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An Exploratory Investigation of a Standardized Exposure Task for Hoarding Disorder

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy

in

Clinical Psychology

by

Mary Elizabeth Dozier

Committee in charge:

University of California San Diego

 Professor Julie Loebach Wetherell, Chair
 Professor Catherine R. Ayers, Co-Chair
 Professor Charles T. Taylor

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 Professor Nader Amir
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2019

The Dissertation of Mary Elizabeth Dozier is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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University of California San Diego

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2019

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would be amiss if I did not take this opportunity to acknowledge my mentor Dr. Catherine Ayers. Five years ago she took a chance on me and I have been grateful ever since for her tutelage and her encouragement. She has been an unwavering supporter of my success throughout my time in San Diego and I feel confident that I would not be the researcher that I am today were it not for her mentorship. I would also like to take this opportunity to thank the members of my committee: Drs. Julie Wetherell, Robin Weersing, Charles Taylor, and Nader Amir. They have all been indispensible in both the evolution of my dissertation and in my professional development.

VITA

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Manuscripts

Peer-reviewed Publications

1. Ayers, C. R, **Dozier, M. E**, Taylor, C. T., Mayes, T. L., Pittman, J. O. E., & Twamley, E. T. (2017). Group Cognitive Rehabilitation and Exposure/Sorting Therapy: A pilot program. *Cognitive Therapy and Research*. Advance online publication. doi: 10.1007/s10608-017-9878-1

2. Ayers, C. R, **Dozier, M. E,** Twamley, E. T., Granholm, E., Saxena, S., Mayes, T. L., & Wetherell, J. L. (2017). Cognitive Rehabilitation and Exposure/Sorting Therapy for hoarding disorder among older adults: A randomized controlled trial. *The Journal of Clinical Psychiatry.* Advance online publication. doi: 10.4088/JCP.16m11072

3. **Dozier, M. E.,** & Ayers, C. R. (2017). The etiology of hoarding disorder: A review. *Psychopathology, 50*, 291-296. doi: 10.1159/000479235

4. **Dozier, M. E**., Taylor, C. T., Castriotta, N., Mayes, T. L., & Ayers, C. R. (2017). A preliminary investigation of the measurement of object interconnectedness in hoarding disorder. *Cognitive Therapy and Research, 41*, 799-805. doi: 10.1007/s10608-017-9845-x

5. Ayers, C. R., **Dozier, M. E.**, & Mayes, T. L. (2017). Psychometric evaluation of the Saving Inventory-Revised in older adults. *Clinical Gerontologist, 40*, 191-196. doi: http://dx.doi.org/10.1080/07317115.2016.1267056

6. Ung, J., **Dozier, M. E.**, Bratiotis, C., & Ayers, C. R. (2017). An Exploratory Investigation of Animal hoarding symptoms in a sample of adults diagnosed with hoarding disorder. *Journal of Clinical Psychology, 73,* 1114-1125. doi: 10.1002/jclp.22417

7. **Dozier, M. E.,** Wetherell, J. L., Twamley, E. W., Schiehser, D. M., & Ayers, C. R. (2016). The relationship between age and neurocognitive and daily functioning in adults with hoarding disorder. *International Journal of Geriatric Psychiatry, 31*, 1329-1336. doi: http://dx.doi.org/10.1002/gps.4438

8. Ayers, C. R., **Dozier, M. E.**, Wetherell, J. L., Twamley, E. W., & Schiehser, D. M. (2016). Executive functioning in participants over age of 50 with hoarding disorder. *The American Journal of Geriatric Psychiatry, 24*, 342-349. doi: http://dx.doi.org/10.1016/j.jagp.2015.10.009

9. **Dozier, M. E.,** Porter, B., & Ayers, C. R. (2015). Age of onset and progression of hoarding symptoms in older adults with hoarding disorder. *Aging and Mental Health, 20,* 736-742. doi: http://dx.doi.org/10.1080/13607863.2015.1033684

10. Ayers, C. R., **Dozier, M. E**., Espejo, E., Mayes, T., Iqbal, Y., Strickland, K., & Wilson, A. (2015). Treatment recruitment and retention of geriatric patients with hoarding disorder. *Clinical Gerontologist, 38,* 235-250. doi: http://dx.doi.org/10.1080/07317115.2015.1032467

11. Saxena, S. S., Ayers, C. R., **Dozier, M. E.,** & Maidment, K. M. (2015). The UCLA Hoarding Severity Scale: Development and validation. *Journal of Affective Disorders, 175*, 488-493. doi: http://dx.doi.org/10.1016/j.jad.2015.01.030

12. Ayers, C. R., Najmi, S., Mayes, T., & **Dozier, M. E**. (2015). Hoarding disorder in older adults. *American Journal of Geriatric Psychiatry*, *23*, 416-422. doi: http://dx.doi.org/10.1016/j.jagp.2014.05.009

13. **Dozier, M. E.,** & Ayers, C. R. (2015). Validation of the Clutter Image Rating in older adults with hoarding disorder. *International Psychogeriatrics, 27,* 769-776. doi: http://dx.doi.org/10.1017/S1041610214002403

14. Ayers, C. R. & **Dozier, M. E.** (2015). Predictors of hoarding severity in older adults with hoarding disorder. *International Psychogeriatrics, 27,* 1147-1156. doi: http://dx.doi.org/10.1017/S1041610214001677

15. **Dozier, M. E.** & Ayers, C. R. (2014). The predictive value of different reasons for saving and acquiring on hoarding disorder symptoms. *Journal of Obsessive-Compulsive and Related Disorders, 3*, 220-227. doi: http://dx.doi.org/10.1016/j.jocrd.2014.05.002

16. Ayers, C. R., Castriotta, N., **Dozier, M. E.,** Espejo, E., & Porter, B. (2014). Behavioral and experiential avoidance in patients with hoarding disorder. *Journal of Behavior Therapy and Experimental Psychiatry, 45*, 408-414. doi: http://dx.doi.org/10.1016/j.jbtep.2014.04.005

17. Campbell L. G., Mehtani S., **Dozier M. E**., & Rinehart J. (2013). Gender-heterogeneous working groups produce higher quality science. *PLoS ONE*, 8, e79147. doi: 10.1371/journal.pone.0079147

Book Chapters and Invited Publications

1. **Dozier, M. E.**, & Ayers, C. R. (2017). Description and prevalence of OCD in the elderly. In J. Abramowitz, D. McKay, & E. Storch (Eds.), *The Wiley handbook of obsessive compulsive disorders* (pp. 44-55). Hoboken, NJ: John Wiley & Sons, Inc.

2. **Dozier, M. E.,** & Ayers, C. R. (2017). Phenomenology of hoarding disorder. In J. Abramowitz, D. McKay, & E. Storch (Eds.), *The Wiley handbook of obsessive compulsive disorders* (pp. 832-846). Hoboken, NJ: John Wiley & Sons, Inc.

3. **Dozier, M. E**., & Ayers, C. R. (2016). Cognitive behavioural therapy. In N. Pachana (Ed.), *Encyclopedia of geropsychology*. Singapore: Springer. doi: 10.1007/978-981-287-080-3

4. **Dozier, M. E**. & Ayers, C. R. (2016). OCD. In S. K. Whitbourne (Ed.), *The encyclopedia of adulthood and aging* (pp. 989-992). Hoboken, NJ: John Wiley & Sons, Inc.

5. Ayers, C. R., **Dozier, M. E.,** & Bratiotis, C. (2015). Social responses to animal maltreatment offenders: Neglect and hoarding. In G. Patronek, T. Grisso, & L. Levitt (Eds.), *Animal maltreatment: Forensic mental health issues and evaluations* (pp. 234-250)*.* New York: Oxford University Press. doi: 10.1093/med:psych/9780199360901.001.0001

6. Ayers, C. R., & **Dozier, M. E**. (2014). The do's and don'ts of CBT for late life depression. [Review of the DVD *Cognitive-Behavioral Therapy for Late-Life Depression,* produced by American Psychological Association, 2013]. *PsycCRITIQUES*, 59(30), 9. doi: 10.1037/a0037446

7. **Dozier, M. E.,** & Ayers, C. R. (2014). Hoarding in late-life: implications for clinicians. *Psychiatric Times, 31(10), 27-28.*

Research Presentations

1. Ayers, C. R., **Dozier, M. E.,** Twamley, E. W., Granholm, E., Saxena, S., Espejo, E., Mayes, T., & Wetherell, J.L. (2016, March). Cognitive Rehabilitation and Exposure/Sorting Therapy for hoarding disorder among older adults: A randomized controlled trial. In **M. Dozier** (Chair), Recent research in geriatric anxiety disorders. Symposium presented at the American Association for Geriatric Psychiatry Annual Conference, Washington, DC.

2. **Dozier, M. E.,** & Ayers, C. R. (2016, March). Social and personal impairment in geriatric hoarding disorder. In **M. Dozier** (Chair), Recent research in geriatric anxiety disorders. Symposium presented at the American Association for Geriatric Psychiatry Annual Conference, Washington, DC.

3. **Dozier, M. E.**, Porter, B., & Ayers, C. R. (2015, November). Age of onset and progression of hoarding symptoms in older adults with hoarding disorder. Presented at Gerontological Society of America Conference, Orlando, FL.

4. Ayers, C. R., **Dozier, M. E.,** Twamley, E. W., Granholm, E., Saxena, S., Espejo, E., Mayes, T., & Wetherell, J. L. (2015, July). Treatment outcomes in geriatric patients with hoarding disorder. In R. Frost (Chair), Novel treatments for hoarding disorder: A closer look at our findings. Symposium presented at the annual meeting of the International Obsessive Compulsive Foundation Annual Conference, Boston, MA.

5. Ayers, C. R., Castriotta, N., **Dozier, M. E.**, Espejo, E., & Porter, B. (2015, July). Behavioral and experiential avoidance in patients with hoarding disorder. In K. Timpano (Chair), An update on research investigating the core features and risk factors for hoarding disorder. Symposium presented at the annual meeting of the International Obsessive Compulsive Foundation Annual Conference, Boston, MA.

6. Ayer, C. R., & **Dozier, M. E**. (2015, March). Cognitive rehabilitation and exposure therapy for geriatric hoarding disorder. Case presented at the American Association for Geriatric Psychiatry Annual Conference, New Orleans, LA.

7. Ayers, C. R., & **Dozier, M. E.** (2014, July). Treatment outcomes in geriatric patients with hoarding disorder. In R. Frost (Chair), Updates on interventions for hoarding. Symposium presented at the annual meeting of the International Obsessive Compulsive Foundation Annual Conference, Los Angeles, CA.

8. **Dozier, M. E.,** & Ayers, C. R. (2014, July). A psychological perspective on animal hoarding. In T. DuVernoy (Chair), Animal hoarding session. Symposium presented at the American Veterinary Medical Association Convention, Denver, CO.

9. Campbell, L. G., Mehtani, S., **Dozier, M. E.,** & Rinehart, J. F. (2010, August). How far she's come: A longitudinal assessment of women's qualifications and productivity in ecology. Paper presented at the annual meeting of the Ecological Society of America, Pittsburgh, PA.

Research Posters

1. **Dozier, M. E.** & Ayers, C. R. (2017, July). A behavioral avoidance task for hoarding disorder in older adults. Poster presented at the 21st IAGG World Congress of Gerontology and Geriatrics, San Francisco, CA.

2. Pittman, J. O. E., Baer, J., Everett, J., **Dozier, M. E.,** Afari, N. (2017, March) Latino Veteran mental health service utilization. Poster presented at the 38th Annual Meeting & Scientific Sessions of the Society of Behavioral Medicine, San Diego, CA.

3. **Dozier, M. E.,** Wetherell, J. L., Twamley, E. W., Schiehser, D. M., & Ayers, C. R. (2016, November). The relationship between age and functioning in adults with hoarding disorder. Poster presented at Gerontological Society of America Conference, New Orleans, LA.

4. **Dozier, M. E.,** Schiehser, D. M., & Ayers, C. R. (2015, August). Executive functioning in late life hoarding disorder. Poster presented at the American Psychological Association Convention, Toronto, ON.

5. Ung, J., **Dozier, M. E.,** & Ayers, C. R. (2015, July) Characterization of animal hoarding symptoms in individuals diagnosed with hoarding disorder. Poster presented at the International OCD Foundation Conference, Boston, MA

6. **Dozier, M. E.,** Feinberg, T., Wong, C., & Ayers, C. R. (2015, July) Gender differences in the regulation of thoughts and emotions in hoarding disorder patients. Poster presented at the International OCD Foundation Conference, Boston, MA

7. Pluim, C., **Dozier, M. E.,** & Ayers, C. R. (2015, July) The relationship between hoarding severity and procrastination, attention, and indecisiveness. Poster presented at the International OCD Foundation Conference, Boston, MA

8. **Dozier, M. E.,** Pluim, C., & Ayers, C. R. (2015, July) The relationship between hoarding severity and regulation of thoughts and emotions. Poster presented at the International OCD Foundation Conference, Boston, MA

9. **Dozier, M. E.,** Schiehser, D. M., & Ayers, C. R. (2015, March). Self-reported behavioral disturbances in older adults with hoarding disorder. Poster presented at the American Association for Geriatric Psychiatry Annual Conference, New Orleans, LA.

10. **Dozier, M. E.,** Schiehser, D. M., & Ayers, C. R. (2014, November). The effect of age on executive functioning in geriatric hoarding disorder. Poster presented at the Gerontological Society of America Conference, Washington, DC.

11. **Dozier, M. E.,** & Ayers, C. R. (2014, July). Validation of the Clutter Image Rating in older adults with hoarding disorder. Poster presented at the International OCD Foundation Conference, Los Angeles, CA.

12. **Dozier, M. E.,** Porter, B., & Ayers, C. R. (2014, July). Age of onset and progression of hoarding symptoms in older adults with hoarding disorder. Poster presented at the International OCD Foundation Conference, Los Angeles, CA.

13. **Dozier, M. E.**, Porter, B., Rhoades, H. M., Kunik, M. E., Stanley, M. A., & Nadorff, M. R. (2012, November). Cognitive behavioral therapy reduces nightmares in older adults with generalized anxiety. Poster presented at the Gerontological Society of America Conference, San Diego, CA.

Professional Service

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- Behaviour Research and Therapy, 2016
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- Journal of Affective Disorders, 2016
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ABSTRACT OF DISSERTATION

An Exploratory Investigation of a Standardized Exposure Task for Hoarding Disorder

by

Mary Elizabeth Dozier

Doctor of Philosophy in Clinical Psychology

University of California San Diego, 2019
San Diego State University, 2019

Professor Julie Loebach Wetherell, Chair
Professor Catherine R. Ayers, Co-Chair

Rationale. Hoarding disorder (HD) is an obsessive-compulsive spectrum disorder characterized by urges to save objects, difficulty discarding current possessions, and excessive clutter levels in the home. Research suggests that HD is progressive, functionally and cognitively debilitating, socially isolating, and may affect up to 6% of the population. Exposure therapy is the gold standard treatment for obsessive-compulsive spectrum disorders, and exposure-based psychotherapy has been found to be effective in the treatment of HD. No studies of HD have yet utilized a standardized exposure task. The establishment of a standardized exposure task for HD

would allow for a uniform way to objectively assess treatment response. The objective of this project was to explore the feasibility and validity of a standardized exposure task for HD by utilizing subjective, physiological, and behavioral assessments of fear response (i.e., response variables) during an exposure-related sorting task.

Design. This study utilized the baseline assessment data from 60 participants enrolled in an ongoing study comparing outcomes for two exposure-based treatments for HD. During the standardized exposure task, all participants sorted items they brought from home and for each item they made the decision to either discard or keep the item. In order to standardize the task, assessors used a script when assisting participants in gathering their items and encouraged participants to gather items from areas of the home that were more difficult to sort (e.g., areas with visible excessive clutter). Assessors also used a script when administering the task to increase the standardization. Throughout the task, participants' heart rate and subjective units of distress (SUDS) were recorded at regular intervals. The number of exposure items sorted and the percent of items discarded were recorded as behavioral indicators of approach-orientation to the task. Aim 1: Demonstrate the feasibility and construct validity of a standardized exposure task for hoarding through the engagement and completion of a baseline standardized exposure task in which HD patients are asked to sort objects from their homes. Aim 2: Using Pearson correlations, explore the associations of objective and subjective baseline hoarding severity with baseline exposure task response variables.

Results. Aim 1: HD patients were able to engage in the standardized exposure task and sorted items brought from their home until either all items were sorted or the allotted time had elapsed. Heart rate data was only successfully collected from 43% of participants, largely due to assessor error. Only 58% of participants reported elevated SUDS ratings for at least a portion of the task. On average, participants reported that the task was "somewhat similar" to when they

sort at home. Participants who reported higher SUDS at the end of the task were more likely to report that the task was similar to sorting at home. A self-report measure of difficulty discarding was significantly correlated with peak SUDS ratings during the task.

Aim 2: Participants' subjective initial fear activation (i.e., their peak SUDS score) during the sorting task was significantly correlated with their subjective within-session habituation (i.e., the change from their peak SUDS score to their final SUDS score); however, participants' physiological initial fear activation (i.e., their peak HR) during the sorting task was not significantly correlated with their physiological within-session habituation (i.e., the change from their peak HR to their final HR). Assessor ratings of clutter were not significantly correlated with any of the task response variables. Participants who self-reported higher levels of excessive acquisition reported higher peak SUDS and discarded a lower percentage of items during the task.

Conclusions. Results suggest that the developed standardized exposure task for HD may have incremental validity in the assessment of hoarding symptomology, but further testing is needed in order to determine if the task is sensitive to change in response to treatment. Once the standardized exposure task is fully validated, clinicians treating HD should consider using this task to assess behavioral change during treatment as well as changes in physiological and subjective distress during sorting.

Introduction

The current project elucidates the clinical picture and treatment of hoarding disorder (HD) by exploring the use of a hoarding-related standardized exposure task and participants' subjective, physiological, and behavioral responses throughout the exposure paradigm. This research informs assessment and treatment of patients with HD as well as the treatment of patients with similar fear-based disorders. Furthermore, the current study investigated the ability of subjective and physiological initial fear activation (IFA) and within-session habituation (WSH), as well as behavioral indicators of approach-orientation, to differentially predict subjective (e.g., urges to acquire and difficulty discarding) and objective (e.g., clutter levels) hoarding symptom severity in a sample of Veterans with HD.

Hoarding disorder may affect between 1.5 – 6% of the population (Timpano et al., 2011; Nordsletten et al., 2013) and is characterized by urges to save and difficulty discarding possessions, often in spite of low monetary value, excessive and debilitating levels of household clutter, and subsequent impairment in occupational, social, or daily functioning (American Psychiatric Association, 2013; see Figure 1). Hoarding symptoms were initially observed in patients with obsessive-compulsive disorder (OCD), but have been theorized to also encapsulate a separate disorder for nearly two decades (Frost & Hartl, 1996). Extant research suggests that a patient's age is not significantly associated with their self-reported hoarding symptom severity (Ayers & Dozier, 2014); however, older adults with HD endorse having suffered from hoarding related symptoms (i.e., urges to save, difficulty discarding, excessive clutter) for multiple decades and report that their symptoms increased steadily, without remission, across their lifespans (Dozier et al., 2015).

Hoarding symptoms are associated with decreased daily functioning (Tolin et al., 2008; Ayers et al., 2012; Frost, Hristova, Steketee, & Tolin, 2013) and impairment in executive

functioning (Ayers et al., 2013; McMillan, Rees, & Pestell, 2013). Adults with HD are less likely to be married and are less socially engaged than non-hoarding adults (Timpano et al., 2011; Diefenbach et al., 2013; Nordsletten et al., 2013). This is especially true of older adults (Kim et al., 2001; Ayers & Dozier, 2014); over 72% of geriatric HD patients report that they are currently single (i.e., not married or living with a partner; Ayers & Dozier, 2014). In contrast, in 2014, only 54% of older men and 27% of older women in the general population reported being currently unmarried (Administration on Aging, 2015).

Hoarding disorder is a public health issue which affects an entire community, including the afflicted individuals, their friends and family, and their neighbors. Hoarding behaviors and the associated clutter have been associated with increased safety hazards and fire-related deaths (Frost, Steketee, & Williams, 2000; Lucini, Monk, & Szlatenyi, 2009). Animal hoarding, a subtype of HD, has been associated with increased risk of disease transmission to neighboring households, as well as decreased air quality within the home (Castrodale et al., 2011).

Timely and effective treatment of HD is critical for the well-being of hoarding patients as well as their surrounding communities. The current first-line treatment of HD is cognitive behavioral therapy (CBT), typically based on the manual developed by Steketee and Frost (2007) for compulsive hoarding. A recent meta-analysis of CBT for HD concluded that although CBT for HD significantly decreases hoarding symptoms, the majority of patients continue to exhibit clinically elevated symptoms after treatment, often with HD symptom severity up to three standard deviations above those of non-hoarding individuals (Tolin, Frost, Steketee, & Muroff, 2015). In contrast, a more behavioral treatment for HD, Cognitive Rehabilitation and Exposure/Sorting Therapy (CREST), has been effective in reducing patient symptoms to sub-clinical levels in older adults by combining cognitive remediation and exposure therapy (Ayers et al., 2014; Ayers et al., 2017a, 2017b). Ayers and colleagues (2017b) recently completed the

first randomized controlled trial comparing two active treatments for HD, CREST and case management, and found moderate between-group effect sizes (.60 - .67) in favor of CREST. Group treatments using both CREST and exposure therapy only have also been found to be effective at treating hoarding disorder across the lifespan (Ayers et al., 2017a). Despite initial evidence of the success of a behavioral treatment for HD, there have not been any investigations into the disparity of success between behavioral and cognitively based interventions for HD. Understanding the mechanisms of effective interventions for HD will allow for the refinement of current treatments.

Assessment of Symptom Change in Exposure Therapy

Exposure therapy is the gold standard treatment for a variety of anxiety-related disorders, including obsessive-compulsive spectrum disorders (OCD; Mathes, Van Kirk, & Elias, 2015), posttraumatic stress disorder (PTSD; Foa, Hembree, & Rothbaum, 2007), panic disorder (PD; Barlow, Craske, Cerny, & Klosko, 1989), and social anxiety disorder (Rodebaugh, Holaway, & Himberg, 2004). Exposure therapy, in the context of CREST or as a standalone treatment, has also been found to be effective in the treatment of HD (Ayers et al., 2014; Ayers et al., 2017a, 2017b).

Exposure therapy utilizes sustained and repeated exposures to the feared stimuli to facilitate habituation to the emotional and physiological response to the source of the acute threat, which could be a contaminated object (OCD), a reminder of past trauma (PTSD), or even an action such as discarding an object (HD). Exposure therapy provides an avenue for patients to acquire evidence against automatic thoughts. Automatic thoughts in the presence of feared stimuli may include maladaptive cognitions such as "I can't throw away newspapers because they have important information" (HD) or "If I have a panic attack, then I will die" (PD).

Patients with HD experience distress when they throw away a possession and exhibit

behavioral avoidance when sorting and discarding their possessions (Ayers et al., 2014; Steketee & Frost, 2007). During exposure therapy for HD, the patient is repeatedly exposed to discarding (e.g., throwing away, giving away, or recycling) their possessions. This process initially stimulates a fear response, including increasing the patient's heart rate (HR) and their reported level of distress, but eventually results in a lowered state of distress, and, ultimately, reduces the compulsion of the HD patient to save items.

Emotion processing theory (EPT; Foa & Kozak, 1986) is the traditional model for describing the mechanism of change in exposure therapy. According to EPT, an individual's fear structure, or their cognitive schema for responding to the feared stimulus, includes (1) representations of the feared stimulus (e.g., a tiger), (2) physiological responses to the stimulus (e.g., increased heart rate), (3) cognitive interpretation of stimulus (e.g., the tiger will eat me), and (4) cognitive interpretation of response (e.g., "If my heart rate has increased, I must be scared of the tiger"). This distress in response to a feared stimulus is often adaptive (e.g., when one is being chased by a tiger, it is appropriate to have an increase in heart rate and to associate this physiological response with the tiger), but can become pathological when it occurs in response to non-threatening stimuli (e.g., when one is being chased by a rabbit).

EPT postulates that the inappropriate response to feared stimuli is the result of an abnormality in the four components of the individual's fear structure. For example, a pathological fear structure for individuals with hoarding disorder may involve misrepresentations of the individual's possessions (e.g., preoccupation with reasons to save objects), inappropriate physiological responses to discarding ordinary objects (e.g., increased heart rate when throwing out used food containers), atypical cognitive interpretation of discarding (e.g., "If I discard these food containers, I won't have them when I really need them"), and maladaptive cognitive interpretation of response (e.g., "If my heart rate has increased, I must be scared of discarding

objects").

According to EPT, exposure therapy works by activating the pathological fear structure and incorporating new, and disconfirming, information into the fear structure. As the individual is exposed to disconfirming information, their distress in response to the perceived feared stimuli gradually decreases (i.e., within-session habituation, WSH), and their distress during subsequent exposures to the stimuli gradually decreases as well (i.e., between-session habituation, BSH). Because the individual's fear structure is modified with each repeated activation, the process of habituation should happen more rapidly with each subsequent exposure to the feared stimuli.

A more recent model of the mechanism of action behind exposure therapy is inhibitory learning (Craske et al., 2008). Inhibitory learning postulates that during exposure therapy the patient creates a second set of associations that competes with the initial fear structure. Thus, habituation is no longer a necessary component of the therapeutic process. Instead, the focus of treatment is more on tolerance of the feared situation (Craske et al., 2008). In the context of HD, this would indicate that it is not necessary for the patient to experience habituation during the sorting process as long as they are able to tolerate continued sorting. Thus, instead of focusing on the HD patient's distress levels during an exposure to sorting, behavioral indicators of exposure success (e.g., percent of items discarded) might be more informative.

Standardized exposure tasks have traditionally been used to assess patients' distress in response to feared stimuli and to track patients' changes in WSH over the course of treatment. During a standardized exposure task, the patient is exposed to a specific fearful stimuli, which could include a specific object (e.g., a toilet seat; OCD), location (e.g., the top of a flight of stairs; height phobia), or action (e.g., public speaking; social phobia). The patient's response is typically assessed throughout the task at standard intervals (e.g., every 60 seconds) using subjective experiences of fear, calculated using the Subjective Units of Distress Scale (SUDS;

Wolpe, 1973), physiological responses to fear, such as changes in heart rate (Kircanski et al., 2012; Meuret et al., 2012; Baker et al., 2010), and concrete behavioral observations, such as the number of seconds a participant holds a feared object (Kircanski et al., 2012).

Initial fear activation (IFA) is typically operationalized as the peak score (either of SUDS or HR) during a given standardized exposure task administration. Within-session habituation (WSH) is typically defined as the change in fear response from the peak score (e.g., IFA) to the final time point. Between-session habituation (BSH) is the change in IFA between sessions or standardized exposure task administrations. Extant evidence for IFA and WSH in exposures for OCD and anxiety disorders suggests that IFA and WSH may not be predictive of treatment outcomes; however, there is some evidence for the predictive ability of BSH (Craske et al., 2008).

Study Aims

This is the first study to utilize a standardized exposure task in the context of hoarding. Because of recent results suggesting that exposure-based therapy may be a more efficacious treatment for HD than traditional CBT (Ayers et al., 2017a, 2017b), understanding the mechanism of action in exposure therapy is especially timely. The current study explored the feasibility and validity of a novel standardized exposure task for HD.

Aim 1 of this project was to demonstrate the feasibility and construct validity of a standardized exposure task for hoarding in which participants are asked to discard objects from their home. I hypothesized that treatment-seeking HD patients would be able to engage and complete a standardized exposure task during a baseline assessment battery. I further hypothesized that task variables would be significantly associated with participants' ratings of difficulty discarding on a validated self-report measure.

Aim 2 of this project was to compare the associations among self-report and clinician-rated hoarding symptom severity and self-report, physiological, and behavioral standardized exposure task response variables in a sample of treatment-seeking HD patients. Self-report task variables include the initial fear activation (IFA; peak score during task) and within-session habituation (WSH; peak score minus final score) of SUDS ratings taken every sixty seconds during the task. Physiological task variables include the IFA and WSH of the mean heart rate calculated every 60 seconds during the task. Behavioral task variables include the number of items sorted during the task and the percentage of items discarded.

Consistent with previous research on HR and SUDS during standardized exposure tasks for anxiety-based disorders (e.g., Baker et al., 2010), I hypothesized that for both SUDS and heart rate, IFA would be significantly correlated with WSH. Finally, I hypothesized that task variables would be more strongly associated with self-reported difficulty discarding than with self-reported clutter or urges to save.

Method

Participants

The current study utilized the baseline assessment data from the first 60 participants enrolled in an ongoing VA Merit Award (CLNA-005-14S) comparing treatment outcomes for Cognitive Rehabilitation and Exposure/Sorting Therapy (CREST) with Exposure Therapy only in a sample of Veterans diagnosed with HD. All study procedures were approved by the institutional review board of the VA San Diego Healthcare System. A portion of the baseline assessment included self-report hoarding symptom severity, clinician-rated household clutter level, and a standardized exposure task designed to assess self-reported, behavioral and physiological responses to distress during an exposure paradigm for discarding the participant's possessions. Enrollment for the parent study began in January 2016 reached 60 enrolled participants in March 2018. Both treatment arms consist of 26-sessions of weekly individual therapy.

Inclusion criteria. Inclusion and exclusion criteria for the current study were restricted to those for the parent study. Participants were required to be over the age of 18, Veterans, and to have a primary diagnosis of HD. Hoarding disorder was diagnosed using the Structured Interview for Hoarding Disorder (SIHD; Nordsletten et al., 2013), a semi-structured interview which assesses for the DSM-5 diagnostic criteria for HD.

Exclusion criteria. Participants were excluded if they were not fluent in English, if they met criteria for a co-morbid psychotic disorder or substance abuse disorder, if hoarding disorder was not their primary diagnosis, if they reported a history of neurodegenerative disease, or if they reported active suicidal ideation. Finally, individuals who were currently receiving psychotherapy for hoarding disorder or exposure therapy for any disorder were excluded.

Recruitment. Participants were recruited primarily through the use of flyers and provider referrals from the VA San Diego Healthcare System. Flyers were posted in a variety of VA clinics, Vet Centers, and neighborhood community centers around San Diego County in order to capture a diverse sample. These recruitment procedures have been previously successful in recruiting participants with hoarding disorder (see Ayers et al., 2015). The parent study aims to recruit 136 participants over a four year period. The current study utilized the baseline assessments of the first 60 participants enrolled in the parent study.

Procedures

Potential participants who called to indicate interest in the study were screened by study staff over the phone to determine if they exhibited at least moderate hoarding severity, as determined by the Hoarding Rating Scale (HRS; Tolin, Frost, & Steketee, 2010), a five-item self-report measure of hoarding symptom severity. Participants who scored a four or higher on the HRS were scheduled for a two-part baseline assessment, the first part of which took place in the participant's home. Following completion of the baseline assessment participants had $20 directly deposited into their bank accounts.

Home assessment. The home assessor obtained informed consent, administered approximately one-half of the baseline measures, determined final study eligibility, and scheduled the second part of the baseline assessment, which took place at the VA hospital. The home assessor also explained the overall procedure of the second assessment battery. The assessor used the following script to discuss the standardized exposure task in order to increase reliability: *"Just to let you know what to expect during the second part of the assessment, we will be doing several different types of computer and hands-on tasks. One of these tasks involves the use of a heart rate monitor, which you will wear over a t-shirt with holes, so that the monitor can touch your skin. Do you have any questions? Another part of the assessment at the VA will*

involve a task in which I will be asking you to make decisions about objects from your home. I'd like to assist you in gathering those items now.'' The assessor assisted the participant in gathering a box full of items from either the participant's living room, kitchen, or bedroom. To prevent pre-sorting (e.g., the participant only selecting low distress items), the assessor selected an area of the home (approximately 24" x 24") with <u>obvious excessive clutter</u> (e.g., accumulation of objects that a reasonable person would consider to be trash, such as used food containers or old periodicals) and placed items from that area into the box. The assessor took pictures of both the area of the home the items came from and the items placed in the box. Although the participant was not allowed to pre-sort the items placed in the box, the assessor avoided placing items of high objective value into the box. To ensure that the participant brought the items for the standardized exposure task to the VA assessment, the assessor asked the participant if they would like help in putting the box into their car in preparation for upcoming appointment (e.g., "*Would it be okay if I help you put this box in your car now?*").

VA baseline assessment. At the beginning of the VA baseline assessment, participants were asked to change into the electrocardiography (ECG) chest band in order to give them ample time to adjust to wearing the chest band. The standardized exposure task was administered approximately two hours into the assessment battery, following a testing battery of neuropsychiatric, self-report, and functional measures. Following the task, participants were administered two additional functional measures and one additional self-report measure. Due to the length of the battery, assessors occasionally split the VA baseline assessment into two appointments. During these occasions, the assessors were asked to administer the sorting task after other measures (if administered on the second day of testing) in order to allow the participant time to habituate to wearing the heart rate monitor.

Measures

Demographic and Background Questionnaire included age, gender, birth date, race/ethnicity, birth country, parent's birth country, religious affiliation, education level, employment status, marital status, children/grandchildren, current medical information, degree of impairment for using various household areas, number of co-habitants, type of home, reasons for saving or not discarding objects, fear and likelihood of falling, relatives' levels of hoarding, and how often other people visit their home.

Hoarding severity was assessed using both self-report measures, including the HRS and the Saving Inventory Revised (SI-R; Frost et al., 2004), and clinician-administered measures, including the SIHD (administered only at baseline) and the Clutter Image Rating (CIR; Frost et al., 2008). The SI-R is a 23-item measure which assesses the patient's perception of their urges to save and acquire items, their overall difficulty discarding items, and their impairment caused by clutter. The CIR is a three-item pictorial measure of clutter level in the home. During the home visit, the CIR was rated by both the participant and the assessor. Only the baseline assessor ratings of the CIR were used for the current investigation, with the exception of two participants for whom only the participant ratings were available.

Other measures administered in the assessment battery but not included in the current study include World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0; Üstün et al., 2010), Specific Levels of Functioning test (SLOF; Schneider & Struening, 1983), Acceptance & Action Questionnaire (AAQ-2; Bond et al., 2011), the MINI International Neuropsychiatric Interview Version 7.0 for the DSM-5 (M.I.N.I. 7.0; Sheehan, 2014), the NIH Cognition Toolbox (McDonald, 2014), UCSD SORT Test (U-SORT; Tiznado et al., 2010), UCSD Performance-Based Skills Assessment (UPSA; Patterson et al., 2001), Wisconsin Carding Sorting Test (WCST; Heaton et al., 1993), the D-KEFS, and the Quality of Life in Neurological Disorders (Neuro-QoL) Positive Affect and Well-Being Short form (Salsman et al., 2013).

Standardized Exposure Task. The following instructions were provided to assessors for the standardized exposure task:

1. "*We are going to start the next section of the study involving the items that you brought with you*." Retrieve the task items the patient brought from home and the "KEEP" and "DISCARD" cards also used for the U-SORT, the emotion faces, and the instructions sheet.

2. Place emotion faces in front of patient and ask them "*What emotion are you currently experiencing? Many people report one of the emotions on this sheet, but you may also be experiencing a different emotion.*" Record their answer on the task answer sheet as "Pre-task emotion."

3. "*During this task, I will be asking how distressed you are on a scale of 0 to 100 with 100 being the most distress you can imagine and 0 is the least amount of distress or the most relaxing. These ratings are known as Subjective Units of Distress or SUDS ratings. To help you determine your SUDS rating, we are going to first fill in your "anchor points" on this worksheet.*" Assist the participant in filling in their SUDS hierarchy and make sure the sheet is visible during the task.

4. Ask patient their current SUDS level and record this as "SUDS prior to starting task."

5. Grab "KEEP" and "DISCARD" signs (if none available, write the words on blank pieces of paper).

6. "*When I tell you to begin, I'd like you to grab the first item at the top of the box without looking, or feeling around. Just grab the first item you put your hand on. We will go one item at a time, again grabbing items from the top, without looking or trying to select anything in particular. You will have two piles, "KEEP" and "DISCARD"* (point to the KEEP and DISCARD signs). ***Your job is to try to discard as many items as you***

***can, in the next fifteen minutes. The task is over once all of the items have been sorted
or fifteen minutes have elapsed, whichever comes first. You will not be allowed to take
discarded items home. While you are sorting, I will ask you about your distress level at
various time points. I know that this might be a difficult task. The instructions are also
printed on this sheet.*** (Point to instructions sheet). *Are you ready to begin?*"

7. Solicit the participants Subjective Units of Distress every 60 seconds, logging it on the
sorting task sheet. "*On a scale of 0 to 100, with 0 indicating no distress and 100
indicating extreme distress, how distressed do you currently feel?*"

8. If participants ask questions during the task about the instructions, please clarify the
instructions and note on the answer form what their confusion was. If they ask validation-
seeking questions, say "*Do the best you can*."

9. Write a description of the items sorted and indicate whether the participants placed the
item in the "KEEP" or in the "DISCARD" pile.

10. Discontinue sorting session once every item has been sorted into either the "KEEP"
or "DISCARD" piles, after 15 minutes have elapsed, or the participant refuses to
continue.

11. Once the task is complete, ask the participant the following question: "*How similar
was this experience to what you feel when you try to discard objects at home?*" and
record their answer on the answer sheet.

12. Place emotion faces in front of patient and ask them "*What emotion are you currently
experiencing? Many people report one of the emotions on this sheet, but you may also be
experiencing a different emotion.*" Record their answer on the answer sheet as "Post-task
emotion."

13. For the remainder of the assessment battery, ask the participant to rate their SUDS approximately every 10 minutes. Record the time (e.g., 3:04PM) and their SUDS on the answer sheet.

The example anchor points on the SUDS hierarchy worksheet completed by participants (see Figure 2) were taken from the CREST/ET manuals used in the parent study. A range of 0 – 100 was selected (as opposed to 0 – 10) in order to allow for greater sensitivity in assessing change of subjective distress level during the sorting task.

Two different answer sheets were used during the course of the study due to a change in task protocol (Figures 3, 4). Participants who completed the sorting task prior to August 26, 2016 ($n = 28$) completed a different variation of the task which involved the following changes: no emotion ratings, no visible instruction sheet (Figure 5), 10 minutes of sorting instead of 15, no standardized response to validation-seeking questions from participants, and no SUDS ratings following completion of the sorting task.

The emotion faces presented to participants before and after the task (see Figure 6) were chosen to provide participants with a selection of the seven most commonly recognized emotions (i.e., joy, surprise, contempt, sadness, anger, disgust, fear; Matsumoto & Ekman, 2008). Participants were also allowed to report a different emotion if they did not feel like the emotions presented accurately described their current emotional state.

Data from the ECG chest band was imported into the Equivital Manager software after each assessment and labeled according to participant ID and assessment date.

Data Analysis

Analysis strategy

For both HR and SUDs scores, IFA was recorded as the peak interval distress score rating and WSH was calculated as the difference between the peak and the final distress scores. Heart

rate for each time period (baseline, minute one, etc.) was assessed as the average HR over a 60 second period of time, including the 30 seconds preceding and following the time mark. For example, the baseline HR was calculated as the average HR from the 30 seconds prior to the task beginning to the 30 seconds following the task beginning. The peak HR was the highest average HR from the 60 second intervals.

All analyses were performed using Stata version 13.0 (StataCorp, 2013). Due to the exploratory nature of the current study, an alpha level of $p < .05$ was used for all analyses. The distribution of all variables was examined for normality and homogeneity of variance. If the assumption of normality was not met, then robust regression was used in place of zero-order correlations.

Power Analyses

Power for aim 2 was estimated using G*Power 3.1. A sample size of 58 is needed to detect an effect size of .5 with .80 power for the analyses in aim 2.

Data management

Missing data. Research assistants reviewed self-report measures (i.e., demographic questionnaire, SI-R, CIR) immediately after completion to ensure that there was no missing data on self-report forms. Due to the nature of the standardized exposure task, not all participants were expected to complete a full fifteen minutes of sorting and discarding. If participants had data from at least two time points during the standardized exposure task, their data was included in the analyses. This included participants who refused to continue the task after a certain time point, participants who sorted all items in the box prior to the fifteen minute mark, and participants who had missing data points due to either not rating their SUDS at regular intervals or else moving too much to provide an accurate HR reading at a given time point.

Heart rate data may also be missing if participants were unable to wear the heart rate

15

monitor, either due to a lack of fit, presence of a pacemaker, or because they did not wear appropriate clothing (e.g., a participant in a dress would be unable to change into the t-shirt with holes and thus unable to wear the monitor). In such cases, the participants' other data (i.e., SUDS and behavioral variables) was still included in the analyses and the reason for the missing HR data was recorded.

Data cleaning. Heart rate data was cleaned using VivoSense software, which is able to identify and remove artifacts in the data (i.e., artificial spikes caused by movement). Cleaned HR data was imported directly into the study database. All self-report measures, including SUDS ratings and behavioral variables, were double-entered to minimize data entry error.

Some of the SUDS ratings were missing in nine of the cases. One participant reported that she was unable to rate her SUDS for the middle five minutes of the task (she sorted for the full 15 minutes and successfully reported SUDS for the first five minutes and for the last five minutes of the task). For eight participants, the start and end times recorded did not correspond to the number of SUDS ratings recorded. For six of these individuals, video tapes of the assessments were available and it was determined that the assessor recorded the end times as being later than the actual end time of the task. For two of the cases, there were no video tapes of the assessment available. One case indicated that the participant sorted for two minutes longer than the available SUDS; the other case indicated that the participants sorted for one minute longer than the available SUDS. For both of these cases, the time sorted was derived from the start and end times listed on the record sheet and the HR data was pulled based on these times as well.

When data was examined for normality, two outlier data points were found in the data set. One participant sorted 200 items during the sorting task. A second participant experienced a dramatic decrease in HR during the course of the task (45 bpm). When the data points were

removed from the data set, both variables (total number of items sorted and change in HR from peak to final) met assumptions of normality.

Aim 1: Feasibility and Construct Validity of a Standardized Exposure Task for Hoarding

The feasibility of the standardized exposure task for HD was assessed by examining acceptability of the task in an HD sample and the success of adaptation of an exposure task for HD (Bowen et al., 2009) through the engagement and completion of a baseline standardized exposure task in which HD patients were asked to sort objects from their home. The construct validity of the task was assessed using the SI-R Difficulty Discarding subscale.

Hypothesis 1.1. I hypothesized that HD patients would be able to tolerate a 15-minute standardized exposure task in which they were asked to sort objects from their home into "Keep" and "Discard" piles. I further hypothesized that all 60 participants would complete at least five minutes of the task. Participants who were able to complete the task (e.g., sort all items) prior to the five minute mark were considered as task completers. Finally, I hypothesized that the majority of participants would report at least moderate levels of distress (e.g., SUDS ratings of 50 or greater) for at least a portion of the task. This would suggest that participants were personally engaged in the task of sorting their items and that the task was able to elicit distress.

Hypothesis 1.2. I hypothesized that HD patients would report that the sorting task had face validity. Following completion of the task, participants were asked to rate the degree of similarity of the task to their experience in sorting objects at home. Acceptable face validity was operationalized as a mean score of four, or participants rating that the task is "generally similar" to their experiences of sorting objects at home.

Hypothesis 1.3. I hypothesized that the task would demonstrate construct validity as indicated using the SI-R Difficulty Discarding subscale such that participants with higher self-

reported difficulty discarding would report higher SUDS and HR during the task, and lower sorting times, number of items sorted, percentage discarded, and habituation during the task.

Aim 2: Examine the Ability of Subjective, Physiological, and Behavioral Exposure Variables to Predict Subjective and Objective Hoarding Symptom Severity

The baseline associations of subjective (e.g., urges to save) and objective (e.g., clutter levels) hoarding severity with behavioral variables (total items sorted and percent of items discarded) and self-reported and physiological fear activation and habituation (i.e., SUDS and HR variables) during a standardized exposure task for HD patients were examined using zero-order correlations. The correlation coefficients between the SUDS, behavioral, and HR variables with objective (CIR) and subjective (SI-R) measures of hoarding severity were compared using the Williams modification of the Hotelling test in order to determine which sets of variables were more strongly associated with objectively versus subjectively assessed hoarding symptoms.

Hypothesis 2.1. Consistent with previous research on HR and SUDS during standardized exposure tasks for anxiety-based disorders (e.g., Baker et al., 2010), I hypothesized that participants with a higher initial distress would demonstrate increased change in their distress over the course of the standardized exposure task. Participants who have higher initial fear in response to the standardized exposure task are more likely to be able to decrease in their level of distress over the course of the exposure. In contrast, participants with lower fear activation experience a floor effect in which they are unable to experience a decrease in fear from their already low levels of distress.

Hypothesis 2.2. Finally, I hypothesized that the SI-R Difficulty Discarding subscale would display a different pattern of associations from the other SI-R subscales (Clutter, Acquisition) since the task is specifically about difficulty discarding.

Assessor Focus Group

Following the data collection of the first 30 participants, the assessors were asked for feedback on the task. They were encouraged to talk about the aspects of the task that tended to go smoothly and any struggles they had in the administration. The assessors stated that participants were able to understand the instructions with the task, but that they tended to struggle with generating personal anchor points for the SUDS ratings. Assessors also reported that patients tended to talk aloud during the sorting process, but that they seemed to be talking to themselves and not asking for any validation ("e.g., I should keep this paper so that I have this information"). According to the assessors, the only questions asked by participants during the task was whether there could be a pile for donation or a pile for shredding. Assessors were told that participants should not be allowed a donation pile, but that they should be allowed to make a subset of the discard pile "to be shredded" and informed that those papers would be placed in a shred box following completion of the assessment.

Additional Analyses: Emotional Response to Task

The emotions reported by participants before and after the task were examined qualitatively. Commonly used synonyms for the emotion words were re-coded for the words presented to participants (e.g., "happiness" was coded as "joy" and "anxious" was coded as "fear") in order to facilitate interpretation of participants' reported emotions before and after the sorting task.

Additional Analyses: Elimination of Participants with Insufficiently Strong Distress Response

There is a precedence for throwing out data collected from exposure tasks if the participant does not report a SUDS of at least 40 during the task (Kircanski et al., 2012; Culver et al., 2012). Thus, additional analyses were run with and without the participants with an insufficiently strong fear level (SUDS < 40) in order to see how the analyses differed and if the

percentage of such participants was congruent with prior studies.

Results

Demographic Characteristics

Participants were mostly older (average age: 61.38, $SD = 10.83$, range: 26 – 82), male ($n = 37$, 61.67%), and Caucasian ($n = 38$, 63.33%). Five participants (8.33%) identified as African-American, five participants (8.33%) identified as Hispanic, four participants (6.67%) identified as Asian, two participants (3.33%) identified as Native American, five participants (8.33%) identified as bi-racial, and one participant (1.67%) refused to indicate their ethnicity. The majority of participants reported that they were not currently married ($n = 46$, 76.67%). Nineteen participants (31.67%) were divorced, two participants (3.33%) were separated, three (5.00%) were living with a partner, four (6.67%) were widowed, and 18 (30.00%) were single and had never been married.

Participants reported an average of 15.55 years of education ($SD = 3.55$, range: 7 – 28). The majority of participants reported that they were not currently employed ($n = 52$, 86.67%); 35 participants reported that they were retired (58.33%), seven participants (11.67%) reported that they were unemployed, and 10 participants (16.67%) reported that they were receiving disability. Only eight participants reported that they were working either full-time ($n = 5$, 8.33%) or part-time ($n = 3$, 5.00%).

Hoarding Symptom Severity

Participants reported clinically severe hoarding symptoms on the SI-R Total (mean: 60.62, $SD = 15.01$, range: 13 – 89), the SI-R Clutter subscale (mean: 25.13, $SD = 7.54$, range: 1 – 36), the SI-R Acquisition subscale (mean: 16.45, $SD = 5.24$, range: 3 – 26), and the SI-R Difficulty Discarding subscale (mean: 19.03, $SD = 5.34$, range: 3 – 27). Participants had a range of household clutter on the CIR (mean: 3.86, $SD = 1.98$, range: 1.33 – 9).

Descriptive Statistics of Task Variables

Subjective units of distress. The average initial SUDS reported was 34.22 (*SD* = 28.28, range: 0 – 100). The average peak SUDS reported was 48.72 (*SD* = 26.31, range: 0 – 100) and was reported most frequently at time zero (*n* = 23; 38.98%). Over half (*n* = 35, 58.33%) reported their peak SUDS by two minutes into the task. The average final SUDS rating was 30.32 (*SD* = 22.24, range: 0 – 75) and the average decrease from peak to final SUDS ratings was 19.07 (*SD* = 22.93, range: 0 – 99). Thirty-five percent of participants (*n* = 21) reported no change from their peak SUDS to their final SUDS score. One participant reported having a SUDS of 0 throughout the task.

Of the 32 participants who completed the revised task, 30 participants were able to continue to report post-task SUDS for one additional time point, 26 participants were able to continue to report post-task SUDS for two additional time points, and 16 participants were able to continue to report post-task SUDS for three additional time points.

The first post-task SUDS rating was an average of 15.27 minutes (*SD* = 7.26, range: 1 – 30) after the task was completed. On average, participants reported an *increase* of 1.77 points (*SD* = 20.37, range: -35 – 60) from their final SUDS rating during the task to their first SUDS rating after the task. Fourteen participants (46.67%) reported a decrease in SUDS from the end of the task to their first post-task rating; four participants (13.33%) reported no change in SUDS, and 12 participants (40.00%) reported an increase in SUDS.

The second post-task SUDS rating was an average of 34.13 minutes (*SD* = 13.67, range: 10 – 57) after the task was completed. On average, participants reported an *increase* of 3.35 points (*SD* = 31.90, range: -50 – 100) from their final SUDS rating during the task to their second SUDS rating after the task. Fourteen participants (53.85%) reported a decrease in SUDS from the end of the task to their second post-task rating, two participants (7.69%) reported no change in SUDS, and 10 participants (38.46%) reported an increase in SUDS.

The third (and final) post-task SUDS rating was an average of 44.50 minutes ($SD =$ 18.92, range: 20 – 86) after the task was completed. On average, participants reported an *increase* of 10.31 points ($SD = 35.61$, range: -30 – 100) from their final SUDS rating during the task to their third SUDS rating after the task. Five participants (31.35%) reported a decrease in SUDS from the end of the task to their third post-task rating, one participant (6.25%) reported no change in SUDS, and 10 participants (62.50%) reported an increase in SUDS.

Post-hoc analysis of the SUDS follow-up data was performed using mixed effects modeling with a random intercept to control for nonindependence of the data. Participants reported that their SUDS significantly increased following completion of the sorting task ($\beta =$ 3.42, $SE = 1.62$, $p = .035$; see Figure 7).

Heart rate data. For the 26 participants with HR data available, the average anticipatory HR (for the minute preceding the task start time) was 82.77 bpm ($SD = 19.44$, range: 53.08 – 133.15). The average HR at time zero was 83.52 bpm ($SD = 20.63$, range: 54.63 – 132.53). The average peak HR was 94.98 bpm ($SD = 24.84$, range: 60.05 – 155.33). The average final HR was 88.65 ($SD = 23.56$, range: 57.58 – 150.63). The average decrease from peak to final HR was 4.78 bpm ($SD = 3.92$, range: 0 – 13.63).

Behavioral variables. Participants sorted an average number of 37.34 items ($SD = 22.30$, range: 6 – 109) and discarded an average of 47.59% of the items sorted ($SD = 19.55$, range: 14.7% – 97%).

Aim 1: Feasibility of a Standardized Exposure Task for Hoarding

Hypothesis 1.1. Ninety-seven percent of participants completed the task on time. Two participants completed the task late because they forgot their items at the initial appointment. Participants sorted for an average of 8.08 minutes ($SD = 4.23$, range: 1 – 15). Seventy-three percent of participants ($n = 44$) sorted for at least five minutes. No participants ended the task

prior to either sorting all items they had brought from home or the end of the task (i.e., some participants had items left at the end of the task due to being stopped by the assessor at the 15-minute mark).

One person discontinued after the first minute, three people discontinued after the second minute, two people discontinued after the third minute, ten people discontinued after four minutes, five people discontinued after five minutes, seven people discontinued after six minutes, three people discontinued after seven minutes, one person discontinued after eight minutes, one person discontinued after nine minutes, fourteen people discontinued after ten minutes, two person discontinued after eleven minutes, and eleven people sorted for fifteen minutes (see Figure 8). Overall, 38.33% of individuals sorted for the full length of the task. Of the 28 individuals who completed the original 10-minute version of the task, 12 (42.86%) sorted for 10 minutes. Of the 32 individuals who completed the revised 15-minute version of the task, 11 (34.38%) sorted for the full 15 minutes.

Time sorted was significantly correlated with peak SUDS ($r = .29$, $p = .027$) and total number of items sorted ($r = .59$, $p < .001$). Time sorted was not significantly correlated with any other task variables (all ps $> .05$; see Table 1).

Heart rate data was only available for 43% of participants ($n = 26$). Heart rate data was not recorded for the following reasons: data was not recorded properly ($n = 20$), no belt was large enough for the participant ($n = 10$), the heart rate monitor was in use during the time of the assessment ($n = 2$), the participant refused to wear the belt ($n = 1$), and the task happened separately from the rest of the assessment and so the assessor determined there would not be enough time for the participant to habituate to wearing the heart rate belt ($n = 1$). Heart rate data for the last two minutes of the task was also missing for one participant because the heart rate monitor had a low battery and shut itself off prior to the end of the task.

Fifty-seven percent of participants (n = 34) reported SUDS ratings of 50 or greater for at least a portion of the task. However, 80% of participants (n = 48) reported SUDS ratings of 25 or greater for at least a portion of the task.

Hypothesis 1.2. On average, participants reported that the task was "somewhat similar" to when they sort at home (mean rating 2.98, SD = 1.36, range: 1 – 5). Forty percent of participants (n = 24) reported that the task was "generally similar" (n = 15) or "highly similar" (n = 9). Participants' ratings of the similarity of the task to sorting at home was not significantly correlated with the length of time sorted (r = .01, p = .963). Similarity ratings were significantly correlated with final SUDS (r = .38, p = .004), such that participants who reported higher SUDS at the end of the task were more likely to report that the task was similar to sorting at home. The similarity ratings were not significantly correlated with any other task variables (all ps > .05; see Table 1).

Hypothesis 1.3. The SI-R Difficulty Discarding subscale was significantly correlated with initial SUDS (r = .47, p < .001), peak SUDS (r = .45, p < .001), and final SUDS (r = .28, p = .031). The SI-R Difficulty Discarding subscale was not significantly correlated with any other task variables (all ps > .05; see Table 1).

Aim 2: Correlations Among Task Variables and Subjective and Objective Hoarding Symptom Severity

The correlations among task variables are presented in Table 2. There were no significant correlations between types of variables (e.g., none of the SUDS variables were significantly correlated with any of the HR or behavioral variables). Correlations between task variables and measures of hoarding symptom severity are presented in Table 3. Because the CIR was not significantly correlated with any of the task variables, no further analyses comparing the correlations of the CIR and the SI-R with the task variables were conducted.

25

Hypothesis 2.1. Participants' initial fear activation (i.e., their peak score) was significantly correlated with their within-session habituation (i.e., the change from their peak to their final score) for their SUDS ratings ($r = .55$, $p < .001$), but not for their HR ($r = .08$, $p = .699$).

Hypothesis 2.2. Both the SI-R Acquisition subscale and the SI-R Difficulty Discarding subscale were significantly correlated with peak SUDS (Acquisition: $r = .39$, $p = .002$; Difficulty Discarding: $r = .45$, $p < .001$), such that participants who self-reported increased urges to acquire items and difficulty discarding current possessions also reported increased distress during the sorting task. However, only the SI-R Acquisition subscale was significantly correlated with the percent of items discarded ($r = -.27$, $p = .035$), such that participants who self-reported increased urges to acquire items also discarded a lower percentage of items during the task. All other correlations between the SI-R subscales and the task variables were not significant (all $ps > .05$).

Additional Analyses: Emotional Response to Task

For the 32 participants who completed the revised task, assessors asked participants to identify their current emotional state before and after the task. Table 4 displays the emotions reported by participants before and after the sorting task and how they were coded. Participants reported the following pre-task emotions: Fear ($n = 14$; 43.75%), Joy ($n = 8$; 25.00%), Surprise ($n = 4$; 12.50%), Contempt ($n = 2$; 6.25%), Anger ($n = 3$; 9.38%), and Disgust ($n = 1$; 3.13%). Three participants reported words that are not emotions ("Neutral," "Tired," and "Exhausted").

Participants reported the following post-task emotions: Joy ($n = 16$; 50.00%), Fear ($n = 6$; 18.75%), Sadness ($n = 5$; 15.63%), Surprise ($n = 5$; 15.63%), Anger ($n = 2$; 6.25%), and Disgust ($n = 1$; 3.13%). One participant reported a word that is not an emotion ("Neutral").

Post hoc analyses were conducted to explore whether participants who reported feeling a fear-related emotion prior to the sorting task had any differences on task response variables and

hoarding symptom severity compared with participants who reported an emotion not related to fear (see Table 5). Participants who reported feeling a fear-related emotion prior to starting the sorting task reported significantly higher SUDS at time zero (t (30) = 1.98, p = .029), peak SUDS (t (30) = 2.75, p = .005), and final SUDS (t (30) = 2.43, p = .011). They also scored significantly higher on the SI-R Difficulty Discarding subscale (t (30) = 1.79, p = .042). Participants who reported feeling a fear-related emotion prior to the task sorted items for a significantly longer length of time (t (30) = 2.70, p = .006), and sorted a significantly greater number of objects during the task (t (29) = 2.56, p = .008). There was no significant difference between participants who reported feeling a fear-related emotion and those who did not on the similarity rating, change in SUDS, percent of items discarded, the SI-R Total, the SI-R Acquisition and Clutter subscales, or any of the HR variables (all ps > .05).

Additional Analyses: Elimination of Participants with Insufficiently Strong Distress Response

Twenty-two participants (36.67%) did not report SUDS of at least 40 during the sorting task. Task response variables and hoarding symptom severity for participants who did and did not report SUDS of at least 40 are compared in Table 6. As expected, the participants who reported SUDS of at least 40 also reported significantly higher initial, final, and peak SUDS, as well as a significantly greater change from peak to final SUDS (all ps < .05). Participants with an insufficiently strong fear response sorted for significantly fewer minutes (t (58) = 1.86, p = .034) and sorted significantly fewer items (t (57) = 1.69, p = .049). They also reported significantly lower hoarding severity on the SI-R Total (t (58) = 2.22, p = .015), the SI-R Acquisition subscale (t (58) = 1.93, p = .029), and the SI-R Difficulty Discarding subscale (t (58) = 3.35, p < .001). Finally, participants who reported SUDS of at least 40 during the task had significantly higher HR at the beginning of the task (t (24) = 1.76, p = .046).

When the correlational analyses were replicated using only the smaller sample of participants who reported SUDS of at least 40 during the sorting task ($n = 38$), the majority of the analyses demonstrated a congruent pattern of significance. Several analyses were no longer statistically significant (SI-R Total and initial SUDS, SI-R Total and peak SUDS, SI-R Acquisition and initial SUDS, SI-R Acquisition and peak SUDS, SI-R Acquisition and percent of items discarded, SI-R Difficulty Discarding and final SUDS, SI-R Difficulty Discarding and peak SUDS, number of items sorted and peak SUDS, number of items sorted and final SUDS, and time sorted and peak SUDS; ps >.05), most likely due to the decreased sample size. However, several previously nonsignificant correlational analyses reached significance in this smaller sample. Change in HR was significantly correlated with the percent of items discarded during the task ($r = .50$, $p = .035$), such that participants who had a greater decrease from their peak HR to their final HR also discarded a greater percentage of items. Change in HR was also significantly correlated with participant scores on the SI-R Total ($r = -.57$, $p = .013$) and on the SI-R Acquisition subscale ($r = -.51$, $p = .030$), such that participants who had a greater decrease from their peak HR to their final HR reported less severe hoarding symptoms on the SI-R Total and the SI-R Acquisition subscale. Furthermore, the number of items sorted was significantly associated with the percent of items discarded ($r = .36$, $p = .027$). Finally, participants' ratings of how similar the task was to sorting at home was significantly correlated with the change from peak to final SUDS ($r = -.34$, $p = .039$).

Discussion

This was the first application of a standardized exposure task for the assessment of hoarding. Overall, the task appears to be feasible to implement at a baseline assessment in which the patient is assisted in gathering items for the task. Many of the task variables were associated with a validated self-report measure of difficulty discarding. However, additional investigation of the task's sensitivity to change is needed before any firm conclusions about its validity can be made.

Aim 1: Feasibility and Construct Validity

Hypothesis 1.1. Hypothesis 1.1 was partially met. The execution of the task itself was feasible. Participants were successfully able to bring a box of items (gathered with the help of an assessor during the initial home visit) to the VA hospital and then sort the items until either all items were sorted or the time allotted for the task was over. However, over one-quarter of participants still sorted for less than five minutes, despite sorting all items brought from home. This could have two reasons: 1) participants did not bring enough items or 2) participants brought items that were not distressing to sort (and thus were able to sort all items quickly).

Hypothesis 1.1 further postulated that participants would report at least moderate levels of distress, operationalized as SUDS of 50 or greater. Only a little more than half of participants reported SUDS of 50 or greater and only 80% of participants reported SUDS of 25 or greater. This suggests that the majority of participants found the task, at least in some parts, to be more distressing than "riding the subway during rush hour" (the example provided for a SUDS of 25). However, only a little over half (58%) considered the task to be as distressing as "being late for an important work meeting" (the example provided for a SUDS of 50).

The high number of low SUDS reporters may be evidence against the validity of the task. The average peak SUDS was 48.72, which is around 10 points lower than what is typically

29

reported for SUDS on other exposure tasks, including for public speaking (Culver et al., 2012), social anxiety disorder (Pittig et al., 2015), and acrophobia (Baker et al., 2010) and is congruent for the mean SUDS reported on a task using a "moderate" item for contamination fears (Kircanski et al., 2012).

Furthermore, participants were able to discard a high percentage of their items (14.7% – 97%). This is particularly notable because the data was from the baseline assessment and this was the participants' first time being asked to sort their items in a clinical environment. One possible explanation is that this was a treatment-seeking sample. In order to participate, participants had to allow for assessors to enter their homes, which is not a small ask for many individuals with hoarding disorder who often face public stigma (Chasson, Guy, Bates, & Corrigan, 2018). Thus, the sample may have been biased towards individuals who are at a more advanced stage of change. It is also possible that, despite gathering the items with the assistance of the home visit assessor, the participants brought items from home that were less distressing to sort than typical items in their homes. This is supported by the high percentage of patients who sorted all items before the end of the allotted time.

Participants' SUDS ratings significantly increased following completion of the sorting task. This suggests that the sorting task, which was ostensibly designed to be a distressful experience, was less distressing than the assessments completed after the sorting task. One possible explanation was that participants were able to choose whether or not to keep each item sorted, which may have made the task less stressful than a task like the UPSA, during which participants might be anxious about providing the wrong answer. Future iterations of exposure tasks for hoarding may want to experiment with paradigms in which participants are forced to discard all items or pick items from more hard-to-sort areas of their homes to sort, and thus may experience greater subjective distress during the sorting task.

Hypothesis 1.2. The second hypothesis of aim 1 was not met. Using a Likert-type scale of 1 (highly unsimilar to 5 (highly similar), the majority of participants indicated that the task was not similar to their experiences sorting objects at home. One possible explanation for the lack of similarity of the task to sorting in the home environment is the length of the sorting task. Participants were able to sort for the full length of the task, or until they had sorted all of their items, which indicates that they may have been able to tolerate a longer sorting task. A longer task, for example lasting half an hour, may be more similar to the sorting experience in the home. However, *post hoc* analysis indicated that similarity ratings were not significantly correlated with length of sorting. Thus, longer sorting time may not increase the similarity of the task to sorting in the participant's home environment.

Participants who experienced greater subjective distress at the end of the task were more likely to indicate that the task was similar to their sorting experiences at home. Sorting their items in a clinical setting, removed from the distractions of their home environments, may make the sorting items both less distressful than sorting at home and also less similar. Future investigations of similar sorting tasks for HD should consider administering the task in patients' homes to increase their emotional engagement.

Hypothesis 1.3. Overall, the results support prior evidence that the IFA and WSH of both self-reported distress and heart rate may not consistently correspond to changes in symptom severity (see Craske et al., 2008 for a review). The IFA on the SUDS was significantly associated with the SI-R Difficulty Discarding subscale, but the WSH on the SUDS, as well as all of the HR response variables, were not. Furthermore, neither the number of items sorted nor the percent of items discarded were associated with the SI-R Difficulty Discarding subscale.

Aim 2: Associations Among Task Response Variables and Hoarding Severity

Contrary to expectations, the CIR was not significantly correlated with any of the task

variables and the SI-R was only correlated with a few of the variables. This has two likely explanations: 1) the task may have incremental validity in that it is tapping into a part of HD not currently captured by the SI-R and the CIR; or 2) the task is not doing an adequate job of tapping into hoarding symptomology. Examining how the task variables change in response to treatment will further elucidate the validity of the paradigm to accurately assess hoarding.

Hypothesis 2.1. Participants' IFA was significantly correlated with their WSH for the SUDS ratings, but not for the HR variables. This could in part be due to the low HR observed for participants. Participants' HR recordings during the task were also substantially lower than the HR reported for participants during other exposure tasks (e.g., Baker et al., 2010; Culver et al., 2012).

Hypothesis 2.2. Hypothesis 2.2 was partially met. The SI-R Difficulty Discarding subscale displayed a different pattern of associations from the Clutter subscale; however, the Acquisition subscale was also strongly correlated with the task response variables and was even significantly correlated with one variable (percent of items discarded) when the Difficulty Discarding subscale was not. These two symptoms (excessive acquisition and difficulty discarding) may tap into the same underlying emotion dysregulation in the presence of objects that one could either acquire or is faced with the prospect of discarding. In contrast, the Clutter subscale focuses on the impairment caused by the excessive household clutter, an external manifestation of hoarding which is separate from the underlying psychopathology.

Additional Analyses: Emotional Response to Task

Of the 32 participants who reported their pre- and post-task emotional states, fear was the most commonly reported type of emotion; however, the majority of participants (56%) reported an emotion other than fear. This suggests that fear may not play as central of a role in hoarding disorder as previously thought (Mataix-Cols et al., 2010). There may also be a subset of hoarding

patients who are driven by emotions other than fear of losing a wanted item. The results of the current investigation suggest that patients who experience a fear-based emotion prior to sorting their possessions also experience greater subjective distress during sorting and report greater difficulty discarding possessions.

Additional Analyses: Elimination of Participants with Insufficiently Strong Initial Distress Response

Thirty-seven percent of participants did not report SUDS of at least 40 during the sorting task. This is substantially lower than what is typically reported by other studies involving standardized exposure tasks (e.g., Culver et al., 2012; Baker et al., 2010) and may indicate that hoarding patients are less able to accurately identify their distress levels. A review of the assessment video tapes of some of the participants who gave extremely low SUDS ratings indicated that the participants had been able to successfully complete a SUDS anchor points sheet. Furthermore, assessors often probed participants multiple times to make sure that they knew the meaning of such low ratings.

Of the 12 participants whose SUDS ratings were all below 25, three participants also provided emotions ratings before the task. All three participants indicated that they were experiencing a positive emotion ("inspired;" "intrigue/wonder;" "joy"). The low SUDS ratings during a baseline assessment may also be a reflection of the treatment-seeking nature of the sample. Patients may have felt happy to be enrolled in a study providing treatment for hoarding disorder. Future investigations of this task may benefit from including additional open-ended follow-up questions to better elucidate the patient's experience during the task.

When the participants with insufficiently strong SUDS were eliminated from the sample, several previously nonsignificant correlational analyses reached significance, including the association between change in HR and percent of items discarded. Within this smaller sample,

participants who experienced greater physiological WSH were able to discard a greater percentage of their items and reported less severe hoarding symptoms on the on the SI-R Acquisition subscale. This provides additional support for the possible utility of physiological WSH as a predictive factor of hoarding severity; however, further investigation of the ability of WSH to predict treatment response is still needed.

Limitations

The current study took place within the context of an existing study, and therefore inclusion criteria and overall study procedures were already established. The parent study of the current investigation is the first study of HD to utilize a fully Veteran sample. Veterans with HD are more likely than non-Veterans with HD to have increased psychiatric co-morbidities and decreased physical health (Ayers et al., 2018). Thus, the sample used in this investigation may not be representative of the more general population of individuals with HD.

The particular heart rate monitor used in this study may have been a barrier to collecting HR data. Heart rate data was only available for 43% of participants. The low availability of HR data suggests that the heart rate monitor used may have been too complicated for assessors to consistently use properly (20 cases did not have HR data due to the assessor incorrectly using the monitor). Furthermore, 10 participants weren't able to wear the monitor due to size restrictions. Given that hoarding has been linked to obesity (Timpano et al., 2011), the need for heart rate monitors that can accommodate larger individuals is not surprising. Future investigations of HR during exposures for hoarding disorder may want to consider using a heart rate monitor that can be worn by participants of any size (e.g., a monitor that is placed on the person's finger) and that is simpler for assessors to use as well.

Future Directions

The sorting task for HD was designed using established behavioral avoidance tasks for

anxiety disorders in the literature as a framework (e.g., Baker et al., 2010; Kircanski et al., 2012). Many of the decisions in designing the procedures were made *de novo* and as such there are many variants of procedural variables which could be tested in future studies, such as standardizing the items used for the task (e.g., only used food containers and old newspapers or junk mail), changing the location of the task (e.g., at the patient's home instead of in the clinic), or focusing on patients' urges to save or acquire items, rather than their difficulties discarding current possessions.

This task placed a heavy burden on assessors to record a large amount of data in a short period of time. Although assessors, for the most part, were able to record all required information, there were several cases of incorrect recordings of the time. This may indicate that a simplification of the recording process could increase the feasibility of implementing this task on a regular basis. For example, it may be more feasible to query a participant's SUDS every two minutes instead of every 60 seconds.

Finally, this investigation focused solely on the administration of the sorting task prior to patients receiving treatment. Future studies of the utility of the task should focus on its sensitivity to change in response to treatment. Despite the lack of clear evidence for the utility of the IFA and WSH variables, task response variables may yet prove to be sensitive to change over the course of treatment. Ideally, this task could be used to provide objective data about a participants' response to treatment through their improved ability to discard items during the standardized task. However, there are many potential obstacles to the administration of a standardized exposure task for hoarding throughout treatment, including the potential for participants to run out of items that need to be discarded or an inability to appropriately gather items for the task when not assisted by an assessor.

Conclusion

This project sets the ground work for future studies utilizing a standardized exposure task for hoarding. Currently, the only objective assessment of HD severity is clinician ratings of household clutter levels. This project demonstrated the feasibility of using a standardized exposure task to assess objective hoarding symptoms (i.e., a participant's ability to sort and discard objects). Although clutter levels provide an objective source of data about the exterior manifestation of hoarding symptoms, clutter is merely one symptom of hoarding and does not always generalize to a patient's difficulty with discarding items. A standardized exposure task provides a uniform method of assessing patients' difficulty sorting and discarding items that could be used in conjunction with ratings of clutter levels to provide a more complete representation of a patient's symptom progression.
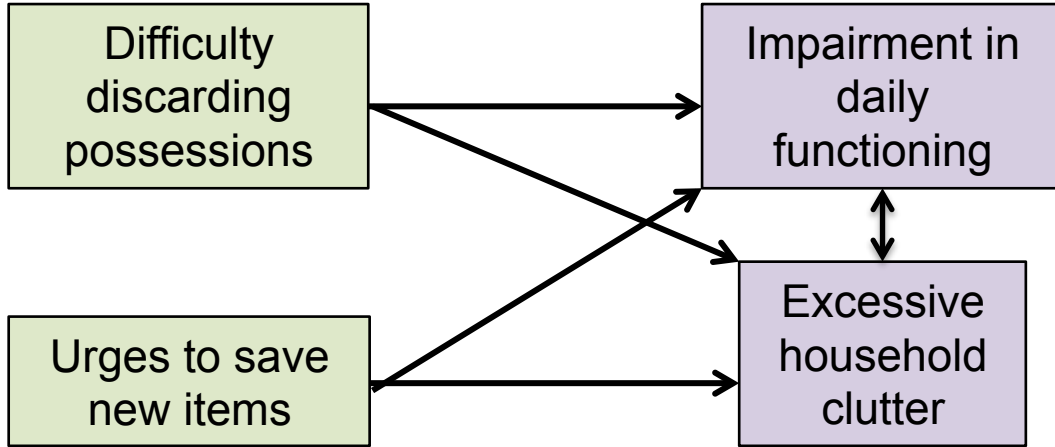
Figure 1. Model of hoarding disorder symptoms.

Subjective Units of Distress (SUDs) Ratings

0   10   20   30   40   50   60   70   80   90   100

Most
relaxing

Most distress
you can imagine

0	25	50	75	100
Example: In bed reading a book	Riding the subway during rush hour	Being late for an important work meeting	Learning that my child broke his arm at school	Life threatening car accident in 1997

Figure 2. SUDS hierarchy used in standardized exposure task for hoarding disorder.

Participant ID: _____ Study ID: M _____ Date of Administration: _____

1. Time HR belt put on: _____

2. Time sorting
began (0 seconds): _____

3. Time sorting
ended (10 minutes): _____

4. SUDS prior
to starting task: _____

Time	SUDS (0-100)
0 Seconds	
1 Minute	
2 Minutes	
3 Minutes	
4 Minutes	
5 Minutes	
6 Minutes	
7 Minutes	
8 Minutes	
9 Minutes	
10 Minutes	

5. Peak SUDS: _____

6. Final SUDS: _____

7. Peak – Final SUDS: _____

8. # Items sorted: _____

9. # Items discarded: _____

10. % Items discarded
(#discarded/#sorted): _____

	Item	T=Trash K=Keep N= Not Sorted
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		

11. How similar was this
experience to what you feel when you try to discard objects at home?

Highly Similar	Generally Similar	Somewhat Similar	Generally Unsimilar	Highly Unsimilar
5	4	3	2	1

Figure 3. Answer sheet for standardized exposure task for HD used for first 28 participants.

Participant ID: _____ Study ID: M _____ Date of Administration: _____

Pre-task emotion: _____

1. Time HR belt put on: _____

2. Time sorting began (0 seconds): _____

3. Time sorting ended (15 minutes):_____

4. SUDS prior to starting Task: _____

Time	SUDS (0-100)
0 Seconds	
1 Minute	
2 Minutes	
3 Minutes	
4 Minutes	
5 Minutes	
6 Minutes	
7 Minutes	
8 Minutes	
9 Minutes	
10 Minutes	
11 Minutes	
12 Minutes	
13 Minutes	
14 Minutes	
15 Minutes	

5. Peak SUDS: _____

6. Final SUDS: _____

7. Peak – Final SUDS: _____

8. # Items sorted: _____

9. # Items discarded: _____

10. % Items discarded (#discarded/#sorted): _____

11. How similar was this experience to what you feel when you try to discard objects at home?

	Item	T=Trash K=Keep N= Not Sorted
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
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23		
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28		
29		
30		
31		
32		
33		
34		
35		

Highly Similar	Generally Similar	Somewhat Similar	Generally Unsimilar	Highly Unsimilar
5	4	3	2	1

Post-Task emotion:_____

SUDS post-Task: Time:_____ SUDS: _____ Time:_____ SUDS: _____ Time:_____ SUDS:_____

Figure 4. Answer sheet for standardized exposure task for HD used for last 32 participants.

SORTING TASK INSTRUCTIONS

1. **Grab the first item at the top of the box without looking or feeling around.**

2. **Grab one item at a time.**

3. **Sort items into two piles, "KEEP" and "DISCARD"**

4. **Try to discard as many items as you can.**

5. **The task is over once all of the items have been sorted or fifteen minutes have elapsed, whichever comes first.**

6. **You will not be allowed to take discarded items home.**

Figure 5. Instruction sheet placed in front of participants during the task.
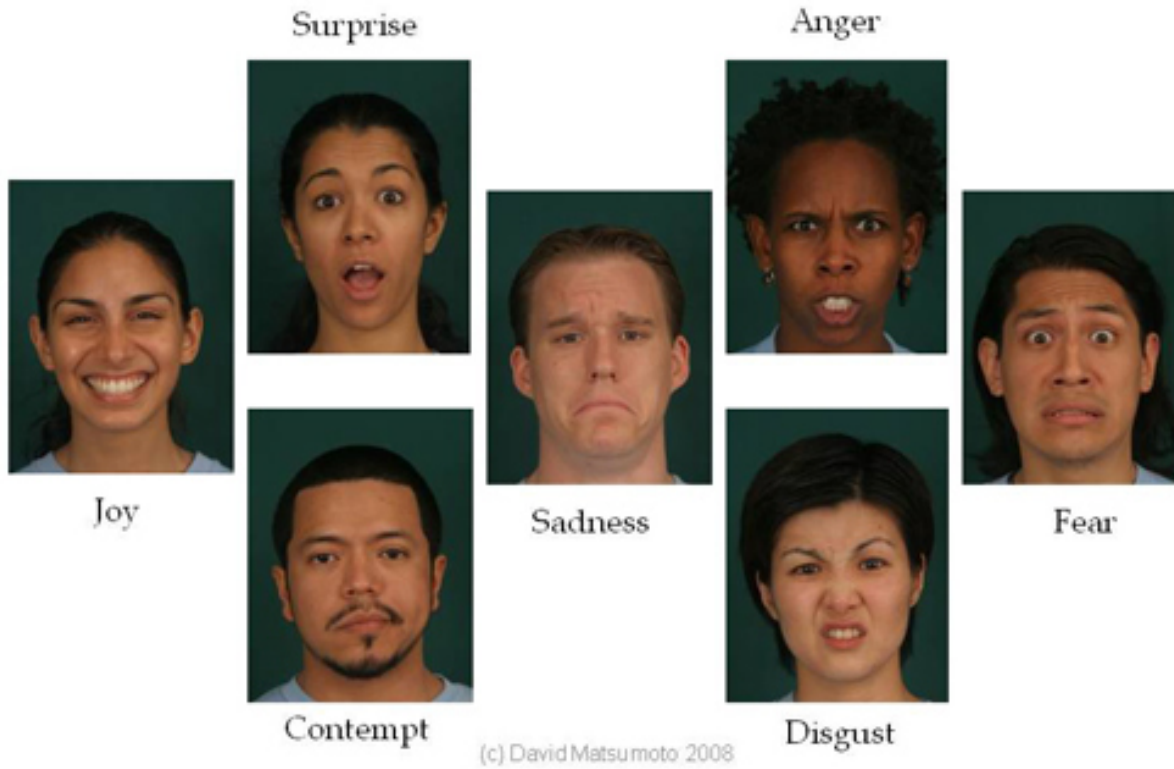
Figure 6. Emotion faces used to facilitate emotion ratings pre- and post- task (Matsumoto &

Ekman, 2008).

Figure 7. Change in participant subjective units of distress (SUDS) ratings following completion

of the task. Data are predicted values based on mixed models with standard error bars.

Figure 8. Length of time participants were able to engage in the sorting task. Twelve of the 14

individuals who sorted for 10 minutes completed the original format of the task and were limited

to only sorting for 10 minutes.

Tables

Table 1. Correlations between Task Variables and Indicators of Feasibility and Construct

Validity.

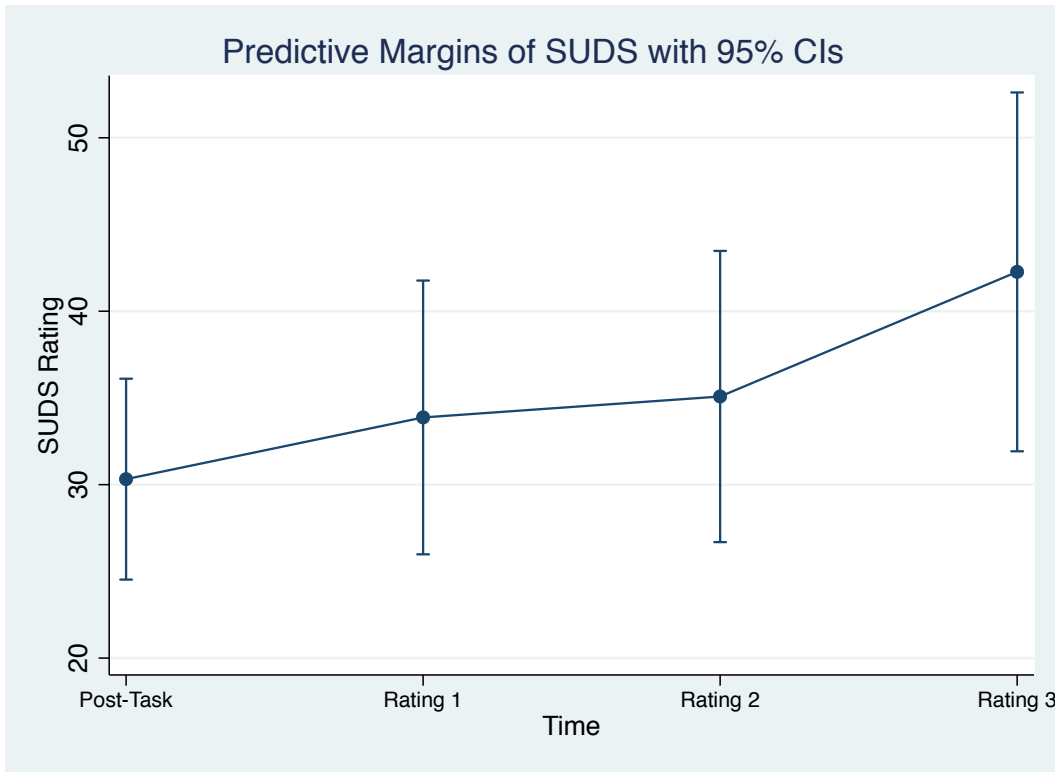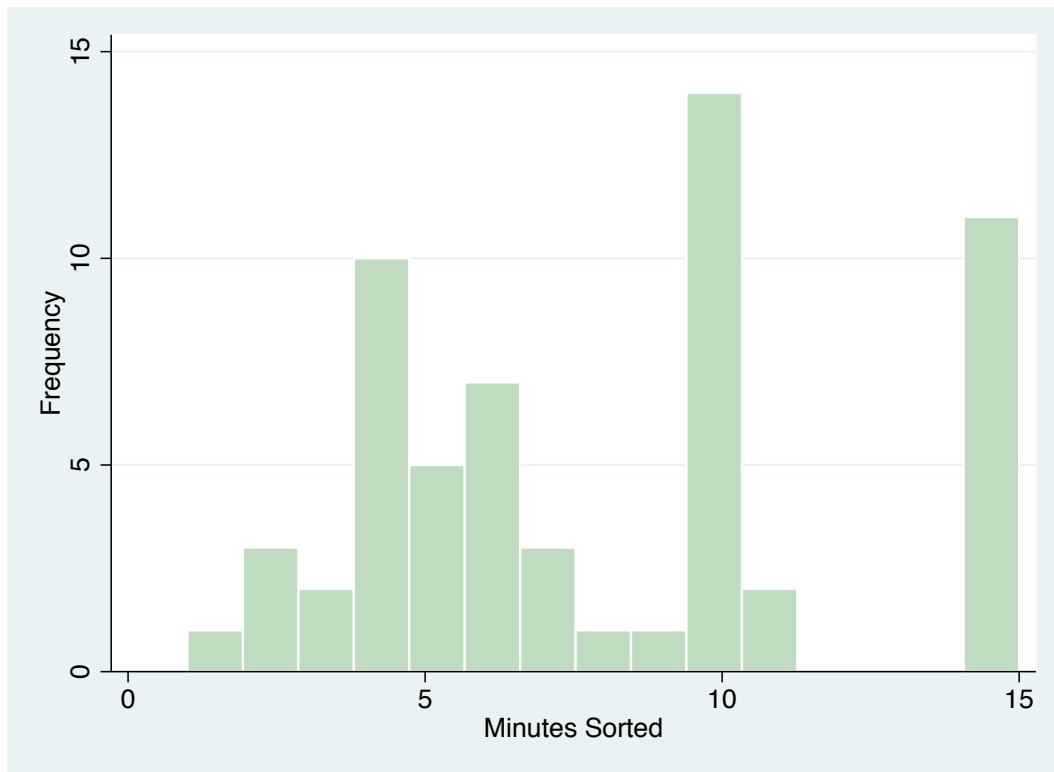|		Time Sorted	Similarity Rating	SI-R Difficulty Discarding
Similarity Rating		$r = .006$, $p = .963$	-	-
SI-R Difficulty Discarding		$r = .06$, $p = .658$	$r = -.07$, $p = .608$	-
SUDS	Initial	$r = .18$, $p = .165$	$r = -.06$, $p = .662$	**$r = .47$, $p < .001$**
	Final	$r = .22$, $p = .096$	**$r = .38$, $p = .004$**	**$r = .28$, $p = .031$**
	Peak	**$r = .29$, $p = .027$**	$r = .11$, $p = .406$	**$r = .45$, $p < .001$**
	WSH	$r = .13$, $p = .319$	$r = -.21$, $p = .109$	$r = .24$, $p = .068$
HR	Initial	$r = .19$, $p = .356$	$r = -.11$, $p = .580$	$r = -.06$, $p = .770$
	Final	$r = -.15$, $p = .458$	$r = -.24$, $p = .228$	$r = -.15$, $p = .462$
	Peak	$r = -.12$, $p = .557$	$r = -.12$, $p = .566$	$r = -.12$, $p = .555$
	WSH	$r = .11$, $p = .603$	$r = .32$, $p = .120$	$r = .04$, $p = .838$
Behavioral	# of Items Sorted	**$r = .59$, $p < .001$**	$r = -.04$, $p = .771$	$r = .15$, $p = .250$
	% of Items Discarded	$r = -.03$, $p = .837$	$r = -.20$, $p = .133$	$r = -.006$, $p = .964$

Note. HR = Heart Rate; SI-R = Saving Inventory-Revised; SUDS = Subjective Units of Distress;

WSH = Within-Session Habituation (change from peak SUDS/HR to final SUDS/HR).

Table 2. Correlations Among Task Variables.

		Behavioral		HR				SUDS		
		% of Items Discarded	# of Items Sorted	WSH	Peak	Final	Initial	WSH	Peak	Final
SUDS	Initial	r = .01, p = .959	r = .25, p = .058	r = -.08, p = .706	r = -.07, p = .746	r = .03, p = .892	r = .28, p = .164	**r = .50, p < .001**	**r = .80, p < .001**	**r = .38, p = .002**
	Final	r = .03, p = .810	**r = .26, p = .047**	r = .34, p = .101	r = .12, p = .553	r = .06, p = .784	r = .13, p = .531	**r = -.31, p = .017**	**r = .60, p < .001**	-
	Peak	r = -.08, p = .552	**r = .26, p = .043**	r = .13, p = .552	r = -.04, p = .848	r = -.02, p = .913	r = .20, p = .318	**r = .55, p < .001**	-	
	WSH	r = -.15, p = .238	r = .02, p = .897	r = -.29, p = .163	r = -.31, p = .127	r = -.20, p = .317	r = -.01, p = .966	-		
HR	Initial	r = .04, p = .850	r = -.10, p = .648	r = .02, p = .908	**r = .72, p < .001**	**r = .82, p < .001**	-			
	Final	r = .07, p = .743	r = -.31, p = .130	r = -.08, p = .698	**r = .94, p < .001**	-				
	Peak	r < -.01, p = .984	r = -.25, p = .234	r = .08, p = .699	-					
	WSH	r = .12, p = .554	r = .32, p = .126	-						
Behavioral	# of Items Sorted	r = .23, p = .074	-							

Note. HR = Heart Rate; SUDS = Subjective Units of Distress; WSH = Within-Session Habituation (change from peak SUDS/HR to final SUDS/HR).

Table 3. Correlations between Task Variables and Measures of Hoarding Symptom Severity.

		SI-R				CIR
		Total	Acquisition	Clutter	Difficulty Discarding	
CIR		*r* = **.27,** *p* = **.037**	*r* = .07, *p* = .586	*r* = **.48,** *p* < **.001**	*r* = **.01,** *p* = **.904**	-
SUDS	Initial	*r* = **.36,** *p* = **.005**	*r* = **.36,** *p* = **.004**	*r* = .13, *p* = .337	*r* = **.47,** *p* < **.001**	*r* = -.11, *p* = .406
	Final	*r* = .21, *p* = .106	*r* = .24, *p* = .06	*r* = .05, *p* = .680	*r* = **.28,** *p* = **.031**	*r* = -.17, *p* = .206
	Peak	*r* = **.38,** *p* = **.002**	*r* = **.39,** *p* = **.002**	*r* = .17, *p* = .182	*r* = **.45,** *p* < **.001**	*r* = -.15, *p* = .239
	WSH	*r* = .24, *p* = .070	*r* = .17, *p* = .21	*r* = .19, *p* = .154	*r* = .24, *p* = .068	*r* = .05, *p* = .730
HR	Initial	*r* = -.26, *p* = .199	*r* = -.07, *p* = .739	*r* = -.38, *p* = .054	*r* = -.06, *p* = .770	*r* = -.27, *p* = .183
	Final	*r* = -.15, *p* = .459	*r* = .04, *p* = .862	*r* = -.21, *p* = .308	*r* = -.15, *p* = .462	*r* = -.27, *p* = .174
	Peak	*r* = -.08, *p* = .709	*r* = .09, *p* = .651	*r* = -.13, *p* = .521	*r* = -.12, *p* = .555	*r* = -.21, *p* = .311
	WSH	*r* = -.21 *p* = .319	*r* = -.26, *p* = .201	*r* = -.21, *p* = .311	*r* = .04, *p* = .838	*r* = -.12, *p* = .561
Behavioral	# of Items Sorted	*r* = .03, *p* = .809	*r* = -.02, *p* = .852	*r* = -.03, *p* = .841	*r* = .15, *p* = .250	*r* = -.03, *p* = .839
	% of Items Discarded	*r* = -.15, *p* = .245	*r* = **-.27,** *p* = **.035**	*r* = -.11, *p* = .404	*r* = -.01, *p* = .964	*r* = -.23, *p* = .076

Note. CIR = Clutter Image Rating; HR = Heart Rate; SI-R = Saving Inventory-Revised; SUDS = Subjective Units of Distress; WSH = Within-Session Habituation (change from peak SUDS/HR to final SUDS/HR).

Table 4. Emotion Ratings Reported by (n = 32) Participants Before and After the Sorting Task.

Pre-task emotion	*n*	Coded as		Post-task emotion	*n*	Coded as
Joy	4	Joy		Joy	5	Joy
At peace	1	Joy		Happy	1	Joy
Inspired	1	Joy		Relief	8	Joy
Intrigue/wonder	1	Joy		Satisfied	1	Joy
Content	1	Joy		Successful	1	Joy
Surprise	4	Surprise		Surprise	5	Surprise
Contempt	2	Contempt		Contempt	2	Contempt
Anger	2	Anger		Sadness	5	Sadness
Frustrated	1	Anger		Angry	1	Anger
Disgust	1	Disgust		Frustrated	1	Anger
Fear	3	Fear		Disgust	1	Disgust
Anxiety	8	Fear		Fear	1	Fear
Stress	1	Fear		Stress	1	Fear
Anticipation	1	Fear		Anxiety	1	Fear
Confusion	1	Fear		Worried	1	Fear
Exhausted	1	no emotion		Anticipation	1	Fear
Tired	1	no emotion		Anxiety	1	Fear
Neutral	1	no emotion		Neutral	1	no emotion

Note. Some participants listed more than one emotion. Three participants listed more than one emotion before the task: Surprise + Joy, Fear + Contempt, Fear + Anger. Six participants listed more than one emotion after the task: Sadness + Surprise; Relief + Anxiety + Surprise; Joy + Surprise; Angry + Sadness; Relief + Anticipation; Contempt + Sadness + Disgust

Table 5. Comparison of Participants Who Did and Did Not Report Feeling Fear Prior to Sorting

Task.

		Mean (*SD*)		*t*	*p*
		Reported fear-related emotion (*n* = 14)	Reported something other than fear (*n* = 18)		
Time Sorted		**11.36 (4.27)**	**6.89 (4.91)**	**2.70**	**.006**
Similarity Rating		2.93 (1.14)	2.39 (1.24)	1.26	.108
SUDS	**Initial**	**51.07 (25.05)**	**34.61 (22.06)**	**1.98**	**.029**
	Final	**40.71 (21.29)**	**24.00 (17.65)**	**2.43**	**.011**
	Peak	**63.93 (22.55)**	**42.56 (21.22)**	**2.75**	**.005**
	WSH	23.21 (24.39)	18.56 (18.09)	.62	.270
HR	Initial	81.38 (18.28)	90.75 (25.23)	-.95	.177
	Final	85.18 (14.64)	99.86 (30.52)	-1.37	.094
	Peak	95.37 (19.61)	103.77 (30.97)	-.72	.239
	WSH	6.31 (3.03)	3.91 (5.17)	1.21	.121
Behavioral	**# of Items Sorted**	**54.54 (22.15)**	**32.17 (25.26)**	**2.56**	**.008**
	% of Items Discarded	44.16 (17.87)	54.50 (19.84)	-1.53	.069
SI-R	Total	64.57 (12.12)	57.33 (14.30)	1.52	.070
	Acquisition	17.93 (5.12)	15.33 (4.91)	1.46	.078
	Clutter	25.86 (8.03)	24.22 (6.25)	.65	.261
	Difficulty Discarding	**20.79 (2.46)**	**17.78 (5.88)**	**1.79**	**.042**
CIR		4.12 (2.29)	3.57 (1.79)	.76	.228

Note. CIR = Clutter Image Rating; HR = Heart Rate; SI-R = Saving Inventory-Revised; SUDS = Subjective Units of Distress; WSH = Within-Session Habituation (change from peak SUDS/HR to final SUDS/HR).

Table 6. Comparison of Participants Who Did and Did Not Report SUDS of at Least 40 During the Task.

		Mean (*SD*)		*t*	*p*
		Reported SUDS of at least 40 (*n* = 38)	Reported SUDS <40 (*n* = 22)		
Time Sorted		**8.84 (4.49)**	**6.77 (3.46)**	**1.86**	**.034**
Similarity Rating		3.08 (1.34)	2.82 (1.40)	.71	.239
SUDS	**Initial**	**48.03 (26.50)**	**10.36 (8.31)**	**6.46**	**<.001**
	Final	**39.55 (22.13)**	**14.36 (10.25)**	**5.02**	**<.001**
	Peak	**65.26 (17.12)**	**20.14 (8.78)**	**11.49**	**<.001**
	WSH	**26.76 (25.18)**	**5.77 (8.27)**	**3.78**	**<.001**
HR	**Initial**	**88.08 (21.31)**	**73.26 (15.60)**	**1.76**	**.046**
	Final	88.41 (22.39)	89.21 (27.66)	-.08	.469
	Peak	93.38 (22.55)	98.59 (30.79)	-.49	.316
	WSH	4.97 (4.26)	4.28 (3.08)	.39	.350
Behavioral	**# of Items Sorted**	**41.05 (24.28)**	**31.09 (17.24)**	**1.69**	**.049**
	% of Items Discarded	48.28 (18.20)	46.39 (22.08)	.36	.361
SI-R	**Total**	**63.79 (12.15)**	**55.14 (17.98)**	**2.22**	**.015**
	Acquisition	**17.42 (4.71)**	**14.77 (5.78)**	**1.93**	**.029**
	Clutter	25.71 (6.69)	24.14 (8.90)	.78	.220
	Difficulty Discarding	**20.66 (4.51)**	**16.23 (5.60)**	**3.35**	**<.001**
CIR		3.66 (1.88)	4.20 (2.13)	-1.02	.157
Pre-Task Emotion (% who reported fear)		47.83% (*n* = 11)	33.33% (*n* = 3)	$X^2 = .55$	.457

Note. CIR = Clutter Image Rating; HR = Heart Rate; SI-R = Saving Inventory-Revised; SUDS = Subjective Units of Distress; WSH = Within-Session Habituation (change from peak SUDS/HR to final SUDS/HR).

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