-R Acquiring	
	<i>F</i>	<i>R</i> ²	<i>F</i>	<i>R</i> ²	<i>F</i>	<i>R</i> ²	<i>F</i>	<i>R</i> ²
DTS	4.39	0.04	3.33	0.03	2.91	0.03	5.23	0.05
ERQ Reappraisal	1.18	0.01	1.04	0.01	1.02	0.01	0.93	0.01
ERQ Suppression	0.29	0.00	0.53	0.00	0.00	0.00	0.55	0.01
IUS	20.41*	0.10	11.95	0.06	22.54*	0.12	21.07*	0.11
DERS Total ^a	16.61*	0.09	8.29	0.05	16.32*	0.09	23.47*	0.13
DERS Non-Accep ^a	4.73	0.03	2.43	0.01	4.68	0.03	6.53	0.04
DERS Goals ^a	19.41*	0.10	13.06*	0.07	22.14*	0.12	16.16*	0.09
DERS Impulsivity ^a	3.60	0.02	0.98	0.01	3.05	0.02	8.91	0.05
DERS Awareness ^a	11.65	0.06	6.66	0.04	9.48	0.05	17.11*	0.10
DERS Strategies ^a	7.84	0.04	3.24	0.02	9.60	0.06	10.71	0.06
DERS Clarity ^a	1.69	0.01	0.15	0.00	2.20	0.01	4.64	0.03

Note. Table displays Step 2 of all models. Step 1 included DASS-Depression and DASS-Anxiety scores. DTS = Distress Tolerance Scale. ERQ = Emotion Regulation Questionnaire. IUS = Intolerance of Uncertainty Scale. DERS = Difficulties in Emotion Regulation Scale. Non-Accep. = Non-Acceptance subscale.

^a = Previously reported in Tolin, Levy, et al. (2018)

**
p < .001

Table 4

Pre- and Post-Treatment EDT/ER Measures

Measure	Pre, <i>M</i> (<i>SD</i>)	Post, <i>M</i> (<i>SD</i>)	<i>t</i> (<i>df</i>)	<i>p</i>	<i>d</i>
DTS	52.29 (14.16)	53.31 (14.15)	-0.69(34)	.495	-0.12
DERS Total	82.09 (27.71)	76.78 (23.45)	2.70(53)	.009	0.36
DERS Non-Acceptance	12.76 (6.49)	11.28 (5.25)	2.78(53)	.008	0.40
DERS Goals	14.83 (4.66)	13.70 (4.76)	2.84(53)	.006	0.39
DERS Impulsivity	10.89 (4.76)	10.30 (4.20)	1.21(53)	.233	0.17
DERS Awareness	17.11 (4.71)	16.83 (4.69)	0.71(53)	.480	0.10
DERS Strategies	16.30 (6.98)	14.56 (5.77)	2.88(53)	.006	0.40
DERS Clarity	11.78 (2.98)	11.74 (2.49)	0.10 (53)	.920	0.02
ERQ Reappraisal	30.17 (7.21)	30.05 (6.51)	0.16(41)	.871	0.03
ERQ Suppression	13.55 (5.23)	12.05 (5.06)	2.31(41)	.026	0.36
IUS	61.02 (20.24)	54.92 (16.70)	3.08(47)	.003	0.46

Note. Some degrees of freedom are different due to differing sample sizes for certain measures. DTS = Distress Tolerance Scale. DERS = Difficulties in Emotion Regulation Scale. ERQ = Emotion Regulation Questionnaire. IUS = Intolerance of Uncertainty Scale.